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Feasibility Study on the Valuation of Public Goods and Externalities in EU Agriculture

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List of Abbreviations

ABM	Adverting Behaviour method
AEI	Agri-environmental indicator
AM	Alpine Mountains
BT	Benefit Transfer
CAP	Common Agricultural Policy
CL	Central Lowlands
CL	Cultural landscape
CLC	Corine Land Cover
CLRTAP	Convention on Long-range Transboundary Air Pollution
CM	Choice Modelling
CO_2	Carbon dioxide
CVM	Contingent Valuation Method
DG-ENV	Directorate-General for the Environment of European Commission
EC	European Commission
EEA	European Environment Agency
EFTEC	Economics for the Environment Consultancy
EG	Eastern Germany
EM	Error margin
EMEP	European Monitoring and Evaluation Programme
ES	Ecosystem services
ESU	European Size Units
EU	European Union
EurObserv'ER	L' Observatoire des energies renouvelables
EUROSTAT	Statistical Office of the European Communities
EUROWATERNET	European Environment Agency's Monitoring and Information Network for Inland Water Resources
EVRI	Environmental Valuation Reference Inventory
FADN	Farm Accounting Data Network
FAO	Food and Agriculture Organization
FB	Farmland biodiversity
FSS	Farm Structure Survey
FTF	Face-to-face
GHG	Greenhouse gases
HAIR	Harmonised environmental Indicators for pesticide Risk
HNV	High Nature Value
HNVF	High Nature Value Farmland
HPM	Hedonic Price method
IFA	International Fertilizer Industry Association
IPTS	Institute for Prospective Technological Studies
IRENA	Indicator reporting on the integration of environmental concerns into agricultural policy
JRC	Joint Research Centre
$L\&B_{at}$	Landscape & Biodiversity attribute-based description
$L\&B_g$	Landscape & Biodiversity general description (L&Bg)

L_{at}	Landscape attribute-based description
LFA	Less-favoured areas
L_g	Landscape general description
LSU	Livestock units
LUT	Lowland-upland transitions
LUZ	Larger urban zones
M_{at}	Landscape and other environmental (social) services
MEA	Millennium Ecosystem Assessment
Med	Mediterranean
MNL	Multinomial logit
MR	Macro-region
MRAEP	Macro-regional agri-environmental problems
MS	Member states
N	Nitrogen
N_2O	Nitrous oxide
NE	Northeast
NF	North-western fringes
NH_3	Ammonia
NOAA	National Oceanic and Atmospheric Administration
NS	Northern Scandinavia
NUTS	Nomenclature of Territorial Units for Statistics
NW	North-west
OECD	Organisation for Economic Co-operation and Development
PCA	Principal Component Analysis
PESERA	Pan-European Soil Erosion Risk Assessment
PG	Public Goods
PGaE	Public Goods and Externalities
PSU	Primary sampling points
RD	Rural development
RDR	Rural Development Report
RES	Renewable Energy Company
RUSLE	Revised Universal Soil Loss Equation model
SAPM	Survey on Agricultural Production Methods
SDA	Severely Disadvantage areas
SE	South-east
SIRENE	Supplementary Information Request at the National Entry
SoEF	State of Europe's Forests
SP	Stated Preference
SW	South-west
TCM	Travel Cost method
TEEB	The Economics of Ecosystems and Biodiversity
TEV	Total Economic Value
UAA	Utilized Agricultural Area
UG	Urban/grazing livestock

UH	Urban/horticulture
UK NEA	United Kingdom National Ecosystem Assessment
UK	United-Kingdom
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
US	United States
UTAD	University of Trás-os-Montes e Alto Douro
VQPRD	Vin de Qualité Produit dans des Régions Déterminées
WTA	Willingness to accept
WTP	Willingness to pay

Executive summary

Study objectives

The main objective of this study is to develop and test an up-scaled non-market valuation framework to value changes in the provision level of the Public Goods and Externalities (PGaE) of EU agriculture from the demand-side (i.e. using valuation surveys). Its specific objectives are the following. The first is the selection of the PGaE to be considered for the development and testing of the valuation framework. Second objective is to deliver a comprehensive description of the selected PGaE addressing the context of non-market valuation. A third objective is to develop a methodology for the valuation of the PGaE of EU agriculture at the EU level, with advantages in relation to the available alternative methodologies in the state-of-art for this field. Fifth objective is testing the valuation framework through a pilot valuation survey. Finally, the sixth objective is to outline alternative sampling plans to the implementation of a large-scale valuation survey at the EU level.

The valuation methodology has been developed to value changes in the provision level of the environmental PGaE (environmental side-effects) of the EU agriculture. Selected PGaE included the following: cultural landscape, farmland biodiversity, water quality and availability, air quality, soil quality, climate stability, resilience to fire and resilience to flooding.

This report is organised according to the above-defined objectives. Chapter 2 presents and describes the selected PGaE, including an extensive literature review, supported by an annex, on the definition and description of agricultural-related PGaE. The chapter 3 develops the valuation methodology, introducing a novel approach to ensure valid measurements, according to the theoretical and methodological referential of non-market valuation, of the individuals willingness-to-pay (WTP) for changes in PGaE supplied at broad scales. Chapter 4 presents the design and the implementation at a pilot scale of the valuation survey proposed to test the valuation framework developed in the former chapter. This chapter includes also the alternative sampling plans for the implementation of an EU level large-scale valuation survey.

Results

This study delivers an up-scaled non-market demand-side valuation framework that allows for obtaining the value in changes of the PGaE of EU agriculture at broad scales, the "macro-regions". The latter are multi-country areas with homogeneous agro-ecological infra-structures across EU. This is a novel methodological approach with a number of advantages in the context of non-market valuation state-of-art, consisting on relevant achievements of this study, namely:

- Designing context-rich valuation scenarios at broad scales, ensuring content validity of the valuation survey and the quality of the resulting value estimates.
- Adopting explicitly an inter-disciplinary approach, crossing knowledge and information from ecological and agricultural sciences with economics.
- Incorporating end-users needs in the design of the valuation scenarios, and hence addressing explicitly their informational needs.

Alongside with the major achievements abovementioned, there are a number of key results that constitute important accomplishments of this study.

The **first** achievement is a comprehensive description of the study selected PGaE within the more relevant approaches to their description for valuation purposes (e.g. ecosystem services approach or total economic value framework), supported by an extensive literature review and the use of the available systems of agri-environmental indicators.

A **second** achievement is to outline the description of the selected agricultural PGaE using agri-environmental indicators, benefiting from the contribution of latest advances in the current state-of-art in this field, provided by on-going research and still unpublished work.

Third achievement is a contribution to a better and more standardised description of the agri-environmental public goods and externalities build on disentangling the macro-regional agro-ecological infra-structures from its ecological and cultural services. This is particularly useful to the delimitation and description of the landscape and the biodiversity in the context of non-market demand-side valuation.

The **fourth** achievement is the delimitation of wide areas with homogeneous agro-ecological infra-structures across EU, designated “macro-regions”.

Fifth achievement consists on the delimitation of the macro-regions, independently from their supply of PGaE, disentangling the respective agro-ecological infra-structure from its ecological and cultural services.

Sixth achievement is the definition of “macro-regional agri-environmental problems” (MRAEP), through the association of the “macro-regions” with the core PGaE supplied by them, delivering non-market demand-side valuation problems relevant to the agricultural and agri-environmental policy decision-makers.

The **seventh** achievement is the design of a Choice Modelling (CM) survey able to gather multi-country value estimates of changes in the provision level of different PGaE supplied by different EU broad regions (the macro-regions).

Eighth achievement supports the previous one, and is the successful testing of the valuation framework through a pilot survey conducted for one of the identified and delimited macro-regional agri-environmental problems: “the farmland abandonment in the Mediterranean Uplands macro-region”, that has been administrated to randomly stratified samples of resident (Portuguese) and non-resident (German) population in this macro-region, through two alternative survey-modes, face-to-face and panel web-based surveys.

The **ninth** achievement is the delivering of alternative sampling plans for the EU level large-scale survey allowing for different options regarding the number of surveyed countries, the size and composition of respective samples, and the survey administration-mode, balanced with estimates for the corresponding budgetary cost.

Outlook

Follow-up work is needed to implement successfully the valuation framework with the EU level large-scale survey. Besides that, this methodological framework can be expanded to other non-market goods and services and/or other geographical contexts.

The follow-up work needed to implement this up-scaled non-market valuation framework to gather the EU population value on changes in the provision level of different PGaE supplied at different macro-regions, comprises the following four tasks.

First task is to carry out qualitative studies (e.g. focus groups) and survey testing (pre-test and pilot), expanded to all the MRAEP identified as relevant from the supply-side, to select the relevant PGaE and respective levels from the public point-of-view.

Second task is to design the questionnaires for the selected macro-regional agri-environmental problems and respective bundle of PGaE, built on the information gathered on the previous task.

Third task is to decide which sampling plan is better suitable given the results desired, namely in terms of their representativeness of the EU population at different levels, and the budget availability.

Fourth task consists on implementing the large-scale survey, which can be done by a survey company operating at the EU level, under the supervision of a scientific team.

Introduction

This document is based on the project "Feasibility Study on the Valuation of Public Goods and Externalities of EU Agriculture"– abbreviated designation: PGaE-VALUE. This study has been commissioned to the University of Trás-os-Montes e Alto Douro (Portugal) as a result of the proposal submitted to the Joint Research Centre of the European Commission invitation to tender IPTS-11-J5-27-NC, published in 18th July of 2011. The study was initiated in December 2011 and was finished in December 2012.

The overall aim of this study is to develop a methodological framework able to generate economic value estimates for public goods and externalities (PGaE) associated to the EU agricultural sector. The need for valuation strategies able to convey up-scaled value estimates is a well-known problem and has been discussed at some extent in the valuation field literature (Santos, 2000; Randall, 2002 and 2007; EFTEC, 2004; Hein *et al*., 2006; Madureira *et al*., 2007).

Therefore, this study develops an up-scaled non-market valuation framework enabling to gauge estimates for the economic value of changes in the provision level of different PGaE. These estimates will measure, in monetary terms, the economic willingness to pay (or accept) of the EU population for changes in the provision level (quantity and/or quality) of agriculture-related PGaE due to potential changes in the current EU agricultural (and agri-environmental) policies.

The up-scaled non-market valuation framework has been developed to estimate the economic value of changes in the provision level of relevant PGaE for the EU general population. Hence, Stated Preference (SP) valuation methods are the adequate option to collect the individual economic values. SP are survey-based methods. Their implementation entails the construction of a contingent market, where a questionnaire is administrated to the potential beneficiaries of the changes in the provision level of the non-market good or service. The Contingent Valuation method (CVM) and the Choice Modelling (CM) approach are the two alternatives for the design and implementation of such contingent markets.

The valuation framework developed and presented in this report builds on the Choice Modelling (CM) approach, which has been selected due to its ability to deliver value estimates for environmental changes designed upon a bundle of attributes. Hence, the CM approach enabled to gather the value of changes in different PGaE delivered as a bundle.

Designing and implementing an up-scaled CM survey substantially increases the challenges raised by this approach to the researchers applying it.

The first challenge is to ensure that the context-dependency of values to be estimated is seriously taken aboard. This requires designing choice scenarios able to convey social context specificity for broad-scale valuation problems. Economic value estimates must be context-dependent, meaning that the value people assign to changes in the provision level of the PGaE depends on the context they take place, i.e. which is the situation responsible for the change (e.g. agricultural intensification due to the farmers need to be competitive) and how the change will be prevented if negative or ensured if positive (e.g. policy measures compensating farmers by losses in their productivity that reduce their competitiveness in the markets).

Second challenge is to identify and specify the relevant attributes (and respective levels) for large-scale target populations.

The third challenge is to ensure the aggregation of the value of PGaE changes across broad large-scale EU regions. If values are obtained for individual PGaE in isolation, its aggregation has to avoid a known sum-up bias (Hoehn and Randall, 1989; Santos, 2000; Madureira, 2001), which requires to estimate and control for demand-side complementary and substitution effects between different PGaE while aggregating value across PGaEs and regions.

This study develops a valuation framework that explicitly addresses these methodological challenges. It encompasses three main steps (they are depicted in Fig. 1, included at the end of this section), which are being developed in an interactive manner to convey the outline of a broad-scale valuation survey able to deliver valid measurements of the economic willingness to pay (or accept) of the EU population for changes in the provision level (quantity and/or quality) of macro-regionally defined sets of PGaE, related to changes in agricultural and agro-environmental policies. These steps are described in the next chapters, in the following sequence: step 1 is described in Chapter 2, step 2 in Chapter 3 and Chapter 4 describes step 3.

The first step is the selection of the PGaE to include explicitly in the valuation framework, while also ensure that the latter (the valuation framework) is flexible enough to accommodate the valuation of other PGaE. Following Cooper *et al*. (2009), the selection of PGaE was discussed in December 2011, during the project kick-off meeting, based on a proposal presented by the project team. The team option has been to select only the environmental PGaE of the EU agriculture. The motivations underpinning this option are further detailed in Chapter 2 of this report.

Chapter 2 also provides, as requested by the invitation to tender, a comprehensive description of the selected PGaE according to a set of dimensions that are found to be relevant in the context of non-market valuation.

Although the motivations underlying the option of relying on SP methods, namely the CM approach, will be made clear along the report, we can underline its flexibility to specify multi-dimensional changes and its ability to measure non-use value. Valuing changes in regionally-delimitated EU PGaE bundles requires considering variations in multiple attributes (specified in Chapter 4). In addition to achieve the the study aim (i.e. providing a valuation framework able to produce valid estimates of the economic value of the agricultural PGaE at the EU level) is needed to select the whole EU population as the survey target population. Encompassing both user and non-user populations entail the use of SP valuation methods.

The second step of the study (see Figure 1) is to establish major ‘macro-regional agri-environmental problems (MRAEP)’ across the EU, which allowed for specifying the valuation problems according to a set of different EU ‘macro-regions’ and thus for the identification of the core PGaE relevant to the definition of each one of these MRAEP. This is an important step to create empirically-based valuation contexts that are relevant from a supply-side perspective (farmers, policy makers) and that can also be shaped so as to be understandable and realistic for respondents (i.e. from the demand-side perspective). In Chapter 3 the concepts of macro-regions and macro-regional agri-environmental problem (MRAEP) are introduced and explained.

Chapter 3 also develops the up-scaled non-market valuation framework to value changes in the provision level of environmental PGaE of EU agriculture. It establishes, describes and implements the concepts of “macro-region” (MR) and of “macro-regional agri-environmental problems” (MRAEP), into four main stages: (1) identifying, delimitating and describing alternative sets of macro-regions; (2) presenting and describing data-driven PGaE indicators; (3) analysing statistical associations between the macro-regions and the PGaE building on the previously established indicators; (4) introducing and describing the macro-regional agri-environmental problems for each macro-region. These problems provide the selection of relevant PGaE for EU large-scale regions, the “macro-regions”, and deliver the (valuation) context for the choice scenarios developed in Chapter 4.

The third step of the study consists of designing and testing an EU level large-scale valuation survey, built on the SP CM approach. The aim of this survey is to gather the economic value of changes in the provision level of the PGaE selected for the different macro-regions according to the respective MRAEP.

Chapter 4 has four sections. The first reshapes the MRAEP, defined and delimited in chapter 3 within a supply-side perspective, into demand-side-adjusted valuation scenarios. These adjustments address the understandability and plausibility of the MRAEP for the public, as well as the (re-) selection of relevant PGaE according to dynamic trends in each MRAEP and the feasibility of delivering each PGaE through EU policy programmes. The second section discusses the main options to undertake when designing CM valuation surveys. This discussion takes account of the options available in the valuation literature and the opinion of valuation experts with important experience in the CM approach. The third section describes the various stages for designing and testing a CM survey for the MRAEP “farmland abandonment at the Mediterranean uplands”. Finally, alternative sampling plans to implement an EU large-scale survey are presented. This comprises establishing the number of country surveys to be implemented for each one of the MRAEP, and then the dimension of each survey in terms of sample size and respective composition (related to the selection method and procedures). Two alternatives for survey-mode administration are considered: face-to-face and panel web-based surveys. Finally, average budget cost estimates for alternative sampling are presented.

Summing up, this report unfolds in three main chapters, after this introduction, and ends up with concluding remarks and further work needs, as well as the references.

In addition, in this document, there are seven annexes, namely:

Annex I presents a schematic and summarised overview of the valuation literature review conducted with the purpose of identifying the more popular specifications for the selected PGaE in the available valuation studies.

Annex II presents maps depicting the geographical distribution in the EU of the different indicators used to delimitate and characterize the macro-regions.

Annex III displays the maps depicting the distribution of the PGaE indicators.

Annex IV includes the questionnaire used in the consultation of valuation experts.

Annex V contains a translation to English of the questionnaire for the pilot survey, originally in Portuguese and German languages.

Annex VI discloses support information to the country MRAEP survey allocation for the sampling plans.

Annex VII makes available the datasets for the stratification of target population in surveys.

There are along the text a considerable number of tables and figures of the authors own elaboration. Therefore, the sources of the tables or figures are only referred when these are not from own elaboration, to avoid repeating the ‘own elaboration’ source.

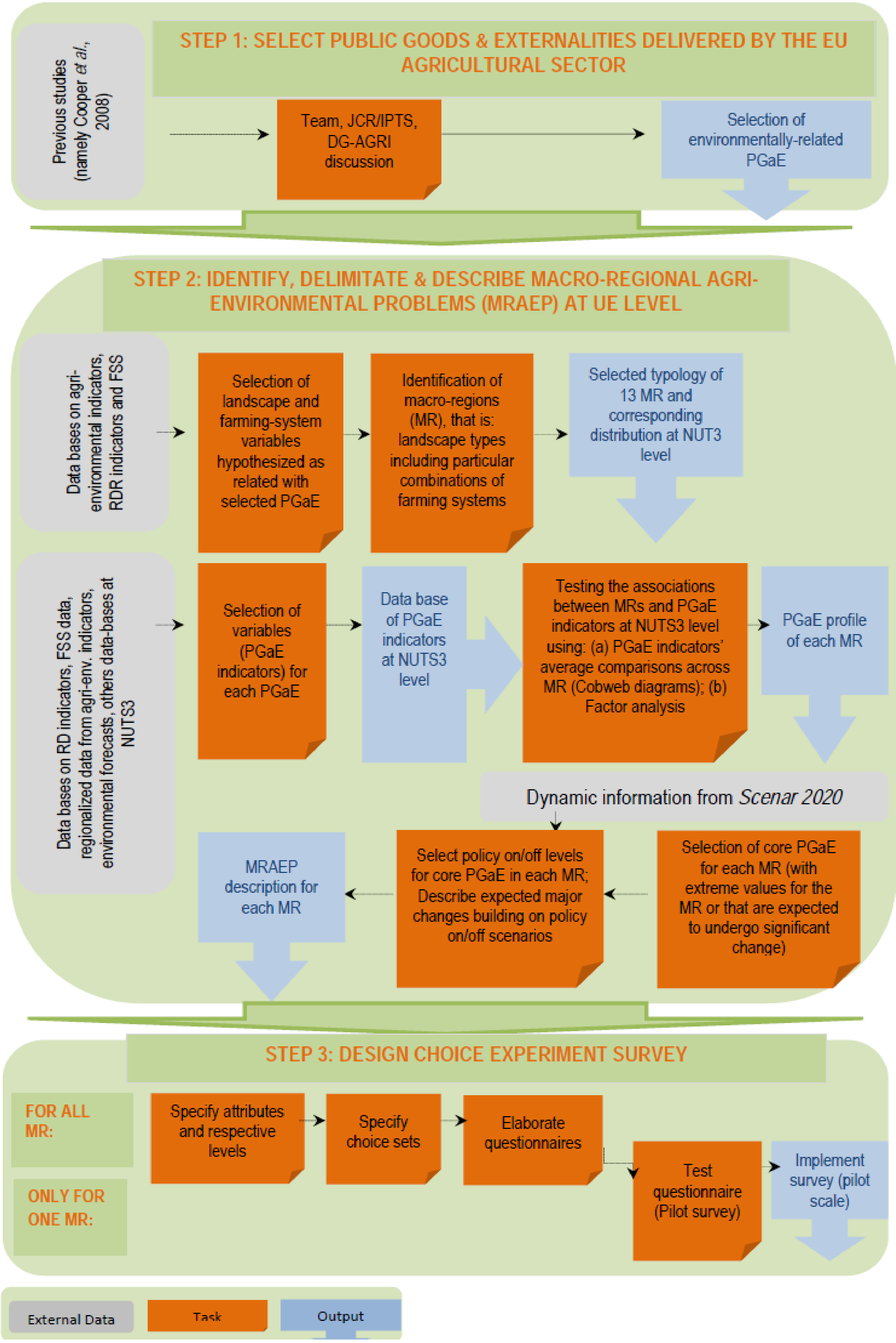

Figure 1 - Chart flow with the description of the methodological framework according to its major steps

2. Description of the PGaE of EU agriculture

2.1. Introduction: focusing on the environmental PGaE

One of the purposes of this study is describing the public goods and externalities (PGaE) of EU agriculture in the context of the framework that is proposed for the valuation of such PGaE. This chapter is dedicated to this description based on a number of relevant dimensions.

The selection of the PGaE to be valued was done during the kick-off meeting. The starting point for that selection was the list proposed by Cooper *et al*. (2009), which includes goods presenting different degrees of publicness[1] that are grouped in two subsets: (1) environmental public goods, and (2) social public goods. The first subset includes agricultural landscapes, farmland biodiversity, water quality and water availability, soil functionality, air quality, climate stability, resilience to flooding, and resilience to fire. The social public goods encompass food security, rural vitality, farm animal welfare and animal health.

The selection of the PGaE to be included in this study derives from basic methodological options underpinning the proposed up-scaled valuation framework. The main criteria guiding this selection are related to: (1) our option for a survey-based choice-modelling approach to valuation, which entails a detailed description of the PGaE attributes and their respective levels; and (2) our goal of promoting the standardisation of the description of the PGaE to be valuated, which requires describing these PGaE based on a number of well-defined dimensions.

Building on these methodological option and goal, the general up-scaled valuation framework delivered by this study is flexible enough to encompass, with minor adjustments, the valuation of alternative sets of agriculturally-related PGaE. Namely, it allows for two alternative options: (1) to obtain individual's trade-offs between (very general) environmental, social and monetary attributes; or (b) to focus on respondents' trade-offs among more precisely defined attributes, inside only one of the abovementioned subsets (i.e.: either environmental or social) plus money, and delivering more accurate value information inside that particular PGaE subset. The latter choice was adopted in this study at the more operational level, which had the advantage of allowing us to focus on the standardisation of environmental PGaE of EU agriculture. Indeed, the currently excessive diversity of descriptions of environmental public goods, such as landscape or farmland biodiversity, seriously limits the use of available value estimates (in an already vast literature) to support broad-scale or supra national policy decisions (Randall, 2002 and 2007; Madureira *et al*., 2007). Given the large number of available valuation studies and value estimates for environmental PGaE of agriculture, it is important to improve the comparability of their descriptions, in spite of the unavoidable heterogeneity imposed by the context-dependency of economic values.

On the other hand, social PGaE, such as food security (or safety) and rural vitality, are rather complex goods and services whose descriptions in valuation studies are limited to a small number of relatively well established attributes, like the number of jobs created (or lost), the number of farms abandoned (or kept), or the health impacts of changes in food safety. There still is an extensive work to be conducted on the definition of social PGaE, namely as regards food security and rural vitality. This work could not be significantly advanced by this study, given its tight time and resource constraints. Furthermore, a comprehensive description of environmental PGaE focused on more standardised specifications will certainly be useful to assist the further definition and

[1] According to Cooper et al. (2009), the degree of publicness determines the maximum number of people who are able to consume the public good.

specification of social PGaE, given the scarcity of available valuation studies addressing multiple attributes in this latter subset of PGaE of agriculture.

To sum up, this chapter presents a comprehensive description of the environmental PGaE of EU agriculture focused on the fields/dimensions that have been evaluated as more relevant to achieve more standardised PGaE specifications for valuation purposes. This is aimed at increasing the usefulness of the corresponding value estimates to inform policy decisions.

2.2. Goals and methodological approach for describing the environmental PGaE of EU agriculture

The main goals of this chapter are: (1) to present a comprehensive description of the environmental PGaE of EU agriculture that is able to provide an overall understanding of this vast set of goods and services and their interactions; (2) to deliver recommendations on how to increase the standardisation of the specifications of complex PGaE to address policy and decision-making needs at broad policy scales.

The description of environmental PGaE is based on six dimensions/fields. Table 1 presents these dimensions and the main sources of information that have been used to assess them. The selection of these dimensions is based on their relevance when it comes to deliver a comprehensive and standardized description of environmental PGaE accounting for the demands of non-market valuation.

Table 1 – Dimensions for describing the environmental PGaExternalities of EU agriculture

Dimensions	Information sources
Concept of PGaE and classes of environmental PGaE	**Literature review: Valuation studies and others**
Content and main components of the PGaE	
Identification and description of the components	**Data bases and literature review**
Specification in the valuation literature **Description building on agri-environmental indicator systems**	**Literature review: Valuation studies** **Agri-environmental indicator systems**
PGaE in the Ecosystem Services framework	**Literature review**
PGaE and the different categories of Total Economic Value	**Literature review**
Geographical scale of the PGaE	**Literature review**
Degree of publicness of the PGaE	**Literature review**

The following six sections are devoted to introducing and discussing the data and the information collected for each of the six criteria. A last section will provide an overall discussion highlighting the interactions and overlapping between the descriptors.

2.3. Concept of PGaE and classes of environmental PGaE

According to economic theory, public goods are both non-excludable and non-rival in consumption. Non-excludability means that once a good or service is provided it becomes available to everybody – that is: excluding some people from consuming it is impossible or too costly. Non-rivalry occurs when one person’s consumption of the good or service does not affect others’ consumption of it.

Some environmental goods and services, such as climate stability, are pure public goods in the sense they are both non-excludable and non-rival. Others are either non-excludable or non-rival (but not both). These latter are classified as impure public goods, signalling some degree of publicness, but not pure public-good character. Examples include water availability or soil quality.

On the other hand, externalities are unpriced side-effects of productive (or consumptive) activities that can be either positive or negative, depending on the sign of their impact on others. They are positive when they increase others' welfare (or other firm's profits); they are negative if they cause welfare decreases to others (or losses to other firms).

Some public goods of agriculture, such as habitat conservation, are usually delivered as positive externalities, that is: as side-effects of production decisions taken for other purposes, such as producing marketable outputs as food and fibre. However, if habitat management is done for that particular purpose, e.g. as the result of a contract between a land manager and a conservation agency, it is still delivering a public good – biodiversity conservation – but it is not an externality or side-effect of productive decisions taken for other purposes.

On the other hand, some negative externalities of agriculture, such as nitrate pollution or greenhouse gas emissions, are side-effects with some (or even a high) degree of publicness, as the side-effects at stake are both non-excludable and non-rival in consumption. In this sense, these externalities are also public 'bads'.

But not all negative externalities of agriculture are public goods or public 'bads'. For example, excessive water abstraction puts agriculture in direct competition with other human uses or with ecosystems that could use the same water to produce useful ecosystem services. In this case, rivalry in consumption (or the opportunity cost of consumption) is the problem, and thus the side-effect is not a (pure) public bad.

This study is concerned with both the side-effect and the public-good dimensions of positive and negative effects of agriculture on non-commodity issues. In some cases, we are dealing with public goods (or bads), in others with externalities, and in others with both.

Due to its long-term and strong interaction with the natural environment, agricultural activities in Europe have reconfigured the landscape, nature and biodiversity across all European regions. While being for millennia basically a productive activity, meant to produce food and other raw materials, agriculture has (as a side-effect) continuously transformed more or less deeply the natural environment, thus originating space- and time-dynamic agro-ecosystems, some of them representing now important local and regional landscapes and habitats. More recently (after the fifties of last century), due to massive technological innovations, as well as market and policy failure (namely incentives provided by the CAP), negative side-effects of agricultural activities have dramatically increased in some European regions and have converted agriculture into a source of visible and unwanted social costs.

Therefore, since the 1980's, the EU has developed agri-environment policies intended to deal with two distinctive, while often interconnected, problems: (a) the insufficient supply of public goods related to positive externalities, such as a cherished landscapes, farmland biodiversity or landscape fire resilience; (b) the oversupply of public bads associated to negative externalities, like surface and ground water pollution due to non-point source agricultural pollution or the GHG emissions from intensive livestock activities. These are typical examples of positive and negative externalities, respectively, with a pure public good character. Nonetheless, as discussed above, there are examples of agricultural externalities that have a lower degree of publicness (being either non-excludable or non-rival, but not both). For instance, water abstracted by irrigation agriculture is a rival good and also shows some possibility of exclusion in a number of situations.

Given that the term "public goods and externalities" (PGaE), including both public goods and unpriced effects with a public-good character, as described and exemplified above, can be taken as an overall designation for the environmental effects of agricultural activities, either positive or negative, this study has chosen to keep it as a key concept for the proposed up-scaled non-market valuation framework. In addition, this concept, PGaE, responds to the EC policy information needs related to the design and evaluation of public policies or specific programmes to stimulate or reduce the "environmental side-effects" of the EU agricultural sector.

The name 'public goods and externalities' has been employed in recent review and assessment studies dealing with the issues of identifying, describing and valuing/evaluating agricultural side-effects, examples being Hanley *et al*. (2007), Cooper *et al*. (2009), and McVittie *et al*. (2009). However, alternative designations have also been used in the literature, such as the term 'non-commodity outputs of agriculture', for instance by Santos (2000), Randall (2002) and Madureira *et al*. (2007).

The more common designation in the valuation literature is simply 'benefits' or 'public benefits' or 'social benefits' related to environmental PGaE (addressing increases in positive externalities and/or decreases in negative externalities), whereas this is a more broadly used term and it is not specifically associated to the valuation of the agricultural side-effects. Often related to agriculture, while also being a general designation, the term amenities/disamenities was employed by the OECD (2000) and other authors, such as Ready and Abdalla (2005) or Mollard *et al*. (2006).

In addition, given the raising importance of the ecosystem valuation approach in the most recent years, the designation 'agricultural ecosystem services' is also coming up in the valuation literature (e.g. ÉcoRessources Consultants, 2009), though it appears to be more associated to recent non-European studies, like Baskaran *et al*. (2009), Reveret *et al*. (2009), Polasky *et al*. (2010) or Gascoigne *et al*. (2011).

The authors who have developed the concept of ecosystem services in the context of economic valuation highlight the difference between ecosystem 'goods and services', and their respective 'benefits' (e.g. Boyd and Banzhaf, 2007; Fisher *et al*., 2009; Bateman at al., 2011). Fisher *et al*. (2009) propose that ecosystem services are seen as the aspects of ecosystems utilised (actively or passively) to produce human well-being. Their concept is thus far broader than the one suggested by Boyd and Banzhaf (2007), who considered only the final services of the ecosystem (so excluding 'internal' or intermediate ecosystem functioning or internal ecosystem structures). For Fisher *et al*. (2009), ecosystem services include ecosystem organization or structure, as well as process and/or functions provided that they are consumed or utilized by humans either directly or indirectly. These authors consider that, for valuation purposes, a classification scheme that divides ecosystem services into intermediate services, final services and benefits (which require not only ecosystem inputs but also capital inputs) would be more appropriate. With this definition, ecosystem processes and structure are classified as services, but they can be considered as intermediate or as final services, depending on their degree of association with human welfare. They highlight that this classification avoids potential double counting problems because it allows for the identification of the final benefits. Bateman *et al*. (2011) state that economic valuation intends to measure welfare changes, which means to measure the benefit (cost) of a change in ecosystem service provision in terms of welfare gains (or losses). Therefore, they highlight that the same good or service can generate a number of different benefits.

The alternative designations that have been employed to denominate environmental side-effects of agriculture in the valuation literature are summed up in Table 2. It summarises also the main criteria underpinning the designation choice and the application scope they fit better.

Table 2 – Designations used to identify environmental side-effects of agriculture in the context of non-market valuation

Designation	Criteria	Scope
Public Goods and Externalities	Publicness and side-effect nature(relevant for public policy)	**Agricultural and agri-environmental policy**
Non-Commodity Outputs	Market failure (publicness)	**International trade policies and agreements**
Amenities (disamenities)	Impacts on environment (individual's welfare changes)	**Local or regional information for public/private decision-making**
Benefits (Costs)	Individual's welfare changes	**Multiple geographical level information for public decision-making –**

		cost-benefit analysis
Goods and Services	Changes in quality/quantity (individual's welfare changes)	**Local or regional information for public/private decision-making**
Ecosystem Services	**Changes in quality/quantity (individual's welfare changes)**	**Multiple geographical level information for public/private decision-making – ecosystem management**

Table 3 summarises the diversity of classifications and designations for the different environmental PGaE that can be found in the valuation literature (not limited to the ones selected for this study) and compare them also with the classification and designations adopted by this study.

Table 3 – Alternative classification of the agricultural public goods and externalities in the context of non-market valuation

Classification of Environmental PGaE adopted in this study	Alternative classifications/designations	
Landscape (cultural)		**Agricultural landscape** **Agricultural landscape, habitats and wildlife** **Landscape quality and wildlife**
Biodiversity	Agricultural landscapes (ecological) Farmland biodiversity	
Water quality and Water availability		
Soil quality	Soil functionality Reduced risk of erosion	
Air quality		
Climate stability	GHG emissions mitigation	
Resilience to fire	Reduced risk of fire	
Resilience to flooding	**Flood protection**	

Our extensive review of valuation studies (see Annex 1), including non-European studies, shows that the agricultural landscape is mostly valued as an overall good encompassing both ecological and cultural dimensions embedded in it. This illustrates what is said by Moran (2005) about the "difficulty in distinguishing what a landscape is from what a landscape does". Swanwick *et al*. (2007) highlight the same difficulty, using a different wording, by saying that it "is needed to investigate the extent to which it is possible to distinguish landscape values from the values of the various ecosystems services provided by environmental assets, in order to avoid double accounting when biodiversity and ecosystems services are included with landscape valuation in overall policy appraisal and evaluation". Both authors acknowledge that the Contingent Valuation Method (CVM) might be more suitable to value landscape within this complex frame including both landscape features and services provided by it.

Apart from these multidimensional PGaE, landscape and biodiversity, there is consensus regarding the classification and terminology of simpler PGaE, such as water quality and water availability, soil functionality, air quality, climate stability, resilience to flooding and resilience to fire. All of them, with the exception of water availability (which is a provisioning service), are included in the category of regulating ecosystem services (defined in section 2.5), and can also be seen as landscape services and included in landscape valuation as shown by some valuation studies (e.g. Bullock and Kay, 1997; Scarpa *et al*., 2007; Borresch *et al*., 2009, Polasky *et al*., 2010).

2.4. Content and main components of the agricultural PGaE

This section reports the substantive description of the selected environmental PGaE, with the aim of detailing their content and disclosing their different dimensions. The description is threefold including: (1) broad descriptions of content and dimensions; (2) common specifications applied in the valuation studies; (3) descriptions building on agri-environmental indicator systems.

2.4.1. Content and dimensions' description

Table 4, presented at the end of this section (Section 2.4.1), summarises the information collected on the content of the various environmental PGaE considered in this study. It also identifies the main dimensions of multidimensional PGaE.

The agricultural **landscape** probably is the environmental PGaE that is most difficult to describe due to the complexity of the concept and its overlapping with biodiversity components. There is a vast literature on landscape definition that highlights its multidimensional character. Authors such as Moran (2005), Oglethorpe (2005), or Swanwick *et al*. (2007) provide an extensive contribution to this debate from the economic valuation side relating to agricultural landscapes. These authors acknowledge the complexity of the landscape and provide a comprehensive review of its multidimensional character. Paracchini (work in progress, unpublished) defines landscape through three major components: structure, degree of naturalness and social awareness.

Moran (2005) defines landscape as being mainly a visual phenomenon resulting from it being an assemblage of physical attributes as viewed by people. These visual attributes according to the author include the geomorphology, land cover and cultural evolve. This author underlines that what makes some landscapes singular is a particular combination of these attributes as perceived by some societal groups.

Oglethorpe (2005) refers the scarcity of landscape valuation studies due to the methodological orientation of environmental valuation literature, and highlights that this has prevented the existence of a data set with systematic valuations of the different agricultural landscapes of England, defined upon its different features, mainly understood as different land cover/uses. These include landscapes such as heather moorland, rough grazing, grassland or woodland. This approach evidences the overlapping between landscape and habitats (biodiversity), rather common in the European agricultural landscape studies, namely in the UK – the country which undoubtedly has the broadest and most systematic set of studies in this domain (e.g. Garrod and Willis, 1995; Moss and Chiltern, 1997; Willis *et al*., 1995; Bateman *et al*., 1996; Hutchinson *et al*. 1996; Bateman and Langford, 1997; Hanley *et al*., 1998; Alvarez *et al*., 1999; Hanley *et al*. 2001; Oglethorpe, 2005).

Swanwick *et al*. (2007) highlight the sense of place associated by people to some landscapes. Addressing specifically the valuation context, they suggest two alternatives to specify the landscape: (a) landscape character *types*, which are distinct types of landscapes that are relatively homogenous in character (they are generic in that they may occur in different regions, but share similar combinations in terms of the geomorphology, land cover and historical land use); (b) landscape character *areas*, which, on the other hand, are discrete geographical areas that are by themselves unique.

The suggestions of Swanwick *et al*. (2007) are particularly relevant for this study, given that it is intended to develop and propose a valuation framework to value the EU agricultural PGaE at a broad scale. The first specification option – that is, landscape character *types* – appears to be the most suitable for this aim, because these types encompass not-site-specific wide-scale landscapes, shared by several regions, such as mountainous areas, characterized by similar land-cover mosaics and similar agricultural activities ('upland landscapes'). On the other hand, landscape character areas (the second option) are mainly local or regional public goods. Large scale valuation surveys can capture the value of local and regional public goods, but proper sampling has to be done to account for it. If sampling procedures have the general public (residents and non-residents of different EU regions; as opposed to local residents or visitors) as its target population, questions must be included in the valuation survey to distinguish the visitors group from both the resident and non-resident population, in order to capture potential increase value due to recreation welfare gains.

When one defines not-site-specific wide-scale landscapes (landscape character types), their ecological dimension as habitat and ecosystem mosaics becomes more evident. Furthermore, wide-scale landscapes, broadly defined within the ecosystem-services approach, are ecological infrastructures supporting ecological processes and functions, and supplying ecosystem services and benefits. They are often valued in this sense, in valuation studies, with composite attributes more or less explicitly dealt with according to the used valuation method. Examples of this approach are Catalini and Lizardo (2004), Vanslembrouck *et al*. (2005), Kallas *et al*. (2006), Scarpa *et al*. (2007), Chiueh and Chen (2008) and Borresch *et al*. (2009).

In addition, wide-scale agricultural landscapes, even when viewed mostly as ecological infrastructures, encompass a cultural dimension derived from the long term intervention and transformation by human labour and technology. In this way, they stress the supply-side connections of wide-scale landscape character types to the particular farming systems that shaped them. Because of this evolving and human-made character, some of the current wide-scale EU agricultural landscapes are not even seen as public goods by the European society – contrarily, some of them are generally disliked by people, as referred by Cooper *et al*. (2009), for example large-scale specialised, mono-cropping wide-landscapes or widespread production under glass or plastic. In these situations, landscape can be envisaged as a public bad, given that its fruition, or simply its acknowledgement, might originate welfare losses both to users (residents or visitors) and non-users (the general public).

To deal with the agricultural landscape's complexity and its multidimensional character, we opted for separating the agro-ecological infrastructure (and its supply-side farming-system connections) from both its ecosystem services (such as water quality or biodiversity) and its landscape cultural dimension (included through landscape cultural services). In this way, the former is 'excluded' from the set of PGaE to be valued; instead, we consider it as the ecological infrastructure providing all of the PGaE's, hence providing part of the valuation context or setting. This is its role as part of the valuation framework developed in this study to value the PGaE of EU agriculture, as explained in chapter 3.

Given that this study proposal for an EU up-scaled valuation framework comprises the selection of macro-regions across Europe, built on land use/cover and farming system data, this infrastructural dimension of the landscape is captured at this methodological level. Therefore, the landscape ecological infrastructure (or agro-ecosystem) will be mainly described as a major component of the (macro-regional) context for the valuation of PGaE changes. This will be accomplished through the outline of valuation narratives describing the selected macro-regional agri-environmental problems, which will be introduced in Chapter 3 and fully implemented in Chapter 4.

This option implies that of confining the landscape PGaE to its cultural services, which facilitates the distinction of the cultural dimension of the landscape from its ecological features, to be included within the biodiversity category and the remaining PGaE. Defining a landscape category of PGaE comprising mainly its cultural goods, services and benefits is in line with the definition of cultural services in the MEA (2005) and more recently in Church *et al*. (2011) and Maes *et al*. (2011).

Within the ecosystem services approach, the category of cultural services includes goods and services, as well as benefits, such as aesthetics, cultural heritage, health, educational, inspirational, religious, leisure, recreational and tourism benefits. This is a complex mix of goods, services and benefits, which will certainly raise some difficulties to the design of standardised descriptions for this PGaE. The presence of important knowledge gaps in the definition and delimitation of cultural goods within the ecosystems services approach is acknowledged by the MEA (2006) and also by Church *et al*. (2011) and Maes *et al*. (2011).

Table 4 highlights the multiple components and dimensions of the agricultural landscape in general, while in this study it has been mainly confined to its cultural dimension. The difficulties in capturing the landscape value through a holistic operational definition are obvious. On the other hand, our approach still allows capturing the landscape major dimensions, because when we value recreational and cultural heritage, we implicitly incorporate a complex vector of various landscape dimensions and respective interactions, namely the visual beauty, the historical and cultural content and the socioeconomic dynamics affecting their appreciation by people.

Biodiversity is another complex public good whose provision in the EU is often the result of the maintenance of particular agricultural landscapes, land-based activities and farming practices. It can also be depleted and threatened by intensive agriculture, high-density livestock activities and productivity-oriented farming practices.

Biodiversity is a broad multi-level concept, difficult to perceive and evaluate by people, namely in the context of environmental valuation. Norris *et al*. (2011) emphasise it can occur at a number of levels of the biological organisation, from genes, through to individuals, populations, species, communities and entire ecosystems. It can be broadly grouped in three main components: (1) the ecosystems and habitats assemblage and network (ecological infrastructure) that supports functional diversity (ecosystems and habitats functions); (2) the ecosystems and habitats diversity; and, (3) the genetic and species diversity.

The first component, the ecosystems and habitats assemblage and network (ecological infrastructure) is a rather elusive component in terms of its delimitation and communication to people in valuation surveys (or others). It corresponds to what Cooper *et al*. (2009) designated as the "ecological infrastructure" and McVittie *et al*. (2009) as "ecological coherence and habitats assemblage/networks". This fundamental component of biodiversity is often valued as an implicitly embedded part of agricultural landscapes, when these are valued as public goods to be safeguarded. This landscape/biodiversity component will be excluded from the categories of PGaE to be explicitly valued in the valuation framework proposed in this study, because, as it has been discussed above in connection with the landscape, it will be alternatively addressed as a major element of the valuation context (macro-regional agri-environmental problems) within which the specific PGaE are to be valued.

The second component, the farmland habitats diversity, is commonly valued as more or less explicit components of agricultural landscapes. Valuation studies addressing information to evaluate agri-environment schemes are quite illustrative of this situation (e.g. Garrod and Willis, 1995; Willis *et al*., 1995; Bateman and Langford, 1997; Bullock and Kay, 1997; Moss & Chiltern, 1997; Hanley *et al*., 1998; Alvarez, 1999).

Many other landscape valuation studies, namely some well-known European and non-European studies, merge the value of both public goods altogether: landscape (aesthetical and cultural heritage) and habitats diversity (e.g. Drake, 1992; Bowker and Didychuck, 1994; Prukner, 1995; Bateman *et al*., 1996; Paliwal *et al*., 1999; White & Lovett, 1999; Fleischer & Tsur, 2000; Le Goffe, 2000; Hanley *et al*., 2001; Bastian *et al*., 2002; Siriex, 2003; Moran *et al*, 2004; Oglethorpe, 2005; Vanslembrouck *et al*., 2005; Mollard *et al*., 2006; Hanley *et al*., 2007). This approach is clearly understandable because the goods are jointly provided and also jointly captured by the people, while the resort to choice modelling valuation techniques allows for distinguishing the value of different attributes of landscape, what might at some extent allow for disentangling the two goods.

Studies valuing specifically farmland habitats diversity can be found in the literature, examples being Willis (1990), Willis *et al*. (1996), Moran *et al*. (2004), or Christie *et al*. (2006).

Studies valuing farmland habitats diversity emphasise the importance of agricultural activities for biodiversity conservation in Europe, but also in other regions worldwide. For instance, pastoral activities in upland areas, Mediterranean extensive farm systems with permanent crops, or extensive grazing in lowlands and meadows define fundamental agro-ecosystems across Europe.

Third, valuation studies addressing the value of farmland genetic and species diversity, often together with habitat diversity, are also available in the literature (e.g. Loomis and White, 1996; White *et al*., 1997; Macmillan and Duff, 1998; White and Lovett, 1999; Lockwood *et al*., 2000; Foster and Mourato, 2000; White and Bennet, 2001; Hanley *et al*., 2006; MacMillan *et al*., 2003; Hynes and Hanley, 2009).

Biodiversity has been negatively affected by changes in land use and intensification of agricultural activities in vast areas of EU regions over the last 60 years. This has converted biodiversity in a scarce good at European level and has created a huge pressure for the introduction of public policies, both by classifying areas at the EU level (Natura 2000 network) and promoting positive changes in farming practices through agri-environmental schemes (e.g. reducing pesticide use or postponing harvesting dates).

The side-effects of agriculture in **water quality** are mostly negative. Non-point source pollution of surface and groundwater due to the leaching of contaminant substances such as nitrogen, phosphorous and pesticides is common across European regions, resulting from the intensive use of inputs as fertilizers, manure and pesticides. These negative side-effects are regulated by EU pollution control policies, but they are still substantial especially in large-scale specialised and mono-cropping farming systems, including irrigated crops, high-yield cereals and intensive livestock.

Nevertheless, in other regions, e.g. upland and low-intensity farming system areas, agricultural activities have not such negative effects on water quality. This is related with farming practices mainly conducted to prevent water runoff and avoid soil erosion. The installation of reed beds and the maintenance of riparian vegetation along rivers and other water bodies crossing farmland protect the soil and water quality because they avoid leaching and silting of water bodies. Other traditional farmland practices such as the maintenance of terraces associated with extensive dry farming also favours water infiltration and storage, prevents water runoff, and protects the soil from water erosion.

There are strong interrelations between water and soil quality as shown above. On the other hand, the soil quality (soil functionality) of farmland facilitates rainwater infiltration, thus preventing water runoff and soil erosion, which has a positive effect on the quality of water bodies both natural and artificial, namely the reservoirs for drinking water supply, hydro-electricity production and recreational uses.

Water quality provides a range of public good services and benefits, including drinking water (provisioning service) and fresh water quality for recreational activities, and supports, as well, biodiversity and landscape quality. It also delivers private benefits such as water quality for irrigation and livestock, positively affecting in this way property values.

Water availability is mostly negatively affected by particular agricultural activities associated to water abstraction for irrigation. Over-abstraction of water from water bodies and aquifers can cause resource exhaustion and reduce water quality/quantity for other (namely recreational) uses, as well as losses in wetland- and freshwater-related biodiversity and landscape quality. Irrigation may also be associated to soil erosion and groundwater contamination due to salinization processes.

There are also positive interrelations between water availability and soil quality. The latter facilitates rainwater infiltration and hence aquifer recharge, which – whilst depending on natural aspects, such as the type of soil and the geological substrate – appears to be especially relevant in mountains and other upland areas that feed watersheds downstream.

There is a considerable number of valuation studies focused on getting the value of water quality and/or water availability, either directly or indirectly through the quality status of water bodies and groundwater. Their major limitation, as regards the purposes of this study, is that, in most of these studies, it is not possible to establish the share of agriculture's contribution to water quality/availability.

When water quality is valued in relation to different uses, such as drinking and recreational, it is possible to find a considerable number of value estimates in the literature, while, as just said, it is not possible, in general, to establish the share of agriculture. Valuation studies measuring the value of water quality for drinking and/or recreational uses are generally related with policies or programmes addressing the reduction of pollutants leaching from farmland and are more common in the US; some examples are Ribaudo *et al*. (1984), Ribaudo, (1989), Ribaudo *et al*. (1994), Poe and Bishop (1999), Lynch *et al*. (2002), Thomassin and Johnston (2008). There are also quite a few studies that address the WTP to reduce low flow problems due to irrigation (e.g. Hanley *et al*., 2006).

Water quality and availability are also often valued together with other PGaE, such as landscape, farmland biodiversity, soil quality, air quality and flood prevention (e.g. Gren, 1995; Catalini and Lizardo, 2004; Travisi and Nijkamp, 2004; Aizaki *et al*., 2006; Scarpa *et al*, 2007; Chiueh and Chen, 2008; Baskaran *et al*., 2009; Borresch *et al*., 2009; Kulshreshtha and Kort, 2009; Polasky *et al*., 2010).

Soil quality is qualified by the MEA (2006) as a support service, which means it is essential for the provision of most of other ecosystem services. The impact of agriculture on soil quality is twofold, as it happens also with water quality. Intensive farming practices tend to reduce soil quality, due to contamination resulting from inputs such as fertilizers, pesticides and herbicides and loss of soil functionality related to the impoverishment of soil capabilities to perform its buffer, filtering and recycling (chemical substances) functions. However, in other areas, namely the regions affected by the soil desertification phenomenon, the maintenance of the agricultural landscape and farming practices might help protecting the soil against erosion and soil degradation.

Soil quality is a private service owned by landowners and farmers in which regards its productive outcomes, but it has also public good proprieties given its fundamental role in supporting the landscape, biodiversity, water quality and carbon storage, as well as contributing to hazards (fire, flooding and landslides) prevention. The provision of these goods and services depends on off-farm effects associated with farmers' and landowners' farmland use and management decisions.

The off-farm impacts of soil erosion have been valued by Clark *et al*. (1985), Feather *et al*. (1999), Hansen and Hellerstein (2007) and Colombo *et al*. (2003 and 2006). Soil quality is mostly valued together with other PGaE, namely water quality and biodiversity (e.g. Ribaudo *et al*., 1994; Hansen *et al*., 1999; Loomis *et al*., 2000; Loureiro *et al*, 2000; Chen, 2006; Ma *et al*, 2011). Soil quality losses are also commonly valued through cost-based valuation techniques, namely replacement cost and opportunity costs.

Air quality is mostly negatively impacted by agriculture. This impact is more or less relevant, depending on the intensity and nature of farming systems. Impact on air quality is a negative externality of agriculture derived from geographically dispersed or concentrated air emissions, comprising particulates from diesel engines, smoke from burning straws and wastes, odours, and contamination from spray drift. Air pollution directly related to agriculture results mainly from raising intensive livestock, which emits ammonia and methane. When these impacts are significant and concentrated they might cause noticeable reductions in local or even regional air quality, affecting human quality of life and even public health.

Most of the valuation studies value negative impacts of air pollution (mainly industrial and urban pollution) due to pollution damages, namely those upon crops and forests. These studies employ typically market-valuation approaches, including the cost-based, namely replacement costs.

Nevertheless, it is possible to find a few valuation studies valuing welfare changes related to farm practices and/or land use, examples being Hanley (1988), Loureiro *et al*. (2000), Kennedy and Wilson (2005), Baskaran *et al*. (2009) and Kulshreshtha and Kort (2009).

Climate stability is a public good that can be positively or negatively affected by agricultural side-effects. Negative externalities arise from GHG emissions from agriculture, which include CO_2 and other air pollutants with GHG effect, namely methane, ammonia and nitrous oxide. On the other hand, agriculture can act as a carbon sink, through soil carbon storage. Particularly important is the prevention of carbon emissions from soils that store considerable amounts of carbon, such as blanket bogs and mountain grasslands, by using them for low-intensive grazing and avoiding ploughing. In addition, some agricultural crops can be used as bio-energy sources, replacing fossil fuel consumption and thus avoiding GHG emissions. So, particular land uses and farming practices have a key role in determining whether there are negative or positive impacts of agriculture on climate stability.

Valuation studies have been basically dedicated to measure the effects of GHG on human activities, namely upon agriculture, while most of the studies refer to non-European countries and resort to market-based valuation approaches (e.g. Adams *et al*., 1999; Mendelsohn, 1999; Segerson and Dixon, 1999).

On the other hand, there are a few studies dedicated to value the carbon storage associated to changes in land use or farming practices affecting soil quality (namely its functionality). Some examples can be found in Manley *et al*. (2003), Cai *et al*. (2010), Polasky *et al*. (2010), and Gascoigne *et al*. (2011).

Up to certain levels of soil carbon content, farming practices and land uses leading to soil carbon accumulation jointly produce climate stability and soil quality.

Fire resilience currently is an important public good which is particularly threatened in areas affected by land abandonment in Mediterranean Europe. Land abandonment has changed landscape structure, with traditional patchwork patterns being replaced by large areas of continuous forest or, more commonly, by continuously scrub-encroached landscapes. The incidence of wildfires tends to be amplified by climate change, which will make of fire resilience a still more important feature of the ecological landscape structure in some European regions. Fire resilience reduces fire frequency and intensity and especially reduces the occurrence of large-scale wildfires, which cause negative effects on other public goods, namely landscape, biodiversity, soil quality, water quality and availability, air quality and climate stability. These large-scale fires also generally cause significant damages in property and the loss of human lives. Fire resilience also means the capacity of landscapes to recover after fires. Positive contribution of agriculture to fire-resilient landscapes can be achieved through land management and protective farming practices, such as the maintenance of extensive grassland and grazing activities in Southern European uplands, which also ensure landscape biodiversity and biomass management.

Valuation studies related to fire resilience tend to focus on wildfire damages, namely in property values (e.g. Loomis, 2004; Snyder *et al*., 2007; Steler *et al*., 2010), while there are also studies of the value of fire risk reduction (Riera and Mogas, 2004), and on the value of preventing impacts of wildfires on biodiversity (Loomis *et al*., 1996; Loomis and González-Cabán, 1996). Nevertheless, there is very little evidence on the value of wildfire prevention or agriculture-based fire resilience for European countries, since the majority of published studies refer to the US context.

Flooding resilience is also an increasing concern of European society, since climate change and also land use change have increased the risk of major floods in Central and Eastern Europe. The agricultural contribution can again be positive or negative, depending on the maintenance or changes in land uses and/or farm practices.

Table 4 summarises the content and main dimensions of the PGaE that have been described. It displays an overall description of goods, services and benefits related to the selected PGaE, including some information on the main interactions among these PGaE, and the respective dimensions.

The description of each PGaE's content distinguishes its main components, as in the case of biodiversity, and identifies the goods, services and benefits delivered by them, including their role as intermediate goods or services for the provision of others PGaE. The different dimensions of the several PGaE are inventoried to highlight their multidimensional character, which must be considered in economic valuation, namely when presenting the benefits of these PGaE for respondents. While, some dimensions, e.g. ecological, historical, cultural and heritage, might comprise significant non-use values, others, such as air and water quality, and fire and flooding resilience involve significant impacts on (public) human health and security.

Table 4 – Content description of the environmental public goods and externalities of the EU agriculture

Environmental PGaE	Content	Dimensions
Landscape (cultural)	The role of landscape in providing cultural services and benefits: Aesthetical, Health, Cultural, Identity, Heritage, Educational, Inspirational, Spiritual, Religious Leisure, recreational and tourism services	**Visual** **Heritage** **Historical** **Cultural** **Social** **Recreational** **Economic (Development)**
	The landscape itself (good/goods) Sense of place Geographical identity Heritage Cultural Leisure, recreational and tourism	
Biodiversity	Ecosystems and habitats assemblage and network (ecological infrastructure) that supports the functional diversity (ecosystems and habitats functions)	**Ecological** **Recreational** **Heritage** **Cultural** **Economic (Development)**
	Ecosystems and habitats diversity Landscape features related to land use, examples: arable land, woodland, Rough grazing, Hay meadow, semi-natural grassland	
	Genetic and species diversity Umbrella species, flagship species, endangered species, rare species, charismatic species, familiar species, locally important species, endemic species, autochthonous breeds	
Water quality and Water availability	Services provided by water availability and quality: Drinking water, bathing water and other recreational uses (e.g. angling, boating), Water for agricultural uses (irrigation, livestock), and for other uses (domestic, industrial). Water quality and availability are intermediate services for: biodiversity, landscape quality (cultural services) and soil quality	**Human health** **Ecological** **Recreational** **Heritage** **Economic**
Soil quality	Services provided by soil quality: Soil fertility and productivity, carbon storage (climate stability) Soil quality is an intermediate (supporting) service for: biodiversity, landscape quality (cultural services), water quality, air quality, resilience to fire and flooding	**Ecological** **Recreational** **Heritage** **Economic**
Air quality	Services provided by air quality: Clean air, visibility Benefits provided by air quality: life quality, human health, biodiversity Air quality is an intermediate service for: biodiversity, climate stability, water quality	**Human health** **Ecological** **Recreational** **Economic**
Climate stability	Services provided by climate stability: Carbon offset, climate stability Benefits provided by climate stability: life quality, human health, biodiversity and landscape quality, hazard prevention (wildfires and flooding)	**Human health** **Ecological** **Recreational** **Heritage** **Economic**
Resilience to fire	Services provided by fire resilience: wildfires prevention; mitigation of wildfires effects Benefits provided by fire resilience: secure property, prevent human lives loss, landscape maintenance, biodiversity preservation, soil quality, water quality and availability, climate stability, resilience to flooding (related to soil quality and ecosystem water regulation functions)	**Human health** **Ecological** **Recreational** **Heritage** **Economic**
Resilience to flooding	Services provided by flooding resilience: prevention of flooding; mitigation of flooding effects Benefits provided by flooding resilience: secure property, prevent human lives loss, landscape maintenance, biodiversity preservation, soil quality, water quality and availability	**Human health** **Ecological** **Recreational** **Heritage** **Economic**

2.4.2. Popular descriptions of environmental PGaE of agriculture in the valuation literature

This section introduces the most common specifications for the selected environmental PGaE in the valuation literature. It is based on the literature review presented in Annex 1. The main sources for this review are the ISI web of knowledge platform and the database EVRI (Environmental Valuation Reference Inventory).

Annex 1 is organised in a set of tables, each corresponding to one of the eight environmental PGaE considered. The references included in the tables resulted from an extensive literature review of valuation studies addressing the selected agricultural PGaE. They include worldwide studies, even though there has been an added effort to review European studies.

Stated preferences methods, namely Contingent Valuation (CVM) and Choice Modelling (CM), are the most popular valuation approach in the literature, whereas other valuation methods, such as Hedonic Pricing method (HPM), and even market-based valuation are also present.

Landscape is by far the public that is more often valued in the reviewed valuation literature. The review presented in Annex 1 highlights five key groups of studies regarding the specification of landscape. These groups are designated: (1) Landscape general description (L_g); (2) Landscape attribute-based description (L_{at}); Landscape & Biodiversity general description ($L\&B_g$); Landscape & Biodiversity attribute-based description ($L\&B_{at}$); (5) Landscape and other environmental (social) services (M_{at}).

The specification of changes in landscape quality, using overall descriptions, often including also habitats and wildlife attributes, is very common in the valuation studies of the nineties. The Contingent Valuation method (CVM) is the valuation technique usually applied, predominantly using the dichotomous choice format, though other valuation formats are also frequent (open-ended and payment card).

These broad specifications of landscape change(s) focus on the description of the context underpinning it. They are used to value changes between policy-on and policy-off scenarios, commonly related to agri-environmental policies and programmes, and, to a lower extent, to land use changes (more common for non-European studies).

The landscape specifications built on attributes, with clearly specified levels, also often include biodiversity components. This category of landscape specification studies have been mostly conducted in the first decade of the current millennium. They have been often conducted with CVM using the dichotomous choice format and/or with the Choice Modelling (CM) approach. The Hedonic Price method (HPM) is also used, but not so often. The attributes specified include landscape features (e.g. hedgerows, habitats, land cover, farm/traditional buildings, archaeological sites), and are in general specified in terms of the presence/absence of the attribute related with policy-on and policy-off scenarios or land use/cover changes. There are a few studies conducted with the Travel Cost method (TCM), often together with CVM, valuing changes in recreational attributes (e.g. recreational activities or recreational resources).

More recently, landscape tends to be valued together with other environmental (and often social) attributes. These studies have been in general conducted within the CM approach, whereas other methods are present, such as CVM, HPM and Benefit Transfer (BT). They acknowledge that landscapes deliver bundles of services that can be easily perceived by the public, thus avoiding the limitations of valuing changes in landscape basically built on descriptions of the context of changes.

The studies addressing the valuation of agriculture-related **biodiversity** are the second most numerous groups of valuation studies, after landscape studies. The reviewed studies, presented in Annex 1, can be assembled in three main sub-groups. These groups are designated: (1) Biodiversity general description (B_g); (2) Biodiversity attribute-based description (B_{at}); (3) Biodiversity and other environmental services (M_{at}).

The studies resorting to general descriptions of biodiversity include different specifications for it. Some of them present overall variations in the biodiversity status, namely habitats, but often including either particular species, related to changes in farming systems or farming practices. Others value changes in more specific components of biodiversity, in particular variations in the conservation status of species. In general those studies are CVM applications, whereas there are also applications of other valuation techniques, such as the CM and TCM.

Attribute-based descriptions for biodiversity are commonly observed in studies valuing changes in interrelated components of biodiversity, like habitat quality and the presence/number of particular species. The CM approach is more popular in these studies, though other valuation techniques are also present.

The valuation of multi-attribute changes where biodiversity is included as a part of a broader set of environmental services, regulating, provisioning and often cultural services, is also common within the studies classified as "biodiversity valuation studies" in Annex 1. In this case, BT is the predominant valuation approach, whereas other valuation techniques have been employed, namely CM and CVM.

The remaining categories of selected PGaE, water quality and availability, soil quality, air quality, climate stability and resilience to fire and flooding, are not so well represented in the reviewed valuation literature. In addition, it is often difficult to identify the share of agriculture in the valued benefits, in particular for water quality and availability, air quality and climate stability, due to overall approach to the measurement of the benefits or costs of these services.

Valuation studies of **water quality and availability** related to agricultural activities can be roughly divided in two groups: (1) those estimating benefits/costs of reducing water pollution; (2) those valuing benefits of water quality improvements in surface and/or groundwater.

The benefits of reducing water pollution related to agriculture are in general measured in the context of public programmes or incentives to farmers to change/introduce farming practices that are less damaging or even beneficial for water-quality, and also often for soil-quality. Some (mainly US) studies, estimate the farmers' willingness-to-accept compensation for changing farming practices leading to lower water pollution. Stated preference (SP) techniques, namely CVM, are again the most popular approach to measure the people's (residents and general public) welfare changes related to improved water quality levels due to reductions in agricultural pollution. Nevertheless, cost-based methods are also commonly used including replacement cost, opportunity cost and policy costs.

The studies valuing changes in surface water quality, namely that of water bodies, often specify them through overall and broad descriptions of variations in ecological (biodiversity) and recreational attributes. In this case, SP techniques are again the most popular, whereas some studies employ TCM and also the BT approach.

Water quality (and availability) is commonly, as abovementioned, included in the valuation of changes in multiple environmental goods and services. This PGaE appears mostly associated with landscape and biodiversity quality, as well as with soil quality.

There are fewer studies valuing the benefits of reducing water abstraction or increasing water availability (namely in water bodies). SP techniques are used as well as HPM and the BT approach.

Valuation studies addressing **soil quality** include mainly the benefits (costs) of reducing (increasing) soil erosion. Different valuation methods are used, including cost-based approaches, while demand-side (namely SP) techniques seem to be the preferred ones.

Changes in soil erosion are, in general, specified according to two alternative situations: (a) related to changes in farming practices; (b) resulting from changes in land use.

Soil quality is also frequently included in the valuation of multi-dimensional changes in multiple environmental goods and services. It appears to be mainly associated with water quality and availability, and landscape and biodiversity quality. In some studies, soil quality is valued through water quality benefits, as silting associated with changes in farming practices or land uses is prevented when soil erosion is reduced.

The reviewed valuation literature is scarce as regards **air quality** externalities from agricultural activities. Most of the studies included in Annex 1 refer to the impacts of urban/industrial pollution on crops and/or the agricultural sector. These studies resorted mainly to market and cost-based valuation techniques. There are very few studies valuing changes in air quality associated with changes in farming practices.

The situation is similar for **climate stability**. We have reviewed one study (Manley *et al*., 2005) that has estimated costs (for farmers) of changing tillage practices in order to increase carbon storage, considering alternative scenarios.

Resilience to fire and flooding are again scarcely found in the reviewed valuation literature, although there are some studies available that address the value of wildfire prevention on property and biodiversity.

2.4.3. Descriptions building on agri-environmental indicator systems

The development, in recent years, of different agri-environmental indicator systems made it possible for us to explore the possibility for describing the selected PGaE by using the existing indicators. This possibility is assessed in this section.

The set of indicators analysed comprise the main agri-environmental indicator systems available for the EU, which have been developed by different institutions such as EUROSTAT, DG Environment, FAO, or EEA.

In the case of **landscape**, given that we have opted for a restricted definition of this PGaE as the cultural services of the landscape, it is not possible to find, in the abovementioned databases, indicators that could support its description. The agri-environmental indicators explicitly related to landscape features, such as land use or cropping/livestock patterns have, on the other hand, been very valuable to describe the agro-ecological landscape infrastructure and thus to establish different macro-regions across the EU (see Chapter 3). As already explained, macro-regions are used in this study to classify different landscape types, which, as agro-ecological infrastructure types, deliver different bundles of PGaE across the EU.

There are relevant indicators to describe biodiversity in the databases analysed, as shown in Table 5.

Table 5 – Agri-Environmental indicators describing the PGaE Biodiversity related to the EU agriculture

Indicators	Corresponding indicators in EUROSTAT, IRENA, EEA and EC documents	Information sources
Agricultural areas under Natura 2000	AEI 2 - Agricultural areas under Natura 2000 IRENA 04 - Area under nature protection RD 11 – Natura 2000 area	**EEA** **DG AGRI** **DG ENV** **CLC 2006**
Genetic diversity	AEI 22 - Genetic diversity IRENA 25 - Genetic diversity EEA 25 - Genetic diversity	**FAO**
High nature value farmland	AEI 23 - High nature value farmland IRENA 26 - High nature value farmland areas EEA 26 - High nature value (farmland) areas RD 18 – Biodiversity: High Nature Value farmland and forestry	**EEA** **CLC** **FADN**
Population trends of farmland birds	AEI 25 - Population trends of farmland birds IRENA 28 - Population trends of farmland birds EEA 28 - Population trends of farmland birds EEA 33 - Impact on habitats and biodiversity RD 17 – Biodiversity: Population of farmland birds	**Pan-European Common Bird Monitoring project**

The indicators presented in Table 5 provide descriptions of both (1) particular areas that are relevant for ecosystems and habitats diversity and (2) genetic and species diversity related to European farmland areas.

The specifications for agriculturally-related biodiversity components found in the valuation literature very often use attributes that are similar to the agri-environmental indicators shown in Table 5. Therefore, these indicators seem helpful to support the design of standardised descriptions of biodiversity components related to agricultural areas. They could even be used to specify evidence-based quantity/quality changes in biodiversity components in up-scale valuation surveys. Unfortunately, the lack of quality data for these indicators with the required level of spatial disaggregation prevented us from following this promising methodological path.

In the case of simpler PGaE, the similarity between the agri-environmental indicators and the attributes mostly used in valuation surveys is even closer. The description of agriculturally-related changes in quality/quantity of PGaE such as water quality and availability, air quality and climate stability could actually be based upon the indicators listed in Tables 6, 7 and 8.

Water quality indicators allow for two alternative descriptions of agriculturally-related changes in water quality. These changes can be presented either as (1) a result of changes in the level of inputs used by farmers, which are available only for fertilizers, or, directly, as (2) changes in surface or groundwater quality, e.g. nitrate and pesticide pollution or the risk of pollution by phosphorous.

Water availability indicators support descriptions of changes in the quantity of this PGaE that are directly related with the agricultural activities.

Air quality indicators allow also for alternative descriptions of changes in air quality related to agricultural activities. These changes can be either (1) presented as resulting from changes in the level of those inputs (fertilizers and pesticides) used by farmers that are responsible for air pollution, or (2) described as changes in air quality due to changes in the main agricultural pollutant emissions, ammonia, methane and nitrous oxide; they can be alternatively (3) described as changes in farm management practices that are implemented by farmers to reduce air pollutant emissions from manure storage associated with intensive livestock activities.

Table 6 – Agri-Environmental indicators describing the PGaE Water Quality and Availability related to the EU agriculture

Indicators	Corresponding indicators in EUROSTAT, IRENA, EEA and EC documents	Information sources
Water use intensity	IRENA 10 - Water use intensity RD 15 - Water use	**EUROSTAT: FSS;** **Farm Structure Survey 2007; Agri-environmental indicators**
Water abstraction	AEI 20 - Water abstraction IRENA 22 - Water abstraction EEA 22 - Water abstraction	**EUROSTAT / OECD Joint Questionnaire**
Share of agriculture in water use	AEI 7 - Irrigation IRENA 34.3 - Share of agriculture in water use EEA 34.3. Share of agriculture in water use	**EUROSTAT: FSS** **EUROSTAT / OECD Joint Questionnaire**
Mineral fertiliser consumption	AEI 5 - Mineral fertiliser consumption IRENA 08 - Mineral fertiliser consumption	**Fertilizers Europe (Fertiliser Manufacturers Association)**
Risk of pollution by phosphorus	AEI 16 - Risk of pollution by phosphorus	**EUROSTAT / OECD Joint Questionnaire**
Water quality	RD 14 – Water quality	**DG Environment**
Water quality – Nitrate pollution	AEI 27.1 - Water quality – Nitrate pollution IRENA 30.1 - Nitrates in water EEA 34.2. Share of agriculture in nitrate contamination RD 20 - Water quality: Gross Nutrient Balances RD 21 -Water quality: pollution by nitrates and pesticides	**EEA: Eionet Water** **EUROSTAT: Agri-environmental indicators** **European Environment Agency (EUROWATERNET)** **OECD**
Water quality – Pesticide pollution	AEI 27.2 - Water quality – Pesticide pollution IRENA 30.2 - Pesticides in water RD 20 - Water quality: Gross Nutrient Balances RD 21 -Water quality: pollution by nitrates and pesticides	**EEA: Eionet Water** **EUROSTAT: Agri-environmental indicators** **European Environment Agency (EUROWATERNET)**

Table 7 – Agri-Environmental indicators describing the PGaE Air Quality related to the EU agriculture

Indicators	Corresponding indicators in EUROSTAT, IRENA, EEA and EC documents	Information sources
Farm management practices	AEI 11 - Farm management practices, AEI 11.3 - Manure storage IRENA 14 - Farm management practices	**EUROSTAT: FSS; SAPM** **FOOTPRINT cultivation calendars**
Mineral fertiliser consumption	AEI 5 - Mineral fertiliser consumption IRENA 08 - Mineral fertiliser consumption	**Fertilizers Europe (Fertiliser Manufacturers Association)**
Ammonia emissions	AEI 18 - Ammonia emissions IRENA 18sub - Atmospheric emissions of ammonia from agriculture EEA 18b - Atmospheric emissions of ammonia	**EEA – CLRTAP** **Officially reported 2004 national total and sectorial emissions to UNECE/EMEP (Convention on Long-Range Transboundary Atmospheric Pollution)**
Emissions of methane and nitrous oxide	EEA 19 - Emissions of methane and nitrous oxide	**Official national total, sectorial emissions, livestock and mineral fertiliser consumption data reported to UNFCCC and under the EU Monitoring Mechanism and Eionet**
Consumption of pesticides	AEI 6 - Consumption of pesticides IRENA 09 - Consumption of pesticides	**EUROSTAT questionnaire**
Pesticide risk	AEI 17 - Pesticide risk	**HAIR project**

Climate Stability indicators seem also useful to create alternative descriptions of changes in GHG emissions from agricultural activities. These can be described (1) as changes in overall GHG emissions or specific GHG emissions from agriculture, which are available only for ammonia; (2) as changes in farm management practices aimed at reducing GHG emissions from manure storage in intensive livestock activities; or (3) as changes in agricultural

GHG emissions due to energy-efficiency gains or the production of bio-energy (the latter, measured indirectly through the UAA devoted to renewable energy).

Table 8 – Agri-Environmental indicators describing the PGaE Climate Stability related to the EU agriculture

Indicators	Corresponding indicators in EUROSTAT, IRENA, EEA and EC documents	Information sources
Farm management practices	AEI 11 - Farm management practices, AEI 11.3 - Manure storage IRENA 14 - Farm management practices	**EUROSTAT: FSS; SAPM** **FOOTPRINT cultivation calendars**
Ammonia emissions	AEI 18 - Ammonia emissions IRENA 18sub - Atmospheric emissions of ammonia from agriculture EEA 18b - Atmospheric emissions of ammonia	**EEA – CLRTAP** **Officially reported 2004 national total and sectorial emissions to UNECE/EMEP (Convention on Long-Range Transboundary Atmospheric Pollution)**
Greenhouse gas emissions	AEI 19 - Greenhouse gas emissions IRENA 19 - GHG emissions IRENA 34.1 - Share of agriculture in GHG emissions RD 26 - Climate change: GHG emissions from agriculture	**EEA – UNFCCC** **EUROSTAT**
Energy use	AEI 8 - Energy use IRENA 11 - Energy use	**DG AGRI: FADN** **EUROSTAT: FSS; SIRENE**
Production of renewable energy	AEI 24 - Production of renewable energy IRENA 27 - Renewable energy from agricultural sources EEA 27 - Production of renewable energy (by source) RD 24 - Climate change: Production of renewable energy from agriculture and forestry	**DG AGRI** **EUROSTAT: Energy Statistics; FSS and RES** **European Bio diesel Board** **EurObserv'ER** **International Energy Agency** **Faostat**
Climate change: UAA devoted to renewable energy	RD 25 - Climate change: UAA devoted to renewable energy	**DG AGRI**

The agri-environmental indicators related to the PGaE **soil quality** are shown in Table 9. In this case, there is also a close correspondence between these indicators and the attributes used in valuation studies to describe changes in soil quality related to changes in farmland practices, such as tillage practices or input (fertilizers and pesticides) use intensity. The existing indicators also allow for describing changes in soil quality due to contamination by pesticides.

On the other hand, the indicator ‘soil quality’ essentially measures carbon storage in the soil. Although for low levels of soil carbon, as in most of Mediterranean Europe and many intensive arable areas elsewhere in Europe, soil carbon is a good indicator of soil fertility, the same is not valid across Europe, as in many cold, wet or acidic soils, a high level of soil carbon is indeed an indicator of unfavourable conditions for plant growth. Under these conditions, soil carbon is not a good indicator of soil quality – on the contrary –, but it still it is a good indicator of the contribution of these soils to climate stability through CO_2 sequestration. In this case, specific management practices (extensive livestock grazing, preventing soil tillage) are advised which conserve soil carbon stock. On the other hand, where soil carbon stock is low, farming practices such as zero tillage or land use as permanent pasture are advised as they contribute to raise this stock, increasing in this way both soil quality and soil’s contribution to climate stability.

So, in this study, we take the ‘soil quality’ indicator as a good one to describe changes in the PGaE **climate stability** everywhere in the EU, and, only under certain circumstances (Mediterranean and arable crops regions), as a good indicator as well of changes in the PGaE **soil quality**.

Table 9 – Agri-Environmental indicators describing the PGaE Soil Quality related to the EU agriculture

Indicators	Corresponding indicators in EUROSTAT, IRENA, EEA and EC documents	Information sources
Farm management practices	AEI 11 - Farm management practices, AEI 11.1 - Soil cover, AEI 11.2 - Tillage practices IRENA 14 - Farm management practices	**EUROSTAT: FSS; SAPM** **FOOTPRINT cultivation calendars**
Mineral fertiliser consumption	AEI 5 - Mineral fertiliser consumption IRENA 08 - Mineral fertiliser consumption	**Fertilizers Europe (Fertiliser Manufacturers Association)**
Gross nitrogen balance	AEI 15 - Gross nitrogen balance IRENA 18.1 - Gross nitrogen balance	**EUROSTAT / OECD Joint Questionnaire**
Risk of pollution by phosphorus	AEI 16 - Risk of pollution by phosphorus	**EUROSTAT / OECD Joint Questionnaire**
Consumption of pesticides	AEI 6 - Consumption of pesticides IRENA 09 - Consumption of pesticides	**EUROSTAT questionnaire**
Pesticide soil contamination	EEA 20 - Pesticide soil contamination	**EUROSTAT: pesticide statistical data; FSS**
Soil erosion	AEI 21 - Soil erosion IRENA 23 - Soil erosion EEA 23 - Soil erosion RD 22 - Soil: Areas at risk of soil erosion	**JRC: PESERA** **JRC Ispra – Revised Universal Soil Loss Equation model (RUSLE)**
Soil quality	AEI 26 - Soil quality IRENA 29 - Soil quality EEA 29 - Soil quality	**JRC: European Soil Database**

The valuation of off-farm effects of soil erosion implies describing composite changes in soil quality, water quality (and availability, e.g. through reservoir filling or reduced soil water storage), biodiversity and landscape, which can be achieved by using a set of agri-environmental indicators for the different PGaE at stake. These sets of indicators might also be useful to describe other multiple-PGaE changes. There is indeed nowadays an increasing interest in valuing multidimensional changes associated with land-use and/or farming-system changes driven by context factors such as policy, market and climate change.

The PGaE related to hazards prevention, **fire resilience** and **flooding resilience**, are still poorly accounted for in agri-environmental indicator systems.

The limitations on agri-environmental indicator systems as regards the absence of indicators describing the cultural dimension of agricultural landscapes and the PGaE related to hazard prevention, fire resilience and flooding resilience, highlight the need for further developments in the current state of art of these indicator systems.

Nevertheless, currently, the major problem with using these indicator systems for developing PGaE specifications in a valuation context lies in the limited available data that is disaggregated at low geographical levels. In particular for simpler PGaE, namely water quality and availability, air quality and climate stability, which could be reasonably described in valuation surveys by resorting to the available indicators, this lack of appropriate levels of spatial disaggregation is the major problem to be solved.

Therefore, we can conclude by saying that in the next years relying on agri-environmental indicators to describe evidence-based agriculturally-related changes in PGaE for valuation purposes will probably become common practice. However, further improvements in agri-environmental indicators systems are required for this to become a reality, especially as regards data availability at regional level (NUTS-3), the development of better indicators for multidimensional PGaE such as landscape and biodiversity, and for agriculturally-related resilience to fire and flooding.

The next four sections (Sections 2.5 to 2.8) review the content descriptions of public goods and externalities of agriculture described in this section as regards their links to four additional dimensions that have been selected as relevant for PGaE description. These are: (a) relating PGaE with the ecosystem services framework, (b) classifying PGaE's content according to the categories of Total Economic Value (TEV) that have been developed within the valuation field; (c) identifying the main geographical scales of supply and demand for the different PGaE, and eventually (d) clarifying their respective degree of publicness.

2.5. Agricultural PGaE in the ecosystem services framework

Because of its focus on our reliance on ecosystems to deliver human well-being, the ecosystem services (ES) framework is a promising approach to get a deeper knowledge of the interface between ecological and economic dimensions of ecosystems. This approach went through important developments in recent years, which have been brought about by the development of a number of major inter-disciplinary studies, conducted at the global, national and local levels, such as the MEA (2005), TEEB (2010) and the UK NEA (2011).

The ES approach relies, on one hand, upon the classification of ecosystem services into four categories – supporting, regulating, provisioning and cultural services –, and, on the other hand, on comprehensively analysing the ES provision chain through a diagrammatical step-by-step frame which interconnects ecosystem structures, processes, functions, services, benefits and their economic values (see e.g. De Groot *et al*., 2010). Services can be both intermediate and final. Processes and functions can be seen as primary and intermediate services, which are often final benefits in respect to human welfare measurement.

Supporting services include the primary production, soil formation and cycling of water and nutrients in ecosystems. Hence, they provide the basic infrastructure for biodiversity and for the provision of all other types of ES. To avoid double accounting, supporting services are usually excluded from economic valuation given that their value is already fully included in other services that are more directly linked to human welfare gains (or losses).

Regulating services encompass a strongly interrelated number of ecological processes/functions, intermediate and final services and benefits. Smith *et al*. (2011) provide a comprehensive list of them, accounting for an increasingly embedding gradation; his list starts with the final services and ends up with the more complex primary and intermediate services. The reported services are the following: climate regulation, hazard regulation, disease and pest regulation, pollination, noise regulation, soil quality regulation, air quality regulation and water quality regulation.

Provisioning services are mostly final services and include important market goods and services, such as food, fuel and fibre, while including as well non-market goods and services like fresh water (which often is a market good), wild fruits and plants, wild mushrooms, game and fishing goods – used by both market and non-market recreational activities –, and genetic resources.

Cultural services comprise a vast group of goods, services and benefits from a diversified set of interrelated categories: leisure, recreation and tourism, health and well-being, aesthetics, heritage, education and informational, inspirational, spiritual and religious. Church *et al*. (2011) define cultural services as the environmental settings that give rise to the cultural goods and benefits that people obtain from ecosystems. In addition, these authors highlight the fact that these environmental settings have been co-produced by continuous and long-term interactions between humans and nature. Therefore, the cultural services category emphasises the multidimensional character of ecosystems and the strong interconnections between nature, technology, culture and economy.

The strong interconnection between ecosystem services and the selected PGaE has been already introduced along the previous sections, nevertheless we provide, in Table 10, a summarized overview of the description of environmental PGaE of agriculture within the ES framework.

Table 10 – Environmental PGaE of agriculture within the ecosystem services framework

Environmental PGaE	Primary services (Processes and Functions)	Intermediate services	Final services	Benefits
Landscape (cultural services)			Cultural services	**Direct, indirect and non-consumptive**
Biodiversity	Ecological infrastructure, and multiple processes and functions (e.g. biological control)	All the other PGaE	Provisioning and Cultural services	**Direct (provisioning)** **Direct, indirect and non-consumptive benefits (cultural)**
Water quality and Water availability	Ecological functions (e.g. water detoxification and purification)	All the other PGaE	Regulating, Provisioning and Cultural services	**Indirect (regulating), Direct (provisioning)** **Direct, indirect and non-consumptive benefits (cultural)**
Soil quality	Ecological processes/functions (e.g. buffer, filter and transform chemical substances)	All the other PGaE	Regulating service	**Indirect (regulating)** **Direct and non-consumptive benefits (cultural)**
Air quality	Ecological functions (e.g. regulating atmosphere concentration and deposition of air pollutants)	All the other PGaE (excluding hazard resilience)	Regulating service	**Indirect (regulating)** **Direct and non-consumptive benefits (cultural)**
Climate stability			Regulating service	**Indirect (regulating)** **Direct and non-consumptive benefits (cultural)**
Resilience to fire			Regulating service	**Indirect (regulating)** **Direct and non-consumptive benefits (cultural)**
Resilience to flooding			Regulating service	**Indirect (regulating)** **Direct and non-consumptive benefits (cultural)**

As shown in Table 10 agricultural PGaE can be easily depicted within the ecosystem services framework. Most of them are regulating services produced and/or influenced by the agro-ecosystem (landscape) infrastructure. The classification according to the benefits is defined in the next section (2.6).

Water quality, soil quality and **air quality** are fundamental regulating services delivered by the agricultural-landscape infrastructure throughout the underlying relationships between ecological processes, land uses, farming systems and practices. Their status determines the provision level of all other remaining PGaE.

Other PGaE, like the regulating services **climate stability** and **resilience to fire and flooding**, are supplied as a result of a good quality status of the agro-ecologic infrastructure and the good condition of underlying ecological processes and functions related to the supporting and elementary regulating services.

It is worthwhile to underline that all PGaE classified mainly as regulating services comprise also cultural dimensions/services. These can be linked either to direct use (e.g. visiting areas to enjoy their air clarity) or non-use (e.g. to enjoy acknowledging that other people or future generations will experience air limpidness).

Water availability is mostly a provisioning service, although, jointly with the water quality can also be seen as a regulating service and as a source of cultural services (related to recreational and cherished water bodies, such as river, lakes and ponds).

Given its complex nature, **biodiversity** supports the provision of all regulating services and is, by itself, a source of provisioning and cultural services.

Landscape, as restricted to its cultural dimension, basically is a set of interrelated cultural services.

Table 10 (as well other tables previously presented, e.g. Table 4) highlight important supply-side interactions between several PGaE. It is to have in mind these interactions when describing multiple-PGaE changes to respondents for valuation purposes, given that changes in some PGaE are jointly produced and thus should be presented in bundles and not independently as if these supply-side interactions did not exist. As there are often also demand-side interactions between these or other PGaE (e.g. when they are substitutes in valuation), it is important that agri-environmental policy makers know the public's valuations of these bundles of PGaE in addition to knowing their valuations for individual changes in each PGaE.

2.6. Agricultural PGaE described according to the TEV categories

The Total Economic Value (TEV) is the concept defining the broadest scope for environmental non-market valuation exercises. It encompasses four main categories of welfare gains (or losses): (a) direct use value, (b) indirect use value; (c) option use value; (d) non-use value (or passive use value).

The direct use value comprises those welfare gains (or losses) that are derived from the direct consumption or use of a good or service (or bad), for example from eating a berry, watching a beautiful landscape or hiking in a wilderness area. The indirect use value results from the indirect use of goods or services, for example the use of air quality or steady climate, which result from the ecosystem regulating services, respectively air quality and climate stability regulation. The option use value captures the people's welfare gains (or losses) associated with securing the option of possible uses of the good or service in the future. The non-use value (or passive use) category includes all the welfare gains (or losses) that are not related either with the direct use (in the present or in the future) or the indirect use of a good or service. It encompasses a set of non-use benefits derived from the people's welfare gains (or losses) motivated by altruistic behaviour towards other people in the future (bequest value) or present (vicarious value), and stewardship attitudes or simply sympathy towards nature or other species (existence value).

Table 11 refines Table 10 in order to highlight the link of each PGaE to the different value categories included in the TEV concept.

Table 11 – TEV categories for the selected PGaE

Environmental PGaE	Direct use value	Indirect use value	Option use value	Non-use value
Landscape (cultural)				
Biodiversity				
Water quality and Water availability				
Soil quality				
Air quality				
Climate stability				
Resilience to fire				
Resilience to flooding				

In Table 11, all categories of TEV are represented for each of the selected PGaE. The cells marked with light colour are meant to sign links that are secondary in comparison to those marked in dark colour.

Regulating services comprise mainly indirect use value. Notwithstanding, one can identify direct and non-use values related with their cultural-services dimension. These values relate to the people's welfare gains that are usually implicitly captured in the valuation of changes in landscape quality, such as **air quality, soil quality and landscape resilience to fire and flooding.**

Water availability (jointly with water quality) basically is a provisioning service. It also comprises an option-value component.

Water quality (depends also on water availability, e.g. flow level of water bodies) comprises important cultural services related with recreation, health and well-being, and others, that might, nevertheless, be captured in the valuation of landscape (as a flow of cultural services). It also comprises an option-value component.

Biodiversity, namely in its component of genetics and species diversity might encompass a substantial option and, in particular, non-use value. Ecosystems and habitat diversity are mostly captured through the (cultural) landscape valuation, whereas they are often valued individually. They comprise important cultural services with direct, indirect, option and non-use value.

Biodiversity includes as well provisioning services, such as wild plants and fruits, mushrooms and other wild non-market (or imperfectly marketed) products with a direct (market or non-market) use value for people.

When disaggregating the value of PGaE of agriculture into its different TEV categories two important caveats need to be taken in mind: (1) summing up the values of the several categories is not a valid procedure to secure the total value of the PGaE provided by a particular agro-ecosystem (or agricultural landscape); and (2) appropriate demand scales of PGaE are largely dependent on the particular TEV category at stake.

The limitations of aggregating the value of different categories of TEV in order to obtain the total economic benefits provided by the ecosystems have been underlined by diverse authors (e.g. Turner et al., 2003). Two problems arise from this procedure: (a) on one hand, it is not possible to capture the total ecosystem value through TEV concept, as there are elusive components related to the primary services (infrastructure and interconnections among processes and functions) that are not fully captured through non-market valuation; and (b) on the other hand, there is a risk of double counting when one aggregates different categories of TEV obtained from the same individual

Therefore, an accurate delimitation of segments of beneficiaries, which means an accurate identification of the demand scales of PGaE, is crucial to obtain consistently aggregated estimates for the economic benefits of each PGaE and their respective bundles.

2.7. Geographical scales of supply and demand of environmental PGaE of agriculture

The selected PGaE are supplied at different scales, from the land parcel to the wide landscape or regional scales. Each particular PGaE and TEV category is supplied at a particular scale, such as the watershed for water availability and quality; fire resilience, for instance, can only be supplied at the landscape scale, where the delimitation of adequate ‘fire basin’ areas should take account of landform features and meteorological variables (e.g. wind direction and intensity) affecting the dissemination of fire.

Geographical scales of supply and demand of PGaE comprise local, regional, national and global levels. While national and global scales are clearly defined, local and regional are more ambiguous delimitations. These boundaries are often related to territorial administrative delimitations, such as the municipality and the regions, settled at national level, which do not necessarily correspond to the relevant ecological or hydrological boundaries. Notwithstanding, relevant data are often only available for administrative units, and one needs to deal with this problem by getting data for the lowest geographical level available and building the appropriate aggregations to get a scale which is as close as possible to the relevant supply or demand scale.

Often the supply of PGaE involves administrative regions from different countries, for example the cases of water quantity and quality, air quality or biodiversity, which is due to their relevant ecological scales, respectively, the watershed, the atmosphere and the habitat/ecosystem/biome. This situation might be designated as an inter-regional scale.

Table 12 summarises the key geographical scales, both from the supply and demand side, for each one of the selected PGaE.

Table 12 – Key geographical scales on the supply and demand sides for the selected PGaE

Environmental PGaE	Supply side Geographical scales	Demand side Main beneficiaries	Demand side Geographical scales
Landscape (cultural services)	Local Regional Inter-Regional	Residents; Visitors General public	**Local; Regional National Global (Europe)**
Biodiversity	Local Regional Inter-Regional	Residents; Visitors General public	**Local; Regional National Global (Europe)**
Water quality and Water availability	Local Regional Inter-regional	Farmers Residents; Visitors General public	**Local; Regional National Global (Europe)**
Soil quality	Local Regional	Farmers Residents General Public	**Local National Global (Europe)**
Air quality	Local Inter-Regional	Residents General Public	**Local National Global (Europe)**
Climate stability	Global	General Public	**Global (World)**
Resilience to fire	Local Regional	Farmers Residents; Visitors General public	**Local National Global (Europe)**
Resilience to flooding	Local Regional	Farmers Residents General public	**Local National Global (Europe)**

Table 12 highlights that the provisioning of PGaE occurs at multiple geographical scales. Public goods such as landscape and biodiversity are often important local or regional goods. These PGaE can also be related to an inter-regional scale when habitat/ecosystem boundaries cross administrative ones.

The **water quality and availability,** given that their ecological scale is the watershed, includes goods and services (provisioning, regulating and cultural) delivered at local, regional and often at inter-regional scales depending on the size of the watershed.

Soil quality, including off-farm impacts of soil quality on other PGaE, is mostly a local or regional service (regulating service).

Air quality changes related to agricultural activities appear mostly as a local issue (odours and localised pollution), while it might be a major problem and exhibit an inter-regional scale. In the UE, due to the existing pollution control measures and enforcement, this is not usually a large-scale agri-environment problem.

Climate stability related with the GHG effects is a global service, in spite of the local and regional nature of the positive or negative contributions (side-effects) of agriculture to it.

Hazard resilience to fire and flooding are mainly local and regional services.

The demand scales for the selected PGaE are also presented in Table 12. Given that these scales are established according to the beneficiary publics, those are identified for each one of PGaE, within the TEV categories commonly used in environmental valuation.

Landscape (cultural) and **biodiversity** yield benefits for resident populations, visitors and the general public. The latter can encompass different geographical scales from regional to global. Nevertheless, in the case of most EU agriculture-related landscape (cultural) and biodiversity PGaE, the global scale is generally confined to Europe, in the sense that most of these do not induce welfare changes in the general population of other world regions (non-use value), differently from e.g. the biodiversity of the Amazonian rainforest or other similar ecosystems.

The beneficiaries of water quantity and quality include the farmers who are their primary users, abstracting water and needing water quality. Residents and some segments of general public who benefit from quality drinking water are another important group of benefiting populations. Visitors also benefit from water quality of water bodies for leisure and recreational activities. In addition, water quantity and quality (including the role of agricultural on/for it) is a public good for national and European population in general.

Soil quality is a service that primarily benefits farmers and landowners in general. In addition, it might affect the welfare of local populations, while it also interacts with water quality, hazard resilience and also landscape quality.

Air quality changes related to EU agricultural activities affect mostly the local population when there are negative impacts caused by agriculture. Air quality (including the role of agricultural on/for it) is a public good for national and European and the world population in general.

Climate stability (including the role of agricultural on/for it) is a service concerning the European (indeed, the global) population in general.

Fire and flooding resilience affect directly farmers and local populations. But they are in addition services whose provision indirectly benefits national and European populations in general.

Fire resilience is a service that benefits also visitors, given that it is often related to mountainous areas with interesting landscape and biodiversity, which are demanded for leisure, recreational and sportive activities.

Systematising the geographical supply and demand scales of the selected PGaE, displayed in Table 12 (previously presented), allowed us to uncover three key aspects: (1) the divergence between supply and demand scales, given that even under the same general designation for the geographical scales are often different spatial delimitations; (2) the local, and often regional, importance of most PGaE, showing the importance of their value for residents and visitors, and (3) that in spite of (2), the provision of the selected PGaE delivers benefits broadly for the European general public, although significant variations are to be expected in the welfare gains (or losses), according to the proximity to the goods and services and/or the problems underpinning their under/over provision.

The European dimension anticipated in the demand scale of the selected PGaE supports the option of valuing them (or more precisely valuing changes in them) through an EU-level valuation survey, as has been planned within the valuation framework developed in this study.

On the other hand, the identification of the beneficiaries of the selected PGaE highlights that the provision of some services has a private dimension, making of their management an important issue for farmers and landowners, which may reduce, in some cases, their policy relevance. This brings along the discussion over the degree of publicness of the selected PGaE which it is presented in the next section.

2.8. Degree of publicness of the agricultural PGaE

The degree of publicness of the selected PGaE has been already introduced in the former sections; therefore we provide here essentially an overall synthesis in this respect.

The degree of publicness is an important descriptor of the content of PGaE, because it provides key information for policy and decision-making. Ultimately, it indicates if there is a stronger need for policy intervention.

Landscape (cultural) and biodiversity are mainly pure public goods in the sense that it is generally difficult to exclude anyone from experiencing their benefits and they are normally non rival in consumption. In the case of very popular landscapes, or wilderness areas, congestion among visitors might occur at local level. Exceptions to the pure public good character of biodiversity are particular uses such as hunting and mushrooms picking, which are rival and often non-excludable goods (they are common, free access goods). This highlights the fact that the type of use matters when identifying the degree of publicness.

Water availability and quality, as well as soil quality, present both public and private dimensions. Private land ownership in the case of soil quality/potential for producing agricultural output, and private control over water use give these services a strong private character. Nevertheless, often, for various reasons (legal, technical, or cultural) the access to water for agricultural activities is not subject to exclusion, although water quantity is a rival good and again a common, free access good when non-excludable.

Non-exclusion to water access leads often to water over-abstraction for irrigation and to water non-point source pollution related to agricultural activities.

Air quality and climate stability are services that can be classified as pure public goods (bads). Their consumption is both non-excludable and non-rival.

Fire and flooding resilience are also pure public goods as far as people cannot be excluded from their benefits and one's consumption does not limit others' consumption (non-rival).

The public (common) good character of all the PGaE just described highlights the importance of using non-market valuation to know its value for people, in this case for the EU population. To know the economic benefits that these goods and services bring to the people is fundamental to design policies and, in particular, agri-environmental payment schemes that address real social demands, and achieve social optima in efficient ways.

2.9. Final selection and description of the agricultural PGaE to be valued in the study

The public goods and externalities (PGaE) selected to be included in the valuation framework developed include: agricultural landscape as a flow of cultural services ('cultural landscape'), agriculturally-related biodiversity (habitats diversity, and species and genetic diversity), water quality and availability, soil quality, air quality, climate stability (GHG mitigation), resilience to fire, and resilience to flooding.

Our methodological approach to the valuation framework entails linking the several PGaE to macro-regional agri-environmental problems (MRAEP) that are spatially delimited at the EU level (as described in next chapter). Landscape is included in this framework as an agro-ecological infrastructure delivering the selected PGaE, and, as such, it is a fundamental piece of the valuation context supporting the description of the PGaE whose changes are to be valued.

This methodological approach allows disentangling the infrastructural elements from the services, in line with the ecosystem-services approach, making it easier to describe the changes in the provision levels of the selected PGaE in a standardised manner. In addition, we assure that the infrastructural dimension of agri-environmental changes is captured through their spatial indexation to the macro-regional agri-environmental problems that will support the construction of valuation scenarios.

Therefore, we are presenting an alternative approach to the description of complex goods, such as landscape and biodiversity, which are often broadly described including different dimensions in different studies, and possibly meaning different attributes to different respondents in the same study. The choice-modelling approach tackles the composition problem of complex valuation goods, but landscape is often described in a relatively loose way or, in other cases, when landscape attributes are differentiated, the valuation is focused on landscape quality variation, given the CM is constrained by the number of attributes that can be included in surveys.

On other hand, the description of simpler PGaE, like water quality and availability, air quality and climate stability, could be grounded on agri-environmental indicators from major European indicator systems. Using these indicators to specify changes in the PGaE would assure standardising descriptions for these PGaE. This would facilitate benefit transfers and better matching between value estimates and policy and decision-making contexts requiring these estimates. Nevertheless, these indicator systems do not provide yet for a systematic description of changes in PGaE, as they do not cover/capture yet all their major dimensions.

In spite of the current limitations of agri-environmental indicator systems, it is worthwhile that approaches aimed at (1) getting standardised (and comparable in space and time) measures of agri-environmental status, impacts and trends and at (2) measuring their values in economic terms come together and converge within a compatible conceptual frame. That would provide a platform for a more effective link between two potentially interconnected technical and research fields, agro-ecology and economics, which are still apart due to difficulties in communicating their concepts and building on similar measures of environmental quality, although their measurement purposes and approaches are (and will remain) different. For instance, in the cases of soil quality and hazard resilience, more research effort is needed from both agro-ecology and economics, given the scarcity of measurements in terms of both: (1) impacts, status and trends, and (2) non-market valuation. This research effort on both sides could be optimized if both work within a same platform of agri-environmental indicators.

The limitations in the available valuation estimates are evident for hazard resilience, fire and flooding resilience, but these limitations also characterize other regulating services, such as water quality and availability, air quality and climate stability, because their valuation scope is defined too broadly, which often does not allow to identify the share of agriculture in value estimates.

These limitations both in the agri-environmental indicator development (scarcity of regionally disaggregated data) and in the economic value estimates (due to broad specification of complex goods, mostly locally-specific value estimates, or just absence of estimates) underlines the advantages of carrying out an up-scaled valuation instead of relying in cumbersome benefit transfer exercises.

In addition, and as has been previously discussed, many PGaE are highly interrelated, which implies that their interactions must be accounted for in valuation. Adding up aggregated estimates of the different PGaE might generate significant measurement bias due to over/under estimation, probably over estimation, given the prevalence of substitution effects on the demand side (Santos, 2000).

Table 13 presents a synthesised description of the selected PGaE accounting for the main dimensions previously used in their comprehensive description. It presents also the way that changes in these PGaE are commonly described in the literature valuation, and which agri-environmental indicators (from major agri-environmental indicators systems) could be used to support their description in the valuation context.

Table 13 – Summarised description of selected PGaE

Environmental PGaE	What are they?	How are (can be) described in valuation surveys?	
		Using existing agri-environmental indicators	Valuation literature
Landscape (cultural services)	Final ecosystem services (Direct, Option use, Non-use value) Cultural services locally/regionally supplied Locally/regionally/globally (Europe) demanded	n.a.	• Overall change in the landscape status • Attribute's landscape changes (e.g. land use/cover, cultural heritage elements); Attribute's level described as presence/absence and/or quantitative variation • Landscape as an attribute of an environmental multi-attribute change (social attributes are also considered, however it is less common)
Biodiversity	Primary, intermediate and final ecosystem services (Direct, Option use, Non-use value) Cultural & Provisioning serv. locally/regionally suppl. Locally/regionally/globally (Europe) demanded	(a) High nature value farm (composite); (b) genetic and species diversity (Genetic diversity; Population trends of farmland birds)	• Changes in farmland practices • Overall change in the biodiversity status • Attribute's biodiversity changes (e.g. habitat; species); Attribute's level described as presence/absence and/or quantitative variation; Biodiversity as an attribute of an environmental multi-attribute change
Water quality and Water availability	Primary, intermediate and final ecosystem services (Direct, Indirect use, Non-use value) Regulating, Provisioning & Cultural serv. locally/region. suppl. Locally/regionally/globally (Europe) demanded	(a) Water abstraction; Share of agriculture water use (quantity); (b) Nitrate pollution; Pesticide pollution; Risk of pollution by phosphorous; Mineral fertilizer consumption (quality)	• Changes in the quantity (or share) of abstracted water for irrigation • Changes in quantity of non-point source pollution from agricultural (globally or for specific pollutants) • Changes in farmland practices • Changes in the quality status of surface (ground) water (built on general or well specified ecological, human health and/or recreational attributes • Water quality as an attribute of an environmental multi-attribute change
Soil quality	Primary, intermediate and final ecosystem services (Indirect, Option use, Non-use value) Regulating serv. locally/regionally supplied Locally/regionally/globally (Europe) demanded	Soil erosion; Risk of pollution by phosphorous; Gross nitrogen balance; Mineral fertilizer consumption; Consumption of pesticides; Farm management practices	• Changes in farmland practices or land use • Soil quality as an attribute of an environmental multi-attribute change • Impact in water quality (reducing sedimentation)
Air quality	Primary, intermediate and final ecosystem services (Indirect use value) Regulating serv. locally/regionally supplied Locally/regionally/globally (Europe) demanded	Ammonia emissions; Emissions of methane and nitrous oxide; Mineral fertilizer consumption; Consumption of pesticides; Farm management practices	• Changes in farmland practices • Air quality as an attribute of an environmental multi-attribute change
Climate stability	Final ecosystem services (Indirect use value) Regulating serv. globally supplied Globally demanded	Ammonia emissions; Share of agriculture in GHG emissions; Farm management practices; Soil quality (carbon storage)	• Changes in farmland practices • Climate stability as an attribute of an environmental multi-attribute change
Resilience to fire	Final ecosystem services (Indirect use value) Regulating serv. locally/regionally supplied Locally/regionally/globally (Europe) demanded	n.a.	• Wildfire measures prevention • (Avoiding) Damages caused by wildfires
Resilience to flooding	Final ecosystem services (Indirect use value) Regulating serv. locally/regionally supplied Locally/regionally/globally (Europe) demanded	n.a.	• (Avoiding) Damages caused by flooding

3. Methodological approach for up-scaled valuation of PGaE in agriculture

3.1. Introduction

This chapter aims at developing the methodological framework for the up-scaled valuation of selected public goods and externalities (PGaE) of EU agriculture. The major goals are (1) justifying the option for a SP CM approach, which resorts to constructed markets through large-scale surveys, (2) identifying and describing geographically-delimitated macro-regional agri-environmental problems (MRAEP), which provide the valuation context for those surveys, through the development of a methodological framework enabling for (a) selecting representative macro-regions in the EU, based on the characteristics of their landscapes and farming systems, and (b) investigating major PGaE problems in each macro-region in order to develop agro-ecological contexts (narratives) and specific attributes for the valuation exercise.

The chapter includes two main sections, following this introduction. Section 3.2 introduces briefly the valuation concepts and methods, in order to justify our option by a SP CM approach. Section 3.3 describes the methodological framework developed to identify, delimitate and describe different MRAEP and presents the respective results. This last section unfolds into four parts, corresponding to the steps of this methodological framework: (a) identification, delimitation and description of macro-regions, (b) PGaE indicators, (c) associations between PGaE and macro-regions and (d) macro-regional agri-environmental problems: narratives and core PGaE. Each of these parts is addressed first from a methodological standpoint and then the results are presented and discussed.

3.2. Explaining the option for SP CM approach

Economic value is a measure of the well-being people obtain from the consumption of a good or service and it varies with the consumed quantity (or quality) of that good or service. The economic value derived from the consumption of an additional unit of a good or service is known as the marginal value of that good or service. In general, the well-being obtained by an individual decreases with the increase in the consumed quantity, and therefore the marginal value is a decreasing function of the good (or service) quantity.

The individual's willingness-to-pay (willingness-to-accept)[2] are measures used in economics to measure, in monetary terms, changes in the individual's well-being resulting from a positive (negative) variation in the quantity or quality of a good or service. As these changes can be either marginal or discrete, the resulting WTP (WTA) is measured in marginal or discrete terms.

When goods and services are traded in markets that work well according to economic theory (basically meaning they are highly competitive), market prices give the individuals' marginal WTP for the (last unit consumed of the) corresponding good or service. In addition, individual (market) demand curves

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[2] Both measures willingness to pay (WTP) and willingness to accept (WTA) are theoretically adequate measures of the individuals' well-being variation, while resulting in different value estimates, with an increasing disparity with the reduction of substitution effect (for a detailed discussion see Hanemann, 1999). However, large disparities observed in empirical studies have led the NOAA panel (Arrow et al., 1993) to recommend the use of WTP instead of WTA.

can be estimated for different goods or services as long there is information on the quantities demanded at different prices, by the individual (or the aggregate set of consumers in the market).

However, if one needs to know the variation in the individual's well-being resulting from a change in the quantity/quality of environmental goods and services, such as the PGaE considered in this study, there is no market, and thus no observable prices and demand. A pertinent question is: *why do we need to know these variations in the individual's well-being?* The answer has to do with the value of having information on the economic benefits (costs) of a policy intervention aimed at improving the condition of those environmental goods and services or that, alternatively, results in the decline of the environmental "status quo". These public economic benefits (costs) can be then compared with their private counterparts – that is, how much has that environmental improvement cost us, or how much have we profited from that environmental degradation – to assess the proposed policy or even to identify an optimal level of policy intervention to correct the underlying market failure.

Therefore, the (*ex ante* and *ex post*) evaluation of agricultural and agri-environmental policies designed to improve the provision of environmental public goods and positive externalities (or to discourage negative externalities) must account for the changes in the well-being of the benefited (prejudiced) individuals. In the case of EU policies, these individuals are (at least) the whole EU population.

Making clear that there is a case, in the context of evaluation of agricultural and agri-environmental policies, for knowing the well-being gains (or losses) for the EU population associated with changes in the provision of environmental PGaE, the next question is how to get this information.

There are basically two valuation approaches to answer it. An indirect approach, based on benefits transfer; or a direct strategy, designed to gather the individual WTP (WTA) in the policy case at stake. Both rely on demand-side data and thus allow for obtaining information on the individuals' well-being variations, resulting for instance from changes in the provision level of environmental PGaE related to different levels of policy intervention. It is thus to be underlined that both of these approaches allow for policy cost-benefit analysis, and thus for full policy efficiency assessment, differently from cost-based approaches, which will simply allow for the assessment of the policy's cost-effectiveness.

Cost-based measures, such as the 'policy costs', building on the additional supply-side costs for farmers due to the adoption of environmentally better practices, do not provide information on the benefit (demand) side, i.e., they do not provide information about the gains of these changes for their potential beneficiaries. Therefore, cost-based measures, which include other approaches, like the restoration or replacement costs, should not be used to measure non-market public benefits (or costs) because they do not establish any link with the individuals' preferences for these non-market benefits (e.g. Freeman, 1993; Bateman *et al*., 2011).

Benefit transfer (BT) is a valuation approach that resorts to pre-existing WTP (WTA) estimates, obtained in 'study sites', and use them ('transfer them') to another geographical (or policy) context (the 'policy site'). There are different methodological approaches to perform BT (for detailed discussion see e.g. Bateman *et al*., 2000 or Navrud and Ready, 2007). A popular approach for BT is meta-analysis.

Meta-analysis is a technique that allows estimating a benefit function from a set of estimates made available for different original valuation studies on a particular non-market good or service (a particular PGaE in this case). The meta-analysis allows for the combination of heterogeneous studies, varying in terms of the valuation methodology employed, the survey modes, the surveyed population or the levels of environmental quality change, among other variations, where the original estimates ('study site') are treated as the observations for a regression analysis. This analysis produces estimates for the average and/or median WTP for the good and service at stake under different (context or methodological) circumstances, based on the use of the estimated regression model.

Meta-analysis has been applied to some PGaE, such as the agricultural landscape, biodiversity and water quality (Brouwer *et al*., 1999; Woodward and Wui, 2000; Santos, 2007; Nijkamp *et al*., 2008; Randall *et al*., 2008; Johnston and Duke, 2009). Yet, the success of this approach is limited by the heterogeneity and quality of the estimates coming from the original studies. Additional limitations, in the case of the agricultural PGaE, are the uneven geographical distribution of the original estimates and the fact of being too scarce for some PGaE. An additional difficulty with meta-analysis is to handle the substitution interactions between PGaE, because it builds on original studies that, in general, do not provide information in that respect (interactions, or substitution effects between goods and services).

Therefore, while it is important to compile the valuation studies available and explore them, namely by resort to meta-analyses, in order to obtain up-scaled estimated values of agricultural PGaE for the EU27 population; we believe that original data collection is needed. Original data can be collected to enable estimates of the WTP (WTA) of the EU27 population for the different macro-regional sets of PGaE that will be identified and geographically delimitated in the next section (Section 3.3).

Therefore, another question is whether to get these original estimates of the WTP (WTA) of the EU population for the different macro-regional sets of PGaE through the Stated-Preference approach or, alternatively, the Revealed Preference approach. The Stated Preference (SP) methods are the only approach, within the demand-side non-market valuation methods that enable the gathering of estimates of the WTP (WTA) including non-use values. In addition, they allow for a much larger flexibility in designing valuation models that fit better the policy evaluation needs of complex, multidimensional policies such as those concerned with PGaE of agriculture.

The Revealed Preference methods, which include Travel Cost (TCM), Hedonic Prices (HPM) and Adverting Behaviour (ABM), include only use values, and can be applied only to users' populations. This would have an additional limitation in this case, because different PGaE involve diverse groups of users, e.g. the use of cultural landscape for recreation involves the visitor population, whereas water availability and quality affects domestic consumers (the resident population of the watershed). Therefore, this approach would entail employing different valuation methods according to the PGaE under valuation, following the above mentioned example, for instance TCM for measuring the recreation value of cultural landscape at different sites and the ABM to measure WTP (WTA) for drinking water quality and availability at different watersheds.

Summing up, SP methods are in this case the appropriate option, given that we are developing a valuation framework to deliver estimates of the WTP (WTA) of the EU population for diverse PGaE, which comprise a potentially relevant non-use value component (see section 2.6), both to the users (residents in the macro-region corresponding to the valued bundle) and non-users (non-residents in that macro-region).

Then, a third question might be: *why choosing the Choice Modelling (CM) approach instead of the Contingent Valuation method (CVM)?*

Both methods make use of hypothetical markets based upon carefully designed questionnaires, which are used to elicit the individual's WTP to obtain (or to avoid) for instance, an improvement (or a decrease) in the state of a particular PGaE, or set of PGaE. These questionnaires comprise the description of the good or service (goods or services) to be valued, as well as the description of the transaction that is proposed to the individual in the hypothetical market (valuation survey).

The main difference between these two SP valuation methods relies on the way those descriptions are made. The CVM describes, in general, the change in the good or service without making the respective attributes[3] explicit, and then asks the individuals to state either directly or indirectly their WTP (WTA) for obtaining (giving up) it, assuming the change is positive. Negative changes are valued similarly, eliciting WTP to avoid them (or WTA to tolerate them). CM describes the good or service as a bundle of attributes, including both several non-monetary attributes and one monetary attribute. Each bundle is a choice alternative. Choice alternatives are combined in a choice set, and the individuals are asked to choose (rank, or rate) their preferred alternative from that choice set (for a detailed description of these valuation methods and respective implementation see, e.g. Carson, 1991; Adamowicz *et al*., 1998; Bateman *et al*., 2002).

The major advantage of CM is that it allows for a simultaneous comparison of at least two choice alternatives in addition to the baseline alternative (e.g. the status quo at zero price), whereas the CVM allows only respondents to compare between one choice alternative and the baseline. That is why CVM is usually specified to value broadly defined changes, though implicitly encompassing defined attribute changes, while CM is preferred when explicit estimates for the attribute's value are wanted, alongside with the global value of the overall change.

Given that we wanted the latter, to develop a valuation framework enabling the gathering of estimates of WTP (WTA) of the EU population for macro-regional PGaE bundles, as well as for changes in the individual PGaE included in those bundles, the CM emerged as the preferred approach.

The design and testing of the SP CM questionnaire is reported in the next Chapter. Nevertheless, an overview of this technique is provided here. It consists basically in defining the changes to be valued (e.g. in the provision level of PGaE bundles, and/or individual PGaE) through the individuals comparison of 'best' ('worst') choice alternatives within a choice set where the baseline alternative is always present. The choice alternatives, as well as the baseline alternative, are defined as combinations of a number of attributes in different levels. The individuals are requested to made trade-offs between different levels of the non-monetary and monetary attributes and thus to choose their preferred alternative, while accounting for the respective cost.

The attributes in this case are the individual PGaE, e.g., cultural landscape or water quality, supplied in different levels. The selected attributes depend on the characteristics of the agri-environmental problem (MRAEP) that establishes the context for the individuals' choices. Basically, the method only works if the respondents understand the problem underpinning the choices that they are requested to make, and find it relevant and plausible. Therefore, in the questionnaires, the technical and policy aspects of the valuation problems (see section 3.3.4) have to be conveyed in a way that might be understood and evaluated as relevant for the common citizen of EU. That's why it is challenging to create the conditions for conveying context-rich scenarios when we are working at broad scales. The next section presents the methodological framework that has been developed in this study to convey context-rich valuation scenarios in which individuals (EU population) can make context-dependent choices, building on relevant problems for agricultural and agri-environmental policy decision-makers.

[3] Nevertheless, CVM can also make the attributes explicit and ask respondents to value multi-attributes changes, while only two situations can be compared by they (an option with a cost to the individual and the zero cost option, the business as usual or status quo) (eg. Santos, 1997 and 1998; Madureira et al., 2005; Madureira, 2006).

The valuation problems, in this case the macro-regional agri-environmental problems (MRAEP), will point out which PGaE to select for the choice sets or scenario descriptions (narratives). However, we have to check on the demand side, from the point of view of the individual respondents, if the selection is understood by respondents, as well how to describe complex attributes and their levels. This testing process is usually done through qualitative techniques, such as focus groups, which allow for people interaction and discussion on choice situations which are new for them.

The specification of the attribute levels also entails trade-offs between what is relevant for EU-level agricultural policy makers and what is understandable and plausible for individual respondents, in this case the EU population. And that it is again a challenging exercise from the survey-design point of view.

The attribute levels' specification is also related to the election of the baseline alternative. This alternative is always included in each choice set, and it should be chosen taking into account the cognitive burden imposed on respondents (e.g. a baseline referring to the current level of the attributes, or alternatively another referring to attribute levels that would occur in 10 years if no policy is adopted). A monetary attribute (price) is included in the SP CM in order to estimate the implicit prices (in this case, the marginal values) of attributes. This allows for the gathering of individuals WTP estimates for the different attributes (PGaE in this case).

The selected attributes and their respective alternative levels originate a number of possible choice alternatives (combinations of attributes at different levels) that is, in general, larger than the number that can be handled in a survey. At this stage, statistical techniques known as 'experimental design' (see e.g. Hensher *et al*., 2005; Scarpa and Rose, 2008) allow for reducing the number of possible combinations to a reasonable number to be handled in a survey.

Choice sets are groups of two (or more) alternatives plus the baseline alternative, which is usually constant across different choice sets. In the surveys, individuals are requested to select their preferred alternative from each choice set. In general, to yield large data sets required by the further statistical modelling of the data, individuals are asked to repeat the choice exercise with different choice sets in the same questionnaire. The number of repetitions (choice situations) has to be defined according to the survey administration mode and the available time, as well as the cognitive effort demanded by each choice exercise.

It is also common to split the choice sets given by the experimental design by different versions of the questionnaire, which are then randomly administrated to the sample to be surveyed. Furthermore, experimental design techniques allow for selecting choice sets enabling the efficient estimation of WTP (WTA) in spite of the significant reduction in the number of choice alternatives actually delivered to the individuals.

The data resulting from these individual choices are then modelled through statistical models, discrete-choice models (see e.g. Louviere *et al*., 2000), which provide information to obtain estimates for the average (median) WTP (WTA) for changes in the level of each attribute, i.e., the marginal value of each attribute (each PGaE in this case).

If the interactions between the attributes are estimated, which is possible depending on the adopted experimental design, average (median) WTP (WTA) estimates can be obtained for the whole change, which means, in this case, to obtain the value of each regional bundle of PGaE.

3.3. Framework to identify and describe macro-regional agri-environmental problems

3.3.1. Identification, delimitation and description of macro-regions

Macro-regions are intended to depict types of landscape/farming systems – the relevant agro-ecological landscape infrastructure – delivering different bundles of public goods and externalities (PGaE) of agriculture. For this purpose, they are identified and delimited based on **landscape** and **farming-system** variables that are hypothesized to be related to one or more of the PGaE at stake and that had available data at the NUTS3 level. This exercise is thus significantly data-constrained.

Macro-regions have been identified/delimited based on variables not used as PGaE indicators (section 3.3.2). Building macro-regions and PGaE indicators on different data is essential to allow us to test, in section 3.3.3, for the degree of association between the different PGaE and the diverse macro-regions. This test has been important as a basis to select the set of PGaE whose changes are to be valued in each macro-region, which is done in sections 3.3.4 and 4.1.3.

Macro-regions are described according to the variables used to identify and delimitate them, plus other variables that, for different reasons, are not used for identification/delimitation but only for descriptive purposes.

As regards the **landscape dimension**, four groups of variables are used for identification, delimitation or description purposes:

- **Land Cover**, including the per-cent shares in area of the four major land-cover classes – agriculture, forest, natural and artificial – as defined in Context Indicator 7 of the Rural Development Report (RDR) 2011 (EC, 2011) by grouping the basic 2-digit CLC categories (CLC 2006, except for Greece where CLC 2000 is used);
- **Agricultural Land Use**, which is intended to detail the land cover/use dimension by providing the per-cent shares of arable, permanent crop and permanent grassland areas in the Utilized Agricultural Area (UAA), from the Farm Structure Survey 2007 as reported by Context Indicator 3 of the RDR 2011 (EC, 2011);
- **Core *versus* Marginal Areas**, which is intended to represent different degrees of natural and other constraints to agriculture by indicating the percentage of UAA in different classes of Less Favoured Areas (LFA) – non-LFA, mountain LFA and Nordic LFA (areas North of the 62nd parallel and adjacent areas) – as reported by Context Indicator 8 of the RDR 2011[4] (according to Eurostat's FSS and communication of MS 2000) (EC, 2011);
- **Biogeographic regions**, defined for Natura 2000 purposes, are used not to identify and delimitate the macro-regions but only to describe/validate them in biophysical/ecological terms.

As regards the **farming-system dimension** of macro-regions, three groups of variables are used for identification, delimitation or description purposes:

- **Specialization Pattern of Farms**, including the per-cent shares of farms classified in different specialization classes – specialist field crops, specialist horticulture, specialist permanent crops, specialist grazing livestock, specialist granivores and mixed farms – retrieved from Eurostat's FSS

[4] Adapted to separate Nordic LFA from mountain LFA, and to assess mountain LFA (from map interpretation) at NUTS3 level for Romania and Bulgaria, which had only available data at the national level.

2005, 2003 or 2000 (according to the most recent year for which it is possible to retrieve the most complete data for each MS).

- **Intensity of farming**, subdivided into three separate variables:
  - *Overall Economic Intensity of Farming*[5], measured through the average Gross Margin in Euros per hectare (GM/ha) computed from Eurostat's FSS 2007 data retrieved from Context Indicator 4 of the RDR (EC, 2011);
  - *Relevance of Irrigation*, measured through the percentage of irrigated area in the UAA; this is estimated from Eurostat's FSS 2007 data retrieved from Context Indicator 15 of the RDR (EC, 2011); this variable is not used to identify/delimitate the macro-regions, as it is not available for all MS and because it is used as a PGaE indicator for Water Availability; however, it is used to describe the intensity of farming in the different macro-regions;
  - *Stocking Rates*, measured through the average number of Livestock Standard Units per hectare of UAA (LSU/UAA) retrieved from Eurostat's FSS 2005, 2003 or 2000 (according to the most recent year for which it is possible to retrieve the most complete data for each MS); as it relates livestock to the overall UAA, this variable also assesses the relevance of livestock activities as compared to crop activities.
- **Physical and Economic Size of Farms**, subdivided into three separate variable sub-groups:
  - *Average (physical) Farm Size*, in hectares, from the Eurostat's FSS 2007 retrieved from Context Indicator 4 of the RDR (EC, 2011); this variable is not used to identify/delimitate macro-regions but only to describe them, in order to avoid giving excessive weigh to size variables;
  - (Per-cent) *Distribution of Farms per Size Class* – using the less-than-5-ha (UAA), between-5-and-50-ha, and 50-or-more-ha classes – from the Eurostat's FSS 2007 retrieved from Context Indicator 4 of the RDR (EC, 2011);
  - *Average Economic Farm Size*, in ESU, from the Eurostat's FSS 2007 retrieved from Context Indicator 4 of the RDR (EC, 2011); this variable is not used to identify/delimitate macro-regions but only to describe them, in order to avoid giving excessive weigh to size variables;

Some of the variables we intended to use, particularly those among the Eurostat's agri-environmental indicators, are not available (e.g. intensification versus extensification) and others didn't have information for all the 27 MS (e.g. irrigation), so we couldn't use them to identify/delimitate macro-regions. When information at NUTS 3 level is not available for some MS but we had NUTS2 information, we used values from NUTS 2 level to fill all NUTS3 units included in the corresponding NUTS2 units.

All the variables used to identify, delimitate or describe macro-regions have been mapped with ArcGIS (cf. Annex 2) to study their distribution in the EU 27 and to interpret and assess the different solutions we got from the cluster analyses described below.

We used two variants of cluster analysis based on the variables listed above to identify and delimitate the macro-regions.

First, a hierarchical cluster analysis using the Ward's method and the Squared Euclidean distance and

[5] This variable has been used in logarithm form in the cluster analysis as it had a very different scale when compared to the other variables and extreme outlier values at the highest extreme (intensive) of the scale.

without variable standardization is run on the raw data in SPSS version 20. Variables have not been standardized previously to the cluster analysis because most of them are percentages and related to either land use or shares in total number of farms (the few ones that are not percentages had a similar numerical scale) and we intended all variables to be ascribed the same weight – that is: 1% in land use should be valued the same way independently of the standard deviation of each variable.

Second, a factorial analysis with the aim of dimension reduction, using Principal Components Analysis (PCA), is run, and then a cluster analysis (with the previously described methodological options) is run on the (un-rotated) first 9 factors from the PCA.[6]

The PCA previous to the cluster analysis has the advantage of avoiding that the inclusion of too many variables representing a group of variables or dimension resulted in a final cluster solution giving this group/dimension too much weigh.

The obtained clusters are then interpreted using descriptive statistics (the means of each variable for each cluster, that is the corresponding centroids) and mapped using the ArcGis. From all solutions, we selected four options: the 6- and 12-cluster solutions from the cluster analysis run on the raw data – thereafter referred to as the **direct cluster analysis** solutions; and the 6- and 13-cluster solutions from the cluster analysis run on the first 9 factors from the PCA – thereafter referred to as the **factorial cluster analysis** solutions.

The direct and factorial cluster analyses solutions are described in a table for each type of cluster analysis, based on the means of the different variables for the 12- and 13-cluster solutions and showing how these 12-13 cluster solutions are grouped into the 6-cluster solutions. The 6-cluster solutions have been also synthetically described based on the same variables (Tables 14 to 17).

As referred before, we selected four options for the macro-regions: the 6 and 12/13-cluster solutions for the direct and the factorial cluster analysis. The maps of each one are presented below (Figures 3 to 6). To provide a biophysical/ecological frame to interpret/validate these solutions we also include here the map of biogeographic regions for Natura 2000 purposes (Figure 2).

Analysing the means of each variable in each cluster (that is, the corresponding cluster centroids), we obtained the main characteristics of each cluster (Tables 14-17). The indicators with an asterisk (*) didn't entered in the analysis and are only used here for descriptive purposes.

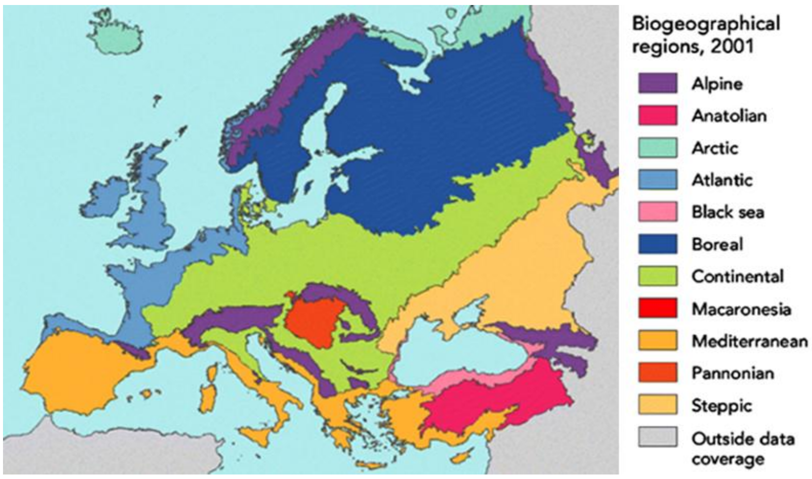

Figure 2 – Biogeographic regions
(from http://www.natura.org/biogeographicregions.html)

[6] The eigenvalue criterion has been used to select only the first 9 factors.

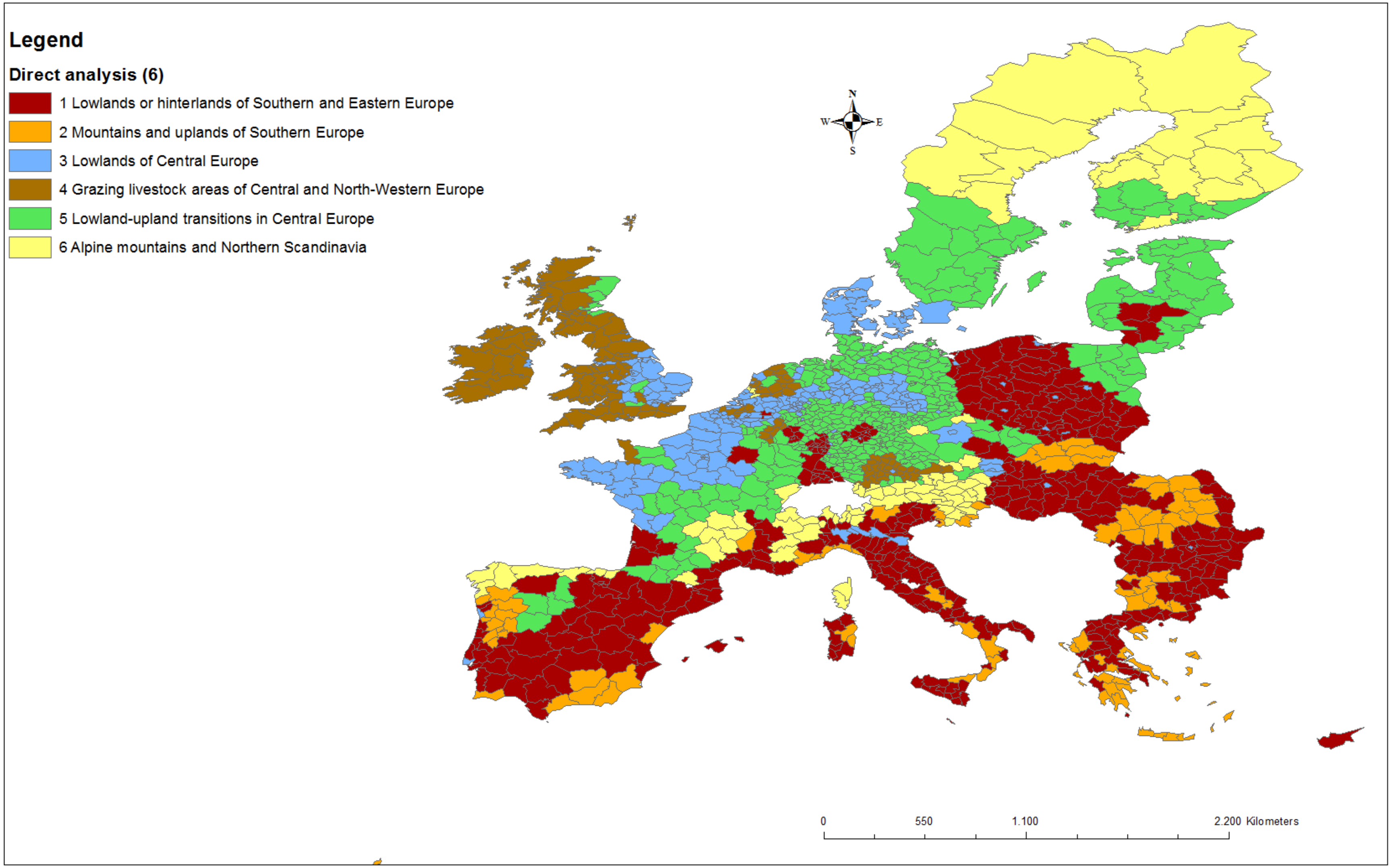

Figure 3 – Macro-regions from the direct cluster analysis (6 clusters)

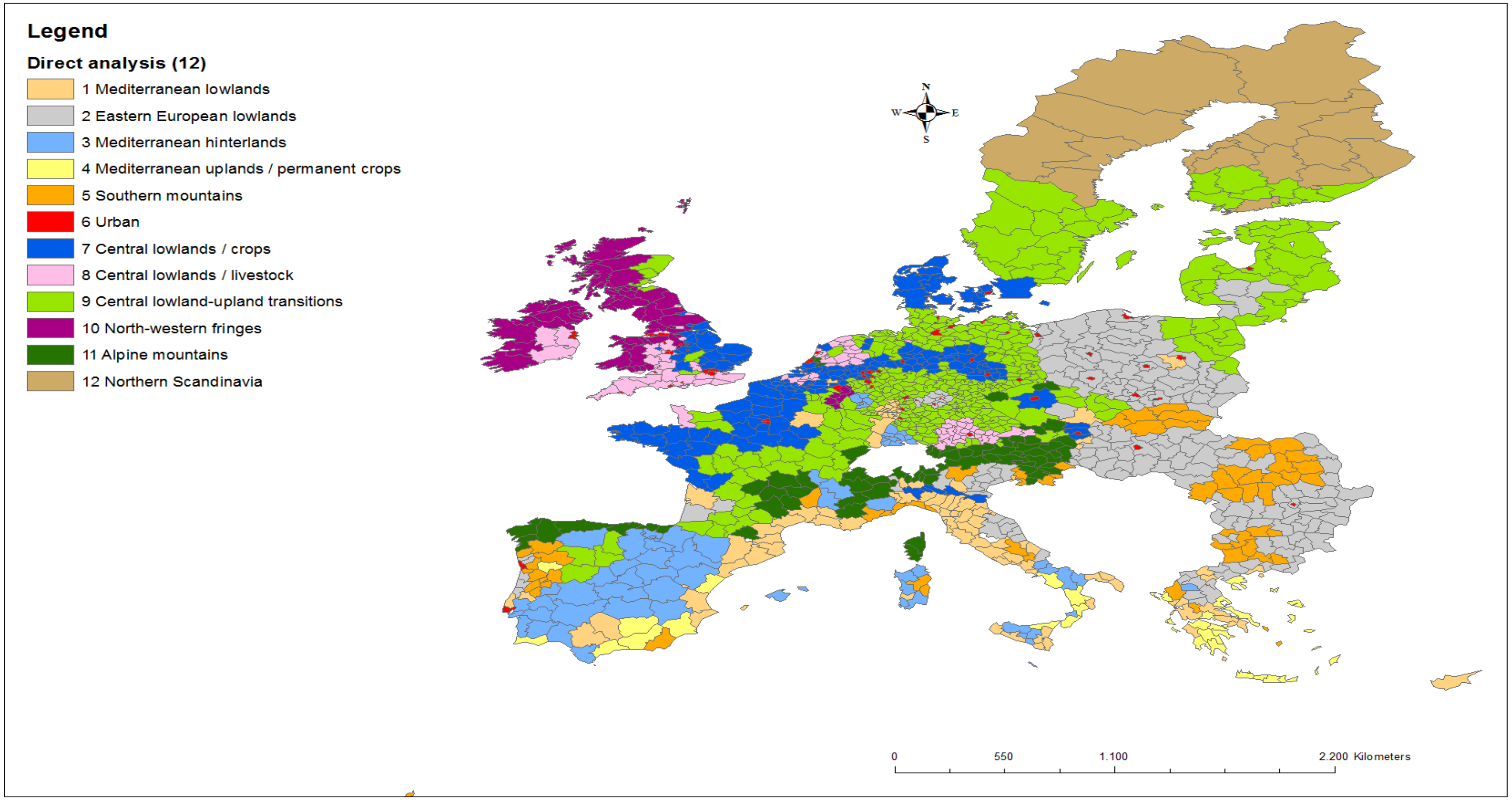

Figure 4 – Macro-regions from the direct cluster analysis (12 clusters)

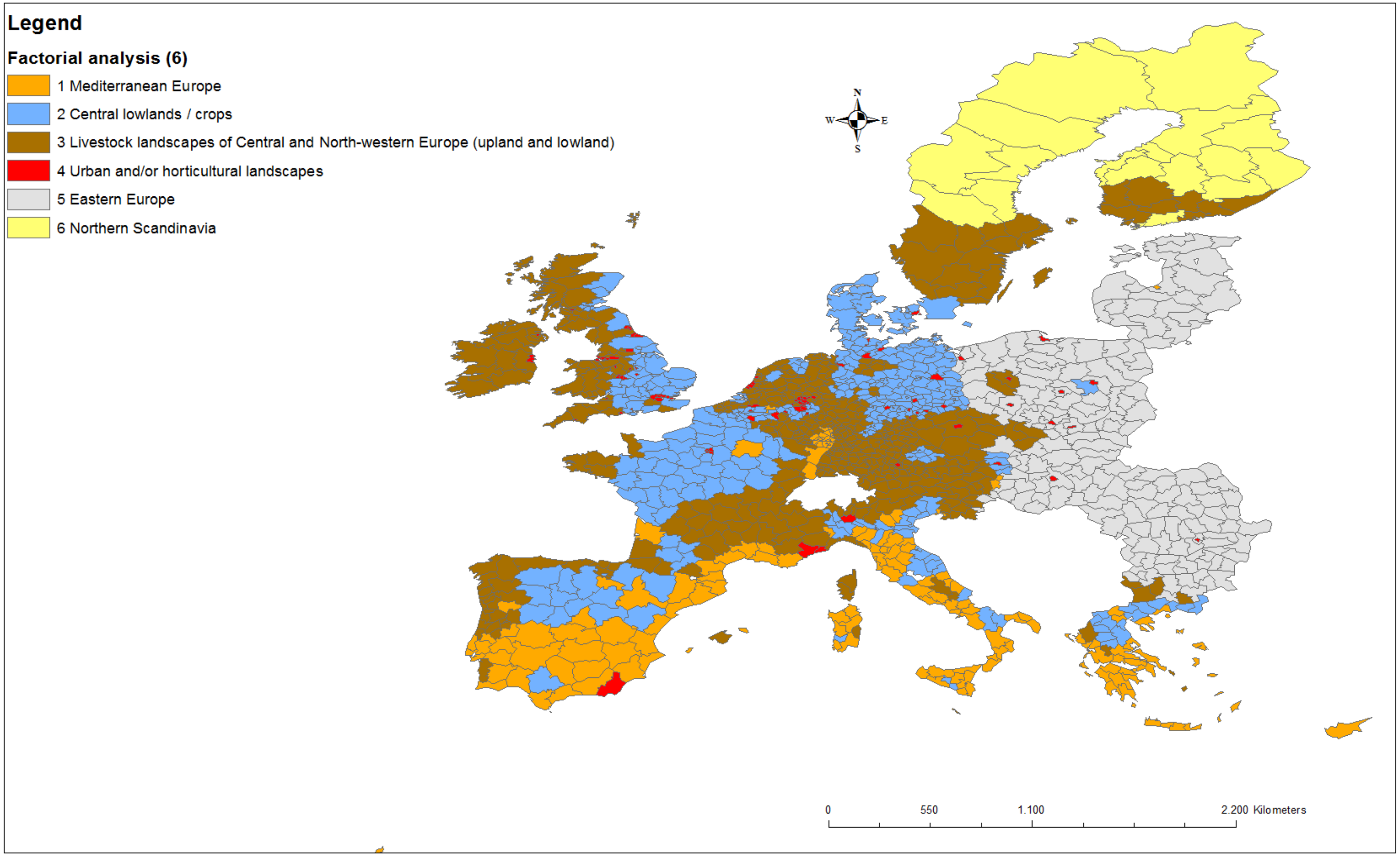

Figure 5 – Macro-regions from the factorial cluster analysis (6 clusters)

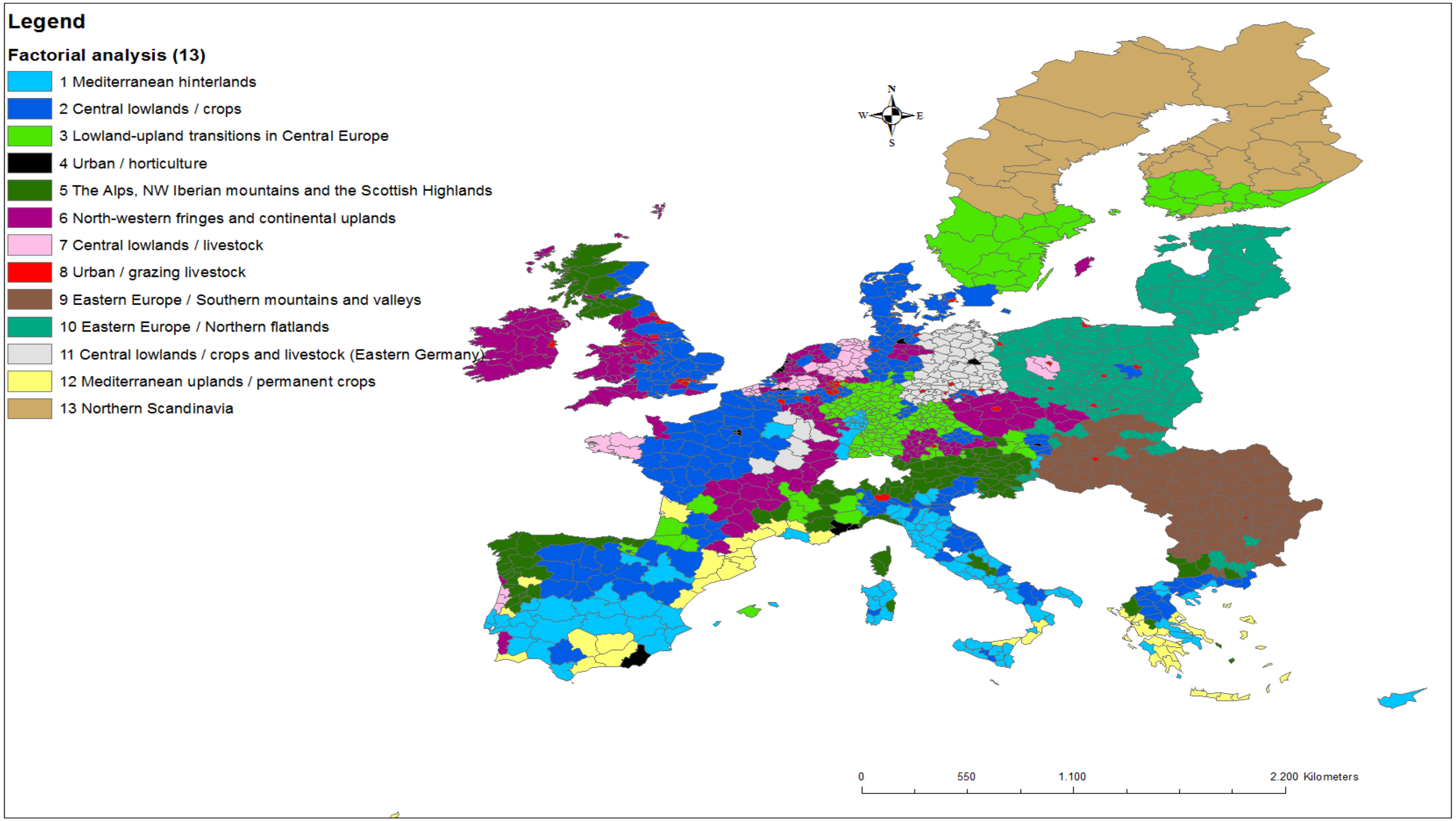

Figure 6 – Macro-regions from the factorial cluster analysis (13 clusters)

Table 14 – Description of macro-regions from the direct cluster analysis (first part)

	1			**2**		**3**	
	Lowlands or hinterlands of Southern and Eastern Europe			**Mountains and uplands of Southern Europe**		**Lowlands of Central Europe**	
	Farmland at or slightly above 50%, some forest, and some or significant natural areas (except Eastern Europe). UAA dominated by arable with significant or very significant permanent crops (except Eastern Europe). Specialization: permanent crops in the Mediterranean types, mixed farming in Eastern Europe, with field crops in all types, grazing livestock in Med. hinterlands and granivores in Eastern Europe. Largely non-LFA in the two lowland types; and non-mountain LFA in Med. hinterlands - some mountain in all types. Low economic intensity of farming and some relevance of irrigation, except in the Med. lowlands where they are high and very high respectively. Low stocking rates, revealing low intensity or irrelevance of livestock activities. Small scale of farming in lowland types, medium scale in Med. hinterlands.			Significant natural areas and farmland below 50%. Permanent crops dominant or significant, and some or dominant grasslands. Specialization: permanent crops or mixed farming. Mostly LFA and mostly or largely mountain LFA. High economic intensity of farming, probably related to the very small scale of farms, but agriculture represents less than half of land cover and the remaining is significantly occupied by natural cover. Irrigation represents some or a high share of the UAA. Low or very low stocking rates, implying low intensity of livestock activities.		Land cover strongly dominated by farmland or artificial (only in urban). Use of UAA strongly dominated by arable. Specialization: field crops with significant grazing livestock; some mixed farming, horticulture (especially in urban) and granivores. Mostly non-LFA. High economic intensity of farming (very high, in urban). Some irrigation (low, in urban). Very high stocking rates (medium, in urban). Very large farm size (large, in urban). Note that farms are both very large and intensive (economically and stocking rates) and that farmland is extended to most of the land with insignificant natural areas.	
	1	**3**	**2**	**4**	**5**	**6**	**7**
Type name	**Mediterranean lowlands**	**Mediterranean hinterlands**	**Eastern European lowlands**	**Mediterranean uplands / permanent crops**	**Southern mountains**	**Urban**	**Central lowlands / crops**
Overall Land Cover	Dominated by farmland (53%) with some forest (26%) and some natural (12%)	Slightly dominated by farmland (49%) with some forest (26%) and significant natural (19%)	Strongly dominated by farmland (60%) with some forest (27%).	Balanced mosaic of farmland (43%) with very significant natural (40%).	Balanced mosaic of forest (40%) and natural (24%) with scarce farmland (32%).	Strongly dominated by artificial (60%).	Strongly dominated by farmland (71%) with some artificial (13%).
Agricultural Land Use	Dominated by arable (57%) with very significant permanent crops (28%).	Balanced mosaic of arable (47%) and significant grassland (41%) with significant permanent crops (12%).	Strongly dominated by arable (81%).	Dominated by permanent crops (47%) with some grassland (30%).	Dominated by grassland (52%) with significant permanent crops (12%).	Dominated by arable (63%) with some grassland (36%).	Strongly dominated by arable (82%).
Specialization pattern of farms	Specialist permanent crops (53%) and specialist field crops (18%).	Specialist permanent crops (34%), specialist field crops (21%) and specialist grazing livestock (21%).	Mixed farming (41%), specialist field crops (30%) and specialist granivores (8%).	Specialist permanent crops (75%).	Mixed farming (41%), specialist permanent crops (19%), and granivores (4%).	Specialist grazing livestock (29%), specialist field crops (21%), specialist horticulture (11%) and granivores (3%).	Specialist field crops (36%), specialist grazing livestock (28%), mixed farming (20%), specialist granivores (5%) and specialist horticulture (4%).

	1	3	2	4	5	6	7
Type name	**Mediterranean lowlands**	**Mediterranean hinterlands**	**Eastern European lowlands**	**Mediterranean uplands / permanent crops**	**Southern mountains**	**Urban**	**Central lowlands / crops**
Core *vs.* marginal areas	Largely non-LFA (66%), with only a small share of mountain (13%).	Mostly LFA (80%) with some mountain (25%).	Largely non-LFA (64%), with only a small share of mountain (10%).	Largely mountain LFA (60%), and mostly LFA (84%).	Mostly mountain LFA (75%), and LFA (86%).	Mostly non-LFA (80%).	Mostly non-LFA (92%).
Biogeographic regions *	Mediterranean	Mediterranean	Mainly Continental and Pannonian,with some Mediter-ranean,Atlantic and Boreal	Mediterranean	Alpine and Mediterranean	Non-applicable	Mainly Atlantic with some Continental
Overall economic intensity of farming (GM/ha)	High (1800-2600)	Low (800-1800)	Low (800-1800)	High (1800-2600)	High (1800-2600)	Very high (>4000)	High (1800-2600)
Relevance of irrigation (% UAA)*	Very high (>20%)	Some (8-15%)	Some (8-15%)	High (15-20%)	Some (8-15%)	Low (0.5-4%)	Some (8-15%)
Stocking rates (LSU/UAA)	Low (0.50-0.90)	Low (0.50-0.90)	Low (0.50-0.90)	Very low (<0.50)	Low (0.50-0.90)	Medium (0.90-1.30)	Very high (1.70)
Average farm size (hectares)*	Small (10-20)	Medium (20-40)	Small (10-20)	Very small (<10)	Very small (<10)	Large (40-60)	Very large (>60)
Distribution of farms per size class (<5, 5-50 and >50 ha)	Dominated by small farms (59%) with some medium farms (34%).	Dominated by small farms (50%) with some medium (37%) and large (13%) farms.	Strongly dominated by small farms (75%).	Strongly dominated by small farms (81%).	Strongly dominated by small farms (83%).	Many small farms (48%), but some medium (34%) and significant large (18%) farms.	Very significant large farms (32%), with many medium (44%).
Average economic size of farms(ESU)*	Medium (25-35)	Small (15-25)	Very small (<15)	Very small (<15)	Very small (<15)	Large (35-60)	Very large (>60)
Overall location in the EU*	West (Portugal), Guadalquivir valley, Valencia and Catalonia (Spain), Med. coast of France, Rhine valley, North and West of Italia; coastal areas in Southern Italy and Greece.	Alentejo (Portugal), most of hinterland SW, Central and NE Spain; sub-coastal areas in Southern France (Rhône valley) and in southernmost Italy; Baleares Islands (Spain) and parts of Sardegna and Sicily Islands (Italy).	Eastern Europe except the Baltic states, CZ., NE Poland, the Carpathians and Balkans. Includes parts of E and NE Italy, C and North coast of Portugal and coastal SW France (Landes).	The Douro valley and the Algarve in Portugal, the Sierra Nevada, Murcia and Castellón in Med. Spain, the Southern tip of Italy including the NE of Sicily, the Peloponeso (Greece), Crete and other Greek islands.	Mountain chains in Eastern Europe- the Carpathians and Balkans;southernmost tips of the Alps (Alp's Maritimes France, part of Slovenia and N Italy), Central Apennines in Italy (Abruzzi) and mountains in Northeast Portugal and Southern Galicia.	Urban areas of major Central and Eastern European cities from Paris to Warsaw.	Most North France except Normandy, SE England, all Denmark, Southern tip of Sweden, parts of Northern Germany, the Netherlands and Belgium, some flatlands of North Italy, E Austria (Vienna) and Prague (CZ).

Table 15 – Description of macro-regions from the direct cluster analysis (second part)

	5	4		6	
	Lowland-upland transitions of Central Europe	**Grazing livestock areas of Central and North-Western Europe**		**Alpine mountains and Northern Scandinavia**	
	Land cover dominated by farmland with some forest. UAA dominated by arable with some grassland. Specialization: grazing livestock, field crops and mixed farming. Largely non-mountain LFA. Low economic intensity of farming. Low irrigation. Medium stocking rates. Very large farm size.	Land cover slightly or strongly (Central lowlands, CL) dominated by farmland, with some artificial (CL) or significant natural (North-western fringes, NF). UAA dominated by grasslands, with significant arable (CL). Specialization: grazing livestock in both; some mixed farming, granivores and horticulture in CL. Mostly non-LFA (CL) or non-mountain LFA (NF). High (CL) vs. very low (NF) economic intensity of farming. Low to very low relevance of irrigation. Very high (CL) vs. medium (NF) stocking rates. Medium (CL) vs. very large (NF) average farm size.		Forest and natural both very significant in land cover; scarce to very scarce farmland (the dominance of forest and scarcity of farming is more dramatic in Northern Scandinavia, NS). UAA strongly dominated by grasslands (Alpine mountains, AM) or arable (NS). Specialization: grazing livestock (AM), field crops and grazing livestock (NS). Both mostly mountain-LFA, which are areas North of the 62º latitude in NS. The economic intensity of farming is low in both cases, and the relevance of irrigation low (AM) to very low (NS). Medium (AM) to low (NS) stocking rates. Medium farm size.	
	9	8	10	11	12
Type name	**Central lowland-upland transitions**	**Central lowlands / livestock**	**North-western fringes**	**Alpine mountains**	**Northern Scandinavia**
Overall Land Cover	Dominated by farmland (54%) with significant forest (32%).	Strongly dominated by farmland (63%) with some artificial (17%).	Slightly dominated by farmland (50%) with significant natural (25%)	Balanced mosaic of forest (43%) and natural (22%) with scarce farmland (29%).	Strongly dominated by forest (67%) with significant natural (24%) and very scarce farmland (8%).
Agricultural Land Use	Dominated by arable (68%) with some grassland (31%).	Dominated by grassland (53%) in mosaic with arable (46%).	Strongly dominated by grasslands (82%).	Strongly dominated by grasslands (71%).	Strongly dominated by arable (96%).
Specialization pattern of farms	Specialist grazing livestock (40%), specialist field crops (26%), and mixed farming (22%).	Specialist grazing livestock (63%) mixed farming (20%), specialist granivores (3%) and specialist horticulture (4%).	Specialist grazing livestock (78%).	Specialist grazing livestock (63%).	Specialist field crops (44%) and specialist grazing livestock (40%).
Core vs. marginal areas	Largely LFA (60%), almost without mountain (2%).	Mostly non-LFA (81%).	Mostly LFA (76%), without mountain.	Mostly mountain LFA (77%), and LFA (88%).	Mostly Nordic LFA (96%).
Biogeographical regions*	Mainly Continental, with some Mediterranean, Atlantic and Boreal	Mainly Atlantic with some Continental.	Atlantic	Alpine with some Atlantic and Continental	Boreal and Alpine
Overall economic intensity of farming (GM/ha)	Low (800-1800)	High (1800-2600)	Very low (<800)	Low (800-1800)	Low (800-1800)
Relevance of irrigation (% UAA)*	Low (0.5-4%)	Low (0.5-4%)	Very low (<0.5%)	Low (0.5-4%)	Very low (<0.5%)
Stocking rates (LSU/UAA)	Medium (0.90-1.30)	Very high (1.70)	Medium (0.90-1.30)	Medium (0.90-1.30)	Low (0.50-0.90)
Average farm size (hectares)*	Very large (>60)	Medium (20-40)	Very large (>60)	Medium (20-40)	Medium (20-40)
Distribution of farms per size class (<5, 5-50 and >50 ha)	Very significant large farms (28%), with many medium (48%).	Dominant medium farms (56%) with some large (15%) farms.	Very significant large farms (32%), with many medium (42%).	Many medium farms (48%), but many small (37%) and a few large (14%) farms.	Dominant medium farms (68%) with some large (17%) farms.
Average economic size of farms (ESU)*	Large (35-60)	Large (35-60)	Medium (25-35)	Small (15-25)	Small (15-25)
	9	8	10	11	12
Type name	**Central lowland-upland transitions**	**Central lowlands / livestock**	**North-western fringes**	**Alpine mountains**	**Northern Scandinavia**
Overall location in the EU*	Most of S. Sweden and S. Finland, most of the Baltic States and NE Poland, most of Germany (including former East Germany) and the CZ., parts of the Nederland's, the Scottish Lowlands, most of Eastern and North-Central France, parts of SW France, and most of the Spanish Northern Meseta.	Southern and Western England and South-eastern Ireland, significant parts of the Nederland's and Belgium, La Manche (France), Southern Germany (Bavaria) and NE Austria (Linz).	North and Western Ireland, Northern England, Wales and Scotland (except the Lowlands) in the UK, and Southern Belgium (Ardennes).	Almost all of the Alps from France to Slovenia, except some southern-most tips; the Massif Central in France; and N Galicia, Asturias and Cantabrian mountains in Atlantic Spain.	All of the Central and Northern regions of Finland and Sweden.

Table 16 – Description of macro-regions from the factorial cluster analysis (first part)

	1		5		2	
	Mediterranean Europe		**Eastern Europe**		**Central lowlands / crops**	
	Farmland below or slightly above 50% of land cover; significant to very significant natural areas. Permanent crops are significant to dominant in the UAA. Specialization: permanent crops. Significant to dominant LFA, always with some mountain (which dominates in Med uplands). High economic intensity of farming related to the small to very small average farm size, but agriculture represents only half or less of land cover and the rest has significant natural cover. Irrigation very relevant. Low stocking rates.		Land cover clearly dominated by farmland with significant forest. UAA strongly dominated by arable. Specialization: mixed farms dominant plus granivores (South) or field crops (North). Dominated by non-LFA with significant mountain LFA (South) and non-mountain LFA (North). Very low economic intensity of farming in small (North) to very small (South) farms. Insignificant irrigation. Low stocking rates.		Farmland-dominated landscapes (with significant forest only in Eastern Germany, EG). UAA strongly dominated by arable. Major specialization of farms is field crops, followed by grazing livestock (and mixed farming only in EG). Non-LFA dominates (significant non-mountain LFA in EG only). Intensity indicators (including stocking rates and irrigation) are at medium (lower in EG) values. Farm size is large (very large in EG) in both physical and economic terms.	
	1	**12**	**9**	**10**	**2**	**11**
Type name	**Mediterranean hinterlands**	**Mediterranean uplands / permanent crops**	**Eastern Europe / Southern mountains and valleys**	**Eastern Europe / Northern flatlands**	**Central lowlands / crops**	**Central lowlands / crops and livestock (Eastern Germany)**
Overall landscape	Still dominated by farmland (53%) but with significant natural (13%) and some forest (25%).	Balanced mosaic of farmland (40%) and natural (39%).	Dominated by farmland (59%) with significant forest (29%).	Dominated by farmland (58%) with significant forest (33%).	Strongly dominated by farmland (68%).	Dominated by farmland (57%) with significant forest (27%) and some artificial (11%).
Use of the UAA	Dominated by arable (56%) with significant permanent crops (22%)	Dominated by permanent crops (48%) with some grasslands (27%) and very scarce arable (25%).	Strongly dominated by arable (71%)	Strongly dominated by arable (73%)	Strongly dominated by arable (76%)	Strongly dominated by arable (78%)
Specialization pattern of farms	Specialist permanent crops (50%), and specialist field crops (17%).	Specialist permanent crops (68%).	Mixed farming (53%) and specialist granivores (14%).	Mixed farming (46%) and specialist field crops (28%).	Specialist field crops (38%) and grazing livestock (29%).	Specialist field crops (35%), grazing livestock (34%) and mixed farming (21%).
Core *vs.* marginal areas	Dominated by non-LFA (54%) but with significant non-mountain LFA (32%) and some mountain LFA (14%).	Dominated by mountain LFA (54%) and mostly LFA (75%).	Largely non-LFA (60%) but with significant mountain LFA (29%).	Dominated by non-LFA (52%) but with significant non-mountain LFA (44%).	Mostly non-LFA (70%).	Dominated by non-LFA (54%) but with significant non-mountain LFA (46%).
Biogeographic regions*	Mainly Mediterranean with some Continental	Mainly Mediterranean with some Atlantic	Mediterranean, Alpine, Continental and Pannonian	Boreal and Continental	Mediterranean, Atlantic and Continental	Continental

Type name	1 Mediterranean hinterlands	12 Mediterranean uplands / permanent crops	9 Eastern Europe / Southern mountains and valleys	10 Eastern Europe / Northern flatlands	2 Central lowlands / crops	11 Central lowlands / crops and livestock (Eastern Germany)
Overall economic intensity of farming (GM/UAA)	High (2500-3500€)	High (2500-3500€)	Very low (<750)	Very low (<750)	Medium (1300-2500€)	Low (750-1300€)
Relevance of irrigation (% UAA)*	High (>15%)	High (>15%)	Very low (<2.5)	Very low (<2.5)	Medium (7.5-15%)	Very low (<2.5)
Stocking rates (LSU/UAA)	Low (0.5-0.75)	Low (0.5-0.75)	Low (0.5-0.75)	Low (0.5-0.75)	Medium/low (0.75-1.00)	Low (0.5-0.75)
Average farm size (hectares)*	Small (10-20)	Very small (<10)	Very small (<10)	Small (10-20)	Large (40-50)	Very large (190)
Distribution of farms per size class (<5, 5-50 and >50 ha)	Dominated by small farms (59%), with significant medium (33%) and a few large (8%).	Dominated by small farms (72%), with some medium (24%).	Strongly dominated by small farms (90%)	Dominated by small farms (65%), with significant medium (32%).	Dominated by medium (40%) and large (28%).	Dominated by large (41%) with significant medium (35%).
Average economic size of farms (ESU)*	Medium (25-50)	Small (10-25)	Very small (<10)	Very small (<10)	Large (50-100)	Very large (140)
Overall location in the EU*	Most of the Southern half of Iberia and the Ebro valley, most of Italy south of the Alps, the Rhine valley, parts of Eastern Greece and Cyprus.	The Douro valley and the Algarve in Portugal, the Sierra Nevada and Catalonia in Spain, most of the Mediterranean coast of France, the Southern tip of Italy including the NE of Sicily, Western Greece, the Peloponeso, Crete and other Greek islands.	Most of Eastern Slovakia, almost all of Hungary, all Romania and most of Bulgaria. It includes a series of important mountain chains, such as the Tatra, the Carpathians and the Balkans.	Most of Estonia, Latvia and Lithuania, and most of Poland.	The Northern Meseta, Huesca, Navarra and lower Guadalquivir in Spain, most of Northern France excluding Brittany and La Manche, the Scottish lowlands and all of Eastern England, all of Denmark, the Southern tip of Sweden, parts of Northern Germany, Nederlands and Belgium, some flatlands of Northern, Eastern and Southern Italy (Torino-Milano, Veneto, Marche, Basilicata), most of Eastern and Northern Greece, parts of lowland Austria and Bavaria, and the area of Warsaw in Poland.	Most of the former Eastern Germany and parts of Eastern France.

Table 17 – Description of macro-regions from the factorial cluster analysis (second part)

	3				6	4	
	Livestock landscapes of Central and North-western Europe (upland and lowland)				**Northern Scandinavia**	**Urban and/or horticultural landscapes**	
	Landscapes vary from those dominated by farmland (Central lowlands, CL) to balanced mosaics of forest and natural with scarce farmland (Alpine mountains, AM). UAA dominated by (or with significant) grassland, except in CL (where arable dominates). The most relevant farm specialization is grazing livestock. Mixed farming is also relevant in CL, lowland-upland transitions (LUT) and AM; granivores and horticulture in CL only; and permanent crops in LUT and AM. CL are mostly non-LFA, while AM are largely mountain LFA (the other 2 types are dominated by non-mountain LFA). The economic intensity of farms also varies widely from high in CL to low in LUT and AM (passing through medium in Northwestern fringes, NF). Irrigation is unimportant except in CL. Stocking rates vary widely from very high in CL and medium/high in NF to lower values in LUT an AM. Farm size is also very different across types: it is physically smaller in CL and larger in NF; economically, it is smaller in AM and larger in CL.				Extremely forested landscapes with significant natural and scarce farmland. UAA strongly dominated by arable. Specialization: mix of specialist field crops and grazing livestock. Almost all the UAA is located in Nordic LFA. Low economic intensity of farming. No irrigation. Low stocking rates. Farms are medium-sized in physical terms, small in economic terms.	Urban landscapes with dominance of artificial land cover - some natural only in UH. Arable and grasslands dominate the UAA. Horticulture is the common theme as regards specialization of farms, although it is only dominant in UH - where specialist permanent crops also appear; in UG grazing livestock and field crops are the major specializations. Non-LFA land dominates the UAA in both. The economic intensity of farming is medium in UG and extremely high in UH. Irrigation is only relevant in UH. Stocking rates are low in UH and medium in UG. In UH, farms are smaller in physical terms, but larger in economic terms.	
Type name	**Central lowlands / livestock**	**Lowland-upland transitions in Central Europe**	**North-western fringes and continental uplands**	**The Alps, NW Iberian mountains and the Scottish Highlands**	**Northern Scandinavia**	**Urban / grazing livestock**	**Urban / horticulture**
Overall landscape	Strongly dominated by farmland (68%) with some artificial (16%)	Balanced mosaic of farmland (43%) and forest (41%) with some artificial (12%).	Dominated by farmland (59%).	Balanced mosaic of forest (40%) and natural (31%) with scarce farmland (25%).	Strongly dominated by forest (67%) with significant natural (24%) and very scarce farmland (8%).	Strongly dominated by artificial (57%).	Dominated by artificial (48%) with some natural (13%).
Use of the UAA	Strongly dominated by arable (72%).	Dominated by arable (65%) with significant grasslands (33%).	Dominated by grasslands (57%).	Strongly dominated by grasslands (68%).	Strongly dominated by arable (95%)	Mosaic of arable (58%) with grasslands (41%).	Balanced mosaic of arable (47%) and grasslands (43%) with some permanent crops (9%).
Specialization pattern of farms	Specialist grazing livestock (39%), mixed farming (28%), granivores (11%) and horticulture (4%).	Specialist grazing livestock (36%), field crops (27%), mixed farming (20%) and permanent crops (11%).	Specialist grazing livestock (63%).	Specialist grazing livestock (50%), mixed farming (23%) and permanent crops (12%).	Specialist field crops (44%) and grazing livestock (40%).	Specialist grazing livestock (37%), field crops (19%) and horticulture (5%).	Specialist horticulture (55%) and permanent crops (11%).
Core *vs* marginal areas	Mostly non-LFA (72%).	Clearly dominated by LFA (64%) but mostly non-mountain LFA (only 6% mountain).	Slighlty dominated by LFA (52%) but mostly non-mountain LFA (only 10% mountain).	Largely mountain LFA (70%).	Mostly Nordic LFA (94%).	Mostly non-LFA (80%).	Mostly non-LFA (69%).
Biogeographic regions*	Mainly Atlantic with some Mediterranean	Continental and Boreal	Atlantic and Continental	Atlantic, Mediterranean and Alpine	Alpine and Boreal	Non-applicable	Non-applicable
Overall economic intensity of farming(GM/UAA)	High (2500-3500€)	Low (750-1300€)	Medium (1300-2500€)	Low (750-1300€)	Low (750-1300€)	Medium (1300-2500€)	Extremely High (>15 000 €)

	7	3	6	5	13	8	4
Type name	**Central lowlands / livestock**	**Lowland-upland transitions in Central Europe**	**North-western fringes and continental uplands**	**The Alps, NW Iberian mountains and the Scottish Highlands**	**Northern Scandinavia**	**Urban / grazing livestock**	**Urban / horticulture**
Relevance of irrigation (% UAA)*	Medium (7.5-15%)	Some (2.5-7.5%)	Very low (<2.5)	Some (2.5-7.5%)	Very low (<2.5)	Very low (<2.5)	Medium (7.5-15%)
Stocking rates (LSU/UAA)	Very high (>4.00)	Medium/low (0.75-1.00)	Medium/high (1.25-1.50)	Medium (1.00-1.25)	Low (0.5-0.75)	Medium (1.00-1.25)	Low (0.5-0.75)
Average farm size (hectares)*	Medium/Small (20-30)	Medium (30-40)	Large (40-50)	Medium (30-40)	Medium/Small (20-30)	Medium (30-40)	Small (10-20)
Distribution of farms per size class (<5, 5-50 and >50 ha)	Dominated by medium (52%) with some large (18%).	Dominated by medium (57%) with some large (19%).	Dominated by medium (50%) and large (24%).	Dominated by small (51%) and medium (37%) with a few large (12%).	Strongly dominated by medium (67%) with some large (12%).	Dominated by small (46%) and medium (34%) with a few large (19%).	Dominated by small farms (73%), with some medium (21%).
Average economic size of farms (ESU)*	Large (50-100)	Medium (25-50)	Medium (25-50)	Small (10-25)	Small (10-25)	Medium (25-50)	Large (50-100)
Overall location in the EU*	The coastal areas of North/Central Portugal, Brittany in France, Northern and Eastern Belgium, Southern Nederland, Northeastern Germany and the Poznan area in Poland.	Most of the Southern regions of Sweden and Finland, most of the Centre-West and Southern areas in Germany, parts of Austria, parts of SE France and NW Italy around the Alps, and parts of SW France.	Most of Ireland, West England and Wales in the UK, the Massif Central and eastern uplands of France from the Jura to the Vosges, Ardennes (South Belgium) Pirenées, parts of sub-alpine Southern Germany, most of the Czech republic, parts of Northern Nederland, and coastal Alentejo in Portugal.	The Scottish Highlands and Southern Uplands, the mountain areas of North and Central Portugal, Galicia, Asturias and Cantabria in Spain, the South of the Massif Central in France and alpine areas of France, Italy, Austria and Slovenia, as well as mountain areas in Southern Bulgaria, the Central Apennines in Italy (Abruzzi), all of Corsica, the East of Sardinia, and Northern Greece.	Most of Sweden and Finland north of 61/62º parallel.	Many areas around major cities especially in Central and Eastern Europe.	Areas around major cities such as Hamburg and Berlin, but also specialized horticultural areas in SE Spain (Almeria), northern coast of the Nederland and the Mediterranean coast of France.

The results from the direct cluster analysis and from the factorial cluster analysis lead to different typologies at the 12/13-cluster level. The way these typologies are clustered at the 6-cluster level is also different. Direct cluster analysis seems to give more emphasis to the landscape dimension (e.g. clustering of mountainous types both in the Mediterranean and Alpine/Nordic areas; emergence of a mountain cluster in Eastern Europe), whereas the factorial cluster analysis seems to give more emphasis to farming systems (e.g. higher level clustering of all livestock specialization patterns in a single cluster irrespective of very different landscapes; separation of Mediterranean and Eastern Europe clusters based on differences in e.g. the relevance of permanent crops). These differences are probably related to one of the advantages of running a PCA previous to cluster analyses referred to above: that of avoiding that the inclusion of too many variables within a dimension (the landscape dimension, in this case) resulted in a final cluster solution giving this dimension too much weigh. In fact, the factorial cluster analysis, in our case, reduced the importance of the landscape dimension probably because some redundancy was initially present in the landscape variables (plus the UAA-use and specialization-pattern variables). This, in addition to the fact that the interpretation of the 13-cluster factorial cluster solution seems to fit better the spatial structure of the UE27 agriculture, led us to select the 13-cluster factorial cluster analysis' results as the ones to be used to build the overall valuation framework proposed in this report. In addition, this 13-cluster solution seems to represent pretty well the major macro-regional agri-environmental problems within the EU27; in this sense, the analyses reported in sections 3.3.3, 3.3.4, 4.1.2 and 4.1.3 constitute further positive external validity tests of the proposed solution.

However, if a smaller number of macro-regions is searched for, the 6-cluster solution of the direct cluster analysis might be considered (with some adaptations, such as separating the Mediterranean from Eastern Europe) as fitting better the spatial structure of the UE27 agriculture than the 6-cluster solution of the factorial cluster analysis.

One final note about the titles chosen for the different macro-regions: these titles focus on the conceptual content of the different macro-regional agri-environmental problems, or MRAEP (given this is the purpose of this cluster analysis), rather than the exact geographic distribution of each type. For example, macro-region 2, the "Central lowlands/crops", is intended to represent a type of European region where the landscape is strongly dominated by farmland, farms are dominated by arable land and field-crop specialization, intensification levels are relatively high, farms are large in physical and economic terms (see table 17), and nitrate surplus, poor farmland biodiversity and cultural landscapes, as well as significant flood risks are major agri-environmental problems (check sections 3.3.3, 3.3.4, 4.1.2 and 4.1.3). The typical geographical location (core area) of such regions is the lowlands of Central Europe (North-eastern France, Eastern England and parts of the Netherlands, Belgium, Denmark and Northern Germany), and this is why we choose the wording "Central lowlands" for the name of this cluster. Despite the fact that other areas, such as the croplands of the Northern Meseta in Spain or some flatlands of Northern Italy or Northern Greece, share some of the characteristics referred to above – and thus have been included in this cluster (Figure 6) – we have named this macro-region according to the type's core area (where the concept is stronger) and not with a concern for exactly delimitating the macro-region's overall geographic distribution. Had we opted for this latter option, we would have reached a geographically more rigorous but conceptually fuzzier term.

3.3.2. PGaE indicators

The second step of the methodology is to identify and collecting data to characterize the particular bundle of public goods and externalities (PGaE) delivered by each type of landscape/farming systems. For this purpose, one or more variables (PGaE indicators) have been identified for each PGaE which are required to be (1) different from the ones used to identify/delimitate macro-regions and (2) available for all of the EU 27 area at the NUTS3 level, so that they can be analysed at the same scale as the macro-regions delimitations.

The obvious starting point for this identification task is the effort reported in chapter 2 to select from institutional agri-environmental indicator data sets those indicators that are closest to the PGaE specification used in this research (cf. tables 5-9 in chapter 2). However many difficulties arose in this task, most of which related to:

- indicators still under construction (e.g. in Eurostat's web page for agri-environmental indicators);
- indicators only available for the EU 15 (e.g. IRENA indicators);
- indicators not available at NUTS3 level, but only at the national level (e.g. census of common farmland birds or nutrient balances).[7]

These difficulties implied that for one of the PGaE (cultural landscape), there is not one indicator perfectly matching the specification used in this study and available at NUTS3 level for the all EU27.

These difficulties have been, however, satisfactorily solved by resort to: (i) studies currently under way to produce regionalized (either statistical or modelled) information on several agri-environmental indicators such as nutrient balances, air pollution, greenhouse-gas emissions, soil erosion, soil carbon or the recreation value of landscapes; (ii) studies with forecasts of environmental conditions for the medium term (e.g. flooding), which could be used to indicate vulnerability, and (iii) other data-bases available (e.g. annual occurrence of forest fires and burnt areas).

Therefore, data to build these PGaE indicators have been provided by the study's authors or person responsible for the corresponding data bases, either as basic data used to build maps presented in the studies or as a result of extractions made at NUTS3 level at our request.

The final list of PGaE indicators for each public good is the following:

Landscape (cultural)

- *Recreation potential index* – modelled indicator based on the assumption that the recreational potential is positively correlated to degree of naturalness (using CLC, intensity of farming and tree species), presence of protected areas, presence of coastlines (lakes and sea) and quality of bathing water. This index is calculated in a normalized scale (average used to normalize); max: 0.5; min: 0.0. Source: Maes *et al.* (2011), data at NUTS3 level has been provided by the study's authors.
- *Cultural heritage* – composite indicator that combines 1) Quality products, including food and spirits under the Protected denomination of Origin and Protected Geographic Indication schemes, and wines under the Vin de Qualité Produit dans des Régions Déterminées (VQPRD) scheme; 2)

[7] Some indicators were selected though they were only available at NUTS2 level, at least for some member-states. In this case, the values only available at NUTS2 level were transferred to all NUTS3 included in those NUTS2. Although the formal validity of this procedure might be questioned, it is required to keep the analysis at NUTS3 level to match the analysis for the delimitation of macro-regions.

Tourism in rural areas; 3) Agricultural areas in protected and valuable sites, and intended to be used as a proxy for the interest/perception that society has for the rural-agrarian landscape. Originally designated as “Societal awareness of rural landscape”. Max: 18; min: 0. Source: Paracchini (Unpublished), data at NUTS 2 level has been provided by the study’s author.

Biodiversity

- *High Nature Value Farmland (HNVF)* – fraction of the CLC agricultural class presenting high value for biodiversity conservation, as inferred from their characteristics of low-input farming and management practices. Max: 1; min: 0. Source: Paracchini *et al*. (2008), with data at NUTs 3 level provided by the study’s author.

Water quality and availability

- *Infiltration* – annually aggregated soil infiltration (mm). Max: 124 mm; min: 0 mm. Source: Maes *et al*. (2011), data at NUTS3 level has been provided by the study’s author.
- *Irrigated UAA* – percentage of utilized agricultural area (UAA) under irrigation. Max: 89%; min: 0%. Source: Farm Structure Survey 2007 (Eurostat) as retrieved from the data sets included in the Rural Development Report 2011 (EC, 2011).
- *Total N input* – Total nitrogen input to agricultural soils (2002) in $Kg.yr^{-1}.Km^{-2}$ calculated from mineral fertilizer data from FAO at national level distributed to crops and regions by the CAPRI model using information from IFA/FAO plus estimated manure, atmospheric deposition, biological fixation and crop residues. 1-sq.-Km raster data is averaged for study-specific territorial units; these averages are then averaged to NUTS3 units with linking tables provided by the study’s author. Max: 279; min: 0. Source: Leip *et al*. (2011).

Soil quality

- *Soil erosion* – estimated soil erosion by water based on the PESERA model (JRC), in $Ton.ha^{-1}.yr^{-1}$. Max: 31.5 $Ton.ha^{-1}.yr^{-1}$; min: 0 $Ton.ha^{-1}.yr^{-1}$. Source Leip *et al*. (2011): retrieved from the data sets included in the Rural Development Report 2011 (EC, 2011).
- *Soil carbon content.* Low values of this indicator (defined below under the climate stability PGaE) indicate soil quality problems; the highest values do not necessarily indicate high soil fertility.

Air quality

- *Total NH_3 emissions* – Total NH_3 emissions (2000) from terrestrial ecosystems, industry and waste management in $Kg.yr^{-1}.Km^{-2}$ (agriculture soils and manure represent 95%). 1-sq.-Km raster data is averaged for study-specific territorial units; these averages are then averaged to NUTS3 units with linking tables provided by the study’s authors. Max: 32 $Kg.yr^{-1}.Km^{-2}$, min:0 $Kg.yr^{-1}.Km^{-2}$. Source: Leip *et al*. (2011).

Climate stability

- *Soil carbon content* – average soil carbon content (%). Max: 38%; min: 0%. Source: Maes *et al*. (2011), data at NUTS3 level provided by the study’s author. The higher values of this indicator are used to indicate contribution to climate stability through carbon storage.

- *Total N_2O emissions* – Total N_2O emissions (2000) from terrestrial ecosystems, industry, energy and waste in $Kg.yr^{-1}.Km^{-2}$ (agriculture soils and manure represent 63%). 1-sq.-Km raster data is averaged for study-specific territorial units; these averages are then averaged to NUTS3 units with linking tables provided by the study's authors. Max: 4 $Kg.yr^{-1}.Km^{-2}$; min: 0 $Kg.yr^{-1}.Km^{-2}$. Source: Leip *et al*. (2011).

Resilience to flooding

- *Flooding risk* – relative area of NUTS2 that is expected to be affected by floods in 2025 based on model estimates (model LISFLOOD). Max: 1; min: 0. Source: European Climate Adaptation Platform., data at NUTS2 level provided by Florian Wimmer (Center for Environmental Systems Research University of Kassel).

Resilience to fire

- *Fire risk* – average yearly burnt area between 1997 and 2006 (except for some countries) as a fraction of total area of NUTS3. Max: 0.11; min: 0. Source: European Forest Fire Information System (JRC). Data at NUTS3 level has been provided by JRC.

All of these PGaE indicators have been mapped with ArcGIS (cf. Annex 3) at the NUTS3 level for the EU 27, to provide a basis for assessing and validating the macro-regions built through cluster analyses.

3.3.3. Associations between PGaE and macro-regions

Associations of PGaE indicators with the macro-regions have been analysed through:

- a comparison of macro-region averages for each PGaE indicator;
- a factor analysis run on data at the NUTS3 level using as variables the PGaE indicators and the 13 selected macro-regions coded as 13 binary-code variables.

Both the comparison of macro-region averages and the factor analysis resulted in clear associations of some macro-regions to some PGaE indicators, but each has their limitations. The comparison of macro-region averages, while not taking into account the multivariate nature of the problem and not using the individual data but averages alone, allowed for clearer associations to be established and maximized the use of available information – because missing data for each PGaE indicator (which is very significant for some PGaE indicators and some countries) only affects the number of observations (NUTS3) used to compute the average of this particular PGaE indicator. On the other hand, factor analysis, while more statistically robust (as it integrates the multivariate nature of the problem and uses individual data) only used circa 1/3 of the NUTS, as missing data in at least one PGaE indicator in a particular NUTS3 leads to the exclusion of that NUTS3 from the analysis. The results of both exercises are, however, discussed below. They are consistent and mutually-reinforcing in which concerns the selection of core PGaE for each macro-region.

The averages of PGaE indicators for each of the selected 13 clusters/macro-regions are presented in table 18 and Figure 7. Table 19 presents the percentage of NUTS3 in each cluster/macro-region with available data for the corresponding PGaE indicator.

Table 18 – Averages of PGaE indicators for each macro-region

		1	12	9	10	2	11	7	3	6	5	13	8	4				
		Mediterranean hinterlands	Mediterranean uplands / permanent crops	Eastern Europe / Southern mountains and valleys	Eastern Europe / Northern flatlands	Central lowlands / crops	Central lowlands / crops and livestock (Eastern Germany)	Central lowlands / livestock	Lowland-upland transitions in Central Europe	North-western fringes and continental uplands	The Alps, NW Iberian mountains and the Scottish Highlands	Northern Scandinavia	Urban / grazing livestock	Urban / horticulture	min	max	average	range/average
Landscape	**Recreation potential index**	0.29	0.35	0.27	0.27	0.24	0.31	0.22	0.35	0.26	0.31	0.29	0.25	0.29	0.22	0.35	0.29	0.40
	Cultural heritage	8.71	10.96	6.11	3.99	7.54	7.20	5.48	10.20	7.98	9.99	4.94	7.85	9.29	3.99	10.96	7.71	0.90
biodiversity	**HNVF**	0.32	0.58	0.34	0.25	0.14	0.11	0.09	0.26	0.27	0.72	0.37	0.12	0.21	0.09	0.72	0.29	2.10
Water quality and availability	**Infiltration**	13.3	15.5	9.16	11.7	15.4	9.7	15.9	17.1	24.3	46.0	25.8	14.5	13.4	9.2	46.0	17.8	2.06
	Irrigated UAA	18.6	19.5	1.2	0.7	12.1	0.3	11.6	6.4	2.2	7.3	0.1	1.8	8.1	0.1	19.5	6.9	2.81
	Total N input	32.7	25.7	27.4	22.3	55.0	37.7	62.3	40.5	56.5	28.4	18.3	57.1	21.3	18.3	62.3	37.4	1.17
Soil quality	**Soil erosion**	5.84	6.53	2.45	1.51	2.90	1.60	1.30	2.82	2.03	7.61	0.21	2.10	2.50	0.21	7.61	3.00	2.40
Air quality	**Total NH_3 emissions**	4.90	3.14	2.62	2.85	6.58	4.70	16.83	6.43	7.53	5.56	1.67	7.93	5.66	1.67	16.83	5.88	2.58
Climate stability	**Carbon soil content**	2.38	1.33	3.56	6.30	3.83	5.45	4.94	5.92	6.81	6.27	17.40	4.13	4.13	1.33	17.40	5.57	2.88
	Total N_2O emissions	0.88	0.68	1.05	0.70	0.86	0.89	1.14	0.93	0.87	0.95	1.02	0.88	0.75	0.68	1.14	0.89	0.50
Resilience to fire	**Fire risk**	.0055	.0051	.0001	.0006	.0026	.0000	.0050	.0003	.0008	.0090	.0004	.0003	.0029	.0000	.0090	.0025	3.59
Resilience to flooding	**Flooding risk**	0.045	0.066	0.029	0.045	0.156	0.082	0.224	0.174	0.238	0.103	0.036	0.235	0.226	0.029	0.238	0.128	1.63

Table 19 – Percentage of NUTS3 in each macro-region with available data for each PGaE indicator

		1	12	9	10	2	11	7	3	6	5	13	8	4
		Mediterranean hinterlands	Mediterranean uplands / permanent crops	Eastern Europe / Southern mountains and valleys	Eastern Europe / Northern flatlands	Central lowlands / crops	Central lowlands / crops and livestock (Eastern Germany)	Central lowlands / livestock	Lowland-upland transitions in Central Europe	North-western fringes and continental uplands	The Alps, NW Iberian mountains and the Scottish Highlands	Northern Scandinavia	Urban / grazing livestock	Urban / horticulture
Landscape	**Recreation potencial index**	100	100	100	100	100	100	100	100	100	100	100	100	100
	Cultural heritage	100	100	100	100	100	89	100	100	100	100	100	100	100
Biodiversity	**HNVF**	100	89	100	100	100	100	100	100	100	100	100	98	94
Water quality and availability	**Infiltration**	100	100	100	100	100	100	100	100	100	100	100	100	100
	Irrigated UAA	82	100	100	94	73	8	57	20	71	100	100	62	88
	Total N input	96	89	54	28	96	88	93	100	96	89	100	68	76
	N surplus	96	89	54	28	96	88	93	100	96	89	100	68	76
Soil quality	**Soil erosion**	92	42	100	100	93	100	97	100	100	97	100	97	94
Air quality	**Total NH3 emissions**	96	89	54	28	96	88	93	100	96	89	100	68	76
Climate stability	**Carbon soil content**	100	100	100	100	100	100	100	100	100	100	100	100	100
	Total N_2O emissions	96	89	54	28	96	88	93	100	96	89	100	68	76
Resilience to fire	**Fire risk**	80	100	98	98	49	98	17	38	26	66	100	22	41
Resilience to flooding	**Flooding risk**	100	100	100	100	100	100	100	100	100	100	100	100	100

The last column of table 18 (range/average ratio for each PGaE indicator) suggests the ability of each PGaE indicator to discriminate between macro-regions. If the indicator does not have much variation across all macro-regions it has not a good discriminating potential. For example, recreation and N_2O indicators have variations of less than 50% of the overall regional average, while the variation of the burnt areas indicator averages is 3.5 times higher than the overall regional average.

Table 19 represents the percentage of NUTS3 in each macro-region with available data for each PgaE indicator. As some indicators do not have information for some countries or for some NUTS within some countries, in some cases, the NUTS with available data might not be representative of the macro-region as a whole, which advises caution in the interpretation of some results in table 18.

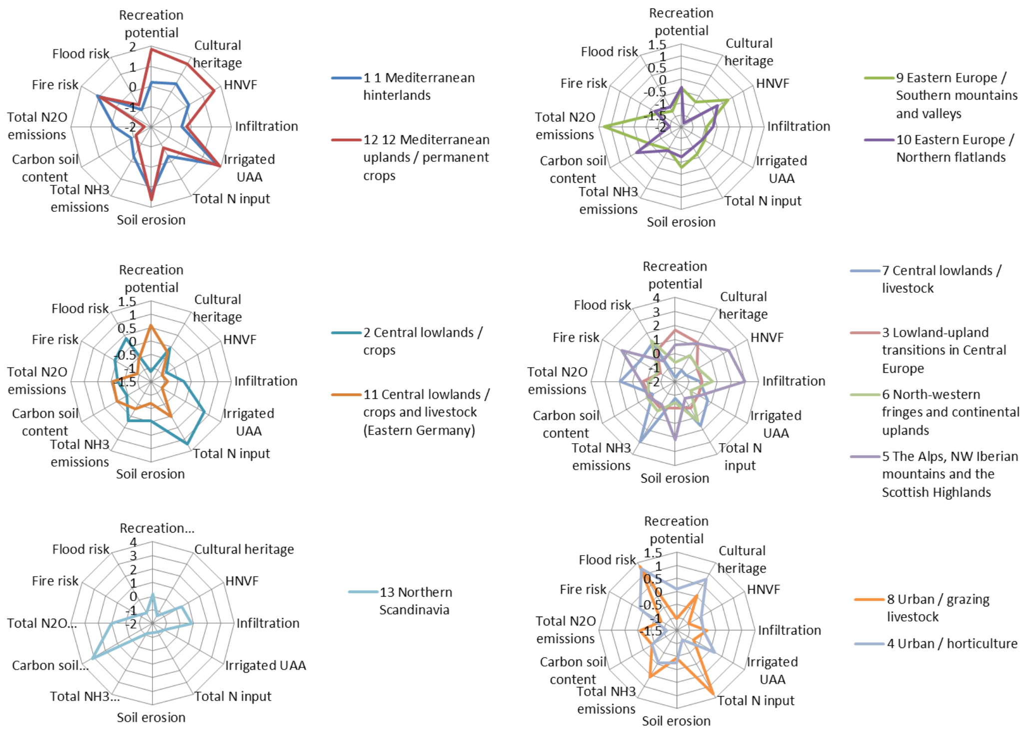

Figure 7 - PGaE profiles of different macro-regions
(Macro-regions are grouped in 6 groups, which represent the 6-cluster solution of the same cluster analysis that generated the 13 macro-regions/clusters)

Figure 7 presents graphically the associations between the PGaE indicators (PGaE indicators' averages are here standardised according to their average and standard deviation across macro-regions) and the macro-regions. The macro-regions in Figure 7 are grouped into six major groups that correspond to the 6-cluster solution of the same cluster analysis that generated the selected 13 macro-regions/clusters. The fact that there are clear similarities in PGaE profiles among macro-regions within the same group reveals consistency between PGaE profiles and the overall cluster analysis from which the macro-regions have been derived. This is a first positive test as regards the usefulness of our cluster analysis (which is built on landscape/land cover and farming systems alone) to discriminate as well different PGaE profiles for different macro-regions, which is a clear pre-condition for those macro-regions to be useful in identifying specific macro-regional agri-environmental problems.

From Figure 7 it is possible to describe clear associations between PGaE indicators and macro-regions (in this section), and also to identify the main features of the agri-environmental problems in each macro-region (in section 3.3.4).

Observing the macro-regional averages of the PGaE indicators, the values for recreation potential index are at the highest levels in the Mediterranean uplands/ permanent crops and Lowland-upland transitions in Central Europe. The Alps, NW Iberian mountains and the Scottish Highlands, as well as Central lowlands/ crops and livestock (former Eastern Germany) also have above-the-average values. The cultural heritage indicator supports the information from recreation potential index, as it shows a similar distribution, with higher values in Mediterranean uplands/ permanent crops and Lowland-upland transitions in Central Europe.

The Mediterranean uplands/ permanent crops and the Alps, NW Iberian mountains and the Scottish Highlands also have larger percentages (clearly above 50%) of their UAA with HNV farmland. Northern Scandinavia, Eastern Europe / Southern mountains and valleys, as well as the Mediterranean hinterlands present moderately high levels of HNV farmland (around or above one third of their UAA). These three macro-regions also present close-to or above-the-average levels of recreation potential index. Four of these macro-regions (the two Mediterranean, the Alpine and Northern Scandinavia) are areas with some degree of naturalness – as it can be shown by the high percentages of natural land covers, and many are associated to low intensity farming systems or high percentages of LFA land (cf. Table 16).

On the other hand, two macro-regions – Central lowlands/ crops and Central lowlands/ livestock – have both the lowest levels of recreation potential index and HNV farmland (9-14% of their UAA is HNV); these macro-regions' land cover is strongly dominated by farmland, their UAA strongly dominated by arable, their farming systems are moderately to highly intensive and represent mostly non-LFA areas (Table 16). So there is a clear connection between land cover, UAA use, intensity and LFA (as macro-regional variables), on the one hand, and, on the other, recreation potential index, cultural landscapes and HNV farmland – the indicators selected to represent the PGaEs landscape and biodiversity.

The two Mediterranean macro-regions (clusters 1 and 12) are the ones with the highest average values of irrigated UAA, as they suffer from seasonal water deficit in summer which is so typical of the Mediterranean climate. Macro-regions where the landscape is strongly dominated by intensive arable land uses, such as the Central Lowlands /crops and Central Lowlands/ livestock, also have significantly high values for irrigated UAA. In these two areas, the values of total N input (and N surplus) are also very high, which means problems of groundwater contamination. On the other hand, the values of infiltration are low in these macro-regions.

Contrarily in the Alps, NW Iberian mountains and the Scottish Highlands, levels of water infiltration are the highest, and total N is low, meaning a recharge of good-quality groundwater. A similar situation occurs in Northern Scandinavia, but not in the North-western fringes and continental uplands – where infiltration is high but total N is also high, indicating potential quality problems for groundwater.

The Alpine (cluster 5) and the two Mediterranean (1 and 12) macro-regions have the highest level of soil erosion, which is certainly related to their slope and climatic characteristics respectively.

The total value of NH_3 emissions is maximum (and significantly above all of the other macro-regions') in the Central lowlands /livestock, as this is a type of pollution associated with intensive livestock and this is the area with the highest stocking rates. Other three macro-regions with significant NH_3 problems (North-western fringes and Continental uplands; Urban/ grazing livestock; Lowland-upland transitions in Central Europe and Central lowlands/ crops) also include relatively intensive livestock farming systems.

For climate stability, the carbon soil content is the highest and above all other macro-regions in Northern Scandinavia, which is explained by the prevailing type of Nordic, cold climate, where the decomposition of organic matter is very slow. Other three macro-regions – North-western Fringes and Continental uplands; the Alps, NW Iberian mountains and the Scottish Highlands, and Eastern Europe/ Northern flatlands –, which also have cold or wet climates, making the decomposition of organic matter slower, also have significantly higher levels of organic carbon in the soil. On the other extreme, the two Mediterranean macro-regions (for climatic reasons) have the lowest levels of soil carbon, and the Central lowlands types (probably due to intensive cultivation and tillage) also have low values of soil carbon. This contrasts help supporting the idea that this indicator, originally created for soil fertility/capacity, is even better (at least, for the highest values in the scale) to identify carbon sequestrated in the soil, although the low levels of the indicator might be interpreted as indicating soil fertility problems as well.

The indicator of total N_2O emissions indicates major problems with greenhouse gas emissions from Central lowlands / livestock, Eastern Europe / Southern mountains and valleys and Northern Scandinavia. Although in the first two macro-regions this is probably related to the presence of intensive livestock, the reason for such a high value in Northern Scandinavia is not clear.

The macro-region with largest incidence of risk of fire are the Alps, NW Iberian mountains and the Scottish Highlands, with a percentage of burnt area of almost 1%, followed by the two Mediterranean macro-regions (clusters 1 and 12) and the Central lowlands/ livestock. These are areas with significant percentage of forest (in the case of mountain areas), or with a long dry summer following mild and wet winters with strong plant growth as in the Mediterranean areas. The lack of data for many truly alpine NUTS3 is the main cause for the very high average level of fire incidence in the alpine macro-region (by exaggerating the weight of the Mediterranean areas in Northern Iberia in the overall average).

Finally the flooding risk is highest in urban macro-regions (8 and 4), North-western fringes and continental uplands, and Central lowlands / livestock. These are possibly areas with higher levels of runoff because of climatic, topographical or land use (built surfaces) reasons, where appropriate adjustments in land use and farming practices might well originate significant flood-reduction benefits because of high population densities and property damages due to floods.

As regards the factor analysis, it is important to underline, first, that a forward stepwise procedure is used to test for inclusion of the intended variables (that is: all PGaE indicators and the binary-code 13 variables indicating the macro-region), which led to the inclusion of all of these variables; second, that a critical eigenvalue of 1.0 is used to determine the number of components/factors to be extracted; third, that factors have been rotated to make them more easily interpreted, using a equamax rotation procedure (which minimizes the number of variables associated to each factor and the number of factors associated to each variable). These procedures led to the extraction of the first 12 components/factors. The scores of the different variables (PGaE indicators and macro-regions) in each component/factor (after rotation) are represented in Table 20.

As regards the results of the analysis, let us first note that each of the 12 components is closely associated to one single macro-region, except component 4 which is negatively associated to macro-region 9 (Eastern Europe / Southern mountains and valleys) and positively associated to macro-region 1 (Mediterranean hinterlands). Associations between the PGaE indicators and the 12 components are weaker, but in many cases considerable, so here we used a lower threshold to identify stronger (module of score no lower than 0.3) and weaker (module of score between 0.2 and 0.3) associations.

Below, we use the scores of the PGaE indicators (and the corresponding signs) on the component that is more strongly linked to a particular macro-region to comment on the associations between PGaEs and that macro-region.

The recreation potential index is positively strongly associated with the Alps, NW Iberian Mountains and the Scottish Highlands, as well as with the Mediterranean uplands/permanent crops; it is negatively strongly associated with the Central lowlands/crops, the Central lowlands/livestock and the Urban/grazing livestock.

The cultural heritage indicator reveals weaker associations with most of the different components, but is also positively associated with the Alps, NW Iberian Mountains and the Scottish Highlands, the Mediterranean hinterlands and the Mediterranean uplands/permanent crops. It is (usually weakly) negatively associated with Northern Scandinavia, Central lowlands/crops, Eastern Europe/Southern mountains and valleys, Lowland-upland transitions in Central Europe and Eastern Europe/Northern flatlands.

The HNVF indicator reveals stronger associations with many components. It is (strongly) positively associated with the Alps, NW Iberian Mountains and the Scottish Highlands, as well as the Mediterranean uplands/permanent crops. On the other hand, it is negatively associated with the Central lowlands/crops, the Central lowlands/livestock, the Central lowlands/crops and livestock (Eastern Germany) and the Urban/grazing livestock.

Table 20 – Scores of PGaE indicators and macro-regions in the different components of the factor analysis (after rotation)

Rotated Component Matrix[a]												
	Component											
	1	2	3	4	5	6	7	8	9	10	11	12
Recreation potencial índex	0.33	0.07	0.41	0.05	0.03	0.04	0.42	-0.30	0.00	-0.08	0.36	0.03
Cultural heritage	0.26	-0.27	0.24	0.44	-0.02	0.21	0.29	-0.04	0.29	-0.09	0.02	0.15
HNVF	0.51	0.01	0.34	-0.06	-0.04	0.00	0.34	-0.22	0.12	-0.24	0.31	-0.07
Infiltration	0.83	0.13	0.07	0.22	0.05	-0.02	-0.03	0.11	0.04	0.04	0.07	-0.01
Irrigated UAA	-0.01	-0.18	-0.23	0.47	-0.24	0.12	0.02	0.32	0.29	-0.18	-0.06	0.01
Total N input	-0.09	-0.12	-0.59	0.10	0.37	0.33	-0.18	0.29	0.20	0.18	0.02	-0.15
Soil erosion	0.34	-0.33	0.13	0.37	-0.28	0.23	0.03	-0.02	0.11	0.02	0.04	0.08
Total NH_3 emissions	0.07	-0.13	-0.37	0.25	0.13	0.35	-0.17	0.55	0.26	-0.05	0.05	-0.06
Carbon Soil Content	0.10	0.90	0.12	-0.12	0.07	-0.16	-0.09	-0.05	-0.03	-0.01	0.03	0.00
Total N_2O emissions	0.11	0.14	-0.01	-0.11	0.16	0.70	-0.18	0.19	0.29	-0.01	0.02	0.08
Fire risk	0.21	-0.12	-0.05	0.18	-0.26	0.00	0.36	-0.01	-0.04	-0.20	0.10	-0.18
Flood risk	0.05	-0.08	-0.28	0.14	0.65	-0.13	-0.04	-0.10	-0.06	0.35	-0.15	0.06
Rotated Component Matrix[a]												
	Component											
	1	2	3	4	5	6	7	8	9	10	11	12
1 Mediterranean hinterlands	-0.40	-0.22	0.41	0.56	-0.23	0.14	-0.24	-0.16	0.13	-0.07	0.13	-0.17
2 Central lowlands / crops	-0.10	-0.09	-0.90	0.04	-0.08	0.02	-0.03	-0.08	0.01	-0.02	0.00	-0.03
3 Lowland-upland transitions in Central Europe	0.05	0.12	0.06	-0.03	0.10	-0.79	-0.19	0.12	0.26	-0.01	0.05	0.03
4 Urban / horticulture	-0.04	-0.03	0.02	0.03	-0.04	0.02	0.00	-0.02	-0.01	-0.03	0.03	0.95
5 The Alps, NW Iberian mountains and the Scottish Highlands	0.87	-0.09	0.08	0.04	-0.13	0.10	0.02	-0.08	0.03	-0.08	0.06	-0.04
6 North-western fringes and continental uplands	-0.05	-0.02	0.14	-0.03	0.82	0.10	-0.03	0.00	-0.01	-0.12	0.03	-0.06
7 Central lowlands / livestock	0.01	-0.03	0.15	-0.03	-0.07	-0.06	0.08	0.83	-0.11	0.02	-0.01	-0.01
8 Urban / grazing livestock	0.04	0.00	0.09	0.01	0.01	0.03	0.02	-0.04	0.03	-0.04	-0.95	-0.03
9 Eastern Europe / Southern mountains and valleys	-0.15	-0.14	0.17	-0.81	-0.21	0.17	-0.12	-0.06	0.12	-0.04	0.01	-0.02
10 Eastern Europe / Northern flatlands	0.00	0.00	0.03	0.03	0.03	0.06	-0.08	0.07	-0.87	-0.02	0.02	0.02
11 Central lowlands / crops and livestock (Eastern Germany)	0.02	-0.02	0.05	-0.01	-0.05	0.03	0.02	0.00	0.02	0.93	0.03	-0.04
12 Mediterranean uplands / permanent crops	-0.17	-0.03	0.02	0.02	0.01	0.01	0.87	0.06	0.09	0.03	-0.01	0.02
13 Northern Scandinavia	-0.04	0.92	0.04	0.06	-0.12	0.11	0.01	-0.08	-0.02	0.01	-0.01	-0.01

So, as regards these indicators of the cultural landscape and biodiversity PGaE's, the results of the factor analysis reveal an inter-region pattern which is clearly the same that is revealed by the comparison of averages of PGaE indicators across regions. Note, however, that there are some individual differences, e.g. the Lowland-upland transitions in Central Europe seem to appear in a better position as regards recreation potential in the comparison of averages as compared to the factor analysis; many of these differences may derive from many excluded NUTS3 in the factor analysis as a result of missing data in any of the PGaE indicators.

Regarding water availability indicators, infiltration is only strongly (positively) associated with the Alps, NW Iberian Mountains and the Scottish Highlands. Irrigated UAA is strongly positively associated with Mediterranean hinterlands and Central lowlands/livestock and negatively with Eastern Europe/Southern mountains and valleys; irrigated UAA has also weaker associations with Central lowlands/crops (positive), North-western fringes and continental uplands (negative) and Eastern Europe/Northern flatlands (negative).

The total N input indicator is strongly associated with Central lowlands/crops (positive and the highest), North-western fringes and continental uplands (positive) and Lowland-upland transitions in Central Europe (negative). Weaker relationships have been found with Central lowlands/livestock (positive) and Eastern Europe/Northern flatlands (negative).

The soil erosion indicator is strongly associated with the Alps, NW Iberian Mountains and the Scottish Highlands (positive), Northern Scandinavia (negative), Mediterranean hinterlands (positive) and Eastern Europe/Southern mountains and valleys (negative); weaker associations have been revealed with North-western fringes and continental uplands, and with Lowland-upland transitions in Central Europe (both negative).

Total NH_3 emissions have been revealed to be strongly associated with Central lowlands/crops and Central lowlands/livestock (both positive), and with Lowland-upland transitions in Central Europe (negative).

Carbon soil content is only (strongly and positively) associated with Northern Scandinavia.

Total N_2O emissions have been revealed to be strongly associated with Lowland-upland transitions in Central Europe (negative) and weakly associated with Eastern Europe/Northern flatlands (also negative).

Fire risk have been revealed to be strongly associated only with Mediterranean uplands/permanent crops (positive), and weakly with the Alps, NW Iberian Mountains and the Scottish Highlands (positive), North-western fringes and continental uplands (negative), and Central lowlands/crops and livestock - Eastern Germany (negative).

Flood risk is positively associated with the North-western fringes and continental uplands (strong), the Central lowlands/crops and livestock - Eastern Germany (strong) and the Central lowlands/crops (weak).

Summarizing, many of the associations revealed by the factor analysis just reported and especially the overall interregional pattern emerging from this analysis are both similar to those revealed by the comparison of averages of PGaE indicators across macro-regions reported earlier in this section. This reveals consistency between the two analyses – one which is univariate and the other which is multivariate. However, the overall pattern emerging from the comparison of averages is richer, clearer and more in accordance with previous expectations. Moreover, note again that, due to missing data in some PGaE, the factor analysis is very weak in coverage, particularly in some macro-regions: only 402 of the original 1100 NUTS3 entered into the factor analysis because of missing data in at least one of the PGaE indicators. These reasons led us to opt for the comparison of averages to identify core PGaE in each macro-region (see next section), taking the results of the factor analysis just reported as generally supportive of the adopted approach , because of its much better coverage in all macro-regions (see table 19).

3.3.4. Macro-regions and their core PGaE

By analysing each macro-region's PGaE bundle/profile within a broad description of its landscape agro-ecological characteristics, this section identifies the core PGaE for each macro-region and provides a broad description of its main agri-environmental problems. These identification and description are first steps in both selecting the set of PGaE to be valued in each macro-region and providing support for building a narrative for each macro-regional agri-environmental problem (MRAEP). Both of these second-step tasks are essential for building the valuation scenarios to be proposed in this study; they are only fully reported in the next chapter, because they require the previous discussion of dynamic information (prospects for land abandonment, farmland expansion or intensification in each macro-region) that is relevant for MRAEP definition.

Mediterranean hinterlands are areas with some potential for recreation and with some HNV farmland. Cultural heritage also plays a relevant role in this macro-region. The climate is characterized by dry summers, which imply, at least for intensive agriculture, irrigated farming and associated high water abstraction levels. Because of relatively low rainfall and infiltration levels, water resources are not particularly abundant, which, combined with water abstraction levels for irrigated agriculture, creates potential for serious trade-offs between agriculture and other human needs (municipal, recreation) or ecosystem quality (wetlands and river flows). As agriculture is not very intensive, total N input is not particularly high. There are serious problems of soil erosion and fire risk, with an average burnt area of 0.5%. The carbon content of soils is low, which implies a low level of sequestrated carbon and also soil fertility problems, which could be partly solved by land use change towards grasslands and practices such as no or low tillage.

In Mediterranean uplands/ permanent crops the potential for recreation, the cultural heritage and the percentage of HNVF are even much higher. Irrigated UAA is also at high levels, as well as soil erosion and fire risk.

In Eastern Europe/ Southern mountains and valleys, in spite of some HNVF, the potential index for recreation and cultural heritage seems to be low. There, the values of infiltration, irrigated UAA and total N input are very low, as agriculture is predominantly low-intensity farming. So, the conflicts and trade-offs between agriculture, other human needs and wildlife habitat/ecosystem quality are lower than in Mediterranean hinterlands – a fact that can be inverted with agricultural land expansion and intensification that are expected under certain future scenarios for these macro-regions (see Scenar 2020 study from the EC, 2007 and 2009). However, total N_2O emissions are high, which can be related to intensive livestock (pigs). There is some soil erosion and the value of soil carbon content is low, indicating low carbon sequestrated in soils (low contribute for climate stability) and possibly soil fertility problems as well.

In Eastern Europe / Northern flatlands, the indicators have a similar behaviour, but the total N_2O emissions are much lower and the carbon soil content is much higher, which indicates a lower importance of intensive livestock rearing and a colder climate, respectively; the latter contributing to a more significant contribution to climate stability through carbon sequestration.

Central lowlands/ crops have a more intensive agriculture and one that occupies most of the land area with intensive arable crops; so the values of the recreation potential, cultural heritage and HNVF indexes are really low. For the same reason, levels of irrigated UAA and total N input are high and very high, respectively. Combined with some water infiltration, these lead to massively contaminated groundwater and eutrophicated coastal seas. There is some fire risk. Flooding risk is probably also a relevant problem.

Central lowlands/ crops and livestock (Eastern Germany) have some potential for recreation (in terms of the indicator *recreation potential index* defined in Section 3.3.2) but the cultural heritage and HNVF is low. This macro-region also has some total N input and total N_2O emissions problems. Soil carbon content is relatively high. The values of infiltration and irrigated UAA are very low.

Central lowlands/ livestock is a type characterized by intensive livestock, with high stocking rates, which are reflected in high values of total N input, total N_2O and total NH_3 emissions. Infiltration levels are medium/high and irrigated UAA is high. It has one of the highest values of fire risk, but it is important to notice that most of NUTS3 included in this macro-region do not have data for this indicator, and the high value of burnt areas refers to only 17% of the cluster's NUTS, most of which incidentally located in Central and Northern Portugal. There is also a high flooding risk in this macro-region.

In Lowland-upland transitions in Central Europe most of indicators are close to the average, as this is precisely a lowland-upland transition type. High recreation potential and cultural heritage stand as a main characteristic of this type (as there are some mountain and forest areas within the type), as well as the relatively high flooding risk.

North-western fringes and continental uplands have high values of total N input, as a result of prevailing intensive livestock farming systems. Nitrate surplus, related to medium-high values of infiltration, can cause some water quality problems. The risk of flooding is the highest in this macro-region. The recreation potential index is relatively low, but cultural heritage and HNVF are at medium values.

The Alps, NW Iberian mountains and the Scottish Highlands have a high potential index for recreation, a very high cultural heritage and the highest percentage of HNVF (72% of UAA). Infiltration is high, which, combined with low total N input, originates a good-quality water recharge of watersheds and groundwater. The soil erosion risk is high. Fire risk is at the highest level in this type, probably because it includes more Mediterranean areas in NW Iberia and some of the other areas are affected by missing data as regards this PGaE.

In Northern Scandinavia, there is some potential for recreation and a relatively high HNVF. However the cultural heritage is low. That could be related to the low agricultural area, low number of farms with quality products and agricultural areas in protected and valuable sites. There is some water infiltration. The carbon soil content is very high, suggesting that carbon soil sequestration is a major function of agricultural land in this macro-region. The values of total N input and total NH_3 emissions are low, as it would be expected from the relatively low intensity of farming systems and their low share in global land use, but the nitrous oxide emissions are at a (difficult to explain) high level.

As expected, urban areas/ grazing livestock (macro-region 8) have a lower potential for recreation. The agriculture is intensive and the value of total N input is very high. There are some NH_3 and total N_2O emissions. There is a high risk of floods.

In Urban / horticulture, the value of total N input is lower, unlike the previous type. Recreation potential index and irrigation are on the high side, as well as fire risk. The value of cultural heritage is high, but this could simply be a result of that variable being measured at NUTS 2 level, which mixes the values of small urban areas included in the cluster and larger surrounding rural areas. The risk of flooding is high.

4. Design and test of large-scale EU valuation survey

This Chapter reports on the ‘Survey design, which comprised three goals. The first is to design a large-scale EU valuation survey according to the methodological framework developed in previous tasks and reported in Chapter 3. The second is to test this survey at a pilot scale. The third goal is to analyse the feasibility of this large-scale valuation survey, comparing alternative options for sample size and selection, administration methods and costs.

This chapter starts by transforming the analysis of macro-regions (MR) and their core PGaE (presented in section 3.3) into macro-regional agri-environmental problems (MRAEPs), which, together with specific PGaE programmes designed to deliver specific PGaE in each MRAEP, are the core components of the choice scenarios proposed in this study for a large-scale valuation survey. A second section of the chapter discusses specific options for the design of the choice-experiments in this context. The third section reports on the design and testing of the pilot survey, and eventually presents alternative sampling plans to extend the pilot survey into an EU large-scale survey, and their estimated costs.

4.1. Designing macro-regional agri-environmental problems (MRAEPs) as valuation scenarios

Transforming the analysis of macro-regions (MR) discussed in previous chapters into the choice-modelling (CM) scenarios to be developed, tested and proposed in this study raises several issues. This section discusses these issues and presents the methodology that is developed and followed in this project to address these issues.

Each CM scenario/questionnaire is aimed at depicting a specific macro-regional agri-environmental problem (MRAEP). Valuation is (and should be) a context-dependent exercise. Thus, each MRAEP is intended to provide a specific context for the valuation of several PGaE changes that match this particular context. Each MRAEP can be characterized by: (1) the types of farming and PGaEs prevailing in a specific MR; (2) an expected direction of future change in land use, e.g. farmland abandonment or afforestation versus farmland expansion or agricultural intensification; and (3) the expected effects of such change on the delivery of PGaEs in that MR. The next element of the CM scenarios has to do with the particular policy options (PGaE programmes) that are available to compensate expected negative trends or promote positive change in particular PGaEs. Each PGaE-delivering programme is to be as targeted as possible to a specific PGaE, so that each PGaE can be separately valued (which implies avoiding, as much as possible, joint-production issues). Nonetheless, possible interactions between the PGaE from the demand-side will be accounted for in the design of choice scenarios.

PGaE programmes can be valued against a policy-off (business-as-usual or do-nothing) scenario, where, in absence of any payment, the particular PGaE at stake would follow the expected policy-off trends. This was shown to be the more realistic approach for focus group participants reported later on, where the MRAEP is characterized by agricultural abandonment. An alternative specification of the baseline, policy-off scenario, where PGaE programmes are valued as an improvement to the current condition of the PGaE, may work better in MRAEP related to intensive agriculture.

Each MR could, in principle, include different MRAEPs, which, for sake of coherence of the valuation exercise (and thus validity of the final valuation outcomes), should be separately addressed in different surveys. For example, processes of land abandonment and agricultural intensification can be expected to occur in different areas (e.g. poorer and richer soil areas respectively) of the same MR. These processes may involve changes in different PGaE (resilience to fire and water quality, respectively) or cause contradictory trends in the same PGaE (e.g. water availability). In this case, the PGaE changes associated to each MRAEP should be separately valued in a separate survey. So, a specific CM scenario should be developed for each different MRAEP, which might imply more than one CM scenario for each MR.

The different sub-sections of this section unfold in the following order: first, some simplifications are made in the overall framework of MR, by reducing the previous number of MRs (13) to keep only those eight MRs whose geographical distribution and connection to one (or more) specific MRAEP are judged to be understandable to respondents; second, each MR is checked to assess whether it includes a single, consistent MRAEP or, alternatively, if it should be split (for sake of coherence) into different MRAEP (as previously explained), which led us to identify a final list of ten MRAEPs; third, PGaEs to be valued in each MRAEP are selected according to some specified criteria; and, fourth, the PGaE programmes that would deliver the selected PGaEs in each MRAEP/scenario are specified.

4.1.1. Simplifying the framework of macro-regions

As referred to above, the previous number of MRs (13) is reduced to eight, so as to keep only those MRs that could be associated to one (or more) specific MRAEP(s) which is (are) judged to be possible to describe and geographically locate in a way that is apparently understandable to respondents (residents in EU). Five MR have been eliminated or merged in this way, to yield a simplified list of eight MR to be used for valuation purposes, according to the following reasons:

- Two MRs – MR4 (Urban/horticulture) and MR8 (Urban/grazing livestock) –, which are very small and scattered across the EU, seemed difficult to associate to a precisely located MRAEP that respondents would clearly understand. To avoid communication problems in the surveys, the NUTS3 in these two MRs are integrated in the larger MRs where they are geographically immerse. In the case that the NUTS3 it is not surrounded by a bigger MR, the closer MR (in terms of production) is assigned.
- Given its similitude with the larger MR2 (Central Lowlands/crops), the MR11 (Central lowlands/crops and livestock, mostly corresponding to Eastern Germany) is merged with the former. The main difference between these two MRs is the larger farm size in the later, which does not translate into a significantly different set of selected PGaE – which otherwise would be a crucial element to segregate among different MRAEPs.
- Given the difficulty to communicate transition types to respondents in ways that they understand them as well-defined and precisely located problems, different areas within the macro-region MR3 (Lowland-upland transitions in Central Europe) are included into adjacent areas of two livestock MRs: either the MR5 (Alps, NW Iberian mountains and the Scottish Highlands) or the MR6 (North-western fringes and continental uplands), according to similarities that have been evaluated according to our general knowledge of the specific areas at stake (e.g. the Central Massif of France is included in the Alpine MR, due to its mountainous ecology and generally extensive livestock farming systems, and not in the North-western fringes, which is characterized by more intensive livestock systems).
- Given the difficulties in specifying two clearly different MRAEP scenarios for the two Eastern Europe MRs (Southern mountains and valleys, and Eastern Europe/Northern flatlands, MRs 9 and 10

respectively), for example as regards significantly different PGaE changes, these two MRs have been merged into a single Eastern European MR.

Figures 8 and 9 below depict, respectively, the geographical distribution of the original 13 MRs and that of the newly defined eight MR, which constitute the simplified framework of MRs to be depicted in the CM scenarios. Each of these eight MRs can be described in terms of one (or more) well-defined and precisely geographically located MRAEP.

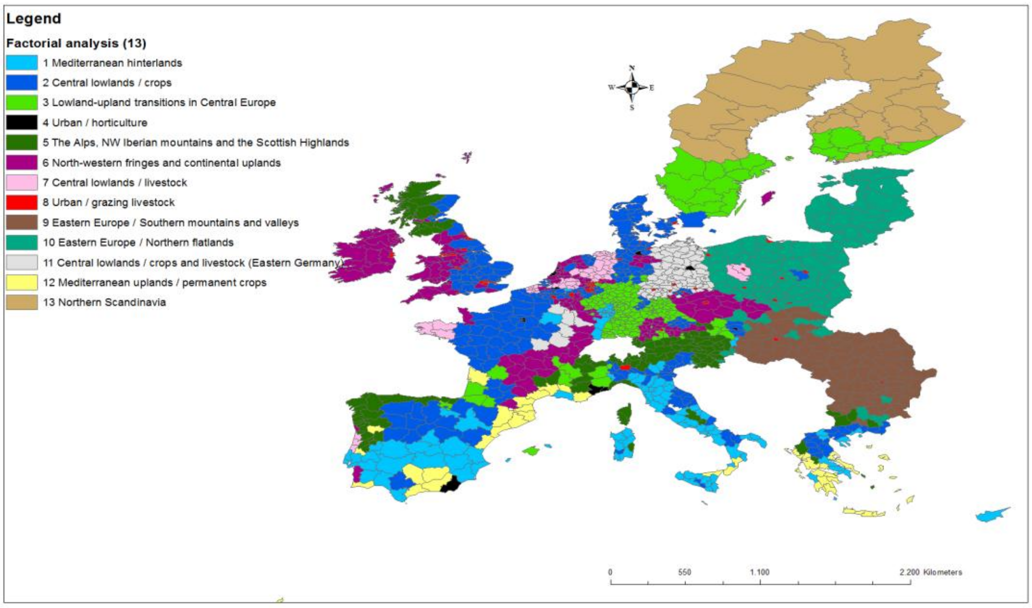

Figure 8 - Selected and described macro-regions (13MRs)

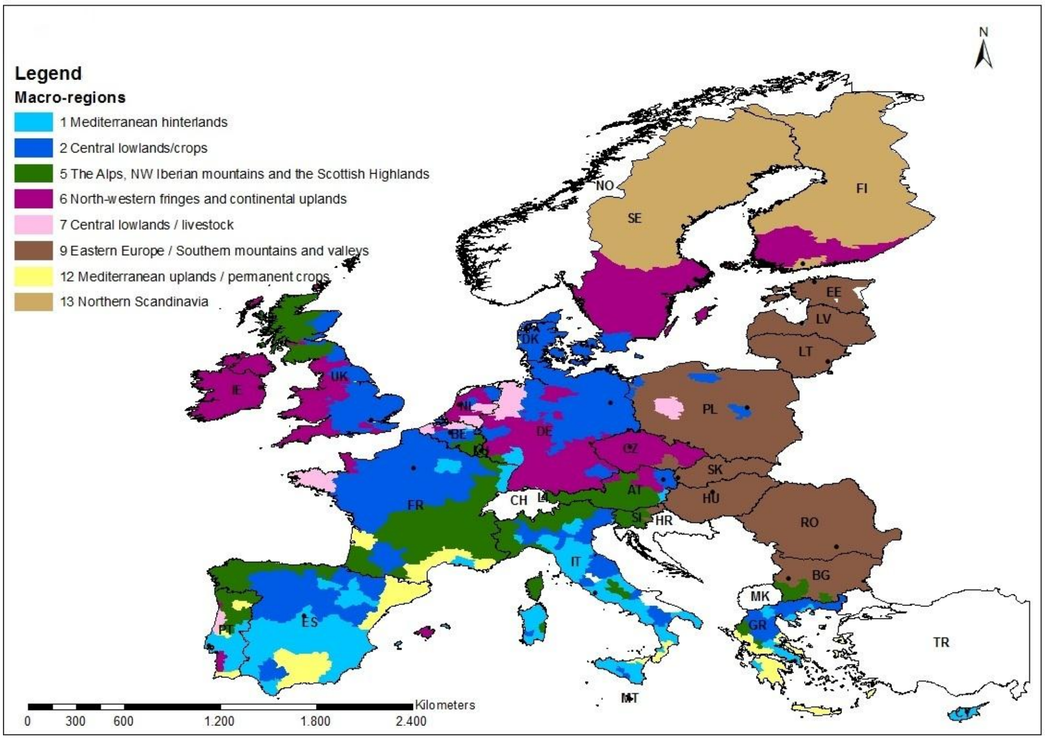

Figure 9 - Macro-regions adopted for choice scenarios

4.1.2. Identifying the macro-regional agri-environmental problems (MRAEPs)

As discussed above, each MR could include different (even contradictory) MRAEP scenarios in terms of the selected PGaEs or opposite directions of change for the same PGaEs. In this case, good practice in CM valuation implies developing two separate CM scenarios for the two different MRAEPs. Only in this way, can the coherence and validity of the valuation exercise be ensured.

Some MR include, in fact, different core dynamic trends causing different PGaE problems, usually at different locations, which is related to heterogeneity of soils, landforms or other factors at a smaller scale inside the MR. For example, in both of the Mediterranean MRs, there are valley areas, with irrigation infrastructure and flatter, better soils, with intensification problems (water quality, intensification-related biodiversity losses), and slope areas with poorer soils, where land abandonment (fires, farmland biodiversity decline, landscape degradation) is instead the major problem. Thus, each MR has been checked to assess whether it includes a single, consistent MRAEP, with a single core dynamic trend (e.g. either farmland abandonment or farmland expansion or agricultural intensification) and a consistent set of related PGaE problems or if, for sake of coherence, this MR should be split into different MRAEPs with a different core dynamic trend associated to each.

This verification has been made based on the PGaE indicators available, which indicate whether their values (e.g. HNVF, cultural landscape, water quality) indicate problems related to intensive agriculture, extensive agriculture or both. If both are present, this is an indication of heterogeneity, which may suggest splitting the MR. Expected future land-use trends from the literature have also been checked to confirm these suggestions. As regards future land-use trends, the Scenar 2020 study has been consulted, in both of its successive versions, about the expected changes in farmland abandonment, land use intensity, and specific land-use transitions (e.g. changes for arable, grassland, and total UAA) to identify expected land-use and intensity trends or, at least, the direction of expected change up to 2020. The need to split a MR into different MRAEP/CM scenarios are only identified in the cases of the Mediterranean hinterlands (MR1) and Mediterranean uplands/permanent crops (MR12). In both cases, the original MR has been split into two MRAEP/CM scenarios: one related to farmland abandonment and the other to agricultural intensification.

This need has been confirmed later on, by checking whether the set of selected PGaE to be valued (Section 4.1.3) are internally coherent among themselves and with the identified core dynamic trend; or whether all selected PGaE could be delivered by independent policy programmes that could be implemented in a consistent way within the same CM scenario/core trend (Section 4.1.4). It is not impossible that other MR – in particular, the Eastern Europe MR – would justify the same treatment. However, our PGaE indicators and the available information on land-use scenarios did not supported this need in other MR. More detailed testing of the MREAP/CM scenarios in the questionnaire building and pre-test phases for the different MRAEPs may collect the required information to proceed to further splits.

With this important caveat in mind, the procedure of checking whether MRs need to be split into different MRAEPs led us to a final list of ten MRAEPs, which is presented in the following table (Table 21).

Table 21 – Final list of macro-regional agri-environmental problems (MRAEP) according to the original MR and core dynamic trend

MRAEP	Original MR	Core dynamic trend / storyline
Farmland abandonment in Mediterranean hinterlands	MR1	Farmland abandonment
Farmland abandonment in Mediterranean uplands/permanent crops	MR12	Farmland abandonment
Agricultural intensification in Mediterranean hinterlands	MR1	Agricultural intensification
Agricultural intensification in Mediterranean uplands/permanent crops	MR12	Agricultural intensification
Agricultural intensification in Eastern Europe	MR 9 and MR10	Agricultural intensification and farmland expansion
Maintenance of intensive agriculture in Central Lowlands Crops	MR2 and MR11	Maintenance of intensive agriculture
Farmland abandonment or decline in the Alps, NW Iberian Mountains and the Scottish Highlands	MR5 and parts of MR3	Farmland abandonment or conversion to forest
Maintenance of intensive agriculture/grazing in North-western fringes and continental uplands	MR6 and parts of MR3	Maintenance of intensive agriculture/grazing
Maintenance of intensive agriculture/livestock in Central lowlands/livestock	MR7	Maintenance of intensive agriculture/livestock
Declining agricultural area in Northern Scandinavia	MR13	Conversion of farmland to forest

4.1.3. Selecting the set of public goods and externalities (PGaE) to be valued in each MRAEP

A particular MRAEP can be characterized according to: (1) types of farming and main (currently delivered) PGaEs; (2) expected direction of future change in land use; and (3) expected effects of such change on PGaE delivery. Within a particular MRAEP, policy options (PGaE-delivering programmes) can be considered which counteract negative PGaE trends or improve the status of particular PGaEs. MRAEPs and PGaE programmes are the crucial elements of our CM scenarios because they provide the required context for the valuation of particular PGaE changes that match the specific context at stake. Coherence, plausibility and understandability of CM scenarios (MRAEP + PGaE programmes) to respondents are essential for the validity and reliability of the valuation results. Achieving these goals requires:

- selecting for valuation only those PGaEs that logically match the MRAEP context and that can be addressed through understandable and plausible policy options (programmes);
- getting information about the respondents' perceptions about those logical matching, understandability and plausibility.

This sub-section and the next one deal with the first bullet point. Later on in this report, it is presented the results of the focus group that are relevant to test whether respondents perceive these scenarios as coherent, plausible and understandable (second bullet point).

We focus next on the selection of the set of PGaE to be valued in each one of the 10 MRAEP/CM scenarios identified in the previous sub-section. This selection builds on three criteria: (1) the current status of the PGaE in the MR according to the available PGaE indicator(s); (2) the core dynamic trend of land use for the next 20 years within the MRAEP, according to the study Scenar 2020, considering three major trends in land use or farming practices (farmland abandonment, agricultural intensification and farmland expansion), and the expected effect of this trend on the PGaE indicator(s); (3) whether there are available policy options (PGaE programmes) with an impact on the PGaE, which can be used to correct negative effects on the PGaE status or improve its status.

As regards the current status of the PGaE in each MR, we used the categories defined in Table 22 to transform the averages of the PGaE indicators in each MR into a more qualitative (but ordinal) scale for assessment purposes. This scale has been defined taking into account the range of MR average values for each PGaE indicator and its respective across-MR average. Using the same categories for all PGaE indicators facilitates the setting of common thresholds for inclusion in the respective MRAEP scenarios. Seven categories are defined for this purpose: very low, low, medium-low, medium, medium-high, high and very high, which are defined for each PGaE indicator in Table 22. In the definition of these categories, the "medium" category has been defined to include the across-MR average of the corresponding PGaE indicator. The remaining categories are defined so as to get, for each PGaE, a balanced distribution of the MR over the different categories, and also to group and separate MR according to the team's accumulated knowledge about overall MR characteristics (gained from previous steps in the methodology). Different approaches have been tested, including statistically based approaches (such as using quartiles or deciles), but taking stock of previous knowledge about MR has revealed to be better than to merely keeping to statistically-driven exercises with no (subjective but experience-based) evaluation of the results' adequacy.

Table 22 – Scale used to assess the MR average of each PGaE

PGaE indicators	Range	Units	Scale						
			Very Low	Low	Medium-Low	Medium	Medium-high	High	Very High
Recreation potential index	0-0.35	(index)	<0.25	0.25- 0.27	0.27-0.29	0.29	0.29-0.31	0.31- 0.33	>0.33
Cultural heritage	0-18	(index)	<5	5- 6.5	6.5- 7.5	7.5- 8	8- 8.5	8.5- 9.5	>9.5
HNVF	0-1	fraction	<0.20	0.20- 0. 25	0.25- 0.29	0.29	0.29-0.35	0.35- 0.50	>0.50
Infiltration	0-124	mm	<10	10- 14	14- 17	17- 20	20-24	24- 30	>30
Irrigated UAA	0-100	%	<1	1-4	4-6	6-7	7-8	8-10	>10
Total N input	0-279	Kg.yr-1.Km-2	<26	26- 30	30- 35	35- 40	40- 45	45 - 55	>55
Soil erosion	0-31.5	Ton.ha-1.yr-1	<2	2- 2.20	2.20- 2.75	2.75 - 3	3 - 5	5- 6	>6
Total NH_3 emissions	0-32	Kg.yr-1.Km-2	<2.5	2.5 - 4	4- 5	5-6	6-7	7-10	>10
Soil carbon content	0-100	%	<3	3-4	4-4.5	4.5-5.5	5.5 – 6.5	6.5 - 10	>10
Total N_2O emissions	0-4	Kg.yr-1.Km-2		<0.75	0.75- 0.85	0.85 – 0.90	0.90- 0.95	0.95- 1	>1
Flooding risk	0-100	%	<0.07	0.07– 0.10	0.10- 0.15	0.15 – 0.17	0.17- 0.20	0.20- 0.23	>0.23
Fire risk	0-100	%	<0.0003	0.0003 – 0.0007	0.0007 – 0.002	0.002- 0.0025	0.0025 – 0.004	0.004- 0.006	>0.006

Tables 23 to 32 present the result of this selection exercise, that is: the **selected set of public goods and externalities (PGaE) to be valued** in each of the 10 MRAEP/CM scenarios. These tables are organized in five columns, where the first lists the PGaEs under consideration in this study. The second presents the current status of each PGaE according to the respective PGaE indicator(s). The third introduces the core dynamic trend for the macro-region, according to the study Scenar2020, and its expected effect on the PGaE indicators. The fourth column checks whether there are available policy options to correct negative effects on PGaEs or to improve them. Finally, the fifth column presents the set of selected PGaEs to be valued in each MRAEP/CM scenario.

When the current value of the PGaE indicator presents a level from medium-high to very high, or low to very-low, it has been considered for selection when:

- the dynamic trend is expected to significantly worsen the condition of the PGaE, and there is a policy option able to counteract this worsening;
- the current status is negative, the dynamic trend is expected not to improve it, and there is a policy option able to improve that negative current status.

Note that the indicator total NO_2 has not been used for PGaE selection given its anomalous and difficult to interpret results. Another remark refers to the cases where the data on the PGaE indicators are available only for 50% or less of the NUTS of the respective MR (Table 19). These situations are signalled by an asterisk (*) in Tables 23-32 and, in these cases, the selection of the PGaE needs to be cautiously considered.

In our first MRAEP – "farmland abandonment in Mediterranean hinterlands" – there is already a land abandonment problem, which is expected to worsen in the near future, especially in the absence of PGaE programmes. This core dynamic trend is associated with the increase of (an already high) fire risk, which will increase the (already high) soil erosion risk. Both landscape cultural services (currently high) and farmland biodiversity (medium-high) would decline as a result of farmland abandonment. There are available counteracting policy options as regards all of these four negative trends, such as public-good payment programmes, which would act in different ways to maintain parts of the farmland component of the current landscape mosaic, preserving the cultural landscape (recreation potential and cultural heritage) and biodiversity values, as well as keeping some resilience to fire and soil erosion (see Table 23). For the specific contents of all of these policy options, see the next sub-section. Climate stability has not ben selected as a PGaE to be valued in this MRAEP because the soil carbon content, although very low, would probably increase with farmland abandonment, and many policy options to improve the soil carbon content are not consistent with those required to prevent land abandonment and improving the status of the other four PGaE.

Table 23 – Farmland abandonment in Mediterranean hinterlands (MR1)

PGaE	PGaE indicators	Core dynamic trend and its effect on PGaE indicators	Available policy options (i.e. PGaE programmes)	Selected PGaE
		Farmland abandonment	e.g. through payments to farmers to maintain current land use	
Landscape (cultural services)	- Very high recreation potential index - **High cultural heritage**	Decrease	Y	X
Biodiversity	- **Medium-high HNVF**	Decrease	Y	X
Water Quality	- Medium-low total N input			
Water Availability	- **Low infiltration** - **Very high irrigated UAA**	Decrease		
Soil Quality	- **High risk of soil erosion**	Increase	Y	X
Air Quality	- Medium-low total NH_3 emissions			
Climate Stability	- **Very low soil carbon content**	Increase		
Resilience to flooding	- Very low flooding risk			
Resilience to fire	- **High fire risk**	Increase	Y	X

The discussion of the next MRAEP, "farmland abandonment in Mediterranean uplands/permanent crops", is very similar, as there is an even more visible farmland abandonment problem, coupled with fire risk increase affecting negatively soil erosion. A policy of public-good payments would also be effective in preventing the expected negative effects of this core dynamic trend on landscape, biodiversity, fire risk and soil erosion. For the same reason, climate stability has also not been selected as a relevant PGaE in this MRAEP (see Table 24).

Table 24 – Farmland abandonment in Mediterranean uplands/permanent crops (MR12)

PGaE	PGaE indicators	Core dynamic trend and its effect on PGaE indicators	Available policy options (i.e. PGaE programmes)	Selected PGaE
		Farmland abandonment	e.g. through payments to farmers to maintain current land use	
Landscape (cultural services)	- Very high recreation potential index - **Very high cultural heritage**	Decrease	Y	X
Biodiversity	- **Very high HNVF**	Decrease	Y	X
Water Quality	- Very low total N input			
Water Availability	- Medium-low infiltration - **Very high irrigated UAA**	Decrease		
Soil Quality	- **Very high risk of soil erosion***	Increase	Y	X
Air Quality	- Low total NH_3 emissions			
Climate Stability	- **Very low soil carbon content**	Increase		
Resilience to flooding	- Very-low flooding risk			
Resilience to fire	- **High fire risk**	Increase	Y	X

Both of the two MRs of Mediterranean Europe exhibit a second MRAEP related to an agricultural intensification trend in some plain irrigated areas, in particular in MR1 (Med. Hinterlands), which implies an increased pressure over water availability in these MR. The core dynamic trend and its effect on PGaEs are, in this case, on the opposite direction of those based on farmland abandonment, and pressure on water availability is expected to grow, together with soil quality problems and climate stability problems related to non-improvement or degradation of soil carbon content, in the absence of PGaE policies. In this case, policy options are available (1) to improve water-use efficiency through changes in irrigation practices, (2) to improve soil quality and carbon sequestration through conservation tillage practices, crop rotations and more grassland cover, and (3) to prevent soil erosion and desertification while improving dry-season water flows through specific conservation works at the watershed level. Water availability, soil quality and climate stability are, therefore, the three PGaEs to be selected for valuation in relation to these two MRAEP (see Tables 25 and 26).

High levels of cultural landscape and farmland biodiversity, as well as fire risk, though representative of the overall MRs as a whole, are not representative of the particularly intensive areas where this MRAEP occurs. Water quality is not a representative problem of the overall MRs but can be locally important. More micro-level good-quality information would be required to support its selection as a PGaE to be valued in these two MRAEP.

Table 25 – Agricultural intensification in Mediterranean hinterlands (MR1)

PGaE	PGaE indicators	Core dynamic trend and its effect on PGaE indicators	Available policy options (i.e. PGaE programmes)	Selected PGaE
		Agricultural intensification	e.g. through payments to farmers to change farming practices	
Landscape (cultural services)	- Very high recreation potential index - **High cultural heritage**			
Biodiversity	- **Medium-high HNVF**			
Water Quality	- Medium-low total N input			
Water Availability	- **Low infiltration** - **Very high irrigated UAA**	Increase	Y	X
Soil Quality	- **High risk of soil erosion**	Increase	Y	X
Air Quality	- Medium-low total NH_3 emissions			
Climate Stability	- **Very low soil carbon content**	Decrease	Y	X
Resilience to flooding	- Very low flooding risk			
Resilience to fire	- **High fire risk**			

Table 26 – Agricultural intensification in Mediterranean uplands/ permanent crops (MR12)

PGaE	PGaE indicators	Core dynamic trend and its effect on PGaE indicators	Available policy options (i.e. PGaE programmes)	Selected PGaE
		Agricultural intensification	e.g. through payments to farmers to change farming practices	
Landscape (cultural services)	- Very high recreation potential index - **Very high cultural heritage**			
Biodiversity	- **Very high HNVF**			
Water Quality	- Very low total N input			
Water Availability	- Medium-low infiltration - **Very high irrigated UAA**	Increase	Y	X
Soil Quality	- **Very high risk of soil erosion***	Increase	Y	X
Air Quality	- Low total NH_3 emissions			
Climate Stability	- **Very low soil carbon content**	Decrease	Y	X
Resilience to flooding	- Very-low flooding risk			
Resilience to fire	- **High fire risk**			

The MRAEP "agricultural intensification in Eastern Europe" includes, as discussed above, both MRs of Eastern Europe, which are merged, because, according to the available data, the current status of PGaE indicators, as well as the core dynamic trends in land use/farming intensity are similar for these MRs.

The study Scenar 2020 foresees agricultural intensification, with expansion of both arable land and grasslands. This trend will negatively affect the cultural landscape, farmland biodiversity, water quality, and climate stability. Policy options to change farming practices through both incentives and regulation are available to counteract these negative effects – e.g. fertilizer taxes or regulations on fertilizer and manure levels; improvements to tillage practices, rotation requirements and permanent grassland protection rules, as well as specific soil conservation practices to restore soil carbon and prevent carbon emissions; some specific areas could be set aside for conservation, which would allow keeping natural vegetation, extensive agriculture and current levels of biodiversity, as well as the cultural landscape. Table 27 identifies the selected set of PGaE for this MRAEP.

Table 27 – Agricultural intensification in Eastern Europe (MR 9 & MR10)

PGaE	PGaE indicators	Core dynamic trend and its effect on PGaE indicators	Available policy options (i.e. PGaE programmes)	Selected PGaE
		Agricultural intensification or farmland expansion	e.g. through payments to farmers to change farming practices	
Landscape (cultural services)	- Medium-low recreation potential index - **Low value for cultural heritage**	Decrease	Y	X
Biodiversity	- **Medium-high HNVF**	Decrease	Y	X
Water Quality	- Low total N input*	Increase	Y	X
Water Availability	- Very low infiltration - Low irrigated UAA			
Soil Quality	- Medium-low soil erosion			
Air Quality	- Low total NH_3 emissions*			
Climate Stability	- **Low soil carbon content**	Decrease	Y	X
Resilience to flooding	- Very low flooding risk			
Resilience to fire	- Very low fire risk			

The MRAEP "maintenance of intensive agriculture in Central Lowlands/ crops" is related to an already negative condition of the PGaEs biodiversity, water quality and availability, air quality and climate stability, which are probably going to worsen or at least not to improve, given the current core dynamic trend (see Table 28). With most of the land occupied by intensive agriculture, policy options exist to improve the current situation or avoid its degradation. For example programmes based on reducing the total N input, through taxes or regulations on fertilizer and manure levels, or improved efficiency of fertilizer use; water use efficiency can also be improved; small patches of indigenous vegetation could be promoted through set-aside schemes in appropriate places, to create mosaic heterogeneity and improve habitat conditions; tillage practices could be improved, rotations and land use (more grassland) changed to increase soil carbon content (climate stability). Manure and fertilizer management can also be improved to reduce air pollution and greenhouse-gas emissions. Resilience to fire is not considered for selection because the medium-high fire risk level is simply related to data shortcomings (come from a minority of NUTS for which data is available). Selected PGaEs for valuation in this MRAEP are identified in Table 28.

Table 28 – Maintenance of intensive agriculture in Central Lowlands/ Crops (MR2 and MR 11)

PGaE	PGaE indicators	Core dynamic trend and its effect on PGaE indicators Maintenance of intensive agriculture	Available policy options (i.e. PGaE programmes) e.g. through payments to farmers to change farming practices	Selected PGaE
Landscape (cultural services)	- Very low recreation potential index - Medium value for cultural heritage			
Biodiversity	- **Very low HNVF**	Decrease	Y	X
Water Quality	- **Very high total N input**	Increase	Y	X
Water Availability	- Medium-low infiltration - **Very high irrigated UAA**	Increase	Y	X
Soil Quality	- Medium risk soil erosion			
Air Quality	- **Medium-high total NH_3 emissions**	Increase	Y	X
Climate Stability	- **Low soil carbon content**	Decrease	Y	X
Resilience to flooding	- Medium flooding risk			
Resilience to fire	- Medium-high fire risk*			

A core dynamic trend of farmland abandonment or conversion to forest characterized the MRAEP "farmland abandonment or decline in the Alps, NW Iberian Mountains and the Scottish Highlands". This trend will negatively affect the (currently very good) status of the PGaEs cultural landscape and biodiversity, as well as the (currently not so good) status of soil quality (erosion) and resilience to fire. There are several policy options to mitigate such negative effects through payment programmes for the corresponding public goods targeted to landscape cultural values, mosaic heterogeneity, fire resilience and specific soil conservation practices. A caveat is justified here which is related to the heterogeneity of this MR, with most of the fire related problems occurring in its Mediterranean part (Iberian mountains) and not so much is truly alpine areas or the Scottish Highlands. Selected PGaEs for valuation in this MRAEP are identified in Table 29.

Table 29 – Farmland abandonment or decline in the Alps, NW Iberian Mountains and the Scottish Highlands (MR5 and parts of MR3)

PGaE	PGaE indicators	Core dynamic trend and its effect on PGaE indicators Farmland abandonment or conversion to forest	Available policy options (i.e. PGaE programmes) e.g. through payments to farmers to maintain current land use	Selected PGaE
Landscape (cultural services)	- High potential for recreation potential index - **Very high cultural heritage**	Decrease	Y	X
Biodiversity	- **Very high HNVF**	Decrease	Y	X
Water Quality	- Low total N input			
Water Availability	- **Very high value for infiltration** - Medium-high irrigated UAA			
Soil Quality	- **Very high soil erosion**	Increase	Y	X
Air Quality	- Medium total NH_3 emissions			
Climate Stability	- **Medium-high soil carbon content**	Increase		
Resilience to flooding	- Medium-low flooding risk			
Resilience to fire	- **Very high fire risk***	Increase	Y	X

In the North-western fringes and continental uplands, the core dynamic trend is the maintenance of intensive agriculture/grazing, which will, at least, keep high the (currently too high) total N input and total NH_3 emission levels, and will worsen the cultural landscape and biodiversity PGaE. Flood risk is currently very high, and is not predicted to improve given the core dynamic trend. Policy options are available to solve these problems. Reducing the (livestock related) total input of N and the NH3 emissions and improving manure and fertilizer management could be achieved through taxes or regulations on fertilizer and manure levels, as well as stocking rates. The resilience to floods could be increased by creating patches of indigenous vegetation in appropriate places. Set aside land (or hedgerows/woodlots) with appropriate locations could create mosaic heterogeneity, improve habitat conditions and landscape values too. The selected PGaEs to be valued in this MRAEP are identified in

Table 30.

Table 30 – Maintenance of intensive agriculture/grazing in North-western fringes and continental uplands (MR6 and parts of MR3)

PGaE	PGaE indicators	Core dynamic trend and its effect on PGaE indicators Maintenance of intensive agriculture/grazing	Available policy options (i.e. PGaE programmes) e.g. through payments to farmers to change farming practices	Selected PGaE
Landscape (cultural services)	- Low potential for recreation potential index - Medium value for cultural heritage	Decrease	Y	X
Biodiversity	- Medium-low HNVF	Decrease	Y	X
Water Quality	- **Very high total N input**	Increase	Y	X
Water Availability	- **High infiltration** - Low irrigated UAA			
Soil Quality	- Low risk soil erosion			
Air Quality	- **High total NH_3 emissions**	Increase	Y	X
Climate Stability	- **High soil carbon content**			
Resilience to flooding	- **Very high flooding risk**	Increase	Y	X
Resilience to fire	- Medium-low fire risk*			

In the Central lowlands/livestock MR, there are problems related to the currently bad conditions of the PGaEs biodiversity, water quality, air quality and resilience to flooding, which are going to worsen, or at least not improve, given the core dynamic trend for the maintenance of highly intensive agriculture/livestock production systems. Policy options are available that might be effective in this case, through incentives or regulations, aimed at creating patches of indigenous vegetation in appropriate places to create mosaic heterogeneity, improve habitat conditions and flood resilience; or through reducing stocking rates, total N inputs and NH_3 emissions. Resilience to fire is not considered for selection because the high fire risk level is due to data shortcomings. The set of selected PGaE to be valued in this MRAEP is identified in Table 31.

Table 31 – Maintenance of intensive agriculture/livestock in Central Lowlands/ livestock (MR7)

PGaE	PGaE indicators	Core dynamic trend and its effect on PGaE indicators Maintenance of intensive agriculture/livestock	Available policy options (i.e. PGaE programmes) e.g. through payments to farmers to change farming practices	Selected PGaE
Landscape (cultural services)	- Very low recreation potential index - **Low value for cultural heritage**			
Biodiversity	- **Very low HNVF**	Decrease	Y	X
Water Quality	- **Very high total N input**	Increase	Y	X
Water Availability	- Medium-low infiltration - Very high irrigated UAA*			
Soil Quality	- Very low risk soil erosion			
Air Quality	- **Very high total NH_3 emissions**	Increase	Y	X
Climate Stability	- Medium soil carbon content			
Resilience to flooding	- **High flooding risk**	Increase	Y	X
Resilience to fire	- High fire risk*			

In the Northern Scandinavia MR, agricultural area only represents 8% of total area and there is a core dynamic trend for the decline of remaining farmland through conversion into forest, with a risk of agricultural (open) area disappearance in many areas. This trend will have an impact in cultural landscape, as well as rich farmland biodiversity. Though the cultural landscape PGaE indicator exhibits a very low level, there is evidence of high values Nordic people place on keeping the remaining open areas and avoiding its shift to closed forests (Drake, 1992), and so we keep this PGaE as relevant for valuation in this MR. The very high carbon content of some waterlogged pasture soils could be reduced under forest use due to higher evapo-transpiration of high forest cover. Policy options, such as public payments, are available to conserve open areas, HNVF areas or wet grasslands, and avoid their conversion to forest. The selected PGaEs to be valued in this MRAEP are identified in Table 32.

Table 32 – Declining agricultural area in Northern Scandinavia (MR13)

PGaE	PGaE indicators	Core dynamic trend and its effect on PGaE indicators Farmland area decline / conversion to forest	Available policy options (i.e. PGaE programmes) e.g. through payments to farmers to maintain current land use	Selected PGaE
Landscape (cultural services)	- Medium recreation potential index - **Very low for cultural heritage**	Decrease	Y	X
Biodiversity	- **High HNVF**	Decrease	Y	X
Water Quality	- Very low total N input			
Water Availability	- **High infiltration** - Very low irrigated UAA			
Soil Quality	- Very low soil erosion			
Air Quality	- Very low total NH_3 emissions			
Climate Stability	- **Very high soil carbon content**	Decrease	Y	X
Resilience to flooding	- Very low flooding risk			
Resilience to fire	- Low fire risk			

4.1.4. Defining the policy programmes that would deliver selected PGaEs

As discussed above, the CM scenarios to be tested later on in this report for one specific MRAEP – Farmland abandonment in Mediterranean uplands include the description of the available policy options (PGaE programmes) to compensate for the negative effects on PGaE resulting from core dynamic trends in each MRAEP or to promote positive change in particular PGaEs.

Each PGaE programme has been designed for this purpose so as to be as targeted as possible to a specific PGaE (which implies avoiding, as much as possible, joint-production issues across programmes in the same scenario), so that each PGaE can be separately valued. Whether programmes are actually perceived by respondents as separately deliverable is a matter for focus groups to be held for all MRAEP before deriving the final versions of the corresponding questionnaires. This report exemplifies, in a later section, the method to be followed to test questionnaires with respect to one single MRAEP (farmland abandonment in Mediterranean uplands).

PGaE programmes are to be valued against a policy-off (business-as-usual or do-nothing) scenario, where, in the absence of payments by respondents, the particular PGaE is expected to follow the policy-off (core dynamic) trend.

For each MRAEP, particular PGaE programmes have been built for this purpose, according to the abovementioned criteria. These programmes complete the valuation scenario for each MRAEP. Tables 33 to 40 present these PGaE programmes for all the MRAEPs (the two Mediterranean MRs are “merged” for presentation purposes in the first two tables).

Table 33 – PGaE programmes delivering the selected PGaEs in MRAEPs Farmland abandonment in Mediterranean hinterlands (MR1), and Mediterranean uplands/permanent crops (MR12)

PGaE	Commitments for farmers	Benefits for society
Landscape (cultural services)	Keep the traditional crops in production; Adopt an environmentally friendly farming style	Conservation of cultural heritage; High quality foods; Traditional landscape available for recreation purposes.
Biodiversity	Conserve the habitats of threatened animal and plant species; Adopt an environmentally friendly farming style.	Knowing that threatened fauna and flora are preserved; Using these wildlife-rich areas for recreation.
Soil quality	Maintaining terraces in high slopes; Keeping the soil covered with vegetation and avoiding soil ploughing.	Ensuring soil fertility and soil capacity to support the landscape and biodiversity.
Resilience to fire	Cleaning scrub growth; Keeping the farmed elements in the landscape mosaic to create barriers to fire progression.	Avoid damage to people and goods; Avoid air pollution and the emission of greenhouse gases.

Table 34 – PGaE programmes delivering the selected PGaEs in MRAEPs Agricultural intensification in Mediterranean hinterlands (MR1), and Mediterranean uplands/permanent crops (MR12)

PGaE	Commitments for farmers	Benefits for society
Water availability	Adoption of water-efficient irrigation techniques; Shift to less-water-demanding crops.	Decreased pressure on water availability and lower competition with non-agricultural water uses; Increased dry-season water flows for recreation and habitat.
Soil quality	Conservation tillage, crop rotations and higher grassland cover; Specific conservation landscape planning (contour strips, terraces).	Conserving soil fertility and prevention of desertification; Reducing off-site impacts of soil erosion (dam filling; river system and habitat degradation).
Climate stability	Conservation tillage; Increased grassland cover.	Reducing net greenhouse-gas emissions; Carbon sequestration.

Note: it is suggested to test in focus groups whether soil quality and climate stability programmes are perceived as sufficiently separable in production.

Table 35 – PGaE programmes delivering the selected PGaEs in MRAEP Agricultural intensification in Eastern Europe (MR 9 and MR10)

PGaE	Commitments for farmers	Benefits for society
Landscape (cultural services)	Conserve cultural landscape elements, e.g. field boundaries, walls or buildings;	Conservation of cultural heritage; Traditional landscape available for recreation purposes.
Biodiversity	Set aside semi-natural areas as habitat for wildlife in a context of agricultural expansion and intensification; Keep some extensive agricultural uses, such as permanent grassland from conversion into more intensive uses.	Knowing that threatened fauna and flora are preserved; Using these wildlife-rich areas for recreation.
Water quality	Adopting good practices for fertilizer and manure management; Keeping some less intensive uses such as grassland.	Preventing degradation of water quality.
Climate stability	Conservation tillage; Limits to grassland conversion into arable.	Reducing net greenhouse-gas emissions; Keeping as much as possible sequestrated carbon, or promoting additional sequestration.

Note: it is suggested to test in focus groups whether the different programmes are perceived as sufficiently separable in production.

Table 36 – PGaE programmes delivering the selected PGaEs in MRAEP Maintenance of intensive agriculture in Central Lowlands/ Crops (MR2 and MR 11)

PGaE	Commitments for farmers	Benefits for society
Biodiversity	Set aside land to create patches of semi-natural vegetation, mosaic heterogeneity and habitat conditions; Adopt environmentally friendly farming styles related to pesticide and fertiliser use.	Restoring the conservation status of fauna and flora species at the landscape scale in intensively farmed areas.
Water quality	Adopting good practices for fertilizer and manure management; Better nutrient management through crop rotations; Adopting integrated protection practices.	Improving water quality.
Water availability	Adoption of water-efficient irrigation techniques; Shift to less-water-demanding crops.	Decreased pressure on water availability and lower competition with non-agricultural water uses.
Air quality	Improving the storage and management of manure.	Reduced emissions of ammonia and better air quality.
Climate stability	Conservation tillage; Increased grassland cover; Better management of fertiliser and manure.	Reduced net greenhouse-gas emissions; Carbon sequestration.

Note: it is suggested to test in focus groups whether the different programmes are perceived as sufficiently separable in production.

Table 37 – PGaE programmes delivering the selected PGaEs in MRAEP Farmland abandonment or decline in the Alps, NW Iberian Mountains and the Scottish Highlands (MR5 and parts of MR3)

PGaE	Commitments for farmers	Benefits for society
Landscape (cultural services)	Keep the traditional livestock/grassland systems; Conserve traditional landscape elements (buildings, terraces, dry stonewalls).	Conservation of cultural heritage; High quality foods; Traditional landscape available for recreation purposes.
Biodiversity	Conserve the semi-natural low-intensity systems that provide habitat for threatened animal and plant species; Preventing the abandonment or conversion to forest of valuable farmland habitats.	Knowing that threatened fauna and flora are preserved; Using these wildlife-rich areas for recreation.
Soil quality	Maintaining grassland and terraces in high slopes; Keeping the soil covered with vegetation, and avoiding soil ploughing.	Ensuring soil fertility and soil capacity to support the landscape and biodiversity.
Resilience to fire	Cleaning scrub growth; Keeping the farmed elements in the landscape mosaic to create barriers to fire progression.	Avoid damage to people and goods; Avoid air pollution and the emission of greenhouse gases.

Note: it is suggested to test in focus groups whether the different programmes are perceived as sufficiently separable in production.

Table 38 – PGaE programmes delivering the selected PGaEs in MRAEP Maintenance of intensive agriculture/grazing in North-western fringes and continental uplands (MR6 and parts of MR3)

PGaE	Commitments for farmers	Benefits for society
Landscape (cultural services)	Conserve cultural landscape elements, e.g. hedgerows, woodlots, field borders, walls or buildings; Improving degraded landscape elements, e.g. hedgerows.	Conservation of cultural heritage; Traditional landscape available for recreation purposes.
Biodiversity	Set aside land to promote patches of semi-natural vegetation, mosaic heterogeneity and habitat conditions; Adopt environmentally friendly farming/grazing styles related to fertiliser use and stocking rates.	Restoring the conservation status of fauna and flora species at the landscape scale in intensively farmed/grazed areas.
Water quality	Adopting good practices for fertilizer and manure management; Reduce stocking rates in critical watershed areas.	Improving water quality.
Air quality	Improving the storage and management of manure.	Reduced emissions of ammonia and better air quality.
Resilience to flooding	Set aside land for grassy and woody vegetation in crucial places of the watershed to promote water infiltration and reduce the speed of water flow.	Reduce the frequency and intensity of flooding as well as the total area affected by floods; Avoid damage to people and goods.

Note: it is suggested to test in focus groups whether the different programmes are perceived as sufficiently separable in production.

Table 39 – PGaE programmes delivering the selected PGaEs in MRAEP Maintenance of intensive agriculture/livestock in Central Lowlands/ livestock (MR7)

PGaE	Commitments for farmers	Benefits for society
Biodiversity	Set aside land to promote patches of semi-natural vegetation, mosaic heterogeneity and habitat conditions; Adopt environmentally friendly farming/grazing styles related to fertiliser use and stocking rates.	Restoring the conservation status of fauna and flora species at the landscape scale in intensively farmed/grazed areas.
Water quality	Adopting good practices for fertilizer and manure management; Reduce stocking rates in critical watershed areas.	Improving water quality.
Air quality	Improving the storage and management of manure.	Reduced emissions of ammonia and better air quality.
Resilience to flooding	Set aside land for grassy and woody vegetation in crucial places of the watershed to promote water infiltration and reduce the speed of water flow.	Reduce the frequency and intensity of flooding as well as the total area affected by floods; Avoid damage to people and goods.

Note: it is suggested to test in focus groups whether the different programmes are perceived as sufficiently separable in production.

Table 40 – PGaE programmes delivering the selected PGaEs in MRAEP Declining agricultural area in Northern Scandinavia (MR13)

PGaE	Commitments for farmers	Benefits for society
Landscape (cultural services)	Keep open farmland areas in the midst of essentially forested landscapes; Keep an environmentally friendly farming style.	Conservation of valued open farmland and preventing the homogenization /closing of forested landscapes; Open landscapes available for recreation purposes.
Biodiversity	Conserve the habitats of threatened farmland species; Keep an environmentally friendly farming style.	Knowing that threatened farmland-dependent fauna and flora are preserved; Using these wildlife-rich areas for recreation.
Climate stability	Conserving wet grasslands as well as other carbon-rich soils.	Managing and storage of important stocks of soil carbon.

Note: it is suggested to test in focus groups whether the different programmes are perceived as sufficiently separable in production.

4.2. Options for the Choice Experiment design

The valuation framework developed in the previous Chapter and in section 4.1 of this chapter selected Choice Modelling (CM) as the appropriate valuation technique for gathering data to estimate the individuals' WTP for the relevant PGaE of agriculture in each MRAEP (the sets of relevant PGaE in each MRAEP are presented in the section 4.1). The motivations for selecting the CM approach is explained in the section 3.2. Here we highlight this technique's ability to deliver estimates for the marginal value of each one of the PGaE included in the different choice sets used for each MRAEP.

The design of choice modelling experiments entails a series of decisions related to the selection of the attributes do be included in the choice scenarios and the way to describe them to respondents in valuation surveys.

The development of the choice scenarios' outline unfolds into four main steps. First, the attributes to be valued, i.e., the PGaE, need to be selected. A second step consists of specifying the selected attributes and their (qualitative or quantitative) levels; this implies deciding how the attributes are described and in which levels they are presented to the respondents in the surveys. The third step is to establish a baseline choice alternative. This can be the current situation regarding the supply of the diverse PGaE (*status quo*), or a future scenario (e.g. a policy-off trend). The fourth step entails the selection of the price attribute, its configuration (e.g. taxes increases or a new tax) and its respective levels.

To assist our decisions as regards the abovementioned issues, guidance has been taken from the literature and through advice by valuation experts.

4.2.1. Literature review on the design of choice experiments to value multiple PGaE

Complementarily to the extensive literature review carried out on section 2.4, a special review of those studies that employed CM to value multiple PGaE is conducted. A number of cases is available in the literature, such as Jianjun *et al.* (2013), Goibov *et al.* (2012), Grammatikopoulou *et al.* (2012), Rodríguez-Entrena *et al*., 2012, Dominguez and Solino (2011), Hasundo *et al.* (2011), Hubber *et al.* (2011), Baskaran *et al.* (2009), Borresh *et al.* (2009), Arriaza *et al.* (2008), Colombo and Hanley (2008), Wang *et al.* (2007), Campbell *et al.* (2006 and 2007), Kallas *et al.* (2006), Takastuka *et al.* (2006), Colombo *et al.* (2005) and MacDonald and Morison (2005).These studies were analysed mainly as regards the number of attributes, their respective levels and the way attributes were conveyed to survey respondents, as well as the payment vehicle chosen to convey the price attribute.

Diverse sets of PGaE have been valued in different valuation contexts, mainly outside Europe, where the framing problems had mostly a local/regional level. A diversity of options has been found in respect to the specification of attributes (continuous or discrete) and their levels (number of levels and respective description).

Jianjun *et al.* (2013) valued a set of PGaE including landscape and soil quality, identified as landscape, land fertility and land facilities, for the local population in Wenling city, China. PGaE were described using alike attributes. Landscape is characterized by the amenity values of cultivated land protection, land fertility by the productive values of cultivated land protection, and land facilities by the level of infrastructures made available by the government, such as roads and water irrigation systems. These attribute levels were depicted by photos.

Goibov *et al.* (2012) valued farmer's preferences for landscape, biodiversity, water quality and social public goods (rural employment) in Konibodom region, Tajikistan. The attributes used were: agricultural land use pattern prioritization, water quality (i.e. nitrate contamination), number of trees per hectare, number of workers in agriculture and loss in number of species. Attributes and levels were built on four alternatives of land management and described with qualitative information.

Grammatikopoulou *et al.* (2012) worked within a municipality-level case study (resident population), in southern Finland, to value a set of PGaE comprising landscape, biodiversity, water quality and social public goods (rural economy). The attributes were described in terms of the proportion of uncultivated land, number of plant species, grazing animals, water protection zones and the condition of production buildings. Attributes and their quantitative levels were explained through text reading.

Rodríguez-Entrena *et al*., (2012) valued a bundle of PGaE consisting of climate stability, soil quality and biodiversity. The attributes were specified as CO_2 sequestration, erosion prevention and biodiversity increase related to different agricultural management systems and support from agri-environmental programmes. The surveyed population were resident people in the region of Andalusia in Spain.

Dominguez and Solino (2011) valued a set of PGaE including biodiversity, landscape, fire resilience and social public goods, related to rural development support programmes in the mountainous region of Cantabria, Spain. The attributes were: endangered wildlife, rural landscape, risk of forest fires, quality of life in rural areas and monuments and traditions at the villages. Attribute levels were conveyed in both formats, qualitatively (almost all of them) or quantitatively (in the case of fire risk, which is presented as the percentage of forest area with high/low fire risk). Residents in the Cantabria region were the surveyed population.

Hasundo *et al.* (2011) valued the public goods biodiversity, landscape and socio-cultural aspects for the Swedish population (through a large-scale mail survey). The selected attributes were: wood fences, stone walls, headlands, ditches, field roads, field islets, cultivation (stone) cairns, ponds, field barns, pollards, cultural heritage, biodiversity, visibility, type of grassland, own consumption, red species list, the surrounding landscape and the size of the grassland, how much grazing, mowing and vegetation, overgrowth by brushwood or thickets, cultivation measures and management. The attribute levels were mostly conveyed through presence/absent or less/more qualitative levels.

Hubber *et al.* (2011) measured preferences of cantonal politicians for future agricultural land-use scenarios in a rural region of the Swiss lowlands (Canton Aargau). Landscape, biodiversity and air quality were the PGaE included in this study. The attributes used were: percentage of arable land for human nutrition, percentage of ecological compensation areas for biodiversity conservation, reduction of environmentally harmful emissions (methane and nitrogen) and additional share of forest area on agricultural surface. Attributes were described by photos with numerical information about the attribute levels (percentage).

Baskaran *et al.* (2009) valued a set of PGaE associated with the pastoral farms in this country by surveying the New Zeeland population (mail survey). Included PGaE were air quality, water quality, water quantity and scenic landscape. Selected attributes were: methane emissions, nitrate leaching, water use for irrigation and scenic view. The attributes and levels were explained by text, quantitatively using variations in percentage.

Borresh *et al.* (2009) valued a set of PGaE including landscape, biodiversity and water quality in the Wetterau region in Germany in a survey of both the urban population of Friedberg and the people living in the smaller and more rural town of Rockenberg, in Germany. The attributes used were: plant biodiversity (absolute number of plants investigated per km^2), animal biodiversity (percentage of desired population of eleven indicator bird species), water quality (water quality measured as nitrate concentration) and landscape aesthetics (landscape options). The attribute levels were mostly described through absolute numbers, except for biodiversity which is described as the percentage of desirable population. The different scenarios considered for landscape scenery were visualized using maps and photos.

Arriaza *et al.* (2008) used a survey of the (resident) population of the Andalusia region, Spain, to value a set of PGaE related to the farming system of mountain olive groves in Andalusia (Southern Spain), comprising landscape, biodiversity, soil quality and social public goods, such as food safety and rural population/depopulation. The attributes used were: percentage of other fruit trees in the mountain areas, rate of soil erosion, amount of pesticide residuals in the food and percentage of abandoned farms in relation to a policy-off situation. The description of attribute is supported by photos and numerical information on attribute levels (percentage variations for all and absolute values for soil erosion).

Colombo and Hanley (2008) valued landscapes as a set of attributes in four English regions containing Severely Disadvantaged Areas (SDA). The selected attributes were heather moorland and bog, rough grassland, mixed and broadleaved woodland, field boundaries and cultural heritage. These attributes were described through photos and numerical information on attribute levels. The residents in same region were the surveyed population.

Wang *et al.* (2007) valued a set of PGaE including climate stability, landscape, water quality and biodiversity delivered by the Loess Plateau region of North West China in a survey of both the local population and the metropolitan population of Beijing, China. The attributes used were sandstorm days per year, vegetation cover, annual sediment discharge and plant species present, all referred to future scenarios for 2020. The attributes and levels were quantitatively conveyed using absolute figures.

Campbell *et al.* (2006) valued landscapes described by the following attributes: wildlife habitats, rivers and lakes, hedgerows, pastures, mountain land, stonewalls, farmyard tidiness and cultural heritage, in a survey of the Irish population. The attributes and their levels were presented through photo-realistic simulations. In 2007, Campbell conducted a follow up valuation study, including only a subset of the previous attributes: mountain land, stonewalls, farmyard tidiness and cultural heritage. In this case, the attributes were described through photos and numerical information was used to convey attribute levels.

Kallas *et al.* (2006) valued mainly socio-economic public goods (rural economy, maintaining population in rural areas and food safety), while including an environmental PG, maintaining biodiversity for the benefit of local resident population (Tierra de Campos, Spain). The attributes used were: full-time employees in the agricultural sector, percentage of farmers living in the municipality where the farm is located, waste due to management of farming systems and number of endangered species. The attributes were presented through photos and numerical information (absolute figures) for the attribute levels, except the food safety where levels were qualitative (conventional, integrated or organic farm production).

Takastuka *et al.* (2006) valued a set of PGaE comprising climate stability, water quality, soil quality and landscape for the New Zealand population. The attributes were greenhouse gas emissions, nitrate leaching, soil quality and scenic views. Attributes and levels were qualitatively described in text form.

Colombo *et al.* (2005) valued a set of PGaE including landscape, water quality, biodiversity and rural economy for the locally resident population at the Genil and Guadajoz watershed areas (in Southern Spain). The attributes were: landscape change (desertification of the semiarid areas), superficial and ground water quality, flora and fauna quality and jobs created. Attributes and levels were explained by text, qualitatively (almost all attributes) or quantitatively (in the case of the 'jobs created' attribute).

MacDonald and Morison (2005) valued the landscape of a rural area in Adelaide (Australia) as a bundle of attributes for South Australian population. The attributes were scrublands, grassy woodlands and wetlands, and were described using photos and numerical information about the attribute levels.

Table 35 (available at the end of this Section) presents a sum up of public goods and externalities valued and their specification in terms of attributes, their respective levels and the way the attributes were conveyed in the surveys.

The payment vehicles used included annual payments to the regional council responsible for the management of the environment over the next five years (Dominguez and Solino, 2011; Baskaran *et al.*, 2009; Borresh *et al.*, 2009; Wang *et al.*, 2007 and Takastuka *et al.*, 2006), a levy on income tax (Hasundo *et al.*, 2011, Arriaza *et al.*, 2008; Campbell *et al.* 2006; Kallas *et al.*, 2006; MacDonald and Morison 2005), green-payments (Hubber *et al.*, 2011), extra tax (Colombo *et al.*, 2005), increase in overall taxes (Rodríguez-Entrena *et al*., 2012; Colombo and Hanley, 2008) and a monthly charge levied on each household (Jianjun *et al.*, 2013; Goibov *et al.*, 2012).

In almost all of the studies, the baseline is the current state (business-as-usual or status quo scenario), except: Wang *et al.* (2007), who choose a pre-program (policy-off) status quo; Colombo *et al.* (2005), who used the situation in 50 years if nothing would have been done to reduce the current high erosion rate (policy-off situation), and Dominguez and Solino (2011), who employed either the status quo as perceived by the respondents or a pre-defined one.

The usual number of choice alternatives in each choice card is three, the exception being Borresh *et al* (2009) and Goibov *et al*. (2012), who have used choice sets with four alternatives.

Some studies used focus groups (Jianjun *et al.*, 2013; Goibov *et al.*, 2012; Grammatikopoulou *et al.* 2012; Dominguez and Solino, 2011; Hasundo *et al.* 2011; Arriaza *et al.*, 2008; Campbell *et al.*, 2007; Wang *et al.*, 2007; Campbell *et al*, 2006; Kallas *et al*, 2006). Pilot surveys were reported by Jianjun *et al.*, 2013; Rodríguez-Entrena *et al*., 2012; Dominguez and Solino, 2011; Hasundo *et al.* 2011; Baskaran *et al.*, 2009; Takastuka *et al.*, 2006. Some authors highlighted the resort to personal interviews (Borresh *et al.*, 2009), experts consultancy (Dominguez and Solino, 2011; Colombo *et al.*, 2005) or informal interviews to common citizens (Colombo *et al.*, 2005).

The set of reviewed studies, while spread across different geographical and cultural contexts, highlights that the agricultural dynamics underlying the choice scenarios are of fundamentally two types: (a) farmland abandonment or (b) intensive use, while worldwide other farmland trends are also relevant, such as the land-use change due to urbanization pressures. Therefore, sets of PGaE similar to the ones selected for our MRAEP can be found. Landscape and biodiversity are generally included in all choice scenarios. Water quality is rather common, while other PGaE, such as soil quality, water availability, air quality, climate stability, fire and flooding resilience are not so often considered (as stated in the former section 2.4). In addition, a relevant number of studies included social public goods, such as rural areas vitality (population and rural culture) and job creation.

The specification of the PGaE through attributes, often distinguishes a different number of aspects for the same public good, in particular for landscape and biodiversity. This is related to the fact that most of the studies value public goods supplied at local/region scale, which leads to more detailed descriptions.

On the other hand, attribute levels are usually specified by quantitative levels. Nevertheless, qualitative levels are often used. The choice appears to be dictated by the available information, which is often limited and leads to adoption of broadly defined attributes. A mix of quantitative and qualitative levels is often used, apparently reflecting, again, the available information. Offering the attributes in qualitative levels addresses changes in their quality, while the quantitative levels correspond to changes in the quantity offered. Therefore, the best choice depended on what is changing quality and/or quantity. Nonetheless, quantitative levels even when available are often difficult to communicate to the people in the surveys (e.g. soil erosion presented as $Ton.ha^{-1}.yr^{-1}$ or air quality loss in terms of pollution quantity $Kg.yr^{-1}.Km^{-2}$)

4.2.2. Experts consultancy on the design of choice experiments for valuing multiple PGaE

The consultation of valuation experts was expected to be organised in a focus group format. However, this was not feasible due to difficulties in joining experts in one same location, given the short time period available[8] for this task. The alternative was to conduct an individual-basis consultancy using a mixed mode approach: (1) first, experts were sent an e-mail asking them to read a presentation letter on the project, a description of the sets of PGaE to be valued through a large-scale survey, and a questionnaire they should answer about options for survey design; (2) second, a personal or phone/Skype talk was arranged, when possible, in order to assist/discuss with the experts their reply to the questionnaire.

Annex IV presents the questionnaire that has been sent, by e-mail, to a group of 10 valuation experts with experience with the CM approach. We got only four replies, one of them followed by a personal talk (Nick Hanley at the University of Stirling, UK); in the other cases, the discussion with the team has been done by phone/Skype talk (Ian Bateman, University of East Anglia, UK; Maria Loureiro, University of Santiago de Compostela, Spain, and Pere Riera, Autonomous University of Barcelona, Spain).

The expert survey comprised six topics concerning the main options to be made in the design of the choice scenarios for the valuation of the selected PGaE for the different MRAEP; these options included the (1) number of attributes in each choice scenario; (2) type of attributes (continuous, discrete, mixed); (3) attribute levels; (4) the baseline choice alternative; (5) methodology and options to select and specify the payment vehicle; and, (6) experimental design to select the choice sets.

The questionnaire included an introduction to each one of the topics as well as possible answers. Experts could pick one of the responses offered or choose to give a different one. Whatever the case, an explanation to the answer given/chosen was asked.

The expert's recommendations were relatively similar and we can sum up them, through the following highlights:

- Use focus groups or other qualitative research formats to assist the selection of attributes.
- Select a small number of attributes, a maximum of four to five non-monetary attributes; if larger sets of attributes needed to be included, a split design (and surveys) should be used.
- Select attribute levels accounting for reference values, i.e., comparative to other future policy scenarios within the same MRAEP, and, when possible, take account of the fact that people might lose both quantity and quality of certain PGaE in the policy-off situation.
- Settle baseline as convenient, depending on how the policy-on and policy-off situations were specified.
- Use focus groups or pilot surveys to support the selection of the payment vehicle.
- Test the payment levels for the different countries included in the large-scale survey, and differentiate it accordingly if relevant differences were found in the people's WTP.
- Select choice sets from the universe of all possible choice alternatives using an efficient design[9].

[8] The fact that this consultation had to be carried during a vacations/busy academic-time with conferences and meetings attendance, the months of June-July, rendered it impossible to schedule meetings with experts within the focus group format.

[9] Efficient design allows for the selection of a small number of choice sets, through statistical techniques that make the selection in order to decrease as much as possible the errors associated with the model estimates. Further these designs can be specified to allow the estimation of interactions among attributes. It is worth citing Carson and Louviere (2009): "*It is also all too easy to construct and implement designs that do not statistically identify the parameters of interest or that greatly diminish the precision of the estimates relative to what could have been achieved*

These recommendations have been followed as far as possible in the design of the pilot survey, which is reported in the next section.

with an efficient design. The underlying statistical theory for generic choice experiments is now wellunderstood, and there is little justification for choosing and using the poor quality designs that appear all too often in the current literature".

Table 41 – Sum up of the literature review on valuing multiple PGaE using CM approach

Public Goods and Externalities		Attributes		Levels	Choice alternatives' design	Source
Landscape	Cultural landscape	Cultural heritage		Less/more		Hasundo *et al*. 2011
		Cultural heritage		No action/ Some action/A lot of action	Image manipulation software was used to prepare photo-realistic simulations, Photos describing the attributes with numerical information for the attributes' levels	Campbell *et al*. 2006 Campbell *et al*. 2007
		Cultural heritage		Rapid decline/no change/much better conservation	Photos describing the attributes with numerical information for the attributes' levels	Colombo & Hanley, 2008
	Aesthetical landscape/ land use	Scenic views		No change/30% more trees, hedges, plantations	Attributes and levels explained by text, qualitatively	Baskaran *et al*. 2009
		Landscape		Current landscape/A better amenity	Photos	Jianjun *et al*. 2013
		Landscape aesthetics		Recent landscape aesthetics/multifunctionality scenario/grassland dominated scenario/intensify scenario (with increased field sizes)/high price scenario (with increasing percentage of cereals)	The different scenarios of the landscape scenery considered were visualized using maps and photos.	Borresch *et al*. 2009
		Landscape		No change/ more variety (more trees, hedgerows and birds and a greater variety of crops on cropping farm's)	Attributes and levels explained by text, qualitatively	Takatsuka *et al*. 2006
		Landscape		10%/20%/30%/40%	Attributes and levels explained by text, quantitatively	Wang *et al*. 2007
		Landscape change: desertification of the semiarid areas		Degradation/Small improvement/Improvement	Attributes and levels explained by text, qualitatively or quantitatively	Colombo *et al*. 2005
		Additional share of forest area on agricultural surface		0%; 7%; 15%	Photos describing the attributes with numerical information for the attributes' levels	Huber *et al*. 2011
		Rural landscape		Deterioration of forest and grassland landscape/Recovery and conservation of forest landscape/Recovery and conservation of grassland landscape/Recovery and conservation of forest and grassland landscape	Attributes and levels explained by text, qualitatively or quantitatively	Dominguez & Solino 2011
		Land cover pattern	Scrublands, Grassy woodlands Wetlands	66,000 ha; 73,000 ha; 80,000 ha; 90.000ha 46,000 ha; 51,000 ha; 56,000 ha; 63,000 ha 73,000 ha; 81,000 ha; 88,000 ha; 99,000 ha	Photos describing the attributes with numerical information for the attributes' levels	Macdonald & Morison 2005
		Agricultural land use pattern prioritization Number of trees per hectare		Current; Equal allocation of land for cotton and fruits; Domination of fruits and vegetables only; Domination of cotton only No increase; 10% increase; 5 % increase	Attributes and levels explained by text, qualitatively	Goibov *et al*. 2012
		Uncultivated land Grazing animals		10%; 5%; 0% No animals; horses; horses and cattle	Attributes and levels explained by text, quantitatively	Grammatikopoulou *et al*. 2012
Landscape + biodiversity		Visual quality of landscapes and preservation of biodiversity		0%/10%/20%	Photos describing the attributes with numerical information for the attributes' levels	Arriaza *et al*. 2008
Biodiversity		Plant biodiversity		205 plants/km2; 170 plants/km2; 190 plants/ km2; 225 plants/km2; 255 plants/km2	The different scenarios of the landscape scenery considered were visualized using maps and photos.	Borresch *et al*. 2009
		Animal biodiversity		70% of desired population/50% of desired population/80% of desired population/90% of desired population/100% of desired population		
		Maintaining biodiversity		21 species/15 species/9 species	Photos describing the attributes with numerical information for the attributes' levels	Kallas *et al*. 2006
		Biodiversity		1600 species/1900 species/ 2200species/2400 species	Attributes and levels explained by text, quantitatively	Wang *et al*. 2007
		Percentage of ecological compensation areas for biodiversity		0%/7%/14%	Photos describing the attributes with numerical information for the attributes' levels	Huber et al 2011

	conservation			
Biodiversity	Biodiversity	Less/more		Hasundo *et al*. 2011
	Flora and fauna quality	Poor/Medium/Good	Attributes and levels explained by text, qualitatively or quantitatively	Colombo *et al*. 2005
	Endangered wildlife	Loss of endangered species in mountain and coastal areas/Recovery and conservation of endangered species in mountain areas/Recovery and conservation of endangered species in coastal areas/Recovery and conservation of endangered species in mountain and coastal areas	Attributes and levels explained by text, qualitatively or quantitatively	Dominguez & Solino 2011
	Loss in number of species	No increase; 10% increase; 5 % increase	Attributes and levels explained by text, qualitatively	Goibov *et al*. 2012
	Number of plant species	3; 5; 10	Attributes and levels explained by text, quantitatively	Grammatikopoulou *et al*. 2012
	Average number of different bird species per hectare	status quo: 10 moderate improvement: 15 significant improvement: 20	Attributes and levels explained by text, quantitatively	Rodríguez-Entrena *et al*. 2012
Water quality	Nitrate leaching	No change/10% reduction/30% reduction	Attributes and levels explained by text, qualitatively	Baskaran *et al*. 2009
	Content of nitrate per litre	Less than 10mg nitrate/l; 10-25mg; 25-50mg; 50-90mg; more than 90mg	The different scenarios of the landscape scenery considered were visualized using maps and photos.	Borresch *et al*. 2009
	Nitrate leaching	No change/ small reduction (20% reduction in nitrate leaching to streams)/ big reduction (50% reduction in nitrate leaching	Attributes and levels explained by text, qualitatively	Takatsuka *et al*. 2006
	Billion tons of annual sediment discharge	100% / 10% less/ 15% less/ 25% less	Attributes and levels explained by text, quantitatively	Wang *et al*. 2007
	Superficial and underground water quality	Low/ Medium/ High	Attributes and levels explained by text, qualitatively or quantitatively	Colombo *et al*. 2005
	Nitrate contamination	10-25 mg/l; 55-75mg/l; > 75mg/l	Attributes and levels explained by text, qualitatively	Goibov *et al*. 2012
	Water protection zones	7m width and mowed; 15m width and mowed; 15m width and natural	Attributes and levels explained by text, quantitatively	Grammatikopoulou *et al*. 2012
Water availability	Water Use for Irrigation	No change/10% reduction/30% reduction	Attributes and levels explained by text, qualitatively	Baskaran *et al*. 2009
Soil quality	Prevention of soil erosion	13 ton/ha/year; 5 ton/ha/year; 1 ton/ha/year	Photos describing the attributes with numerical information for the attributes' levels	Arriaza *et al*. 2008
	Soil erosion in olive grove surface equivalent to…	status quo: 30 Olympic stadiums moderate improvement: 16 Olympic stadiums significant improvement: 2 Olympic stadiums	Attributes and levels explained by text, quantitatively	Rodríguez-Entrena *et al*. 2012
	Soil quality	No change/ small change (soil organic matter and structure are retained over 25 years)	Attributes and levels explained by text, qualitatively	Takatsuka *et al*. 2006
	Fertility	Current fertility/better land fertility	Photos	Jianjun *et al*. 2013
Air quality	Reduction of environmentally harmful emissions (methane and nitrogen)	0%; 10%; 20%	Photos describing the attributes with numerical information for the attributes' levels	Huber *et al*. 2011
Climate stability	Methane emissions	No change/10% reduction/30% reduction	Attributes and levels explained by text, qualitatively	Baskaran *et al*. 2009
	Greenhouse gas emissions	No change/ small reduction (20% reduction in nitrate leaching to streams)/ big reduction (50% reduction in nitrate leaching	Attributes and levels explained by text, qualitatively	Takatsuka *et al*. 2006
	Sandstorm days per year	22; 20; 18; 16	Attributes and levels explained by text, quantitatively	Wang *et al*. 2007
	Carbon sequestration (emission reduction equivalent to a city with … inhabitants)	status quo: 300 000 inhabitants moderate improvement: 500 000 inhabitants significant improvement: 700 000 inhabitants	Attributes and levels explained by text, quantitatively	Rodríguez-Entrena *et al*. 2012

Fire resilience	Risk of forest fires	75% forest surface high risk; 25% forest surface low risk/50% forest surface high risk; 50% forest surface low risk	Attributes and levels explained by text, qualitatively or quantitatively	Dominguez & Solino al. 2011

4.3. Designing and testing the survey at pilot scale

The complete design and testing of the questionnaire has been conducted only for one of the macro-regional agri-environmental problem (MRAEP). The selected MRAEP is the “farmland abandonment in the Mediterranean uplands”. The team decision has been to work with a familiar region, and one also enabling to implement the pilot survey within the face-to-face administration mode, in Portugal, given that this represented an opportunity to fully supervise the tasks assigned to a research market and field studies company. These tasks encompassed the qualitative studies, two focus groups, and the administration of the pilot survey. In between, a pre-test of the questionnaire has been directly administrated by the team using research fellows working at the UTAD to whom proper training has been delivered.

This section reports on the diverse steps carried out to prepare and implement the questionnaire up to the pilot survey.

4.3.1. Qualitative studies

Following the recommendations on good-practice guidelines for the stated preference (SP) methods implementation (see e.g. SEPA, 2006; Söderqvist and Soutukorva, 2009; Riera *et al*., 2012a; Riera *et al*., 2012b), which have been reiterated by the consulted experts, the focus group technique has been used to assist the design of choice scenarios for the pilot survey. The focus-groups approach consists in getting together a small number of people (8-12) that must be as homogenous as possible regarding their socioeconomic characteristics, especially the ones judged to affect the individual’s opinions, attitudes and preferences regarding the issue under discussion. In this case the general aims of the focus groups were to check whether (and how much) common people knew agro-ecological diversity across the EU and how the MRAEP of farmland abandonment in Mediterranean Europe, in particular, should be described and presented in order to create understandable, relevant and plausible choice situations.

Two focus groups were carried out. They were prepared by the team and implemented with a leading Portuguese company on market research and field studies. The company selected the participants and implemented the meetings. A first group met on the 18th October 2012 and a second one was held on the 22nd October 2012. Both groups included medium-high education persons, from both genders, and living in the metropolitan area of Lisbon. The two groups were differentiated according to people’s age. This differentiation has been decided based on the expectation that, by joining people with different ages, the group would not be homogeneous as regards people’s reactions to the topics under discussion, namely biodiversity. Education towards nature and biodiversity is recent in Portugal, and thus younger people tend to have a better knowledge and to be more concerned about biodiversity when compared to older people with a similar education level.

In both groups participants were individuals in charge of the household expenditures; one of the groups included younger persons, with ages between 29 and 39 years old; the second group had individuals with ages varying between 46 and 57 years old.

The focus group conduction was similar in both groups and unfolds into three parts, which comprised six main steps.

The first part addressed the previous knowledge and awareness of people on the macro-regions and respective agri-environmental problems at the UE scale. It encompasses the two first steps of the focus groups. The second part comprised a series of tasks and discussions to gather qualitative information to help in the design of the choice scenarios for the pilot survey. Three main steps can be distinguished, addressing the fundamental pieces of the choice scenarios: describing the choice context, selecting and describing the attributes, and finally specifying the price attribute (the payment). The final (sixth) step of the focus group collected participants' opinions regarding the quality and interest of the visual material they were requested to watch along the previous steps of the meeting.

The first step checked the individual's knowledge and awareness about the different macro-regions (MR) delimitated by our methodological framework, as shown in the map presented in the Figure 10. Participants were requested, through a group exercise, to associate (non labelled) photographs depicting typical views of the different MR with the particular MR names as they are presented in the map legend. A set of 16 photographs was shown, including two photos for each one of the eight MR.

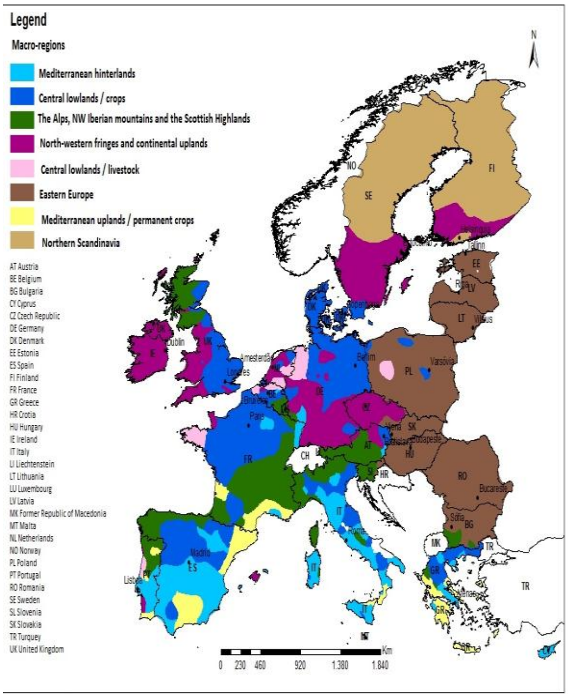

Figure 10 – Map of the macro-regions (translated to English)

Following the identification of the MR, the participants were asked (again as a group exercise) to relate each one of the eight MR in the map to one of two major agri-environmental dynamic trends: (1) "farmland abandonment"; or (2) "agricultural intensification or expansion".

In the second part of the focus groups, the tasks requested from the participants differed slightly between the two groups. Information gathered in the first meeting was incorporated into the script for the second focus group in order to achieve an understandable description of the attributes to be included in the choice scenarios and to improve the realism and acceptability of the choice context description.

In the first focus group, the participants were involved in a spontaneously driven discussion, intended to identify and rank environmental problems and/or consequences of the farmland abandonment that is occurring in Mediterranean Europe MR.

Agri-environmental problems identified by the participants included: increased wildfire risk, soil erosion, air pollution (related to wildfires), urbanisation of agricultural land, fauna and flora loss, and decreasing quality of the landscape. There was convergence between the participants' spontaneous selection of problems and the set of PGaE selected in section 4.1. The exception was the problem of farmland urbanisation. Nevertheless, the participants saw this problem as a consequence of land being abandoned (the trend) and so available for other uses. This problem was not a relevant attribute for choice scenarios described in section 4.1, as these only comprise changes in the provision levels of environmental goods and services related to agri-environmental policy-on and policy-off states.

Regarding the relative importance of the PGaE that were identified by this first group of participants, wildfire risk increase was placed in the top position, followed by the urban development of farmland. Soil erosion and air pollution were perceived as closely related to the wildfires. Landscape quality was not seen as an environmental problem, but more as a socio-economic issue. On the other hand, some of the participants in this first group (younger group) tended to view farmland abandonment as beneficial to biodiversity preservation, and to hold a dichotomous vision between biodiversity preservation and human action. These views anticipated difficulties in conveying farmland biodiversity trends to the respondents in the pilot survey, and thus particular attention needed to be devoted to finding the best way to do it.

The second group (the older one) was presented with the set of selected PGaE as described in section 4.1. The discussion undertook by the participants in this group showed that the set of selected PGaE was found understandable and plausible. Regarding the relative importance of the different PGaE, participants classified wildfire risk as the most severe problem, followed by soil erosion and biodiversity (defined as diversity and disappearance of fauna and flora species), and, at last, the decline of typical landscape.

The information gathered with the focus groups showed that participants knew something about dominant farmland uses and farming systems in terms of agricultural intensity, and that they were able to relate this knowledge with some of the EU macro-regions. However, they had little knowledge about the agricultural landscape of the more distant and less familiar macro-regions, such as Eastern Europe, Northern Scandinavian and the North-Western Fringes.

This distance pattern in the ability of individuals to identify the macro-regions has repeated, as expected, with their ability to relate the different macro-regions with the two major land use dynamic trends. Accordingly, Central Lowlands Crops and Central Lowlands/Livestock were correctly related to the intensification trend, as well as the Mediterranean Uplands with farmland abandonment. For the cases of Alps and Mountains, Eastern Europe, North-Western Fringes and Northern Scandinavia, only some of the participants seemed able to do the right match. Different weights were assigned by different participants to attributes such as landforms, mechanisation, landscape organisation and development level of the countries when they were dealing with unfamiliar regions, what has led to divergent matches. On the other hand, participants tended to associate more extensive landscapes, namely grazing areas, with good environmental practices supported by the EU agri-environmental policies.

In addition, a relevant finding resulting from this matching exercise (macro-region with agricultural dynamic trend), confirmed along the group discussions, was that the participants consensually matched farmland abandonment with Mediterranean uplands, while that was not so clear in respect to Mediterranean hinterlands, often matched with the intensification trend. But, even when they did not relate this dynamic trend with this macro-region, they found this as a macro region in a positive state, and blame the EU agricultural policy for hindering Portuguese (and European) farmers to produce more in this MR.

These group discussions highlighted an important insight for the specification of the attributes in the choice scenarios: the fact that individuals perceived farmland abandonment and the resulting vegetation succession as a dynamic process where intermediate stages are seen as unstable situations. This outcome indicates that attributes defining farmland abandonment MRAEP appear to be better specified using only quantity levels related to the extreme quality levels, corresponding respectively to the “initial” and “final” stages of the land abandonment process: cultivated land vs. abandoned landscape.

The discussion of issues related to the selection of the payment vehicle and its levels raised generalised protest behaviour, mainly due to the coincidence of the focus groups with the heated public protest held in Portugal at that time (October, 2012) about huge tax raises launched by the then fresh proposals for the State budget for 2013, presented in October of 2012. Consequently, the participants in the focus groups were not able to reach a consensus regarding the best payment vehicle, although the payment through general taxes appeared more consensual among the younger participants, whilst some of the participants of the older group also considered a food tax as a fair payment vehicle, given that everybody would pay, and so all could pay less (on a per capita basis).

The most useful insights of the focus groups for the design of choice scenarios are highlighted in the next six bullets.

- Delimitation of the macro-regions was plausible to the participants.
- EU agri-environmental policy is related with a good environmental status of agricultural landscapes.
- Mediterranean Uplands MR was consensually related to the farmland abandonment trend.
- Participants would like to see more production in the Mediterranean Hinterlands, and think current agricultural policy is hindering that.
- Farmland biodiversity, expressed by the diversity and presence of endangered species, (the HNVF areas), has revealed to be difficult to convey to participants.
- Specification of the attributes conveying the PGaE for the MRAEP “farmland abandonment” should exclude intermediate (quality) levels, judged as unstable and transient by respondents.

4.3.2. Design of the questionnaire

Face-to-face survey mode remains so far the favoured format for valuation surveys. The NOAA Panel recommend it in the nineties (Arrow *et al*., 1993) and, in spite of its high costs, it continues to be the most popular survey administration mode among the researchers applying SP methods. Mail surveys face the problem of low response rate and telephonic interviews do not allow showing images or presenting choice cards (Bateman *et al*., 2002). The latter mode also experienced, in the later years, decreasing response rates and problems of coverage bias as a consequence of the expansion of individual cell phones and other advanced technological multi-task devices (Dilman *et al*., 2009). Mixed-modes, combining face-to-face interviews with mail or telephonic contact or interviewing, have been experimented in SP surveys with relative success (e.g. González-Cabán *et al*., 2007).

More recently, due to the lower cost and increasing access and use of the internet at the household level, web-based surveys started to be adopted in valuation surveys, while mostly within the CVM (Canavari *et al*., 2005; Marta *et al*., 2007; Olsen, 2009; Nielsen, 2011; Lindhjem and Navrud, 2011). Few studies have compared the results of internet SP surveys with the face-to-face format (e.g. Nielsen, 2011; Lindhjem and Navrud, 2011). For the time being, internet surveys still face a considerable distrust regarding data quality mainly due to their potential for large coverage bias. Nevertheless, there are many practical advantages of internet surveys, such as low cost, convenience and fast delivery.

Our decision was to carry out the pilot survey within two alternative administration modes: face-to-face and panel-based internet (on-line) surveys. To assure data comparability, an electronic questionnaire was developed allowing for computer-assisted personal interviewing (CAPI) in the face-to-face interviews.

CAPI presents basically the same quality control advantages as CATI (computer assisted telephone interviewing), allowing for a high standardisation level which is demanded by a quantitative survey (Lavrakas, 1998). Although the CAPI format does not avoid the social desirability bias[10] (see e.g. DeMaio, 1984; Green and Tunstall, 1999; Lindhjem and Navrud, 2011; Nielsen, 2011), due to the presence of the interviewer, it is less prone to this bias, given that the respondent is focused on the technical device (e.g. tablet) presenting the questionnaire and has less interaction with the interviewer in comparison with paper-based face-to-face surveys.

The questionnaire developed in this study unfolds into three major parts (it is available in English in Annex V). The first part includes a small set of questions addressing the familiarity and experience of the respondent with the Mediterranean uplands MR and the viewing of a map showing the delimitation of this macro-region, to which some pictures of well-known areas (in different countries) in this MR were added (see Figure 11).

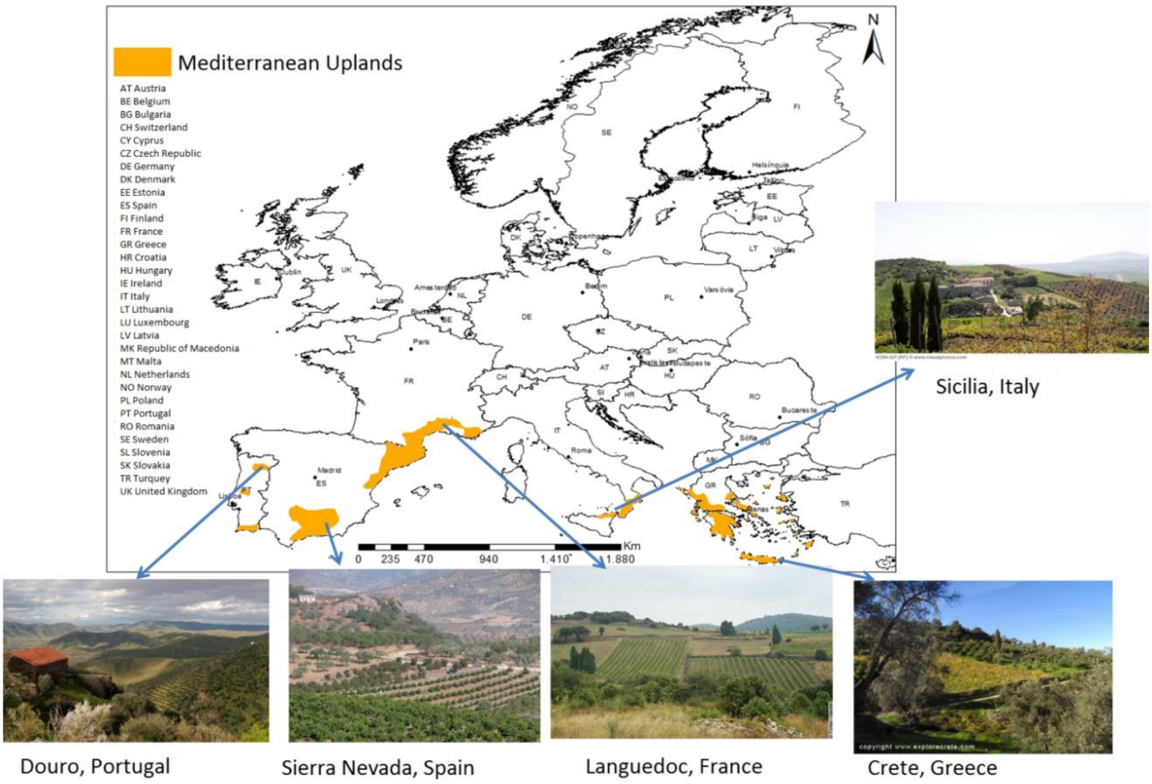

Figure 11 – Delimitation of Mediterranean Upland macro-region including views of sites in this MR

[10] The social desirability bias happens when the respondent answers in a way he or she thinks that pleases the interviewer. That might bias true response, the one that would be given by the respondent if he or she self-responded to the survey (e.g. by mail or internet).

The second part of the questionnaire comprises the choice-experiment and follow-up questions. The third part includes the questions to collect socioeconomic data on the respondent and respective household.

The choice experiment starts with the description of the choice context, followed by the introduction of the attributes and respective levels. After attributes are explained to the respondents, they are requested to accomplish the choice tasks. Finally, they are asked about their choice decisions with a set of follow-up questions.

Choice scenarios are described through the following two steps.

First, the choice context is introduced, and then the choice scenarios are explained, comprising the attributes description, their baseline and reference levels and the payment vehicle.

To facilitate the conveying of the choice context, given that usually respondents get bored with long readings, a video was set up with a description of the MRAEP "farmland abandonment in Mediterranean upland MR". The video comprises four takes, as described in the next bullets.

- First the Mediterranean upland MR is introduced to the respondents through the visualisation of a map showing its geographical delimitation together with photos at some reference points (as presented in the Figure 11).
- Next, the video displays a view[11] with the main components of the mosaic landscape characterising this MR, described in terms of the selected public goods: (a) the flora and fauna diversity and the presence of functional and endangered species (farmland biodiversity) and (b) the cultural landscape.
- The third take shows again the same view, but now with some highlights of the benefits for people resulting from the provision of the: (a) preservation of endangered species; (b) local high-quality foodstuffs; (c) opportunities for leisure and recreation; and, (d) the heritage dimension of cultural landscape.
- The last view in the video shows the degradation of the mosaic landscape resulting from the farmland abandonment, displaying the expansion of scrubland, the presence of burned areas, and the dereliction of stone walls and rural buildings, highlighting the increased wildfire and soil erosion risks, as well as the loss of farmland biodiversity and cultural landscape aspects.

After the choice context description, through the video display, the attributes are introduced and described. They correspond to the four selected PGaE for the farmland abandonment MRAEP: cultural landscape, farmland biodiversity, soil quality, and fire resilience, which would be delivered through EU programmes (policy-on level) assuring the provision of these PGaE through contracts with the farmers and landowners that would supply them in alternative to farmland abandonment (the policy-off level).

The selected PGaE and their benefits to respondents would be supplied through these programmes as independent in production. Therefore, all of the possible combinations of the four public-goods programmes (and the corresponding bundles of environmental and cultural benefits) were assumed to be possible.

Figure 12 shows the presentation of public-goods programmes, highlighting, on one hand, the farmer's commitments to supply the service and, on the other hand, the benefits society derives from them.

[11] The views shown by the video were obtained, through manipulation image techniques, from an original, and recently took, photograph of the Douro region (Portugal).

The different PGaE are supplied through these public-goods programmes, which act as the attributes for the choices. These programmes also help to standardise the quantities being offered. This option, allows overcoming the problem found in the pre-test to the survey: some respondents misunderstood the concept of quantity of the service delivered, for instance when 100% fire risk prevention was delivered, some understood that they would have zero wildfires.

Landscape Conservation 		**Erosion Control** 	
Farmers' commitment:	**Society's benefits:**	**Farmers' commitment:**	**Society's benefits:**
Maintain production of traditional crops Practice an environmental friendly agriculture	Safeguard the cultural heritage Enjoy high quality and tasty products Enjoy the traditional countryside for recreation and leisure	Keep terraces on steep sloped terrain Keep the soil covered with vegetation and avoid ploughing	Ensure soil fertility Ensure the soil's ability to support landscape and biodiversity

Biodiversity Conservation 		**Fire risk reduction** 	
Farmers' commitment:	**Society's benefits:**	**Farmers' commitment:**	**Society's benefits:**
Maintain the habitats for endangered fauna and flora Practice an environmental friendly agriculture	Preserve animal and plant species from extinction Enjoy nature for recreation and leisure	Bushes' removal Keep crops as barriers to the progression of fires	Ensuring the integrity of people and goods Avoid air pollution and emissions of greenhouse gases

Figure 12 – Programmes delivering the selected public goods

The option for quantitative levels, instead of qualitative, was dictated by the difficulty in conveying meaningful "quantities" of the quality of the services to the respondents. Firstly, because the indicators for the selected PGaE were only available in relative quantitative measurements, such as indexes and percentages, the soil erosion being the exception, because it was expressed in absolute values, but still difficult to convey to respondents (as shown by Table 22). Secondly, while they were converted into a qualitative scale (see Table 23), its use was difficult for the MRAEP "farmland abandonment" because people did not found plausible the stable delivery of intermediate quality states. Hence, the option to use only the initial and final (quality) stages, lead us to opt for quantitative (area) levels.

To ensure that attribute levels are understandable, the programme packages for the services quantity (area) provision was adopted, because it makes it clearer how much quantity was being offered, the maximum being the current level (*status quo*). Increasing the quantity beyond the current situation was technically possible, but not realistic to the respondents, at least considering the qualitative information gathered through the focus groups discussions. Increases beyond the current level might be realistic, as discussed above, for other land-use dynamic trends, such as intensive agriculture in other MRAEP.

To sum up, the policy-on situation corresponds to the quantity level represented by the current situation (basically the maintenance of the policies, while targeted to promote the public goods supply) and the policy-off level corresponds to the farmland abandonment situation.

To allow for variation in the delivered quantity, the alternatives of applying the public-goods programmes in only an half of the area currently occupied by the mosaic agricultural landscape in the

Mediterranean Uplands, or in the overall such area, were offered to respondents. Other percentages were possible to convey in a realistic way, yet more interviews would be needed. Given that testing the valuation framework at a pilot scale was essential to assess its feasibility, we choose to adopt a simpler frame for the PGaE delivery levels. It consisted on settling the non-monetary attributes levels based on two criteria: (1) to offer a different number of programmes (attributes), from just one to the whole four; and (2) to offer the programmes for 100% or only for 50% of the agricultural area (threatened by land abandonment) of the MR (see Table 42). Offering the PGaE for different quantity levels expressed in terms of the occupied area allows for gathering the individuals WTP for the different PGaE per hectare.

Table 42 – Non-monetary attribute levels

Attribute	%area benefited	%area benefited	%area benefited
Cultural landscape	0%	50%	100%
Farmland biodiversity	0%	50%	100%
Soil quality	0%	50%	100%
Fire resilience	0%	50%	100%

The payment vehicle was defined as a tax increase, generally described. It was told to the respondents that the implementation of the programmes and the supply of the public goods entailed a cost for them (their households) in the form of a tax increase, which could be an increase in income tax and/or the creation of indirect taxes, over products or visitants. This overall tax increase over individual income has been used by other authors (e.g. Colombo and Hanley, 2008).

The tax increase was specified as an annual pre-defined amount to be paid by the household during a period of five years. Such time period was chosen to match the duration of payments to farmers, ensured by five-year contracts. Several authors valuing multiple PGaE (e.g. Takastuka *et al*., 2006, Wang *et al.*, 2007, Baskaran *et al.*, 2009; Borresh *et al.*, 2009) had also opted for this time span for the price attribute, building on the supply-side contracts duration.

The option for the payments at the household level was driven by the fact that they made clearer the budgetary restriction for the respondents, which is, in general, managed at the household level.

The levels for the price attribute were firstly established with an ad hoc procedure, using as guideline a very rough estimate of the average amount the EU taxpayers currently pay to fund the CAP, which is around 40 euros per household[12]. This amount was settled as the maximum bid for the set of bids tested in the pre-test survey. The bid set tested in the pre-test survey included the following amounts: 2, 5, 10, 20 and 40 euros.

The pre-test was conducted in a closed-end elicitation format because, given that were available referential values, such as the total contribution of the EU households for the common agricultural policy (CAP), which represents the bulk of the EU overall budget. This elicitation format allowed for gathering prior information on the estimates for the attribute's coefficients. This was fundamental to adopt an efficient design for the pilot survey. The evidence that this type of experimental design allows for quality estimates with relatively small samples, combined with its flexibility regarding the estimation of interaction between attributes, lead us to elect it for the pilot survey.

[12] CAP expenditure was at around 50 billion Euro in 2010 (see e.g. http://ec.europa.eu/agriculture/cap-post-2013/graphs/graph1_en.pdf). With 500 million inhabitants in the EU27, this makes around 100 Euros per capita for the overall CAP expenditure. To translate this to a per household expenditure, we took an average household for our expected survey of a little more than 2 individuals per household, which established our rough estimate at around 40 Euros per household.

Experimental design techniques were mandatory use, because the combination of the four non-monetary attributes with two levels together with the four levels for the price originated 256 possible choice alternatives and 4096 possible choice sets. An efficient design was adopted (see e.g. Hensher *et al*., 2005; Rose and Bliemer, 2009). Efficient designs aim to minimise standard errors of parameter estimates. To get this aim, prior information on the estimates for the attribute's coefficients are needed.

To the pre-test survey an efficient design was obtained with Ngene software (version 1.1.1). It has been assumed a MNL model specification, assuming zeros as priors[13] of the estimates of the PGaE coefficients. The experimental design finally selected, comprised 20 choice sets, which were randomly assigned to four blocks of five choice sets. Consequently, experimental design options entailed four questionnaire versions, each presenting five choice situations to each respondent.

After the description of the choice context and presentation of the choice scenarios, the respondent was requested to undertake the choice task. This consisted in the respondent choosing of his/her preferred alternative from a set of three alternatives, one of them constant across choice sets.

The constant alternative always represented the policy-off scenario, where the programmes to provide the public goods were not implemented – a situation that did not entailed extra-costs to the respondent. Thereafter, this alternative represented the baseline level of the valued variation, and the respondents were indirectly asked about their WTP (Euros) to avoid the negative change in the provision level of the selected public goods (policy-on scenario). These latter policy-on scenarios, build on the current situation, the status quo, while comprising the possibility of implementing only partially (50%) the public goods programmes, thus allowing, in principle, to obtain the individuals (or households) WTP per hectare.

The choice cards presented to the respondents allowed for trade-offs between the attributes (packaged in the public goods programmes) offered at different levels, thus raising the likelihood of estimating the respective interaction effects.

An example of a choice set is showed at the Figure 13.

Programs providing services …	No application	Option A	Option B
 **Landscape conservation**	0 %	0 %	100 %
 **Biodiversity conservation**	0 %	100 %	0 %
 **Soil erosion control**	0 %	50 %	50 %
 **Fire risk reduction**	0 %	100 %	0 %
Increase in taxes or fees (annually for 5 years)	0 €	3 €	21 €

Figure 13 – Example of a choice set showed in the pilot survey

A verbal description of each choice card was given by the interviewer in the case of face-to-face survey.

Each respondent faced five choice situations, meaning that has choosing his/her preferred alternative from different five choice sets.

After the choice tasks, the respondents were asked a group of three follow-up questions. The first addressed to check if the respondent exhibits some pattern of lexicographic choice, for instance by ignoring one or more attributes in a systematic manner. This type question allows for assessing the

[13]The literature review on the valuation of multiple public goods, presented in the section 4.2.1, was not helpful to provide indicative values for the estimates of the MNL model parameters.

attribute non-attendance bias (Scarpa *et al*., 2009). A second follow-up questions group intend to collect information on possible joint demand of attributes, which have been offered as separately offered services. The final group of follow-up questions collects the motivations for protest answers, as well as motives for willingness-to-pay.

4.3.3. Pre-test of the questionnaire

Pre-testing the questionnaire is a mandatory step in the preparation of quantitative surveys. Further, in this case, information was needed on the range of prices people were willing to pay. The pre-test was administrated to a random sample of individuals selected at their homes through a random-route procedure. Three middle-class neighbourhoods of Lisbon metropolitan area were previously selected to conduct the survey. Interviews were conducted during a period of three days (31st October and 1-2 November, 2012). The questionnaire was administrated face-to-face, but not in the CAPI format, a paper-based questionnaire was used with some show-cards.

A total of 30 valid interviews were obtained delivering 150 choice observations. No-response was around 30%, mainly due to refusal to answer motivated by justifications not related with the survey topic. These include refusing to answer surveys in general, lack of time and refuse to participate in surveys by principle and related motivations. From the contacted households who accepted answering the survey, only six respondents resulted in invalid answers, because they refused to proceed after the introduction of the topic of the need for tax payment.

The pre-test indicates the questionnaire was well accepted and understood by the interviewed. The difficulties experienced by some respondents respected four main issues:

- The concept of biodiversity that was not clearly known for some of the respondents.
- The non-monetary attribute levels were, in some cases, misunderstood, meaning that some individuals perceived they would have 100% of preserved farmland biodiversity, instead of the actual offer of maintaining its current level in 100% or 50% of the region.
- Some respondents jointly valued some attributes (e.g. farmland biodiversity and fire risk prevention, meaning that they perceive that avoiding fires ensures biodiversity conservation without additional programmes (and costs).
- The verbal description of the valuation context, read by the interviewers, was often found too long and tedious by the respondents.

These difficulties were accounted for in the amendments included in the final version of the questionnaire. The choice scenario description was placed in a video format, where the concept of farmland biodiversity was explained in detail. The levels of the non-monetary attributes (changes in the quantity/area covered by programmes, not in the quality of PGaE) were described and highlighted in the questionnaire. Follow-up questions were included to test for joint valuation of attributes.

The bid distribution according to the different tax increases proposed to respondents, while for different combinations and quantities of the non-monetary attributes, shows a response pattern that indicates that generally the bid set is reasonably fitted to the respondents' WTP, as showed by Figure 14.

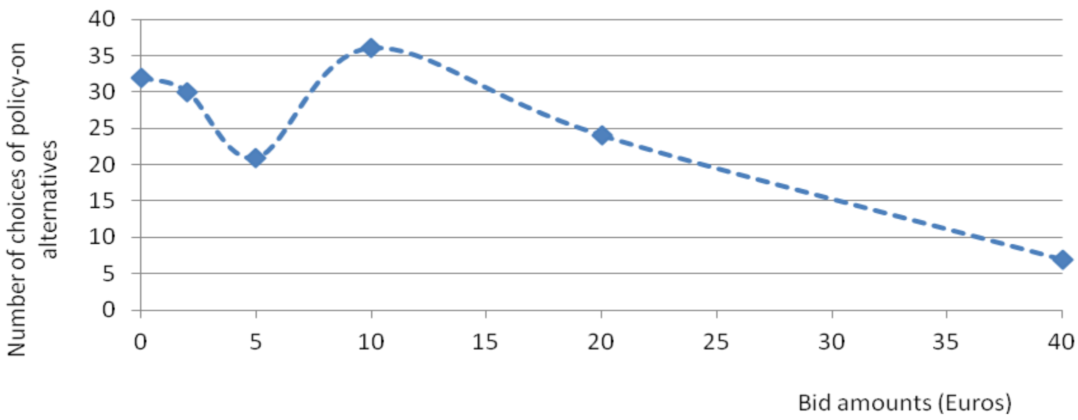

Figure 14 – Bid distribution obtained for individuals' choices in the pre-test survey

The graphic (in Figure 14) shows that, independently of the public goods delivered (through the programmes), and their respective quantities (50% or 100% of current area), the individual's WTP declines smoothly for a value between 10 and 20 euros. The 40 euros bid receive a much reduced number of choices (5 in a total of 150 choices) evidencing the maximum price is close.

The data from the pre-test survey were modelled through the MNL model and that delivered quality estimates for most of the model parameters when interactions were not included. Nevertheless, it has been possible to estimate a significant estimate for the interaction between cultural landscape and biodiversity (which showed a negative signal).

MNL model estimates are presented in Table 43 for a no-interaction specification and for a 'farmland biodiversity x Cultural landscape interaction.

Table 43 – Estimates for the MNL model with pre-test survey

Attribute	Non-interactions MNL	MNL with one interaction
Cultural landscape (CL)	0.0387	0.601
Farmland biodiversity (FB)	0.466*	1.159**
Soil quality	0.556**	0.405
Fire resilience	1.200***	0.956***
Price	-0.0480***	-0.053***
FBXCL (interaction between the 2 attributes)		-1.433*
Log-Likelihood function	-143.074	-141.253
No Observations	150	150

Note:. ***, **, * denote significance at 1%, 5%, 10% level, respectively

These estimates were then used as priors to specify a simple MNL model to generate an efficient design to deliver the choice sets for the pilot survey. In spite of its negative impact on the design efficiency, a constrained specification (ChoiceMetrics, 2010) was adopted to avoid the presence of incongruent choice sets in the final design. These referred to the selection of alternatives with zero programmes but positive price, as well as those including higher bids for inferior alternatives (inferior levels for the same non-monetary attributes).

In the pilot survey the set of bids was adjusted accounting for the results of the pre-test pilot (see next section, 4.3.3). A set of four prices was adopted, including the following amounts: 3, 12, 21 and 39 euros.

The final design included again 20 choice sets which were randomly assigned to four blocks of five choice sets.

The results of the pre-test highlight three important findings in respect to the questionnaire testing.

First, they show that the MRAEP "farmland abandonment in the Mediterranean uplands MR" and the selected PGaE were revealed to be understandable, realistic and plausible to the respondents. This disclosed a second finding: the geographical delimitation of this macro-region also proved realistic and plausible. Third, attributes are apparently valued by people as expected. In spite of the small sample size, and consequent limitations of model estimates and respective interpretation, respondents seem to have done the requested trade-offs between price and non-monetary attributes. In addition, they seem to assign higher value to fire resilience and soil quality, in line with the PGaE ranking presented by the participants in the focus group.

Globally, the questionnaire worked properly, was completed within an adequate time period and the wording employed appeared to be clear to respondents. Questions for familiarity and experience, as well as the follow-up questions, did not presented noticeable problems.

4.3.4. Pilot survey

The questionnaire used in the pilot survey was very similar to the pre-test questionnaire. Minor amendments were included into this latter to overcome the respondents' difficulties identified during the pre-test. Main changes comprised the use of a video to convey the context for the choice scenario, which comprised a description of farmland biodiversity in that context.

The pilot questionnaire was administered in two survey-modes: face-to-face and panel-based internet modes.

A random stratified sample (for gender and age) of the residents in the metropolitan area of Lisbon was selected for the face-to-face survey. A three-stage sampling was adopted. Firstly, 11 sampling points were selected. These neighbourhoods ('freguesias') were randomly selected from a spatial grid to ensure coverage of the different areas of the Metropolitan area of Lisbon (this area concentrates around 2 million of persons, representing almost 20% of the Portuguese population). The second stage consisted in selecting the household through a random route procedure. The third sampling stage involved the selection of respondents. The interviewers selected only individuals in charge of the household expenses, with 18 or more years old, and in accordance with the previously established quotas for gender and age.

The option for sampling only one (the largest) metropolitan area in Portugal resulted from the study's budget constraint. To conduct a large-scale survey, in a follow-up study/survey, entails sampling the whole population at the country or NUTS2 level, as explained in the next section.

The questionnaire for the face-to-face survey was programmed to be implemented as a CAPI by trained interviewers equipped with electronic tablets. The interviewers training included a briefing delivered by the study team together with the company in charge of the survey.

A total of 300 valid interviews were obtained as expected. The survey was conducted during 3 weeks, between November and December 2012.

The face-to-face questionnaire has been adjusted for the web-based survey mode. A national sample for Portugal and Germany was selected in this case. Samples were constrained by the panels' composition, but were stratified by region (NUTS2), gender and age. An international company was hired, which has done the CAPI programming and conducted the surveys based on their own panels for the national population in both countries.

A total of 300 valid interviews were obtained for each one of the countries. The on-line surveys were conducted in December of 2012. Each one took around 7-10 days to be accomplished.

There are two databases, one from the face-to-face survey undertook in Portugal, and a second with the data obtained from the web-based surveys in Portugal and Germany.

The information from the surveys shows that the web-based sample for the Portuguese population includes respondents whose average age (36 years old) is lower than the average of the general population between 18 and 75 years old. Therefore, these respondents are considerably younger that those interviewed through the face-to-face mode. As a consequence, the web-based sample includes only a residual percentage of retired persons. An additional bias in this sample is the relatively low percentage of people with elementary education, only 6.3%, when the percentage in the face-to-face sample was 16.3%. The web-based sample of the Germany resident population does not present, apparently, this coverage bias.

The familiarity and experience of respondents with the Mediterranean Uplands is larger for the Portuguese in relation to the German as expected. Nonetheless, the Germans were more familiar with areas in the MR but outside Portugal, comparatively to the Portuguese, who were more familiarised with the Portuguese areas alone.

Attitudes regarding the choice scenarios, namely the price attributes are similar across the two country samples. The bid amounts offered are evaluated as acceptable. Trust attitudes towards proper use of the funds, and programme implementation are dominant (around 70-80% believe on that). Also predominant is the idea that the European authorities would take the survey into consideration. This information indicates, at least for the Portuguese and Germany population, a relatively high degree of trust in the EU programmes and the proper application of taxpayers' money. However, the Portuguese from the web-panel, younger and more educated people than the average Portuguese population, showed a little more mistrust about the proper application of the funds (trust attitudes represent only 56% of respondents), while they trusted equally about programme implementation and about EU authorities' interest on the survey.

Regarding the benefits delivered by the programmes, the individuals interviewed face-to-face had a higher appreciation of the benefits for all the considered beneficiaries (more than 90% evaluated them as important to very important), that is (a) the European population in general; (b) the respondents, and (c) the residents and visitors in the areas directly benefited by the programmes. These percentages decrease slightly for the Portuguese in the internet-based survey (respectively 82%, 84% and 87%), and are lower for the Germans (respectively 74%, 70% and 85%).

These preliminary results appear to indicate that web-based surveys work well, since panels with representative samples for resident population in the country are available. This seems to be the case for Central and Northern-European countries, where the internet penetration rates are above 65%. More problematic countries include Bulgaria, Greece, Hungary and Portugal due to internet penetration rates below 50%. In fact, the results of this pilot survey tend to confirm the existence of coverage bias in the internet panels for the Portuguese resident population.

From the preliminary analysis of the survey, it can be concluded the feasibility of valuing PGaE at broad scales, keeping the context-dependency of the estimates and the ability of the individuals to understand and value variations in different PGaE's provision levels. Moreover, the definition and delimitation of conceptually-driven and data constrained macro-regions and respective macro-regional agri-environmental problems proved to be a workable framework to deal with the complexity involved in the design and implementation of choice modelling techniques applied to value changes in the levels of multiple attributes, as required by the valuation of the provision of PG by agricultural activities.

4.4. Sampling plans

The aim of this section is to present a package of alternative sampling plans built on different sampling criteria and different samples in terms of its composition and size, as well as for alternative administration modes, including estimates for the respective budget and time costs. It starts by discussing and establishing MRAEP questionnaires/surveys allocation options, followed by the selection of alternative samples and the presentation of alternative sampling plans and their respective cost estimates.

4.4.1. Alternatives for the MRAEP questionnaires allocation

The first decision regarding the sampling plans is to define how many surveys to implement for each of the identified and delimited MRAEP and how to allocate them across the EU27 countries. All options are based on the need to survey two basic target populations: (1) the residents in the macro-region, where the MRAEP and the respective PGaE are supplied; and (2) the non-residents in that macro-region. A second question to answer is which territorial unit to adopt to implement the surveys.

The choice of the territorial unit encompasses basically two options in this case: (1) the country or some sub-unit of it, such as NUTS2; and, (2) the macro-regions themselves. Given that the country allows for incorporating inter-personal heterogeneity within the same socio-cultural entity, it appears to be the 'natural' choice. Country sub-units, such as NUTS2, could be an option, but due to the additional complexity they would introduce in the MRAEP survey allocation, we have chosen to avoid it. Besides, they can be considered in the stratification of the sample for the respective country. On the other hand, MR do not configure a good choice, given they are scattered across countries and that the same country spreads across various MR. An additional limitation of using MRs as sampling units is that they are not, in general, a socio-demographic and cultural entity.

Getting back to the first question, how many surveys should be implemented for each MRAEP and how to allocate them across the EU27, different criteria were considered for the resident and non-resident populations.

A country population is classified as non-resident regarding a particular MR (corresponding to the MRAEP) when this (the MR) represents less than 2.5% of the country area. Hence, the resident population for each MR is the country population of countries where the MR comprises 2.5% or more of the country area.

Figure 15 sums up the survey allocation criteria for the two target populations, the residents and non-residents in macro-regions.

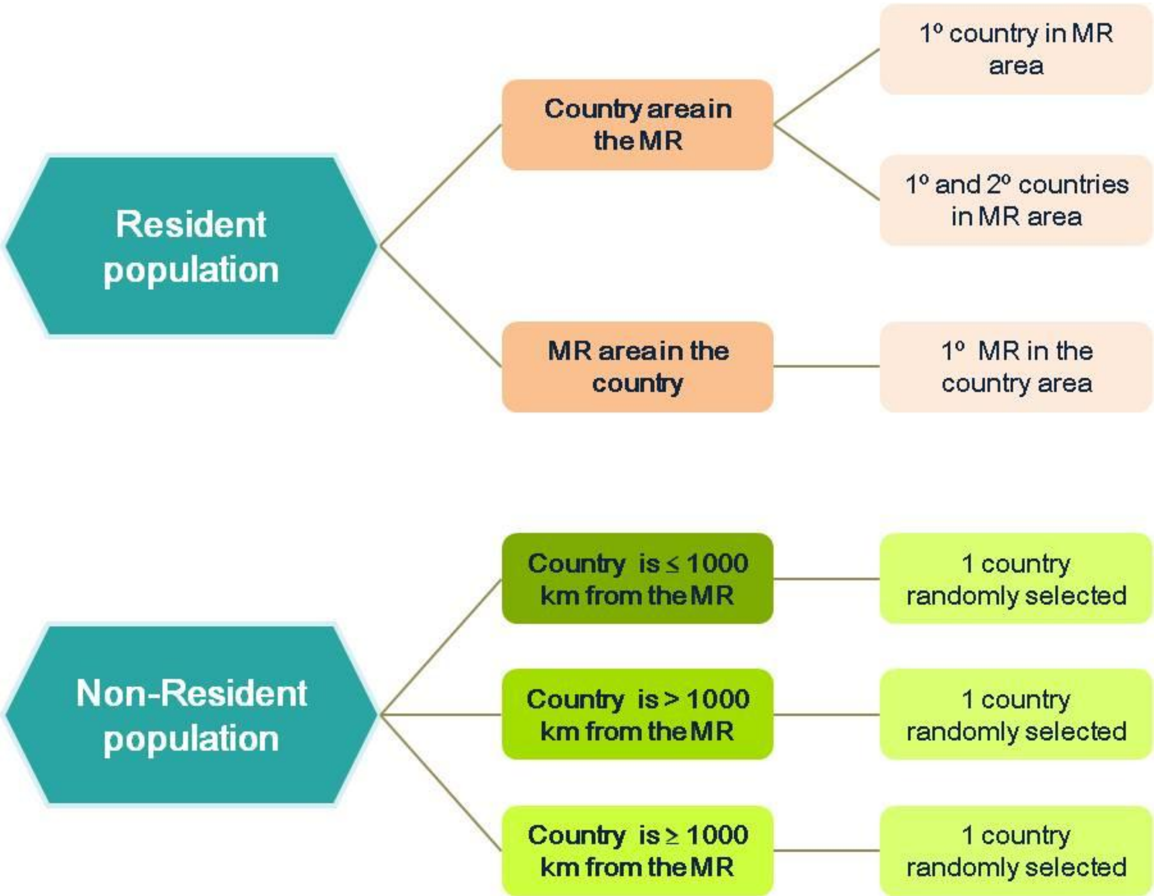

Figure 15 – Criteria to allocate the MRAEP surveys to the resident and non-resident population in the respective MR by country

The survey allocation proposed for the case of the resident population, is based on two criteria: (1) the weight of the country in the total area of the MR (harbouring the MRAEP); (2) the importance of each MR in the country area. Build on these two criteria, three survey allocation options (Options A, B and C) were defined, as shown in Table 44 and in Figure 16.

In the case of the non-resident population, the MRAEP surveys were allocated to the survey plans according to a distance criterion.

The software Google Earth has been used to calculate the distance between countries and macro-regions. For each country its main city has been selected as the beginning point; and for the macro-regions the reference point has been chosen as representing roughly their centre, when possible represented also by a main city. The references points for MR were: Rome (Italy) for the Mediterranean hinterlands MR, Paris (France) for the Central lowlands/crops MR, Corsica (France) for the Alps, NW Iberian Mountains and the Scottish Highlands MR, Prague (Czech Republic) for the North-Western Fringes MR, Brittany (France) for Central lowlands/livestock MR, Budapest (Hungary) for the Eastern Europe MR, Calabria (Italy) for the Mediterranean uplands MR, and finally Helsinki (Finland) for the Northern Scandinavia MR. The distance between the country's main city and the MR reference point has been calculated using the Google Earth tool 'Path' that creates straight lines between two points, and allow for measuring the distance between them. Distances calculation matrix can be found in the Table 3 from the Annex VI.

Accounting for the distance between the country and the MR, the countries were grouped according to the following distance ranges, ≤1000, >1000 & <1500, and ≥1500 Km. Three groups of non-residents were created for each MR. Then, through random selection (without replacement) countries were selected, ensuring that one to three countries were allocated a survey for each MR.

The options (Options D, E and F) considered for allocating the MRAEP surveys to the non-residents are shown in Table 46 and in Figure 17.

Table 44 – Options for MRAEP survey allocation to the resident population by country

	OpA-1º country area in MR			OpB-1&2º country area in MR			OpC-More represent. MR in country		
	Country select.	Popul. (>15 years)	%Pop.	Country select.	Popul. (>15 years)	%Pop.	Country select.	Popul. (>15 years)	%Pop.
Austria							1	7 130 420	1.7%
Belgium							1	9 007 671	2.1%
Bulgaria							1	6 537 510	1.5%
Cyprus							1	678 302	0.2%
Czech Republic							1	9 012 443	2.1%
Denmark							1	4 533 420	1.1%
Estonia							1	1 137 219	0.3%
Finland				1	4 463 104	1.1%	1	4 463 104	1.1%
France	2	52 695 452	12.5%	2	52 695 452	12.5%	1	52 695 452	12.5%
Germany	2	70 779 623	16.7%	3	70 779 623	16.7%	2	70 779 623	16.7%
Greece				1	9 681 359	2.3%	1	9 681 359	2.3%
Hungary							1	8 537 468	2.0%
Ireland							1	3 514 172	0.8%
Italy				3	51 862 391	12.3%	1	51 862 391	12.3%
Latvia							1	1 939 220	0.5%
Lithuania							1	2 829 740	0.7%
Luxembourg							1	412 955	0.1%
Malta							1	349 845	0.1%
Netherlands							1	13 662 078	3.2%
Poland	1	32 384 552	7.7%	2	32 384 552	7.7%	1	32 384 552	7.7%
Portugal							1	9 021 096	2.1%
Romania				1	18 210 068	4.3%	1	18 210 068	4.3%
Slovakia							1	4 593 605	1.1%
Slovenia							1	1 759 701	0.4%
Spain	3	39 116 787	9.3%	3	39 116 787	9.3%	1	39 116 787	9.3%
Sweden	1	7 791 240	1.8%	2	7 791 240	1.8%	1	7 791 240	1.8%
United Kingdom							1	51 193 290	12.1%
Total	9	202 767 654	48%	18	286 984 576	68%	28	422 834 731	100%

Source: Own construction, build on data from Eurostat (indicator: Population on 1 January by five years age groups and sex [demo_pjangroup], data extracted for 2010). Unit: persons

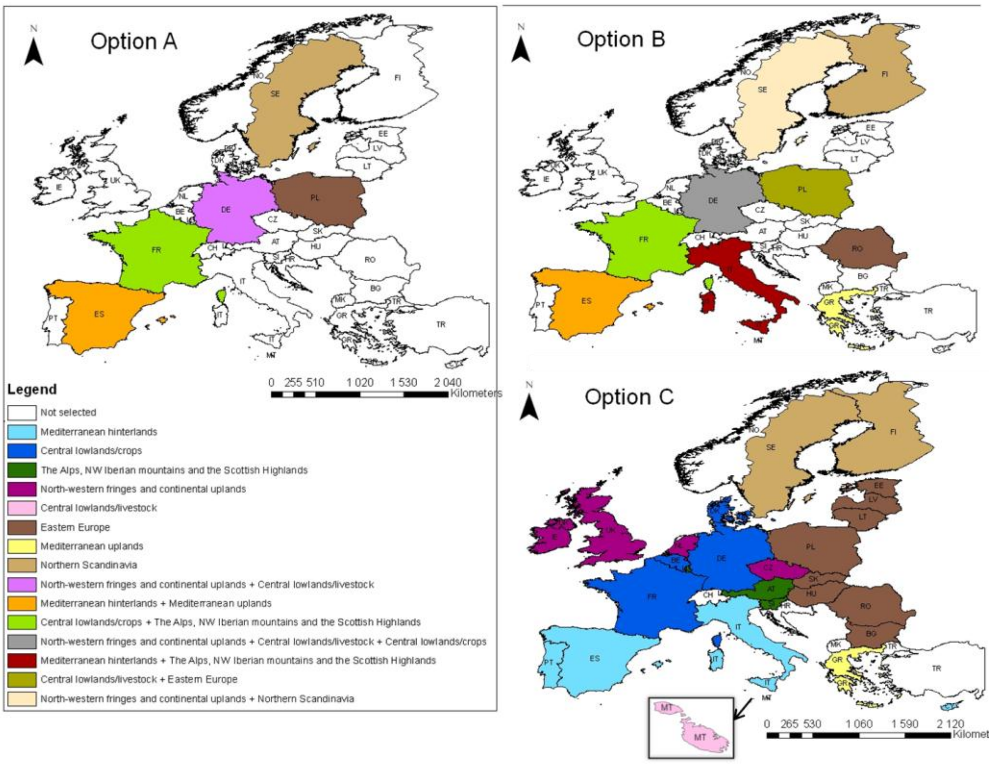

Figure 16 – Surveyed country, according alternative options for MRAEP survey allocation to the resident population by country

Option A is a minimal one, consisting on selecting the country where locates the larger percentage of the MR total area. This option originates a set of nine surveys, allocated to five countries.

Option B is an incremental option regarding to the option A. It adopts the same criterion but allows for the selection of the two more representative countries in the total area of the respective MR. It comprises 18 surveys, allocated to nine countries.

Option C adopts the alternative criterion that selects all the EU27 countries and allocates to each one the survey corresponding to the more important MR/MRAEP according to the MRs area in the country. This option entails to conduct one survey in each of the EU27 countries, with a variable number of surveys implemented by each MR. However, given that for the MRAEP "agriculture intensification in Central lowlands/livestock" this option elects Malta as the country to be surveyed, and that this country represents only 0.4% of the total area of the MR corresponding to this MRAEP, is recommend to include a second country where this MRAEP is important at both levels, at the country area and for at the MR total area. Germany is the best placed country in this respect. That is the reason why a total of 28 countries are selected to this option (Option C) in the Table 44.

While Table 44 shows the importance of the different options according to the EU27 population with +15 years old (closest to the target population), Table 45 highlights the impacts of the described survey allocation options in terms of the area of each MR considered by the survey plan (data for the MR area per country are available in the Table 1 from the Annex VI, which has either data for the country population distribution per MR in Table 2).

Table 45 – Options for MRAEP survey allocation to the resident population according MR area

	OpA-1º country area in MR			OpB-1&2º country area in MR			OpC-More represent. MR in country		
	Nº Countries	Area (km^2)	% Area	Nº Countries	Area (km^2)	% Area	Nº Countries	Area (km^2)	% Area
Mediterranean hinterlands	1	196 438	45%	2	334 657	77%	4	379 174	87%
Central lowlands / crops	1	245 166	28%	2	415 028	47%	4	469 561	53%
The Alps, NW Iberian mountains and the Scottish Highlands	1	209 150	40%	2	276 449	53%	3	75 962	14%
North-western fringes and continental uplands	1	155 949	24%	2	293 264	46%	4	253 449	40%
Central lowlands / livestock	1	21 883	28%	2	33 069	42%	2	22 199	28%
Eastern Europe	1	286 570	30%	2	524 961	56%	8	930 634	99%
Mediterranean uplands / permanent crops	1	91 855	44%	2	146 406	70%	1	54 551	26%
Northern Scandinavia	1	292 664	52%	2	568 107	100%	2	568 107	100%
Total	5	1 499 674	35%	9	2 591 942	60	28	2 753 636	64%

Source: Own construction; build on data created by the project. The area for each country in macro-region has been calculated based on the NUT3'area using the ArcGIS' (version 2010) tool "calculated geometry". The areas of NUT3 in each macro-region were summed up, obtaining the total area in that country in macro-region.

Table 46 – Options for MRAEP survey allocation to the non-resident population

	OpD -1 distance level			OpE - 2 distance levels			OpF - 3 distance levels		
	Country selec.	Popul. (>15 years)	%Pop.	Country selec.	Popul. (>15 years)	%Pop.	Country selec.	Popul. (>15 years)	%Pop.
Austria							1	7 130 420	1.7%
Belgium				1	9 007 671	2.1%	1	9 007 671	2.1%
Bulgaria							1	6 537 510	1.5%
Cyprus	1	678 302	0.2%	1	678 302	0.2%	1	678 302	0.2%
Czech Republic							1	9 012 443	2.1%
Denmark				1	4 533 420	1.1%	1	4 533 420	1.1%
Estonia	1	1 137 219	0.3%	1	1 137 219	0.3%	1	1 137 219	0.3%
Finland	1	4 463 104	1.1%	1	4 463 104	1.1%	1	4 463 104	1.1%
France				1	52 695 452	12.5%	1	52 695 452	12.5%
Germany	1	70 779 623	16.7%	1	70 779 623	16.7%	1	70 779 623	16.7%
Greece	1	9 681 359	2.3%	1	9 681 359	2.3%	1	9 681 359	2.3%
Hungary							1	8 537 468	2.0%
Ireland	1	3 514 172	0.8%	1	3 514 172	0.8%	1	3 514 172	0.8%
Italy	1	51 862 391	12.3%	1	51 862 391	12.3%	1	51 862 391	12.3%
Latvia				1	1 939 220	0.5%	1	1 939 220	0.5%
Lithuania							1	2 829 740	0.7%
Luxembourg							1	412 955	0.1%
Malta							1	349 845	0.1%
Netherlands				1	13 662 078	3.2%	1	13 662 078	3.2%
Poland				1	32 384 552	7.7%	1	32 384 552	7.7%
Portugal	1	9 021 096	2.1%	1	9 021 096	2.1%	1	9 021 096	2.1%
Romania				1	18 210 068	4.3%	1	18 210 068	4.3%
Slovakia				1	4 593 605	1.1%	1	4 593 605	1.1%
Slovenia							1	1 759 701	0.4%
Spain							1	39 116 787	9.3%
Sweden	1	7 791 240	1.8%	1	7 791 240	1.8%	1	7 791 240	1.8%
United Kingdom				1	51 193 290	12.1%	1	51 193 290	12.1%
Total	9	158 928 506	38%	18	347 147 862	82%	27	422 834 731	100%

Source: Own construction build on data from Eurostat (indicator: Population on 1 January by five years age groups and sex [demo_pjangroup], data extracted for 2010) (Unit: persons), and data created by the project for the distances as calculated in Table 3 from Annex VI.

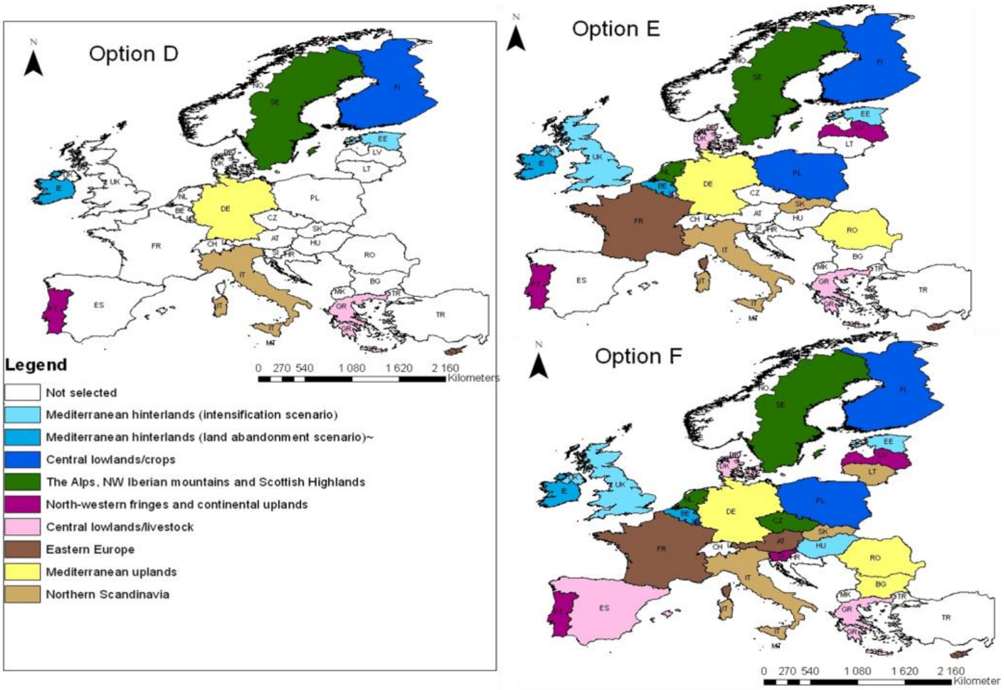

Figure 17 – Surveyed country, according alternative options for MRAEP survey allocation to the non-resident population by country

Option D is a minimal one, and selects only one country per each MRAEP/MRs, a country belonging to the group of higher range of distance. This option entails a set of nine surveys, allocated to nine different countries.

Option E and F are incremental to the Option D.

Option E selects two countries per each MR, one from the group of the higher distance range and another from the intermediate distance range. Comprises 18 surveys allocated to 18 different countries.

Option F selects three countries per each MR, including one from the group of narrow distance range. Comprises 27 surveys allocated to the 27 countries of EU27.

Final plan for MRAEP survey allocation can be obtained combined each of three options for each one of the population groups. Obvious combinations being: Option A + Option D; Option B + Option E; Option C + Option F. Nonetheless, other combinations are possible, for instances maximum option for residents, Option C, with intermediate or even minimum option for the non-residents (Options E and D)

In addition, alternative criterion to the randomly selection of non-resident countries can be considered, for instances selecting the larger country in population terms in each distance range group, or select the countries according groups defined through to socioeconomic-based clustering[14].

4.4.2. Alternative samples

Previous section addressed the number of surveys needed to implement a large-scale EU survey enabling the valuation of all selected sets of PGaE. This section deals with the question of the composition and size of sample for each country included in the different options for survey allocation sampling plans, as well as with choice of the survey administration mode.

Target population is the resident population of the country, as defined for statistical purposes, the inhabitants of a given area on 1 January of the year in question, with more than 18 years old and in charge of household expenses.

A probabilistic random sample is the best suited for the purposes of a large-scale survey, because the sample can be selected to ensure the representativeness of the population.

Sample size can be defined based on the whole population or set by population stratum. A common procedure is to define the sample size for the whole population, and then allocate it according to the strata or quota defined to describe more precisely the population. But sampling can be done directly from the different strata or clusters considered.

Due to the fact of working with infinite populations (greater than 50,000 individuals) a simple formula can be used to establish the sample size, as a function of the required level of precision, confidence level, and degree of variability.

$$n = \frac{Z_{\alpha/2}^{2} . p . q}{E^{2}}$$

[14] Country clustering was essayed using variables such as the GDP per capita, percentage of urban population and attitudes toward environment and rural development. However no coherent grouping has been found.

where n is sample size; Z is the Z-value (e.g. 1.96 for at 95% confidence level); p and q are the proportions of the population that do (p) and do not (q) have the characteristic of interest in the percentage of the population, and E is the sampling error.

The proportions of the population p that has the characteristic of interest, also called observed percentage, is often unknown, as in this case, and is the reason for sampling, because one does not know the true distribution of the variable of interest (Bateman *et al*., 2002).

The sampling error measures the difference between the sample and the actual population. The smaller the better, meaning the higher is the precision level, i.e., the closeness with which the sample predicts where the true values of the population lie.

Sample size can established for 95% confidence level, the higher level of heterogeneity $p = 0.5$ (observed percentage of the characteristic of interest) and three alternative levels of sampling errors 2.5, 3.5 and 4.5, considering that is generally recommend not to overpass the threshold of 5 points for sampling error. This sampling error would correspond to the following samples sizes per each EU country: 1500, 800 and 500.

The definition of the sample size is not an independent question of the sample composition (neither of the survey administration-mode).

Two alternative survey administration-modes are proposed for the EU large-scale survey: (1) face-to-face interviews adopting the CAPI technique; (b) panel web-based interviews. The reasons for that have been discussed in section 4.3.2. The latter have limitations due different internet penetration rates in different EU countries, yet are incomparably cheaper and faster that the face-to-face surveys.

In respect to the sample composition, face-to-face survey-mode allows for considerable latitude in the way the sample is selected. A multi-stage sampling (e.g. Henry, 1998) is recommended as usual in large-scale surveys, unfolding into three-stage steps:

- Selection of the primary sampling units (PSU).
- Selection of households.
- Selection of respondents within the household.

On the first stage, primary sampling units (PSU), the sampling points (NUTS4 or lower if possible) have to be selected.

The selection of the PSU has to be based on administrative units that can be randomly selected according to the proportion of type of areas considered for the population stratification. Using data from the Eurostat for the EU27 countries, there are two applicable possibilities: (1) stratify the population of each country per NUTS2, and then assign the population inhabiting in each NUTS2 accordingly the proportions of the population living in predominately urban, median urban and predominantly rural areas (OECD density criterion); (2) stratifying the resident population of each country according to the categories metropolitan and non-metropolitan[15].Samples sizes per each country for the two options are presented in the Tables 1 and 2 of the Annex VII (data from Eurostat that were at this step are available in the Tables 3 and 4 of this annex).

[15] Metropolitan regions are NUTS3 regions or a combination of NUTS3 regions which represent all agglomerations of at least 250.000 inhabitants. These agglomerations were identified using the Urban Audit's Larger Urban Zones (LUZ). Each agglomeration is represented by at least one NUTS3 region. If in an adjacent NUTS3 region more than 50% of the population also lives within this agglomeration, it is included in the metropolitan.

The options regarding the selection of the PSU are determinant for surveys cost. Simpler stratification, such as the Metropolitan versus Non-Metropolitan areas, decrease survey costs, both in budget and time, in comparison to the typologies encompassing more detailed stratification of the population in the space, such as the OECD typology. Therefore, the decision has to be taken based on the balance between the territory coverage (influential for the sample representativeness) and the survey costs.

Accordingly the stratification adopted to base the selection of the PSU, these places (NUTS4 or lower) must be randomly selected in a number that is, in general, proportional to the sample size (e.g. 10% of the sample size, means sampling 100 points for a 1000 households sample, to get 10 interviews for each PSU).

Second stage is the selection of the households in the randomly selected sampling points (PSU). To ensure the random selection of the households random-route protocols are good option. These allow for defining a residential grid for each PSU ease to implement by the interviewers.

The third stage of the sampling is to select the respondent in the household.

As previously referred the target population are the individuals with 18 or more years old and in charge of the expenses of the household. To increase the representativeness of the sample (i.e. is similarity with the universe) the stratification of this population is useful. The usual strata in this case are gender, age, and eventually, education degree.

It is noteworthy to underline that stratification is basically a technique for structuring the population before extracting the sample, and thus it can be used with different sampling techniques. Its major advantage is to increase precision of the estimates of actual characteristics of the entire population, what is particularly relevant when large and heterogeneous populations are sampled. Given that it is the case, population stratification is recommended.

Data available on the Eurostat[16] allow for stratifying each EU country population by gender, age and education degree (and for other socio-demographic variables). Data allows to cross gender and age, and thus to stratify individuals by age and simultaneously by gender. However, stratification for education degree has to be done separately. It is possible to obtain it just for the target population, persons between 18 and 74 years old, thus excluding the youngest and mostly dependent population. The stratification of EU27 resident population at country level per age and gender and the by education degree is available in the Tables 5 and 6 of the Annex VII.

An alternative sampling procedure is to settle the sample size according a complete stratification of the population, adopting as well a random stratified sample, while using simultaneously various stratification criteria, and then assigning it according to the selected sample points. The results in terms of sample sizes per each country might differ significantly if data available allow for cross stratification. This entails to cross data on a series of categories, such as region (NUTS2), type of region (e.g. Metropolitan), gender, age and, eventually, degree of education. This stratification procedure might be possible at UE27 level if data were collect on the respective national statistics (Census data), but not with available data in the Eurostat databases. Therefore, the sampling procedure suggested here is to select sample size by country, with two options: (1) assigning sample according to Metropolitan and non-metropolitan areas; (2) allocating it by NUTS2 in each country according to the population proportions inhabiting in predominately urban, median urban and predominantly rural areas. And then

[16] http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database (accessed in several days on the months of November and December, 2012).

select the respondents, at the household level according the country population strata for age, gender and degree of education.

Table 47, at the end of this section, shows the alternative sampling options build on the survey allocation plans selected in the previous section, when sample size is established at country level (see Table 1 in the Annex VII) for sampling errors of 3.5 and 4.5.The first option, sampling error of 3.5, is a better one in terms of sample representativeness, and correspond to a sample size level of around 800 interviews per country.

For the case of panel-based internet survey the sampling strategies rely on the population stratification in order to ensure samples as representative as possible. And a block of initial socioeconomic questions in the questionnaire is fundamental to select the respondents according to various strata. Panels allows in general for stratification by NUTS2, gender, and age, while other variables might be available.

Table 47 – Alternative sampling at the EU level

	Sampling alternatives														
	Option A + Option D			Option B + Option E			Option B + Option D			Option C + Option F			Option C + Option E		
	Country select.	Number of interviews		Country select.	Number of interviews		Country select.	Number of interviews		Country select.	Number of interviews		Country select.	Number of interviews	
		EM = 3.5	EM= 4.5		EM = 3.5	EM= 4.5		EM = 3.5	EM= 4.5		EM = 3.5	EM= 4.5		EM = 3.5	EM= 4.5
Austria										2	1 600	1 000	1	800	500
Belgium				1	800	500				2	1 600	1 000	2	1 600	1 000
Bulgaria										2	1 600	1 000	1	800	500
Cyprus	1	800	500	1	800	500	1	800	500	2	1 600	1 000	2	1 600	1 000
Czech Republic										2	1 600	1 000	1	800	500
Denmark				1	800	500				2	1 600	1 000	2	1 600	1 000
Estonia	1	800	500	1	800	500	1	800	500	2	1 600	1 000	2	1 600	1 000
Finland	1	800	500	2	1 600	1 000	2	1 600	1 000	2	1 600	1 000	2	1 600	1 000
France	2	1 600	1 000	3	2 400	1 500	2	1 600	1 000	2	1 600	1 000	2	1 600	1 000
Germany	3	2 400	1 500	4	3 200	2 000	4	3 200	2 000	3	2 400	1 500	3	2 400	1 500
Greece	1	800	500	2	1 600	1 000	2	1 600	1 000	2	1 600	1 000	2	1 600	1 000
Hungary										2	1 600	1 000	1	800	500
Ireland	1	800	500	1	800	500	1	800	500	2	1 600	1 000	2	1 600	1 000
Italy	1	800	500	4	3 200	2 000	4	3 200	2 000	2	1 600	1 000	2	1 600	1 000
Latvia				1	800	500				2	1 600	1 000	2	1 600	1 000
Lithuania										2	1 600	1 000	1	800	500
Luxembourg										2	1 600	1 000	1	800	500
Malta										2	1 600	1 000	1	800	500
Netherlands				1	800	500				2	1 600	1 000	2	1 600	1 000
Poland	1	800	500	3	2 400	1 500	2	1 600	1 000	2	1 600	1 000	2	1 600	1 000
Portugal	1	800	500	1	800	500	1	800	500	2	1 600	1 000	2	1 600	1 000
Romania				2	1 600	1 000	1	800	500	2	1 600	1 000	2	1 600	1 000
Slovakia				1	800	500				2	1 600	1 000	2	1 600	1 000
Slovenia										2	1 600	1 000	1	800	500
Spain	3	2 400	1 500	3	2 400	1 500	3	2 400	1 500	2	1 600	1 000	1	800	500
Sweden	2	1 600	1 000	3	2 400	1 500	3	2 400	1 500	2	1 600	1 000	2	1 600	1 000
United Kingdom				1	800	500				2	1 600	1 000	2	1 600	1 000
Total of surveys	**18**	**14 400**	**9 000**	**36**	**28 800**	**18 000**	**27**	**21 600**	**13 500**	**55**	**44 000**	**27 500**	**46**	**36 800**	**23 000**

4.4.3. Budget for alternative sampling plans

The budget for different sampling plans depends basically on the next four decisions:

- The number of surveys to be implemented and in how many different countries.
- The size of the samples.
- The geographical distribution of the sample in each country.
- The survey administration mode.

The number of surveys has been defined in the section 4.4.1, and varies between a minimum of 18 surveys to be implement in 12 different countries, to a maximum of 55 surveys to implement in all EU27 member states.

The average sample size recommend based on the sampling error margin (and respective representativeness) is 800 to 1000[17] valid interviews per country, for a respectively sampling error of 3.5 and 3.0. This error is the maximum observable it can be smaller depending on the variability of the characteristic of interest.

The geographical dispersion of sampling points (PSU) across each country (or respective NUTS2) influences the costs both in budget and time. Increasing territory coverage increases costs, which are at this level very variable across countries. Therefore, at this point balance has to me done between costs and representativeness. Increasing the later entails to work with a refine typologies of areas, such as the metropolitan, urban and rural; opting to select only metropolitan and non-metropolitan decreases costs, while there might a representativeness trade-off at least for some countries.

Survey-mode is determinant for cost, both budget and time, face-to-face being the more expensive in comparison to other survey-modes. Panel-based internet surveys are a promising alternative, given they are much cheaper both in time and money. However, they face problems with target population coverage in particular for the countries with lower rates for domestic internet access and use that have already been mentioned. Nevertheless, if this panels were rapidly improved, we-based survey deserves serious consideration, given they appear to work well, as we conclude from the pilot survey implementation, and are incomparably cheaper, both in budget and time, that the face-to-face surveys.

In order to deliver cost estimates (in terms of the budget) for an EU large-scale survey five survey companies working at European level have been consulted. Three companies have replied[18]. The information they had supplied to us is variable in detail and presents relatively different prices. The company TNS presented the more detailed proposal following all the recommend good practices in survey implementation to ensure representativeness, hence the costs they present can be envisaged as the maximum cost of a large-scale survey within alternative options. The information received from the other companies suggests costs can be lowered. So, the Table 48 presented next, builds on the Table 47, includes two indicative values, a maximum and an intermediate cost total survey cost, based on an

[17] In the case of small countries the recommended samples, e.g. Eurobarometer, are of a maximum of 500 units. These countries are Cyprus, Luxemburg and Malta. In the cases of Estonia, Latvia, Lithuania, Ireland, Slovakia and Slovenia, international survey companies do not recommend to exceed 800 units (respondents).

[18] These companies were TNS (www.tnsglobal.com/), GFK (www.gfk.com) and GMI (www.gmi-mr.com/) that does only web-surveys.

average cost per interview in the different EU countries. Differences between interviewing cost per country were not considered given this just indicative information on the costs for a large-scale survey.

The average values per interview, for the face-to-face survey mode, used as maximum estimates are respectively: 69 euros (for sample with 800 interviews) and 55 euros (for sample with 800 interviews). These costs include translation expenses from an original questionnaire to the 25 non-English speaking and the CAPI programming. The intermediate estimates for similar average cost per interview[19] are 50 euros (for sample with 800 interviews) and 45 euros (for sample with 1000 interviews).

The average values per interview, for the panel web-based survey mode, used as maximum and intermediate estimates are respectively: 9 euros and 7.5 euros (for sample with 800 interviews) and 7.5 euros and 6 euros (for sample with 1000 interviews).

Actual cost of such a survey has to be negotiated with different companies based on well-defined options regarding the decisions to be held, listed above in this section, which are the: (a) number of surveys to be implemented and in how many different countries; (b) samples sizes; (c) number of sampling points; (d) survey administration mode.

The costs estimated for the different sampling plans refer only to the large-scale survey; they do not include qualitative studies and pre-test to the questionnaire that will need to be conducted for the proper implementation of the valuation framework developed by this study. These qualitative and pre-test must be conducted for the all eight macro-regions. The ideal would be conducted them in more than one country for each macro-region, to account for the cultural and socioeconomic differences of different countries included in the same macro-region.

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[19] It is worth noticing that these are rough estimates given the company only supplied the interviewing costs for the central Europe countries.

Table 48 - Estimates for the budget costs of alternative sampling at the EU level

	Sampling alternatives														
	Option A + Option D			Option B + Option E			Option C+ Option F			Option B + Option D			Option C + Option E		
	Country select.	Number of interviews		Country select.	Number of interviews		Country select.	Number of interviews		Country select.	Number of interviews		Country select.	Number of interviews	
		EM = 3.5	EM= 3.0		EM = 3.5	EM= 3.0		EM = 3.5	EM= 3.0		EM = 3.5	EM= 3.0		EM = 3.5	EM= 3.0
Austria							2	1600	2000				1	800	1000
Belgium				1	800	1000	2	1600	2000				2	1600	2000
Bulgaria							2	1600	2000				1	800	1000
Cyprus	1	500	500	1	500	500	2	1000	1000	1	800	100	2	1000	1000
Czech Republic							2	1600	2000				1	800	1000
Denmark				1	800	1000	2	1600	2000				2	1600	2000
Estonia	1	800	800	1	800	800	2	1600	1600	1	800	800	2	1600	1600
Finland	1	800	1000	2	1600	2000	2	1600	2000	2	1600	2000	2	1600	2000
France	2	1600	2000	3	2400	3000	2	1600	2000	2	1600	2000	2	1600	2000
Germany	3	2400	3000	4	3200	4000	3	2400	3000	4	3200	4000	3	2400	3000
Greece	1	800	1000	2	1600	2000	2	1600	2000	2	1600	2000	2	1600	2000
Hungary							2	1600	2000				1	800	1000
Ireland	1	800	800	1	800	800	2	1600	1600	1	800	800	2	1600	1600
Italy	1	800	800	4	3200	4000	2	1600	2000	4	3200	4000	2	1600	2000
Latvia				1	800	800	2	1600	1600				2	1600	1600
Lithuania							2	1600	1600				1	800	800
Luxembourg							2	1000	1000				1	500	500
Malta							2	1000	1000				1	500	500
Netherlands				1	800	1000	2	1600	2000				2	1600	2000
Poland	1	800	1000	3	2400	3000	2	1600	2000	2	1600	2000	2	1600	2000
Portugal	1	800	1000	1	800	1000	2	1600	2000	1	800	1000	2	1600	2000
Romania				2	1600	2000	2	1600	2000	1	800	1000	2	1 600	1 000
Slovakia				1	800	800	2	1600	1600				2	1600	1600
Slovenia							2	1600	1600				1	800	800
Spain	3	2400	3000	3	2400	3000	2	1600	2000	3	2400	3000	1	800	1000
Sweden	2	1600	2000	3	2400	3000	2	1600	2000	3	2400	3000	2	1600	2000
United Kingdom				1	800	1000	2	1600	2000				2	1600	2000
Total of interviews	**18**	**14 400**	**16 900**	**36**	**28 500**	**34 700**	**55**	**42 200**	**49 600**	**27**	**21 600**	**25 700**	**46**	**34 000**	**40 000**
Estimate cost for the large-scale survey based on upper and lower average cost per interview (values are in Euros) and for alternative survey modes: face-to-face and panel web-based															
F2F (upper)		**993 600**	**929 500**		**1 966 500**	**1 908 500**		**2 911 800**	**2 728 000**		**1 490 400**	**1 413 500**		**2 346 000**	**2 200 000**
F2F (lower)		**720 000**	**760 500**		**1 425 000**	**1 561 500**		**2 110 000**	**2 232 000**		**1 080 000**	**1 156 500**		**1 700 000**	**1 800 000**
Web (upper)		**129 600**	**126 750**		**256 500**	**260 250**		**379 800**	**372 000**		**194 400**	**1927 50**		**306 000**	**300 000**
Web (lower)		**108 000**	**101 400**		**213 750**	**208 200**		**316 500**	**297 600**		**1620 00**	**154 200**		**255 000**	**240 000**

5. Concluding remarks and further work

This report presents an **up-scaled non-market valuation framework** developed to value the environmental public goods and externalities (PGaE) of the EU agriculture. The name PGaE is selected to describe positive/negative side-effects of the agricultural activities, with different degrees of publicness, which can be influenced through appropriate agricultural and/or agri-environmental policies.

This valuation framework introduces a novel approach to tackle broad-scale demand-side valuation of multidimensional goods and services. Its **novelty** builds on four main dimensions:

- the delimitation of wide areas with homogeneous agro-ecological infra-structure across the EU, the "macro-regions";
- macro-regions are delimitated based on variables not used to measure their supply of PGaE, thus disentangling the agro-ecological infra-structure from its ecological and cultural services;
- the definition of "macro-regional agri-environmental problems" (MRAEP), through the association of the "macro-regions" with the core PGaE supplied by each of them, as well as core dynamic trends raising problems related to future PGaE delivery; these MRAEP define the non-market demand-side valuation problems in each macro region that are relevant to the agricultural and agri-environmental policy decision-makers;
- the design of a Choice Modelling (CM) survey able to gather multi-country value estimates of changes in the provision level of different PGaE supplied by different EU broad regions (the macro-regions), within well-defined valuation contexts provided by the respective MRAEP.

The macro-regions (MR) are identified and delimitated using multivariate statistical techniques, namely cluster analysis run on the results of a factorial analysis of NUT3-level data for two groups of variables: landscape indicators and farming system indicators. As a result of the clustering process, different typologies of EU MR have been identified. A 13 macro-region typology has been retained as the spatial reference for the following analyses.

The macro-regions played a double role in the up-scaled non-market valuation framework: (1) they provided the spatial basis to identify and define the MRAEP, so providing the spatial dimension of the valuation contexts; (2) they allowed a clear disentangling of the agro-ecological (infrastructural) dimension of landscapes from other strongly interrelated PGaE, such as biodiversity or cultural landscape services, as well as primary/intermediate regulating services, such as water quality and availability, air quality and soil quality. This analytical distinction between the agro-ecological infrastructure and its PGaE delivery has been implemented by using different indicators to delimitate the MR and to describe the PGaE.

The identification of the core PGaE for each MRAEP is essential to focus the valuation exercise on the PGaE that are, in fact, in each case, the relevant side-effects of the agricultural activities to be addressed by agricultural and/or agri-environmental policies. This detailed evidence-based approach in developing the valuation framework, though not often followed (especially at such a broad scale, because of data problems), is essential to make sure that the estimated values are policy relevant.

The MRAEP is a key concept in the proposed up-scaled non-market valuation framework also because it enables the design of context-rich valuation scenarios, at a broad scale, in which the individuals (the EU population) can make context-dependent choices, which are, as we have just seen, also built on policy-relevant problems.

The novelty introduced by the developed valuation framework reinforces its ability to effectively address three major challenges that have so far prevented a wider use of value estimates produced by non-market valuation methods, namely when applied to the environment. These challenges are overcome by this methodological framework by:

- explicitly adopting an inter-disciplinary approach, which links knowledge and information from ecological and agricultural sciences (namely agri-environmental indicators) to economic and valuation concepts;
- incorporating end-users' needs in the design of the valuation scenarios, and thus explicitly addressing their informational needs;
- designing context-rich valuation scenarios at broad scales, ensuring the content validity of the valuation survey and the quality of the resulting value estimates.

The inter-disciplinary approach underpinning the development of the proposed valuation framework is particularly valuable, because it makes possible to match the supply-side with the demand-side of PGaE of EU agriculture. This link is fundamental to address end-users informational needs when their decisions are mainly addressing the supply-side, which is the case with agri-environmental policy decision-makers, because valuation provides crucial information from the demand-side.

The design of context-rich valuation scenarios is always a challenging aspect of the design and implementation of SP valuation methods, but it is even more defying when we move to supra-national scales. Each MR encompasses several EU countries, and the potential beneficiaries of the PGaE supply from a particular MR are the population of countries within and outside the MR – that is: all EU countries. Such multi-country valuation of a bundle of PGaE from a specific MR has never been done before, as far as we know.

Nonetheless, and probably due to the degree of innovation involved in this **up-scaled non-market valuation framework**, it has some limitations, which are mainly due to **data constraints** and the limits of Choice Modelling as a valuation method.

Data constraints at the PGaE supply-side significantly limit the possible descriptions of the PGaE delivered by each selected macro-region, and thus the development of standardised descriptions of these PGaE within the proposed non-market valuation framework. The currently available agri-environmental indicator systems are still insufficient to ensure that PGaE are described for their main dimensions, and/or, in particular, that these descriptions can be made at a reasonable spatial scale, such as NUTS3 (often information is only available at NUTS2 or country level, which is inappropriate to develop homogeneous MRAEP). Therefore, most of the information used in this report came from on-going technical and research studies focusing on the construction of regionally-disaggregated agri-environmental indicators, and especially on developing methods and models that generate data for them. Eventually, it has been possible to get at least one indicator for each PGaE with data disaggregated at the NUT3 level.

The consolidation of this linking of supply-side policy-relevant information with demand-side valuation of the agricultural PGaE largely depends on the expected developments in agri-environmental indicator systems. For the current state-of-the art in this area, there are PGaE, namely landscape (when confined to the cultural services), that are not sufficiently covered at the EU level. Lack of information might lead to underestimating the value of important PGaE in some of the macro-regions. This possibility has been acknowledged in designing the macro-regional agri-environmental problems (MRAEP) for certain macro-regions, namely the Eastern Europe.

Other dimension of constraints to the proposed valuation framework is related to the limits of the used valuation method. Whereas CM is a rather flexible technique allowing for the design of complex choice scenarios with multiple attributes in different levels, the ability of people (respondents) to do, in the context of a short-duration survey, the trade-offs between different attributes at different levels is limited. In addition, it is fundamental to select attributes and specify them, in particular their levels, in a comprehensive and realistic way from the view point of the respondents (the EU common citizen, in this case). This comes out with a cost, in particular when one is designing choice scenarios at supra-national scales addressing a broad range of multiple benefits for multiple beneficiaries, which means we are approaching the boundaries/limits of SP valuation methods. This cost is translated into the various decisions the researcher has to do during the design of choice scenarios, namely the attributes selected, the way they are conveyed to the people and the levels at which they are to be supplied. Decisions taken at this step must be careful to ensure the validity of final valuation results, that is: to make sure that what is actually being gauged are economic value estimates (and therefore including a payment attribute) and not simply non-economic, symbolic preference rankings. For this purpose, choice scenarios have to be carefully designed to ensure that respondents understand what they are requested to value and that they judge scenario descriptions as realistic and plausible. This focus on the validity of the value estimates might come out with a cost in terms of the information that is gathered in valuation surveys. It is not possible to get everything we would like to get to perfectly match end-users informational needs, but only what people are able to deliver. A good example of this can be taken from the pilot survey developed in this study for the farmland abandonment in Mediterranean uplands MRAEP. In this case, the policy-off level of all PGaE attributes has been set at those levels that are associated with a policy-off (abandoned) landscape in the future, according to the identified trends, and the policy-on levels were associated to the current state of PGaE. This does not mean that it is not possible, in this case, to achieve better levels of some PGaE (e.g. fire risk) in relation to their present condition. So changes in some PGaE (e.g. fire risk) could be presented and valued as improvements upon the their current condition, whereas for other PGaE (e.g. landscape and biodiversity) changes would be presented and valued as WTP to conserve their current condition and avoid their policy-off, abandoned condition. But this would present a heavy cognitive burden for respondents, by creating two divergent narratives for the same geographical MRAEP, which would probably undermine the validity of results. So we had to keep to a simpler consistent narrative at the cost of not getting values for all available supply-side policy options. In addition, what people are able to deliver is also a good indicator on what it is relevant from the demand-side, which is also valuable information for end-users, in particular for public policy decision-makers.

At this stage the reader’s question is probably what is the **usefulness** of this novel **up-scaled non-market valuation framework**, which, like any other novel methodology, has its limitations.

The main usefulness of this non-market valuation framework is its ability to deliver information on the value people (the EU common citizen) have for changes regarding the supply of the environmental PGaE of EU agriculture. It allows for obtaining the different PGaE value per hectare. Thereafter, it is useful to the design and evaluation of agricultural and agri-environmental policies and/or programmes because it provides information on the public's (EU taxpayers') well-being variations in response to increases/decreases in the agriculture side-effects that can be influenced or controlled by public policies and/or programmes.

This valuation framework is able to deliver information on these EU-level variations of well-being due to changes in PGaE delivery at the macro-regional scale. Hence, it is useful to support the design and the evaluation of macro-regional agri-environmental programmes built on the identification of the core PGaE that can be delivered by consistent supply-side interventions in different macro-regions; it is also useful to inquire by how much the delivery of PGaE should be stimulate (reduced) through the use of public funds to maximise the welfare gains these changes cause to EU taxpayers. In addition, because of the proposed survey strategy, the valuation framework also makes it possible to compare welfare variations across different EU countries in response to a change in the supply of a particular PGaE in a particular macro-region. This is valuable information to prioritise PGaE and/or macro-regions according to their relevance for the overall EU-population's welfare taking into account the policy's budget constraint.

Given that this valuation framework builds on the matching of PGaE identified as relevant from the supply-side with the correspondent demand-side perception of realism and relevance perception to the common citizen, it allows for obtaining the value of the set of relevant PGaE for each macro-region. The relevancy being first settled by the supply conditions and then redefined by the people. This mean that PGaE found not relevant from the supply-side might be evaluated as relevant from the demand-side and vice-versa. Nonetheless, major discrepancies are not expected, as shown by the pilot survey undertook by this study. Further, if there is relevant PGaE from the supply-side that are not considered as that by the people, the description of the choice scenarios can be improved and tested to check if there is a communication problem. Summing-up, what is possible to get with this methodological approach? The value (per household or individual and per hectare) of the PGaE included in the relevant set of PGaE for each macro-region by the people (resident and non-resident form different EU countries); the relevancy largely dictated by the supply conditions as described to the people in the choice scenarios. There will be not valued PGaE for each macro-region, meaning they are not relevant there (e.g. fire resilience in Northern Scandinavian macro-region).

Still value aggregation at UE level will be possible within certain limits; it is possible to know the average value of fire resilience accounting for its value in different macro-regions. In the aggregation exercise is fundamental to ensure the same PGaE has been valued, for instances farmland biodiversity in Central crops macro-region is not equivalent to the farmland biodiversity in Alps, NW Iberian Mountains and the Scottish Highlands macro-region (where policies are designed to maintain it through the prevention of the farmland abandonment).

Additional uses of this methodological framework are the following:

- To deliver a significant contribution for the outline of standardised descriptions of the PGaE of agriculture, as well as the environmental goods and services in general, through the adoption of an inter-disciplinary approach allowing for matching the supply-side with the demand-side of these non-market goods and services.
- The latter is particularly relevant to increase the effectiveness of the value estimates of environmental changes obtained by the non-market valuation approach, given that the current lack of standardisation of PGaE limits their comprehensiveness and usefulness by their potential users, which is a growing

group, including policy-makers, land-managers and their representatives, non-governmental associations, and even the general public.

- To show the advantages and the practicability of adopting inter-disciplinary approaches to the valuation of environmental goods and services.
- To deliver a methodological framework that can be further developed to the valuation of other public goods of agriculture, namely food safety and rural vitally;
- To deliver a methodological framework that can be applied in other geographical contexts where large-scale valuation studies are relevant, such as within multi-lateral trade or environmental agreements where the EU has a genuine interest in promoting a better integration of non-trade issues, such as the non-market environmental (and social) side-effects of agriculture through their pricing.

Further work is needed to implement this **up-scaled non-market valuation framework** to gather the EU population's value for changes in the provision levels of different PGaE supplied by different macro-regions. This basically entails proceeding with qualitative studies and survey testing, expanded to all the MRAEP identified in this study as relevant from the supply-side. This report presents and discusses the testing procedures, and respective findings, implemented to design the CM survey for a specific MRAEP ("farmland abandonment in the Mediterranean Uplands macro-region"). The extensive tests that have been carry out appear to be determinant for the success attained in the pilot survey, which has been administrated to both resident (Portuguese) and non-resident (German) European citizens. The results of this pilot survey, namely the fact that the data gathered enabled economic modelling and produced quality estimates for the individuals' WTP (value for changes in the provision level of the PGaE selected for this MR) in accordance with theoretical and empirical expectations demonstrates that, when preceded by the appropriate qualitative and pre-test procedure, the proposed valuation framework can be implemented successfully.

Qualitative research and extensive testing of the questionnaire to implement the valuation survey are recommended by all good-practice guidelines. In fact, they proved particularly useful for fundamental decisions as regards the design of the CM surveys implemented in this feasibility study: (a) to confirm if the selected PGaE based on supply-side relevance were also relevant from the demand-side perspective; (b) to understand how PGaE, and the context explaining their change (the MRAEP), should be described in order to be understandable and realistic for the respondents; and (c) to establish understandable and plausible changes in the provision levels of PGaE (attributes levels) within the framework of feasible policy options. Therefore, it is fundamental to carry out similar qualitative and pre-test work, as well as pilot surveys, for the different MRAEP surveys, that are derived from the MRAEP identified based on supply-side relevance alone.

The extension of this qualitative and testing work must be proportional to the number of countries involved in the final EU large-scale survey. This report presents alternative sampling plans, which deliver different alternatives in terms of the number of country surveys to be conducted. A minimal alternative sampling plan regarding the number of surveys entails to deliver only one survey to the resident population of each one of the 9 MRAEP, that would be concentrated in 5 different EU countries, and to carry out 9 surveys to the non-resident population in 9 different EU countries. Alternative sampling plans increase the number of countries to involve to a maximum that includes all of the 27 EU countries.

On the other hand, to ensure comparability and potential aggregation of the value of the similar PGaE changes obtained for different macro-regions, the qualitative studies and survey testing procedures should be coordinated and administrated within a similar frame in different countries. CM surveys should be designed upon this qualitative information and tested at pilot scale. Only after these steps are undertaken, the large-scale survey should be implemented.

To the implementation of a large-scale EU survey, alternative sampling plans are provided by this report in terms of sample size and composition, survey-mode of administration and estimates for the respective budgetary costs. At this level, the decisions (e.g. on sample size and composition) must be made according to the information needs in terms of the sample representativeness and the error margin admissible for the survey, balanced by the budget availability.

Regarding the administration mode, two alternatives were tested in this report, face-to-face and panel web-based survey. The results show the latter to be a feasible alternative since representative samples can be ensured through the panel available (or to be assembled).

Finally, regarding **further work in general terms**, the up-scaled non-market valuation framework presented could be easily adopted to value other environmental multidimensional changes, namely within the ecosystem-services framework. It can be also further developed to be implemented to value social public goods of EU agriculture. This could boost the work on the definitions and indicators to measure these multidimensional and complex public goods.

And it can be exported to other geographical contexts to address broad-scale valuation challenges related to land-use changes, international trade or environmental-policy decisions and diverse end users' informational needs, e.g. to compare alternative land-use options at up-scaled levels (macro-regional for larger countries or at a supra-national level).

References

Adamowicz W., Boxall P., Louviere J., Swait J. & Williams M. (1999). Stated-Preference Methods for Valuing Environmental Amenities. In I. Bateman and K. Willis (Eds.), Valuing Environmental Preferences: Theory and Practice of the Contingent Valuation. Oxford University Press, Oxford, pp. 460-479.

Adams R. M., McCarl B. A., Segerson K., Rosenzweig C., Bryant K.J., Dixon B.L., Conner R., Evenson R.E. & Ojima D. (1999). Economic Effects of Climate Change on US Agriculture in the Impact of Climate Change on the United States Economy. Edited by Neumann J. E. Industrial Economics Incorporated, Cambridge, Massachusetts.Aizaki H., Sato K. & Osari H. (2006). Contingent valuation approach in measuring the multi-functionality of agriculture and rural areas in Japan. Paddy Water Environment 4: 217-222.

Arriaza M., Gómez-Limón J. A., Kallas Z., Nekhay O. (2008). Demand for Non-Commodity Outputs from Mountain Olive Groves. Agricultural Economics Review 9: 5-23.

Arrow K., Solow R., Portney P., Leamer E., Radner R. & Schuman H. (1993). Report of the NOAA panel on contingent valuation. Federal Register 58: 4602-4614.

Baskaran R., Cullen R., Wratten S. (2009). Estimating the Value of Agricultural Ecosystem Service: A Case Study of New Zealand Pastoral Farming – A Choice Modelling Approach. Australasian Journal of Environmental Management 16 : 103-112.

Bastian C. T., McLeod D. M., Germino M. J., Reiners W. A. & Blasko B. J. (2002). Environmental Amenities and Agricultural Land Values: A Hedonic Model Using Geographic Information Systems Data. Ecological Economics 40: 337-349.

Bateman I. J. & Langford I. (1997). Non user' willingness to pay for a national Park: an application and critique of the contingent valuation method. Regional Studies 21: 571-582.

Bateman I., Abson D., Beaumont N., Darnell A., Fezzi C., Hanley N., Kontoleon A., Maddison D., Morling P., Morris J., Mourato S., Pascual U., Perino G., Sen A., Tinch D., Turner K., Valatin, G., Andrews B., Asara V., Askew T., Aslam U., Atkinson G., Beharry-Borg N., Bolt K., Cole M., Collins M., Comerford E., Coombes E., Crowe A., Dugdale S., Dunn H., Foden J., Gibbons S., Haines-Young R., Hattam C., Hulme M., Ishwaran M., Lovett A., Luisetti T., MacKerron G., Mangi S., Moran D., Munday P., Paterson J., Resende G., Siriwardena G., Skea J., van Soest, D. & Termansen M. (2011). Economic values from ecosystems. In The UK National Ecosystem Assessment Technical Report. UK National Ecosystem Assessment, UNEP-WCMC, Cambridge.

Bateman I., Carson R., Day B., Hanemann W., Hanley N., Hett T., Jones-Lee M., Loomes G., Mourato S., Özdemiroglu E., Pearce D., Sugden, R. & Swanson J. (2002). Economic Valuation with Stated Preference Techniques: A Manual. Edward Elgar Publishing, Cheltenham.

Bateman I., Diamand, E., Langford H. & Jones A. (1996). Household Willingness to Pay and Farmers` Willingness to Accept Compensation for Establishing a Recreational Woodland. Journal of Environmental Planning and Management 39: 21-43.

Bateman I., Jones A., Nishikawa N. & Brouwer R. (2000). Benefits transfer in theory and practice: a review. CSERGE Working Paper GEC 2000-25.

Bateman I.J., Mace G.M., Fezzi C., Atkinson G. & Turner R.K. (2011). Economic analysis for ecosystem service assessments. Environmental and Resource Economics 48: 177–218.

Borresch R., Maas S. Schmitz K. & Schmitz P.M. (2009). Modeling the Value of a Multifunctional Landscape: A Discrete Choice Experiment. Paper presented at the International Association of Agricultural Economics Conference. Beijing, China.

Bowker J. & Didychuk D. (1994). Estimation of nonmarket benefits of agricultural land retention in eastern Canada. Agricultural Resource Economics Review 23: 218-225.

Boyd J. & Banzhaf S. (2007). What are ecosystem services? The need for standardized environmental accounting units. Ecological Economics 63: 616–626.

Brouwer R., Slangen L.H.G.(1998). Contingent valuation of the public benefits of agricultural wildlife management: the case of Dutch peat meadow land. European Review of Agricultural Economics 25: 53-72.

Bullock C. H. & Kay J. (1997). Preservation and charge in the upland landscape: The public benefits of grazing management. Journal of Environmental Planning and Management 40: 315-334.

Cai B., Cameron T. A. & Gerdes G. R. (2010). Distributional Preferences and the Incidence of Costs and Benefits in Climate Change Policy. Environmental Resource Economics 46: 429-458.

Campbell D. (2007). Willingness to Pay for Rural Landscape Improvements: Combining Mixed Logit and Random-Effects Models. Journal of Agricultural Economics 58: 467–483.

Campbell D., Hutchinson W.G., Scarpa R. (2006). Using Discrete Choice Experiments to Derive Individual-Specific WTP Estimates for Landscape Improvements under Agri-Environmental Schemes: Evidence from the Rural Environment Protection Scheme in Ireland. Paper presented at the Second International Conference on "Tourism and Sustainable Economic Development -Macro and Micro Economic Issues" Chia, Italy, 16-17 September 2005.

Canavari, M., Nocella, G., Scarpa, R., (2005). Stated willingness-to-pay for organic fruit and pesticide ban: an evaluation using both web-based and face-to-face interviewing. Journal of Food Products Marketing 11: 107–134.

Carson R. & Louviere J. (2009). Experimental design and the estimation of willingness to pay in choice experiments for health policy evaluation. Working series papers (10-09). Center for Environmental Economics, University of California, San Diego.

Catalini A. H. & Lizardo M. (2004). Agriculture, Environmental Services and Agro-Tourism in the Dominican Republic. Journal of Agricultural and Development Economics 1: 87-116.

Chen M. (2006). Evaluation of Environmental Services of Agriculture in Taiwan. Working paper.

Chiueh Y-W & Chen M-C (2008). Environmental multifunctionality of paddy fields in Taiwan: an application of contingent valuation method. Paddy Water Environment 6: 229-236.

ChoiceMetrics, 2010. Ngene 1.0.2 User Manual& Reference Guide. ChoiceMetrics. Version 4/02/2010.

Christie M., Hanley N., Warren J., Murphy K., Wright R. & Hyde T. (2006). Valuing the diversity of Biodiversity. Ecological economics 58: 304 – 317.

Church A., Burgess J., Ravenscroft N., Bird N., Blackstock K., Brady E., Crang M., Fish R., Gruffudd P., Mourato S., Pretty J., Tolia-Kelly D., Turner K. & Winter M. (2011). Cultural Services. In The UK National Ecosystem Assessment Technical Report. UK National Ecosystem Assessment, UNEP-WCMC, Cambridge.

Clark E.H., Haverkamp J.A. & Chapman W. (1985). Eroding Soils: The off-farm Impacts. The Conservation Foundation, Washington, DC.

Colombo S., Calatra-Requena J., Hanley N. (2006). Analysing the social benefits of soil conservation measures using stated preference methods. Ecological Economics 58: 850-861.

Colombo S., Calatrava-Requena J. Gonzalez-Roa M.C. (2005). Testing choice experiment for benefit transfer. Paper prepared for presentation at the 99th seminar of the EAAE (European Association of Agricultural Economists), ‘The Future of Rural Europe in the Global Agri-Food System Copenhagen, Denmark, August 24-27, 2005.

Colombo S., Calatrava-Requena J., Hanley N. (2003). The economic benefits of soil erosion control: an application of the contingent valuation method in the Alto Genil basin of southern Spain. Journal of Soil and Water Conservation 58: 367–371.

Colombo S., Hanley N. (2008). How Can We Reduce the Errors from Benefits Transfer? An Investigation Using the Choice Experiment Method. Land Economics 84 : 128-147.

Cooper T., Hart K. & Baldock D. (2009). Provision of Public Goods through Agriculture in the European Union. Report Prepared for DG Agriculture and Rural Development, Contract No 30-CE-0233091/00-28, Institute for European Environmental Policy: London.

De Groot R.S., Fisher B., Christie M., Aronson J., Braat L., Haines-Young R., Gowdy J., Maltby E., Neuville A., Polasky S., Portela R. & Ring I. (2010). Integrating the ecological and economic dimensions in biodiversity and ecosystem service valuation. Chapter 1. In Kumar, P. (Ed), The Economics of Ecosystems and Biodiversity (TEEB): Ecological and Economic Foundations, Earthscan, London.

DeMaio, T. J. (1984). Social desirability and survey measurement: A review. In C. F. Turner and E. Martin (Eds.). Surveying subjective phenomena. Vol.2, pp. 257-281. New York, Russel Sage.

Dillman D., Smyth J. D., Christian L. M. (2009). Internet, Mail and Mixes Mode surveys: The Tailored Design Method, 3rd edition. John Wiley: Hoboken, NJ.

Domínguez-Torreiro M., Soliño M. (2011). Provided and perceived status quo in choice experiments: Implications for valuing the outputs of multifunctional rural areas. Ecological Economics 70:2523–2531.

Drake L. (1992). The Non-market Value of the Swedish Agricultural Landscape. European Review of Agricultural Economics 19: 351-364.

EC - Directorate-General for Agriculture and Rural Development (2011) Rural Development in the European Union. Available on: http://ec.europa.eu/agriculture/statistics/rural-development/2011/index_en.htm

ÉcoRessources Consultants (2009). Évaluation économique des biens et services environnementaux engendrés par l'agroforesterie. Étape 9 du projet Biens et services écologiques et agroforesterie: l'intérêt du producteur agricole et de la société. Report for Programme d' Adaptation d' Agriculture et Agroalimentaire Canada.

EFTEC (2004). Framework for Environmental Accounts for Agriculture. EFTEC, London. http://www.statistics.defra.gov.uk/esg/reports/envacc/ default.asp.

European Climate Adaptation Platform. Available on: http://climate-adapt.eea.europa.eu/map-viewer?cswRecordFileIdentifier=343166f9f0ad40cf07422939b1726510e81d55e6)

European Commission - Directorate-General Agriculture and Rural Development (2007). Scenar 2020 – Scenario study on agriculture and the rural world. Available on: http://ec.europa.eu/agriculture/agrista/2006/scenar2020/final_report/scenar2020final.pdf

European Commission - Directorate-General Agriculture and Rural Development (2007). Scenar 2020-II – Update of scenario study on agriculture and the rural world. Final report. December 2009. Available on:http://ec.europa.eu/agriculture/analysis/external/scenar2020ii/index_en.htm

European Forest Fire Information System (JRC) Available on: http://effis-viewer.jrc.ec.europa.eu/wmi/viewer.html

Eurostat – Agri-enviromental indicators. Available on: http://epp.eurostat.ec.europa.eu/portal/page/portal/agri_environmental_indicators/indicators_overview

Fisher B., Turner K. R. & Morling P. (2009). Defining and classifying ecosystem services for decision making. Ecological Economics 68: 643-653.

Fleischer A. & Tsur (2000). Measuring the Recreational Value of Agricultural Landscape. European Review of Agricultural Economics 27: 385-398.

Foster V. & Mourato S. (2000). Valuing the Multiple Impacts of Pesticide Use in the UK: A Contingent Ranking Approach. Journal of Agricultural Economics 51: 1-21.

Freeman A. III (1993). The Measurement of Environmental and Resource Values. Resources for the Future. Washington, DC.

Garrod G. D. & Willis K. G. (1995). Valuing the Benefits of the South Downs Environmentally Sensitive Area. Journal of Agricultural Economics 46: 160-173.

Gascoigne B., Koontz L., Hoag D., Tangen B., Gleason R. & Shaffer T. (2011). Valuing Ecosystem and Economic Services Across Land-use Scenarios in the Prairie Pothole Region of the Dakotas, USA. Ecological Economics 70: 1715-1725.

Goibov M., Schmitz P.M., Bauer S. and Ahmed M.N. (2012). Application of a Choice Experiment to Estimate Farmers Preferences for Different Land Use Options in Northern Tajikistan. Journal of Sustainable Development Vol 5, Nº 5.

González-Cabán, A., Loomis, J. Rodriguez, A., Hesseln, H. (2007). A comparison of CVM survey response rates, protests and willingness-to-pay of Native Americans and general population for fuels reduction policies. Journal of Forest Economics 13: 49-71.

Grammatikopoulou I., Pouta E., Salmiovirta M. and Soin K. (2012). Heterogeneous preferences for agricultural landscape improvements in southern Finland. Landscape and Urban Planning 107: 181-191.

Green, C. and Tunstall, S. (1999) A psychological perspective. In . Bateman and K. G. Willis (Eds.) Valuing environmental preferences: Theory and practice of the contingent valuation method in the US, EU, and developing countries, pp. 207-257. Oxford Oxford University Press.

Gren I.M. (1995). The Value of Investing in Wetlands for Nitrogen Abatement. European Review of Agricultural Economics 22: 157-172.

Hanemann M. (1999). The Economic Theory of WTP and WTA. In I. Bateman and K. Willis (Eds), Valuing Environmental Preferences: Theory and Practice of the Contingent Valuation. Oxford University Press, Oxford, pp. 42-96.Hanley N., Colombo S., Mason P. & Johns H. (2007). The reforms of support mechanisms for upland farming: paying for public goods in the Severely Disadvantage Areas of England. Journal of Agricultural Economics 58: 433-453.

Hanley N. (1988). Using Contingent Valuation to Value Environmental Improvements. Applied Economics 20: 541-549.

Hanley N., Colombo S., Tinch D., Black A. & Aftab, A. (2006). "Estimating the benefits of water quality improvements under the Water Framework Directive: are benefits transferable? European Review of Agricultural Economics 33: 391-413.

Hanley N., MacMillan D., Patterson I. & Wright R. E. (2006). Economic and the Design of Nature Conservation Policy: A Case Study of Wild Geese Conservation in Scotland. Animal Conservation 6: 123-129.

Hanley N., Macmillan, Wright R. E., Bullock C., Simpson I., Parsisson D. & Crabtree B. (1998). Contingent valuation versus choice experiments: estimating the benefits of environmentally sensitive areas in Scotland. Journal of Agricultural Economics 49: 1-15.

Hanley N., Oglethorpe D., Wilson M. & McVittie A. (2001). Estimating the value of environmental features, stage two, report to MAFF, Institute of Ecology and Resource Management University of Edinburgh and Scottish Agricultural College Edinburgh.

Hansen L. & Hellerstein D. (2007). The Value of the Reservoir Services Gained with Soil Conservation. Land Economics 83: 285-301.

Hansen L., Feather P. & Shank D. (1999). Valuation of Agriculture's Multi-site Environmental Impacts: An Application to Pheasant Hunting. Agricultural and Resources Economics Review 28: 199-207.

Hasund K., Kataria M., Lagerkvist C. (2011). Valuing public goods of the agricultural landscape: a choice experiment using reference points to capture observable heterogeneity. Journal of Environmental Planning and Management 54:31-53.

Hein L, van Koppen K., de Groot R.S. & van Ierland E.C. (2006). Spatial scales, stakeholders and the valuation of ecosystem services. Ecological Economics 57: 209-228.

Henry, G. T. (1998) Practical Smapling. In Bickman, Leonard e Debra J. Rog (Eds.), Handbook of Applied Social Research Methods, pp. 101-126. London & New Deli: Sage Publications.

Hensher D.A., Rose J.M. & Greene W.H. (2005). Applied Choice Analysis: A Primer, Cambridge University Press, Cambridge, UK.

Hoehn, J. & Randall, A. 1989. Too Many Proposals Pass the Benefit Cost Test. American Economic Review 79: 544-531.

Huber R., Hunziker M., Lehmann B. (2011). Valuation of agricultural land-use scenarios with choice experiments: a political market share approach. Journal of Environmental Planning and Management. 54: 93-113.

Hutchinson, W.G., Chilton, S.M. & Davis, J. (1996) Integrating Cognitive Psychology into the Contingent Valuation Method to Explore the Trade-Offs Between Non-Market Costs and Benefits of Alternative Afforestation Programmes in Ireland. In Adamowicz, W.L., Boxall, P., Luckert, M.K., Phillips, W.E. and White, W.A. (Eds) Forestry, Economics and the Environment, Oxford University Press.

Hynes S. & Hanley N. (2009). The Crex Crex Lament: Estimating Landowners Willingness to Pay for Corncrake Conservation on Irish Farmland. Biological Conservation 142: 180-188.

Jianjun J., Chong J., Thuy T.D., Lun L. (2013). Public preferences for cultivated land protection in Wenling City, China: A choice experiment study. Land Use Policy 30: 337– 343.

Johnston R., Schultz E., Segerson K., Besedin E., Ramachandran M. (2012). Enhancing the Content Validity of Stated Preference Valuation: The Structure and Function of Ecological Indicators. Land Economics 88: 102–120.

Johnston R.J. & Duke J.M. (2009). Informing preservation of multifunctional agriculture when primary research is unavailable: an application of meta-analysis. American Journal of Agricultural Economics 91: 1353–1359.

Kallas Z., Gómez-Limón J., Arriza M. (2006). Are citizens willing to pay for agricultural multifunctionality? Contributed paper prepared for presentation at the international Association of Agricultural Economists Conference, Gold Coast, Australia, August 12-18, 2006.

Kallas Z., Gómez-Limón J.A., Arriaza M. & Nekhay O. (2006). Análisis de la demanda de bienes y servicios no comerciales procedentes de la actividad agraria: el caso del olivar de montaña andaluz. Economía Agraria y Recursos Naturales 6: 49-79.

Kennedy A. M. & Wilson P. N. (2005). Reduced Tillage as an Economic Response to Clean Air Regulation. Cardon Research Papers in Agricultural and Resource Economics.

Kulshreshtha S. & Kort J. (2009). External Economic Benefits and Social Goods from Prairie Shelterbelts. Agroforestry Systems 75: 39-47.

Lavrakas, P. (1998). Methods for Sampling and Interviewing in Telephone Surveys. In Bickman, Leonard e Debra J. Rog (Eds.), Handbook of Applied Social Research Methods. London & New Deli: Sage Publications.

Le Goffe, P. (2000). Hedonic Pricing of Agriculture and Forestry Externalities. Journal Environmental and Resource Economics 15: 397-401.

Leip A *et al*. (2011). Integrating nitrogen fluxes at the European scale. In Mark A. Sutton, Clare M. Howard, Jan Willem Erisman, Gilles Billen, Albert Bleeker, Peringe Grennfelt, Hans van Grinsven and Bruna Grizzetti (ed.), The European Nitrogen Assessment. Cambridge University Press, pp. 345-376. (http://afoludata.jrc.ec.europa.eu/index.php/dataset/files/237)

Lindhjem, H. and S. Navrud (2011). Are Internet surveys an alternative to face-to-face interviews in contingent valuation? Ecological Economics 70: 1628-1637.

Lockwood M., Walpole S. & Miles C. (2000). Stated Preference Surveys of Remnant Native Vegetation Conservation. National Research and Development on Rehabilitation, Management and Conservation of Remnant Vegetation, Research Report 2/00.

Loomis J. (2004). Do nearby forest fires cause a reduction in residential property values? Journal of Forest Economics 10: 149-157.

Loomis J. B., González-Cabán A. & Gregory R. (1996). A Contingent Valuation Study of the Value of Reducing Fire Hazards to Old-Growth Forests in the Pacific Northwest. Research Paper PSW-RP-229-Web. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture, 24p.

Loomis J., Kent P., Strange L., Fausch K. & Covich A. (2000). Measuring the Total Economic Value of Restoring EcoSystem Services in an Impaired River Basin: Results from a Contingent Valuation Survey. Ecological Economics 33: 103-117.

Loomis J.B. & White D.S. (1996). Economic benefits of rare and endangered species: summary and meta-analysis. Ecological Economics 18: 197-206.

Loureiro M. L., McCluskey J. J. & Mittelhammer R. C. (2000). Willingness to Pay for Sustainable Agriculture. Report to the Federal State Marketing Improvement Program.

Louviere J.J., Hensher D.A. & Swait J.D. (2000). Stated Choice Methods – Analysis and Application. Cambridge University Press, UK.

Lynch L., Hardie I. & Parker D. (2002). Analyzing Agricultural Landowners' Willingness to Install Streamside Buffers. Working Paper of the Department of Agriculture and Resources Economics. The University of Maryland, College Park.

Ma S., Lupi F., Swinton S. M. & Chen H. (2011). Modeling Certainty-Adjusted Willingness to Pay for Ecosystem Service Improvement from Agriculture. Agricultural & Applied Economics Association´s 2011 AAEA & NAREA Joint Annual Meeting, Pittsburgh.

MacDonald D., Morrison M. (2005). The value of habitat and agriculture. CSIRO Land and Water Client Report.

MacMillan D., Philip, L, Hanley N. & Alvarez-Fariz B. (2003). Valuing non-market benefits of wild goose conservation: a comparison of interview and group-based approaches. Ecological Economics 43: 49-59.

Macmillan D.C. & Duff E.I (1998). The non-market benefits and costs of native woodland restoration. Forestry 71: 247-259.

Madureira L. (2006). Multi-attribute valuation of Douro Valley winescape based upon qualitative data for individual's attitudes regarding rural heritage and nature-related attributes. Paper presented at the II Conference of Associação Hispano-Portuguesa para o Ambiente e Recursos Naturais (AERNA) 2-3th June, 2006, ISCTE, Lisbon. Available at http://aerna2006.de.iscte.pt//.

Madureira L. (2001). Valoração Económica de Atributos Ambientais e Paisagísticos através de Escolhas Contingentes. Ph Thesis. Universidade de Trás-os-Montes e Alto Douro, Portugal.

Madureira L., Nunes L. C. & Santos, J. L. (2005). Valuing Multi-Attribute Environmental Changes: Contingent Valuation and Choice Experiments. Paper presented at the 14th EAERE (European Association of Environmental and Resources Economics) Annual Conference, 23-26th June, 2005, Bremen, Germany.

Madureira L., Rambonilaza T. & Karpinski I. (2007). Review of methods and evidence for economic valuation of agricultural non-commodity outputs and suggestions to facilitate its application to broader decisional contexts. Agriculture Ecosystems & Environment 120: 5-20.

Maes J., Braat L., Jax K., Hutchins M., Furman E., Termansen M., Luque S., Paracchini M. L., Chauvin C., Williams R., Volk M., Lautenbach S. Kopperoinen L., Schelhaas M.-J., Weinert J., Goossen M., Dumont E., Strauch M., Görg C., Dormann C., Katwinkel M., Zulian G., Varjopuro R., Ratamäki O., Hauck J., Forsius M., Hengeveld G., Perez-Soba M., Bouraoui F., Scholz M., Schulz-Zunkel C., Lepistö A., Polishchuk Y. & Bidoglio, G. (2011). A spatial assessment of ecosystem services in Europe: methods, case studies and policy analysis - phase 1. PEER Report No 3. ISPRA: Partnership for European Environmental Research.

Manley J. G, van Kooten G.G., Moeltner K., & Johnson D. W. (2003). Creating Carbon Offstes in Agriculture through No-Till Cultivation: a Meta-Analysis of Costs and Carbon Benefits. Working Paper.

Marta, C., Freitas, H., Domingos, T., (2007) Testing for the survey mode effect on contingent valuation data quality: a case study of web based versus in-person interviews. Ecological Economics 62: 388–398.

McVittie A., Moran D. & Thomson S. (2009). A Review of Literature on the Value of Public Goods from Agriculture and the Production Impacts of Single Farm Payment Scheme. Rural Policy Centre Research Report.

MEA (Millennium Ecosystem Assessment) (2005). Ecosystems and human well-being: synthesis. Island Press, Washington D.C. [http://www.millenniumassessment.org]

Mendelsohn R. (1999). The Impact of Climate Variation on US Agriculture in the Impact of Climate Change on the United States Economy. In Neumann J. E. and Mendelsohn R. (Eds.), Industrial Economics Incorporated. Cambridge, Massachusetts.

Mollard A., Rambonilaza M. & Vollet D. (2006). Aménités environnementales et rente territoriale sur un marché de services différenciés : le cas du marché des gîtes ruraux labellisés en France. Reveu d'économie politique 116: 251-275.

Moran D. (2005). The economic valuation of rural landscapes, AA21 study for SEERAD.

Moran D., McVittie A., Allcroft D. & Elston D. (2004). Beauty, beast and biodiversity: what does the public want from agriculture? Final report to SEERAD.

Moss & Chiltern (1997). A Socio-Economic Evaluation of the Mourne Mountains and Slieve Croob Environmentally Sensitive Areas Scheme, Centre for Rural Studies.

Natura 2000 network available on: http://www.natura.org/.

Navrud, S & R. Ready (eds.) (2007). Environmental Value Transfer: Issues and Methods. Dordrect, The Netherlands: Springer (Kluwer Publishers).

Nielsen, J. S. (2011). Use of the Internet for Willingness-to-pay Surveys. A Comparison of Face-To-Face and Web-Based Interviews. Resource and Energy Economics 33: 119–129.

Nijkamp P., Vindigni G. & Nunes P. A.L.D. (2008). Economic valuation of biodiversity: A comparative study. Ecological Economics 67: 217-231.

Norris K., Bailey M., Baker S., Bradbury R., Chamberlain D., Duck C., Edwards M., Ellis C. J., Frost M., Gibby M., Gilbert J., Gregory R., Griffiths R., Harrington L., Helfer S., Jackson E., Jennings S., Keith A., Kungu E., Langmead O., Long D., Macdonald D., McHaffie H., Maskell L., Moorhouse T., Pinn E., Reading C., Somerfield, P., Turner S., Tyler C., Vanbergen A. & Watt A. (2011). Biodiversity in the Context of Ecosystem Services. In The UK National Ecosystem Assessment Technical Report. UK National Ecosystem Assessment, UNEP-WCMC, Cambridge.

OECD (2000). Valuing Rural Amenities. OECD, Paris, France.

Oglethorpe D. R. (2005). Environmental Landscape Features (ELF) Model Update. Report to DEFRA.

Olsen, S. B. (2009). Choosing Between Internet and Mail Survey Modes for Choice Experiment Surveys Considering Non-Market Goods. Environmental and Resource Economics 44: 591–610.

Paliwal R., Geevarghese G. A., Babu P. R. & Khanna P. (1999). Valuation of Landmass Degradation Using Fuzzy Hedonic Method: A Case Study of National Capital Region. Environmental and Resources Economics 14: 519-543.

Paracchini M.L., Petersen J.-E., Hoogevee, Y., Bamps C., Burfield I. & Swaay C. (2008). High Nature Value Farmland in Europe - An estimate of the distribution patterns on the basis of land cover and biodiversity data. Joint Research Centre.

Poe G. L. & Bishop R. C. (1999). Valuing the Incremental Benefits of Groundwater Protection when Exposure Levels are Known. Environmental and Resources Economics 13: 341-367.

Polasky S., Nelson E., Pennington D. & Johnson K. A. (2011). The Impact of Land-Use Change on Ecosystem Services, Biodiversity and Returns to Landowners: A Case Study in the State of Minnesota. Environmental and Resources Economics 48: 219-242.

Pruckner, G. (1995). Agricultural Landscape Cultivation in Austria: An Application of the CVM. European Review of Agricultural Economics 22: 173-190.

Randall A., Kidder A. & Chen D.R. (2008). Meta-Analysis for Benefits Transfer – Toward Value Estimates for Some Outputs of Multifunctional Agriculture. 12th Congress of the European Association of Agricultural Economists – EAAE 2008.

Randall, A. (2002). Valuing the outputs of multifunctional agriculture. European Review of Agricultural Economics 29: 28–307.

Randall, A. (2007). A consistent valuation and pricing framework for non-commodity outputs: Progress and prospects. Agriculture, Ecosystems & Environment 120: 21-30.

Ready R. & Abdalla C. (2005). The amenity and disamenity impacts of agriculture: estimates from a hedonic pricing model. American Journal of Agricultural Economics 87: 314–326.

Revéret J. P., Dupras J., Charron I. & Lucchetti J. L. (2009). Volonté de payer de citoyens que cois pour des biens et services écologiques issues de changement de pratiques agricoles. Report of Agriculture et Agroalimentaire Canada et Groupe AGÉCO.

Ribaudo M. (1989). Water Quality Benefits from the Conservation Reserve Program. U.S. Dept. of Agriculture, Economic Research Service.

Ribaudo M. O., Osborn T. & Konyar K. (1994). Land Retirement as a Tool for Reducing Agricultural Nonpoint Source Pollution. Land Economics 70: 77-87.

Ribaudo M., Young C. E., Epp D. J. (1984). Recreation Benefits from an Improvement in Water Quality at St. Albans Bay, Vermont. United States. Dept. of Agriculture. Natural Resource Economics Division.

Riera P, Signorello G, Thiene M, Mahieu P-A, Navrud S, Kaval P, Rulleau B, Mavsar R, Madureira L, Meyerhoff, J, Elsasser P, Notaro S, Salvo M., Dragoi S. (2012). Non-Market Valuation Good Practice Guidelines Proposal for Forest Goods and Services. Journal of Forest Economics 18: 259-270.

Riera, P. & Mogas, J. (2002). Evaluation of risk reduction in forest fires in a Mediterranean region. Forest Policy and Economics 6: 521-528.

Riera, P. and Signorello, G. (Eds.) (2012). Good Practice Guidelines for the Non-Market Valuation of Forest Goods and Services. Leading authors: Kaval, P, Madureira, L, Mahieu, P-A, Meyerhoff, J, Mavsar, R, Navrud, S, Riera, P, Rulleau, B, Salvo, M, Signorello, G, Thiene, M. DiGeSA, Department of Agri-Food and Environmental Systems Management. University of Catania, Italy.

Rodríguez-Entrena M., Barreiro-Hurlé J., Gómez-Limón J. A., Espinosa-Godedd M., Castro-Rodriguez J. (2012). Evaluating the demand for carbon sequestration in olive grove soils as a strategy toward mitigating climate change. Journal of Environmental Management 112: 368-376.

Rose J. M. and Bliemer M. C. J. (2008). 'Stated Preference Experimental Design Strategies' in Handbook of Transport Modelling, ed. D.A Hensher and K.J. Button, Elsevier, Oxford, United Kingdom, pp. 151-179.

Rose, J. M. & Bliemer, M. C. J. (2009). Constructing Efficient Stated Choice Experimental Designs. Transport Reviews 99999: 1-39.

Santos J. (1997). Valuation and Cost-Benefit Analysis of Multi-Attribute Environmental Changes. Ph Thesis. University of Newcastle upon Tyne, United Kingdom.

Santos J. (1998). The Economic Valuation of Landscape Change. Theory and Policies for Land Use and Conservation. Edward Elgar, Cheltenham.

Santos J. L. (2000). Problems and Potential in Valuing Multiple Outputs: Externality and Public-good non-commodity Outputs from Agriculture. In OCDE (Ed), Towards Policies for Rural Amenities? Valuing Public Goods and Externalities, Paris, OECD: 41-79.

Santos J. L. (2007). Transferring landscape values: how and how accurately? In Navrud, Stale and Richard Ready (Eds), Environmental value transfer. Issues and Methods. Dordrecht, The Netherlands: Springer: 45-75.

Scarpa R. & Rose, J.M. (2008). Design efficiency for non-market valuation with choice modelling: how to measure it, what to report and why. The Australian Journal of Agricultural and Resource Economics 52: 253–282.

Scarpa R., Campbell D. & Hutchinson G. (2007). Benefit Estimates for Landscape Improvements: Sequential Bayesian Design and Respondents' Rationality in a Choice Experiment. Land Economics 83: 617-634.

Scarpa, R., Gilbride, T.J., Campbell, D., Hensher, D. A. (2009). Modelling attribute non-attendance in choice experiments for rural landscape valuation. European Review of Agricultural Economics 36: 151-174.

Segerson K. and Dixon B. L. (1999). Climate Change and Agriculture: The Role of Farmer Adaptation, in the Impact of Climate Change on the United States Economy Edited by Neumann J. E. and Mendelsohn R. Industrial Economics Incorporated, Cambridge, Massachusetts.

SEPA (2006). An instrument for assessing quality of environmental valuation studies. In S. E. P. Agency (Ed.). Bromma.

Siriex A. (2003). Le Paysage Agricole: Un Essai d'Évaluation. Thèse por obtenir le grade de Docteur de L´Universite de Limoges.

Smith P., Ashmore M., Black H., Burgess P., Evans C., Hails R., Potts S.G., Quine T., Thomson A., Biesmeijer K., Breeze T., Broadmeadow M., Ferrier R., Freer J., Hansom J., Haygarth P., Hesketh H., Hicks K., Johnson A., Kay D., Kunin W., Lilly A., May L., Memmott J., Orr H., Pickup R., Purse B. & Squire G. (2011). Regulating services. In The UK National Ecosystem Assessment Technical Report. UK National Ecosystem Assessment, UNEP-WCMC, Cambridge.

Snyder S. A., Kilgore M. A., Hudson R. & Donnay J. (2007). Determinants of forest land prices in northern Minnesota: a hedonic pricing approach. Forest Science 53: 25-36.

Söderqvist, T. and Soutukorva, Å. (2009). On how to assess the quality of environmental valuation studies. Journal of Forest Economics 15: 15-36.

Stetler K.M, Ven T. J & Calkin D. E. (2010). The Effects of Wildfire and Environmental Amenities on Property Values in Northwest Montana, USA. Ecological Economics 69: 233-243.

Swanwick C., Hanley N. & Termansen M. (2007). Scoping study on agricultural landscape valuation. Final Report to DEFRA.

Takatsuka Y., Cullen R., Wilson M., Wratten S. (2006). Values of Ecosystem Services on Arable Land and the Role of Organic Farming. Paper prepared for the 3rd World Congress of Environmental and Resource Economists, Kyoto, Japan on July 3-7, 2006.

TEEB (The Economics of Ecosystems and Biodiversity) (2010). The economics of ecosystems and biodiversity: Ecological and economic foundations. Earthscan, London. [http://www.teebweb.org].

Thomassin, P. J. & R. Johnston (2008). Benefit Transfer of Water Quality Improvements from Agricultural Landscapes: A Meta-Analysis. Presentation at the Apllied Economics Association Annual Meeting, 29th July, 2008, Orlando, Florida.

Travisi C. & Nijkamp P. (2004). Willingness to Pay for Agricultural Environmental Safety: Evidence From a Survey of Milan, Italy, Residents. FEEM Working paper Nº 100-04.

Turner R.K., Paavola J., Cooper P., Farber S., Jessamy V. & Georgiou, S. (2003). Valuing nature: lessons learned and future research directions. Ecological Economics 46: 493-510.

UK NEA- UK National Ecosystems Assessment (2011). Synthesis of the key findings. UNEP-WCMC, Cambridge. [http:/uknea.unep-wcmc.org]

Vanslembrouck, I., Huylenbroeck G. V. & Meensel J. V. (2005). Impact of Agriculture on Rural Tourism: A Hedonic Pricing Approach. Journal of Agricultural Economics 56: 17-30.

Wang X., Bennett J., Xie C., Zhang Z., Liang D. (2007). Estimating non-market environmental benefits of the conversion of cropland to forest and grassland program: a choice modeling approach. Ecological Economics 63: 114-125.

White E., Veeman M. &Adamowicz W. (2004). Financial and Health Costs of Pesticide Use in Growing Conventional and Genetically Modified Potatoes in Prince Edward Island. Annual Meeting of The Canadian Agricultural Economics Society, Halifaz, 2004.

White P. C. L. & Lovett J. C. (1999). Public Preference and Willingness-to-Pay for Nature Conservation in North York Moors National Park, UK. Journal of Environmental Management 55: 1-13.

White P.C.L., Bennett A.C. & Hayes E.J.V. (2001). The use of willingness-to-pay approaches in mammal conservation. Mammal Review 31: 151-167.

White P.C.L., Gregory K.W., Lindley P.J. & Richards G. (1997). Economic values of threatened mammals in Britain: A case study of the otter Lutra lutra and the water vole Arvicola terrestris. Biological Conservation 82: 345-354.

Willis K. & Garrod G.D. (1990). The Individual Travel Cost Method and the Value of Recreation: The Case of the Montgomery and Lancaster Canals. Environment and Planning C: Government and Policy 8: 315-326.

Willis K. G., Garrod G. D., Benson J. F. & Carter M. (1996). Benefits and Costs of the Wildlife Enhancement Scheme: A Case Study of the Pevensey Levels. Journal of Environmental Planning and Management 39: 387-402

Willis, K.G., Garrod G. D. & Saunders, C. M. (1995). Benefits of Environmentally Sensitive Area Policy in England: A Contingent Valuation Assessment. Journal of Environmental Management 44: 105–125.

Woodward R.T. & Wui Y. S. (2000). The economic value of wetland services: a meta-analysis. Ecological Economics 37: 257-270.

Annexes

Annex I - Literature review on the specification of public goods related to agriculture for non-market valuation

Landscape

	Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
Lg	Alvarez-Farizo *et al.*, 1999	CVM-OE	Landscape change (prevent change); Wildlife & Landscape quality	Broadleaved, native woodlands, wetlands, herb rich pasture, heather moorland, dykes, hedges, archaeological features	Regional: ESAs Breadalbane & Machair (Scotland, UK)	Decline	Maintenance	Resident; Visitors; General Public (UK)
Mat	Arriaza *et al.*, 2008	CM	Non-commodity goods and services of mountain olive groves in the region of Andalucía	Provision of landscape (visual quality and preservation of biodiversity)-%other fruit trees; Soil erosion control-reduction on erosion rate; Food safety-reduction in residual substances in olive oil; Maintenance of rural populations-reduction in farm abandonment	Regional: Andalusia, Spain	Only olive groves; soil erosion rate 13t/ha/year; Amount of residuals in the food. Status quo: Current level; Percentage of abandoned farms after policy reform: 50% farm abandonment	1) Percentage of other fruit trees-Level 1: 10% of the area with other fruit trees; Level 2: 20% of the area with other fruit trees; 2) Rate of soil erosion; Level 1: 5 t/ha/year; Level 2: 1 t/ha/year; 3) Amount of residuals in the food. Level 1: 50% reduction; Level 2: 100% reduction; 4) Percentage of	Residents

	Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
							abandoned farms after policy reform. Level 1: 25% farm abandonment; Level 2: 10% farm abandonment.	
Mat	Baskaran *et al.*, 2009	CM	Improvement in the quality of 4 ecosystems services linked to agriculture	Air quality (30%, 10% and none reduction in methane gas emissions); Water quantity (30%, 10% and none reduction in water use for irrigation; Water quality (30%, 10% and none reduction in nitrate leaching to waterways; Scenic landscape (30% more scenic views –such trees-on pastoral farms, no change in scenic views on pastoral farms	Regional: Oxfords Recreational Hunting area, NZ	No change	Combination of levels of attributes	New Zealand (NZ)
Lg	Bastian *et al.*, 2002	HP-GIS based	Valuation of environmental amenities and agricultural land	Remote agricultural lands: Wildlife habitats, angling opportunities and scenic vistas	Regional: Wyoming, US			(Land market of Wyoming, US)
L&Bg	Bateman & Langford, 1997	CV-OE	Preservation of wetland		Local: Norfolk Broads (National Park)	SQ (P-off): Saline flooding	ESA (P-on)	Non-users (UK)

	Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
Lg	Bateman *et al.*, 1996	CV-OE	Provision of 40 ha of community woodland		Local: Oxfordshire	Arable	Woodland. (Values for specific land use change)	UK
Lg	Bellù and Cistulli, 1997	CV and TCM	Forest	Value of forest recreational activities and tourism	Regional: Seven forest areas in Liguria Region, Italy	Current	Maintenance of the current conditions	visitors
Lat	Bonnieux & La Goffe, 1997	CVM-DC	Landscape change (obtain improvement): restoration (restore 2,400 km of hedgerows over a 10 year period)	Hedgerows	Regional: NRP (France)	Disappearance	Increase	Resident population
Mat	Borresch *et al.*, 2009	CE	Value of multifunctional agricultural landscape	Plant biodiversity (170, 190, 205-SQ, 225, 255 plants/km2); Animal biodiversity (50%, 70%-SQ, 80%, 90%, 100% of desire population); Water quality (<10 mg,10-25 mg,50-90 mg, >90 mg Nitrate/l; Landscape aesthetics (SQ, Multifunctional scenario, Grassland dominated scenario, Intensity scenario, High price scenario	Regional: Wetterau, Germany	SQ	Increase and decrease	Residents
Lg	Bostedt & Mattson, 1995	CV	Forest recreation use	Stand density; proportion of broadleaves; size of clear-cuts; tree age, accessibility	Regional: Norrbotten and Blekinge, Sweden			Visitors

	Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
Lg	Bowker & Didychuk , 1994	CV-PC	Value of farmland preservation	Preserved land (acres)	Regional: Moncton, Brunswick, Canada		Prevent farmland development	Residents
L&Bg	Brouwer & Slanger, 1997	CV	Wildlife preservation measures by farmers	Peat meadow land, NL	National: Dutcheat meadow land		Preserving peat meadow land	Residents
L&Bg	Buckley *et al.*, 2009	CV-DC	Public access and trail improvements on commonage farmland	Walking related attributes; site attributes: landscape, biodiversity, trail facilities/features	Regional: Lencoaghan and the Connemara National Park	SQ – Informal access	Way marked scenario	Visitors
Lg	Bullock & Kay, 1997	CV-DC (+Continuous follow up)	Landscape change: Reductions in grazing levels	Degree of erosion; Quantity of heather or scrub; Diversity	Regional: Central Southern Uplands of Scotland (ESA)	SQ (P-off)	2 Grazing extensification scenarios (P-on)	Visitors; General public (UK)
Lat	Campbell *et al.*, 2005	CE	Landscape' features preservation	Mountain land Landscape with cultural heritage Landscape with stonewalls	Ireland	SQ (P-off)	Actions aimed to improve landscape features (2 levels of action) (P-on)	General public Ireland
Lat	Campbell *et al.*, 2005	CE	Landscape' features preservation	Pastures Landscapes with hedgerows Landscape with wildlife habitats	Ireland	SQ (P-off)	Actions aimed to improve landscape features (2 levels of action) (P-on)	General public Ireland

	Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
Lat	Catalini & Lizardo, 2004	CV	Agro-tourism and positive externalities of agriculture	Soil conservation; efficient water use; biodiversity; habitat conservation; forest conservation; natural landscape conservation; conservation of rural traditions and culture; development of organic agriculture	Regional: Rio Limpio, San Juan de la Maguana, Dominican Republican	Agro-tourism in conventional farming	Agro-tourism in organic farming	Visitors
Lat	Chiueh & Chen, 2008	CV-DC	Preservation of agricultural land; Environmental multifunctional benefits of paddy fields	Space; green land; natural habitats; helping retaining excessive rainwater and supply for ground water	National: Taiwan	Current decreasing in paddy land due to free trade	Restoring arable land (1% and 4%)	General public Taiwan
Lg	Colson and Stenger, 1996	CV-PC	Landscapes bocager	Recovery of bocages	Regional: Departement of Loire Atlantique - All agricultural land	Current	Restore landscape	General public, France
Lg	Crossman & Bryan, 2008	Actual expenditure/market price of output (Opportunity costs for farmers)	Value of ecological restoration (from traditional farming)		Regional: Murray-Darling Basin, Australia	Ecological restoration	Traditional farming	

	Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
L&Bg	Drake, 1992b	CV-PC; OE	Prevent change in land use (Preserve agricultural farmland)	Variety of goods and services associated with the “open varied” agricultural landscape. Include biological diversity (rare plant species), scenic view, and services such walking, etc.	National: Sweden	Spruce forest	Agricultural farm land	General Population, SW
Mat	EcoRessources Consultants, 2009	BT; Change in productivity; HP; CE	Value of a set of 8 environmental goods and services provide by agro-forest	Reduction in agricultural odours; landscape aesthetics; improvement of surface quality water; enrichment of terrestrial species diversity; carbon sequestration; increase in number of pollinator wild insects; reduction in the cost of treating drinking water	Regional: Watershed of two rivers in Quebec, Canada		Change in agricultural and forest practices	Residents
Lg	Fleischer & Tsur, 2000	CV & TCM	Preserving agricultural landscape		Regional: Hula and Jezreel Valleys, Israel	Urbanisation for tourism (resort development)		Visitors
	Garcia and Jacob, 2010	TCM	Forest	Use of the forest to recreation				France
Lat	Garrod &Willis, 1992	HP	Rural landscape and presence of forestry	Housing (nº), Woodland, Water and Wetland				

	Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
L&Bg	Garrod & Willis, 1995	CV-OE. CV-DC	Conservation of agricultural landscape (Chalk downland)	Scenic quality; chalk grassland; important flora and fauna; breeding sites for birds, ancient field systems; archaeological sites	South Downs ESA	SQ (P-off) Current	ESA (P-On)	Residents Visitors General public, UK
Lat	Goio & Gios, 2011	CV-OE	Recreational function of the landscape	Woods, mushrooms, angling	Local: Sinnelo Valley, Trento, Italy	Opening a quarry		Fisherman; Mushroom pickers; Residents; Tourists and Hickers
Lg	Hackl *et al.*, 2007	Panel data estimation	Landscape amenities	Continued provision of agricultural landscape services in mountain regions	Alpine touristic communities (Switzerland)	Provision of agricultural landscapes services endangered.	To guarantee optimal provision of local public goods in the form of agricultural landscape services	Farmers
L&Bg	Hanley &Craig, 1991	CV-OE	Environmentally sensitive peat bogs (habitats)		Local: Flow, country of Northern Scotland (Wetland)	Current afforestation rate	No more afforestation. (Values for specific land use change)	
Lg	Hanley & Knight, 1992	CV	Prevent greenbelt land from development (urbanisation)	pastureland	Local: 38 ha, Greenbelt around Chester, UK	Existing pasture plot	Maintenance of pasture plot vs. construction	Residents

	Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
Lat	Hanley *et al*., 1998	CV-OE; CV-DC; CE	Prevent loss in wildlife and landscape quality	Flora, landscape, archaeological features; Woods; archaeological; Heather moors; Wet grassland; Dry stone walls	Regional: Breadalbane (ESA),Scotland	Agricultural methods that fail to maintain wildlife and landscape quality. SQ (P-off)	Improve (change agricultural practices through ESA agri-environmental scheme (P-on)	General public (UK): Residents; Visitors
L&Bg Lat	Hanley *et al*., 2001	CV-OE CE	Value of landscape features	Rough grassland; Heather moorland; Salt marsh; Farm woodland; Wetland; Hay meadows; Field margins; Hedgerows Hedgerows (0-10% increase); Hedgerows (0-50% increase); Field margins (0-10% increase); Field margins (0-25% increase)	Various regions: Devon, Hereford, Cambridge-shire, Yorkshire Pilot-Regional	SQ (P-off)	Increase in the area in good condition and well managed of; Increase in extension (in % variation for CE)-P-on Hedgerows (0-10% increase); Hedgerows (0-50% increase); Field margins (0-10% increase); Field margins (0-25% increase)	Residents
L&Ba t	Hanley *et al*., 2007	CE	Valuing landscape features and habitats	Heather moorland and bog; Rough grassland; Mixed and broadleaved woodland; Field boundaries; Cultural heritage (traditional farm buildings, traditional livestock breeds, traditional farming practices as shepherding with sheep dogs)	4 Less Favoured Areas of England	Hill-farm viability now depends on subsidy support, and many farms would have a negative income in the absence of subsidies	Varying levels -12%; -2%; +5% Etc. For every 1km 50; 100; 200 m restored. Rapid decline; no change; much better conservation)	Residents; General population

	Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
L&Bg	Hutchins on *et al.*, 1996	CV-PC	Increase woodland	10% and 20% increase in woodland	North Ireland	Rough grazing; Peatland	Woodland (Values for specific land use change)	North Ireland
Mat	Kallas *et al.*, 2006	CE	Benefits of upland olive groves	Landscape quality (% of other fruit trees); Soil erosion (ton of soil lost per year); Food safety (% of residual in comparison with conventional farming); Rural population fixation	Andalucía	Risk of land abandonment (olive groves)	Other fruit trees (SQ; =10%; 20%); Soil erosion; (SQ-13 t/year; 5 t/year; 1 t/year); (SQ; reduction by halve of food residuals; total elimination); Exploitations abandonment (SQ-505; 25%; 10%)	Resident
Mat	Kubickov a, 2004	CV	Agricultural landscape amenities	Landscape amenities: environmental protection, quality of life, protection of cultural heritage, prosperity of tourism; Agricultural landscape-cultivating activities include mowing grasslands, care of rural trails, preservation of species	PLA-Protected Landscape Area of White Carpathians, Czech Republic	Decrease (P-off)	Current level of agricultural landscape amenities (P-on) Agri-environment scheme	Residents; Visitors
Lat	Le Goffe & Delache, 1997	HP	Preferences towards different land uses of landscape	Cultivated fields; Pasture; Sea; Permanent prairies; Forest	Regional: Bretagne, France			Visitors
Lat	Le Goffe, 2000	HP	Preferences towards different land uses of landscape (External effects of	Livestock density; Permanent grassland; Cereal crops; Forests	Britanny, France			Visitors

	Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
			agriculture and forest activities)					
Mat	Leitch and Hovde, 1996	BT: input-output analysis	Wetlands	Groundwater Recharge, Flood Control, Wildlife Habitat, Aquatic Habitat, Agricultural Uses, Sediment Entrapment, Nutrient Assimilation, Aesthetics, and Education/Research.	National: Nome wetland Buchanan; Alice; Tower City wetland Rush Lake wetland complex	Current	Maintenance of the current values	
Lat	Liljenstolpe, 2011	HP-GIS based	Valuation of visual effects (of landscape)	Grasslands, Meadows, Wetlands, Cultivate land, Pasture, Riparian land,	National: Sweden			Visitors
Lat	Loureiro & Lopez, 2008	CM	Valuing cultural landscape and rural heritage	History (historical monuments); Tradition (preservation of local traditions, local foods, and rural settlements); Environment (preserving local environmental and keeping it clean); Agri-forest landscape (preserving agricultural and forestry traditional landscape)	Local: Ribeira Sacra, Spain	Abandonment of agriculture landscapes and local traditions, which results in the disuse of local cultural and historical sites	Two alternative programmes	Visitors
Lg	MacMillan and Duff, 1998	CV	Forest	Forest restoration	Local: Affric and Strathspey forests, Schotish	Current moorland landscape	Landscape impact, recreational opportunities ,importance ‘keystone’ species of the target state (a restored native forest)	Residents

	Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
Lat	Madureira *et al.*, 2005	CV CM	Agricultural landscape attributes	% area with traditional almond orchards; % Woodland; %Scrubland	Local: Alto Douro, Portugal	SQ – P-off	Agri-environmental schemes to preserve traditional landscape and/or avoid land abandonment – P-on	Visitors General population
Lat	Madureira, 2006	CV	Agricultural landscape attributes	Dry stone terrace; hedges; woodland; Biodiversity high spots	Local: Douro winescape	SQ – P-off	Agri-environmental schemes to preserve traditional vineyards an related attributes	Visitors
L&Bat	Marta *et al.*, 2005	CV	Cereal steppes of Castro Verde (Portugal)	(1) rural landscape; (2) refuge for many steppe birds, such as the great bustard, Otis tarda L., the little bustard, Tetrax tetrax L., and the lesser kestrel, Falco naumanni Fleisher; (3) the provision of aesthetic information.	Local: Castro Verde, Portugal	current environmental services, namely:(a) scenic beauty; (b)birds species preservation	Maintenance the area scenic beauty and species	General population
Lat	McCollum *et al.*, 1990	TCM	Forest	Recreational activities in forests: general recreation, developed camping, primitive camping, swimming, wildlife observation, cold water fishing, warm water fishing, day hiking, big game hunting, picnicking, sightseeing, gathering forest products, and wilderness recreation.	Regional: 9 United States Forest Service (USFS) regions and the state of Alaska.			Visitors
Lat	Mollard *et al*, 2006	HP	Landscape features and environmental amenities in rural lodgement rice	Fodder surface; Prairies area; Communal land area	Regional: Touristic destinies, France (Aubrac and Baronnies)			Visitors

	Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
Lg	Moran *et al.*, 2004	CE	Landscape (general)		National: South, Central and North Scotland	Current practices	Enhance landscape appearance	
Lg	Moss & Chiltern, 1997	CV	Rough land protected		Mourme mountains and Slieve Croob ESA scheme	SQ (P-off)	ESA (P-On)	General population, North Ireland
L&Bg	Nunes, 2002	CV	Rural and wild rural landscape	Park protection from tourist pressure	National Park in Portugal			General population, Portugal
L&Bg	Oglethorpe, 2005	BT	Avoid loss in landscape features	Hay meadow; Heather moorland or heathland; Rough grazing; Woodland; Arable headland; Hedgerows, Wetland				UK
Lg	Paliwal, 1999	HP	Preservation of agricultural land		Local: National Capital Territory (NTC) of Delhi, India		Non-agriculture use (urbanisation)	

	Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
L&Bg	Oglethorpe, 2005	CV	Wetland	wetland retention and restoration	Manitoba, Canada	continued decline in wetlands from the current (2008) wetland area of 1,044,102 acres to 949,184 acres (or 70% of the wetland areas that existed in 1968) in 2020	A change in the number of wetland acres that would exist in 2020 as follows: a) Retention at the 2008 current level of 1,044,102 acres; b) Restoration to 80% of the 1968 level of 1,355,977 acres; c) Restoration to 83% of 1968 level; d) Restoration to 89% of 1968 level; e) Restoration to 100% of 1968 level; f) Retention and low restoration levels (80% and 83%) combined; and g) Retention and high restoration levels (89% and 100%) combined.	Manitoba residents
L&Bg	Pruckner, 2005	CV	Value of agricultural landscape	Mowing grassland; thinning out forest; taking care of rural trails	Austria	Assure preservation. WTP per party travel per day into a fund		Tourists

	Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
Lat	Oglethorpe, 2005	CE	Hedgerows, farm buildings and scrubland	landscape quality (the landscape integration of farm buildings; the maintenance or planting of hedges to relay agri-environmental action; and the preservation of scrubland from forest extension)	Monts d'Arrée region (in Brittany, France)	no public landscaping action	Landscaping action programme in terms of the visual landscape attributes and the financial burden attribute.	Tourist; Residents
Mat	Ready & Abdalla, 2005	HP-GIS based	Amenity and disamenity impacts of agriculture	Open space; wildlife habitat, groundwater recharge	Regional: Berks County, Pennsylvania			Residents
Lat	Santos, 200	CV-DC	Preserving traditional landscape	Farm terraces Meadows Woodland	Local National Park Peneda-Gerês, Portugal	SQ/P-off	Preserve landscape feature with agri-environmental schemes	Visitors
Lat	Sayadi *et al.*, 1999	CA	Agrarian landscape features	Type of vegetation layer (abandoned, dry, irrigated, virgin lands); Density of rural buildings (none, light, intense); Level of incline (Low, intermediate, High)	Regional: Alpujarras (Granada, Spain)			Visitors
Lat	Sayadi *et al.*, 2009	CVM; CA	Value of agricultural landscapes	CA (1999). CVM WTP for a day lodging enjoying different views	Regional: Alpujarras (Granada, Spain)			Visitors

	Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
Lat	Scarpa *et al*, 2007	CM CE	Benefits of major landscapes improvements addressed by the Rural Environmental Protection Scheme	Value of landscape improvements including mountain land, stonewalls, farmyard tidiness (phosphorous loading); cultural heritage	Ireland	No action – current SQ (P-off)	The magnitude level of environmental change is either a high level ('A Lot of Action') or intermediate level ('Some Action') of improvement under the Rural Environmental Protection Scheme. "A lot of action"; "Some action"(P-on)	General population, Ireland
L&Bg	Shresta *et al.*, 2007	CV-OE	Value of the Reserve, which is particularly important for wild Asiatic buffalo and migratory birds.	wild Asiatic buffalo and migratory birds.	Koshi Tappu Wildlife Reserve, Nepal	Compensation for their foregone access to resources and perpetual protection of the Koshi Tappu Wildlife Reserve	Preserve wildlife reserve	Residents (households)
Lg	Siriex, 2003	CVM	Open landscapes (agricultural)		Park Natural Regional, Millevaches, Limousin, France		P-On (agri-environmental scheme)	Residents; Visitors

	Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
Lg	Souhtgate el al., 2010	CV	WTA scaling back farmed area		Regional: Two watershed areas in the Andean region, Ecuador and Guatemala	Current cultivate area	Reduce cultivate areas	Farmers
Lat	Taylor *et al*., 1997	CV	Characteristics and quality of forest landscape	Species diversity; Ideal forest	Whole country			UK
Lg	Tempesta, 1998	CV-OE	Landscape conservation		Isonzo and Tagliamento Rivers (Friuli-Venezia Giulia)			Residents
Mat	Vanslembrouck *et al*., 2005	HP	Preferences towards different land uses of landscape (External effects of agriculture and forest activities)	Livestock density; Nitrogen (/ha TSA); Fodder crops; Permanent grassland; Cereal crops; Fruits; Vegetables; Forests	Flanders, Belgium			Visitors

	Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
L&Bg	White & Lovett, 1999	CV-DC	Preserving landscape	Heather moorland; Woodland; Traditional hill farming	Regional: National Park of North York Moors, UK and all National Parks of UK	Intensive agriculture and forest	Traditional farming practices	General public
L&Bg	Willis & Whitby, 1985	CV-OE	Prevent the loss of amenity value of green belt land		Local: Tyneside Greenbelt	Development of land/conversion of habitat	Preserve	UK
L&Bg	Willis & Garrod, 1993	CV	Preferences towards different hypothetical landscapes	Abandoned; semi-intensive agricultural; intensive agricultural; planned; conserved; sporting; wild	Regional: National Park, Yorkshire Dales, UK	Current	Alternative landscapes	Visitors; Residents
L&Bg	Willis *et al.*, 1995	CV-DC; CV-PC	Conservation of agricultural landscape (Chalk grassland)	Low lying flat land; ditches; Peat; Meadows	Somerset Levels and Moors	SQ (P-off). Current	ESA (P-On)	General public: residents and visitors
Mat	Yrjölä &Kola, 2004	CV-OE	Multifunctional as whole in Finland	Food safety; Animal welfare; Rural landscape				General public, Finland

Biodiversity

	Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
B_g	Aakkula, 1998 (PhD thesis)	CV	Economic value of pro-environmental farming	Pro-environmental farming: "a production practice in which the emphasizes is on the maintenance of distinctive characteristics of rural environment and on the protection of the functions of natural ecosystems (entails using less fertilizers, pesticides	National: Finland	SQ- Conventional farming	Pro-environmental farming	General public (Finland)
B_g	Adekunle *et al.*, 2006	CV	Forest	Shade provision, pollution reduction, climatic amelioration and aesthetics, food and medicinal services	Local: University of Agriculture, Abeokuta, Nigeria		Current	Students
B_g	Armand-Balmat, 2002	Utility function and of expenses	Organic products	Traditional Farming vs. Organic farming.	National: Auchan supermarkets			
B_{at}	Barkmann *et al.*, 2008	CE	Availability of rattan, availability of water, amount of cocoa, population size of anoa		Local: Lore Lindu National Park in Central Sulawesi, Indonesia	Status quo	Distance rattan- village (10, 15, 20 km), water shortage (0, 1, 2, 3 months), shade in local cocoa plantations (5, 35, 65, 95 % under shade), population size of the endemic dwarf buffalo anoa: (10, 180, 350,	Households

	Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
							520 number of animals), and cost in extra taxes or donations to the village fund (0, 18, 36, 54, 72 x 1000 IDR/year)	
B_g	Bastian *et al.* 2002	HP	Agricultural land	Impact of amenity and agricultural production land characteristics on price per acre for a sample of agricultural parcels.	Local: Wyoming., USA			
M_{at}	Beukering *et al.*, 2003	Production function market price; CV	Individual valuation of different functions	Water supply: remains constant; ability to meet demand declines 74% to 12%. Fisheries: constant; declines 1% annually. Flood and Drought prevention: probability of flooding increases linearly. Hydropower: constant; declines. Tourism: constant; tourism days decline 5% annually. Biodiversity: declines carbon sequestration; declines fire prevention	Local: Leuser National Park, Northern Sumatra, Indonesia	Deforestation	1-conservation: 2-mid-point (2000 to 2030 at a discount rates 4%)	

	Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
B_{at}	Birol *et al.*, 2006	CA	Non-use values of wetlands	Biodiversity; Open water surface; Research and education; Re-training of farmers and fisheries	Local: Cheimaditida Wetland, Greece	SQ (pressures from other land uses; agriculture, urbanization …	Low and High management impact	
M_{at}	Bulte *et al.*, 2002	Meta/ synthesis analysis	Forests: timber, non-timber forest products, ecological services and wildlife habitat		National: Atlantic Coast of Costa Rica		Amount of change needed to achieve a balance between forest conservation and agricultural	
M_{at}	Chiabai *et al.* 2009	meta/ synthesis analysis;	Provisioning, regulating and cultural services of forests	Changes in agricultural land use (forest areas converted into farmland) and in forest management (natural forest versus managed forest)	World			
B_{Gg}	Christie at al., 2006	CVM-DC	WTP for agri-env. Schemes; WTP for habitat creation; WTP to protect farmland currently under agri-env. from urbanization	Conservation of headlands; reduced use of pesticides and fertilizers; Habitat creation, including seasonal flood plains, reed beds and more natural river flows	Regional: Cambridgshire and Nothumberland			FG; Resident population
B_{at}	Christie at al., 2006	CE	Preserving farmland biodiversity	Familiar species of wildlife; Rare, unfamiliar species of wildlife; Habitat quality; Ecosystem process	Local: Nothumberland (UK)	Do nothing: Continuing decline in the population of rare familiar and unfamiliar species; Continued decline in wildlife habitats and ecosystem functions	T1 (P-on): Protect rare familiar species from further decline; Slow down the rate of decline of rare unfamiliar species; Habitat restoration; Only services that have direct impact on humans:T2 (P-on)	FG; Resident population

	Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
B_{at}	DSS Management Consultants, 2010	modified production function method		Wild pollination for the production of apples and other fruits; natural water supply for the production of wood; and primary productivity services for the fish harvest	National: Canada		5%, 10%, 20%, 30%, 40%, and 50% reduction from the current levels in the supply of each of the ecological goods and services	
B_{at}	Ferguson *et al.*, 1989	CE; Opportunity cost; cumulative impact assessment	Wetlands	1) Use values for fishing, hunting and wildlife viewing; 2) A preservation value for the estuary.	Local: Cowichan Estuary on Vancouver Island, British Columbia	Current	1) port expansion would impact the estuary; 2) agricultural reclamation would occur in the wetland areas	
B_{at}	Foster, 1998; Foster & Mourato, 2000	CR	Reduced number of mild cases of human illness and in number of bird species to decline	Cases of human illness from pesticides poison and number of farmland bird	UK	SQ	Reduce pesticides use	General Public (UK)
B_{at}	Gallai *et al.*, 2009	Market approaches	Valuation of the world agriculture vulnerability confronted with pollinator decline		World scale			
M_{at}	Gren, 1995	Market price; Replacing Costs and CV	Increase in wetland restoration; Increase in sewage treatment of nitrogen abatement; (Wetland ecology; habitat;	Drinking water quality and secondary benefits; Habitat provision, nitrogen abatement; And regional income	Regional: Wetland in Gotland			SW

	Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
			Environmental services)					
B_{at}	Hanley *et al.*, 2006	CV; CE	Preserve the wild geese	Change in geese population through shooting managing habitat vs. no shooting; Species protected: all geese, endangered only; habitat management vs. habitat management and shooting ; species reserve only vs. all sites in Scotland	Local: Islay, Scotland	Decline	1-Prevent 10% decline: 2-Increase 10%	General public; residents
B_g	Hansen, 1999	TCM	Pheasan	Changes in agricultural land uses, in particular, specialization in production and increased insecticide and herbicide use	Regions: Midwestern states USA	2) baseline - current Conservation Reserve Program (CRP) acreage based on erosion criteria	1) No CRP; 2) if all CRP acres were re-selected using the 1997 Environmental Benefit Index (EBI).	
B_g	Harrison & Burgess, 2000	Discussion groups, Stakehold er Decision Analysis	Sites of Special Scientific Interest (SSSIs)		National: National and Local Nature Reserves, UK			residents; farmers

	Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
B_{at}	Horne, 2006	CE	Trees and woodland		National: Finland: Whole country without Ahvenanmaa		1)small patches of protected forest; 2) voluntary nature management plan protecting natural values but enables harvesting; 3) total ban on silvicultural practises; 4) limiting other uses as well.	
B_{at}	Hynes & Hanley, 2009	CV	Value of restoring and conserve endangered farmland bird, the corncrake	Irish farmers	National	Restoring sustainable population of corncrake		Irish farmers
B_{g}	Kirkland, 1988	CV	Value of improvements in the quality of a Wetland		Local: Whangamarino Wetland, Waikato Region, New Zealand.	Status quo	1) Development of the wetland for agriculture causing large areas of the natural wetland to be lost, leading to permanent changes making it less suitable for leisure, wildlife and scientific uses; 2) An improvement in the wetland by increasing the quality and quantity of the natural areas through prevention of agricultural development, decreasing areas presently farmed and provision of better public services.	Resident

	Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
B_{at}	Kontogianni *et al.*, 2001	Rating and focus group	Wetland	The ecological value of landscape elements	Local:Kalloni Bay on the island of Lesvos, Greece	Disturbance and degradation of natural habitats of the Kalloni wetland by human activities. Incremental damage caused to the wetland by rubbish tipping, encroachment and illegal sand removal.	4 scenarios of wetland conservation	Residents and visitors
B_g	Kooten, 1993	Optimization Model	Wetland		Local: Prairie Pothole Region, Alberta, Saskatchewan, and Manitoba, Canada			
B_{at}	Kuriyama, 2000	CE	Wetland		Local: Kushiro Wetland National Park, Japan		different protection levels of the wetland and the surrounding areas	Households and visitors
B_g	Lannas and Turpie, 2009	Actual expenditure/market price	Wetland flora and fauna	Livestock grazing, hunting, and crop production	Local: Letseng-la-Letsie wetlands in Lethoso and Mfuleni wetlands in South Africa			Households

	Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
B_{at}	Lockwood & Carberry, 1998	CV; CM	Value of remnant native vegetation	Number of plants and animal; Extent of future use for farmers	Regional: Victoria, Australia		Decline due to agricultural and forest activities	Resident
B_{at}	MacMillan *et al.*, 2002	CV-PC	Preserve the wild geese	Species			Project that would increase the population of 4 species of geese by 10% or alternatively only endangered species of geese	Scotland
M_{at}	Martin-Lopez *et al.*, 2011	Market-based approach; CV; TCM	Ecosystem services	Provisioning services; regulating services and existence value; cultural services	Local: Doñana Protected Area (PA), Spain		Current: agriculture, fishing (estuary and marshes), cattle, coastal shell-fishing, forest resources; maintenance of soil fertility and water quality, erosion control, hydrological regulation, and micro-climatic regulation; tourism, religious tourism, research and environmental education	Users
B_g	Moran *et al.*, 2004	CE	Enhance wildlife habitats	Habitats	National/Regional: North, Central Belt, South and whole Scotland	SQ- Current policies	Increase	Scotland
B_{at}	Naidoo & Adamowicz, 2005	Demand Analysis; Count data models; CE	Preservation of bird species biodiversity	Cost and benefits of forest preservation was assembled from various sources.	Local: Mariba Forest Reserve, Uganda			Visitors

	Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
B_g	Niskanen, 1998	Change in productivity and Replacement costs	Reforestation	Reforestation options : 1)industrial,2) community 3) agroforestry (intercropping of trees and cassava)	Regional: northeast Thailand			
B_g	Nunes & Schokkaert, 2003	CV			Local: Alentejo Natural Park, Portugal	Current	Financing the protection efforts of the Natural Park's management agency by 1) Recreation Areas protection program (RA), 2) Wilderness Areas protection program (WA), 3) Wilderness and Recreation Areas protection program (WA+RA)	
B_g	Olewiler, 2004	BT	Value of conserving natural capital in four areas of Canada	Landscape; Wetlands/constructed wetlands; drinking water; fresh water; birds; fishes; invertebrates; mammals; riparian; woodland	National: Canada (four areas)		Conservation of natural areas to other uses (agricultural stressors)	

	Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
M_{at}	Polasky *et al.*, 2010	Integrated Valuation of Ecosystem Services and Trade-offs (Invest)	Value of changes in carbon storage, water quality, habitat quality for grassland and forest birds and general terrestrial biodiversity, agriculture and timber production and value of urban land use		Minnesota (1992 to 2001)		1-No agricultural expansion; 2-no urban expansion; 3-agricultural expansion; 4-forestry expansion; 5-Conservation	
B_g	Pyo, 2000	CV - DB	Wetland		Local: Youngsan river in South Korea	Current	Preserve the tidal wetland under the current conditions.	Households
M_{at}	Revéret *et al.*, 2009	CV;CE	Value for environmental goods and services of changing farming practices	Water quality (index of quality); landscape aesthetics (diversity in terms of cultures, trees and woods) and biodiversity (species of fishes and birds- related to angling and bird watching); (levels high, moderate and low)	National: Rivers and reservoirs in Quebec, Canada			Visitors and residents
B_g	Scarpa *et al.* 2000	CV	Creation of nature reserves in all Irish forests currently without one.	Forest attributes (presence or absence of a nature reserve, total area, age of trees, type of trees, and site congestion)	National: Ireland	Forest without reserves	Creation of reserves	Visitors

	Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
B_g	Schultz & Taff, 2004	HP	Implicit prices of wetland easements in areas of production agriculture		Regional: North Dakota, US			
B_g	Simonit and Perrings, 2011	Benefit transfer	Nutrient buffering function of wetlands		Local: Lake Victoria, Kenya	Proposed for conversion to crop production		
B_g	Stevens *et al*., 2001	CVM	species	Bald eagles, wild turkeys, coyotes, and salmon.	Regional: US, New England		Current	Resident
B_g	Tong *et al*., 2007	Actual Market Pricing Methods, Replacement costs, CV	restoration of wetland	Price of water and products; disturbance regulation, environment purification and gas regulation instead of local reservoir storage, sewage treatment, and afforestation; heavy metal removal by the wetland	Local: Sanyang wetland, China	Degradated wetland		
M_{at}	Troy and Bagstad, 2009	Benefit transfer	Ecosystem services	Agriculture, grassland/pasture/hayfield, Non urban forest, Urban forest, Suburban forest, Forest adjacent to stream, Hedgerow forest, Urban herbaceous green space, River, Suburban river, Inland lake, Great Lake near shore, Estuary/tidal bay, Non-urban and non-coastal wetlands, Urban/suburban	Regional: Great Lakes of Ontario			

	Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
				wetlands, Great Lakes coastal wetlands and beach.				
B_g	Urban & Melichar, 2009	CV	bird	Black Stork protection	National: Czech Republic	Current	1) the Black Stork is endangered due to "Markof Disease" and the population needs to be vaccinated; 2) the population is threatened due to the destruction of their habitats.	Households
B_g	Van der Heide *et al.*, 2008	CV	Forests	Benefits of habitat defragmentation: unobstructed dispersal of animals better chance for visitors and other users to see wildlife	Regional: Veluwe region, Netherlands	Patchwork of habitat fragments	Scenarios 1) which connects the central part of the Veluwe with the Ijssel river pastures in the north-east; 2) which focuses defragmentation towards the south-west by connecting the Veluwe with the river pastures.	Visitors

	Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
B_g	van Vuuren and Roy, 1990	TCM, actual expenditures techniques	Wetland	Recreational hunting and angling, and muskrat trapping	Local: marsh complex near Lake St. Clare in Ontario, Canada		Flood hazard reduction, water purification, provision of habitat for fish and migratory birds, erosion control along river and lake shorelines, and aesthetic and scientific benefits	Tourists
B_g	Willis, 1990	CV-OE	Preserve Wildlife conservation (in 3 nature reserves)	Habitats	Local: 3 SSSI in Northern England; Derwent Ings; Upper Teesdale; Skipwith Common	Adverse agricultural practices	(avoided)	UK
B_g	Willis *et al.*, 1996	CV-IB	Preserve Wet grassland marsh	Habitats	Local: Pevensey Levels SSI East Sussex			UK
M_{at}	Xu *et al.*, 2008	Benefit transfer	Ecological functions and services of forest biodiversity	Abandoned land, reduced soil fertility loss, reducing silt accretion, soil deposit, water conservancy, CO2-fixation	Local: Yaoluoping National Nature Reserve, China			

Water

Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
Aizaki *et al.*, 2006	CV-DC (Doubled bound)	Valued different functions of multi-functional agriculture	Water conservation Flood prevention; Recharging groundwater; Soil erosion prevention; Organic resource utilization; Development of favourable landscapes; Recreation and leisure; Wildlife protection	National: Japan	Current	To avoid 20% decrease in current quota of multifunctional agricultural within the next 30 years	General public
Bond *et al.*, 2011	CR	Preferred irrigation systems build on 4 attributes	Risk of crop loss; Nitrate leaching; Soil erosion (Low, medium, high)	Regional: South Platte river Valley Basin, Colorado, US	Sediment runoff and nitrate leaching		Agricultural producers (WTP)
Cooper, 1997	CV	Farmers willingness to improve farming practices towards less water pollution		Regional: Eastern Iowa and Illinois basin, USA	Conventional farm management practices	Best management practices.	Farmers
Crutchfield *et al.*, 1997	CV-DC	Improvement drinking water	Filter to be installed on the respondents' water tap which would eliminate nitrates. The questionnaire contained background information on health risks from nitrates but avoided trigger words such as cancer.	Regional: White River, Indiana; Central Nebraska, Lower Susquehanna, Pennsylvania; Mid-Columbia	Current	2 levels: 1) minimum safety standards for nitrate concentrations, 2) complete elimination.	Households

Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
				Basin, Washington			
Cullen *et al.*, 2006	CV	Water Quality	Pressure-state-response format.	National: New Zealand			Residents
Davy, 1998	BT	Benefits of investing in clean water	Drinking water		Nitrate leaching from agriculture	3 different levels of N pollution, L, M, H, entailing increasing effort to clean the water	
Eftec & CSERGE, 1998	CV-PC	Enhance water level (water quality, ecology and recreation)	River flow; Water quality: Vegetation/algae; fish	Local: River Ouse		Increase and avoid decrease in water level	UK (Apportion ment of agriculture required)
Eftec, 2003	BT	Increased water availability in the environment	Water quantity	National: UK	Over-abstraction of water	Reduce abstraction (reducing the demand for water)	UK (Apportion ment of agriculture required)

Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
Garrod &Willis, 1996	CV-OE	Maintained or improved flow levels	Water quantity	Regional: Darent river (South East England) and 40 low flow rivers in England	Water extraction by water supply companies and other users	In stream flow	General public UK (Apportion ment of agriculture required)
Giraldez and Fox, 1995	Adverting behaviour :	Groundwater contamination		Local: Hensall, Ontario, Canada		The reduction in nitrate emissions primarily considered was from 147 kg/ha to 140 kg/ha. This reduction of approximately 16.67% was said to be sufficient to reduce nitrate levels to 10mg/L (acceptable standard) from the existing levels ranging from 10 - 12 mg/L.	
Gren, 1995	Various: CV-Replacem ent Costs –Input-output model	Value of investing in wetlands for nitrogen purification		Regional: Gotland, SW	Nonpoint pollution due to nitrogen leaching from drainage of peat bogs and agricultural application of nitrogen fertilizer and manure	Nitrogen abatement measures: 1-wetlands restoration; 2-sewage treatment works investment ; 3- reduced nitrogen fertilizer use in agriculture	General population
Hanley, 1991	CV-OE	Drinking water quality	Drinking and fresh water quality	Regional: East Anglia	Nitrates Directive (often not respected)	Assure nitrates never exceed thresholds of EC Directive and WHO recommendations	Residents (Apportion ment of agriculture

Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
							required)
Hauser *et al*., 1993	CV	Drinking water quality	Nitrate concentration	Regional: Abbotsford region of British Columbia, Canada.		The baseline level of water safety when considering nitrates in the water is 10mg/L. WTP to get to this level	Households
Hoekstra *et al*., 2001	"value-flow" concept. Different methods	Value of water in different stages of its cycle		Regional: Zambezi river basin, southern Africa,			
Hurd *et al*., 1999	Models	Impact of climate change in water resources	Climate (temperature and precipitation) changes	Regional: 4 river basins, Colorado, Missouri, Delaware, and Apalachicola-Flint-Chattahoochee			
Lago & Glenk, 2008	CE	Improvement in river water quality by 2015; Improvement in loch water quality by 2015	1% increase in total area of good status	National: Scotland	SQ-Current quality water status		Scotland (Apportionment of agriculture required)

Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
Lant & Tobin, 1989	CV	riparian wetlands	Main Stream Floodplain Area (acres); Riparian Wetland Area (acres); River Quality Difference Between Two Rivers; Additional Wetland Acres Necessary to Improve to Level of Higher Quality River.	Regional: Illinois and Iowa, USA (rivers: Edward, South Skunk and the Wapsipinicon).	Conversion of wetlands to cropland in prime agricultural. The loss of these wetlands has negatively affected rivers and streams because of reduced filtration and an increase in sedimentation.	water quality improvements from poor to fair, from fair to good and from good to excellent	Residents in the shores
Lant, 1991	CV	Nonpoint source pollution of agricultural watersheds	The magnitude of change was retirement of these croplands to establish permanent vegetative covers, which would act as filters to control runoff of sediment and associated pollutants.	Regional: Fayette County, Illinois, USA	Current farming practices on cropland near streamside's and floodplains	I) filter strips, standard rules ii) filter strips, haying allowed; iii) greenbelts, standard rules, iv) greenbelts, haying allowed; v) greenbelts grazing allowed; vi) greenbelts, 20-year contract; vii) greenbelts, drainage removal required; viii) greenbelts, tree planting required and ix) greenbelts, timber cutting allowed.	Farmers
Lee and Nielsen, 1987	Benefit transfers	Groundwater	Service flows to society from preserving the quality of ground water aquifers used for drinking water	Regional: ,437 counties throughout the U.S.			
Lynch *et al.*, 2002	CV (WTA)	WTA of landowners to install streamside buffers	Fresh water quality	Local: Chesapeake Bay, Maryland, US	Chemical runoffs from agriculture (N, P)	To know the value of incentives needed for buffers installation	Maryland landowners

Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
Ma *et al.*, 2011	CV-DC	Benefits of ecosystem services from agriculture		Regional: Michigan, US		Programme that reduces lakes eutrophication and reduce GHG emissions (reducing fertilizer input for winter crops)	Residents
Martin-Ortega, 2010	CE & Analytical Hierarchy Process (AHP)	Water quality	1) Poor water quality – not suitable for any direct use without treatment; corresponds to the lowest level of the ladder; 2) Moderate water quality – suitable for agricultural irrigation; 3) Good water quality – suitable for swimming; and 4) Very good water quality – suitable for drinking; also called the natural state of the river;	Regional: Guadalquivir River Basin (GRB), Spain	Current		
McCann & Easter, 1998	CV	Measuring the magnitude of transaction costs associated with the policies		Regional: Minnesota river, US		4 Policies to reduce agricultural non-point source pollution	Staff of governmental agencies
Moran *et al.*, 2004	CE	Enhancing water quality	Water quality	National: North, Central Belt, South and whole Scotland	Current policies	Enhance water quality	Scotland (Apportionment of agriculture required)

Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
Patrick *et al.*, 1991	TCM	reductions in non-point source pollution		Local: Indiana, USA	Current level of total suspended solids (TSS) and other pollutants	i) A one, five, ten and fifteen percent increase in the total suspended solids (TSS), and ii) Similar percentile increases in TSS plus other pollutants.	Fisherman
Phillips and Forster, 1987	Benefit transfer and CV	Impact acid rain has on forest, aquatic, and agricultural ecosystems		Regional: Eastern Canada	several baseline quality levels		
Poe *et al.*, 1999	CV	Value of incremental benefits of groundwater protection (from nitrates pollution)	Drinking water	Regional: Portage County, Wisconsin, US	Current quality of households drinking water	Reduce the health risk of exposure by 25% in the next 5 years	Residents
Pretty *et al.*, 2003	Damage costs and policy costs	Costs of freshwater pollution (eutrophication and nutrient enrichment)	Water quality				England and Wales (Apportion ment of agriculture required)
Ribaudo *et al.*, 1989	TCM	Recreational use of fresh water	Quality of fresh water	Local: St Albans Bay, Vermont, US	Pollution, mainly phosphorous loading; agriculture (dairy farms non-point source pollution) represents 23%	Improvement in water quality for recreational purposes	Users (current and former)
Ribaudo *et al.*, 1994	Models	Water quality benefits		National: US		Scenarios: 1) reduction in cropland of 11.6%, 2) 2.5%, 3) 1.6%, 4) 1.0%	

Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
Shaik *et al.*, 2002	Market based approaches	Estimate direct and indirect shadow prices and costs of N pollution abatement (built on input-output model)		Regional: Nebraska agricultural sector, US			
Shresta & Alavati, 2004	CE	Valuing environmental benefits of silvopasture practice	Water quality; Carbon sequestration; Wildlife protection	Regional: Lake Okeechobee watershed, Florida, US	SQ- Lake is threaten by non-point source pollution runoff from cattle ranching	High and Moderate improvements	Residents
Stevens *et al.*, 1997	CA; CA equiv. CV-DC	Groundwater protection programs		Regional: Massachusetts, US			Residents (Apportionment of agriculture required)
Thomassin & Johnston, 2007	BT- Meta	Water quality improvements from agricultural landscapes	RFF water quality ladder (linked to pollutants levels, which, in turn, are linked to the presence of aquatic species and suitability for recreational uses	Studies from Canada and US (36 studies; 97 observations; studies between 1973 and 2001)	Current (pollution)	Improvement	
Travisi & Nijkamp, 2004	CA-CE; CV	Valuing agriculture environmental safety	Farmland biodiversity (birds); Water quality : drinking water (human health); groundwater quality (soil and aquifer contamination)	Regional: Milan, Italy			Residents (payment in food prices)

Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
Veeman *et al.*, 1997	HP	Irrigation water in the region	Amount buyers and sellers are willing to pay/accept for access to water.	Regional: Alberta, Canada			
Vesterinen & Pouta, 2008	TCM	Recreational benefit from water quality improvements	Quality of fresh water	National: Finland for swimming, fishing and boating	Flow of nutrients from agriculture (in particular animal farming)	Reduce eutrophication in surface waters	General public; Visitors (TCM)
Willis, 2002	Replacement costs	Costs and benefits of forestry to water supply and quality		National: England and Wales			

Soil

Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
Amorós & Riera, 2001	CR; CE	Conversion from agricultural land to forest	Forest recreation, carbon storage, erosion protection	Regional: Catalonia	Current area of forest (40% of the total area)	Increase of forest area for more 10%	Residents
Brethour & Weersink, 2001	Physical risk assessment combined with CV	Benefits of environmental services change in response to change levels of pesticides use	Risk for human health; Ground water; surface water; species.	Regional: Ontario, Nevada, US			

Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
Bui, 2001	Opportunity cost of soil erosion	Opportunity costs of soil erosion associated with alternative land use systems	1-Upland rice-based systems; 2-Sugarcane system; 3-Fruit tree-based agro-forestry; 4-Eucalyptus-based system.	Local: Xuanloc Commune, Phu Loc District, Vietnam	Soil erosion caused by erosive farming practices and bi-graphical factors (intense rainfall, sloping topography) and rapid population increase and problems related to open access		
Chen, 2005	CV- OE &DC	Value of environmental services of agriculture	Environmental services, such as open green spaces; natural habitats; regulation of rainwater and ground water; species.	National: Taiwan	Agricultural trade liberalisation impact on domestic rice producers	Avoid reductions in agricultural land and corresponding ecological services (1%, 10% and 20%)	General public (Taipei city); Agricultural professionals
Colombo *et al*, 2006	CE	Benefits of a programme to mitigate off-farm impacts of soil erosion	1-Landscape change: desertification of semiarid areas; 2-Surface and groundwater quality; 3-Flora and fauna quality; 4-Rise in agricultural production-jobs created; 5-Area of project (km2).	Regional/Local: Alto Genil watershed in Andalusia, Spain	1-Degradation; 2-Low; 3-Poor; 4-0; 5-0	1-Degradation; Small improvement; Improvement; 2-Low; Medium: High; 3-Poor, Medium, High; 4-0,100, 200; 5-330, 660, 990.	FG; Resident
	CVM		The same		The same	1-Small improvement; 2-Medium; 3- Medium; 4-100; 5-330	

Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
Crowder, 1987	Several methods: Benefit transfer	cropland erosion in relation to lost water supply	Cost of reservoir sedimentation using total capacity; cropland sediment impacts on total reservoir capacity	National: US			
Ekanayake & Abeygunawardena, 1994	CV	Forest TEV	Recreation, fuel wood and as source of non-timber forest products, reduction of soil erosion, option value, bequest and existence values.	Local: Sinharaja forest,Sri Lanka	Forest for recreation and as source of fuel wood and non-timber forest products t	Shift from the existing use to be conserved as a wet zone forest.	Residents around the forest
Hansen & Hellerstein, 2007	Replacement costs	Soil conservation on reservoirs services		National: 2,111 reservoirs across the US	Reduction in soil erosion for more than 70,000 reservoirs that are included in the US Army Corps of Engineers National Inventory of Dams		
Loomis *et al.*, 2000	CVM	Benefits of restoring ecosystem services	Fresh water (dilution of wastewater, soil (erosion control), habitat for fish and wildlife	Regional: South Plate River, Denver, US	Agricultural irrigation has drawn down the river increasing flows of nitrates and ammonia from farmland and has eroding river beds	Buying easement to landowners to restore the ecosystem (300,000 acres)	Residents
Loureiro *et al.*, 2000	CV	Premium for sustainable agriculture apples	Food safety; Soil quality; Air quality; Groundwater quality	Local: Portland, Oregon, US		Eliminate pesticides, conserve the soil and water, providing safe and fair conditions to workers.	Consumers

Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
Nam *et al.*, 2001	market price of output	Extractive use of forest		Regional: Melaleuca forests, Mekong River Delta, Vietnam		"buffer zone", strict protection, contract household and joint venture arrangement, family/household commercial forest farms	
Ribaudo, 1986	Various methods; BT		Recreational and commercial fishing, boating, swimming and benefits from soil erosion reduction	National: US		Conservation practices to reduce soil erosion caused by agriculture	
Thao, 2001	Several methods: Benefit transfer	Soil conservation practices	Reduced soil loss on sloping lands, reduced fertilizer use, and increased crop productivity.	Regional: mountainous regions of northern Vietnam	Serious soil erosion problems due to high rainfall levels and bad farming practices.		
Wang *et al.*, 2007	CE	Land use changes to reduce soil erosion	Sandstorm days per year; vegetation cover; plant species; billion tons of sediment in the Yellow River by 2020.	Regional: Loess Plateau region of China	Current value for the attributes	Increase forest cover that would change the values of attributes	Households of Northern China

Air Quality

Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
AEA Technology, 2004*	CV for reductions in mortality and morbidity	External costs of emissions from electricity generation; transport sector	Emissions of air pollutants; NOx, VOC, SO2,				UK
Bateman *et al.*, 2002	CV	Reduce the impact of air pollution	Reductions in respiratory and heart diseases, reduce the impacts to plants (e.g. acid rain)	Local: University of East Anglia, UK			Students at the University of East Anglia, UK
Crocker & Regens, 1985	Cost of damages and replacement	Benefits of reducing pollution sulphur (industrial pollution) on main item	Human health, crops, forests				
Eyre *et al.*, 1997*	Variety of market values and non-market values	External costs of methane and nitrogen oxide emissions	Emissions of air pollutants; Impacts of pollution include (health, crops, building materials, crops, forests and ecosystems)				UK

Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
Fanhhauser , 1995	Sum of partial equilibrium costs; Actual expenditure /market price of output.	Damage associated with a doubling of atmospheric carbon dioxide (CO_2) concentrations.	The damage range from 1% to 2% of Gross National Product (GNP) for doubling of atmospheric CO_2 concentration by the year 2100.	World			
Gascoigne *et al*., 2011	Cost replacemen t and market based approaches	Valuing ecosystem and economic services across land use scenarios	Carbon sequestration; Waterfowl production; Sediment reduction.	Prairie Pothole region, North and South Dakota, US		1- Aggressive conservation; 2- CRP mitigation, increase in conservation land programs 3- current levels (market forces); Extensive conservation (reducing conservation	
Holland *et al*., 1999	Market approaches for crops	Impacts of air pollution in several items, including crops		Europe			
Johansson & Kristom, 1998	CVM	Benefits of reducing pollution sulphur (industrial pollution) on main item	Human health, crops, forests	Sweden			

Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
Kennedy & Wilson, 2005	CVM	Valuing changes in agricultural practices do reduce dust emissions from agriculture	Impact on air quality: Local and human health	Maricopa and Pinal Counties, Arizona, US		Reducing tillage operations	
Kulshreshtha, 2009	CVM	Value of ecological goods and services resulting from shelterbelts	Reduced soil erosion; Reduced GHG; Improved air quality (non-odour related); Protect or enhance biodiversity; improved water quality; bird watching; Energy conservation-based GHG emissions reduction; Health benefits; Aesthetics and Property Values; Improved transportation safety; wastewater management and reduced pesticide drift	Saskatchewan, Alberta (Canadian Prairie) Canada		Tree seedling distributed by the agriculture and agri-food Canada shelterbelt centre	
Kwat *et al.*, 2001	CV	Air quality improvement	Soiling damage, visibility, agricultural damage, public mortality, public morbidity, and global warming	Regional: Seoul, Korea	Current	A unit of reduction of each attribute	Residents
Rittmaster, 2004	Environment Canada's Air Quality Valuation Model	Smoke from forest fires	Premature mortality, restricted activity days and hospital admissions	Local: Chisholm, Alberta, Canada			

Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
Spash, 2001	Not valuation study	Impact of air pollution on crop damage					
Tol, 1999	Climate Framework for Uncertainty, Negotiation and Distribution model	Impacts of GHE for several items, including crops		world			
Tol & Dowing, 2002*	Mix of market and non-market approaches	External costs of climate forcing pollutants (methane and nitrogen dioxide)					UK
Tser-Yieth & Chun-Sheng, 2003	Market approaches	Benefits of pollution reduction on agriculture yields (air quality used as an input for rice production)	Pollution by ozone and sulphur dioxide	Taiwan		Reducing pollution, increasing yelds	
White *et al.*, 2004	Market approaches	Impacts of pesticides inhalation effects used by potato farming	Health costs for farmers and PEI population	Prince Edward Island, Canada	conventional	Genetically modified	

Climate Stability

Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
Adams *et al*., 1999	Agricultural sector model; Market based approaches	Impacts of climate change on agriculture		US			
Cai *et al*., 2010	CVM	Avoiding expected equity and environmental impacts due to climate change	Agriculture, Water, Ecosystems, Human health, Oceans, Weather, Equity and Fairness	Canada	BAU	Complete and partial mitigation	
Hope & Paul, 1996	Models	Impacts of global warming such as impacts on sea level rise, agriculture and forestry, ecosystems, energy requirements, extreme weather conditions, human health, and water supply, among others.		World	A one tonne increase in the business as usual (BAU) CO_2 emissions		

Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
Manley *et al*., 2005	BT-Meta	Meta 1- costs of switching to no-till cropping is worth the amount of carbon annually sequestered; Meta 2 compare carbon sequestration from two alternative tillage practices	Meta 1 52 studies and 536 obs.; Meta 2 51 studies and 374 obs.	The prairies, Corn Belt and Southern regions of North America			
Mendelsohn, 1999	Agricultural sector model; Market based approaches	Impacts of climate change on agriculture		US			
Segerson & Dixon, 1999	Profit function; Market based approaches	Impacts of climate change on agriculture		US			
Weber & Hauer, 2003	Actual expenditure /market price of output	Impact of climate change on agricultural land values	Changes in temperature and precipitation	National: Canada			
Whitney & van Kooten, 2011	Benefit transfer	Climate change impact on ducks and wetlands	Duck hunting and nonmarket ecosystem services and amenity values from ducks and wetlands.	Regional: Prairie pothole region of Western		1) an increase in temperature of 3 °C, no change in precipitation; 2) no increase in temperature, a decrease in precipitation of 20%; 3) an	

Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
				Canada		increase in temperature of 3 °C, a decrease in precipitation of 20%; 4) an increase in temperature of 3 °C, an increase in precipitation of 20%.	

Resilience to Fire

Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
Fried *et al.*, 1999	CVM	Reduction in the probability that a wildfire will destroy or damage their property		Local: Grayling Township, Crawford County, Michigan	Wildfires threaten residential properties		Residents
Hesseln, 2004	Revealed and Stated preference count data travel cost model	Changes in hiking trip demand	Recreation	Colorado and Montana, US	Economic impact of fire and fuel management on forest recreation		Visitors
Loomis, 1996	CM: OE-DC	To protect old growth forests and critical spotted owl habitat from forest fires		Local: Oregon, US	300 fires and 7,000 acres burned	a fire prevention and control program involving greater fire prevention, earlier fire detection, and quicker and larger fire response	Households

Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
Stetler *et al.*, 2010	HP		Property	Montana, US			

Resilience to Floods

Authors	Valuation Method	Valued Good	Attributes	Geographic Scale	Baseline	Target	Population
Oglethorpe & Miliadou, 2000	CVM	Value of non-use attributes of lake/watershed	Flood protection; Water supply; Water pollution control	Lake Kerkini, Greece	Agriculture pollutants, overfishing, recreational pressure		
Pattanayak & Kramer, 2001	CVM	Value of drought mitigation (provided by tropical forest watershed)		Ruteng Park, Indonesia		Increase in the base flow	Residents

References "Landscape"

Alvarez-Farizo B., Hanley N., Wright R., McMillan D. (1999). Estimating the benefits of agri-environmental policy: econometric issues in open-ended contingent valuation studies. Journal of Environmental Planning and Management 42: 23-43.

Arriaza M., Gómez-Limón J. A., Kallas Z., Nekhay O. (2008). Demand for Non-Commodity Outputs from Mountain Olive Groves. Agricultural Economics Review 9: 5-23.

Baskaran R., Cullen R., Wratten S. (2009). Estimating the Value of Agricultural Ecosystem Service: A Case Study of New Zealand Pastoral Farming – A Choice Modelling Approach. Australasian Journal of Environmental Management 16: 103-112.

Bastian C. T., McLeod D. M., Germino M. J., Reiners W. A., Blasko B. J. (2002). Environmental Amenities and Agricultural Land Values: A Hedonic Model Using Geographic Information Systems Data. Ecological Economics 40: 337-349.

Bateman I. J. and Langford I. (1997). Non user' willingness to pay for a national Park: an application and critique of the contingent valuation method. Regional Studies 21: 571-582

Bateman, I., Diamand, E., Langford, H. and Jones, A. (1996) Household Willingness to Pay and Farmers` Willingness to Accept Compensation for Establishing a Recreational Woodland, Journal of Environmental Planning and Management 39: 21-43.

Bellú L. G. and Cistulli V. (1997). Economic Valuation of Forest Recreation Facilities in the Liguria Region (Italy). CSERGE Working Paper GEC 97-08.

Bonnieux F. and Le Goffe P. (1997). Valuing the benefits of landscape restoration a case study of the Cotentin in Lower-Normandy France. Journal of Environmental Management 50: 321-333.

Borresch, R., S. Maas, K. Schmitz and P. M. Schmitz (2009). Modeling the Value of a Multifunctional Landscape: A Discrete Choice Experiment. Paper presented at the International Association of Agricultural Economics Conference. Beijing, China.

Bostedt, G. & Mattsson, L. (1994). The Value of Forests for Tourism in Sweden. Annals of Tourism Research 22: 671-680.

Bowker J. and Didychuk D. (1994). Estimation of nonmarket benefits of agricultural land retention in eastern Canada. Agricultural Resource Economics Review 23: 218-225.

Brouwer R. and Slangen L.H.G. (1997). Contingent valuation of public benefits of agricultural wildlife management: the case of Dutch peat meadow land. European Review of Agricultural Economics 25: 53-72.

Buckley C., van Rensburg T. M., Hynes S. (2009). Recreational Demand for Farm Commonage In Ireland: A Contingent Valuation Assessment. Land Use Policy 26: 846-854.

Bullock C. H. and Kay J. (1997). Preservation and charge in the upland landscape: The public benefits of grazing management. Journal of Environmental Planning and Management 40: 315-334.

Campbell, D., G. Hutchinson and R. Scarpa (2005). Using Choice Experiments to Value Farm Landscape Improvements: Implications of Inconsistent Preferences. Applied Environmental Economics Conference, London.

Campbell, D., G. Hutchinson and R. Scarpa (2006). Lexicographic Preferences in Discrete Choice Experiments: Consequences on Individual-Specific Willingness to Pay Estimates. Nota di Lavoro 128, Fondazione Eni Enrico Mattei, Milano.

Catalini, A. H. and Lizardo M. (2004). Agriculture, Environmental Services and Agro-Tourism in the Dominican Republic. Journal of Agricultural and Development Economics 1: 87-116.

Chiueh Y-W and Chen M-C (2008). Environmental multifunctionality of paddy fields in Taiwan: an application of contingent valuation method. Paddy Water Environmnet 6: 229-236.

Colson F. and Stenger-Letheux A. (1996). Evaluation contingente et Landscape s agricoles. Application au bocage de Loire-Atlantique. Cahiers d'Economie et Sociologie Rurales 39 : 151-177.

Crossman N. D. and Bryan B. A. (2008). Identifying cost-effective hotspots for restoring natural capital and enhancing landscape multifuntionality. Ecological Economics 68: 654-668.

Drake L. (1992). The Non-market Value of the Swedish Agricultural Landscape, European Review of Agricultural Economics 19: 351-364.

ÉcoRessources Consultants (2009). Évaluation économique des biens et services environnementaux engendrés par l’agroforesterie. Étape 9 du projet Biens et services écologiques et agroforesterie: l'intérêt du producteur agricole et de la société. Report for Programme d’ Adaptation d’ Agriculture et Agroalimentaire Canada.

Fleischer A. and Tsur (2000). Measuring the Recreational Value of Agricultural Landscape. European Review of Agricultural Economics 27: 385-398.

Garcia S. and Jacob J. (2010). La valeur récréative de la forêt en France : une approche par les coûts de déplacement. Reveu d’ Etudes en Agriculture et Environnement 91: 43-71.

Garrod, G D. and Willis, K. G. (1992). Valuing Goods' Characteristics: An Application of the Hedonic Price Method to Environmental Attributes. Journal of Environmental Management 34: 59-76.

Garrod, G. D. and Willis K. G. (1995). Valuing the Benefits of the South Downs Environmentally Sensitive Area. Journal of Agricultural Economics 46: 160-173.

Gios, G., I. Goio, S. Notaro and R. Raffaelli (2011). The Value of Natural Resources for Tourism: a Case Study of the Italian Alps. International Journal of Tourism Research 8: 77-85.

Hackl F., Halla M., Pruckner G. J. (2007). Local compensation payments for agri-environmental externalities: a panel data analysis of bargaining. European Review of Agricultural Economics 24: 295-320.

Hanley, N. and Craig, S., (1991). Wilderness development decisions and the Krutilla-Fisher model: the case of Scotland's 'flow country'. Ecologic Economics 4: 145-164.

Hanley N. and Knight J. (1992). Valuing the Environment: Recent UK Experience and an Application to Green Belt Land. Journal of Environmental Planning and Management 35: 145-160.

Hanley N., Macmillan, Wright R. E., Bullock C., Simpson I., Parsisson D., Crabtree B. (1998). Contingent valuation versus choice experiments: estimating the benefits of environmentally sensitive areas in Scotland. Journal of Agricultural Economics 49: 1-15.

Hanley N., Oglethorpe D., Wilson M., McVittie A. (2001). Estimating the value of environmental features, stage two, report to MAFF, Institute of Ecology and Resource Management University of Edinburgh and Scottish Agricultural College Edinburgh.

Hanley N., Colombo S., Mason P., Johns H. (2007). The reforms of support mechanisms for upland farming: paying for public goods in the Severely Disadvantage Areas of England. Journal of Agricultural Economics 58: 433-453.

Hutchinson, W.G., Chilton, S.M. and Davis, J. (1996) Integrating Cognitive Psychology into the Contingent Valuation Method to Explore the Trade-Offs Between Non-Market Costs and Benefits of Alternative Afforestation Programmes in Ireland. In Adamowicz, W.L., Boxall, P., Luckert, M.K., Phillips, W.E. and White, W.A. (eds) Forestry, Economics and the Environment, Oxford University Press.

Kallas Z., Gómez-Limón J.A., Arriaza M., Nekhay O. (2006). Análisis de la demanda de bienes y servicios no comerciales procedentes de la actividad agraria: el caso del olivar de montaña andaluz. Economía Agraria y Recursos Naturales 6: 49-79.

Kubickova S. (2004). Non-market evaluation of landscape function of agriculture in the PLA White Carpathians. Agricultural Econonomics– Czech 50: 388–393.

Le Goffe and Delache X. (1997). Impacts de l'agriculture sur le tourisme, une application des prix hédonistes. Journal Économie rurale 239: 3-10.

Le Goffe, P. (2000). Hedonic Pricing of Agriculture and Forestry Externalities. Journal Environmental and Resource Economics 15: 397-401.

Leitch, J. A. and Hovde, B. (1996). Empirical Valuation of Prairie Potholes: Five Case Studies. Great Plains Research. A Journal of Natural and Social Sciences. Paper 269.

Liljenstolpe C. (2011) Valuation of environmental impacts of the Rural Development Program - A hedonic model with application of GIS. 122nd EAAE Seminar 2011.

Loureiro, M. L. and Lopez, E. (2008). Valuing preferences towards cultural landscapes and rural heritage: perspective from Northern Spain in Choice Experiments Informing Environmental Policy edited by Birol E. and Koundouri P. New Horizons in Environmental Economics. Edward Elgar, USA.

Macmillan D. C. and Duff E. I. (1997). Estimating the Non-Market Costs and Benefits of Native Woodland Restoration Using the Contingent Valuation Method. Forestry 71: 247-259.

Madureira, L., Nunes, L. C., Santos, J. L. (2005). Valuing Multi-Attribute Environmental Changes: Contingent Valuation and Choice Experiments. Paper presented at the 14th EAERE (European Association of Environmental and Resources Economics) Annual Conference, 23-26th June, 2005, Bremen, Germany.

Madureira, L. (2006). Multi-attribute valuation of Douro Valley winescape based upon qualitative data for individual's attitudes regarding rural heritage and nature-related attributes. Paper presented at the II Conference of Associação Hispano-Portuguesa para o Ambiente e Recursos Naturais (AERNA) 2-3th June, 2006, ISCTE, Lisbon. Available at http://aerna2006.de.iscte.pt//

Marta C., Freitas H., Domingos T. de Groot R.S., Gort G. (2005). Using contingent valuation surveys to estimate the benefits of agri-environmental programs: The case of the Zonal Program of Castro Verde (Portugal). 14th EAERE (European Association of Environmental and Resources Economics) Annual Conference, 23-26th June, 2005, Bremen, Germany.

McCollum, D.W., G.L. Peterson, J.R. Arnold, D.C. Markstrom, and D.M. Hellerstein (1990). The Net Economic Value of Recreation on the National Forests: Twelve Types of Primary Activity Trips Across Nine Forest Service Regions. Research Paper RM-289, February. U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.

Mollard A., Rambonilaza M., Vollet D. (2006). Aménités environnementales et rente territoriale sur un marché de services différenciés : le cas du marché des gîtes ruraux labellisés en France. Reveu d'économie politique 116: 251-275.

Moran D., McVittie A., Allcroft D., Elstin D. (2004). Beauty, beast and biodiversity: what does the public want from agriculture? Final Report to SEERAD.

Moss and Chiltern (1997). A Socio-Economic Evaluation of the Mourne Mountains and Slieve Croob Environmentally Sensitive Areas Scheme, Centre for Rural Studies.

Nunes P. (2002). Using factor analysis to identify consumer preferences for the protection of a natural area in Portugal. European Journal of Operational Research 140: 499-416.

Oglethorpe D. (2005). Environmental Landscape Features (ELF) Model Update, Report to Defra.

Paliwal R., Geevarghese G. A., Babu P. R., Khanna P. (1999). Valuation of Landmass Degradation Using Fuzzy Hedonic Method: A Case Study of National Capital Region. Environmental and Resources Economics 14: 519-543.

Pattison J., Boxall P. C., Adamowicz W. (2011). The Economic Benefits of Wetland Retention and Restoration in Manitoba Canadian Journal of Agricultural Economics 59: 223-244.

Pruckner, G. (1995). Agricultural Landscape Cultivation in Austria: An Application of the CVM. European Review of Agricultural Economics 22: 173-190.

Rambonilaza M. and Dachary-Bernard J. (2007). Land-use planning and public preferences: What can we learn from choice experiment method? Landscape and Urban Planning 4: 318-326.

Ready, R. and Abdalla C. (2005). The Amenity and Disamenity Impacts of Agriculture: Estimates from a Hedonic Pricing Model. American Journal of Agricultural Economics 87: 314-326.

Santos, J., (1998). The Economic Valuation of Landscape Change. Theory and Policies for Land Use and Conservation. Edward Elgar, Cheltenham.

Sayadi S., Gonzalez M.C. , Calatrava J. (1999). Estimating Relative Value of Agrarian Landscape by Conjoint Analysis: The Case of the Alpujarras (Southeastern Spain). Paper presented at the IX Annual Conference of The European Association of Environmental and Resource Economists (EAERE), Oslo, June 1999.

Sayadi S., González-Roa M. C., Calatraya- Requena J. (2009). Public Preferences for Landscape Features: The Case of Agricultural Landscape in Mountainous Mediterranean Areas. Land Use Policy 26: 334-344.

Scarpa R., Campbell D., Hutchinson G. (2007). Benefit Estimates for Landscape Improvements: Sequential Bayesian Design and Respondents' Rationality in a Choice Experiment. Land Economics 83: 617-634.

Shrestha R. K., Alavalapati J. R. R., Seidl A. F., Weber K. E., Suselo T. B. (2006). Estimating the Local Costs of Protecting Koshi Tappu Wildlife Reserve, Nepal: A Contingent Valuation Approach. Environment, Development and Sustainability 9: 413-426.

Siriex A. (2003). Le Paysage Agricole: Un Essai d'Évaluation. Thèse por obtenir le grade de Docteur de L´Universite de Limoges.

Southgate D., Haab T., Lundine J., Rodriguez F. (2010). Payments for Environmental Services and Rural Livelihood Strategies in Ecuador and Guatemala. Environment and Development Economics 15: 21-37.

Taylor K., Reaston P., Hanley P., Wright N., Butler B. (1997). Valuing landscape improvements in ENTEC UK Ltd, in association with Environmental Economics Research Group, Stirling University and Wood Holmes Marketing, British Forests.

Tempesta T. (1998). The economic value of rural landscape: an application to the area between Isonzo and Tagliamento Rivers (Friuli-Venezia Giulia). In Bishop, R. and Romano, D. (Eds.), Environmental Resource Valuation: Applications of the Contingent Valuation Method in Italy. Kluwer Academic Publisher, Boston, Dordrech, London, pp. 213-232.

Vanslembrouck, I., Huylenbroeck G. V. & Meensel J. V. (2005). Impact of Agriculture on Rural Tourism: A Hedonic Pricing Approach. Journal of Agricultural Economics 56: 17-30.

White P. C. L. and Lovett J. C. (1999). Public Preference and Willingness-to-Pay for Nature Conservation in North York Moors National Park, UK. Journal of Environmental Management 55: 1-13.

Willis K. G. and Whitby M.C. (1985). The value of green belt land. Journal of Rural Studies 1: 147-162.

Willis, K. G. and Garrod, G. D. (1993). Valuing Landscape: a Contingent Valuation Approach. Journal of Environmental Management 37: 1-22

Willis, K.G., Garrod G. D., Saunders, C. M. (1995). Benefits of Environmentally Sensitive Area Policy in England: A Contingent Valuation Assessment. Journal of Environmental Management 44: 105–125.

Yrjöla T. and Kola J. (2004). Consumer Preferences Regarding Multifunctional Agriculture. International Food and Agribusiness Management Review 7: 78-90.

References "Biodiversity"

Aakkula J. (1999). Economic Value of Pro-Environmental Farming - A Critical and Decision-Making Oriented Application of the Contingent Valuation Method. Dissertation, University of Helsinki. Publications 92, Agricultural Economics Research Institute, Finland.

Adekunle M.F., Adedokun M.O., Adedoja A.A. (2006). Willingness to Pay for Environmental Service of Forest Trees by Cooperate Organisations. Farm Management Association of Nigeria (FAMAN) Papers.

Armand-Balmat C. (2002). Comportement du consommateur et produits biologiques : le consentement à payer pour la caractéristique biologique. Revue d'économie 112: 33-46.

Barkmann J., lenk K., Keil A., Leemhuis C., Dietrich N., Gerold G., Marggraf R. (2008). Confronting unfamiliarity with ecosystem functions: The case for an ecosystem service approach to environmental valuation with stated preference methods. Ecological Economics 65: 48-62.

Bastian, C. T., McLeod D. M., Germino M.J., Reiners W. A., Blasko B.J. (2002). Environmental amenities and agricultural land values: a hedonic model using geographic information systems data. Ecological Economics 40: 337-349.

Beukering P.J.H., Cesar H.S.J, Janssen M.A. (2003). Economic Valuation of the Leuser National Park on Sumatra Indonesia. Ecological Economics 44: 43-64.

Birol E., Karaousaki K., Koundouri P. (2006). Using a Choice Experiment to Estimate the Non-Use Values of Wetlands: The Case of Cheimaditida Wetland in Greece. Ecological Economics 60: 145-156.

Bulte, E., Soest, D. V., Kooten G. C. V., Schipper R. A. (2002). Forest Conservation in Costa Rica when Nonuse Benefits are Uncertain but Rising. American Journal of Agricultural Economics 84: 150-160.

Chiabai A., Travisi C. M., Ding H., Markandya A., Nunes P.A.L.D. (2009). Economic Valuation of Forest Ecosystem Services: Methodology and Monetary Estimates. Sustainable Development Series. Fondazione Eni Enrico Mattei.

Christie, M., Hanley N., Warren J., Murphy K., Wright R., Hyde T. (2006). Valuing the Diversity of Biodiversity. Ecological Economics 58: 304 – 317.

DSS Management Consultants (2010). Valuation of Ecological Goods and Services in Canada's Natural Resources Sectors. Technical Report for Environment Canada.

Ferguson A., Holman G., Kistritz R. U. (1989). Wetlands are not wastelands: application of wetland evaluation methods to the Cowichan Estuary, British Columbia. Candian Wildlife Service: Wildlife Habitat Canada.

Foster, V. and Mourato, Susana and Tinch, R. and Ozdemiroglu, Ece and Pearce, D. W. (1998). Incorporating external impacts in pest management choices. In: Vorley, B. and Keeney, D., (eds.) Bugs in the system: redesigning the pesticide industry for sustainable agriculture. Eartscan, London, U.K., pp. 94-106.

Foster V. and Mourato S. (2000). Valuing the Multiple Impacts of Pesticide Use in the UK: A Contingent Ranking Approach. Journal of Agricultural Economics 51: 1-21.

Gallai N., Salles J-M., Settele J., Vaissière B. E. (2009). Economic Valuation of the Vulnerability of World Agriculture Confronted with Pollinator Decline. Ecological Economics 68: 810-821.

Gren, I.M. (1995). The Value of Investing in Wetlands for Nitrogen Abatement. European Review of Agricultural Economics 22: 157-172.

Hanley N., MacMillan D., Patterson I., Wright R. E. (2006). Economic and the Design of Nature Conservation Policy: A Case Study of Wild Geese Conservation in Scotland. Animal Conservation 6: 123-129.

Hansen L., Feather P., Shank D. (1999). Valuation of Agriculture's Multi-site Environmental Impacts: An Application to Pheasant Hunting. Agricultural and Resources Economics Review 28: 199-207.

Harrison C. and Burgess J. (2000). Valuing nature in context: the contribution of common-good approaches. Biodiversity and Conservation 9: 1115-1130.

Horne P. (2006). Forest Owners' Acceptance of Incentive Based Policy Instruments in Forest Biodiversity Conservation - A Choice Experiment Based Approach. Silva Fennica 40: 169-178.

Hynes S. and Hanley N. (2009). The Crex Crex Lament: Estimating Landowners Willingness to Pay for Corncrake Conservation on Irish Farmland. Biological Conservation 142: 180-188.

Kirkland W. T. (1988). Preserving the Whangamarino Wetland - An Application of the Contingent Valuation Method. a Thesis Presented in Partial Fulfillment of the Requirements for the Degree of Master of Agricultural Science at Massey University.

Kontogianni A., Skourtos M.S., Langford I.H., Bateman I.J., Georgiou S. (2001). Ecological Economics 37: 123-138.

Kooten G. C. (1993). Bioeconomic Evaluations of Government Agricultural Programs on Wetlands Conversion. Land Economics 69: 27-38

Kuriyama K. (2000). Measuring the Value of the Ecosystem in the Kushiro Wetland: An Empirical Study of Choice Experiments. Journal of Forest Research 5: 7-11.

Lannas, K. S. M., and J. K. Turpie (2009). Valuing the provisioning services of wetlands: contrasting a rural wetland in Lesotho with a peri-urban wetland in South Africa. Ecology and Society 14: 18.

Lockwood M., Walpole S., Miles C. (2000). Stated Preference Surveys of Remnant Native Vegetation Conservation. National Research and Development on Rehabilitattion, Management and Conservation of Remnant Vegetation, Research Report 2/00.

Macmillan, D.C., L. Philip, N. Hanley and B. Alverez-Farizo (2002). Valuing the Non-Market Benefits of Wild Goose Conservation: A Comparison of Interview and Group-Based Approaches. Ecological Economics 43: 49-59.

Martín-López B., García-Llorente M., Palomo I., Montes C. (2011). The Conservation against Development Paradigm in Protected Areas: Valuation of Ecosystem Services in the Doñana Social-Ecological System (southwestern Spain). Ecological Economics 70: 1481-1491.

Moran D., McVittie A., Allcroft D., Elstin D. (2004). Beauty, beast and biodiversity: what does the public want from agriculture? Final Report to SEERAD.

Naidoo R. and Adamowicz W. L. (2005). Economic Benefits of Biodiversity Exceed Costs of Conservation at an African Rainforest Reserve. Proc. Natl. Acad. Sci. USA 102: 16712-16716.

Niskanen A. (1998). Value of External Environmental Impacts of Reforestation in Thailand. Ecological Economics 26: 287-297.

Nunes P.A.L.D. amd Schokkaert E. (2003). Identifying the warm glow effect in contingent valuation. Journal of Environmental Economics and Management 45: 231-245.

Olewiler N. (2004). The Value of Natural Capital in Settled Areas of Canada. Publish by Ducks Unlimited Canada and the Nature Conservancy of Canada.

Polasky S., Nelson E., Pennington D., Johnson K. A. (2011). The Impact of Land-Use Change on Ecosystem Services, Biodiversity and Returns to Landowners: A Case Study in the State of Minnesota. Environmental and Resources Economics 48: 219-242.

Pyo H_D. (2000). Measurement of the Conservation Value for Korean Coastal Wetlands Using the Contingent Valuation Method and Cost Benefit Analysis. EAERE 2000.

Revéret, J. P., Dupras J., Charron I., Lucchetti J. L. (2009). Volonté de payer de citoyens que cois pour des biens et services écologiques issues de changement de pratiques agricoles. Report of Agriculture et Agroalimentaire Canada et Groupe AGÉCO.

Scarpa R., Chilton S. M., Hutchinson W. G., Buongiorno J. (2000). Valuing the Recreational Benefits from the Creation of Nature Reserves in Irish Forests. Ecological Economics 33: 237-250.

Schultz S. and Taff S. (2004). Implicit Prices of Wetland Easements in Areas of Production Agriculture. Land Economics 80: 501-512.

Simonit S. and Perrings C. (2011). Sustainability and the Value of the Regulating Services: Wetlands and Water Quality in Lake Victoria. Ecological Economics 70: 1189-1199.

Stevens T.H., Echeverria J., Glass R. J., Hager T., More T. A. (1991). Measuring the Existence Value of Wildlife: What Do CVM Estimates Really Show? Land Economics 67: 390-400.

Tong C., Feagin R. A., Lu J., Zhang X., Zhu X., Wang W., He W. (2007). Ecosystem service values and restoration in the urban Sanyang wetland of Wenzhou, China. Ecological Engineering 29: 249-258.

Troy A. and Bagstad K. (2009). Estimating Ecosystem Services in Southern Ontario. Report commissioned by the Ontario Ministry of Nature Resources.

Urban J and Melichar J. (2009). Willingness to Pay for Conservation of Black Stork. EAERE 2009.

Van der Heide, C. M., van den Bergh J. C. J. M., van Ierland E. C. Nunes P.A.L.D. (2008). Economic Valuation of Habitat Defragmentation: A Study of the Veluwe, the Netherlands. Ecological Economics 67: 205-216.

van Vuuren and Roy (1990). Social and Private Returns from Wetland Preservation. Paper published by the American Water Resources Association, International and Transboundary Water Resources Issues.

Willis K. and Garrod G.D. (1990). The Individual Travel Cost Method and the Value of Recreation: The Case of the Montgomery and Lancaster Canals. Environment and Planning C: Government and Policy 8: 315-326.

Willis K. G., Garrod G. D., Benson J. F. Carter M. (1996). Benefits and Costs of the Wildlife Enhancement Scheme: A Case Study of the Pevensey Levels. Journal of Environmental Planning and Management 39: 387-402.

Xu H., Qian Y., Zheng L., Peng B. (2003). Assessment of Indirect Use Values of Forest Biodiversity in Yaoluoping National Nature Reserve, Anhui Province. Chinese Geographical Science 13: 277-283.

References "Water"

Aizaki H. Sato K., Osari H. (2006). Contingent valuation approach in measuring the multi-functionality of agriculture and rural areas in Japan. Paddy Water Environment 4: 217-222.

Bond C. A., Hoag L.D., Kipperberg G. (2011). Agricultural producers and the environment: A stated preference analysis of Colorado corn producers. Canadian Journal of Agricultural Economics 59: 127-144.

Cooper J. C. (1997). Combining Actual and Contingent Behavior Data to Model Farmer Adoption of Water Quality Protection Practices. Journal of Agricultural and Resource Economics 22: 30-43.

Crutchfield S. R., Cooper J. C., Hellerstein D. (1997). Benefits of Safer Drinking Water: The Value of Nitrate Reduction. Agriculture Economic Report nº 752.

Cullen R., Hughey K., Kerr G. (2006). New Zealand freshwater management and agriculture impacts. The Australian Journal of Agricultural and Resource Economics 50: 327-346.

Davy T. (1998). Benefits of Investment in Clean Water. Thesis. Université des Sciences Sociales de Toulouse.

Eftec and CSERGE (1998). Valuing Preferences for Changes in Water Abstraction from the River Ouse, Report to Yorkshire Water, Bedford.

Eftec (2003). PR04 WRP: Environmental Valuation of Demand Management Options, report to Southern Water Eftec, London.

Garrod G. and Willis K. (1996). Estimating the Benefits of Environmental Enhancement: A Case Study of the River Darent. Journal of Environmental Planning and Management 39: 189-203.

Giraldez C. and Fox G. (1995). An Economic Analysis of Groundwater Contamination from Agricultural Nitrate Emissions in Southern Ontario. Canadian Journal of Agricultural Economics 43: 387-402.

Gren I-M. (1995). The Value of Investing in Wetlands for Nitrogen Abatement. European Review of Agricultural Economics 22: 157-172.

Hanley N. (1991). The Economics of Nitrate Pollution in the UK. In Hanley, N.D. Farming and the Countryside: An Economic Analysis of External Costs and Benefits. CAB, Oxford.

Hauser A., Van Kooten G. C. (1993). Benefits of Improving Water Quality in the Abbotsford Aquifer: An Application of Contingent Valuation Methods. Canada. Environment Canada, Fraser River Action Plan (Canada).

Hoekstra, A. Y., Savanije H. H. G., Chapagain A. K. (2001). An Integrated Approach Towards Assessing the Value of Water: A Case Study on the Zambezi Basin. Integrated Assessment 2: 199-208.

Hurd (1999). Economic Effects of Climate Change on US Water Resources in the Impact of Climate Change on the United States Economy, edited by Robert Mendelsohn and James E. Neumann.

Lant C. L. and Tobin G. A. (1989). The Economic Value of Riparian Corridors in Cornbelt Floodplains: A Research Framework. The Professional Geographer 41: 337-349.

Lant C. L. (1991). Potential of the Conservation Reserve Program to Control Agricultural Surface Water Pollution. Environmental Management 15: 507-518.

Lee L. K and Nielsen E. G. (1987). The Extent and Costs of Groundwater Contamination by Agriculture. Journal of Soil and Water Conservation 42: 243-248.

Lynch L., Hardie I., Parker D. (2002). Analyzing Agricultural Landowners' Willingness to Install Streamside Buffers. Working Paper of the Department of Agriculture and Resources Economics. The University of Maryland, College Park.

Ma S., Lupi F., Swinton S. M., Chen H. (2011). Modeling Certainty-Adjusted Willingness to Pay for Ecosystem Service Improvement from Agriculture. Agricultural & Applied Economics Association´s 2011 AAEA & NAREA Joint Annual Meeting, Pittsburgh.

Martin-Ortega J. and Derbel J. (2010). Using Multi-Criteria Analysis to Explore Non-Market Monetary Values of Water Quality Changes in the Context of the Water Framework Directive. Science of the Total Environment 408: 3990-7.

McCann, L. M.J. Easter, K. W. (1998). Estimating Transaction Costs of Alternative Policies to Reduce Phosphorous Pollution in the Minnesota River. University of Minnesota, Department of Applied Economics, Staff Papers.

Moran D., McVittie A., Allcroft D., Elstin D. (2004). Beauty, beast and biodiversity: what does the public want from agriculture? Final Report to SEERAD.

Patrick R., Fletcher J., Lovejoy S.,Van Beek W., Holloway G.,Binkley J. (1991). Estimating Regional Benefits of Reducing Targeted Pollutants: an Application to Agricultural Effects on Water Quality and the Value of Recreational Fishing. Journal of Environmental Management 33: 301-310.

Phillips T. P. and Foster B. A. (1987). Economic Impacts of Acid Rain on Forest, Aquatic, and Agricultural Ecosystems in Canada. American Journal of Agricultural Economics 69: 963-969.

Poe G. L. and Bishop R. C. (1999). Valuing the Incremental Benefits of Groundwater Protection when Exposure Levels are Known. Environmental and Resources Economics 13: 341-367.

Pretty J., Mason C., Nedwell D., Hine R., Leaf S. and Dils, R. (2003). Environmental costs of freshwater pollution, Environmental Science and Tecnology 37: 201-208.

Ribaudo M. (1989). Water Quality Benefits from the Conservation Reserve Program. U.S. Dept. of Agriculture, Economic Research Service.

Ribaudo M. O., Osborn T., Konyar K. (1994). Land Retirement as a Tool for Reducing Agricultural Nonpoint Source Pollution. Land Economics 70: 77-87.

Shaik S., Helmers G.A., Langemeier, M. R. (2002). Direct and Indirect Shadow Price and Cost Estimates of Nitrogen Pollution Abatement Journal of Agriculture and Resource Economics 27: 420-432.

Shrestha R. and Alavalapati J. R. R. (2004). Valuing Environmental Benefits of Silvo pasture Practice: A Case Study of the Lake Okeechobee Watershed in Florida. Ecology Economics 49: 349-359.

Stevens T. H., Barrett C. B., Willis, C. E. (1997). Conjoint analysis of groundwater protection programs. Agricultural and Resource Economics Review 26: 229-236.

Thomassin, P. J. and R. Johnston (2007). Benefit Transfer of Water Quality Improvements from Agricultural Landscapes: A Meta Analysis Agriculture Canada and Agri-Food.

Travisi C. and Nijkamp P. (2004). Willingness to Pay for Agricultural Environmental Safety: Evidence From a Survey of Milan, Italy, Residents. FEEM Working paper Nº 100-04.

Veeman T. (1997). Conserving Water in Irrigated Agriculture: The Economics and Valuation of Water Rights. Department of Rural Economy, Faculty of Agriculture, Forestry and Home Economics, University of Alberta.

Vesterinen J. and Pouta J. (2008). Water Recreation Benefits from Reduced Eutrophication in Finnish Surface Waters. EAAE 2008.

Willis (2002). Benefits and Costs of Forests to Water Supply and Water Quality. Report to the Forestry Commission, CREAM, University of Newcastle.

References "Soil"

Amorós J. M and Riera P. (2001). Comparación de la ordenación contingente y del experimento de elección en la valoración de las funciones no privadas de los bosques. Economía Agraria y Recursos Naturales 1: 125-147.

Brethour C. and Weersink A. (2001). An Economic Evaluation of the Environmental Benefits from Pesticide Reduction. Agricultural Economics 25: 219-226.

Bui D. T. (2001). The Economics of Soil Erosion and the Choice of Land Use Systems by Upland Farmers in Central Vietnam. EEPSEA publications.

Chen M. (2006). Evaluation of Environmental Services of Agriculture in Taiwan. Working paper.

Colombo S., Calatra-Requena J., Hanley N. (2006). Analysing the social benefits of soil conservation measures using stated preference methods. Ecological Economics 58: 850-861.

Crowder B. M. (1987). Economic Costs of Reservoir Sedimentation: A Regional Approach to Estimating Cropland Erosion Damages. Journal of Soil and Water Conservation 42: 194-197.

Ekanayake, E. R. M. and Abeygunawardena P. (1994). Valuation of Conservation Commodity of the Sinharaja Forest: Towards Total Economic Value. Sri Lanka Journal of Agricultural Economics 2: 115-129.

Hansen L. and Hellerstein D. (2007). The Value of the Reservoir Services Gained with Soil Conservation. Land Economics 83: 285-301.

Loomis J., Kent P., Strange L., Fausch K., Covich A. (2000). Measuring the Total Economic Value of Restoring EcoSystem Services in an Impaired River Basin: Results from a Contingent Valuation Survey. Ecological Economics 33: 103-117.

Loureiro M. L., McCluskey J. J., Mittelhammer R. C. (2000). Willingness to Pay for Sustainable Agriculture. Report to the Federal State Marketing Improvement Program.

Nam M. V., Nham T. N., Trinh B. V., Thong P. L. (2001). Forest Management Systems in the Mekong River Delta, Vietnam. EEPSEA publications.

Ribaudo M. O. (1986). Reducing Soil Erosion: Offsite Benefits. Natural Resource Economic Division, Economic Research Service, U.S. Department of Agriculture. Agricultural Economic Report nº 561.

Thao T. D. (2001). On-Site Costs and Benefits of Soil Conservation in the Mountainous Regions of Northern Vietnam. EEPSEA publications.

Wang X., Bennett J., Xie C., Zhang Z., Liang D. (2007). Estimating Non-Market Environmental Benefits of the Conversion to Cropland to Forest and Grassland Program: A Choice Modelling Approach. Ecological Economics 63: 114-125.

References "Air quality"

AEA Technology Environment (2004). Evaluation of the Air Quality Strategy, a study for Defra (Environmental Protection and Economics) forthcoming.

Bateman I. J., Georgiou S., Langford I. H., Poe G. L., Tsoumas A. (2002). Investigating the Characteristics of Expressed Preferences for Reducing the Impacts of Air Pollution: a Contingent Valuation Experiment. CESERGE working paper EDM 02-02.

Crocker T.D. and Regens J. L. (1985) Acid Deposition Control, A Benefit-Cost Analysis. Environmental Science and Technology 19: 112-116.

Eyre N., Downing T., Hoekstra R., Rennings K., Tol R. (1997). Global Warming Damages: Final Report of the external global warming sub-task, DG Environment, European Commission, Brussels. Farmer, M.C. and Randall, A. (1997) The Rationality of a Safe Minimum Standard, land Economics 74: 287-302.

Fankhauser S. (1995). The Economic Costs of CO2 Concentration Doubling in the Valuing Climate Change in The Economic Cost of Gobal Warming. Earthscan Publication Limited.

Gascoigne B., Koontz L., Hoag D., Tangen B., Gleason R., Shaffer T. (2011). Valuing Ecosystem and Economic Services Across Land-use Scenarios in the Prairie Pothole Region of the Dakotas, USA. Ecological Economics 70: 1715-1725.

Holland M., Forster D., King K., Haworth A., Watkiss P. (1999). Economic Evaluation of Proposals for Emission Ceilings for Atmospheric Pollutants. AEA Technology, Interim Report for DGXI of the European Commission. Analysis of Scenarios from IIASA's Seventh Interim Report.

Johansson P.O. and Kriström B. (1988). Measuring Values for Improved Air Quality from Discrete Response Data: Two Experiments. Journal of Agricultural Economics 39: 439-445.

Kennedy A. M. and Wilson P. N. (2005). Reduced Tillage as an Economic Response to Clean Air Regulation. Cardon Research Papers in Agricultural and Resource Economics.

Kulshreshtha S. and Kort J. (2009). External Economic Benefits and Social Goods from Prairie Shelterbelts. Agroforestry Systems 75: 39-47.

Kwak S-J., Yoo S-H., Kim T-Y. (2001). A Constructive Approach to Air-Quality Valuation in Korea. Ecological Economics 38: 327-344.

Rittmaster R., Adamowicz W.L., Amiro B., Pelletier R. T. (2006). Economic Analysis of the Human Health Effects from Forest Fires. Canadian Journal of Forest Resources 36: 368-877.

Tol R.S.J. and Downing T. (2002) Appendix 4: Marginal Cost of Greenhouse Gas Emissions, in AEA Technology, Quantification and Valuation of Environmental Externalities: The Case of Global Warming and Climate Change – A Report Produced for the European Investment Bank, August 2002.

Tol, R. S. J. (1999). The Marginal Costs of Greenhouse Gas Emissions. The Energy Journal 20: 61-82.

White E., Veeman M., Adamowicz W. (2004). Financial and Health Costs of Pesticide Use in Growing Conventional and Genetically Modified Potatoes in Prince Edward Island. Annual Meeting of The Canadian Agricultural Economics Society, Halifaz, 2004.

References "Climate Stability"

Adams R. M., McCarl B. A., Segerson K., Rosenzweig C., Bryant K.J., Dixon B.L., Conner R., Evenson R.E., Ojima D. (1999). Economic Effects of Climate Change on US Agriculture in the Impact of Climate Change on the United States Economy. Edited by Neumann J. E. Industrial Economics Incorporated, Cambridge, Massachusetts.

Cai B., Cameron T. A., Gerdes G. R. (2010). Distributional Preferences and the Incidence of Costs and Benefits in Climate Change Policy. Environmental Resource Economics 46: 429-458.

Manley J. G, van Kooten G.G., Moeltner K., Johnson D. W. (2003). Creating Carbon Offstes in Agriculture through No-Till Cultivation: a Meta-Analysis of Costs and Carbon Benefits. Working Paper.

Mendelsohn R. (1999). The Impact of Climate Variation on US Agriculture. In Neumann J. E. and Mendelsohn R. (Eds.) The Impact of Climate Change on the United States Economy. Industrial Economics Incorporated. Cambridge, Massachusetts.

Segerson K. and Dixon B. L. (1999). Climate Change and Agriculture: The Role of Farmer Adaptation. In Neumann J. E. and Mendelsohn R. (Eds.) The Impact of Climate Change on the United States Economy. Industrial Economics Incorporated. Cambridge, Massachusetts.

Weber M. and Hauer G. (2003). A Regional Analysis of Climate Change Impacts on Canadian Agriculture. Canadian Public Policy – Analyse de Politiques, vol XXIX Nº 2.

Withey P. and van Kooten G.G. (2011). The Effect of Climate Change on Optimal Wetlands and Waterfowl Management in Western Canada. Ecological Economics 70: 768-805.

References "Resilience to Fire"

Fried J.S., Winter G.J., Gilless K. J. (1999). Assessing the Benefits of Reducing Fire Risk in the Wildland-Urban Interface: A Contingent Valuation Approach. International Journal of Wildland Fire 9: 9-20.

Hesseln H., Loomis J. B., Gonzalez-Caban A. (2004). Comparing the Economic Effects of Fire on Hiking Demand in Montana and Colorado. Journal of Forest Economics 10: 21-35.

Loomis J. B., González-Cabán A., Gregory R. (1996). A Contingent Valuation Study of the Value of Reducing Fire Hazards to Old-Growth Forests in the Pacific Northwest. Res. Paper PSW-RP-229-Web. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture.

Stetler K.M, Ven T. J, Calkin D. E. (2010). The Effects of Wildfire and Environmental Amenities on Property Values in Northwest Montana, USA. Ecological Economics 69: 2233-2243.

Referecnces "Resilience to floods

Oglethorpe D. R. and Miliadou D. (2000). Economic Valuation of the Non-Use Attributes of a Wetland: A Case-Study for Lake Kerkini. Journal of Environmental Planning and Management 43: 755-767.

Pattanayak S. K. and Kramer R.A. (2001). Pricing Ecological Services: Willingness to Pay for Drought Mitigation from Watershed Protection in Eastern Indonesia. Water Resources Research 37: 771-8.

Annex II – Indicators used to delimitated macro-regions and relevance of each macro-region

- Distribution of Land Cover Classes in the EU (as defined in Context Indicator 7 of the Rural Development Report (RDR) 2011 (EC, 2011) by grouping the basic 2-digit CLC categories (CLC 2006, except for Greece where CLC 2000 is used))

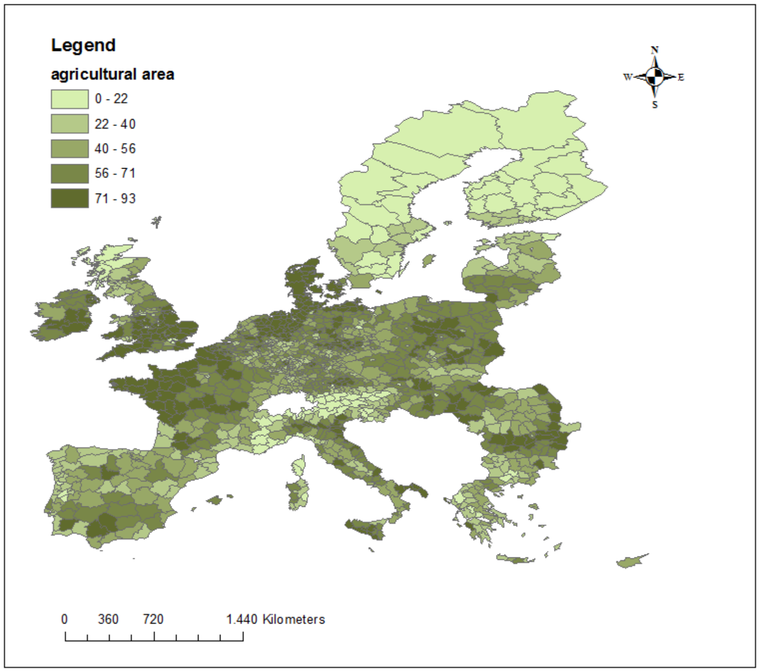


Figure 18 – Agricultural area (%)

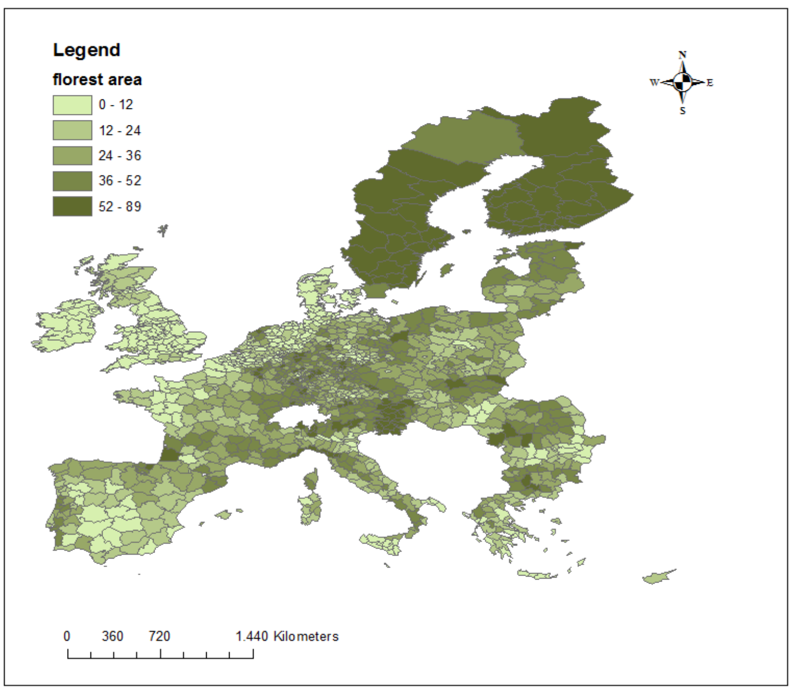


Figure 19 - Forest area (%)

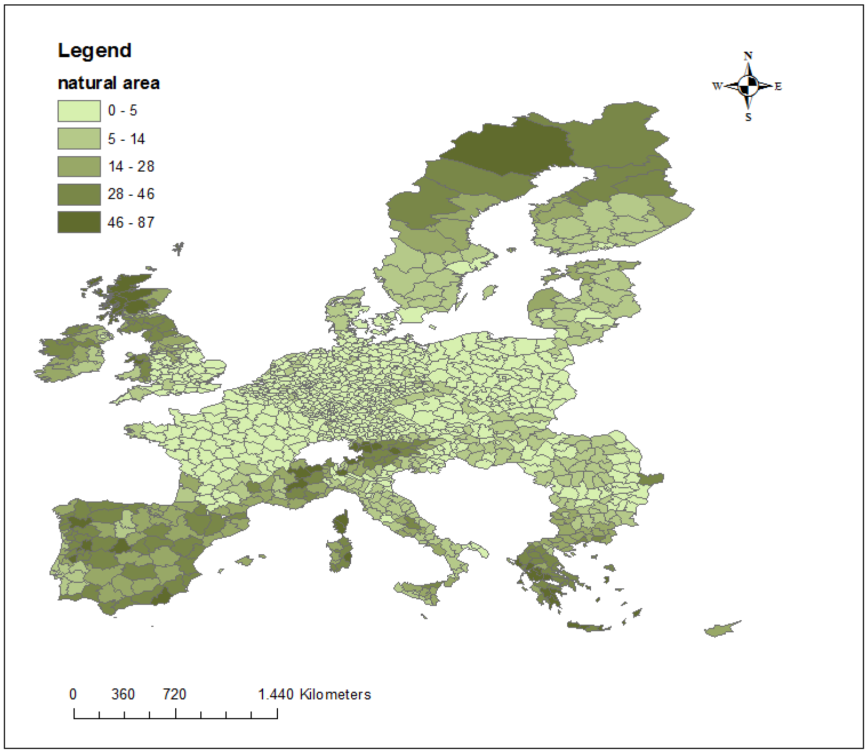


Figure 20 - Natural area (%)

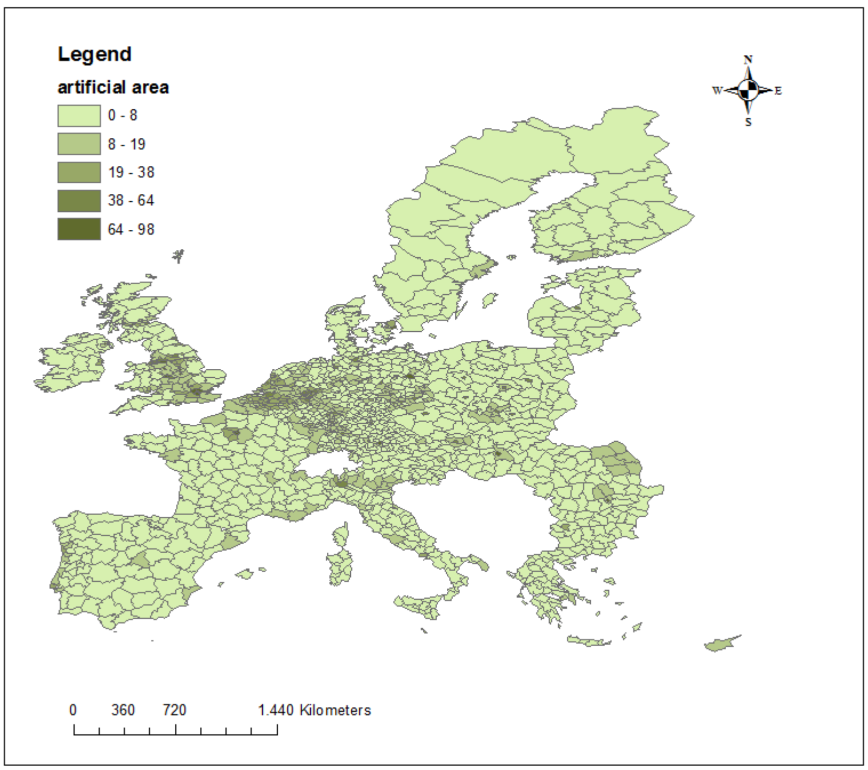


Figure 21 - Artificial area in UE (%)

- Distribution of Agricultural Land Use in the EU (from the Farm Structure Survey 2007 as reported by Context Indicator 3 of the RDR 2011)

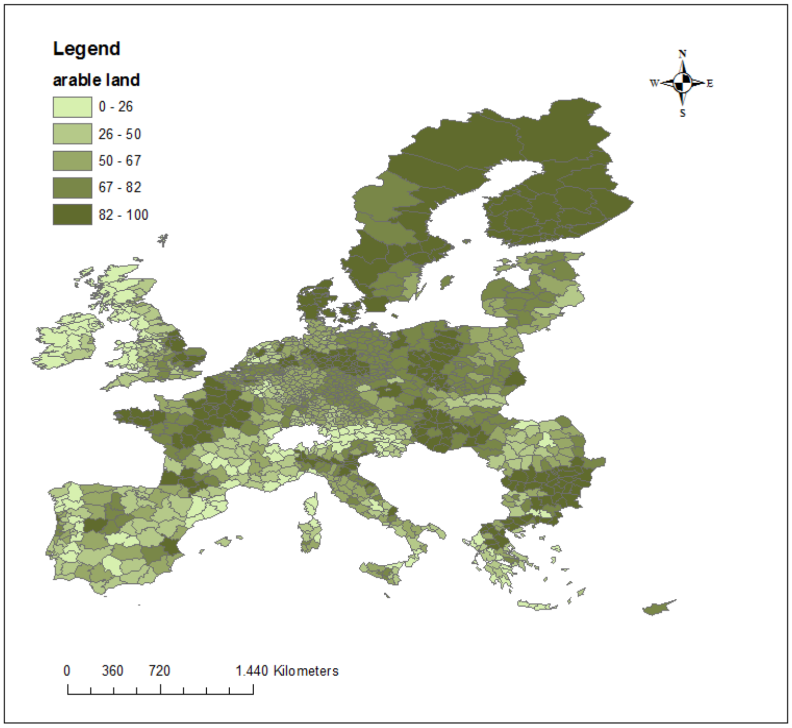


Figure 22 - Arable land (percent of UAA)

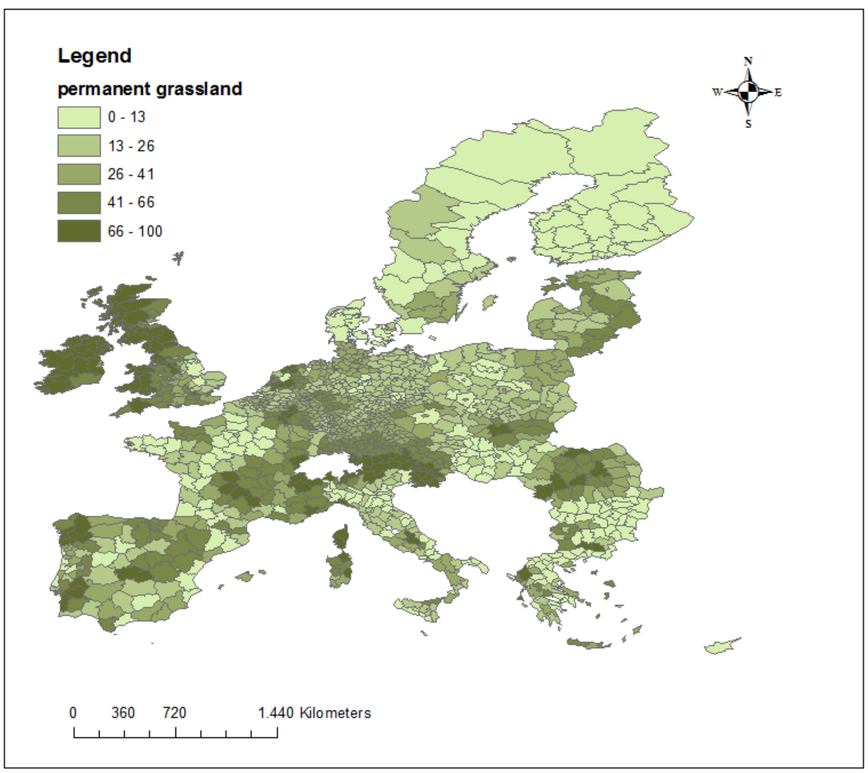


Figure 23 - Permanent grassland (% of UAA)

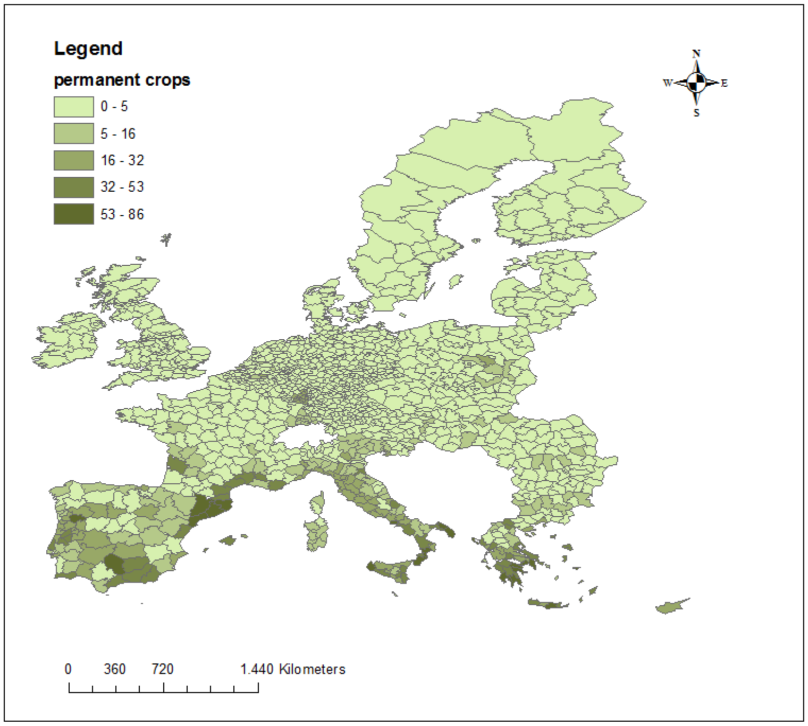


Figure 24 - Permanent crops (% of UAA)

- Distribution of Core versus Marginal areas in the EU (as reported by Context Indicator 8 of the RDR 201, according to Eurostat's FSS and communication of MS 2000)

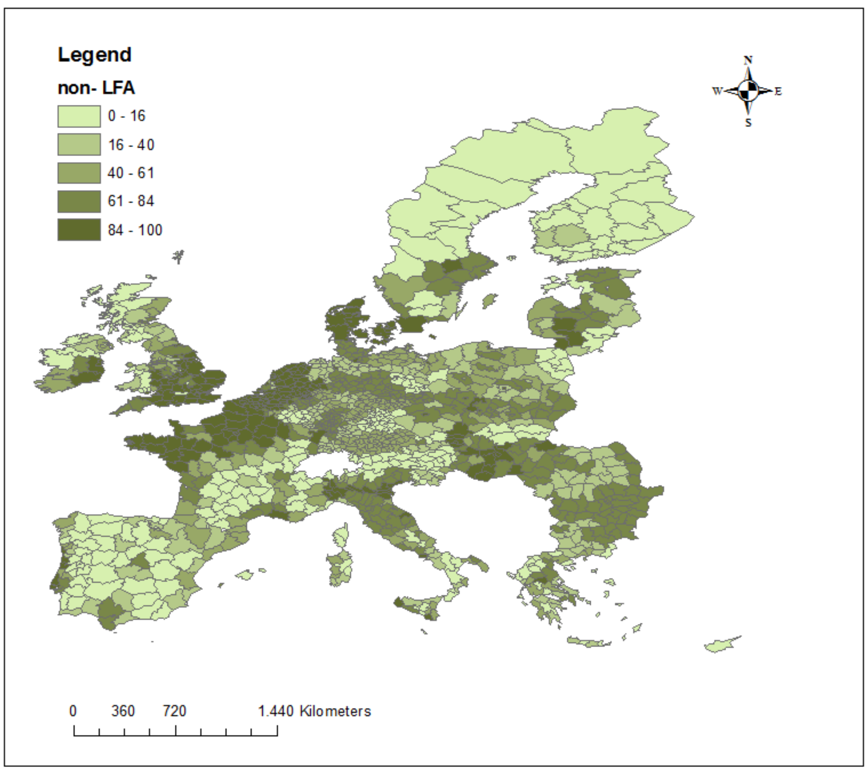


Figure 25 - Non-LFA area (% of UAA)

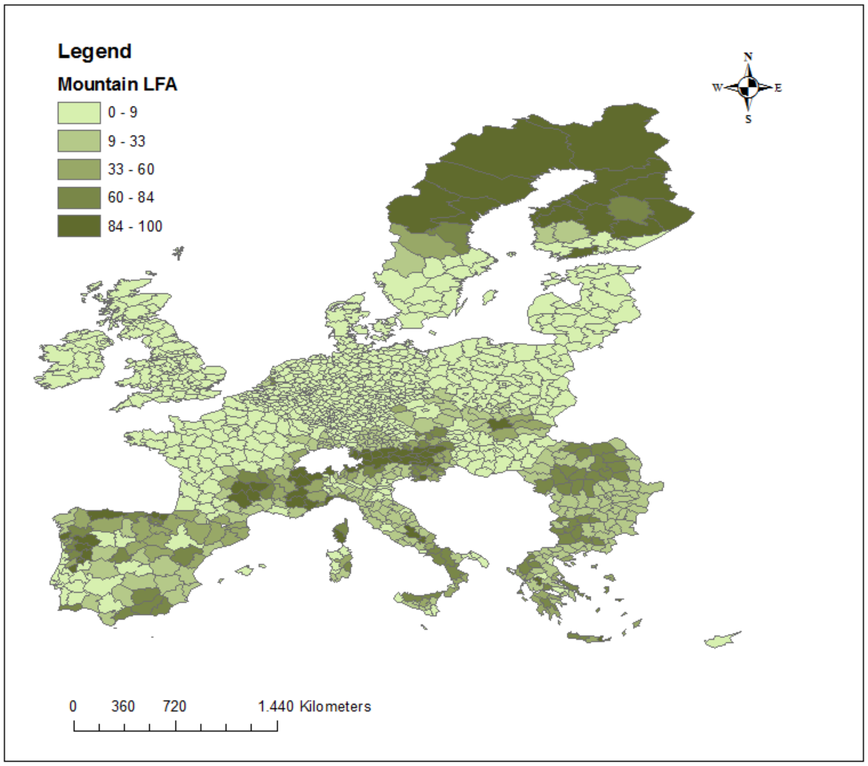


Figure 26 - Mountain LFA area (% of UAA)

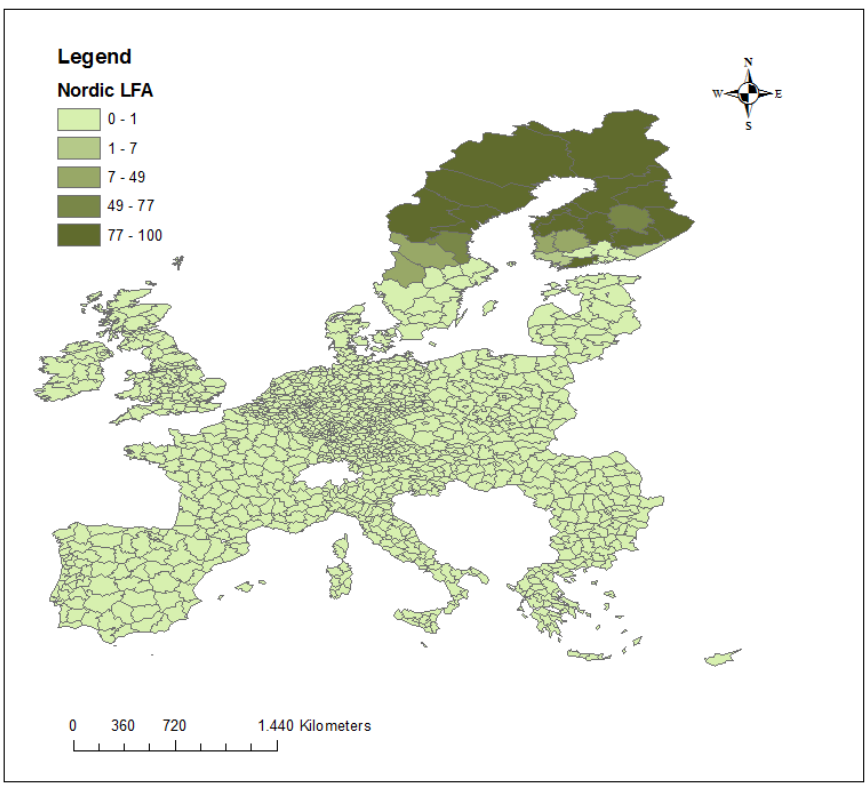


Figure 27 - Nordic LFA (% of UAA)

- Distribution of Specialization Pattern of Farms in UE (retrieved from Eurostat's FSS 2005, 2003 or 2000)

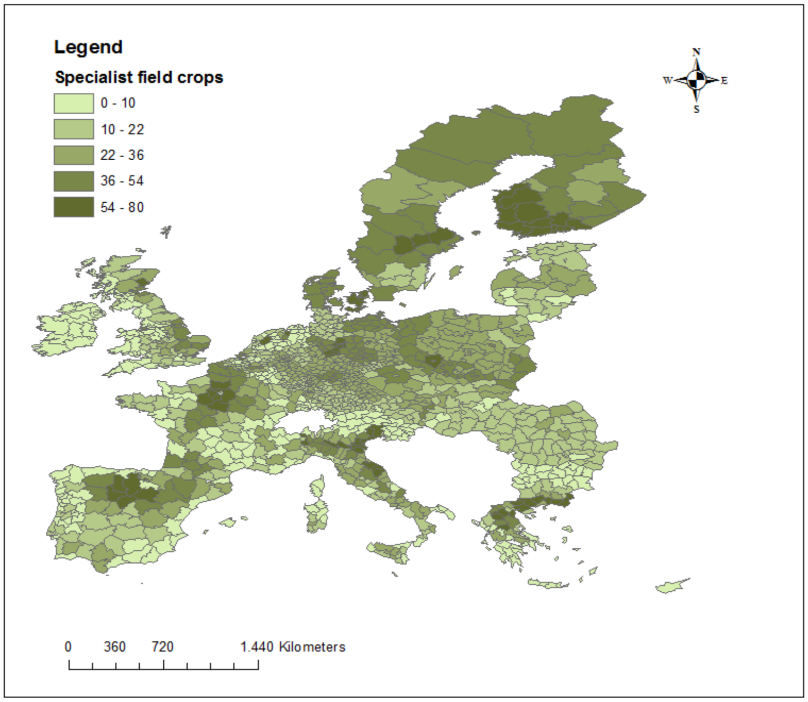


Figure 28 - Farms specialized in field crops (% of farms)

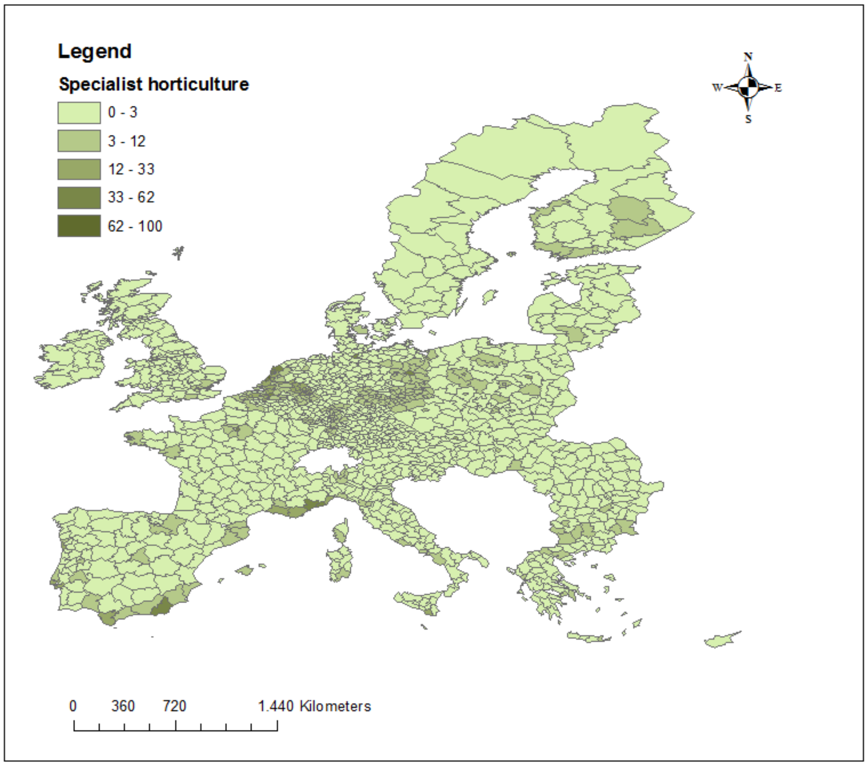


Figure 29 - Farms specialized in horticulture (% of farms)

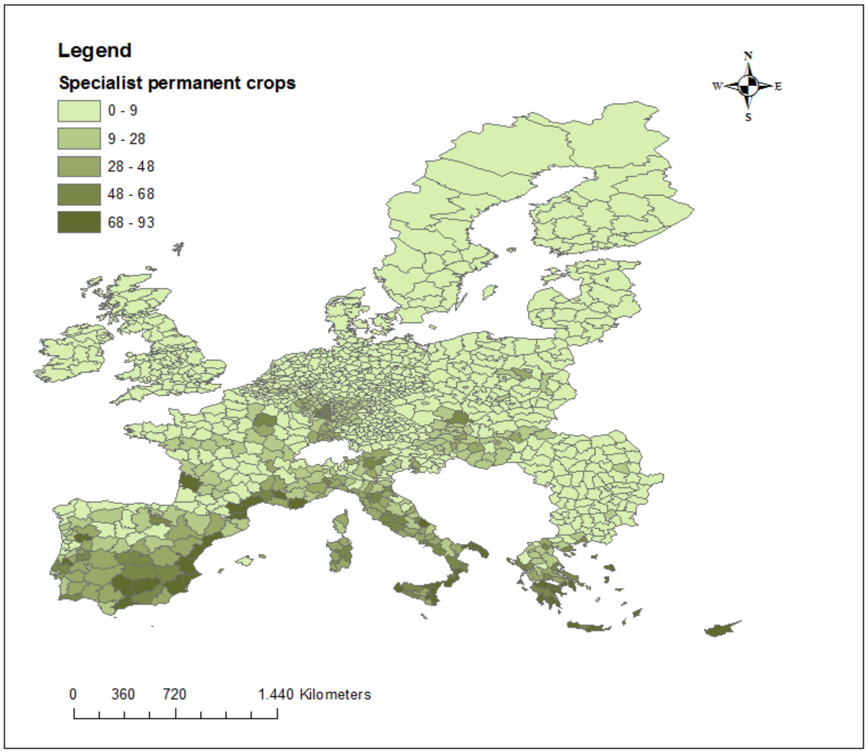


Figure 30 - Farms specialized in permanent crops (% of farms)

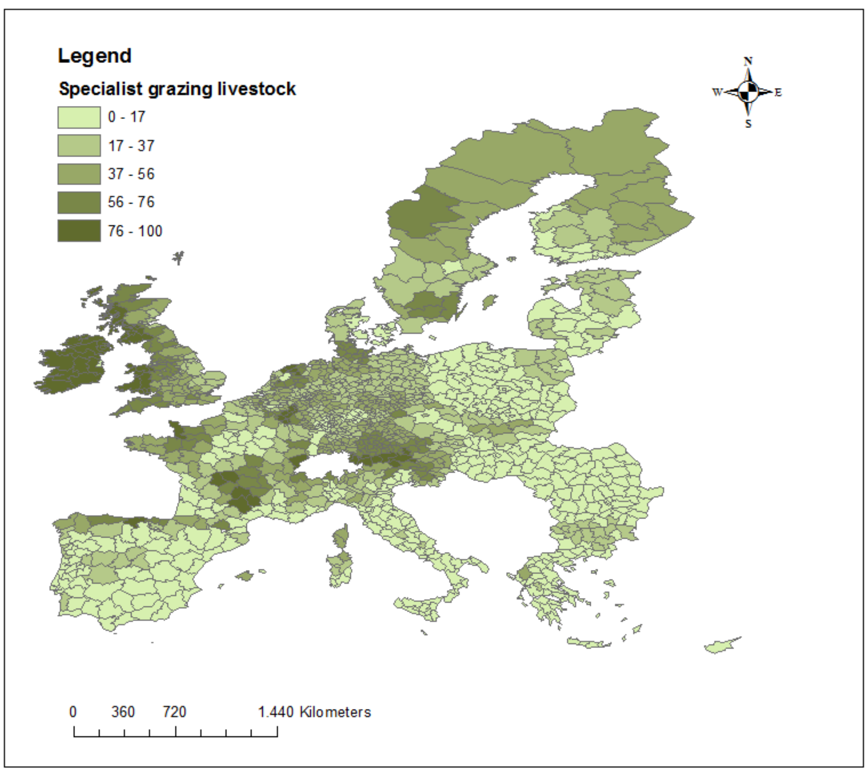


Figure 31 - Farms specialized in grazing livestock (% of farms)

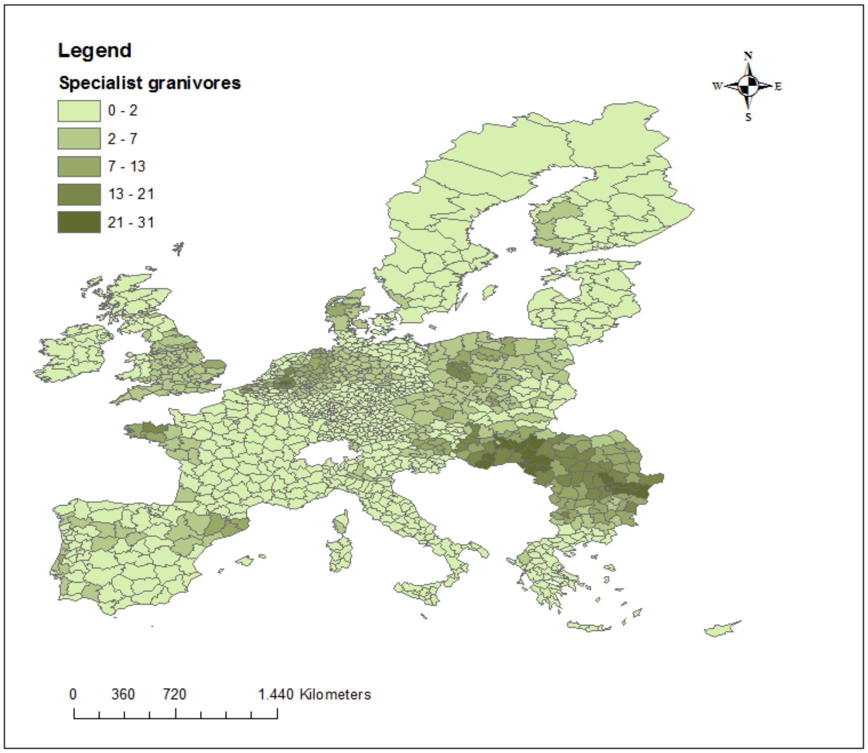


Figure 32 - Farms specialized in granivores (% of farms)

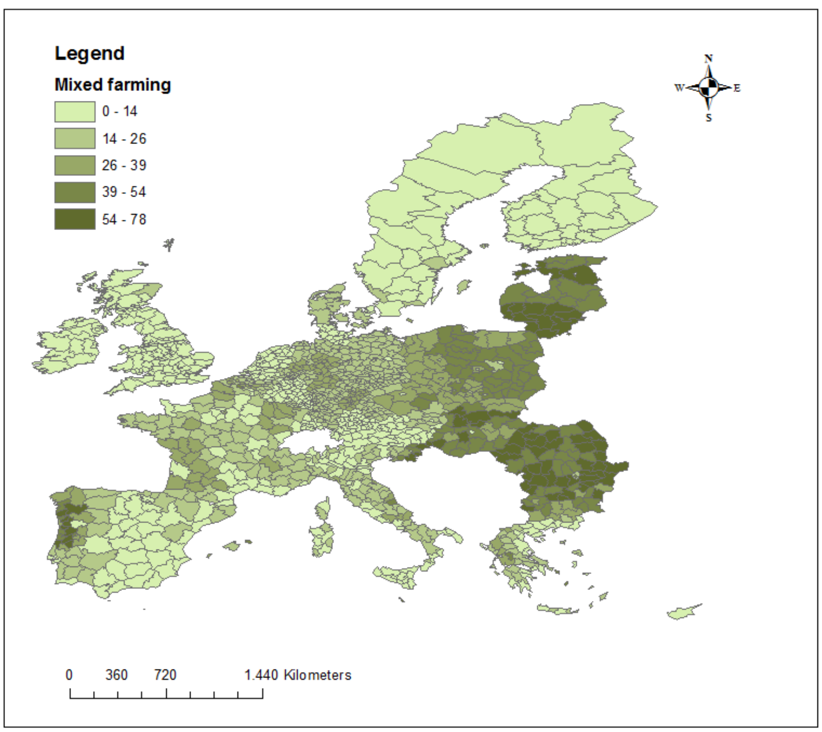


Figure 33 - Mixed farms (% of farms)

- **Distribution of intensity of farming in the EU**

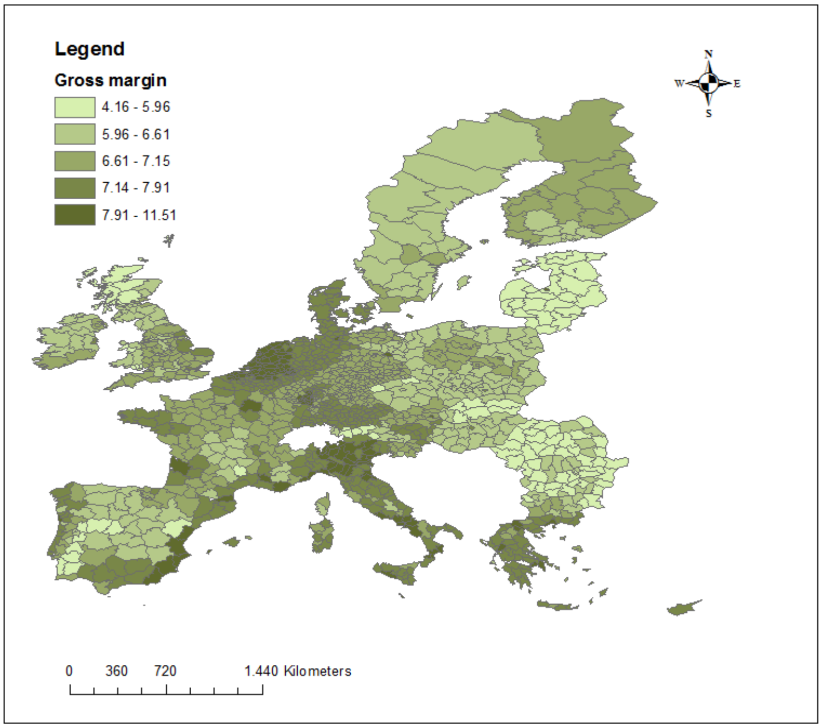


Figure 34 - Overall Economic Intensity of Farming (average gross margin in €/ha)
(Computed from Eurostat's FSS 2007 data retrieved from Context Indicator 4 of the RDR)

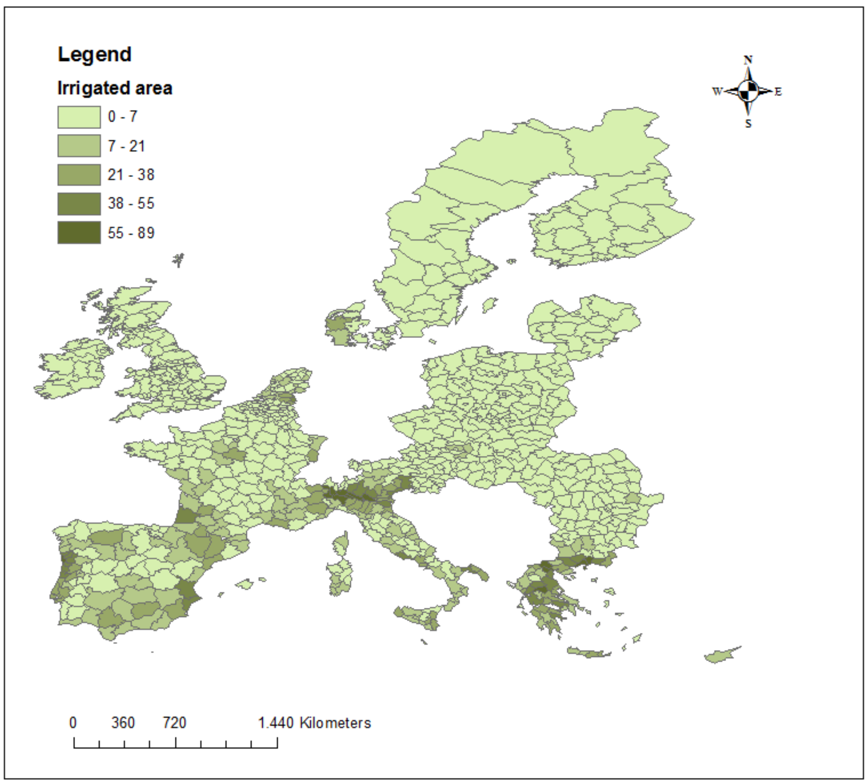


Figure 35 - Irrigated area (% of UAA)
(Estimated from Eurostat's FSS 2007 data retrieved from Context Indicator 15 of the RDR)

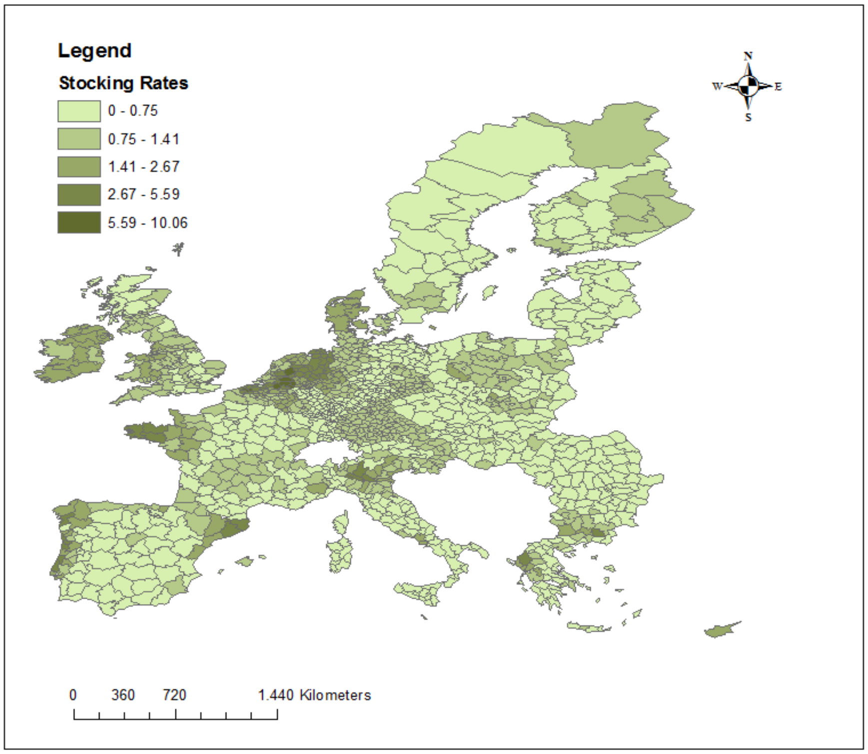


Figure 36 - Stocking rates (LSU/UAA)
(Retrieved from Eurostat's FSS 2005, 2003 or 2000)

- Distribution of Physical and Economic Size of Farms in the EU

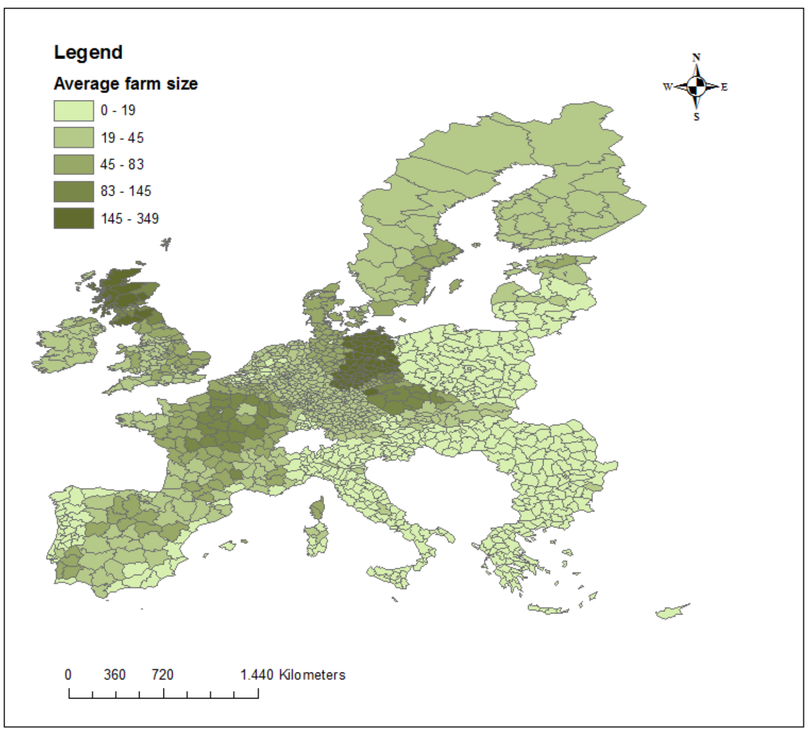


Figure 37 - Average physical farm size (ha)
(From the Eurostat's FSS 2007 retrieved from Context Indicator 4 of the RDR)

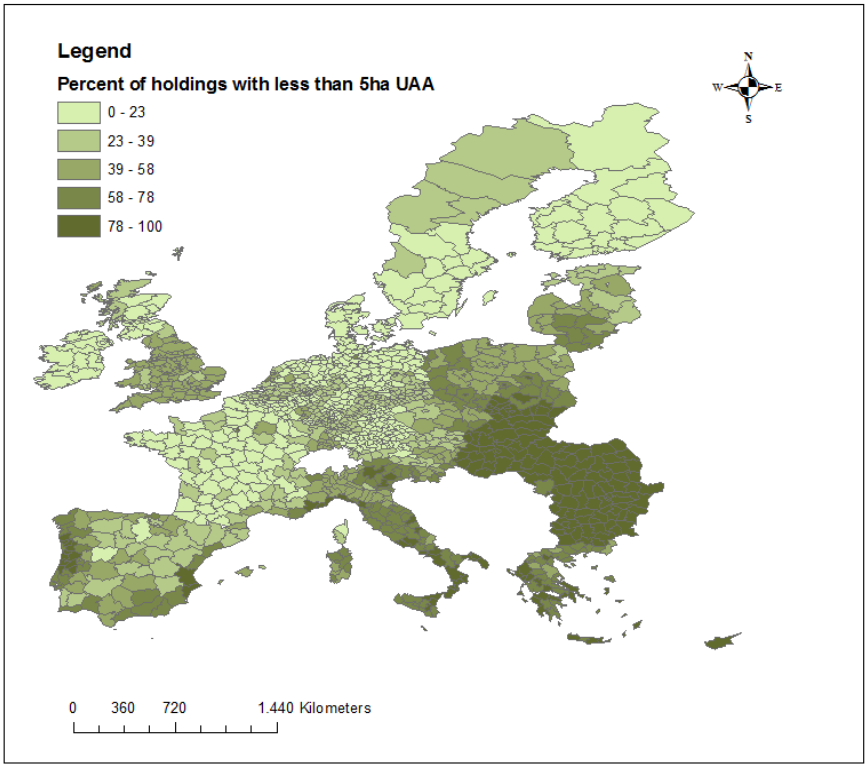


Figure 38 - % of holding with less than 5 ha (UAA)
(From the Eurostat's FSS 2007 retrieved from Context Indicator 4 of the RDR)

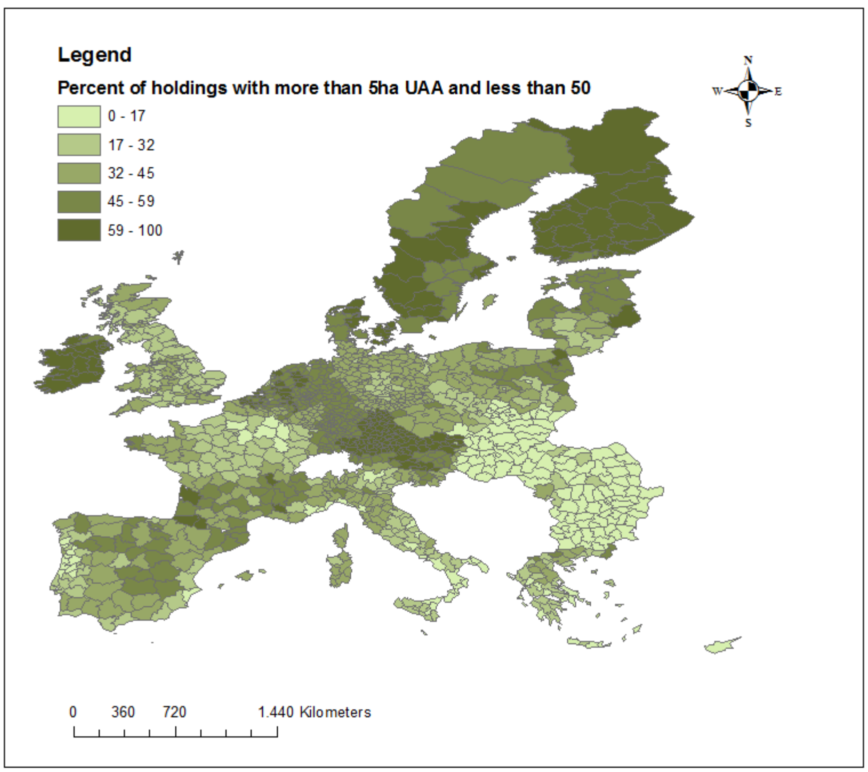


Figure 39 - % of holdings with more than 5 ha but less than 50 (UAA)
(From the Eurostat's FSS 2007 retrieved from Context Indicator 4 of the RDR)

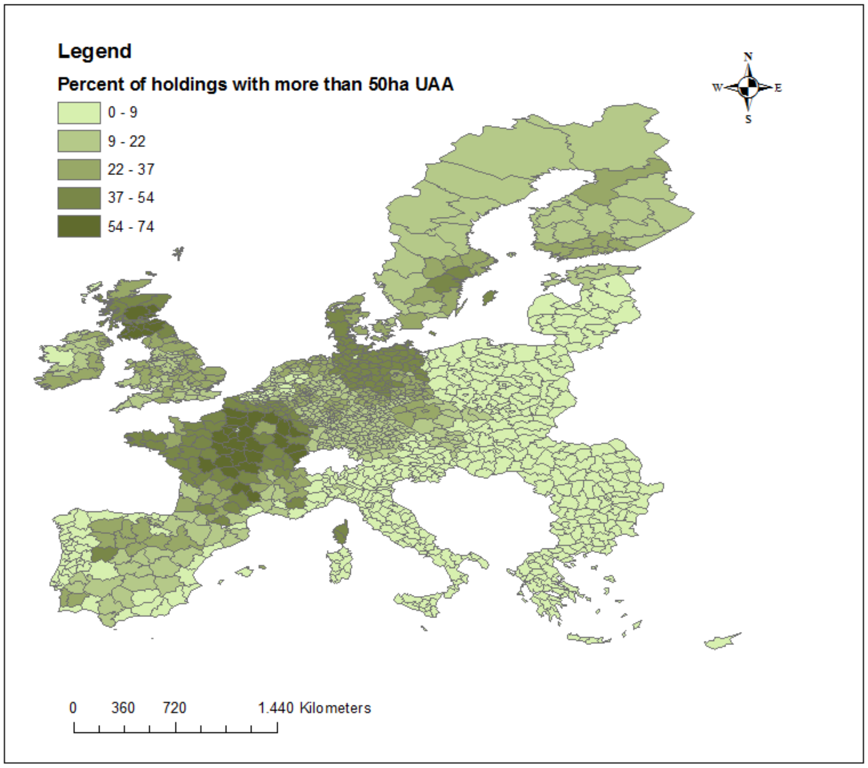


Figure 40 - % of holding with more than 50 ha (UAA)
(From the Eurostat's FSS 2007 retrieved from Context Indicator 4 of the RDR)

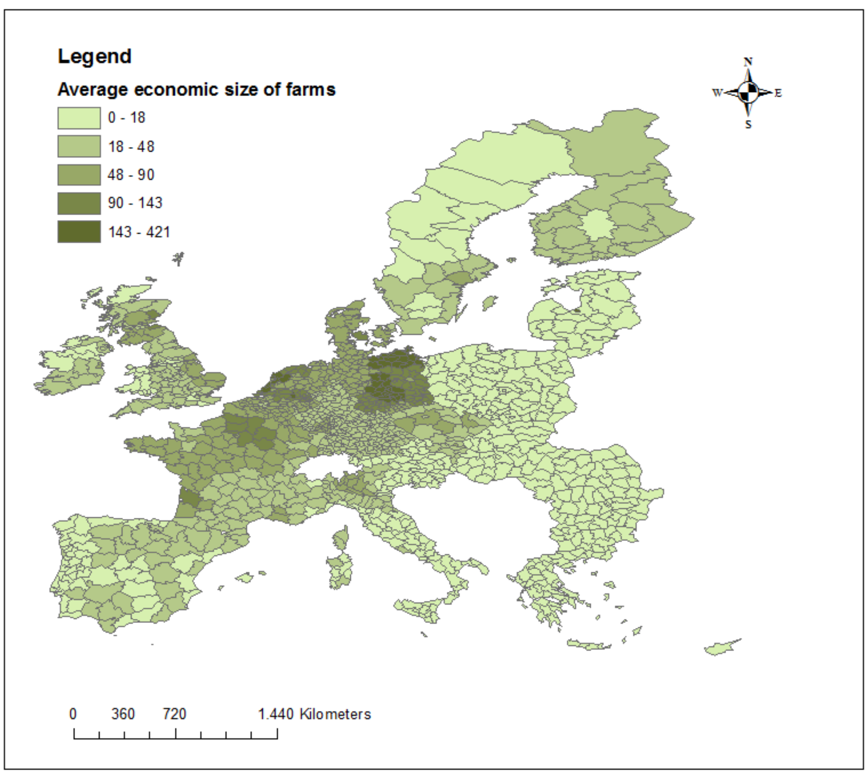


Figure 41 - Average economic farm size (ESU)
(From the Eurostat's FSS 2007 retrieved from Context Indicator 4 of the RDR)

- Relevance of macro-regions from different analysis in terms of number of NUT, area and UAA

Table 49 - Direct cluster analysis (6)

	Nº NUTS	% NUTS	area (km^2)	% area
1	340	26%	1240798	37%
2	101	8%	393313	12%
3	251	19%	375147	11%
4	149	11%	255256	8%
5	369	28%	751664	23%
6	83	6%	294507	9%
TOTAL macro-regions	1293	99%	3310685	99%
TOTAL	1301	100%	3330621	100%

Table 50 - Direct cluster analysis (12)

	Nº NUTS	% NUTS	area (km2)	% area
1	102	8%	259718	8%
2	170	13%	787168	24%
3	68	5%	193912	6%
4	35	3%	107097	3%
5	66	5%	286216	9%
6	94	7%	21468	1%
7	157	12%	353679	11%
8	93	7%	130173	4%
9	369	28%	751664	23%
10	56	4%	125083	4%
11	67	5%	239386	7%
12	16	1%	55120	2%
TOTAL macro-regions	1293	99%	3310685	99%
TOTAL	1301	100%	3330621	100%

Table 51 - Factorial cluster analysis (6)

	Nº NUTS	% NUTS	area (km2)	% area
1	166	13%	452529	14%
2	323	25%	762458	23%
3	507	39%	1093414	33%
4	109	8%	42524	1%
5	171	13%	901465	27%
6	17	1%	58295	2%
TOTAL macro-regions	1293	99%	3310685	99%
TOTAL	1301	100%	3330621	100%

Table 52 - Factorial cluster analysis (13)

	Nº NUTS	% NUTS	area (km2)	% area
1	113	9%	289164	9%
2	230	18%	616895	19%
3	191	15%	319521	10%
4	17	1%	19967	1%
5	93	7%	307551	9%
6	165	13%	387655	12%
7	58	4%	78686	2%
8	92	7%	22557	1%
9	85	7%	483920	15%
10	86	7%	417545	13%
11	93	7%	145562	4%
12	53	4%	163366	5%
13	17	1%	58295	2%
TOTAL macro-regions	1293	99%	3310685	99%
TOTAL	1301	100%	3330621	100%

References

EC - Directorate-General for Agriculture and Rural Development (2011) Rural Development in the European Union. Available on:

http://ec.europa.eu/agriculture/statistics/rural-development/2011/index_en.htm

Eurostat – Agri-enviromental indicators. Available on:

http://epp.eurostat.ec.europa.eu/portal/page/portal/agri_environmental_indicators/indicators_overview

Annex III – PGaE indicators

- Landscape

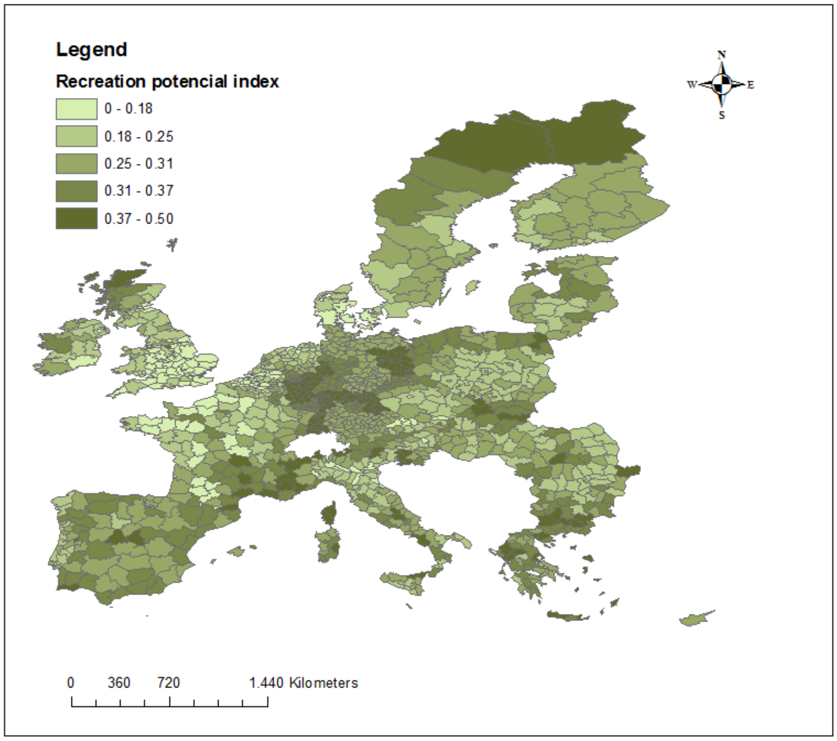


Figure 42 - Distribution of recreation potential index in UE
(In Maes *et al*., 2011)

- Biodiversity

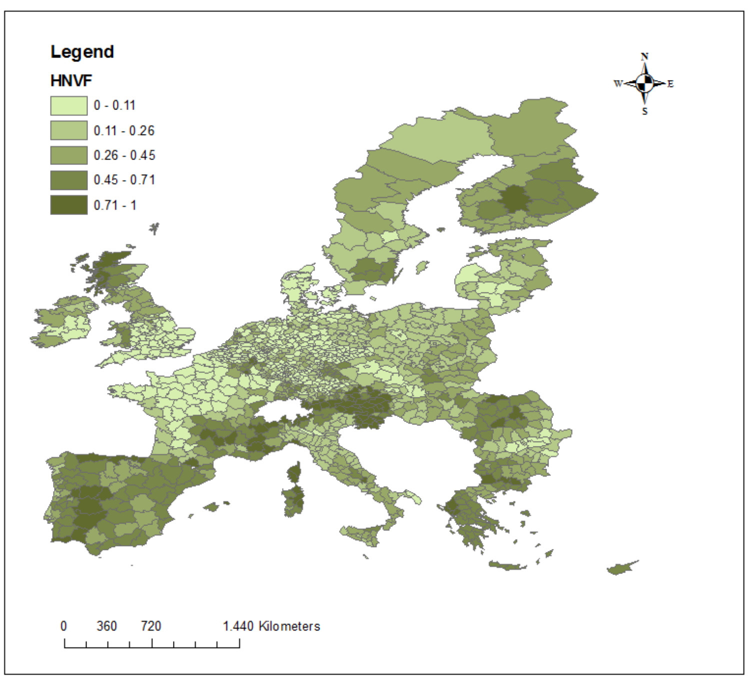


Figure 43 - Distribution of HNVF in UE (fraction UAA)
(In Paracchini *et al*., 2008)

- Water quality and availability

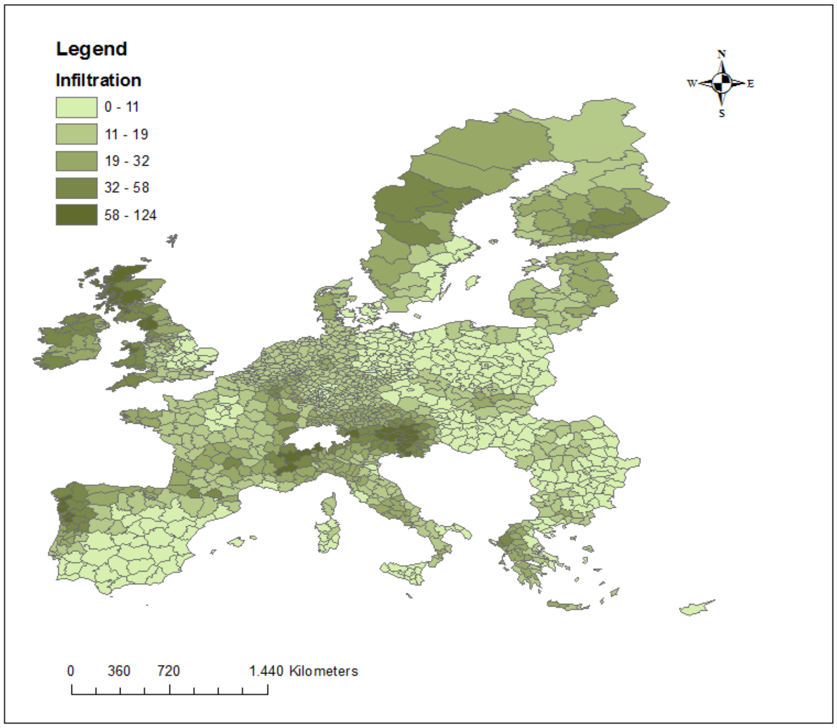


Figure 44 - Distribuition of infiltration in UE (mm)
(In Maes *et al*., 2011)

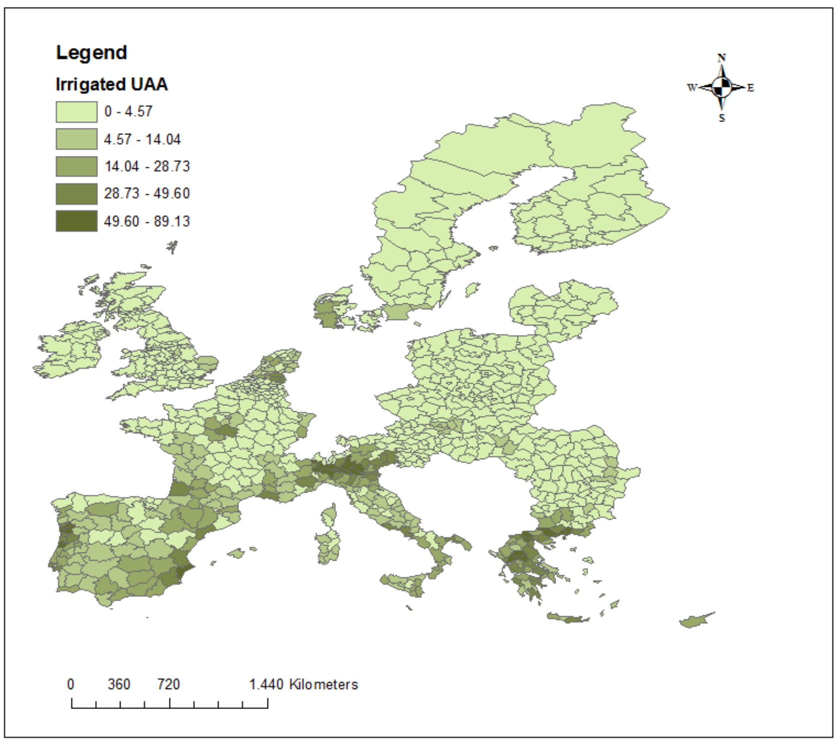


Figure 45 - Distribution of irrigated UAA in UE (percentage of UAA)
(In Farm Structure Survey 2007 (Eurostat) as retrieved from the data sets included in the Rural Development Report 2011)

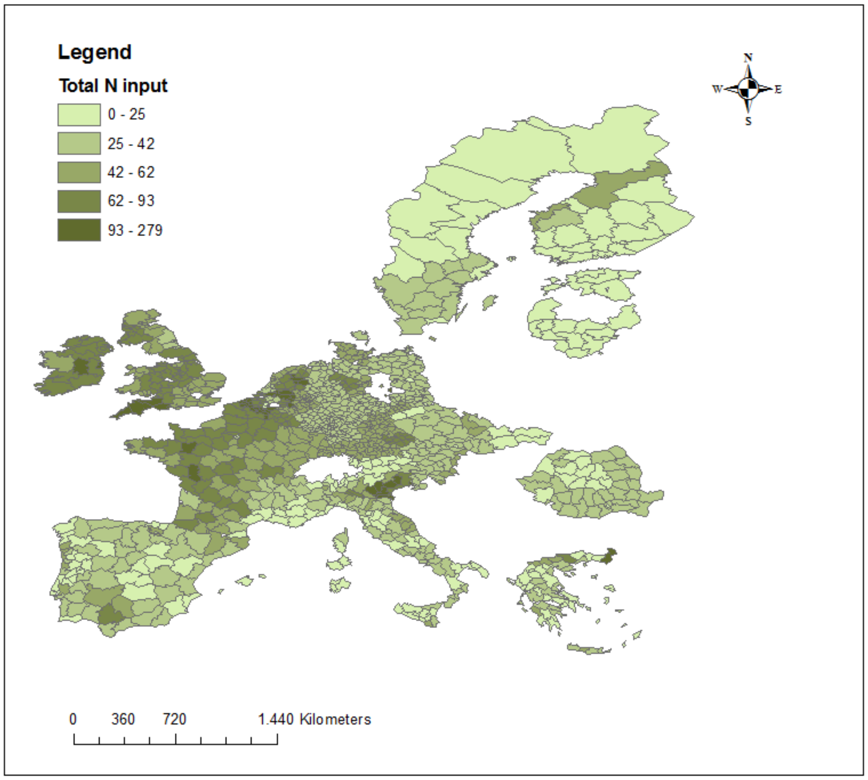


Figure 46 - Distribution of total N input in UE (Kg.yr-1.Km-2)
(In Leip *et al.*, 2011)

- Soil quality

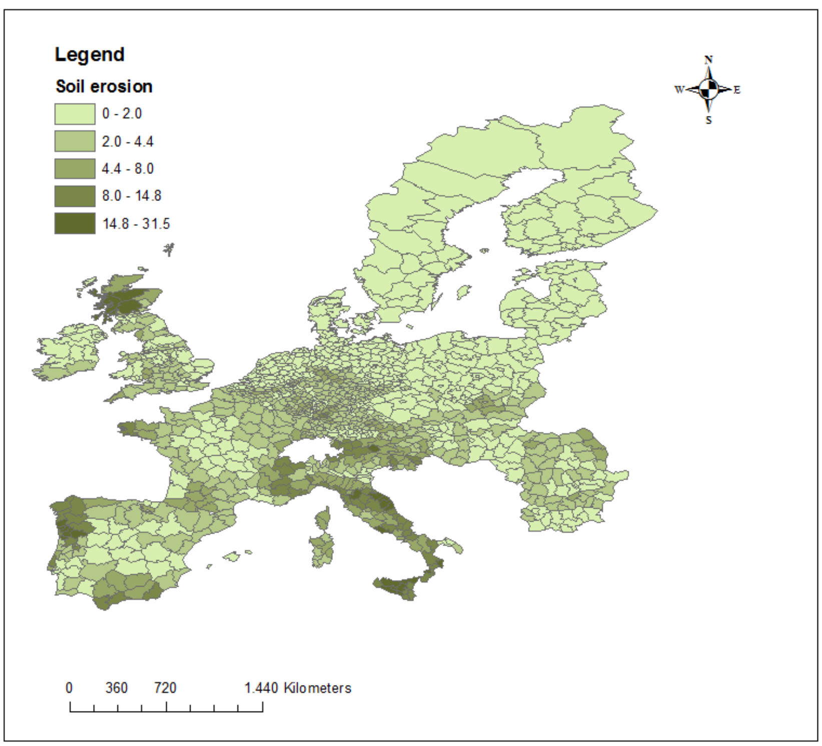


Figure 47 - Distribution of soil erosion in UE (Ton.ha-1.yr-1)
(Retrieved from the data sets included in the Rural Development Report 2011)

- Air quality

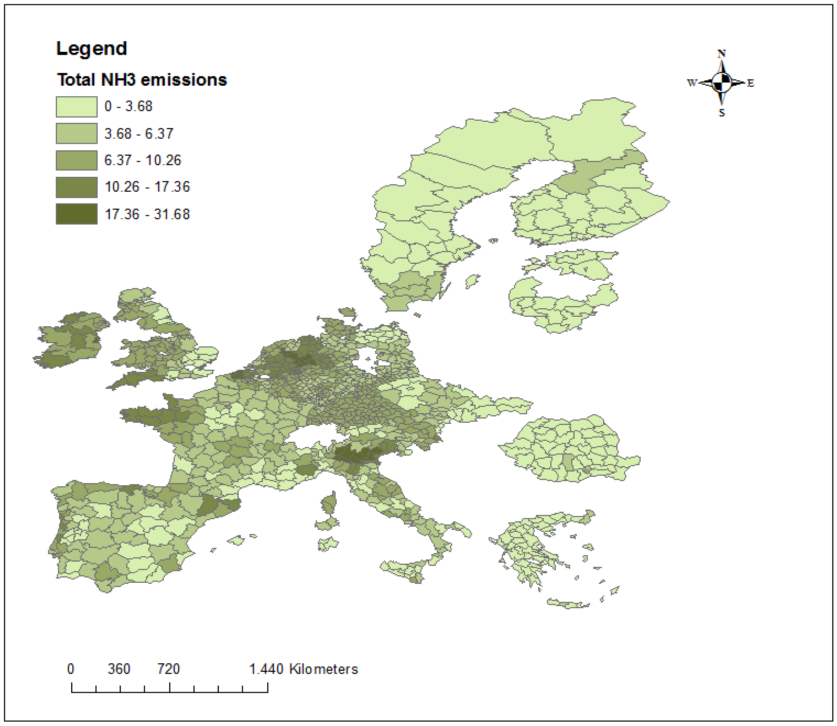


Figure 48 - Distribution of total NH3 emissions in UE (Kg.yr-1.Km-2)
(In Leip *et al*., 2011)

- Climate stability

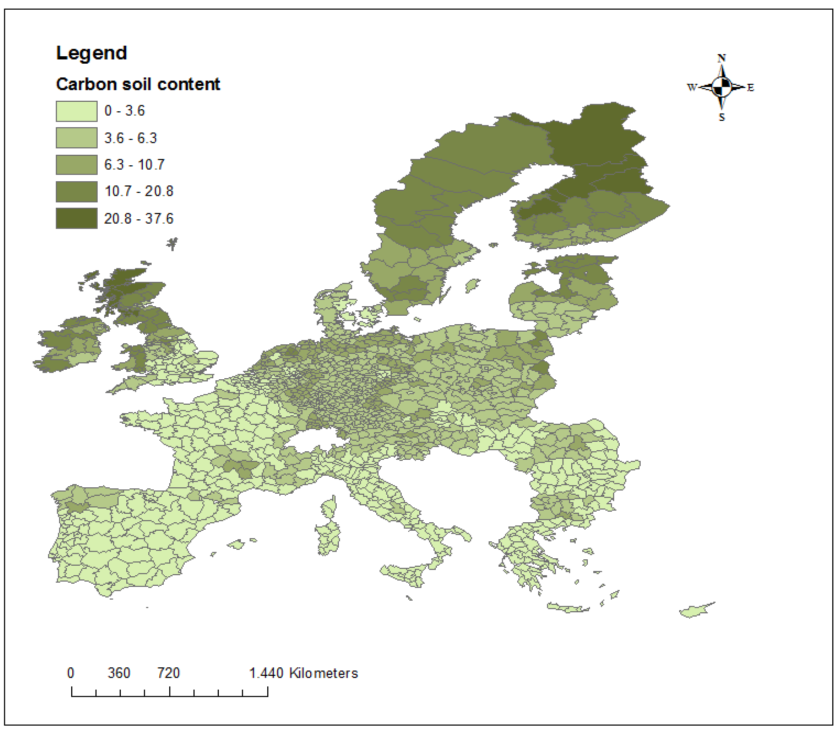


Figure 49 - Distribution of carbon soil content in UE (percentage)
(In Maes *et al*., 2011)

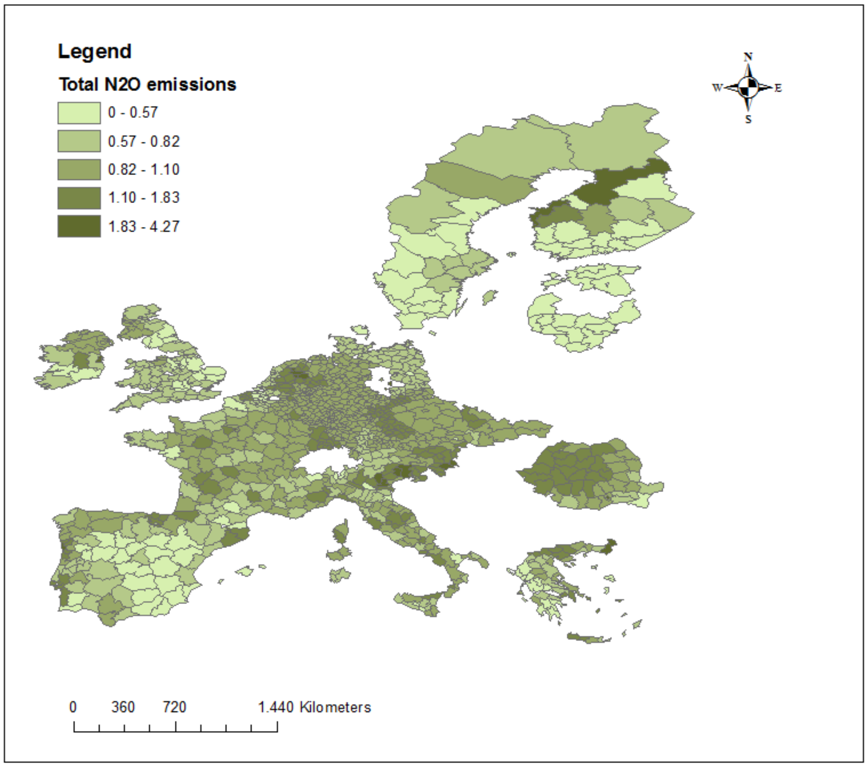


Figure 50 - Distribution of total N2O emissions in UE (Kg.yr-1.Km-2)
(In Leip *et al*., 2011)

- Resilience to flooding

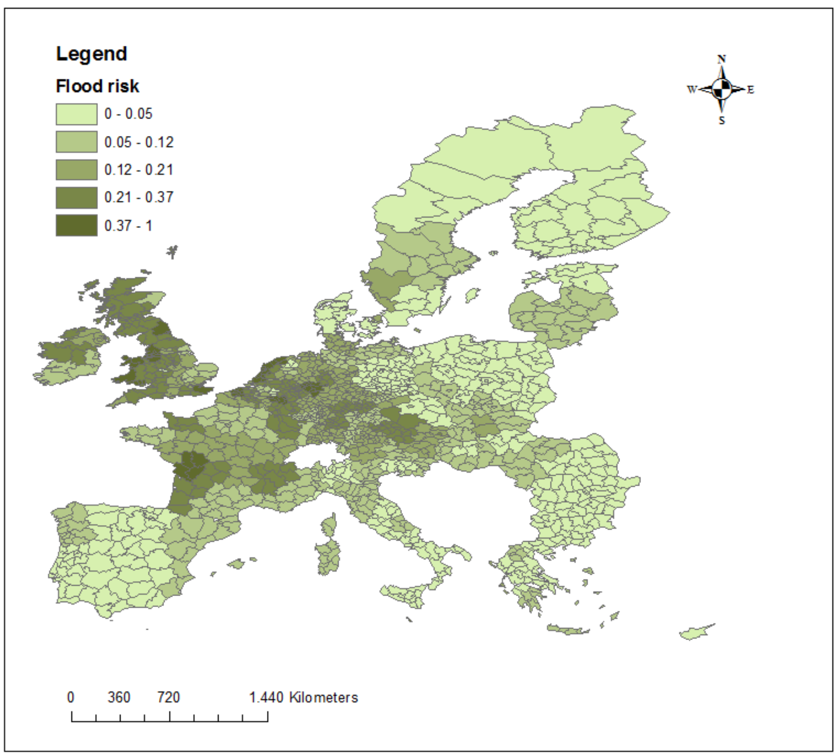


Figure 51 - Distribution of flood risk in UE
(European Climate Adaptation Platform)

- Resilience to fire

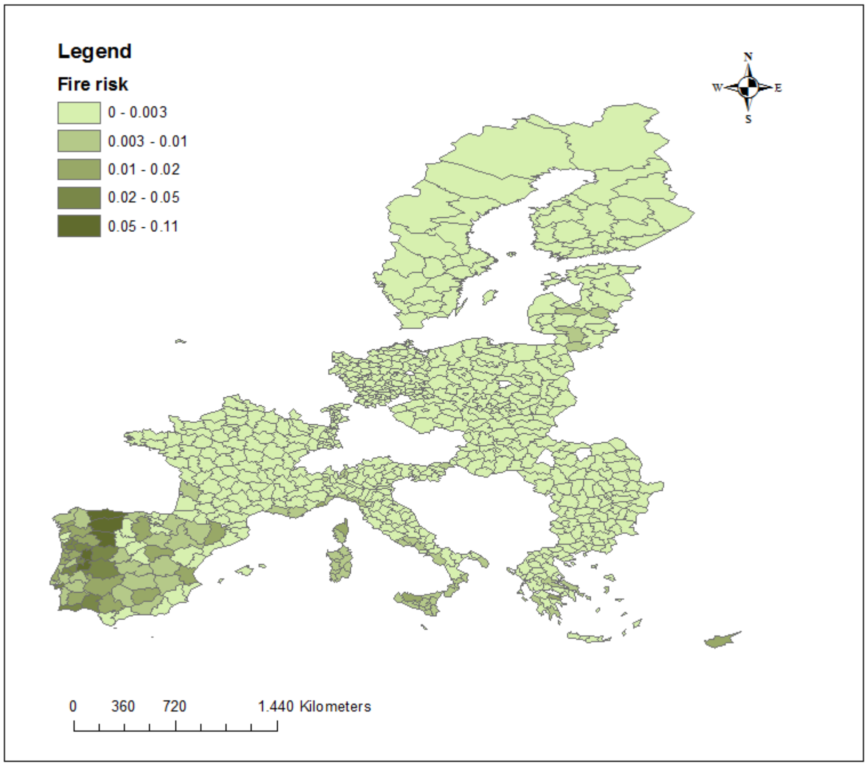


Figure 52 - Distribution of fire risk in UE (percentage of burnt area)
(In European Forest Fire Information System)

References

EC - Directorate-General for Agriculture and Rural Development (2011) Rural Development in the European Union. Available on: http://ec.europa.eu/agriculture/statistics/rural-development/2011/index_en.htm

European Climate Adaptation Platform. Available on: http://climate-adapt.eea.europa.eu/map-viewer?cswRecordFileIdentifier=343166f9f0ad40cf07422939b1726510e81d55e6)

European Forest Fire Information System (JRC) Available on: http://effis-viewer.jrc.ec.europa.eu/wmi/viewer.html

Leip A *et al.* (2011). Integrating nitrogen fluxes at the European scale. In Mark A. Sutton, Clare M. Howard, Jan Willem Erisman, Gilles Billen, Albert Bleeker, Peringe Grennfelt, Hans van Grinsven and Bruna Grizzetti (ed.), The European Nitrogen Assessment. Cambridge University Press, pp. 345-376. (http://afoludata.jrc.ec.europa.eu/index.php/dataset/files/237)

Maes J., Braat L., Jax K., Hutchins M., Furman E., Termansen M., Luque S., Paracchini M. L., Chauvin C., Williams R., Volk M., Lautenbach S. Kopperoinen L., Schelhaas M.-J., Weinert J., Goossen M., Dumont E., Strauch M., Görg C., Dormann C., Katwinkel M., Zulian G., Varjopuro R., Ratamäki O., Hauck J., Forsius M., Hengeveld G., Perez-Soba M., Bouraoui F., Scholz M., Schulz-Zunkel C., Lepistö A., Polishchuk Y. & Bidoglio, G. (2011). A spatial assessment of ecosystem services in Europe: methods, case studies and policy analysis - phase 1. PEER Report No 3. ISPRA: Partnership for European Environmental Research.

Paracchini M.L., Petersen J.-E., Hoogevee, Y., Bamps C., Burfield I. & Swaay C. (2008). High Nature Value Farmland in Europe - An estimate of the distribution patterns on the basis of land cover and biodiversity data. Joint Research Centre.

Annex IV - Experts' consultancy regarding options for survey design

Introduction

At this stage of the project we are conducting a consultancy with SP CM valuation experts', which is requested by our contract with the EC/JCR/IPTS, and that is critical for the work development.

We need to take a number of decisions regarding the design of the choice experiment component of the questionnaire. Expert's knowledge and experience would be very valuable to us regarding the first steps of the questionnaire design, namely:

1. Number of attributes
2. Type of attributes
3. Attribute levels
4. Settling baseline choice alternative
5. Settling methodology to define the payment vehicle
6. Choosing payment vehicle
7. Account for heterogeneity in the payment vehicle
8. Experimental design

In order to collect your expertise we organise these topics on the following table (Table 1). We would like you to focus on each of the topics and indicate us (preferably writing directly on the second column) what would be the best or the possible options according to your knowledge and experience in this field. Please justify your preferences regarding the best/possible options.

Also add general comments if you find that relevant.

Many Thanks!

Table 1: Possible and best options to design an experiment design for an EU level SP CM survey (build on the methodology described on the project presentation)

Decision topic in the choice experiment	Introducing the topic	Possible answers
1. **Number of attributes**	As described in the project introduction, we have selected a typology of 13 macro-regions and established the respective macro-regional agri-environmental problems (MRAEP). These allow us to identify the core public goods and externalities (related to agriculture) for each MRAEP (the ones that are to undergo significant change). However, an alternative option would be to value all the attributes for all the macro-regions.	**a)** Select core PGaE for each macro-region, according respective macro-regional agri-environmental problems **b)** Include all (nine attributes, if each PgaE described is described by one attribute) **COMMENT (including other potential options):**
2. Attribute type	Given that the methodology that has been developed is built on, as much as possible, on agriculture-related public goods and externalities indicators, and that we find it useful to define the attributes based on these indicators, also as much as possible, that would imply some indicators could be described as continuous (varying in intensive margin), whereas other have to be described as discrete (varying in extensive margin). Therefore that would entail to use a mixed frame for attributes description, some would be continuous (e.g. water quality), whereas other would be varying discretely (e.g.	**a)** Mixed (Some continuous other discrete, according available indicators) **b**) Only continuous (intensive margin variation) **c)** Only Discrete (extensive margin variation) **d) COMMENT (including other potential options):**

	biodiversity based on HNVF proportion). However, some might find best to use similar description for attributes, both in terms of facilitating respondent's task, as well as in terms of modelling outcomes. However in this option some of the attributes could not be described using the agri-environmental indicators.	
3. Attributes level	The selection of attributes levels should reflect the range of situations that respondent may face. This range will depend on the scenarios to be considered. However, it might be very heterogeneous within and across macro-regions. However, we have to ensure the aggregation of the attributes marginal (and attributes bundles) value across macro-regions in order to have the aggregated value for EU. Also we need to balance the comprehensiveness and relevance of the variation range for the respondents.	**a)** Extreme range within one macro-region **b)** Average range within one macro-region **c)** Using reference levels build on comparing macro-regions **COMMENTS (including other potential options):**
4. Baseline choice alternative	Regarding the baseline definition, two different assumptions may be envisaged: (1) Consider as baseline the "status quo" of the public good and externalities (PgaE) status in each macro-region; (2) consider baseline a policy-off scenario, such as e.g. a	**a)** Status quo of the PgaE for each macro-region with zero cost associated **b**) Status quo of the PgaE for each macro-region with cost associated **c)** Policy-off (e.g. liberalization scenario) with zero cost associated

	"liberalization scenario". Further the first option, using the "status quo", policy-on scenario, could be offered a zero cost or have a price associated.	**COMMENTS (including other potential options):**
5. **Methodology to define the payment vehicle**	This topic is related to the baseline choice (previous topic), basically we envisage two options: (a) Resorting to meta-analysis estimates for the different public goods and externalities (PgaE) considered by this study; (b) organising focus groups with potential respondents. Option b) will be very limited in this study due to its time and budget constraints.	**a)** Using data (estimates) from meta-analysis studies
		b) Organising focus groups with potential respondents
		COMMENTS (including other potential options):
6. **Payment vehicle**	Here to major options can be envisaged: (a) using variation in current tax (increase/decrease); (b) introducing a new eco-tax (e.g. a food tax or other).	**a)** Eco-tax
		b) Normal tax
		COMMENTS (including other potential options)
7. **Heterogeneity in the payment vehicle**	The choice on payment vehicle comprises other important issues, such as: (1) the geographical level – i.e., settled levels at macro-region level, country level, EU level; (2) Time-span, settled the duration of the payment.	**COMMENTS on the geographical level**
		COMMENTS on time-span

<table>
<tr><td></td><td></td><td>OTHER COMMENTS:</td></tr>
<tr><td rowspan="3">8. Experimental design</td><td rowspan="3">Fractional factorial design is expected to be needed in order to allow for a number of alternatives manageable by the survey. Given that we want to estimate the WTP, a baseline alternative will be included in all choice sets (all choice situations).

On the other hand we intent to estimate interactions between attributes in order to account for possible substitution/complementary effects between them.</td><td>a) Optimal design</td></tr>
<tr><td>b) Efficient design
b.1) assuming parameters = 0
b.2) single fixed prior
b.3) Bayesian estimator</td></tr>
<tr><td>COMMENTS (including other potential options)</td></tr>
<tr><td>GENERAL COMMENTS YOU FIND RELEVANT TO ADD</td><td colspan="2"></td></tr>
</table>

Annex V – Questionnaire for pilot Survey (translated to English language)

Dear participant,
This questionnaire is part of a study that is being conducted by the University of Trás os Montes e Alto Douro and the University Técnica de Lisboa by request of the European Commission with the aim of obtaining information about the opinion and preferences of the European citizen about the policies for agriculture in Europe, particularly the Mediterranean Uplands' region.

Your participation is very important to the validity of this survey.
We would appreciate very much your collaboration. There is no right or wrong answer.

The information that you give is confidential and anonymous.

S1. Please select an option

Female ☐ Male ☐

S2. What is your age?

Age in years	

S3. What is your area of residence?

Choose one option

Region	
Algarve	
Alentejo	
Center	
Lisbon e Tagus Valley	
North	

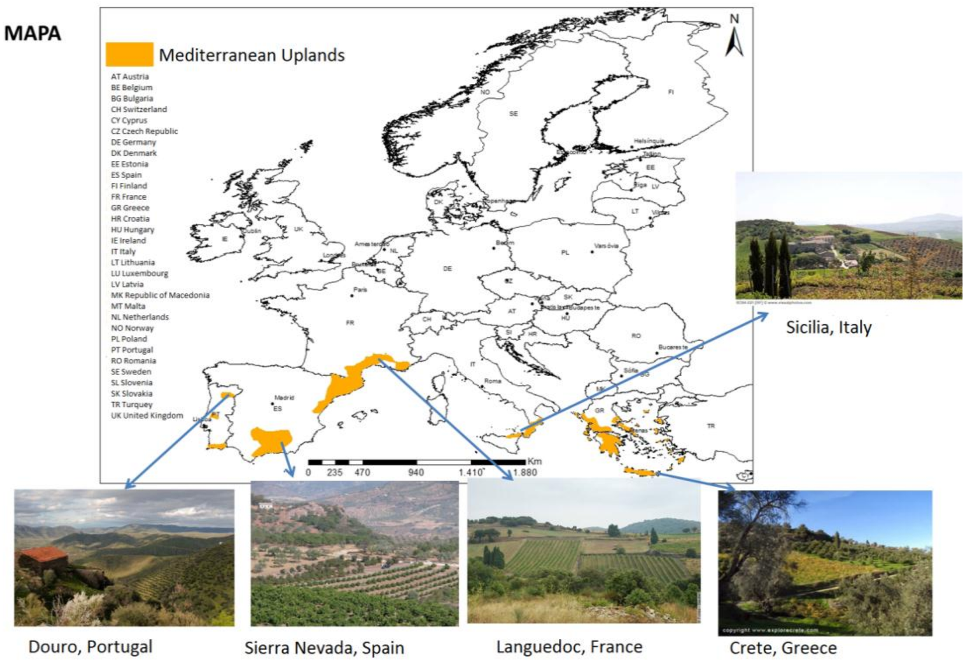
S4. Please, confirm if you are the responsible for expenditure management of your household

Yes ☐ No ☐

[PART I- EXPERIENCE AND FAMILIARITY]

In this map that represents Europe

MAPA



the orange area indicates the region of the most mountainous and dry Mediterranean areas, known as "Mediterranean Uplands". These areas include, for example, the Douro and the Serra Algarve, in Portugal, Sierra Nevada, in Spain, Languedoc, in South of France, Sicily island, in Italy, Crete, in Greece.

1. In this region, which of the following areas did you visited in the last 5 years?

Areas of Mediterranean Uplands region	Visited	Didn't visited	Don't know/ Don't answer (DK/DA)
Douro			
Serra Algarve			
Sierra Nevada			
Languedoc (South of France)			
Sicily			
South of Italy			
Crete			
Santorin			
Greece			

⇒IF RESPONDENT VISITED ANY, GO TO NEXT QUESTION

⇒ IF RESPONDENT DID NOT VISIT ANY GO TO QUESTION 3

2. Which were the main objectives of your visit to the region? (Choose 3)

Objectives of the visit	
Holidays/Weekends	
Stay in cottages	
Train/boat ride	
Organized tours	
Family/friends' visit	
Support for elderly relatives	
Land cultivation	
Maintenance of property / home	
Rest/relax	
Visit typical villages	
Nature related activities	
Visit monuments	
Make walls/hikes	
Wine tasting	
Buying local products	
Thermal baths	
Others: what?	

=> IF RESPONDENT ANSWERED THIS QUESTION (Q2) GO TO "Part II"

3. Do you know other rural areas out of this region, but that presents the same characteristics (Mediterranean, mountain and dry)? Which ones?

Other areas

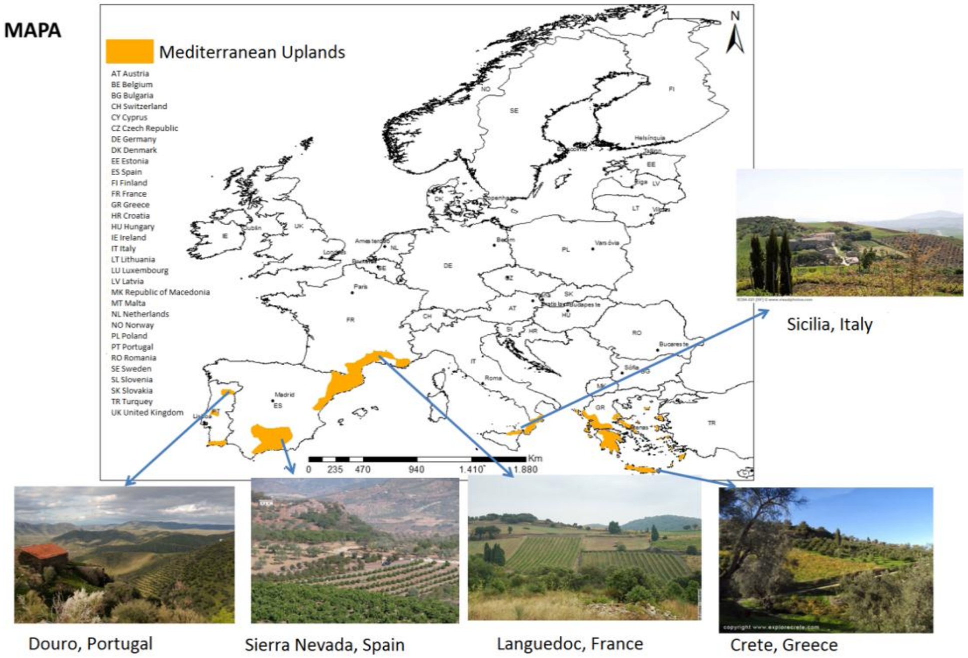
4. Did you visited, in last 5 years, rural areas with recreational or leisure purposes?

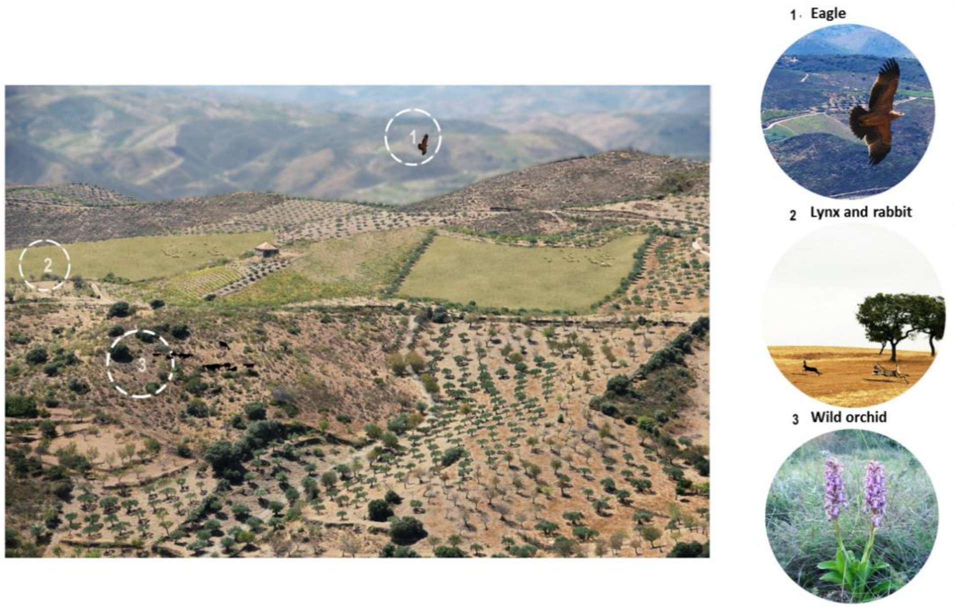
Yes ____ No ____ Don’t know/ Don’t answer (DK/DA) ____

[PART II- CHOICE EXPERIMENTS]

Please remember that, over the next few questions, we're talking about:

MAPA





In this large European region, the natural landscape has been transformed by the agriculture, being visible a wide variety of crops such as olive-groves, vineyards and almond-yards. There are, however, pieces of natural vegetation.

This combination of cultivated areas, pastures and natural areas, form a diversified landscape that supports unique ecosystems and species, including endangered plants (such as the, wild-orchid) and animals like the rabbit, which are food for species in risk of extinction, such as the lynx and the imperial eagle. Agriculture has, therefore, a very important role for biodiversity conservation in this region of Europe.

Agriculture has also in this region an important role for conservation of traditional landscape and the provision of high quality local products.

In this region, agriculture is unprofitable due to the adversity of natural conditions. So it is more likely to be abandoned. Abandonment is followed by the uncontrolled growth of the scrubland, which completely changes the landscape, reduces biodiversity and increases the risk of large wildfires, which have, in turn, very negative impacts on soil erosion.

Therefore the European Union has being compensating farmers for the maintenance of agriculture in this region.

Currently, due to budgetary constraints, policy support for agriculture is being reviewed. It is now being studied the creation of new measures that encourage the provision of services such as:

- Conservation of traditional landscape,

- Conservation of biodiversity (diversity of animal and plant species),

- Erosion control

- Fire risk reduction.

We are going to explain you what are these programmes about.

The next image explains which are the farmers obligations in each programme and which are the benefits for the society.

Landscape Conservation

Farmers' commitment:	**Society's benefits:**
Maintain production of traditional crops Practice an environmental friendly agriculture	Safeguard the cultural heritage Enjoy high quality products and flavor Enjoy the traditional countryside for recreation and leisure

Biodiversity Conservation

Farmers' commitment:	**Society's benefits:**
Maintain the habitats for endangered fauna and flora Practice an environmental friendly agriculture	Preserve animal and plant species from extinction Enjoy the traditional countryside for recreation and leisure

Erosion control

Farmers' commitment:	**Society's benefits:**
Keep terraces on steep sloped Keep the soil covered with vegetation and prevent crops	Ensure soil fertility Ensure the soil's ability to support landscape and biodiversity

Fire risk reduction

Farmers' commitment:	**Society's benefits:**
Bushes' cleaning Keep crops as barriers to the progression of fires	Ensuring the integrity of people and goods Avoid air pollution and emissions of greenhouse gases

There are several options to apply these programmes.

One option is to pay farmers to maintain all of these services or to pay only some of them (for example, only conservation of landscape or fire risk reduction).

Another option is to apply each programme in all the region of Mediterranean Uplands (100% of region) or only in half of region (50% of region).

Applying each programme in 100% of the area of the region will ensure the maintenance of the existing traditional landscape, preserve all currently endangered species and prevent the increase of the risk of erosion and fire risk compared to the current situation.

Applying each programme in 50% of the area of the region will ensure maintenance of the existing traditional landscape, preserve all currently endangered species and prevent the increase of the risk of erosion and fire risk compared to the current situation, but only in 50% of the area in the region.

As you can guess, these options have a different cost.

This cost have to be support by the European citizens, including you, by higher taxes, or creating special rates on products or about visitors to this region.

We are going to present you five different alternatives for the implementation of these programmes.

Programme providing services …	No application	Option A	Option B
 **Landscape conservation**	0 %	0 %	100 %
 **Biodiversity conservation**	0 %	100 %	0 %
 **Soil erosion control**	0 %	50 %	50 %
 **Fire risk reduction**	0 %	100 %	0 %
Accrued taxes or fees (annually for 5 years)	0 €	3 €	21 €

We want you to compare three options: (1) the non-implementation of programmes, situation without any cost for you, (2) options A and B are different combinations of programmes with different cost for you.

The "non-application of programmes" has no cost to you, but implies the disappearance of traditional landscapes and unique biodiversity, and an increasing risk of erosion and fires throughout the Mediterranean Uplands'region.

Option A would have an annual cost of 3 euros for your household, for 5 years, but would allow the implementation of the programme of conservation of the biodiversity conservation programme in 100% of the area of this region; the implementation of the programme of soil erosion control in 50% of the area in the region, and the programme of reducing the risk of fire in 100% of the area of this region.

Finally, option B would have an annual cost of 21 euros for your household, for 5 years, but would allow the implementation of the programme of conservation of traditional landscapes in 100% of the area of this region and of the programme of reducing the risk of fire in 50% of the area of this region.

Which option do you prefer?

No application ___ Option A ____ Option B ___

Programme providing services …	No application	Option A	Option B
Landscape conservation	0 %	50 %	50 %
Biodiversity conservation	0 %	50 %	50 %
Soil erosion control	0 %	0 %	50 %
Fire risk reduction	0 %	50 %	50 %
Accrued taxes or fees (annually for 5 years)	0 €	21 €	39 €

We want you to compare three options: (1) the non-implementation of programmes, situation without any cost for you, (2) options A and B are different combinations of programmes with different cost for you.

The "non-application of programmes" has no cost to you, but implies the disappearance of traditional landscapes and unique biodiversity, and an increasing risk of erosion and fires throughout the Mediterranean Uplands'region.

Option A would have an annual cost of 21 euros for your household, for 5 years, but would allow the implementation of the programme of conservation of traditional landscapes in 50 % of the area of this region; the implementation of the programme of the biodiversity conservation programme in 50% of the area of this region; and the programme of reducing the risk of fire in 50% of the area of this region.

Finally, option B would have an annual cost of 39 euros for your household, for 5 years, but would allow the implementation of the programme of conservation of traditional landscapes in 50 % of the area of this region; the implementation of the programme of the biodiversity conservation programme in 50% of the area of this region; the implementation of the programme of soil erosion control in 50% of the area of this region; and the programme of reducing the risk of fire in 50% of the area of this region.

Which option do you prefer?

No application ___ Option A ____ Option B ___

Programme providing services …	No application	Option A	Option B
 **Landscape conservation**	0 %	0 %	100 %
 **Biodiversity conservation**	0 %	0 %	100 %
 **Soil erosion control**	0 %	100 %	0 %
 **Fire risk reduction**	0 %	100 %	0 %
Accrued taxes or fees (annually for 5 years)	0 €	12 €	3 €

We want you to compare three options: (1) the non-implementation of programmes, situation without any cost for you, (2) options A and B are different combinations of programmes with different cost for you.

The "non-application of programmes" has no cost to you, but implies the disappearance of traditional landscapes and unique biodiversity, and an increasing risk of erosion and fires throughout the Mediterranean Uplands'region.

Option A would have an annual cost of 12 euros for your household, for 5 years, but would allow the implementation of the programme of soil erosion control in 100 % of the area of this region; and the programme of reducing the risk of fire in 100% of the area of this region.

Finally, option B would have an annual cost of 3 euros for your household, for 5 years, but would allow the implementation of the programme of conservation of traditional landscapes in 100 % of the area of this region; and the implementation of the programme of the biodiversity conservation programme in 100% of the area of this region.

Which option do you prefer?

No application ___ Option A _____ Option B ___

Programme providing services …	No application	Option A	Option B
 **Landscape conservation**	0 %	50 %	50 %
 **Biodiversity conservation**	0 %	100 %	50 %
 **Soil erosion control**	0 %	100 %	50 %
 **Fire risk reduction**	0 %	0 %	50 %
Accrued taxes or fees (annually for 5 years)	0 €	12 €	39 €

We want you to compare three options: (1) the non-implementation of programmes, situation without any cost for you, (2) options A and B are different combinations of programmes with different cost for you.

The "non-application of programmes" has no cost to you, but implies the disappearance of traditional landscapes and unique biodiversity, and an increasing risk of erosion and fires throughout the Mediterranean Uplands'region.

Option A would have an annual cost of 12 euros for your household, for 5 years, but would allow the implementation of the programme of conservation of traditional landscapes in 50 % of the area of this region; the implementation of the programme of the biodiversity conservation programme in 100% of the area of this region; and the programme of soil erosion control in 100% of the area of this region.

Finally, option B would have an annual cost of 39 euros for your household, for 5 years, but would allow the implementation of the programme of conservation of traditional landscapes in 50 % of the area of this region; the implementation of the programme of the biodiversity conservation programme in 50% of the area of this region; the implementation of the programme of soil erosion control in 50% of the area of this region; and the programme of reducing the risk of fire in 50% of the area of this region.

Which option do you prefer?

No application ___ Option A _____ Option B ___

Programme providing services ...	No application	Option A	Option B
Landscape conservation	0 %	50 %	100 %
Biodiversity conservation	0 %	50 %	100 %
Soil erosion control	0 %	50 %	0 %
Fire risk reduction	0 %	0 %	100 %
Accrued taxes or fees (annually for 5 years)	0 €	39 €	3 €

We want you to compare three options: (1) the non-implementation of programmes, situation without any cost for you, (2) options A and B are different combinations of programmes with different cost for you.

The "non-application of programmes" has no cost to you, but implies the disappearance of traditional landscapes and unique biodiversity, and an increasing risk of erosion and fires throughout the Mediterranean Uplands'region.

Option A would have an annual cost of 39 euros for your household, for 5 years, but would allow the implementation of the programme of conservation of traditional landscapes in 50 % of the area of this region; the implementation of the programme of the biodiversity conservation programme in 50% of the area of this region; and the programme of soil erosion control in 50% of the area of this region.

Finally, option B would have an annual cost of 3 euros for your household, for 5 years, but would allow the implementation of the programme of conservation of traditional landscapes in 100 % of the area of this region; the implementation of the programme of the biodiversity conservation programme in 100% of the area of this region; and the programme of reducing the risk of fire in 100% of the area of this region.

Which option do you prefer?

No application ___ Option A _____ Option B ___

10. Tick please the importance you gave in your choices, to each of the various factors of choice, according to the following scale: VERY IMPORTANT (1) IMPORTANT (2), LITTLE IMPORTANT (3), NOT IMPORTANT (4)

		1	2	3	4	DK/DA
	Programme of landscape conservation					
	Programme of biodiversity conservation					
	Programme of erosion control					
	Programme of reduction of fire risk					
	Increasing of taxes					

(DK/DA: Don´t know/Don’t answer)

11. Tick please your opinion, using the following scale: TOTALLY AGREE (1), AGREE (2), DISAGREE (3), TOTALLY DISAGREE (4) regarding the following statements:

	1	2	3	4	DK/ DA
It is not possible to keep the landscape without reducing the fire risk					
It is not possible to preserve biodiversity without reducing the fire risk					
It is not possible to control erosion without reducing the fire risk					
We cannot conserve biodiversity without conserving landscape					

12. Tick please your opinion, using the following scale: TOTALLY AGREE (1), AGREE (2), DISAGREE (3), TOTALLY DISAGREE (4, regarding the following statements:

		1	2	3	4	5	DK/DA
	The amounts requested are acceptable						
	Right now I can pay the amounts ordered						
	I already paid enough taxes so that programmes are implemented without having to pay more						
	I believe that the amounts paid will be well used to implement the various programmes						
	Visitors or residents of the Mediterranean Uplands region should pay more than the other						
	I believe that, with the necessary money, the programmes will be implemented						
	I believe the results of this survey will be taken into account by the European authorities						
	These programmes are good to all Europeans						
	At least some of the programmes are very good for my quality of life						
	At least some of the programmes are very beneficial to visitors and residents of the region						

[PART III-SOCIO-ECONOMIC CHARACTERISTICS]

To finish we need you to provide us information to characterize you and your household. I remind you that all information you give us will be treated confidentially and statistics.

13. Which level of education did you completed?

Primary school	
Middle school	
High school	
Master degree	
Doctorate	
DK/DA	

14. How many dependents (aged less than 16 years) live in your household?

None	
1	

2	
3	
More than 3	
DK/DA	

15. What's your situation regarding work?

Work for others	
Self-employed	
Unemployed	
Retired	
Domestic	
Student	
DK/DA	

16. In which of the following categories fits your profession?

Managers	
Professionals	
Technicians and associate professionals	
Clerical support workers	
Service and sales workers	
Skilled agricultural, forestry and fishery workers	
Craft and related trades workers	
Plant and machine operators, and assemblers	
Elementary occupations	
Armed forces occupations	
DK/DA	

17. Which of the following categories best match with MONTHLY NET INCOME OF YOUR HOUSEHOLD?

Up to 600 €	
Between 601 e 1000 €	
Between 1001 e 2000 €	
Between 2001 e 3000 €	
Between 3001 e 5000 €	
More than 5000 €	
DK/DA	

18. What is your residence area?

Locality	3 first digits from postal code			3 last numbers		

[PART IV- RESPONDENT EVALUATION]

19. How do you evaluate the degree of difficulty of answering to this questionnaire, according to the following scale: VERY EASY (1), EASY (2), DIFICULT (3), VERY DIFICULT **(4?)**

	1	**2**	**3**	**4**	**NS/NR**
Degree of difficulty in answering the questionnaire					

20. How do you evaluate the interest of this questionnaire for you, according to the following scale: VERY INTERESTING **(1),** INTERESTING **(2),** LITTLE INTERESTING **(3),** and NOT INTERESTING **(4?)**

	1	**2**	**3**	**4**	**NS/NR**
Interest of the questionnaire for you					

THANK YOU FOR COOPERATING!

Annex VI – Sampling plans: country surveys allocation

Table 1 - Distribution of the MR area by the EU27 countries

	Distribution of the MR area by the E27 countries															
	Mediterranean hinterlands		Central lowlands / crops		The Alps, NW Iberian mountains and the Scottish Highlands		North-western fringes and continental uplands		Central lowlands / livestock		Eastern Europe		Mediterranean uplands / permanent crops		Northern Scandinavia	
	Area(km2)	%	Area(km2)	%	Area(km2)	%	Area(km2)	%	Area(km2)	%	Area(km2)	%	Area(km2)	%	Area(km2)	%
Austria	2171	1%	8818	1%	57495	11%	15395	2%		0%		0%		0%		0%
Belgium	906	0%	11574	1%	8958	2%	1286	0%	7806	10%		0%		0%		0%
Bulgaria		0%		0%	17182	3%		0%		0%	93718	10%		0%		0%
Cyprus	9251	2%		0%		0%		0%		0%		0%		0%		0%
Czech Republic		0%		0%		0%	71671	11%		0%	7195	1%		0%		0%
Denmark		0%	42959	5%		0%		0%		0%		0%		0%		0%
Estonia		0%		0%		0%		0%		0%	40334	4%		0%		0%
Finland		0%		0%		0%	62987	10%		0%		0%		0%	275443	**48%**
France	21529	5%	245166	**28%**	209151	**40%**	5938	1%	20433	26%		0%	41749	20%		0%
Germany	6651	2%	169863	**19%**	2569	0%	155949	**24%**	21883	**28%**		0%		0%		0%
Greece	23055	5%	44584	5%	9431	2%		0%		0%		0%	54551	**26%**		0%
Hungary		0%		0%		0%		0%		0%	93026	10%		0%		0%
Ireland		0%		0%		0%	69798	11%		0%		0%		0%		0%
Italy	138220	**32%**	72544	8%	67299	**13%**		0%		0%		0%	8822	4%		0%
Latvia	304	0%		0%		0%		0%		0%	64258	7%		0%		0%
Lithuania		0%		0%		0%		0%		0%	65300	7%		0%		0%
Luxembourg		0%		0%	2586	0%		0%		0%		0%		0%		0%
Malta		0%		0%		0%		0%	316	0%		0%		0%		0%
Netherlands		0%	10952	1%		0%	19913	3%	10678	14%		0%		0%		0%
Poland		0%	14923	2%		0%		0%	11186	**14%**	286570	**30%**		0%		0%
Portugal	35266	8%		0%	30678	6%	6124	1%	5610	7%		0%	11411	5%		0%
Romania		0%		0%		0%		0%		0%	238391	**25%**		0%		0%

	Distribution of the MR area by the E27 countries															
	Mediterranean hinterlands		Central lowlands / crops		The Alps, NW Iberian mountains and the Scottish Highlands		North-western fringes and continental uplands		Central lowlands / livestock		Eastern Europe		Mediterranean uplands / permanent crops		Northern Scandinavia	
	Area(km2)	%	Area(km2)	%	Area(km2)	%	Area(km2)	%	Area(km2)	%	Area(km2)	%	Area(km2)	%	Area(km2)	%
Slovakia		0%		0%		0%		0%		0%	49036	5%		0%		0%
Slovenia		0%		0%	15881	3%		0%		0%	4392	0%		0%		0%
Spain	196438	**45%**	161311	18%	52735	10%	3640	1%		0%		0%	91855	**44%**		0%
Sweden		0%	11369	1%		0%	137315	**21%**		0%		0%		0%	292664	**52%**
United Kingdom		0%	86176	10%	51197	10%	92067	14%		0%		0%		0%		0%
Total of MR area (Option1)	196438	45%	245166	28%	209151	40%	155949	24%	21883	28%	286570	30%	91855	44%	292664	52%
Total of MR area (Option2)	334657	77%	415028	47%	276449	53%	293264	46%	33069	42%	524961	56%	146406	70%	568107	100%
Total area of MR	433791		880237		525160		642084		77912		942221		208387		568107	

Table 2 - Distribution of countries' area in each MR in km2

	Questionnaires for MRAEP																
	Mediterranean hinterlands		Central lowlands / crops		The Alps, NW Iberian mountains and the Scottish Highlands		North-western fringes and continental uplands		Central lowlands / livestock		Eastern Europe		Mediterranean uplands / permanent crops		Northern Scandinavia		Total (km^2)
	Area (km^2)	%	Area (km^2)	%	Area (km^2)	%	Area (km^2)	%	Area (km^2)	%	Area (km^2)	%	Area (km^2)	%	Area (km^2)	%	
Austria	2171	3%	8818	11%	57495	69%	15395	18%		0%		0%		0%		0%	83879
Belgium	906	3%	11574	38%	8958	29%	1286	4%	7806	26%		0%		0%		0%	30530
Bulgaria		0%		0%	17182	15%		0%		0%	93718	85%		0%		0%	110900
Cyprus	9251	100%		0%		0%		0%		0%		0%		0%		0%	9251
Czech Republic		0%		0%		0%	71671	91%		0%	7195	9 .1%		0%		0%	78865
Denmark		0%	42959	100%		0%		0%		0%		0%		0%		0%	42959
Estonia		0%		0%		0%		0%		0%	40334	100%		0%		0%	40334
Finland		0%		0%		0%	62987	19%		0%		0%		0%	275443	81%	338431

	Questionnaires for MRAEP																Total (km^2)
	Mediterranean hinterlands		Central lowlands / crops		The Alps, NW Iberian mountains and the Scottish Highlands		North-western fringes and continental uplands		Central lowlands / livestock		Eastern Europe		Mediterranean uplands / permanent crops		Northern Scandinavia		
	Area (km^2)	%	Area (km^2)	%	Area (km^2)	%	Area (km^2)	%	Area (km^2)	%	Area (km^2)	%	Area (km^2)	%	Area (km^2)	%	
France	21529	3%	245166	39%	209150	33%	5938	1%	20433	3%		0%	41749	7%		0%	543965
Germany	6651	2%	169862	48%	2569	1%	155949	44%	21883	6%		0%		0%		0%	356915
Greece	23055	18%	44584	34%	9431	7%		0%		0%		0%	54551	41%		0%	131621
Hungary		0%		0%		0%		0%		0%	93026	100%		0%		0%	93026
Ireland		0%		0%		0%	69798	100%		0%		0%		0%		0%	69798
Italy	138220	48%	72544	25%	67299	23%		0%		0%		0%	8822	3%		0%	286884
Latvia	304	0%		0%		0%		0%		0%	64258	100%		0%		0%	64562
Lithuania		0%		0%		0%		0%		0%	65300	100%		0%		0%	65300
Luxembourg		0%		0%	2586	100%		0%		0%		0%		0%		0%	2586
Malta		0%		0%		0%		0%	316	100%		0%		0%		0%	316
Netherlands		0%	10952	26%		0%	19913	48%	10678	26%		0%		0%		0%	41543
Poland		0%	14923	5%		0%		0%	11186	4%	286570	92%		0%		0%	312679
Portugal	35266	38%		0%	30678	33%	6124	7%	5610	6%		0%	11411	12%		0%	89089
Romania		0%		0%		0%		0%		0%	238391	100%		0%		0%	238391
Slovakia		0%		0%		0%		0%		0%	49036	100%		0%		0%	49036
Slovenia		0%		0%	15881	78%		0%		0%	4392	22%		0%		0%	20273
Spain	196438	39%	161310	32%	52734	10%	3640	1%		0%		0%	91855	18%		0%	505978
Sweden		0%	11368	3%		0%	137315	31%		0%		0%		0%	292 664	66%	441347
United Kingdom		0%	86176	38%	51197	22%	92067	40%		0%		0%		0%		0%	229439
Total	433790	10%	880237	20%	525160	12%	642084	15%	77912	2%	942221	22%	208387	5%	568 107	13%	4277898

Source of data: The area for each NUTS3 were calculated with ArcGis' tool "Calculate Geometry". The area for NUTS3 in same country and MR were added, obtaining the area of that country in each MR

Table 3 - Distribution of countries' population in each MR in number of persons

	1		2		5		6		7		9		12		13		Total
	Mediterranean hinterlands		Central lowlands / crops		The Alps, NW Iberian mountains and the Scottish Highlands		North-western fringes and continental uplands		Central lowlands / livestock		Eastern Europe		Mediterranean uplands / permanent crops		Northern Scandinavia		
Austria	135254	2%	2126770	34%	2765394	45%	1138052	18%		0%		0%		0%		0%	6165470
Belgium		0%	3784138	49%	487854	6%	192521	2%	3277509	42%		0%		0%		0%	7742022
Bulgaria		0%		0%	618499	14%		0%		0%	3679297	86%		0%		0%	4297796
Cyprus	803147	100%		0%		0%		0%		0%		0%		0%		0%	803147
Czech Republic		0%		0%		0%	6504548	100%		0%		0%		0%		0%	6504548
Denmark		0%	2250745	100%		0%		0%		0%		0%		0%		0%	2250745
Estonia		0%		0%		0%		0%		0%	995305	100%		0%		0%	995305
Finland		0%		0%		0%	815547	24%		0%		0%		0%	2554890	76%	3370437
France	3295768	6%	30668641	56%	13977336	25%		0%	2210510	4%		0%	4006757	7%		0%	55217507
Germany	1522545	2%	30569999	43%	883999	1%	34412755	49%	3504759	5%		0%		0%		0%	70894057
Greece	4719262	47%	2695470	27%	111571	1%		0%		0%		0%	2449772	25%		0%	9976075
Hungary		0%		0%		0%		0%		0%	7964049	100%		0%		0%	7964049
Ireland		0%		0%		0%	3561166	100%		0%		0%		0%		0%	3561166
Italy	19878753	46%	10366486	24%	11885548	27%		0%		0%		0%	1219566	3%		0%	43584072
Latvia		0%		0%		0%		0%		0%	1242455	100%		0%		0%	1242455
Lithuania		0%		0%		0%		0%		0%	2779064	100%		0%		0%	2779064
Luxembourg		0%		0%	502066	100%		0%		0%		0%		0%		0%	502066
Malta		0%		0%		0%		0%	31301	100%		0%		0%		0%	31301
Netherlands		0%	2314622	19%		0%	6745157	56%	3039131	25%		0%		0%		0%	12098910
Poland		0%	1563772	6%		0%		0%	1677504	7%	22369925	87%		0%		0%	25611201
Portugal	730974	17%		0%	1590179	38%		0%	998926	24%		0%	664798	16%		0%	4232276
Romania		0%		0%		0%		0%		0%	12954607	100%		0%		0%	12954607
Slovakia		0%		0%		0%		0%		0%	3964728	100%		0%		0%	3964728
Slovenia		0%		0%	1110082	71%		0%		0%	442891	29%		0%		0%	1552973

	1		2		5		6		7		9		12		13		Total
	Mediterranean hinterlands		Central lowlands / crops		The Alps, NW Iberian mountains and the Scottish Highlands		North-western fringes and continental uplands		Central lowlands / livestock		Eastern Europe		Mediterranean uplands / permanent crops		Northern Scandinavia		
Spain	17956320	50%	3724822	10%	3042472	8%	853530	2%		0%		0%	10148939	28%		0%	35798598
Sweden		0%	1231062	14%		0%	6119758	71%		0%		0%		0%	1303283	15%	8654103
United Kingdom		0%	31831362	60%	1436879	3%	19921349	37%		0%		0%		0%		0%	53189590
Total	49042023	13%	123127889	32%	38411879	10%	80264383	21%	14739640	4%	56392321	15%	18489832	5%	3858173	1%	385938268

Source of data: Based on Eurostat's indicator: Population on 1st January by broad age groups and sex - NUTS 3 regions, for 2010.

Table 4 - Distances from non-residents countries to macro-regions in kilometres

Countries	Mediterranean hinterlands	Central lowlands / crops	The Alps, NW Iberian mountains and the Scottish Highlands	North-western fringes and continental uplands	Central lowlands / livestock	Eastern Europe	Mediterranean uplands / permanent crops	Northern Scandinavia
Austria	752				1288	213	1112	1443
Belgium	1172			709		1095	1667	1660
Bulgaria	895	1752		1081	2105		805	1965
Cyprus		2752	2243	2256	3340	1920	1597	2851
Czech Republic	935	886	963		1285	439	1328	1319
Denmark	1644		1536	632	1317	1004	1977	898
Estonia	2156	1804	2252	1237	2160		2411	80,5
Finland	2209	1868	2292		2195	1382	2504	
France				874		1200		1867
Germany	1192		1210			587	1626	1110
Greece			1326	1535	2496	1124		2483
Hungary	820	1262	997	441	1710		1062	1463
Ireland	1924	814	1692		544	1907	2393	2042
Italy				917	1464	823		2226
Latvia	1890	1732	1984	1012	2080		2150	380
Lithuania	1756	1702	1829	918	2046		1943	630
Luxembourg	1009	291		601	707	987	1488	1684
Malta	689	1761	879	1588		1352	285	2799
Netherlands	1344		1164			1148	1791	1511
Poland	1322	1392	1448	522			1602	928
Portugal		1441		2260		2460		3333
Romania	1143	1880	1444	1092	2306		1102	1749
Slovakia	771	1108	951	300	1518		1112	1350

Slovenia	492	976		428	1292		881	1724
Spain				1786	909	1992		2927
Sweden	1996	1648	2031		1835	1339	2361	
United Kingdom	1453	350			380	1465	1947	1831

Software Google Earth (v.5) is used to calculate the distance between countries and macro-regions. For each country its main city has been selected as the beginning point; and for the macro-regions the reference point has been chosen as representing roughly their centre, when possible represented also by a main city. The references points for MR were: Rome (Italy) for the Mediterranean Hinterlands MR, Paris (France) for the Central Lowlands Crops MR, Corsica (France) for the Alps, NW Iberian Mountains and the Scottish Highlands MR, Prague (Czech Republic) for the North-Western Fringes MR, Brittany (France) for Central Lowlands Livestock MR, Budapest (Hungary) for the Eastern Europe MR, Calabria (Italy) for the Mediterranean Uplands MR, and finally Helsinki (Finland) for the Northern Scandinavia MR. The distance between the country's main city and the MR reference point has been calculated using the Google Earth tool 'Path' that creates straight between two points, and allow for measuring the distance between them.

Table 5 – Sampling options for non-resident survey

	Questionnaires for the MRAEP								
	Mediterranean hinterlands (Land abandonment)	Mediterranean hinterlands (Intensification)	Central lowlands / crops	The Alps, NW Iberian mountains and the Scottish Highlands	North-western fringes and continental uplands	Central lowlands / livestock	Eastern Europe	Mediterranean uplands / permanent crops	Northern Scandinavia
Option D (9 countries)	Ireland	Estonia	Finland	Sweden	Portugal	Greece	Cyprus	Germany	Italy
Option E (20 countries)	Belgium, Ireland	United Kingdom, Estonia	Finland, Poland	Sweden, Netherlands	Latvia, Portugal	Denmark, Greece	France, Cyprus	Romania, Germany	Italy, Slovakia
Option F (27 countries)	Belgium, Malta, Ireland	United Kingdom, Hungary, Estonia	Finland, Luxembourg, Poland	Czech Republic, Netherlands, Sweden	Latvia, Portugal, Slovenia	Denmark, Greece, Spain	Austria, Cyprus, France	Bulgaria, Germany, Romania	Italy, Slovakia, Lithuania

Annex VII – Sampling options (sample size and sampling points)

Table 1 - Sample size for each of EU country accounting for the type of area (Metropolitan, Non-Metropolitan)

	Resident Population	Weight of Metropolitan areas	Weight of Non-metropolitan areas	Sample for Metropolitan areas	Sample for Non-metropolitan areas	Sample Size	Sample for Metropolitan areas	Sample for Non-metropolitan areas	Sample Size	Sample for Metropolitan areas	Sample for Non-metropolitan areas	Sample Size
Country	Total	%	%	Sampling Error = 2.5			Sampling Error = 3.5			Sampling Error = 4.5		
Austria	8375290	47	53	715	821	1537	365	419	784	221	253	474
Belgium	10839905	56	44	859	677	1537	438	346	784	265	209	474
Bulgaria	7563710	32	68	491	1046	1537	251	533	784	152	323	474
Cyprus	819140	98	2	1507	30	1537	769	15	784	465		465
Czech Republic	10506813	52	48	800	737	1537	408	376	784	247	227	474
Denmark	5534738	68	32	1045	492	1537	533	251	784	323	152	474
Estonia	1340127	39	61	604	933	1537	308	476	784	186	288	474
Finland	5351427	46	54	708	829	1537	361	423	784	218	256	474
France	64694497	64	36	985	551	1537	503	281	784	304	170	474
Germany	81802257	64	36	980	556	1537	500	284	784	303	172	474
Greece	11305118	47	53	717	820	1537	366	418	784	221	253	474
Hungary	10014324	42	58	642	894	1537	328	456	784	198	276	474
Ireland	4467854	54	46	821	715	1537	419	365	784	253	221	474
Italy	60340328	58	42	893	644	1537	456	328	784	276	199	474
Latvia	2248374	49	51	749	788	1537	382	402	784	231	243	474
Lithuania	3329039	46	54	700	837	1537	357	427	784	216	258	474
Luxembourg	502066	100	0	1537	0	1537	784	0	784	474		474
Malta	414372	92	8	1421	116	1537	725	59	784	438		438
Netherlands	16574989	66	34	1018	519	1537	519	265	784	314	160	474
Poland	38167329	59	41	907	630	1537	463	321	784	280	194	474
Portugal	10637713	39	61	595	942	1537	303	481	784	184	291	474

Country	Resident Population	Weight of Metropolitan areas	Weight of Non-metropolitan areas	Sample for Metropolitan areas	Sample for Non-metropolitan areas	Sample Size	Sample for Metropolitan areas	Sample for Non-metropolitan areas	Sample Size	Sample for Metropolitan areas	Sample for Non-metropolitan areas	Sample Size
	Total	%	%	Sampling Error = 2.5			Sampling Error = 3.5			Sampling Error = 4.5		
Romania	21462186	33	67	508	1029	1537	259	525	784	157	318	474
Slovakia	5424925	26	74	397	1140	1537	202	582	784	122	352	474
Slovenia	2046976	42	58	640	896	1537	327	457	784	198	277	474
Spain	45989016	74	26	1140	396	1537	582	202	784	352	122	474
Sweden	9340682	52	48	793	744	1537	405	379	784	245	230	474
United Kingdom	62026962	72	28	1113	424	1537	568	216	784	344	131	474
European Union (27 countries)	501120157	60	40	23284	18205	41489	11880	9288	21168	7186	5574	12760

Source: Eurostat. Data refer to year 2010

Table 2 - EU country resident population and households per Metropolitan area

Country	Resident Population	Total Households		Metropolitan areas		Non-Metropolitan areas		Weight of Metropolitan areas	Weight of Non-metropolitan areas
	Total	Average dimension	Number	Resident population	No Households	Resident population	No Households	%	%
Austria	8375290	2.3	3641430	3898841	1695148	4476449	1946282	47	53
Belgium	10839905	2.3	4713002	6061274	2635337	4778631	2077666	56	44
Bulgaria	7563710	2.9	2608176	2416947	833430	5146763	1774746	32	68
Cyprus	819140	2.8	292550	803147	286838	15993	5712	98	2
Czech Republic	10506813	2.5	4202725	5467503	2187001	5039310	2015724	52	48
Denmark	5534738	2.0	2767369	3764003	1882002	1770735	885368	68	32
Estonia	1340127	2.3	582664	526505	228915	813622	353749	39	61
Finland	5351427	2.1	2548299	2464892	1173758	2886535	1374540	46	54
France	64694497	2.2	29406590	41476860	18853118	23217637	10553471	64	36
Germany	81802257	2.0	40901129	52184173	26092087	29618084	14809042	64	36
Greece	11305118	2.7	4187081	5273993	1953331	6031125	2233750	47	53

Country	Resident Population	Total Households		Metropolitan areas		Non-Metropolitan areas		Weight of Metropolitan areas	Weight of Non-metropolitan areas
	Total	Average dimension	Number	Resident population	No Households	Resident population	No Households	%	%
Hungary	10014324	2.6	3851663	4185505	1609810	5828819	2241853	42	58
Ireland	4467854	2.7	1654761	2388073	884471	2079781	770289	54	46
Italy	60340328	2.4	25141803	35071315	14613048	25269013	10528755	58	42
Latvia	2248374	2.6	864759	1095706	421425	1152668	443334	49	51
Lithuania	3329039	2.5	1331616	1516633	606653	1812406	724962	46	54
Luxembourg	502066	2.5	200826	502066	200826	0	0	100	0
Malta	414372	2.9	142887	383071	132093	31301	10793	92	8
Netherlands	16574989	2.2	7534086	10981145	4991430	5593844	2542656	66	34
Poland	38167329	2.8	13631189	22525673	8044883	15641656	5586306	59	41
Portugal	10637713	2.7	3939894	4116219	1524526	6521494	2415368	39	61
Romania	21462186	2.9	7400754	7093350	2445983	14368836	4954771	33	67
Slovakia	5424925	2.8	1937473	1400826	500295	4024099	1437178	26	74
Slovenia	2046976	2.6	787298	852989	328073	1193987	459226	42	58
Spain	45989016	2.7	17032969	34124916	12638858	11864100	4394111	74	26
Sweden	9340682	2.1	4447944	4819702	2295096	4520980	2152848	52	48
United Kingdom	62026962	2.3	26968244	44926098	19533086	17100864	7435158	72	28
European Union (27 countries)	501120157	2.4	208800065	300321425	125133927	200798732	83666138	60	40

Source: Eurostat. Data refer to year 2010

Definitions:

Metroplitan areas: Metropolitan regions are NUTS3 regions or a combination of NUTS3 regions which represent all agglomerations of at least 250 000 inhabitant

Rural areas: Areas where the share of the population living in rural areas is higher than 50%

Table 3 is divided in two parts. The first refers to resident population per NUTS2 according OECD typology of rural areas and the second part refers to sampling options according to resident population in each NUTS2.

Table 3 - Resident population per NUTS2 according OECD typology of rural areas and sampling options (part 1)

	Population urban		Population intermediate		Population rural		Total population
NUTS2	total	%	Total	%	Total	%	Total
AT11 – Burgenland	0	0	0	0	283965	100	283965
AT12 - Niederösterreich	621448	39	252687	16	733841	46	1607976
AT13 – Wien	1698822	100	0	0	0	0	1698822
AT21 – Kärnten	0	0	276288	49	283027	51	559315
AT22 – Steiermark	0	0	566186	47	642186	53	1208372
AT31 - Oberösterreich	0	0	778651	55	632587	45	1411238
AT32 – Salzburg	0	0	346080	65	183781	35	529861
AT33 – Tirol	284141	40	0	0	422732	60	706873
AT34 – Vorarlberg	280391	76	0	0	88477	24	368868
	2884802		2219892		3270596		8375290
BE10 - Région de Bruxelles-Capitale / Brussels Hoofdstedelijk Gewest	1089538	100	0	0	0	0	1089538
BE21 - Prov. Antwerpen	1309643	75	435219	25	0	0	1744862
BE22 - Prov. Limburg	408370	49	430135	51	0	0	838505
BE23 - Prov. Oost-Vlaanderen	1230410	86	201916	14	0	0	1432326
BE24 - Prov. Vlaams-Brabant	1076924	100	0	0	0	0	1076924
BE25 - Prov. West-Vlaanderen	853290	74	150573	13	155503	13	1159366
BE31 - Prov. Brabant Wallon	0	0	379515	100	0	0	379515
BE32 - Prov. Hainaut	749391	57	476737	36	83752	6	1309880
BE33 - Prov. Liège	604062	57	204981	19	258642	24	1067685
BE34 - Prov. Luxembourg	0	0	0	0	269023	100	269023
BE35 - Prov. Namur	0	0	301472	64	170809	36	472281
	7321628		2580548		937729		10839905
BG31 – Severozapaden	0	0	0	0	902537	100	902537
BG32 - Severen tsentralen	0	0	379145	41	535794	59	914939
BG33 – Severoiztochen	0	0	665170	67	323765	33	988935
BG34 – Yugoiztochen	0	0	1116560	100	0	0	1116560
BG41 – Yugozapaden	1249798	59	281826	13	580895	27	2112519
BG42 - Yuzhen tsentralen	0	0	958092	63	570128	37	1528220
	1249798		3400793		2913119		7563710
CY00 – Kypros	0	0	819140	100	0	0	819140
	0		819140		0		819140
CZ01 – Praha	1249026	100	0	0	0	0	1249026
CZ02 - Stredni Cechy	1247533	100	0	0	0	0	1247533
CZ03 – Jihozápad	0	0	0	0	1209506	100	1209506
CZ04 - Severozápad	0	0	1143834	100	0	0	1143834
CZ05 - Severovýchod	0	0	993429	66	516329	34	1509758
CZ06 - Jihovýchod	0	0	1151708	69	514992	31	1666700

NUTS2	Population urban total	%	Population intermediate Total	%	Population rural Total	%	Total population Total
CZ07 - Stredni Morava	0	0	0	0	1233083	100	1233083
CZ08 - Moravskoslezsko	0	0	1247373	100	0	0	1247373
	2496559		4536344		3473910		10506813
DE11 – Stuttgart	2419941	60	1258002	31	322905	8	4000848
DE12 – Karlsruhe	2032623	74	281406	10	426474	16	2740503
DE13 – Freiburg	0	0	1889327	86	306691	14	2196018
DE14 – Tübingen	0	0	1210727	67	596825	33	1807552
DE21 - Oberbayern	1650013	38	2037396	47	659056	15	4346465
DE22 - Niederbayern	0	0	0	0	1189194	100	1189194
DE23 – Oberpfalz	0	0	466705	43	614712	57	1081417
DE24 - Oberfranken	0	0	673942	63	402458	37	1076400
DE25 - Mittelfranken	1174047	69	0	0	536098	31	1710145
DE26 - Unterfranken	0	0	830875	63	491082	37	1321957
DE27 - Schwaben	0	0	1088622	61	696131	39	1784753
DE30 – Berlin	3442675	100	0	0	0	0	3442675
DE41 - Brandenburg – Nordost	0	0	816434	72	317935	28	1134369
DE42 - Brandenburg – Südwest	0	0	1101723	80	275433	20	1377156
DE50 – Bremen	547685	83	114031	17	0	0	661716
DE60 – Hamburg	1774224	100	0	0	0	0	1774224
DE71 – Darmstadt	3288417	87	407022	11	97502	3	3792941
DE72 – Gießen	0	0	933280	89	110989	11	1044269
DE73 – Kassel	0	0	432747	35	791994	65	1224741
DE80 - Mecklenburg-Vorpommern	0	0	1005868	61	645348	39	1651216
DE91 – Braunschweig	0	0	1397914	86	218806	14	1616720
DE92 – Hannover	1130262	53	601461	28	410717	19	2142440
DE93 – Lüneburg	112029	7	1133381	67	448244	26	1693654
DE94 - Weser-Sem	74512	3	1647428	67	754061	30	2476001
DEA1 – Düsseldorf	4864749	94	308090	6	0	0	5172839
DEA2 – Köln	3922319	89	460725	11	0	0	4383044
DEA3 – Münster	1009520	39	1588116	61	0	0	2597636
DEA4 – Detmold	573331	28	1321411	65	148470	7	2043212
DEA5 – Arnsberg	2961342	81	714690	19	0	0	3676032
DEB1 – Koblenz	0	0	1040268	70	450443	30	1490711
DEB2 – Trier	0	0	246068	48	267726	52	513794
DEB3 - Rheinhessen-Pfalz	889903	44	843632	42	274635	14	2008170
DEC0 – Saarland	826183	81	105241	10	91161	9	1022585
DED1 – Chemnitz	495922	34	891235	61	84219	6	1471376
DED2 – Dresden	663818	41	967668	59	0	0	1631486
DED3 – Leipzig	779634	73	0	0	286236	27	1065870
DEE0 - Sachsen-Anhalt	0	0	1695774	72	660445	28	2356219
DEF0 - Schleswig-Holstein	302430	11	2095177	74	434420	15	2832027

NUTS2	Population urban total	%	Population intermediate Total	%	Population rural Total	%	Total population Total
DEG0 - Thüringen	0	0	1197960	53	1051922	47	2249882
	34935579		32804346		14062332		81802257
DK01 - Hovedstaden	1191565	71	446451	27	42255	3	1680271
DK02 - Sjælland	0	0	234574	29	585990	71	820564
DK03 - Syddanmark	0	0	484862	40	715415	60	1200277
DK04 - Midtjylland	0	0	826923	66	427075	34	1253998
DK05 - Nordjylland	0	0	0	0	579628	100	579628
	1191565		1992810		2350363		5534738
EE00 – Eesti	0	0	695161	52	644966	48	1340127
	0		695161		644966		1340127
EL11 - Anatoliki Makedonia, Thraki	0	0	0	0	606721	100	606721
EL12 - Kentriki Makedonia	1164245	60	0	0	790337	40	1954582
EL13 - Dytiki Makedonia	0	0	0	0	293061	100	293061
EL14 - Thessalia	0	0	203989	28	532094	72	736083
EL21 - Ipeiros	0	0	189195	53	169901	47	359096
EL22 - Ionia Nisia	0	0	0	0	234440	100	234440
EL23 - Dytiki Ellada	0	0	349189	47	396208	53	745397
EL24 - Sterea Ellada	0	0	0	0	554359	100	554359
EL25 - Peloponnisos	0	0	0	0	591230	100	591230
EL30 – Attiki	4109748	100	0	0	0	0	4109748
EL41 - Voreio Aigaio	0	0	0	0	199968	100	199968
EL42 - Notio Aigaio	0	0	0	0	308647	100	308647
EL43 – Kriti	0	0	454639	74	157147	26	611786
	5273993		1197012		4834113		11305118
ES11 - Galicia	0	0	2069953	76	668649	24	2738602
ES12 - Principado de Asturias	0	0	1058114	100	0	0	1058114
ES13 - Cantabria	0	0	577997	100	0	0	577997
ES21 - País Vasco	1828030	85	310558	15	0	0	2138588
ES22 - Comunidad Foral de Navarra	0	0	619011	100	0	0	619011
ES23 - La Rioja	0	0	314005	100	0	0	314005
ES24 - Aragón	948063	72	0	0	364954	28	1313017
ES30 - Comunidad de Madrid	6335807	100	0	0	0	0	6335807
ES41 - Castilla y León	0	0	1885646	75	613509	25	2499155
ES42 - Castilla-la Mancha	0	0	0	0	2035516	100	2035516
ES43 - Extremadura	0	0	0	0	1082792	100	1082792
ES51 - Cataluña	5352034	73	1518866	21	430232	6	7301132
ES52 - Comunidad Valenciana	2512597	50	2481725	50	0	0	4994322
ES53 - Illes Balears	0	0	987877	92	91217	8	1079094
ES61 - Andalucía	3444884	42	4106467	50	654706	8	8206057
ES62 - Región de Murcia	0	0	1460664	100	0	0	1460664
ES63 - Ciudad Autónoma de Ceuta	74403	100	0	0	0	0	74403

NUTS2	Population urban total	%	Population intermediate Total	%	Population rural Total	%	Total population Total
ES64 - Ciudad Autónoma de Melilla	72515	100	0	0	0	0	72515
ES70 – Canarias	1736446	83	224715	11	127064	6	2088225
	22304779		17615598		6068639		45989016
FI13 - Itä-Suomi	0	0	0	0	652346	100	652346
FI18 - Etelä-Suomi	1421463	53	1154648	43	96079	4	2672190
FI19 - Länsi-Suomi	0	0	484436	36	870732	64	1355168
FI1A - Pohjois-Suomi	0	0	0	0	643989	100	643989
FI20 - Åland	0	0	0	0	27734	100	27734
	1421463		1639084		2290880		5351427
FR10 - Île de France	10470990	89	1326031	11	0	0	11797021
FR21 - Champagne-Ardenne	0	0	870196	65	466046	35	1336242
FR22 - Picardie	0	0	804115	42	1110729	58	1914844
FR23 - Haute-Normandie	0	0	1250264	68	587124	32	1837388
FR24 – Centre	0	0	1247232	49	1297559	51	2544791
FR25 - Basse-Normandie	0	0	683536	46	790410	54	1473946
FR26 - Bourgogne	0	0	525607	32	1119149	68	1644756
FR30 - Nord - Pas-de-Calais	2572374	64	1462895	36	0	0	4035269
FR41 - Lorraine	0	0	1778425	76	573899	24	2352324
FR42 – Alsace	0	0	1851443	100	0	0	1851443
FR43 - Franche-Comté	0	0	670564	57	501985	43	1172549
FR51 - Pays de la Loire	1277320	36	784225	22	1505141	42	3566686
FR52 - Bretagne	0	0	1884127	59	1313848	41	3197975
FR53 - Poitou-Charentes	0	0	0	0	1770149	100	1770149
FR61 - Aquitaine	1447817	45	654517	20	1129526	35	3231860
FR62 - Midi-Pyrénées	1246480	43	0	0	1642756	57	2889236
FR63 - Limousin	0	0	0	0	744187	100	744187
FR71 - Rhône-Alpes	1721999	28	3175166	51	1324880	21	6222045
FR72 - Auvergne	0	0	631077	47	714635	53	1345712
FR81 - Languedoc-Roussillon	0	0	1492938	57	1143383	43	2636321
FR82 - Provence-Alpes-Côte d'Azur	3061011	62	1557779	32	298140	6	4916930
FR83 – Corse	0	0	0	0	309339	100	309339
FR91 – Guadeloupe	0	0	448681	100	0	0	448681
FR92 – Martinique	396308	100	0	0	0	0	396308
FR93 – Guyane	0	0	0	0	230441	100	230441
FR94 – Réunion	828054	100	0	0	0	0	828054
	23022353		23098818		18573326		64694497
HU10 - Közép-Magyarország	1721556	58	1229880	42	0	0	2951436
HU21 - Közép-Dunántúl	0	0	312431	28	786223	72	1098654
HU22 - Nyugat-Dunántúl	0	0	0	0	996390	100	996390
HU23 - Dél-Dunántúl	0	0	393758	42	554228	58	947986
HU31 - Észak-Magyarország	0	0	692771	57	516371	43	1209142

	Population urban		Population intermediate		Population rural		Total population
NUTS2	total	%	Total	%	Total	%	Total
HU32 - Észak-Alföld	0	0	541298	36	951204	64	1492502
HU33 - Dél-Alföld	0	0	423240	32	894974	68	1318214
	1721556		3593378		4699390		10014324
IE01 - Border, Midland and Western	0	0	0	0	1204423	100	1204423
IE02 - Southern and Eastern	1207971	37	0	0	2055460	63	3263431
	1207971		0		3259883		4467854
ITC1 - Piemonte	2297598	52	718683	16	1429949	32	4446230
ITC2 - Valle d'Aosta/Vallée d'Aoste	0	0	127866	100	0	0	127866
ITC3 - Liguria	1106786	68	509200	32	0	0	1615986
ITC4 - Lombardia	6855787	70	2375039	24	595315	6	9826141
ITD1 - Provincia Autonoma Bolzano/Bozen	0	0	0	0	503434	100	503434
ITD2 - Provincia Autonoma Trento	0	0	524826	100	0	0	524826
ITD3 – Veneto	0	0	4451265	91	461173	9	4912438
ITD4 - Friuli-Venezia Giulia	379173	31	313870	25	541036	44	1234079
ITD5 - Emilia-Romagna	307085	7	3423375	78	646975	15	4377435
ITE1 - Toscana	932464	25	1951111	52	846555	23	3730130
ITE2 - Umbria	0	0	900790	100	0	0	900790
ITE3 – Marche	0	0	869385	55	708291	45	1577676
ITE4 – Lazio	4154684	73	551217	10	975967	17	5681868
ITF1 - Abruzzo	0	0	321192	24	1017706	76	1338898
ITF2 - Molise	0	0	0	0	320229	100	320229
ITF3 - Campania	3079685	53	2456694	42	288283	5	5824662
ITF4 - Puglia	0	0	3401270	83	682765	17	4084035
ITF5 - Basilicata	0	0	0	0	588879	100	588879
ITF6 - Calabria	0	0	565756	28	1443574	72	2009330
ITG1 - Sicilia	2333776	46	2536207	50	173009	3	5042992
ITG2 - Sardegna	0	0	561080	34	1111324	66	1672404
	21447038		26558826		12334464		60340328
LT00 - Lietuva	850324	26	1042858	31	1435857	43	3329039
	850324		1042858		1435857		3329039
LU00 - Luxembourg	0	0	502066	100	0	0	502066
	0		502066		0		502066
LV00 - Latvija	1095706	49	299506	13	853162	38	2248374
	1095706		299506		853162		2248374
MT00 - Malta	414372	100	0	0	0	0	414372
	414372		0		0		414372
NL11 - Groningen	0	0	576668	100	0	0	576668
NL12 – Friesland	0	0	646305	100	0	0	646305
NL13 – Drenthe	0	0	490981	100	0	0	490981
NL21 - Overijssel	623432	55	506913	45	0	0	1130345

NUTS2	Population urban total	%	Population intermediate Total	%	Population rural Total	%	Total population Total
NL22 - Gelderland	1362273	68	636663	32	0	0	1998936
NL23 – Flevoland	387881	100	0	0	0	0	387881
NL31 – Utrecht	1220910	100	0	0	0	0	1220910
NL32 - Noord-Holland	2298905	86	370179	14	0	0	2669084
NL33 - Zuid-Holland	3505611	100	0	0	0	0	3505611
NL34 – Zeeland	0	0	274582	72	106827	28	381409
NL41 - Noord-Brabant	1807183	74	636975	26	0	0	2444158
NL42 - Limburg	607784	54	514917	46	0	0	1122701
	11813979		4654183		106827		16574989
PL11 - Lódzkie	1120750	44	0	0	1421082	56	2541832
PL12 - Mazowieckie	1714446	33	2136541	41	1371180	26	5222167
PL21 - Malopolskie	1434433	43	633799	19	1230038	37	3298270
PL22 - Slaskie	3456153	74	1184572	26	0	0	4640725
PL31 - Lubelskie	0	0	713229	33	1443973	67	2157202
PL32 - Podkarpackie	0	0	611223	29	1490509	71	2101732
PL33 - Swietokrzyskie	0	0	775833	61	494287	39	1270120
PL34 - Podlaskie	0	0	504845	42	684886	58	1189731
PL41 - Wielkopolskie	1132496	33	0	0	2275785	67	3408281
PL42 - Zachodniopomorskie	0	0	1318491	78	374707	22	1693198
PL43 - Lubuskie	0	0	1010047	100	0	0	1010047
PL51 - Dolnoslaskie	1177157	41	1699470	59	0	0	2876627
PL52 - Opolskie	0	0	0	0	1031097	100	1031097
PL61 - Kujawsko-Pomorskie	761565	37	0	0	1307518	63	2069083
PL62 - Warminsko-Mazurskie	0	0	613565	43	813553	57	1427118
PL63 - Pomorskie	0	0	1737778	78	492321	22	2230099
	10797000		12939393		14430936		38167329
PT11 - Norte	2099556	56	974775	26	671244	18	3745575
PT15 - Algarve	0	0	0	0	434023	100	434023
PT16 - Centro (PT)	0	0	401114	17	1979954	83	2381068
PT17 - Lisboa	2830867	100	0	0	0	0	2830867
PT18 - Alentejo	0	0	0	0	753407	100	753407
PT20 - Região Autónoma dos Açores	0	0	245374	100	0	0	245374
PT30 - Região Autónoma da Madeira	247399	100	0	0	0	0	247399
	5177822		1621263		3838628		10637713
RO11 - Nord-Vest	0	0	1285296	47	1434423	53	2719719
RO12 - Centru	0	0	1023004	41	1501414	59	2524418
RO21 - Nord-Est	0	0	2104432	57	1607964	43	3712396
RO22 - Sud-Est	0	0	1692213	60	1119005	40	2811218
RO31 - Sud - Muntenia	0	0	1455173	45	1812097	55	3267270
RO32 - Bucuresti - Ilfov	2261698	100	0	0	0	0	2261698
RO41 - Sud-Vest Oltenia	0	0	704436	31	1541597	69	2246033

NUTS2	Population urban total	%	Population intermediate Total	%	Population rural Total	%	Total population Total
RO42 - Vest	0	0	1141897	59	777537	41	1919434
	2261698		9406451		9794037		21462186
SE11 - Stockholm	2019182	100	0	0	0	0	2019182
SE12 - Östra Mellansverige	0	0	1558292	100	0	0	1558292
SE21 - Småland med öarna	0	0	336044	41	474022	59	810066
SE22 - Sydsverige	0	0	1231062	89	152591	11	1383653
SE23 - Västsverige	0	0	1866283	100	0	0	1866283
SE31 - Norra Mellansverige	0	0	0	0	825931	100	825931
SE32 - Mellersta Norrland	0	0	0	0	369708	100	369708
SE33 - Övre Norrland	0	0	249019	49	258548	51	507567
	2019182		5240700		2080800		9340682
SI01 - Vzhodna Slovenija	0	0	323343	30	761592	70	1084935
SI02 - Zahodna Slovenija	529646	55	313315	33	119080	12	962041
	529646		636658		880672		2046976
SK01 - Bratislavský kraj	622706	100	0	0	0	0	622706
SK02 - Západné Slovensko	0	0	599214	32	1267186	68	1866400
SK03 - Stredné Slovensko	0	0	697502	52	653186	48	1350688
SK04 - Východné Slovensko	0	0	778120	49	807011	51	1585131
	622706		2074836		2727383		5424925
UKC1 - Tees Valley and Durham	1170983	100	0	0	0	0	1170983
UKC2 - Northumberland and Tyne and Wear	1112927	78	311534	22	0	0	1424461
UKD1 - Cumbria	0	0	494696	100	0	0	494696
UKD2 – Cheshire	1007486	100	0	0	0	0	1007486
UKD3 - Greater Manchester	2615144	100	0	0	0	0	2615144
UKD4 - Lancashire	1447494	100	0	0	0	0	1447494
UKD5 – Merseyside	1352000	100	0	0	0	0	1352000
UKE1 - East Yorkshire and Northern Lincolnshire	0	0	919439	100	0	0	919439
UKE2 - North Yorkshire	0	0	799304	100	0	0	799304
UKE3 - South Yorkshire	1322812	100	0	0	0	0	1322812
UKE4 - West Yorkshire	2238127	100	0	0	0	0	2238127
UKF1 - Derbyshire and Nottinghamshire	2089453	100	0	0	0	0	2089453
UKF2 - Leicestershire, Rutland and Northamptonshire	990860	59	685555	41	0	0	1676415
UKF3 – Lincolnshire	0	0	700466	100	0	0	700466
UKG1 - Herefordshire, Worcestershire and Warwickshire	0	0	1092515	86	179210	14	1271725
UKG2 - Shropshire and Staffordshire	1069479	70	455036	30	0	0	1524515
UKG3 - West Midlands	2646889	100	0	0	0	0	2646889
UKH1 - East Anglia	0	0	2358545	100	0	0	2358545

NUTS2	Population urban total	%	Population intermediate Total	%	Population rural Total	%	Total population Total
UKH2 - Bedfordshire and Hertfordshire	1298044	76	413462	24	0	0	1711506
UKH3 – Essex	1729185	100	0	0	0	0	1729185
UKI1 - Inner London	3072181	100	0	0	0	0	3072181
UKI2 - Outer London	4717184	100	0	0	0	0	4717184
UKJ1 - Berkshire, Buckinghamshire and Oxfordshire	1595048	71	644500	29	0	0	2239548
UKJ2 - Surrey, East and West Sussex	2174091	81	513805	19	0	0	2687896
UKJ3 - Hampshire and Isle of Wight	1736606	93	140360	7	0	0	1876966
UKJ4 – Kent	1674986	100	0	0	0	0	1674986
UKK1 - Gloucestershire, Wiltshire and Bristol/Bath area	1090080	47	1249588	53	0	0	2339668
UKK2 - Dorset and Somerset	712622	58	524328	42	0	0	1236950
UKK3 - Cornwall and Isles of Scilly	0	0	535364	100	0	0	535364
UKK4 – Devon	0	0	1140501	100	0	0	1140501
UKL1 - West Wales and The Valleys	1125783	59	207840	11	562233	30	1895856
UKL2 - East Wales	692294	63	283199	26	131524	12	1107017
UKM2 - Eastern Scotland	1060588	53	829116	41	112779	6	2002483
UKM3 - South Western Scotland	1789003	78	360437	16	148353	6	2297793
UKM5 - North Eastern Scotland	0	0	460117	100	0	0	460117
UKM6 - Highlands and Islands	0	0	185676	41	262052	59	447728
UKN0 - Northern Ireland (UK)	656095	37	726377	40	411890	23	1794362
	44187444		16031760		1808041		62027245
Total	117670053	23	206248963	41	177201424	35	501120440

Table 3 part 2

NUTS2	Sampling Error = 2.5			Sampling Error = 3.5			Sampling Error = 4.5		
	Sample for PU+MU areas	Sample for PR areas	Sample Size	Sample for PU+MU areas	Sample for PR areas	Sample Size	Sample for PU+MU areas	Sample for PR areas	Sample Size
AT11 – Burgenland	0	52	52	0	27	27	0	16	16
AT12 - Niederösterreich	160	135	295	82	69	151	50	42	91
AT13 – Wien	312	0	312	159	0	159	96	0	96
AT21 – Kärnten	51	52	103	26	26	52	16	16	32
AT22 – Steiermark	104	118	222	53	60	113	32	36	68
AT31 - Oberösterreich	143	116	259	73	59	132	44	36	80
AT32 – Salzburg	63	34	97	32	17	50	20	10	30
AT33 – Tirol	52	78	130	27	40	66	16	24	40
AT34 – Vorarlberg	51	16	68	26	8	35	16	5	21

NUTS2	Sample for PU+MU areas	Sample for PR areas	Sample Size	Sample for PU+MU areas	Sample for PR areas	Sample Size	Sample for PU+MU areas	Sample for PR areas	Sample Size
	Sampling Error = 2.5			Sampling Error = 3.5			Sampling Error = 4.5		
			1537			784			474
BE10 - Région de Bruxelles-Capitale / Brussels Hoofdstedelijk Gewest	154	0	154	79	0	79	48	0	48
BE21 - Prov. Antwerpen	247	0	247	126	0	126	76	0	76
BE22 - Prov. Limburg	119	0	119	61	0	61	37	0	37
BE23 - Prov. Oost-Vlaanderen	203	0	203	104	0	104	63	0	63
BE24 - Prov. Vlaams-Brabant	153	0	153	78	0	78	47	0	47
BE25 - Prov. West-Vlaanderen	142	22	164	73	11	84	44	7	51
BE31 - Prov. Brabant Wallon	54	0	54	27	0	27	17	0	17
BE32 - Prov. Hainaut	174	12	186	89	6	95	54	4	57
BE33 - Prov. Liège	115	37	151	59	19	77	35	11	47
BE34 - Prov. Luxembourg	0	38	38	0	19	19	0	12	12
BE35 - Prov. Namur	43	24	67	22	12	34	13	7	21
			1537			784			474
BG31 – Severozapaden	0	183	183	0	94	94	0	57	57
BG32 - Severen tsentralen	77	109	186	39	56	95	24	34	57
BG33 – Severoiztochen	135	66	201	69	34	103	42	20	62
BG34 – Yugoiztochen	227	0	227	116	0	116	70	0	70
BG41 – Yugozapaden	311	118	429	159	60	219	96	36	132
BG42 - Yuzhen tsentralen	195	116	311	99	59	158	60	36	96
			1537			784			474
CY00 – Kypros	1537	0	1537	784	0	784	474	0	474
			1537			784			474
CZ01 – Praha	183	0	183	93	0	93	56	0	56
CZ02 - Strední Cechy	182	0	182	93	0	93	56	0	56
CZ03 – Jihozápad	0	177	177	0	90	90	0	55	55
CZ04 - Severozápad	167	0	167	85	0	85	52	0	52
CZ05 - Severovýchod	145	76	221	74	39	113	45	23	68
CZ06 - Jihovýchod	168	75	244	86	38	124	52	23	75
CZ07 - Strední Morava	0	180	180	0	92	92	0	56	56
CZ08 - Moravskoslezsko	182	0	182	93	0	93	56	0	56
			1537			784			474
DE11 – Stuttgart	69	6	75	35	3	38	21	2	23
DE12 – Karlsruhe	43	8	51	22	4	26	13	2	16
DE13 – Freiburg	35	6	41	18	3	21	11	2	13
DE14 – Tübingen	23	11	34	12	6	17	7	3	10
DE21 - Oberbayern	69	12	82	35	6	42	21	4	25
DE22 - Niederbayern	0	22	22	0	11	11	0	7	7
DE23 – Oberpfalz	9	12	20	4	6	10	3	4	6
DE24 - Oberfranken	13	8	20	6	4	10	4	2	6
DE25 - Mittelfranken	22	10	32	11	5	16	7	3	10

NUTS2	Sample for PU+MU areas	Sample for PR areas	Sample Size	Sample for PU+MU areas	Sample for PR areas	Sample Size	Sample for PU+MU areas	Sample for PR areas	Sample Size
	Sampling Error = 2.5			Sampling Error = 3.5			Sampling Error = 4.5		
DE26 - Unterfranken	16	9	25	8	5	13	5	3	8
DE27 - Schwaben	20	13	34	10	7	17	6	4	10
DE30 – Berlin	65	0	65	33	0	33	20	0	20
DE41 - Brandenburg – Nordost	15	6	21	8	3	11	5	2	7
DE42 - Brandenburg – Südwest	21	5	26	11	3	13	6	2	8
DE50 – Bremen	12	0	12	6	0	6	4	0	4
DE60 – Hamburg	33	0	33	17	0	17	10	0	10
DE71 – Darmstadt	69	2	71	35	1	36	21	1	22
DE72 – Gießen	18	2	20	9	1	10	5	1	6
DE73 – Kassel	8	15	23	4	8	12	3	5	7
DE80 - Mecklenburg-Vorpommern	19	12	31	10	6	16	6	4	10
DE91 – Braunschweig	26	4	30	13	2	15	8	1	9
DE92 – Hannover	33	8	40	17	4	21	10	2	12
DE93 – Lüneburg	23	8	32	12	4	16	7	3	10
DE94 - Weser-Sem	32	14	47	17	7	24	10	4	14
DEA1 – Düsseldorf	97	0	97	50	0	50	30	0	30
DEA2 – Köln	82	0	82	42	0	42	25	0	25
DEA3 – Münster	49	0	49	25	0	25	15	0	15
DEA4 – Detmold	36	3	38	18	1	20	11	1	12
DEA5 – Arnsberg	69	0	69	35	0	35	21	0	21
DEB1 – Koblenz	20	8	28	10	4	14	6	3	9
DEB2 – Trier	5	5	10	2	3	5	1	2	3
DEB3 - Rheinhessen-Pfalz	33	5	38	17	3	19	10	2	12
DEC0 – Saarland	18	2	19	9	1	10	5	1	6
DED1 – Chemnitz	26	2	28	13	1	14	8	0	9
DED2 – Dresden	31	0	31	16	0	16	9	0	9
DED3 – Leipzig	15	5	20	7	3	10	5	2	6
DEE0 - Sachsen-Anhalt	32	12	44	16	6	23	10	4	14
DEF0 - Schleswig-Holstein	45	8	53	23	4	27	14	3	16
DEG0 - Thüringen	23	20	42	11	10	22	7	6	13
			1537			784			474
DK01 - Hovedstaden	455	12	467	232	6	238	140	4	144
DK02 - Sjælland	65	163	228	33	83	116	20	50	70
DK03 - Syddanmark	135	199	333	69	101	170	42	61	103
DK04 - Midtjylland	230	119	348	117	60	178	71	37	107
DK05 - Nordjylland	0	161	161	0	82	82	0	50	50
			1537			784			474
EE00 – Eesti	797	740	1537	407	377	784	246	228	474
			1537			784			474
EL11 - Anatoliki Makedonia, Thraki	0	82	82	0	42	42	0	25	25

NUTS2	Sample for PU+MU areas	Sample for PR areas	Sample Size	Sample for PU+MU areas	Sample for PR areas	Sample Size	Sample for PU+MU areas	Sample for PR areas	Sample Size
	Sampling Error = 2.5			Sampling Error = 3.5			Sampling Error = 4.5		
EL12 - Kentriki Makedonia	158	107	266	81	55	136	49	33	82
EL13 - Dytiki Makedonia	0	40	40	0	20	20	0	12	12
EL14 - Thessalia	28	72	100	14	37	51	9	22	31
EL21 - Ipeiros	26	23	49	13	12	25	8	7	15
EL22 - Ionia Nisia	0	32	32	0	16	16	0	10	10
EL23 - Dytiki Ellada	47	54	101	24	27	52	15	17	31
EL24 - Sterea Ellada	0	75	75	0	38	38	0	23	23
EL25 - Peloponnisos	0	80	80	0	41	41	0	25	25
EL30 – Attiki	559	0	559	285	0	285	172	0	172
EL41 - Voreio Aigaio	0	27	27	0	14	14	0	8	8
EL42 - Notio Aigaio	0	42	42	0	21	21	0	13	13
EL43 – Kriti	62	21	83	32	11	42	19	7	26
			1537			784			474
ES11 - Galicia	69	22	92	35	11	47	21	7	28
ES12 - Principado de Asturias	35	0	35	18	0	18	11	0	11
ES13 - Cantabria	19	0	19	10	0	10	6	0	6
ES21 - País Vasco	71	0	71	36	0	36	22	0	22
ES22 - Comunidad Foral de Navarra	21	0	21	11	0	11	6	0	6
ES23 - La Rioja	10	0	10	5	0	5	3	0	3
ES24 - Aragón	32	12	44	16	6	22	10	4	14
ES30 - Comunidad de Madrid	212	0	212	108	0	108	65	0	65
ES41 - Castilla y León	63	21	84	32	10	43	19	6	26
ES42 - Castilla-la Mancha	0	68	68	0	35	35	0	21	21
ES43 - Extremadura	0	36	36	0	18	18	0	11	11
ES51 - Cataluña	230	14	244	117	7	124	71	4	75
ES52 - Comunidad Valenciana	167	0	167	85	0	85	51	0	51
ES53 - Illes Balears	33	3	36	17	2	18	10	1	11
ES61 - Andalucía	252	22	274	129	11	140	78	7	85
ES62 - Región de Murcia	49	0	49	25	0	25	15	0	15
ES63 - Ciudad Autónoma de Ceuta	2	0	2	1	0	1	1	0	1
ES64 - Ciudad Autónoma de Melilla	2	0	2	1	0	1	1	0	1
ES70 – Canarias	66	4	70	33	2	36	20	1	22
			1537			784			474
FI13 - Itä-Suomi	0	187	187	0	96	96	0	58	58
FI18 - Etelä-Suomi	740	28	767	377	14	391	228	9	237
FI19 - Länsi-Suomi	139	250	389	71	128	199	43	77	120
FI1A - Pohjois-Suomi	0	185	185	0	94	94	0	57	57
FI20 - Åland	0	8	8	0	4	4	0	2	2
			1537			784			474
FR10 - Île de France	280	0	280	143	0	143	86	0	86
FR21 - Champagne-Ardenne	21	11	32	11	6	16	6	3	10

	Sample for PU+MU areas	Sample for PR areas	Sample Size	Sample for PU+MU areas	Sample for PR areas	Sample Size	Sample for PU+MU areas	Sample for PR areas	Sample Size
NUTS2	Sampling Error = 2.5			Sampling Error = 3.5			Sampling Error = 4.5		
FR22 - Picardie	19	26	45	10	13	23	6	8	14
FR23 - Haute-Normandie	30	14	44	15	7	22	9	4	13
FR24 – Centre	30	31	60	15	16	31	9	10	19
FR25 - Basse-Normandie	16	19	35	8	10	18	5	6	11
FR26 - Bourgogne	12	27	39	6	14	20	4	8	12
FR30 - Nord - Pas-de-Calais	96	0	96	49	0	49	30	0	30
FR41 - Lorraine	42	14	56	22	7	29	13	4	17
FR42 – Alsace	44	0	44	22	0	22	14	0	14
FR43 - Franche-Comté	16	12	28	8	6	14	5	4	9
FR51 - Pays de la Loire	49	36	85	25	18	43	15	11	26
FR52 - Bretagne	45	31	76	23	16	39	14	10	23
FR53 - Poitou-Charentes	0	42	42	0	21	21	0	13	13
FR61 - Aquitaine	50	27	77	25	14	39	15	8	24
FR62 - Midi-Pyrénées	30	39	69	15	20	35	9	12	21
FR63 - Limousin	0	18	18	0	9	9	0	5	5
FR71 - Rhône-Alpes	116	31	148	59	16	75	36	10	46
FR72 - Auvergne	15	17	32	8	9	16	5	5	10
FR81 - Languedoc-Roussillon	35	27	63	18	14	32	11	8	19
FR82 - Provence-Alpes-Côte d'Azur	110	7	117	56	4	60	34	2	36
FR83 – Corse	0	7	7	0	4	4	0	2	2
FR91 – Guadeloupe	11	0	11	5	0	5	3	0	3
FR92 – Martinique	9	0	9	5	0	5	3	0	3
FR93 – Guyane	0	5	5	0	3	3	0	2	2
FR94 – Réunion	20	0	20	10	0	10	6	0	6
			1537			784			474
HU10 - Közép-Magyarország	453	0	453	231	0	231	140	0	140
HU21 - Közép-Dunántúl	48	121	169	24	62	86	15	37	52
HU22 - Nyugat-Dunántúl	0	153	153	0	78	78	0	47	47
HU23 - Dél-Dunántúl	60	85	145	31	43	74	19	26	45
HU31 - Észak-Magyarország	106	79	186	54	40	95	33	24	57
HU32 - Észak-Alföld	83	146	229	42	74	117	26	45	71
HU33 - Dél-Alföld	65	137	202	33	70	103	20	42	62
			1537			784			474
IE01 - Border, Midland and Western	0	414	414	0	211	211	0	128	128
IE02 - Southern and Eastern	416	707	1123	212	361	573	128	218	346
			1537			784			474
ITC1 - Piemonte	77	36	113	39	19	58	24	11	35
ITC2 - Valle d'Aosta/Vallée d'Aoste	3	0	3	2	0	2	1	0	1
ITC3 - Liguria	41	0	41	21	0	21	13	0	13
ITC4 - Lombardia	235	15	250	120	8	128	73	5	77
ITD1 - Provincia Autonoma	0	13	13	0	7	7	0	4	4

NUTS2	Sample for PU+MU areas	Sample for PR areas	Sample Size	Sample for PU+MU areas	Sample for PR areas	Sample Size	Sample for PU+MU areas	Sample for PR areas	Sample Size
	Sampling Error = 2.5			Sampling Error = 3.5			Sampling Error = 4.5		
Bolzano/Bozen									
ITD2 - Provincia Autonoma Trento	13	0	13	7	0	7	4	0	4
ITD3 – Veneto	113	12	125	58	6	64	35	4	39
ITD4 - Friuli-Venezia Giulia	18	14	31	9	7	16	5	4	10
ITD5 - Emilia-Romagna	95	16	112	48	8	57	29	5	34
ITE1 - Toscana	73	22	95	37	11	48	23	7	29
ITE2 - Umbria	23	0	23	12	0	12	7	0	7
ITE3 – Marche	22	18	40	11	9	20	7	6	12
ITE4 – Lazio	120	25	145	61	13	74	37	8	45
ITF1 - Abruzzo	8	26	34	4	13	17	3	8	11
ITF2 - Molise	0	8	8	0	4	4	0	3	3
ITF3 - Campania	141	7	148	72	4	76	43	2	46
ITF4 - Puglia	87	17	104	44	9	53	27	5	32
ITF5 - Basilicata	0	15	15	0	8	8	0	5	5
ITF6 - Calabria	14	37	51	7	19	26	4	11	16
ITG1 - Sicilia	124	4	128	63	2	66	38	1	40
ITG2 - Sardegna	14	28	43	7	14	22	4	9	13
			1537			784			474
LT00 - Lietuva	874	663	1537	446	338	784	270	204	474
			1537			784			474
LU00 - Luxembourg	1537	0	1537	784	0	784	474	0	474
			1537			784			474
LV00 - Latvija	954	583	1537	487	297	784	294	180	474
			1537			784			474
MT00 - Malta	1537	0	1537	784	0	784	474	0	474
			1537			784			474
NL11 - Groningen	53	0	53	27	0	27	16	0	16
NL12 – Friesland	60	0	60	31	0	31	18	0	18
NL13 – Drenthe	46	0	46	23	0	23	14	0	14
NL21 - Overijssel	105	0	105	53	0	53	32	0	32
NL22 - Gelderland	185	0	185	95	0	95	57	0	57
NL23 – Flevoland	36	0	36	18	0	18	11	0	11
NL31 – Utrecht	113	0	113	58	0	58	35	0	35
NL32 - Noord-Holland	248	0	248	126	0	126	76	0	76
NL33 - Zuid-Holland	325	0	325	166	0	166	100	0	100
NL34 – Zeeland	25	10	35	13	5	18	8	3	11
NL41 - Noord-Brabant	227	0	227	116	0	116	70	0	70
NL42 - Limburg	104	0	104	53	0	53	32	0	32
			1537			784			474
PL11 - Lódzkie	45	57	102	23	29	52	14	18	32
PL12 - Mazowieckie	155	55	210	79	28	107	48	17	65
PL21 - Malopolskie	83	50	133	42	25	68	26	15	41

NUTS2	Sample for PU+MU areas	Sample for PR areas	Sample Size	Sample for PU+MU areas	Sample for PR areas	Sample Size	Sample for PU+MU areas	Sample for PR areas	Sample Size
	Sampling Error = 2.5			Sampling Error = 3.5			Sampling Error = 4.5		
PL22 - Slaskie	187	0	187	95	0	95	58	0	58
PL31 - Lubelskie	29	58	87	15	30	44	9	18	27
PL32 - Podkarpackie	25	60	85	13	31	43	8	19	26
PL33 - Swietokrzyskie	31	20	51	16	10	26	10	6	16
PL34 - Podlaskie	20	28	48	10	14	24	6	9	15
PL41 - Wielkopolskie	46	92	137	23	47	70	14	28	42
PL42 - Zachodniopomorskie	53	15	68	27	8	35	16	5	21
PL43 - Lubuskie	41	0	41	21	0	21	13	0	13
PL51 - Dolnoslaskie	116	0	116	59	0	59	36	0	36
PL52 - Opolskie	0	42	42	0	21	21	0	13	13
PL61 - Kujawsko-Pomorskie	31	53	83	16	27	43	9	16	26
PL62 - Warminsko-Mazurskie	25	33	57	13	17	29	8	10	18
PL63 - Pomorskie	70	20	90	36	10	46	22	6	28
			1537			784			474
PT11 - Norte	444	97	541	227	49	276	137	30	167
PT15 - Algarve	0	63	63	0	32	32	0	19	19
PT16 - Centro (PT)	58	286	344	30	146	175	18	88	106
PT17 - Lisboa	409	0	409	209	0	209	126	0	126
PT18 - Alentejo	0	109	109	0	56	56	0	34	34
PT20 - Região Autónoma dos Açores	35	0	35	18	0	18	11	0	11
PT30 - Região Autónoma da Madeira	36	0	36	18	0	18	11	0	11
			1537			784			474
RO11 - Nord-Vest	92	103	195	47	52	99	28	32	60
RO12 - Centru	73	108	181	37	55	92	23	33	56
RO21 - Nord-Est	151	115	266	77	59	136	46	36	82
RO22 - Sud-Est	121	80	201	62	41	103	37	25	62
RO31 - Sud - Muntenia	104	130	234	53	66	119	32	40	72
RO32 - Bucuresti - Ilfov	162	0	162	83	0	83	50	0	50
RO41 - Sud-Vest Oltenia	50	110	161	26	56	82	16	34	50
RO42 - Vest	82	56	137	42	28	70	25	17	42
			1537			784			474
SE11 - Stockholm	332	0	332	169	0	169	102	0	102
SE12 - Östra Mellansverige	256	0	256	131	0	131	79	0	79
SE21 - Småland med öarna	55	78	133	28	40	68	17	24	41
SE22 - Sydsverige	203	25	228	103	13	116	62	8	70
SE23 - Västsverige	307	0	307	157	0	157	95	0	95
SE31 - Norra Mellansverige	0	136	136	0	69	69	0	42	42
SE32 - Mellersta Norrland	0	61	61	0	31	31	0	19	19
SE33 - Övre Norrland	41	43	84	21	22	43	13	13	26
			1537			784			474
SI01 - Vzhodna Slovenija	243	572	815	124	292	416	75	176	251

NUTS2	Sample for PU+MU areas	Sample for PR areas	Sample Size	Sample for PU+MU areas	Sample for PR areas	Sample Size	Sample for PU+MU areas	Sample for PR areas	Sample Size
	Sampling Error = 2.5			Sampling Error = 3.5			Sampling Error = 4.5		
SI02 - Zahodna Slovenija	633	89	722	323	46	368	195	28	223
			1537			784			474
SK01 - Bratislavský kraj	176	0	176	90	0	90	54	0	54
SK02 - Západné Slovensko	170	359	529	87	183	270	52	111	163
SK03 - Stredné Slovensko	198	185	383	101	94	195	61	57	118
SK04 - Východné Slovensko	220	229	449	112	117	229	68	71	138
			1537			784			474
UKC1 - Tees Valley and Durham	29	0	29	15	0	15	9	0	9
UKC2 - Northumberland and Tyne and Wear	35	0	35	18	0	18	11	0	11
UKD1 - Cumbria	12	0	12	6	0	6	4	0	4
UKD2 – Cheshire	25	0	25	13	0	13	8	0	8
UKD3 - Greater Manchester	65	0	65	33	0	33	20	0	20
UKD4 - Lancashire	36	0	36	18	0	18	11	0	11
UKD5 – Merseyside	34	0	34	17	0	17	10	0	10
UKE1 - East Yorkshire and Northern Lincolnshire	23	0	23	12	0	12	7	0	7
UKE2 - North Yorkshire	20	0	20	10	0	10	6	0	6
UKE3 - South Yorkshire	33	0	33	17	0	17	10	0	10
UKE4 - West Yorkshire	55	0	55	28	0	28	17	0	17
UKF1 - Derbyshire and Nottinghamshire	52	0	52	26	0	26	16	0	16
UKF2 - Leicestershire, Rutland and Northamptonshire	42	0	42	21	0	21	13	0	13
UKF3 – Lincolnshire	17	0	17	9	0	9	5	0	5
UKG1 - Herefordshire, Worcestershire and Warwickshire	27	4	32	14	2	16	8	1	10
UKG2 - Shropshire and Staffordshire	38	0	38	19	0	19	12	0	12
UKG3 - West Midlands	66	0	66	33	0	33	20	0	20
UKH1 - East Anglia	58	0	58	30	0	30	18	0	18
UKH2 - Bedfordshire and Hertfordshire	42	0	42	22	0	22	13	0	13
UKH3 – Essex	43	0	43	22	0	22	13	0	13
UKI1 - Inner London	76	0	76	39	0	39	23	0	23
UKI2 - Outer London	117	0	117	60	0	60	36	0	36
UKJ1 - Berkshire, Buckinghamshire and Oxfordshire	55	0	55	28	0	28	17	0	17
UKJ2 - Surrey, East and West Sussex	67	0	67	34	0	34	21	0	21
UKJ3 - Hampshire and Isle of Wight	47	0	47	24	0	24	14	0	14
UKJ4 – Kent	42	0	42	21	0	21	13	0	13

NUTS2	Sample for PU+MU areas	Sample for PR areas	Sample Size	Sample for PU+MU areas	Sample for PR areas	Sample Size	Sample for PU+MU areas	Sample for PR areas	Sample Size
	Sampling Error = 2.5			Sampling Error = 3.5			Sampling Error = 4.5		
UKK1 - Gloucestershire, Wiltshire and Bristol/Bath area	58	0	58	30	0	30	18	0	18
UKK2 - Dorset and Somerset	31	0	31	16	0	16	9	0	9
UKK3 - Cornwall and Isles of Scilly	13	0	13	7	0	7	4	0	4
UKK4 – Devon	28	0	28	14	0	14	9	0	9
UKL1 - West Wales and The Valleys	33	14	47	17	7	24	10	4	14
UKL2 - East Wales	24	3	27	12	2	14	7	1	8
UKM2 - Eastern Scotland	47	3	50	24	1	25	14	1	15
UKM3 - South Western Scotland	53	4	57	27	2	29	16	1	18
UKM5 - North Eastern Scotland	11	0	11	6	0	6	4	0	4
UKM6 - Highlands and Islands	5	6	11	2	3	6	1	2	3
UKN0 - Northern Ireland (UK)	34	10	44	17	5	23	11	3	14
			1537			784			474

Table 4 - Resident population per NUTS2 according OECD typology of rural areas

	Population urban		Population intermediate		Population rural		Total population
NUTS2	Total	%	Total	%	Total	%	
AT11 – Burgenland	0	0	0	0	283965	100	283965
AT12 – Niederösterreich	621448	39	252687	16	733841	46	1607976
AT13 – Wien	1698822	100	0	0	0	0	1698822
AT21 – Kärnten	0	0	276288	49	283027	51	559315
AT22 – Steiermark	0	0	566186	47	642186	53	1208372
AT31 – Oberösterreich	0	0	778651	55	632587	45	1411238
AT32 – Salzburg	0	0	346080	65	183781	35	529861
AT33 – Tirol	284141	40	0	0	422732	60	706873
AT34 – Vorarlberg	280391	76	0	0	88477	24	368868
BE10 - Région de Bruxelles-Capitale / Brussels Hoofdstedelijk Gewest	1089538	100	0	0	0	0	1089538
BE21 - Prov. Antwerpen	1309643	75	435219	25	0	0	1744862
BE22 - Prov. Limburg	408370	49	430135	51	0	0	838505
BE23 - Prov. Oost-Vlaanderen	1230410	86	201916	14	0	0	1432326
BE24 - Prov. Vlaams-Brabant	1076924	100	0	0	0	0	1076924
BE25 - Prov. West-Vlaanderen	853290	74	150573	13	155503	13	1159366
BE31 - Prov. Brabant Wallon	0	0	379515	100	0	0	379515
BE32 - Prov. Hainaut	749391	57	476737	36	83752	6	1309880
BE33 - Prov. Liège	604062	57	204981	19	258642	24	1067685
BE34 - Prov. Luxembourg	0	0	0	0	269023	100	269023
BE35 - Prov. Namur	0	0	301472	64	170809	36	472281
BG31 – Severozapaden	0	0	0	0	902537	100	902537
BG32 - Severen tsentralen	0	0	379145	41	535794	59	914939
BG33 – Severoiztochen	0	0	665170	67	323765	33	988935
BG34 – Yugoiztochen	0	0	1116560	100	0	0	1116560
BG41 – Yugozapaden	1249798	59	281826	13	580895	27	2112519

NUTS2	Population urban Total	Population urban %	Population intermediate Total	Population intermediate %	Population rural Total	Population rural %	Total population
BG42-Yuzhentsentralen	0	0	958092	63	570128	37	1528220
CY00–Kypros	0	0	819140	100	0	0	819140
CZ01–Praha	1249026	100	0	0	0	0	1249026
CZ02-StredníCechy	1247533	100	0	0	0	0	1247533
CZ03–Jihozápad	0	0	0	0	1209506	100	1209506
CZ04–Severozápad	0	0	1143834	100	0	0	1143834
CZ05–Severovýchod	0	0	993429	66	516329	34	1509758
CZ06–Jihovýchod	0	0	1151708	69	514992	31	1666700
CZ07-StredníMorava	0	0	0	0	1233083	100	1233083
CZ08–Moravskoslezsko	0	0	1247373	100	0	0	1247373
DE11–Stuttgart	2419941	60	1258002	31	322905	8	4000848
DE12–Karlsruhe	2032623	74	281406	10	426474	16	2740503
DE13–Freiburg	0	0	1889327	86	306691	14	2196018
DE14–Tübingen	0	0	1210727	67	596825	33	1807552
DE21–Oberbayern	1650013	38	2037396	47	659056	15	4346465
DE22–Niederbayern	0	0	0	0	1189194	100	1189194
DE23–Oberpfalz	0	0	466705	43	614712	57	1081417
DE24–Oberfranken	0	0	673942	63	402458	37	1076400
DE25–Mittelfranken	1174047	69	0	0	536098	31	1710145
DE26–Unterfranken	0	0	830875	63	491082	37	1321957
DE27–Schwaben	0	0	1088622	61	696131	39	1784753
DE30–Berlin	3442675	100	0	0	0	0	3442675
DE41-Brandenburg–Nordost	0	0	816434	72	317935	28	1134369
DE42-Brandenburg–Südwest	0	0	1101723	80	275433	20	1377156
DE50–Bremen	547685	83	114031	17	0	0	661716
DE60–Hamburg	1774224	100	0	0	0	0	1774224
DE71–Darmstadt	3288417	87	407022	11	97502	3	3792941

	Population urban		Population intermediate		Population rural		Total population
NUTS2	Total	%	Total	%	Total	%	
DE72–Gießen	0	0	933280	89	110989	11	1044269
DE73–Kassel	0	0	432747	35	791994	65	1224741
DE80-Mecklenburg-Vorpommern	0	0	1005868	61	645348	39	1651216
DE91–Braunschweig	0	0	1397914	86	218806	14	1616720
DE92–Hannover	1130262	53	601461	28	410717	19	2142440
DE93–Lüneburg	112029	7	1133381	67	448244	26	1693654
DE94-Weser-Sem	74512	3	1647428	67	754061	30	2476001
DEA1–Düsseldorf	4864749	94	308090	6	0	0	5172839
DEA2–Köln	3922319	89	460725	11	0	0	4383044
DEA3–Münster	1009520	39	1588116	61	0	0	2597636
DEA4–Detmold	573331	28	1321411	65	148470	7	2043212
DEA5–Arnsberg	2961342	81	714690	19	0	0	3676032
DEB1–Koblenz	0	0	1040268	70	450443	30	1490711
DEB2–Trier	0	0	246068	48	267726	52	513794
DEB3-Rheinhessen-Pfalz	889903	44	843632	42	274635	14	2008170
DEC0–Saarland	826183	81	105241	10	91161	9	1022585
DED1–Chemnitz	495922	34	891235	61	84219	6	1471376
DED2–Dresden	663818	41	967668	59	0	0	1631486
DED3–Leipzig	779634	73	0	0	286236	27	1065870
DEE0-Sachsen-Anhalt	0	0	1695774	72	660445	28	2356219
DEF0-Schleswig-Holstein	302430	11	2095177	74	434420	15	2832027
DEG0–Thüringen	0	0	1197960	53	1051922	47	2249882
DK01-Hovedstaden	1191565	71	446451	27	42255	3	1680271
DK02–Sjælland	0	0	234574	29	585990	71	820564
DK03-Syddanmark	0	0	484862	40	715415	60	1200277
DK04–Midtjylland	0	0	826923	66	427075	34	1253998
DK05–Nordjylland	0	0	0	0	579628	100	579628

	Population urban		Population intermediate		Population rural		Total population
NUTS2	Total	%	Total	%	Total	%	
EE00–Eesti	0	0	695161	52	644966	48	1340127
EL11-AnatolikiMakedonia,Thraki	0	0	0	0	606721	100	606721
EL12-KentrikiMakedonia	1164245	60	0	0	790337	40	1954582
EL13-DytikiMakedonia	0	0	0	0	293061	100	293061
EL14–Thessalia	0	0	203989	28	532094	72	736083
EL21–Ipeiros	0	0	189195	53	169901	47	359096
EL22-IoniaNisia	0	0	0	0	234440	100	234440
EL23-DytikiEllada	0	0	349189	47	396208	53	745397
EL24-StereaEllada	0	0	0	0	554359	100	554359
EL25-Peloponnisos	0	0	0	0	591230	100	591230
EL30–Attiki	4109748	100	0	0	0	0	4109748
EL41-VoreioAigaio	0	0	0	0	199968	100	199968
EL42-NotioAigaio	0	0	0	0	308647	100	308647
EL43–Kriti	0	0	454639	74	157147	26	611786
ES11–Galicia	0	0	2069953	76	668649	24	2738602
ES12-PrincipadodeAsturias	0	0	1058114	100	0	0	1058114
ES13–Cantabria	0	0	577997	100	0	0	577997
ES21-PaísVasco	1828030	85	310558	15	0	0	2138588
ES22-ComunidadForaldeNavarra	0	0	619011	100	0	0	619011
ES23-LaRioja	0	0	314005	100	0	0	314005
ES24–Aragón	948063	72	0	0	364954	28	1313017
ES30-ComunidaddeMadrid	6335807	100	0	0	0	0	6335807
ES41-CastillayLeón	0	0	1885646	75	613509	25	2499155
ES42-Castilla-laMancha	0	0	0	0	2035516	100	2035516
ES43-Extremadura	0	0	0	0	1082792	100	1082792
ES51–Cataluña	5352034	73	1518866	21	430232	6	7301132
ES52-ComunidadValenciana	2512597	50	2481725	50	0	0	4994322

NUTS2	Population urban Total	Population urban %	Population intermediate Total	Population intermediate %	Population rural Total	Population rural %	Total population
ES53-IllesBalears	0	0	987877	92	91217	8	1079094
ES61–Andalucía	3444884	42	4106467	50	654706	8	8206057
ES62-RegióndeMurcia	0	0	1460664	100	0	0	1460664
ES63-CiudadAutónomadeCeuta	74403	100	0	0	0	0	74403
ES64-CiudadAutónomadeMelilla	72515	100	0	0	0	0	72515
ES70–Canarias	1736446	83	224715	11	127064	6	2088225
FI13-Itä-Suomi	0	0	0	0	652346	100	652346
FI18-Etelä-Suomi	1421463	53	1154648	43	96079	4	2672190
FI19-Länsi-Suomi	0	0	484436	36	870732	64	1355168
FI1A-Pohjois-Suomi	0	0	0	0	643989	100	643989
FI20–Åland	0	0	0	0	27734	100	27734
FR10-ÎledeFrance	10470990	89	1326031	11	0	0	11797021
FR21-Champagne-Ardenne	0	0	870196	65	466046	35	1336242
FR22–Picardie	0	0	804115	42	1110729	58	1914844
FR23-Haute-Normandie	0	0	1250264	68	587124	32	1837388
FR24-Centre	0	0	1247232	49	1297559	51	2544791
FR25-Basse-Normandie	0	0	683536	46	790410	54	1473946
FR26–Bourgogne	0	0	525607	32	1119149	68	1644756
FR30-Nord-Pas-de-Calais	2572374	64	1462895	36	0	0	4035269
FR41-Lorraine	0	0	1778425	76	573899	24	2352324
FR42–Alsace	0	0	1851443	100	0	0	1851443
FR43-Franche-Comté	0	0	670564	57	501985	43	1172549
FR51-PaysdelaLoire	1277320	36	784225	22	1505141	42	3566686
FR52-Bretagne	0	0	1884127	59	1313848	41	3197975
FR53-Poitou-Charentes	0	0	0	0	1770149	100	1770149
FR61-Aquitaine	1447817	45	654517	20	1129526	35	3231860
FR62-Midi-Pyrénées	1246480	43	0	0	1642756	57	2889236

NUTS2	Population urban Total	Population urban %	Population intermediate Total	Population intermediate %	Population rural Total	Population rural %	Total population
FR63-Limousin	0	0	0	0	744187	100	744187
FR71-Rhône-Alpes	1721999	28	3175166	51	1324880	21	6222045
FR72-Auvergne	0	0	631077	47	714635	53	1345712
FR81-Languedoc-Roussillon	0	0	1492938	57	1143383	43	2636321
FR82-Provence-Alpes-Côted'Azur	3061011	62	1557779	32	298140	6	4916930
FR83–Corse	0	0	0	0	309339	100	309339
FR91–Guadeloupe	0	0	448681	100	0	0	448681
FR92–Martinique	396308	100	0	0	0	0	396308
FR93–Guyane	0	0	0	0	230441	100	230441
FR94–Réunion	828054	100	0	0	0	0	828054
HU10-Közép-Magyarország	1721556	58	1229880	42	0	0	2951436
HU21-Közép-Dunántúl	0	0	312431	28	786223	72	1098654
HU22-Nyugat-Dunántúl	0	0	0	0	996390	100	996390
HU23-Dél-Dunántúl	0	0	393758	42	554228	58	947986
HU31-Észak-Magyarország	0	0	692771	57	516371	43	1209142
HU32-Észak-Alföld	0	0	541298	36	951204	64	1492502
HU33-Dél-Alföld	0	0	423240	32	894974	68	1318214
IE01-Border,MidlandandWestern	0	0	0	0	1204423	100	1204423
IE02-SouthernandEastern	1207971	37	0	0	2055460	63	3263431
ITC1–Piemonte	2297598	52	718683	16	1429949	32	4446230
ITC2-Valled'Aosta/Valléed'Aoste	0	0	127866	100	0	0	127866
ITC3–Liguria	1106786	68	509200	32	0	0	1615986
ITC4-Lombardia	6855787	70	2375039	24	595315	6	9826141
ITD1-ProvinciaAutonomaBolzano/Bozen	0	0	0	0	503434	100	503434
ITD2-ProvinciaAutonomaTrento	0	0	524826	100	0	0	524826
ITD3-Veneto	0	0	4451265	91	461173	9	4912438
ITD4-Friuli-VeneziaGiulia	379173	31	313870	25	541036	44	1234079

	Population urban		Population intermediate		Population rural		Total population
NUTS2	Total	%	Total	%	Total	%	
ITD5-Emilia-Romagna	307085	7	3423375	78	646975	15	4377435
ITE1–Toscana	932464	25	1951111	52	846555	23	3730130
ITE2–Umbria	0	0	900790	100	0	0	900790
ITE3–Marche	0	0	869385	55	708291	45	1577676
ITE4–Lazio	4154684	73	551217	10	975967	17	5681868
ITF1-Abruzzo	0	0	321192	24	1017706	76	1338898
ITF2-Molise	0	0	0	0	320229	100	320229
ITF3-Campania	3079685	53	2456694	42	288283	5	5824662
ITF4-Puglia	0	0	3401270	83	682765	17	4084035
ITF5-Basilicata	0	0	0	0	588879	100	588879
ITF6-Calabria	0	0	565756	28	1443574	72	2009330
ITG1-Sicilia	2333776	46	2536207	50	173009	3	5042992
ITG2-Sardegna	0	0	561080	34	1111324	66	1672404
LT00-Lietuva	850324	26	1042858	31	1435857	43	3329039
LU00-Luxembourg	0	0	502066	100	0	0	502066
LV00-Latvija	1095706	49	299506	13	853162	38	2248374
MT00-Malta	414372	100	0	0	0	0	414372
NL11-Groningen	0	0	576668	100	0	0	576668
NL12–Friesland	0	0	646305	100	0	0	646305
NL13–Drenthe	0	0	490981	100	0	0	490981
NL21-Overijssel	623432	55	506913	45	0	0	1130345
NL22-Gelderland	1362273	68	636663	32	0	0	1998936
NL23–Flevoland	387881	100	0	0	0	0	387881
NL31–Utrecht	1220910	100	0	0	0	0	1220910
NL32-Noord-Holland	2298905	86	370179	14	0	0	2669084
NL33-Zuid-Holland	3505611	100	0	0	0	0	3505611
NL34–Zeeland	0	0	274582	72	106827	28	381409

	Population urban		Population intermediate		Population rural		Total population
NUTS2	Total	%	Total	%	Total	%	
NL41-Noord-Brabant	1807183	74	636975	26	0	0	2444158
NL42-Limburg	607784	54	514917	46	0	0	1122701
PL11-Lódzkie	1120750	44	0	0	1421082	56	2541832
PL12-Mazowieckie	1714446	33	2136541	41	1371180	26	5222167
PL21-Malopolskie	1434433	43	633799	19	1230038	37	3298270
PL22–Slaskie	3456153	74	1184572	26	0	0	4640725
PL31-Lubelskie	0	0	713229	33	1443973	67	2157202
PL32-Podkarpackie	0	0	611223	29	1490509	71	2101732
PL33-Swietokrzyskie	0	0	775833	61	494287	39	1270120
PL34-Podlaskie	0	0	504845	42	684886	58	1189731
PL41-Wielkopolskie	1132496	33	0	0	2275785	67	3408281
PL42-Zachodniopomorskie	0	0	1318491	78	374707	22	1693198
PL43-Lubuskie	0	0	1010047	100	0	0	1010047
PL51-Dolnoslaskie	1177157	41	1699470	59	0	0	2876627
PL52-Opolskie	0	0	0	0	1031097	100	1031097
PL61-Kujawsko-Pomorskie	761565	37	0	0	1307518	63	2069083
PL62-Warminsko-Mazurskie	0	0	613565	43	813553	57	1427118
PL63-Pomorskie	0	0	1737778	78	492321	22	2230099
PT11–Norte	2099556	56	974775	26	671244	18	3745575
PT15–Algarve	0	0	0	0	434023	100	434023
PT16–Centro	0	0	401114	17	1979954	83	2381068
PT17–Lisboa	2830867	100	0	0	0	0	2830867
PT18-Alentejo	0	0	0	0	753407	100	753407
PT20-RegiãoAutónomadosAçores	0	0	245374	100	0	0	245374
PT30-RegiãoAutónomadaMadeira	247399	100	0	0	0	0	247399
RO11-Nord-Vest	0	0	1285296	47	1434423	53	2719719
RO12–Centru	0	0	1023004	41	1501414	59	2524418

	Population urban		Population intermediate		Population rural		Total population
NUTS2	Total	%	Total	%	Total	%	
RO21-Nord-Est	0	0	2104432	57	1607964	43	3712396
RO22-Sud-Est	0	0	1692213	60	1119005	40	2811218
RO31-Sud–Muntenia	0	0	1455173	45	1812097	55	3267270
RO32-Bucuresti–Ilfov	2261698	100	0	0	0	0	2261698
RO41-Sud-VestOltenia	0	0	704436	31	1541597	69	2246033
RO42–Vest	0	0	1141897	59	777537	41	1919434
SE11–Stockholm	2019182	100	0	0	0	0	2019182
SE12-ÖstraMellansverige	0	0	1558292	100	0	0	1558292
SE21-Smålandmedöarna	0	0	336044	41	474022	59	810066
SE22–Sydsverige	0	0	1231062	89	152591	11	1383653
SE23–Västsverige	0	0	1866283	100	0	0	1866283
SE31-NorraMellansverige	0	0	0	0	825931	100	825931
SE32-MellerstaNorrland	0	0	0	0	369708	100	369708
SE33-ÖvreNorrland	0	0	249019	49	258548	51	507567
SI01-VzhodnaSlovenija	0	0	323343	30	761592	70	1084935
SI02-ZahodnaSlovenija	529646	55	313315	33	119080	12	962041
SK01-Bratislavskýkraj	622706	100	0	0	0	0	622706
SK02-ZápadnéSlovensko	0	0	599214	32	1267186	68	1866400
SK03-StrednéSlovensko	0	0	697502	52	653186	48	1350688
SK04-VýchodnéSlovensko	0	0	778120	49	807011	51	1585131
UKC1-TeesValleyandDurham	1170983	100	0	0	0	0	1170983
UKC2-NorthumberlandandTyneandWear	1112927	78	311534	22	0	0	1424461
UKD1–Cumbria	0	0	494696	100	0	0	494696
UKD2–Cheshire	1007486	100	0	0	0	0	1007486
UKD3-GreaterManchester	2615144	100	0	0	0	0	2615144
UKD4–Lancashire	1447494	100	0	0	0	0	1447494
UKD5–Merseyside	1352000	100	0	0	0	0	1352000

	Population urban		Population intermediate		Population rural		Total population
NUTS2	Total	%	Total	%	Total	%	
UKE1-EastYorkshireandNorthernLincolnshire	0	0	919439	100	0	0	919439
UKE2-NorthYorkshire	0	0	799304	100	0	0	799304
UKE3-SouthYorkshire	1322812	100	0	0	0	0	1322812
UKE4-WestYorkshire	2238127	100	0	0	0	0	2238127
UKF1-DerbyshireandNottinghamshire	2089453	100	0	0	0	0	2089453
UKF2-Leicestershire,RutlandandNorthamptonshire	990860	59	685555	41	0	0	1676415
UKF3–Lincolnshire	0	0	700466	100	0	0	700466
UKG1-Herefordshire,WorcestershireandWarwickshire	0	0	1092515	86	179210	14	1271725
UKG2-ShropshireandStaffordshire	1069479	70	455036	30	0	0	1524515
UKG3-WestMidlands	2646889	100	0	0	0	0	2646889
UKH1-EastAnglia	0	0	2358545	100	0	0	2358545
UKH2-BedfordshireandHertfordshire	1298044	76	413462	24	0	0	1711506
UKH3–Essex	1729185	100	0	0	0	0	1729185
UKI1-InnerLondon	3072181	100	0	0	0	0	3072181
UKI2-OuterLondon	4717184	100	0	0	0	0	4717184
UKJ1-Berkshire,BuckinghamshireandOxfordshire	1595048	71	644500	29	0	0	2239548
UKJ2-Surrey,EastandWestSussex	2174091	81	513805	19	0	0	2687896
UKJ3-HampshireandIsleofWight	1736606	93	140360	7	0	0	1876966
UKJ4–Kent	1674986	100	0	0	0	0	1674986
UKK1-Gloucestershire,WiltshireandBristol/Batharea	1090080	47	1249588	53	0	0	2339668
UKK2-DorsetandSomerset	712622	58	524328	42	0	0	1236950
UKK3-CornwallandIslesofScilly	0	0	535364	100	0	0	535364
UKK4–Devon	0	0	1140501	100	0	0	1140501
UKL1-WestWalesandTheValleys	1125783	59	207840	11	562233	30	1895856
UKL2-EastWales	692294	63	283199	26	131524	12	1107017

NUTS2	Population urban		Population intermediate		Population rural		Total population
	Total	%	Total	%	Total	%	
UKM2-EasternScotland	1060588	53	829116	41	112779	6	2002483
UKM3-SouthWesternScotland	1789003	78	360437	16	148353	6	2297793
UKM5-NorthEasternScotland	0	0	460117	100	0	0	460117
UKM6-HighlandsandIslands	0	0	185676	41	262052	59	447728
UKN0-NorthernIreland(UK)	656095	37	726377	40	411890	23	1794362
	117670053	23	206248963	41	177201424	35	501120440

Source:Eurostat.Datarefertoyear2010
Definitions:
Rural areas: the share of the population living in rural areas is higher than 50%
Intermediate areas: share of the population living in rural areas is between 20% and 50%
Urban areas: if the share of the population living in rural areas is below 20%

Table 5 - Distribution of population by age groups and sex

	Total					From 20-29					
	Total	Males	%	Females	%	Total	%	Males	%	Females	%
Belgium	10839905	5312221	49	5527684	51	1352427	12	676803	6	675624	6
Bulgaria	7563710	3659311	48	3904399	52	1053558	14	540484	7	513074	7
Czech Republic	10506813	5157197	49	5349616	51	1459661	14	754486	7	705175	7
Denmark	5534738	2743286	50	2791452	50	637505	12	322375	6	315130	6
Germany	81802257	40103606	49	41698651	51	9912877	12	5039521	6	4873356	6
Estonia	1340127	617323	46	722804	54	208691	16	106064	8	102627	8
Ireland	4467854	2216444	50	2251410	50	680506	15	331847	7	348659	8
Greece	11305118	5597465	50	5707653	50	1406027	12	732397	6	673630	6
Spain	45989016	22672420	49	23316596	51	5999889	13	3061819	7	2938070	6
France	64694497	31317418	48	33377079	52	8094663	13	4038479	6	4056184	6
Italy	60340328	29287403	49	31052925	51	6622926	11	3357960	6	3264966	5
Cyprus	819140	399605	49	419535	51	137779	17	68682	8	69097	8
Latvia	2248374	1037451	46	1210923	54	355118	16	181176	8	173942	8

	Total					From 20-29					
	Total	Males	%	Females	%	Total	%	Males	%	Females	%
Lithuania	3329039	1547751	46	1781288	54	510333	15	260571	8	249762	8
Luxembourg	502066	249406	50	252660	50	64451	13	32590	6	31861	6
Hungary	10014324	4756900	48	5257424	52	1349591	13	688876	7	660715	7
Malta	414372	206315	50	208057	50	61673	15	32280	8	29393	7
Netherlands	16574989	8203476	49	8371513	51	2012265	12	1014928	6	997337	6
Austria	8375290	4079093	49	4296197	51	1078074	13	542607	6	535467	6
Poland	38167329	18428742	48	19738587	52	6234876	16	3168164	8	3066712	8
Portugal	10637713	5148203	48	5489510	52	1357494	13	690157	6	667337	6
Romania	21462186	10451093	49	11011093	51	3349762	16	1711079	8	1638683	8
Slovenia	2046976	1014107	50	1032869	50	281758	14	148064	7	133694	7
Slovakia	5424925	2636938	49	2787987	51	872826	16	445815	8	427011	8
Finland	5351427	2625067	49	2726360	51	669106	13	343010	6	326096	6
Sweden	9340682	4649014	50	4691668	50	1177212	13	602785	6	574427	6
United Kingdom	62026962	30508632	49	31518330	51	8486637	14	4336354	7	4150283	7
European Union (27 countries)	501120157	244625887	49	256494270	51	65427685	13	33229373	7	32198312	6

Continuation of table 5

	From 30 to 44						From 45 to 54					
	Total	%	Males	%	Females	%	Total	%	Males	%	Females	%
Belgium	2235536	21	1130033	10	1105503	10	1587594	15	797995	7	789599	7
Bulgaria	1650517	22	838258	11	812259	11	1050415	14	516484	7	533931	7
Czech Republic	2474329	24	1271685	12	1202644	11	1380689	13	695475	7	685214	7
Denmark	1155335	21	582193	11	573142	10	764132	14	385894	7	378238	7
Germany	16839909	21	8566315	10	8273594	10	13076517	16	6629551	8	6446966	8
Estonia	272832	20	134711	10	138121	10	186345	14	86660	6	99685	7
Ireland	1039863	23	520550	12	519313	12	563229	13	282070	6	281159	6
Greece	2623074	23	1345869	12	1277205	11	1577072	14	782093	7	794979	7
Spain	11687860	25	6000511	13	5687349	12	6436717	14	3203948	7	3232769	7

	From 30 to 44						From 45 to 54					
	Total	%	Males	%	Females	%	Total	%	Males	%	Females	%
France	12946900	20	6410149	10	6536751	10	8807210	14	4308404	7	4498806	7
Italy	13973197	23	7020820	12	6952377	12	8697812	14	4295904	7	4401908	7
Cyprus	174484	21	81157	10	93327	11	109939	13	53762	7	56177	7
Latvia	467200	21	233332	10	233868	10	327111	15	154246	7	172865	8
Lithuania	693661	21	342379	10	351282	11	495369	15	232491	7	262878	8
Luxembourg	119056	24	59915	12	59141	12	75173	15	38440	8	36733	7
Hungary	2280258	23	1157553	12	1122705	11	1313467	13	633461	6	680006	7
Malta	82074	20	42050	10	40024	10	58785	14	29705	7	29080	7
Netherlands	3477287	21	1747871	11	1729416	10	2465924	15	1241165	7	1224759	7
Austria	1839645	22	922296	11	917349	11	1291442	15	647701	8	643741	8
Poland	8006077	21	4043292	11	3962785	10	5523894	14	2713150	7	2810744	7
Portugal	2442202	23	1221817	11	1220385	11	1486967	14	725473	7	761494	7
Romania	5117973	24	2603622	12	2514351	12	2742883	13	1341688	6	1401195	7
Slovenia	461492	23	240378	12	221114	11	311297	15	159243	8	152054	7
Slovakia	1248032	23	633424	12	614608	11	778058	14	385040	7	393018	7
Finland	1007492	19	514636	10	492856	9	756378	14	380421	7	375957	7
Sweden	1877627	20	956314	10	921313	10	1206282	13	611522	7	594760	6
United Kingdom	12786468	21	6367563	10	6418905	10	8448436	14	4165837	7	4282599	7
European Union (27 countries)	108980380	22	54988693	11	53991687	11	71519137	14	35497823	7	36021314	7

Continuation of table 5

	From 55 to 64						> than 65 years					
	Total	%	Males	%	Females	%	Total	%	Males	%	Females	%
Belgium	1321323	12	654541	6	666782	6	2267738	21	956965	9	1310773	12
Bulgaria	1040701	14	484139	6	556562	7	1628081	22	659217	9	968864	13
Czech Republic	1482890	14	712017	7	770873	7	1919705	18	764989	7	1154716	11
Denmark	722661	13	360077	7	362584	7	1062499	19	470425	8	592074	11

	From 55 to 64						> than 65 years					
	Total	%	Males	%	Females	%	Total	%	Males	%	Females	%
Germany	9731506	12	4799956	6	4931550	6	20002358	24	8527292	10	11475066	14
Estonia	159151	12	68496	5	90655	7	276563	21	90427	7	186136	14
Ireland	450043	10	225957	5	224086	5	602245	13	270895	6	331350	7
Greece	1361480	12	661083	6	700397	6	2654409	23	1165667	10	1488742	13
Spain	5006525	11	2428102	5	2578423	6	9452445	21	4023753	9	5428692	12
France	8091955	13	3930279	6	4161676	6	13048750	20	5401118	8	7647632	12
Italy	7394625	12	3586592	6	3808033	6	14736720	24	6212038	10	8524682	14
Cyprus	89771	11	44276	5	45495	6	122565	15	55492	7	67073	8
Latvia	255839	11	110387	5	145452	6	468611	21	151488	7	317123	14
Lithuania	354901	11	152776	5	202125	6	649623	20	217950	7	431673	13
Luxembourg	54425	11	27639	6	26786	5	84988	17	36147	7	48841	10
Hungary	1326876	13	602306	6	724570	7	2003721	20	728243	7	1275478	13
Malta	58480	14	28828	7	29652	7	73695	18	31149	8	42546	10
Netherlands	2152851	13	1081233	7	1071618	6	3034155	18	1324116	8	1710039	10
Austria	944094	11	459399	5	484695	6	1746121	21	725130	9	1020991	12
Poland	4929172	13	2299537	6	2629635	7	6316137	17	2370097	6	3946040	10
Portugal	1266578	12	599498	6	667080	6	2316477	22	965402	9	1351075	13
Romania	2529334	12	1180886	6	1348448	6	3915978	18	1577721	7	2338257	11
Slovenia	261154	13	130931	6	130223	6	410960	20	160695	8	250265	12
Slovakia	661369	12	309757	6	351612	6	801538	15	296717	5	504821	9
Finland	785051	15	387259	7	397792	7	1090112	20	449531	8	640581	12
Sweden	1200809	13	601136	6	599673	6	1994838	21	889026	10	1105812	12
United Kingdom	7328564	12	3591998	6	3736566	6	12200658	20	5365248	9	6835410	11
European Union (27 countries)	60962128	12	29519085	6	31443043	6	104881690	21	43886938	9	60994752	12

Source: Eurostat. Data refer to year 2010

Table 6 - Distribution of population (with ages beteween 18 and 74 years) according to education attainment level

	All ISCED 1997 levels	Pre-primary, primary and lower secondary education (levels 0-2)		Upper secondary and post-secondary non-tertiary education (levels 3 and 4)		First and second stage of tertiary education (levels 5 and 6)	
	Total	Total	%	Total	%	Total	%
Austria	6102	1279	21	3799	62	1024	17
Belgium	7722	2523	33	2829	37	2370	31
Bulgaria	5605	1454	26	3040	54	1111	20
Cyprus	562	164	29	217	39	181	32
Czech Republic	7996	918	11	5898	74	1179	15
Denmark	3931	1126	29	1624	41	1072	27
Estonia	984	155	16	526	53	303	31
Finland	3819	867	23	1717	45	1235	32
France	42735	13506	32	18125	42	11102	26
Germany	60769	11387	19	35215	58	14057	23
Greece	7957	3271	41	3076	39	1610	20
Hungary	7359	1850	25	4231	58	1277	17
Ireland	3122	911	29	1123	36	997	32
Italy	43930	21358	49	17073	39	5499	13
Latvia	1690	292	17	1011	60	385	23
Lithuania	2461	394	16	1402	57	665	27
Luxembourg	361	92	26	149	41	105	29
Malta	311	219	70	53	17	40	13
Netherlands	11820	3635	31	4806	41	3302	28
Poland	27938	4546	16	17827	64	5566	20
Portugal	7794	5372	69	1387	18	1035	13
Romania	16090	5066	31	9147	57	1878	12
Slovakia	4088	554	14	2906	71	628	15
Slovenia	1550	306	20	928	60	316	20
Spain	33765	17166	51	7506	22	9094	27
Sweden	6651	1570	24	3140	47	1918	29
United Kingdom	43571	10136	23	17734	41	13062	30
European Union (27 countries)	360681	110117	31	166487	46	81008	22

Source: Eurostat. Data refer to year 2010

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Abstract

The present report develops and test an up-scaled non-market valuation framework to value changes in the provision level of the Public Goods and Externalities (PGaE) of EU agriculture from the demand-side (i.e. using valuation surveys). The selected PGaE included in the study are the following: cultural landscape, farmland biodiversity, water quality and availability, air quality, soil quality, climate stability, resilience to fire and resilience to flooding. The following achievements have been accomplished along the project development: 1) comprehensive description of the study selected PGaE, 2) quantification of the selected agricultural PGaE using agri-environmental indicators, 3) standardised description of PGaE disentangling the macro-regional agro-ecological infra-structures from its ecological and cultural services, 4) delimitation of wide areas with homogeneous agro-ecological infra-structures across EU (macro-regions), 5) delimitation of the macro-regions, independently from their supply of PGaE, 6) definition of "Macro-Regional Agri-Environmental Problems" (MRAEP), through the association of the macro-regions with the core PGaE supplied by them, delivering non-market demand-side valuation problems relevant to the agricultural and agri-environmental policy decision-makers, 7) design of a Choice Modelling (CM) survey able to gather multi-country value estimates of changes in the provision level of different PGaE supplied by different macro-regions, 8) successful testing of the valuation framework through a pilot survey and 9) delivering of alternative sampling plans for the EU level large-scale survey allowing for different options regarding the number of surveyed countries, the size and composition of respective samples, and the survey administration-mode, balanced with estimates for the corresponding budgetary cost.

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