

1. Introduction

1.1 Background information and problem statement

Over centuries agriculture has been the most dominant land use in a large part of Europe, creating a multitude of agricultural and cultural landscapes with various ecological, economic, and societal features. In a certain way, a landscape reflects the multiple human-nature interactions that shape the surrounding environment; changes in the intensity of these interactions affect the way the landscape and environment are amended. The twentieth century was especially remarkable for the dynamics of such changes. Technological progress led to intensification of agriculture – mechanization of all the operations, systematic use of chemical and mineral fertilizers, high levels of agricultural specialization – and increased the productivity of farming in many areas of Europe. This process was, however, not evenly distributed among areas and was especially problematic for marginal areas where intensification strategies were more costly, needed special adaptation, and consequently did not always make sense. As a result, these marginal agricultural systems, for instance in mountainous areas, have undergone transformations that make them a very interesting case study for research on human-nature interactions. In many cases these systems are characterized by low-intensity agriculture based on traditional farming practices, which can provide – directly and indirectly – public goods such as biodiversity and landscapes (Beaufoy, 2007; Gallardo et al., 2005; Baldock et al., 1996; Beaufoy et al., 1994). However, two processes typical for these areas – intensification or land use abandonment – can threaten the provision of natural amenities. At the landscape level, this can potentially lead to landscape homogenization or “landscape closure” (in the case of land use abandonment, forest succession, and loss of open-land species). This situation sets certain challenges for the related agri-environmental policies.

The experience of the European Union (EU) in this field is very important. The Common Agricultural Policy (CAP) incorporates two aims: economic (increase of agricultural productivity) and environmental (provision of environmental public goods). However, the effectiveness of these measures can be viewed from various perspectives. For instance, the ability of the cross-compliance framework to achieve environmental aims is questioned. The argument is that “commercial constraints will necessarily dominate” and environmental public goods will be undersupplied (Beard and Swinbank, 2001, p.142). Payments within this policy measure are not connected to the levels of nature provision; if some farms show better

environmental indicators than others, they still receive area-based payments. Agri-environmental schemes and payments have been developed to solve this problem; however, they face another challenge: since the compensation level is not adapted to the actual performance of the farms, this leads to overcompensation of some producers (Schader, 2009). Moreover there are no schemes elaborated specifically for the areas with low-intensity agriculture, which are usually less competitive than intensified regions. Therefore sensible methods for evaluating farm performance are needed for more targeted and balanced agricultural support.

From the perspective of agri-environmental policy, we consider the situation of farming in the Ukrainian Carpathians. “Traditional farming in this area of Ukraine is accompanied by a high degree of biodiversity, landscape appearance, and amenities. It is based on traditional knowledge deeply imbedded in the peasant culture of the local population and on the labour-intensive operations and traditional technologies such as hand mowing and weeding, cropping small fields, and rotation recognition of tuber crops that are prerequisites for good ecology” (Nuppenau et al., 2011). Therefore, on the one hand we assume that the traditional farming system in the Carpathians has reached by evolution a rather high degree of connectivity between local economic activities and biodiversity, but on the other hand there are many problems that threaten this situation. This farming system is labour intensive and subsistence oriented and leads to relatively low standards of living and a lack of future perspectives for younger generations. Furthermore, being a part of a poverty syndrome, the local division of labour is very low, and there are problems such as low sales potential and bad infrastructure that make market integration very difficult. As a consequence, there are and will be driving forces that will redirect land use in this remote area. Typical processes that can be expected are either modernization, farm growth, landscape changes, and a loss of biodiversity as in other mountainous areas (Switzerland, Austria, Norway, etc.) or the abandonment of farming and settlement and forest growth (France, Spain, Italy, etc.). In any case, the still prevalent biodiversity is under threat (Nuppenau et al., 2011; Solovyeva et al., 2011).

Within this context, both policy aims are extremely important for Ukraine; the economic goal of productivity growth for small-scale family farms and self-subsistence household plots, which provide a significant part of country’s agricultural output, and the environmental goal connected to maintaining biodiversity and landscape amenities. Therefore a suitable method of evaluating economic and environmental performance would allow us to analyse the overall situation of the agricultural sector in the region of the Ukrainian Carpathians on the one hand and to identify the potential challenges with respect to either of the aims on the other. It is, however, important to mention that the policy context in Ukraine is quite different from the EU member states and also

in comparison to its closest neighbours in Romania, Poland, and Slovakia. These countries have comparable initial conditions of marginal agricultural areas within the Carpathians, but at the same time they have already joined the EU and started implementing EU policies. In the current situation, political solutions for Ukraine should be found independently of CAP agri-environmental schemes. Eventually other political options must be considered.

Therefore this study is focused on an efficiency analysis of farming, taking into consideration its positive environmental impacts in the Ukrainian Carpathians.

1.2 Research questions

The aforementioned focus of the study is multifaceted and needs theoretical, methodological, and empirical elaboration. The following research questions (RQs) are designed to handle the analysis of farm performance in the context of the Ukrainian Carpathians:

- **RQ 1:** What is the relationship between traditional farming in the Ukrainian Carpathians and the biodiversity of semi-natural grasslands?
- **RQ 2:** What efficiency measure is suitable for integrating economic and environmental evaluations and incorporating the environmental impacts of farming and in particular biodiversity provision?
- **RQ 3:** How efficient are farmers in the study region when considering biodiversity provision?
- **RQ 4:** Can farmers in the study area be distinguished according to economic-environmental performance?
- **RQ 5:** What factors are significant in determining farmers' efficiency in the context of farming in the Ukrainian Carpathians?
- **RQ 6:** What implications might the results of the current efficiency analysis have for farming in the study region?

1.3 Research objectives

The main research objective of this thesis is **to analyse the efficiency of farming, taking into consideration its positive environmental impacts, in particular the provision of biodiversity in the Ukrainian Carpathians, by applying methods for evaluating economic and environmental farm performance.**

The specific objectives are directly related to the research questions and are summarized in Table 1.1:

Table 1.1 Research objectives of the study

	Related RQ
✓ 1. To examine the context of farming in the region of the Ukrainian Carpathians	RQ 1
✓ 2. To provide a theoretical background for the relationship between farming and biodiversity provision and to review current research providing evidence on form and types of this relationship	RQ 1
✓ 3. To examine and analyse methodological approaches to efficiency analysis that would allow integration of economic and environmental evaluation and incorporation of the environmental impacts of farming, in particular biodiversity provision	RQ 2
✓ 4. To develop a methodological approach to environmental efficiency analysis of farming suitable for the context of this study	RQ 2 and RQ 3
✓ 5. To analyse the efficiency of farmers in consideration of biodiversity provision	RQ 3
✓ 6. To examine possibilities of distinguishing farmers in the study area according to economic-environmental performance	RQ 4
✓ 7. To identify and interpret the significant factors in determining farmers' efficiency within the Ukrainian Carpathian region	RQ 5
✓ 8. To examine and articulate possible implications of the environmental efficiency analysis results for farming in the study region	RQ 6

1.4 Structure of the thesis

This section briefly describes the structural organization of this thesis. After chapter 1 presents the background information, problem statement, research questions, and objectives of this thesis, chapter 2 will deal more specifically with the context of farming in the region of the Ukrainian Carpathians. The main characteristics and problems of the study area will be presented in the broader context of the related discourse on farming in marginal areas (section 2.1) and on High Nature Value (HNV) farming (section 2.2). The next two sections will give an overview of the study area including the issues related to land use change examined against the historical

background as well as the national institutional framework with respect to agricultural and environmental policies.

Chapter 3 will deal with the conceptual background of this study, starting with an analysis of the relationship between farming and biodiversity provision. Section 3.1 will provide the theoretical foundation for conceptualizing environmental impacts in agriculture, which are usually seen as external effects and can be also viewed within the context of joint production concept. The following section 3.2 particularly will examine biodiversity provision as an externality and by-product produced jointly with agricultural goods. Sub-section 3.2.2 will give a review of current research that provides evidence of the form and types of relationships between biodiversity and agricultural activities. The importance of the choice of biodiversity indicators used in research will be emphasized in sub-section 3.2.3. In contrast to the first two sections of Chapter 3, section 3.3 will deal with conceptualization of the methodological approach to the analysis of economic-environmental farm performance. First, the general context of efficiency analysis will be presented (sub-section 3.3.1). Then the concept of environmental efficiency, approaches to its evaluation, and measurement methods most often used in related literature will be introduced (sub-sections 3.3.2 and 3.3.3). Section 3.4 will consider possible limitations of the environmental efficiency approach.

Chapter 4 will generally deal with the research design for this thesis and the development of a methodological approach to environmental efficiency analysis of farming suitable for the context of this study. Thus section 4.1 will present details of the study area and the methods used for data collection. Sub-section 4.1.3 will introduce the production settings and specifically the framework of production technology, which are important within a methodological approach to efficiency analysis. Some descriptive statistics obtained from socio-economic survey will be used to present the details on farming systems in the study area. Moreover, some results from a botanical survey will be presented to evaluate the biodiversity provision in the area and emphasize the interrelation between agriculture and grassland biodiversity. Sub-section 4.1.3(iii) will deal with the calculation of the biodiversity index designed for this study. Section 4.2 will describe the research methodology for efficiency analysis. Sub-section 4.2.1 will present a Data Envelopment Analysis (DEA) approach to efficiency evaluation. The next sub-section will describe the development of the methodology suitable for the study area: first of all, a general model for efficiency evaluation will be presented; then data on inputs and outputs based on the production settings will be given; and finally additional options for efficiency evaluation available within the DEA approach will be considered. Sub-section 4.2.3 will deal with the

methodology used within the second stage of efficiency analysis in which the efficiency determinants are identified and evaluated.

Chapter 5 will present the results of the efficiency analysis. Along with the evaluation of economic and environmental technical efficiencies, the results on comparative analysis between these two measures will be presented. Section 5.3 will interpret the factors influencing efficiency scores.

These results will be discussed within Chapter 6 where the most important conclusions and their implications will be summarized. Thus section 6.1 will deal with the scientific contribution of the current thesis. The last section 6.2 will consider policy implications important within the national and international contexts.

2. Context of farming in the Ukrainian Carpathians

This chapter aims to introduce the reader the study area, the Ukrainian Carpathians, with its main characteristics and problems. However, we would like to present it within the broader context of an interrelated discourse on comparable areas within Europe, which would bring us to implications on current research results for other areas and policies, for instance, also in the European Union. To do this, we start by addressing, first generally within the European context, the most important characteristics of the region. We consider in particular the marginality of farming and the connected problems of land abandonment and landscape homogenization (section 2.1) as well as types of policies that might address these issues (for example policies applied in the European Union – see section 2.2). The next two sections, 2.3 and 2.4, deal with the related characteristics of the area in focus and with current policies implemented in Ukraine related to the issues considered.

2.1 Farming in marginal areas

Technological processes and agricultural intensification have always been problematic for marginal areas due to additional implementation costs and the necessity of special adaptation to local conditions. As a result, these marginal agricultural systems, for instance in mountainous areas, are often characterized by nature-oriented farming. Thus they have undergone certain transformations that make them a very interesting case study for investigating human-nature interactions.

First of all, it is important to summarize the most common features of marginal areas connected to agriculture. These features can be divided into environmental, economic, social, and cultural, although all of them are closely interrelated and together create a special system (Solovyeva et al., 2011).

Environmental features: (1) Nature-oriented farming areas are usually remote and disadvantaged due to difficult geographic and climatic conditions (e.g., high altitudes, complicated relief, and bad weather conditions in the mountainous areas).

(2) Moreover, they have more inclusion of natural elements (frequently as semi-natural grasslands) than fertile lowlands, and their affiliation with (need for) ecosystem services is bigger than in lowlands (Millennium Ecosystem Assessment, 2005).

Economic features: (3) The environmental issues and natural conditions mentioned above often lead to certain economic problems such as limited possibilities for intensification through mechanization due to the peculiarities of relief and topography.

(4) Therefore, farming in these areas has stayed very labour intensive. This feature also has a special interrelation with the inclusion of natural elements into the production process. For example, in mountainous areas a farmer has to invest a lot of time and workforce into the “reproductive work” as Bätzing (2015, p. 108) calls it: this work aims to stabilize the cultural landscape, which is strongly unstable from an ecological perspective. This “reproductive work” includes maintenance and construction activities such as terrace construction for arable fields to avoid soil erosion through landslides, removal of stones from fields and meadows, or necessary repairs after storms or floods (Bätzing, 2015).

(5) Limited capacity for mechanization leads to a situation where traditional, relatively small-scale farming still prevails. Its labour-intensive character makes it quite uncompetitive in comparison to intensified agricultural production from favourable agricultural areas and limits opportunities to participate in markets, which makes these farms more subsistence oriented.

(6) As a consequence, poverty and the danger of vicious cycles of underdevelopment could prevail (outmigration, loss of integration, etc., for example, “montes” in Spain: Domínguez-García, 2007).

Social and cultural features: (7) Environmental and economic peculiarities, mentioned above, create a need for support within a community, and therefore the need for collective action is bigger than in more advantageous areas. For instance, often the mountainous areas prevail as silvio-pastoral systems (Eichhorn et al., 2006) that require coordination for things such as transhumance, grazing in the forest, and common dates for mowing, harvesting wild fruits, hunting, etc.

(8) Additionally, mountains historically have often been areas for retreat, and they are characterized frequently by ethnic splits.

All these features contributed to some ambivalent reactions from farmers in many marginal areas to the modernization processes of the twentieth century. Some of the typical processes observed are modernization, farm growth, landscape changes, and loss of connectivity with nature as in some mountainous areas of Switzerland, Austria, and Norway. At the same time, abandonment of farming and forest growth as in some areas in France, Spain, Italy, etc. is

another tendency typical for remote, disadvantaged areas. One could also distinguish these processes even within one mountain chain such as the Alps. Bätzing (2015, pp. 351-352) distinguishes three types of structural changes in the Alps:

- Growth of urban centres in the plains and urbanization of tourist centres as well as intensification of the agricultural areas more suitable for farming purposes, for instance, mostly for producers with specialization in livestock breeding (Bätzing, 2015, p. 154) – modernization scenario.
- Economic and cultural devaluation of traditional economic activities including agriculture, which leads to depopulation or even disappearance of certain settlement regions – devaluation of tradition scenario;
- There are some stable rural areas where one can still find a successful combination of traditional farming and some innovative economic activities that help reach a balance between modernization and traditional components of mountain culture.

Processes of modernization or abandonment started in the marginal areas of many European countries in 1880/90. The number of agricultural enterprises in the Alpine region decreased by more than 35% between 1980 and 2011 (Bätzing, 2015, p.154). These processes of agricultural change were also characteristic for other marginal areas, for instance, in Finland, Spain, Italy, and France. Similar outcomes that led to certain landscape changes were observed (Selby et al., 1996) and were brought in the discussion of so-called “landscape closure” and landscape homogenization (Berlan-Darqu   et al., 2007). Such landscape change is characterized by transformations of semi-natural components. In areas suitable for agricultural intensification, erosion of semi-natural habitats can be observed, leading to vast areas of cultivated landscape. In contrast, “landscape closure” is more typical for more marginal areas in the mountains and Mediterranean regions, where land abandonment leads to shrub succession, and consequently large areas of forest landscape emerge (Berlan-Darqu   et al., 2007). Thus homogenization characterized by “development of binary landscapes” – vast forests and cultivated areas – has become an important issue for many countries of Western Europe (Berlan-Darqu   et al., 2007; Caplat et al., 2006; Eriksson and Cousins, 2014; Grunewald et al., 2014; Renwick et al., 2013; Lepart and Debusche, 1992; Lindborg et al., 2008).

Such developments have recently become characteristic for Eastern Europe as well, although its dynamic differs from the countries in Western Europe, and it is argued that the main driving forces are also quite different (Alix-Garcia et al., 2012; Baumann et al., 2011; Prishchepov et al., 2012; Munteanu et al., 2014; Kuemmerle et al., 2008; Palang et al., 2006; S  li-Zakar, 1999).

Specifically, land abandonment in Western Europe has a long history, and it is usually connected to processes such as urbanization, modernization (Palang et al., 2006; Bätzing, 2015), and decreasing viability of farming, which can be observed within extensive and small-scale agricultural systems (Renwick et al., 2013). In Eastern Europe the process only became prominent in the 1990s, and it is usually explained by a complex mixture of socioeconomic, institutional, and political driving forces linked to the transition from centralized to market economies (Alix-Garcia et al., 2012; Baumann et al., 2011; Kuemmerle et al., 2008; Kuemmerle et al., 2011; Palang et al., 2006):

- In particular the socialist past had a strong impact on the developments with regard to farmland abandonment. For instance agriculture was subsidized, and as a result farming was maintained even in marginal areas though it was unprofitable (Kuemmerle et al., 2011, p. 1345). Land abandonment rates became significant after the prices were liberalized, markets were opened, and governmental support was practically withdrawn.
- At the same time, the transition period characterized by difficult economic situations made agriculture an important buffer and source of survival for many people. Subsistence farming became the source of livelihood (Kuemmerle et al., 2011), and agriculture was often seen as a readjustment to the new conditions (Süli-Zakar, 1999). Small farms, even in the marginal areas, became “enterprises of necessity” (Süli-Zakar, 1999, p. 194).
- Initial conditions in the beginning of the transition period varied in different Eastern European countries, which made development in these countries take quite different paths. Land abandonment processes also were not homogenous, neither within the countries nor between them. The differences can be explained by many factors, among which are land reform endowments, differences in liberalization strategies, environmental conditions, etc. (Alix-Garcia et al., 2012; Kuemmerle et al., 2008).

The fact that Eastern Europe seems to be taking the same path of landscape development as Western Europe is commented by Palang et al. (2006, p. 349) as follows: big “turnovers” such as the breakdown of the Soviet Union and the associated socialist system could “slow down processes that would happen anyway, e.g. modernization, industrialization, globalization.” The question is if this is inevitable. Do these processes necessarily lead to the same outcomes – radical homogenization of landscapes and associated problems? For instance, it is becoming more important for many Western European countries to revert the existing abandonment trends with the help of certain policies. The next section will consider more thoroughly the problems

associated with land abandonment and currently existing policy options to prevent the worst outcomes of this process.

2.2 High Nature Value (HNV) farming: policy options to address agriculture in the marginal areas.

Various problems connected to land abandonment and associated landscape homogenization made policy makers look for suitable options to reverse certain trends linked to these processes.

It is important to mention that there are positive as well as negative effects of land abandonment. For example, Baumann et al. (2011) argue that there might be positive effects on soil erosion, water quality, carbon sequestration, and biodiversity (at least for certain species not associated with farmland). However, some types of landscapes rely on low-intensity agricultural activities to such extent that abandonment of these activities would profoundly affect ecosystems and lead to loss of valuable biodiversity (Bartolomé et al., 2005; Bolliger et al., 2007; Fonderflick et al., 2010; Csörgő et al., 2013; Baumann et al., 2011). Moreover, other negative outcomes could be permanent decreases in agricultural production and loss of cultural identity, especially in landscapes with a long land use history (Baumann et al., 2011). Therefore it is important to distinguish areas in which abandonment takes place: the ecosystems of highly intensified agricultural landscapes might benefit from farmland abandonment, whereas cultural landscapes dependent on low-intensity farming systems would be negatively affected. This leads to the recognition that conserving certain landscapes with high nature value depends on the continuation of low-intensity farming systems or traditional farming.

In this regard the concept of High Nature Value (HNV) farming is new (Beaufoy et al., 1994; Beaufoy, 2007; Andersen et al., 2003) and is one option within the European agri-environmental policy to attract attention to intact types of landscapes and address problems typical for them – decrease in farm activity, land abandonment, associated landscape homogenization, and loss of biodiversity. The HNV farming concept covers well-established conceptual approaches in farming system and landscape analysis (such as extensive farming, farming with nature provision). The concept was developed for the landscapes, within which one still finds an intact nature and ecological values have a high ranking. Therefore the main characteristics of HNV farming are the following (see Figure 2.1) (Beaufoy, 2007; Plieninger and Bieling, 2013):

- Low-intensity farming practices with respect to fertilizer implication, livestock pressure, application of pesticides, machinery, etc.