Agricultural landscapes as multi-scale public good and the role of the Common Agricultural Policy

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Summary

Since 50 years, the Common Agricultural Policy (CAP) has impacted the evolution of agricultural landscapes by driving changes in land use and farming practices in Europe. Based on a critical literature review, this paper discusses to what extent the CAP is contributing to the management of EU agricultural landscapes. Agricultural landscapes are described as a multi-scale public good. Optimal management of agricultural landscapes requires actions on three scales: (1) the management of landscape elements at farm level, (2) the integration of farms in the agricultural landscape at landscape level, and finally (3) the conservation of the diversity of agricultural landscapes in EU as a global public good. The CAP has until now mainly focused on the first scale. We show how policy instruments could be refined for the CAP to integrate the two other scales. This paper provides a knowledge base to support an effective CAP policy design in the direction of improved landscape management, an important component of the EU project towards a more sustainable agriculture.

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I. INTRODUCTION

Agriculture is both a large-scale user of land and a provider of landscapes. Soil conditions, topography, as well as structure and composition of the landscape affect the agricultural production technology and land use. In contrast, agriculture itself affects landscapes' physical characteristics to meet its production requirements. Hence, European landscapes are shaped by agriculture, a millennia-old activity in Europe. Despite the low share of agricultural production in total economic production, agriculture remains the main land use in Europe. In 2010, the total utilised agricultural area (UAA) covered 160 million hectares in the EU-27, representing 42% of the whole EU territorial area (FSS 2010). The adaptation of agricultural practices to local conditions has led to a wide variety of agricultural landscapes in Europe, ranging from almost entirely man-made and intensively managed polders in the Netherlands to semi-natural extensive grazing areas in the high Alps (Cooper, Hart et al. 2009).

Of all the environmental public goods provided by farming, landscape is probably the most difficult to describe due to its multidimensional character and the overlap with other public goods. Moran (2005) defines landscape as "an assemblage of physical attributes that is viewed by people". These attributes include landform (mountain/plain), geology, vegetation (crops/forest/pasture), water, colour, adjacent scenery etc. But it is difficult to distinguish "what a landscape is from what a landscape does" (Moran 2005). Agricultural landscapes offer various aesthetical, recreational and cultural benefits, and are the ecological infrastructure necessary for the existence and/or provision of other public goods (such as food provision, carbon sequestration and storage, waste-water treatment, erosion prevention, pollination, biological control, habitat for biodiversity, tourism, aesthetic appreciation and inspiration for culture, art and design) (Millennium Ecosystem Assessment 2005). Landscape is also a representation of natural and cultural interactions. The role of human factors is underlined by the European Landscape Convention (2004) defining landscape as "an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors".

Among the human factors, there are farmers' land use and agricultural production decisions in response to market demand and agricultural policies. With technological development and the evolution of demand for food, structural changes in agriculture in the second half of the twentieth century have led to increased intensification, concentration and specialization of production in some areas and marginalization and abandonment in others, leading to significant changes in the farmed landscapes. While farmers had historically provided environmental and landscape amenity benefits for free, these changes have undermined the apparently complementary relationship between agriculture and rural environment.

Such processes were accelerated by the entry into force in 1957 of the Common Agricultural Policy (CAP), whose priority at that time was to increase agricultural productivity in order to ensure farmers a satisfactory and equitable standard of living, and to stabilize agricultural markets and farmers' income. Since then, the multi-functionality of agriculture and the need to integrate the environmental and the agricultural policies were recognized. Actions were taken to provide incentives to farmers to protect their farm environment in general and the landscape in particular.

Although, the CAP is not a landscape policy per-se, it is often put forward as being the principal driver of changes in land use and farming practices in Europe, which in turn have an influence on rural landscapes. The CAP has been in place during the most widespread and rapid changes of the rural environment in the whole of European history, due to various changes in the socio-economic and technological context. It would therefore be naïve to lay all the responsibility for the transformation of rural landscape at the feet of the CAP (Brouwer and Lowe 2000). Nevertheless, the CAP represent a significant proportion of EU budget expenditure (41% of the EU's total budget in 2011, EUR 55 billion per year), and it is also the most important funding instrument for EU agriculture. Given that it influences the management of the majority of agricultural land, it has the potential to encourage the delivery of landscape public goods on a European scale.

In this viewpoint paper, we discuss to what extent the Common Agricultural Policy is contributing to the management of EU agricultural landscapes. In the section II, the multi-scale nature of the agricultural landscapes public good is described. We argue that optimal management of agricultural landscapes require actions on three scales: (1) the management of landscape elements at farm level, (2) the integration of farms at landscape level, and finally (3) the conservation of the diversity of agricultural landscapes in the EU as a global public good. In section III, we provide evidence that the Common Agricultural Policy has until now mainly focused on the first scale. We also illustrate how the agricultural policy could be designed to encourage collaboration and co-ordinate actions at the two other scales to enhance the landscape management in Europe.

II. AGRIGULTURAL LANDSCAPE: A MULTI-SCALE PUBLIC GOOD

Agricultural landscapes are complex constructions whose management requires good understanding of, and responses to, the multi-scale nature of the associated bio-geophysical and human systems and the interactions between them across scales (Cash, Adger et al. 2006). We refer to scale as any specific geographically bounded level at which a particular phenomenon is recognizable (Cash and Moser 2000). A good understanding of the scales relevant for landscape management is a prerequisite to formulate policy recommendations for more efficient landscape management strategies in the CAP. We propose here a three-scales typology likely to serve this goal. We define each scale and present the drivers of the landscape changes associated with each of them.

1) Farm scale: Landscape elements

The landscape elements are the elementary spatial object of agricultural landscape design. They include land cover (cropping patterns, semi-natural and natural land cover), field sizes and uncultivated landscape elements such as hedges, fences, drainages, permanent meadows, woodlots and the wide array of buildings, linear networks and other elements supporting production activities or connecting agricultural fields to the environment (Rizzo, Marraccini et al. 2012).

Farmers, as owners or managers of private land, can decide to modify, organize, conserve or suppress landscape elements according to the private costs and benefits from such actions. Farmers' landscape management decisions are better understood by recognizing the three distinctive role farmers can play: producer, owner and citizen (Primdahl and Kristensen 2001). As a producer, the farmer is affecting the landscape through land-use decisions (cropping patterns and crop rotation, cultivation of permanent crops, permanent pasture, forest management) and specific farming practices at the field level (tillage, fertilization, spraying, livestock density, organic farming…). Isolated trees or hedgerows for example have been removed in many arable fields to enable the use of modern machinery with increased size. Farmers also react to external drivers such as the agricultural policy. Many orchard farmers in UK have removed trees from their farms since it as presumed at the time of the introduction of single farm payments that payments cannot be made for areas with a tree density greater than 50 trees per hectare (Vidal 2004).

But the farmer is not only a producer, is very often a land owner. The farm property is therefore both a working tool, an asset and a place to live. In 2010, more than 52% of the agricultural land is owned by the farmer, covering over 90% of all agricultural holdings across the EU-27 (FSS 2010). Many decisions impacting landscapes, such as hedgerow plantings, afforestation, digging of new ponds, etc. are more closely related to "property management", rather than production. Moreover, with the switch from payments coupled to production to payments associated to land, the decoupling reform of the Common Agricultural Policy (CAP) has resulted to a certain extent in a changing balance between producers' versus owners' interests. In this context, it is important that the farmer's role as 'owner' is taken into account in the design of instruments and implementation strategies of landscape measure (Primdahl and Kristensen 2001). The third role concerns the farmer as a citizen, member of a community. Farmers participate in community life and in collective actions of various kinds, including landscape restoration projects. While the major motivation of full-time farmers for landscape management is maximisation of profit from agricultural production, aesthetic and environmental functions are important drivers for smaller part time and hobby farmers (Levin 2006).

Despite the evidence that farmers have a role on landscape management at farm level scale, they rarely have full ownership, which would include besides the right to use and exploit, also the right to control landscape development. In Europe, the land property rights often only captures a limited number of rights and obligations that pertain to land (Penker 2009). Individually owned land is subjected to numerous regulations. Water, air and soil as well as outstanding landscape features and endangered species are protected by legal acts and standards set and controlled by European, national and regional authorities (Water Framework Directive, Nitrate Directive…). Particularly harmful interventions, such as the suppression of landscape elements like terraces or the conversion from grassland into arable land, are forbidden by laws or are at least subject to formal approval procedures. In the CAP, this is included in cross compliance rules (GAEC standards). In the second part of the paper, more details will be given on how the CAP influence farmers' landscape and land use management decisions.

2) Landscape scale: Landscape structure and the integration of farms in rural landscape entities

Landscape scale refers to a spatial scale above the field- and farm- scales. It can be an area of coherent landscape character or a sub-unit of a natural region (Prager, Reed et al. 2012). At landscape scale, the holistic image reflects the composition and configuration of the landscape elements (Tuan 1979). Composition refers to the amount of different entities (e.g. different land cover types). Configuration refers

to the size and form of the different patches and corridors[1] as well their spatial arrangement (e.g. connectivity and isolation) (McCarigal, Cushman et al. 2002).

At farm level, decision making towards creation, conservation or suppression of landscapes elements is based on private costs and benefits. The impact of individual actions on the provision of the landscape public goods will depend on the technology of supply underlying the desired landscape. The technology of supply refers to the contribution of each landowner's action to the resulting landscape change (Sandler 1998). For example, in a pasture landscape with stonewalls, all the walls are contributing to the integrated image, therefore corresponding to the additive technology, where actions of each contributor are perfect substitutes and the different contribution sum-up. The visual aspect of diverse cropping patterns is closer to the threshold model, where a minimum contribution is required, and the public good is produced only beyond this threshold. Indeed, the visual quality is largely reduced if only few farmers participate to the diversification of cropping patterns and associated colours. In hilly arable landscapes, single trees can be of high visual quality. In this case, the sole contribution of one farmer to maintain a tree is providing most of the benefits. This corresponds to the best-shot model, when one or a few efficient contributions are enough to provide almost all the value of the public good. A good understanding of the technology of supply generating landscape public goods at landscape scale is crucial to design efficient coordination mechanisms.

In the absence of coordinated efforts beyond farm-level scale, landscape management effort will be determined only by the value of landscape elements that can be captured in an individual farm plot. Every member of the community may have an incentive to free ride on the conservation efforts of others and to neglect the benefits that his or her conservation efforts confer on other members of the community. For example, an individual farmer may not take into account in his management decisions the full value of hedgerows as habitat for pollinators and other beneficial insects because some of the benefits will be captured outside farm gates. Another example is the grazing of animals in pasture. Many people enjoy seeing these animals and consider that they enhance the agricultural landscape. However, the farmer decides when and how long to graze animals only according to his production plan, not according to the benefits for visitors. Landscape management requires integrative instrument to coordinate the scattered actions of multiple landowners and to insure that all public benefits associated with landscapes are captured.

3) European scale: The existence value of landscape diversity in EU as a global public good

A further coordination need arises from the fact that the physical boundaries of a landscape rarely fit within administrative borders. Moreover, the social linkages between EU countries and regions, due to the flow of goods, people and information, are such that the services provided by landscapes also provide benefits outside the territory where the landscape is situated. The amenity and cultural values of well-managed landscapes attract tourists. Moreover, landscapes have an existence value even for those who do not visit the place, providing there is sufficient flow of information for those people to know the existence of these landscapes. For example, producers of traditional food increasingly communicate on their surrounding landscapes and how they impact the quality of the product (Ministère francais de l'agriculture et de la pêche 2006). Landscapes are therefore global environmental public goods, covering sometimes more than one country and benefiting a broad spectrum of the global population (Kaul, Grunberg et al. 1999).[2] This is

[1] Corridors are line elements connecting patch elements together and/or splitting up the matrix of cultivated land (e.g. hedgerows).

[2] Other examples of global public good usually found in the literature include the conservation of the genetic diversity, the mitigation of climate change, the control of emerging infectious diseases, the management of sea areas beyond national jurisdiction…(Arriagada and Perrings 2011).

underlined by the World Heritage Convention, which states that "World Heritage sites belong to all the peoples of the world, irrespective of the territory on which they are located" (UNESCO 2005b: 2). In promoting the idea of landscape with 'outstanding universal value', the Convention elevates cultural landscape heritage to the level of a global public good (Pannell 2006). Since 1992, 82 sites, among which 38 in Europe, have been included as cultural landscapes on the World Heritage List, with the objective "to reveal and sustain the great diversity of the interactions between humans and their environment, to protect living traditional cultures and preserve the traces of those which have disappeared". Among these landscapes, many are shaped by agricultural activities.[3]

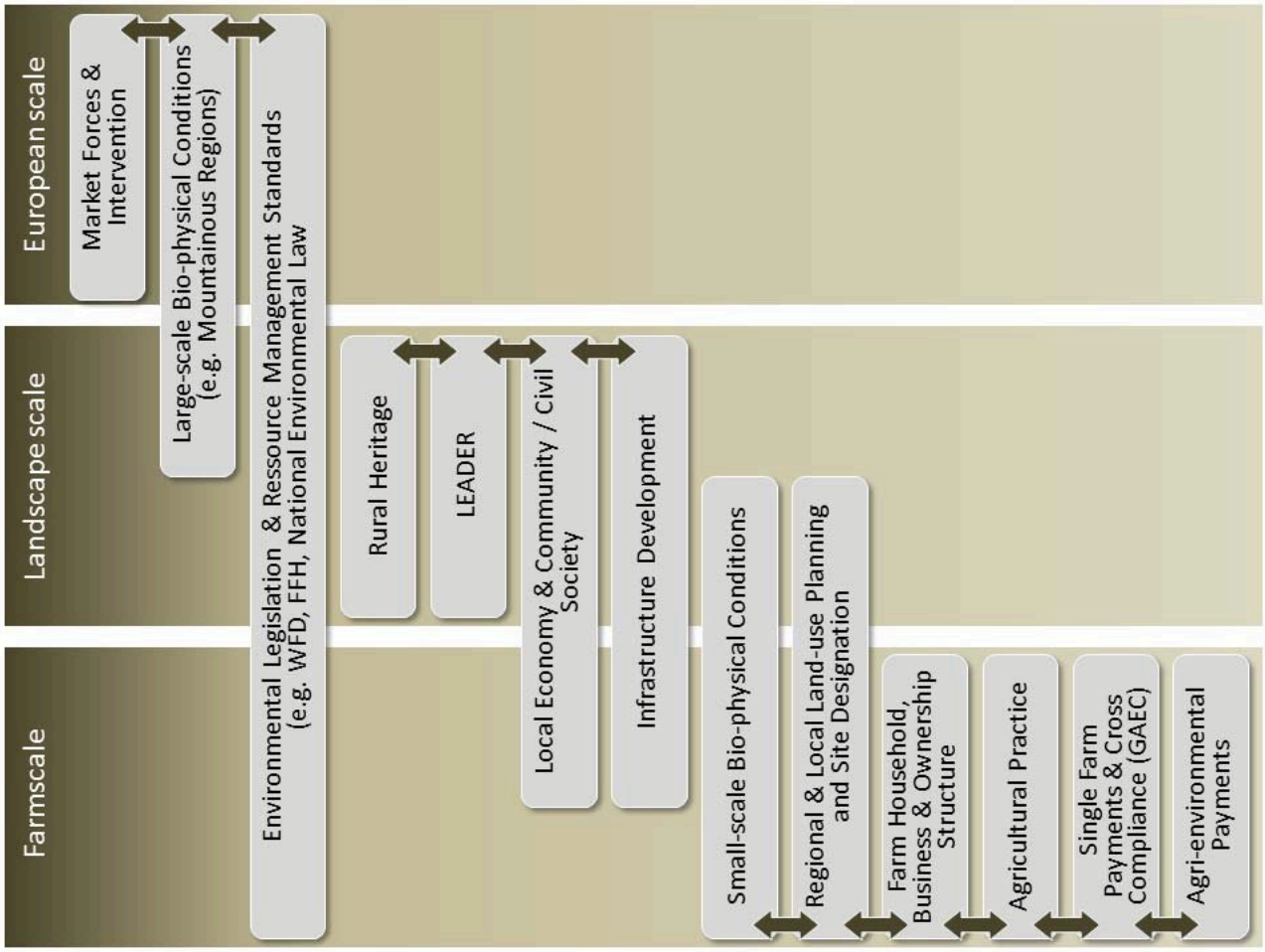
The benefits from landscape global public good is not only determined by the quantity of well-managed landscapes, but also by their diversity across Europe. The EU territory is diverse in many respects, and we can see clear distinctions among individual Member States in terms of landscape structures. Landscape ecologists have developed several concepts to characterize such diversity. Richness of agricultural land use refers to the number of different land-cover classes (cultivated crops, fallow land …) on utilised agricultural area. Evenness refers to the uniformity of distribution of the area among land-cover classes (Olson and Francis 1995). Dissimilarity is a pairwise measure of the evenness of two areas. Heterogeneity refers to the overall level of differences in structure, composition or function of landscapes between various areas (Cadenasso, Pickett et al. 2006). All these concepts can be applied at different spatial scales: from the diversity of landscape elements within a particular landscape structure, to the diversity of landscapes at a larger scale such as the territory of the EU.

However, the conservation of landscape diversity cannot be restricted to the few "hot spots" included in the World Heritage List. The rural landscapes of Europe are in a process of polarization between the marginalization of farmland and forests and the more intensive use of highly productive land, due to the changes in agriculture and forestry practices, (Jongman 2002). Regional distinctiveness is disappearing due to the impact of farm modernization and globalization of food production (Jongman 2002). Regional differences and the associated cultural landscapes will be maintained only if the diversity dimension is integrated in landscape planning and policies.

We have seen in this section that the concept of landscape is multi-scale in nature. The three scales and the drivers of the changes in each scale are reported in Figure 1. Multi-scale management of landscapes is accordingly an issue of multi-level governance. Landscape is an example of divided ownership: different individuals and organisations hold use or control rights to different landscape scales: land owners and farmers control landscape elements; landscape configuration depends on interactions within the local community, and landscape diversity depends upon multi-level governance processes. In the following section, we analyse what is the role and potential impact of the CAP in landscape management in such a complex multi-scale framework.

[3] Examples in Europe include 'Southern Öland' (Sweden, grazing livestock), the 'Costiera Amalfitana' and the 'Portovenere, Cinque Terre, and the Islands (Palmaria, Tino and Tinetto)' (Italy, citrus, vines), the 'Alto Douro Wine Region' and the 'Landscape of the Pico Island Vineyard Culture' (Portugal, vines), 'The Causses and the Cévennes, Mediterranean agro-pastoral Cultural Landscape' (France, grazing livestock), the 'Juridiction St Emilion' (France, vines), the Wachau Cultural Landscape (Austria, vines) and the Pyrénées – Mont Perdu (Spain, France, Pastoral land).

Figure 1: The multi-scale nature of agricultural landscape. Adapted from Levin (2006a).



III. TOWARDS MORE EFFICIENT AGRICULTURAL POLICY INSTRUMENTS FOR AGRICULTURAL LANDSCAPES MANAGEMENT

Whereas the focus of the CAP is mostly restricted to the modification/conservation of practices at the farm-level scale, we see a growing concern for landscape issues within the multi-functionality framework of the agricultural policy. In this section, we show how the CAP focuses quasi exclusively on landscape management at farm scale, with very limited attention to the two other scales. We also show how policy instruments could be refined for the CAP to better integrate the two other scales in order to facilitate the coordination of farm actions and avoid the risk of homogenization and maintain diversity of agricultural landscapes at EU level.

1) CAP impacts on landscape elements at farm-scale

In the first 20 years of its history, the CAP remained almost completely divorced from environmental considerations (Vanslembrouck and VanHuylenbroeck 2005). The priority at that time was to increase agricultural productivity in order to ensure farmers a satisfactory and equitable standard of living, and to stabilize agricultural markets and farmers' income. With the MacSharry 1992 reform, environmental protection became a concern of the CAP. Under the agri-environmental regulation 2078/92, aid was made

available to farmers to reduce agro-chemical inputs, to facilitate shifts to organic farming and extensive forms of production and more generally to support production methods that protect the environment and maintain the countryside. The multi-functionality of agriculture was then recognized by the Agenda 2000 reform and the establishment of the Rural Development Policy (RDP) as the second pillar of the CAP. Today, the CAP is divided into two pillars. Pillar I includes direct payments to farmers and market management measures while pillar II measures are related to the RDP. Pillar I dominates the CAP budget, with a budget close to four times the size of that of pillar II in the last programming period 2007-2013. The EU expenditures for Rural Development, having risen from 2.9% of the total CAP budget in the 1990ties to 12.3% in the beginning of the 2010ths, reflecting the growing strategic and societal value attached to this policy in addressing the new global challenges for rural areas in the enlarged EU.

The role of farming in providing higher quality landscape public good is now recognized in the CAP. For example, the legal proposal for CAP post 2013 establishes a sub-priority for the Rural Development policy on restoring and preserving the State of European Landscapes (2011/0280 (COD) and 2011/0282 (COD)). Moreover, "landscape state and diversity" is one of the indicator retained in the set of 28 agri-environmental indicators (AEI) that has been adopted in order to portray agricultural production systems, farm management practices, pressures and risks to the environment and the state of natural resources, as well as to track the integration of environmental concerns into the CAP (Communication "Development of agri-environmental indicators for monitoring the integration of environmental concerns into the common agricultural policy" (COM (2006) 508 final)).[4]

Moreover, it is recognized that a wide range of CAP measures have an impact on landscapes through their impact on land use and production systems. While pillar I measures are disconnected from any landscape provision objective, they contribute to farm income, and therefore indirectly contribute to farm maintenance and to the preservation of agriculturally managed landscapes. Support to farmers' incomes provided by CAP payments foster structural change in agriculture. Structural change has the potential to impact landscapes through two main trends: uniformization in productive areas (reduction of cropping diversity, increase in parcel size, disappearance of animals from the open landscape, due to indoor housing of animals) and fragmentation in less favoured areas (due to land abandonment or non-agricultural use of land for housing) (Piorr, Müller et al. 2007; Piorr, Ungaro et al. 2009). On the contrary, Pillar II includes measures with direct focus on enhancing the conservation of rural landscapes (Axis 2 agri-environmental and less-favoured area measures). Rural Development measures targeting the protection of the environment in general (Axis 2), modernisation (Axis 1) and the quality of life and diversification of farm activities (Axis 3) also have potential indirect effects on landscapes (European Commission DG Agriculture and Rural Development 2011). The table in annex summarizes how the different CAP measures influence the farm-level components of landscapes. For a more complete pictures, the interested reader can refer to the report "The influence of the Common Agricultural Policy on agricultural landscapes" (Lefebvre, Espinosa et al. 2012).

Current CAP design is confronted to a scale mismatch to deal with landscape issues, i.e. an inconsistency between the scale of administrative management (the farm scale in the CAP) and the scale of the ecological process being managed (the landscape scale) (2006). Given that the majority of CAP support is provided to individual farmers (with the exception of few Pillar II axis 1, 3 and 4 measures, where municipalities or groups of actors from the non-farming sector are eligible to receive support), they impact landscape mostly at farm scale. Landscape-scale management remains the exception rather than the rule as it requires coordination between several land owners and managers (Selman 2006).

[4] The "landscape state and diversity" indicator (AEI28). is based on three sub-indicators: 1 - the dominance and internal structure of the rural-agrarian landscape in the context of the wider landscape matrix; 2- the hemeroby state (or degree of naturalness) which shows the distance from the natural state due to human (agricultural) activities; 3- the interest and perception that society has for the rural-agrarian landscape (tourism, local products).

The need to account for the landscape-scale have been raised in the recent debate on the greening of the CAP. According to the proposal of the European Commission for the reform of the CAP post 2013 (European Commission DG Agriculture and Rural Development 2010), farmers would have to fulfil three conditions to receive full direct payments: crop diversification, protecting permanent grassland and conservation of ecological focus area (EFA). In theory, these requirements would impact land cover and therefore agricultural landscapes. The real environmental and landscape impacts of these three measures are expected to be very limited (Matthews 2012), and would depend upon the spatial implementation. For example, for the EFA, not only the area allocated is important, but also the location and the connectivity among the EFAs of each farmer. The effectiveness of the greening measures would be enhanced by tailoring them to local conditions and stimulating the realisation of 'green infrastructure' through regional coordination (Westhoek, van Zeijts et al. 2012).

The fact that coordination of landscape management actions between farms is not encouraged can be viewed as the consequence of the conceptual framework underlying the greening of the Common Agricultural Policy, where public good provision in general and landscape management in particular are perceived as a by-product, or a joint production of agricultural activity. Relying exclusively on the theory of production to design the agricultural policy limits the focus on farm scale and avoids to go deeper in the difficult issue of the spatial aggregation of actions taken by different farmers at landscape scale (Lifran 2009). Moreover, it fails to address the question of the provision of the landscape diversity global public good at European scale. In the following, we review possible instruments that could be integrated in European Policies such as the CAP to overcome these limits and better account for the multi-scale nature of landscapes.

2) The coordination of farm landscape management actions

In this section, we present instruments likely to create a better integration of farm- and landscape- scales, by favouring the coordination of farm actions to obtain a landscape effect. Most of the CAP measures focusing on landscape management target individual farmers.

This means that in addition to implementing policies that target individual farmers (eg. agri-environmental measures), different approaches are needed to promote collective action (OECD 2013). Collective action can be defined as action taken by a group in pursuit of members' perceived shared interests (Scott and Marshall 2005). Collective action makes it possible to deliver public goods characterised by a large geographical scale, such as landscape-scale , that could not be provided or protected by a single farmer (OECD 2013). As an illustration, in the OECD report on "Providing agri-environmental public goods through collective action" (OECD 2013), among the 24 of the collective action case studies analysed in thirteen countries, four of them target landscape management: the "Almühl Valley Bavaria" Landcare Associations (Germany), the "Wetland" restoration Elder Valley (Germany), the Mountain pasture management in the Aosta Valley (Italy) and the Water, Land & Dijken Association (The Netherlands).

There are a number of potential barriers for the implementation of collaborative landscape management incentives. Patterns of land ownership and tenure increase transaction costs for coordinated landscape management (Goldman, Thompson et al. 2007). Collaborative environmental planning is based on voluntary co-operation and therefore commitment is often weak. There is also a risk of lack of communication and mutual understanding between farmers (Emery and Franks 2012; Prager, Reed et al. 2012).

The key factors for successful collective action have been reviewed by OECD (2013). They can be divided into four groups: 1) the characteristics of the resource to be managed, 2) the characteristics of the groups that depend on these resources, 3) the institutional context, and 4) the external environment. Prager et al. (2012)

have developed a guideline for scheme design and implementation, putting particular emphasis on the role of participation and joint participation from various disciplines. Several authors have proposed payment design including incentives for coordination between farmers.

Dupraz et al. (2009) propose a design of agri-environmental schemes when the bio-physical processes are characterised by threshold effects. The idea of threshold effect can perfectly apply to some landscapes where no perceptible change in the landscape state occurs unless a specified farming practice is applied on a minimal area in the zone of interest. The basic idea is the following: the payment to each individual farmer is conditional upon the total intention of contracting being greater than the area needed to pass the threshold. The proposed design account for the following potential difficulties: the lack of information on farmers' characteristics or actions and/or the uncertainty on the relationship between farming practices and environmental quality.

Such payments provide an answer to the challenge of achieving coordination of action between farms. A second challenge arises from the necessity to integrate the spatial arrangements of various landscape components. There is evidence that it may be more economically efficient to spatially target agri-environmental payments according to the ecosystem service potential of the land at relevant scales, than current approaches that are not spatially differentiated (Wünscher, Engel et al. 2008). Spatial targeting seeks to carry out AEM at the most suitable sites, for example, by basing the eligibility of parcels on site conditions (Uthes, Matzdorf et al. 2010; Schouten, Polman et al. 2011). The definition of target areas is already widely practiced (for example, by limiting input-reducing AEM to water catchment areas or habitat-enhancing measures to the NATURA 2000 network), but not for landscape management. The agglomeration payment proposed by Parkhust et al. (2002) provides incentive for non-cooperative landowners to voluntarily create a contiguous reserve across their common border. The mechanism was originally proposed in order to protect endangered species and biodiversity by reuniting fragmented habitats across private land, but it can be adapted to landscape, either to obtain a uniform landscape with the agglomeration of patches with the same land uses, or to encourage land cover diversity. In this case, the basic payment would be given for the change in land use, while an additional payment would be conditional to the proposed plot being contiguous to another with a similar or distinct land use. Lifran (2009) present the example of preferences for a diversified landscape, with a mix of forested patches and fields equally scattered in the landscape unit. A high rate of landowners choosing to afforest their land results in failure to fulfil the objective of landscape mosaic. The support to afforestation should therefore be conditioned upon the rate of forest and field in each local neighbourhood. Therefore, the design of the afforestation schemes should promote the diversity of patches in terms of land use in the neighbourhood.

Payment design constitutes one element to foster coordination between farmers but will rarely be sufficient. It should be part of a wider institutional setting to promote collective action. Promoting Environmental Cooperatives (ECO) is one possible tool to foster collective action in landscape management. ECO can be described as local organisations of farmers and often non-farmers who work in close collaboration with each other and with local, regional and national agencies to integrate environmental management into farming practices (Franks and Mc Gloin 2007). The first ECO was established in the Netherlands in 1992 as a self-help group with voluntary membership, principles that still characterise all ECO. One particularity of the ECO is that the stakeholders affected by the rural management program are involved in the three stages of the policy: the design, implementation and evaluation. Concerning landscape management, the following benefits are achieved from the ECO: first the environmental goal could be set at the rural landscape level with the participations of individual farmers, therefore the mismatch between the administrative and the nature scale does not longer exist (assuming that the farms involved in the ECO are sufficient and spatially efficiently distributed). Secondly, there is less uncertainty in the farmer participation as the instrument is discussed and designed by the ECO members. Thirdly, in the ECO the cost-effectiveness of the agri-

environmental policy is improved as the asymmetric information between the farmer and the policy maker that affects the cost-effectiveness is reduced (OECD 2010). Moreover, the administrative, implementation, monitoring and enforcement costs are reduced.

3) The management of landscape diversity at EU level

In this section, we present instruments likely to create a better integration of the landscape- and European-scales, by insuring the conservation and management of the diversity of EU landscapes. Regional agricultural peculiarities across EU and the associated cultural landscapes will be maintained only if the diversity dimension is integrated as an objective of landscape planning and policies.

Effective landscape management in each individual member state creates support the overall quality of EU landscapes. It is important that, at local level, landscape managers are aware of regional landscape particularities contributing to regional identity. However, insuring the conservation of EU landscapes diversity requires specific action at the global scale. EU Landscape diversity is a complex public good that can be approximated to a weighted sum public good, where the contribution of each hectare of land depends not only on its characteristics but as well as on the existence (or not) of a similar landscape somewhere else in EU. Therefore supra-national institutions also need to contribute to the diversity of landscapes through strategic framework development and facilitation of knowledge and experience transfer, such as the Pan-European Biological and Landscape Diversity Strategy (PEBLDS).

Currently, in the absence of real policy instrument to tackle this issue, the solution chosen is to rely on international conventions, in order to promote a common approach to the conservation of European landscapes and coordinated actions. At the European level, there are two major conventions dealing with landscapes diversity: the Pan-European Biological and Landscape Diversity Strategy (PEBLDS) and the European Landscape Convention (ELC).

The Pan-European Biological and Landscape Diversity Strategy was created in 1995 to promote a consistent approach and common objectives for national and regional action in Europe for the implementation of the Convention on Biological Diversity (1992). It has been signed by 55 European countries, who, doing so, recognised the special need for international cooperation in efforts to conserve biodiversity and landscapes of European importance. Interestingly, both biological and landscape diversity were targeted in the PEBLDS. A specific pan-European convention dealing with landscapes issues has since then be created: the European Landscape Convention.

The European Landscape Convention (ELC) promotes the protection, management and planning of European landscapes. The ELC aims to encourage public authorities to adopt landscape policies at local, regional, national and international levels and organises European co-operation on landscape issues. The ELC acknowledges not only that the quality of European landscapes constitute a common resource, but also their diversity. Although the ELC is a weak policy document in terms of legal obligations and power, it represents a substantial appeal for the member states to establish an active landscape policy (Landscape Europe website). The convention was adopted on 20 October 2000 and came into force in 2004. It has been signed by 37 of the 47 Member States of the Council of Europe. It is open to all European countries (EU Member States and others), as well as the European Commission itself, but this latter has not signed it. The signature by the European Commission of the European Landscape Convention could provide an impetus towards the better integration of the effect on landscape in the Common Agricultural Policy.

IV. CONCLUSIONS

In this paper, we have focused on the role of the CAP in shaping EU agricultural landscapes, and how this role could be improved with a better coordination of actions beyond farm scale. We have shown that optimal management of agricultural landscapes requires actions on three scales: (1) the management of landscape elements at farm level, (2) the integration of fields and farms in the agricultural landscape at landscape level, and finally (3) the conservation of the diversity of agricultural landscapes in EU as a global public good. We have reviewed the potential influence of the different CAP measures on landscape and concluded that the impact is mostly limited to the farm-scale. We have shown how policy instruments could be refined for the CAP to integrate the landscape and European scales. This paper provides a knowledge base to support an effective CAP policy design in the direction of improved landscape management, an important component of the EU project towards a more sustainable agriculture.

The paper has focused on the importance of considering multiple spatial scales for landscape management. Time scales are also important. While preferences and collective norms towards landscape evolve over time, the socio-ecological process of landscape change follows its own path, and it is often impossible to immediately streamline the new social norms with the current state of the landscape (Lifran 2009). Policies focused on landscape management can have effects over different timeframes, depending on their interaction with previous policies and how agricultural practices and natural elements respond to policies (Chassany and Miclet 2005). The chronology embodied in landscapes should not be underestimated (Widgren 2012). All the changes in land use are incorporated into subsequent landscapes, and they tend to survive in different social and political contexts. Each landscape is a result of the superposition of different layers of changes that have occurred at very different points in time. The impact of agricultural and landscape policies implemented at a given point in time should therefore not be overestimated.

As a last remark, it is interesting to note that landscape objectives tend to be defined in the CAP in terms of conservation, i.e. in a defensive manner, more than in terms of thinking/developing new forms. A management action is considered as contributing towards landscape if "it maintains or protects individual landscape elements or the characteristic structure of a more traditional agricultural landscape as a whole" (Institute for European Environmental Policy 2011). However, one difficulty with landscape policies intended to conserve historically dated landscape relates to the fact that in the meanwhile economic and social conditions prevalent at the time of reference have changed (Van Haaren, 2007). In the new conditions, there is a risk that "conservation" policies will not achieve their objectives and/or that they will result in reducing the landscape to a museum, i.e. to de-link its aesthetic elements from the social and economic ones. It is useful to remember the experiences of important periods of history, e.g. Renaissance, during which the issue of landscape was central to society's thinking on the "agricultural project" (Ambroise 2004).[5] The same logic could apply now: the EU project towards a more sustainable agriculture may face the challenge of setting-up a new-landscape project.

[5] See for example the influence of the series of frescoes painted by Ambrogio Lorenzetti in 1339 "The Allegory of Good and Bad Government" on the agricultural landscape project of the Italian society. In 17th century France, Olivier de Serres claimed that agriculture was the first art and he worked on how to promote a sustainable agriculture (de Serres 1600). Thanks to these projects, a number of regions in France and Italy are nowadays still considered the "garden of Europe" or recalled as "beautiful landscape", whereas some of these rural landscapes were in a deplorable state upon the eve of the Revolution in 1789 (Young 1792; Sereni 1961).

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Table 1: The influence of the Common Agricultural Policy on agricultural landscapes.

CAP measure	Influence on agricultural landscapes
Coupled payments and land use patterns	Coupled payments and market support (minimum price levels, quotas) give incentives to farmers to grow the supported crops, and can therefore potentially lead to a reduction in crop diversity and rotation at farm level (Centre d'Analyse Stratégique 2011). The associated homogenisation of agricultural landscape is perceived as a reduction of its visual beauty, due mainly to the lack of colour variety (Arriaza, Cañas-Ortega et al. 2004) and shapes diversity.
Decoupled payments, intensification and marginalization of landscapes	With the decoupling reform, direct payments are no longer linked to production. Brady et al. (2009) found that decoupling has small influences on the landscape mosaic in relatively productive regions, since land use remains largely unchanged. However, in marginal agricultural regions, decoupling was shown to have a negative influence because of the homogenisation of land use that results from land being taken out of production (because farmers can receive payments without producing). (Miettinen, Hietala-Koivu et al. 2004) also found that with decoupled payment the amount of fallow land will increase causing homogenisation of agricultural land use at landscape level. Overall, because of this dichotomous effect of intensification-marginalization, decoupled payments may not contribute to maintain landscapes with high aesthetic value if those landscapes are those marginalized (Cooper, Hart et al. 2009).
Cross compliance standards associated to landscape management	Agricultural land eligible for direct payments must meet minimum agricultural and environmental standards. The statutory management requirements (SMR) cover existing directives and regulations such as the nitrate and groundwater directives, Flora-Fauna Habitat (FFH) or the water framework directive and apply to all farmers (even those not receiving EU support). In addition, in order to receive the full decoupled direct payment a farmer has to comply with good agricultural and environmental condition (GAEC) standards. On the basis of a pre-defined list of issues and standards to be covered, Member States can define their own GAEC standards at national or regional level, taking into account the specific characteristics of the areas concerned, including soil and climatic condition, land use, crop rotation, farming practices and farm structures. Many of these GAEC standards have an impact on landscape management at farm level. For example, the maintenance of landscape features like terraces, stonewalls, field margins, hedges, ponds, ditches and trees contribute directly to the aesthetic value of landscapes. The requirement of minimum soil cover and minimum land management impede the deterioration of the visual aspect of agricultural land generally associated with soil erosion, the overgrowth of vegetation and the closure of landscapes. Establishment of buffer strips along water courses also influences the landscape mosaic when plots are along water courses, even if the first aim is to protect water against pollution and run-off. Bans on the conversion of permanent grassland to arable land at farm level contribute to the diversity of cropping patterns …
Agri-environmental measures (RDP axis 2) and management of landscape elements at farm level	Agri-environmental measures (AEM) are the primary policy instrument used to encourage farmers to protect and enhance landscape elements on their farmland. On contract basis, they provide payments to farmers in return for a service related to reducing environmental risks associated with modern farming and/or preserving natural resources, soil and cultivated landscapes. According to the typology prepared by the European Commission, the most important types of agri-environmental commitments in terms of area enrolled are related to the management of landscape, pastures and high nature value (HNV) areas (13.5 million hectares and represented 39% of the total area committed across the EU-27). Those measures encompass the conservation of historical features (e.g. stone walls, terraces, small woodlands), management of pastures (including limits on livestock stocking rates, low-intensity measures, mowing), creation of pastures or the management of other High Nature Value farmland areas, like traditional orchards. Organic farming is supported in all Member Stated through a specific AEM. There exists a general expectation that organic farming have a beneficial effect on landscape composition (European Commission website on organic farming)[6] and evidence that it contributes to the diversity of landscapes and farming system (van Mansvelt, Stobbelaar et al. 1998). As organic farms are prohibited to use conventional fertilisers and pesticides, they basically rely on crop rotation strategies, which increase the diversity of crops and

[6] http://ec.europa.eu/agriculture/organic/environment/landscape_en

	therewith contribute to landscape diversity (Stolze, Piorr et al. 2000). In 2009, the agricultural area enrolled in AEM amounted to nearly 38.5 million ha and represented 20.9% of the UAA in the EU-27 (European Commission DG Agriculture and Rural development 2011). Targeting of the land likely to yield to the higher environmental benefits is difficult (Primdahl, Peco et al. 2003). Moreover, even if AEM impact landscape elements at farm-level, the impact on landscapes' structures at a larger scale can be limited if there is insufficient or uncoordinated commitment of individual farmers. Most of AEM neither require nor encourage landscape level coordination but favour a farm scale approach leading to individual, disconnected actions (Prager, Reed et al. 2012).
Support to Less Favoured Areas (RDP axis 2) and the maintenance of farmed landscapes	The Less Favoured Areas (LFA) policy was conceived as a structural policy to reduce the differences in farm income due to differences in productivity across regions within the EU, and to prevent land abandonment by maintaining agricultural activities and rural population. In the EU-27, more than half of the total UAA (54%) has been classified as LFA. Due to the handicap to farming, the probability of land abandonment is higher in LFA. The continuity of farming systems in Less Favoured Areas is seen as central to the preservation of cultural landscapes. When farming declines, land is abandoned or under-used, scrub and forest encroach and the open landscape disappears (Vanslembrouck and VanHuylenbroeck 2005). CAP support to LFA contributes to mitigate the risk of land abandonment. However, LFA payments are not restricted to the areas of greatest landscape value or where the risk of land abandonment is greatest, leading therefore to uncertain effect on landscape (Cooper, Baldock et al. 2006).
Afforestation and agro-forestry measures (RDP axis 2): influence on land-use change	In the Rural Development Policy 2007-2013, three measures are related to afforestation and agroforestry (221, 222 and 223). The promotion of afforestation has a drastic influence on landscape due to the land use change from field/permanent crops to tree plantations. Tahvanainen et al. (1996) studied the visual impacts of gradual afforestation in Finland and found that the scenic beauty declared by the respondents was negatively correlated with the intensity of afforestation. The choice of fast-growing species and the use of simplified stand structures to facilitate machine operations are often cited as predominantly negative aspects of plantations, in comparison with natural forests (Halldorsson, Sigurdis Oddsdottir et al. 2005). Nowadays, the development of the practice of forest landscape design has enabled a better integration of tree plantations into the landscape (Halldorsson, Sigurdis Oddsdottir et al. 2005). One example is the co-existence in the same landscape of agricultural and forest plots, i.e. 'agroforestry'. On top of the wide range of environmental, agronomic and economic benefits associated to agroforestry, it also has the potential to create high value landscapes including the presence of fixed elements such as trees on cultivated land (Palma, Graves et al. 2007; McAdam, Burgess et al. 2009). Despite this evidence, some of the initial policies developed under the CAP included measures against its development, such as direct support for the removal of trees and hedges from fields. While these harmful incentives have been removed, agroforestry systems have for long been excluded from CAP support due to higher than permitted tree density (Lawson, Dupraz et al. 2002; Liagre and Dupraz 2008). The benefits of integrating trees with agricultural systems are now recognised in most countries and agroforestry plots are generally eligible for direct payments (Angeniol and Liagre 2010). Moreover, since 2003, national governments have been allowed to include the planting of agroforestry systems within their Rural Development Programmes. Under measure 222 of RDP, support can be granted for the first establishment of agroforestry systems on agricultural land (Council regulation 2004/0161).
Food quality schemes and the promotion of cultural landscapes	The EU food quality policy promotes and protects the names of quality agricultural products and foodstuffs with three different schemes: PDO (protected designation of origin), PGI (protected geographical indication), TSG (traditional speciality guaranteed). On top of the certification schemes, CAP support is available to support farmers who participate in food quality schemes (measure 132) and producers groups for information and promotion activities of these products (measure 133). Food quality schemes have the potential to influence landscape as product specification must include not only the description of the agricultural product, but also the definition of the geographical area (European Commission 2007). It is recognized that landscape elements, such as soil type, topography, vegetation etc, as well as climate/microclimate can influence the final product. The specification must specify and justify the link between the landscape and the product, and show how the specific characteristics of a particular region influence the product (Ministère francais de l'agriculture et de la pêche 2006). For example, for vineyards and fruit trees, the specification of authorized variety, density and pruning rules

	influences the visual aspect of landscapes by changing its colours. In the Saint Marcellin cheese certification, the associated landscape is defined as polyculture in foothills and windy areas. The certification also specifies that these landscape features enable to obtain a good lactic curd of cow milk. Including these landscape elements in the product specification can therefore encourage farmers to take actions for landscape conservation, so that they conserve the benefits associated with product certification.
CAP support to the modernisation of farm activities (RDP axis 1) and potential impacts on landscapes	Axis 1 of the Rural Development Policy concerns the improvement of the competitiveness of the agricultural and forestry sector. By supporting the modernisation and the viability of farms, these measures support income and therefore contribute indirectly to the conservation of farms and farmed landscapes. However, when the support is directed towards investment in machinery, it can potentially have a detrimental influence on landscapes: farmers may increase plot size, rectify their geometry, and reduce the number of fixed elements in order to enable the use of machinery and increase the economic efficiency of the farm. Greenhouse parks, where several large greenhouses are clustered on the same site, are another good example of conflict between innovation –that can be supported by Axis 1 measures and aesthetic influence on landscapes. These parks enable producers to reduce production costs by sharing infrastructure such as energy, water and gas facilities but they severely impact the aesthetic of the surrounding landscapes (Rogge, Nevens et al. 2008).
CAP support to rural quality of life and diversification of farm activities (RDP axis 3) and potential impacts on landscapes	Axis 3 concerns actions supporting the diversification of farm activities and the maintenance and development of services and actions in rural areas. By supporting farm incomes in regions where there are few other economic activities, it ensures the maintenance of farmers and their families in rural areas and favours the maintenance of farmed landscape and reduces the risk of land abandonment. The measures targeting the conservation and integration of rural buildings (323) play a crucial role in landscape management (Torreggiani and Tassinari 2012). Traditional farms and buildings create aesthetic value for rural landscapes (Tempesta 2010; European Commission DG Agriculture and Rural Development 2011) and make a fundamental contribution to rural economies, though their impact on tourism. An example of farm activities' diversification influencing the visual aspects of rural landscapes is renewable energy production. In regions of low agricultural productivity and high potential for renewable energy production, farmers can be tempted to install or rent their land for the installation of solar panels and windmills (Prados 2010). Opinions on the visual impact on landscape of windmills and solar panels are diverse (Thayer and Freeman 1987; Wind Focus 2003; Wolsink 2007), but for sure changes resulting from the implementation of renewable energy plants in the territory will change the way the landscape is perceived as a symbol of the European natural and cultural heritage (Council of Europe 2000).