TEXT: VALUATION OF AGRICULTURAL EXTERNALITIES: ANALYSIS OF ALTERNATIVE METHODS

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Abstract
The paper focuses on the analysis of agricultural externalities and their valuation methods. Agricultural activity beyond supplying food and fibre, can also be instrumental in forming the landscape, providing natural resources, and preserving biodiversity. Furthermore, agriculture contributes to the achievement of societal goals such as the viability of rural areas and their development, food security, and preservation of cultural heritage. Positive externalities of agriculture assert in the form of public goods, whereas intensive environmentally unbalanced agricultural activity causes damage to the environment. The objectives of this paper are to define agricultural externalities and to analyse methods of their valuation. In order to achieve the research aim, characteristics of agricultural externalities in farming systems have been analysed; evaluation methods of the benefit and cost of externalities in farming systems, revealing their advantages and disadvantages have been examined, and scientific studies on evaluation of externalities have been reviewed. Methods of systemic and logic analysis were applied for analysis of agricultural externalities and their evaluation. The analysis has showed that stated preference methods are commonly used for determination of the positive externalities. The most limited methods are travel cost and hedonic pricing methods, which are suitable only for the evaluation of public goods related to recreation or leisure. For evaluation of negative externalities the external costs of agricultural activity are estimated.

Key words: agriculture, externalities, farming systems, external benefit, external cost.

Introduction
Society has predominantly viewed agriculture only as a food producer, and the science of economics has long concentrated on the issues of intensification of agriculture and promotion of its economic efficiency. However, other aspects, such as food safety and security, preservation of biodiversity, family farms, local culture and rural traditions are gaining greater importance despite the society’s view towards agriculture as “the quantity at the lowest prices”. The long list of negative externalities also leads scientists and politicians to concentrate not only on the increasing of the efficiency of agriculture, but also on inclusion of the effects of externalities into the total benefit from agriculture. It is obvious that all farms and enterprises seek higher production efficiency. However, creation of marketable goods and services is accompanied by agricultural externalities, which are non-marketable goods and services created by the agricultural activity. They come in the form of uncompensated damage or benefit to the third parties. These values must also be taken into account when evaluating the efficiency of agricultural activity. Moreover, provision of positive and negative externalities from intensive and extensive farming systems is different. Therefore, integration of externalities into the total value of agricultural activity could be useful for politicians who support the multifunctional agriculture and sustaining the effectiveness of the policy. Having determined the benefit and cost of externalities, it is easier to assess the efficiency of farming systems. This is essentially important for farms, the agricultural activity of which has great impact on environment by creation of positive and negative externalities.

Members of the academia are becoming more and more interested in evaluation of agricultural externalities. Research on valuation of agricultural externalities has been done at the national, regional, and farm level. There are studies that focus on estimation of the total external cost (Pretty, 2000; Hartridge and Pearce, 2001; Tegtmeier and Duffy, 2004), while other studies choose a specific group of externalities, for example, soil erosion (Pimentel et al., 1995; Ribaudo et al., 1999), location (Vanslembrouck et al., 2005; Le Goffe, 2000), or agricultural activity (Szabó, 2010). Thereby, scientists often concentrate on the analysis of positive or negative externalities. Although there is a great interest among scientists towards estimation of external cost and benefit and their integration into the assessment of efficiency of farming systems during the last decade, little effort has been made to estimate the cost and benefit of externalities by integration.

The objectives of this paper are to define agricultural externalities and to analyse methods of their valuation. The paper is structured as follows. The first section of the results and discussion analyses the main characteristics of agricultural externalities with a focus on intensive and extensive farming systems. The following section outlines the main valuation methods appropriate for determination of the benefit and cost caused by externalities. Attention is given to the differences between valuation methods and specifics of their application. Findings of recent studies on valuation of agricultural external benefit and cost.
are also presented in this section with the discussion on valuation of positive and negative externalities. Conclusions are drawn in the last section of the paper.

Materials and Methods
In order to achieve the research aim, analysis of economic scientific literature was done, characteristics of agricultural externalities in farming systems have been analyzed; evaluation methods of the benefit and cost of externalities in farming systems, revealing their advantages and disadvantages have been examined, the necessity of externalities evaluation was substantiated. The main focus was given to the analysis of environmental valuation methods as stated and revealed preference and cost methods.

Methods of systemic and logic analysis were applied for analysis of characteristics of agricultural externalities.

Results and Discussion
1. Characteristics of agricultural externalities in farming systems
According to the agro-technological approach, farming systems are divided into intensive and extensive farming systems. Traditionally they are supposed to be alternative farming or agricultural systems. Intensive farming is also designated as high-input farming system (Poux, 2008; Nemecek et al., 2008) or conventional farming system (Pacini et al., 2003; James et al., 1990) in scientific literature.

However, a lot of changes in the definition of extensive farming systems have occurred during the recent decades. These systems were designated to be low chemical, energy conserving, recourse efficient etc. Scientists have been using definitions of alternative, biological, natural and sustainable agriculture. In the modern scientific studies, extensive farming systems are designated as low-input farming systems (Elbersen and Andersen, 2008; Poux, 2008; Nemecek et al., 2008; Viaux, 2008; Caballero, 2007), extensive farming systems (Vickery et al., 2004; Stott et al., 2005), low intensity farming systems (Beaufoy et al., 1994; Gómez Sal and González García, 2007). Therefore, when analysing scientific literature on farming systems these definitions could be interpreted as synonyms.

The review of scientific studies (Pacini et al., 2003; Nieberg, 2004; Viaux, 2008; Scmid et al., 2008) has shown that low-input farming systems bring great benefits: environmental, social and health, including landscape aesthetic value, recreation, soil formation, flood protection and absorption of gas emissions. These farming systems are hardly dependent on external energy and input, almost do not suffer from soil erosion, preserve biodiversity, create job places for rural inhabitants, and provide high quality food for consumers. Environmental problems such as biodiversity loss caused by intensive use of herbicides and other fertilizers are increasingly emphasized in the academic studies (Reiganold et al., 1990; Poux, 2008; Nemecek et al., 2008). On the one hand, intensification of agricultural activity leads to negative externalities in the form of loss of quality of natural habitats, water, air and soil pollution. On the other hand, it is usually related to economic efficiency of production and creation of marketable goods.

Thereby, agricultural externalities are non-marketable goods and services created by agricultural activity in the form of uncompensated damage or benefit for the third parties. An externality is any action that affects the welfare of an individual or group without direct payment or compensation and may be positive or negative. The types of externalities encountered in the agricultural sector have five features: J. Pretty et al., (2000, p.114) emphasize five features of the types of externalities encountered in the agricultural sector: “their costs are often neglected; they often occur with a time lag; they often damage groups whose interests are not represented; the identity of the producer of the externality is not always known; they result in sub-optimal economic and policy solutions”.

The scientific literature analysis (Jianjun et al., 2013; Grammatikopoulou et al., 2012; Vanslembrouck et al., 2005 Kubíčková, 2004; Yrjola and Kola, 2004; Tegtmeier and Duffy, 2004; Le Goffe, 2000; Krumalova, 2002; Pretty et al., 2000) allows distinguishing the most common externalities of farming systems (table 1). They are positive or negative effects created by the agricultural activity in the form of uncompensated damage or benefit for consumers or producers.

All farming systems are multifunctional, which refers to the fact that agricultural production provides not only food and fibre, but also various non-market commodities. A range of studies (Nieberg, 2004; Viaux, 2008; Scmid et al., 2008) have acknowledged that extensive farming systems usually are the creators of the positive externalities (as cultural and traditional heritage; biodiversity is also the habitat for flora and fauna, enhances the aesthetic value of landscapes, provides conditions for recreation, as well as maintains viability of rural areas i.e. increases employment in rural areas, absorbing inhabitants with a lower educational degree). Conversely intensive or conventional farming usually creates negative externalities, which cause huge damage to ecological features of systems (soil erosion, water and air pollution, reduced biodiversity and impoverished landscape). Such negative effects are commonly generated by inaccurate and inordinate use of pesticides and fertilizers. Vaznonis (2009) emphasizes that in Lithuania during the Soviet period, intensive melioration destroyed natural meadows and
pastures, lots of wetlands, destroyed farms, lots of rivers converted to canals etc. All these consequences impoverished Lithuanian landscape, recreational potential, and decreased biodiversity.

Finally, it should be noted that agriculture, by its primary function of production of marketable goods and services, creates externalities in the form of uncompensated damage or benefit to third parties not related to that activity. Extensive farming provides public goods for the society, while intensive farming usually stipulates creation of negative externalities.

2. Valuation of agricultural externalities

The need of valuation of externalities, i.e. the calculation of benefit or the cost received occurs at two levels. At first, when political strategies are created. In this case all cost, including costs of externalities, are determined. These calculations provide information for policy creators. The analysis of externalities lets identify where the need of intervention is. On the second level, policies, programs and projects are being created or the effectiveness of the policy is analysed. In this case estimates of social costs and benefits, in the form of cost-benefit or cost-effectiveness studies, can help in decision making which agri-environmental schemes are best suited to reducing externalities or providing positive externalities.

Methods of environmental evaluation are applied generally for determination of the value (benefit or loss/cost) of non-marketable goods and services of a farming system. Scientists in environmental and natural resources economics have developed these methods specifically for assessment of non-marketable value of ecosystem goods and services. Some of them focus on the determination of consumer benefit, others on producer benefits, but the rest on calculation of the cost received.

Externalities which appear as agricultural public goods (i.e. positive externalities) are being evaluated inquiring stated preference, revealed preference; pricing and benefit transfer methods (table 2).

The evaluation of agricultural and agri-environmental policies designed to improve the provision of environmental public goods and positive externalities (or to reduce negative externalities) must account for the changes in the well-being of the benefited individuals. Therefore, stated preference valuation methods are used most often for the estimation of the benefits of agriculture goods provided for consumers. Contingent valuation and choice modelling are methods for the determination of the value of environmental goods. Both methods make use of hypothetical markets based upon carefully designed questionnaires, which are used to know the individual’s willingness to pay to obtain (or to avoid), for instance, an improvement (or a decrease) in the state of a particular externality, or a set of them. These questionnaires comprise the description of the good or service to be valued, as well as the description of the transaction that is proposed to the individual in the hypothetical market. The main difference between these valuation methods relies on the way those descriptions are made (Madureira et al., 2013).

Therefore, stated preference methods are the only way to collect information about consumers’ willingness to pay or get a compensation for the
reduction of the provision of public goods. They are based on demand-site evaluation of non-marketable goods and services, which includes non-use values. 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 externalities of agricultural activity. However, the main limitation of these methods is the nature of hypothetical markets, because respondents could over- or underestimate the value of the goods, which causes the wrong interpretation of the research results.

Revealed preference valuation methods refer to the topical behaviour of respondents, which was determined by sensing. However, when applying these methods it is impossible to calculate the non-use values of agricultural goods. Travel cost refers to determination of the travel cost for the visit to the ecosystem and shows the relation between the frequency of the visits by inhabitants to the ecosystem and travel distances. By this method it is possible to determine the value of recreational goods as well as other values specific to this locality. The number of visitors and travel costs show the demand for forest locality and allows calculating the consumer benefit value provided by the ecosystem. Hedonic pricing method is usually used for the assessment of aesthetic or other qualitative features such as air quality, landscape beauty and cultural values. As Freeman (1993) has noted, this hedonic method is used for determination of the benefits of environmental goods, directly influenced by the market price.

It should be noted that revealed preference valuation methods are quite limited, because on the one part they are suitable for the determination of the use value, on the other part they could be applied for goods users only. For example, different externalities 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).

With the lack of information on particular localities, the benefit transfer methods, which refer to the evaluation of the benefits of other localities and goods of ecosystems provided through the market and not through the market, can be applied. There are three following methods: unit value, benefit function transfer and Meta-analysis methods. Benefit transfer methods are defined as the least reliable valuation type in scientific literature (Arigoni Ortiz and Serôa da Motta, 2002), because the willingness of the inhabitants from different localities to pay usually differs; moreover, the differences of the salaries of inhabitants from different localities are not taken into consideration, and the level of income differs not only on the national, but also on the regional level.

Cost calculation is used for determination of the value of positive and negative externalities. Cost methods are commonly used for evaluation of

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<th>Subject of valuation</th>
<th>Application</th>
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<td>Stated preference methods</td>
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<tr>
<td>Contingent valuation</td>
<td>Determination of the amount of money the respondent is willingness to pay for support/maintenance of certain public goods</td>
<td>All values of public goods</td>
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<td>Kubíčková (2004)</td>
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<tr>
<td>Choice modelling</td>
<td>Determination of the value of public goods by using respondents’ choice to maintain certain environmental instruments</td>
<td>All values of public goods</td>
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<td>Jianjun et al. (2013)</td>
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<td>Grammatikopoulou et al. (2012)</td>
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<td>Revealed preference methods</td>
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<tr>
<td>Travel cost</td>
<td>Determination of the respondents’ travel price to get to the recreational place by evaluating their alternative cost</td>
<td>Recreational benefit</td>
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<td>Heal (2000)</td>
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<td>Hedonic pricing</td>
<td>Determination of public goods’ value by using the differences of the prices of the real property/estate where these public goods are provided and where are not.</td>
<td>air quality, landscape beauty, cultural values</td>
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<td>Vanslembrouck et al. (2005)</td>
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<td>Le Goffe (2000)</td>
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<td>Benefit transfer methods</td>
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<tr>
<td>Unit value transfer</td>
<td>Determination of the benefits of other localities and goods of ecosystems provided through the market and not through the market</td>
<td>All values of public goods</td>
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<td>Brouwer (2000)</td>
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<td>Benefit function transfer</td>
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<td>Brouwer and Spaninks (1999)</td>
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<td>Meta-Analysis</td>
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<td>Randall et al. (2008)</td>
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environmental goods and services by determination of the farmers’ damage or income loss caused by sustainable farming. Assessing the value of negative externalities the damage for environment and human health caused by agricultural activity is being calculated (Pretty et al., 2001; Tegtmeier and Duffy, 2004).

Krumalova (2002) assessing the value of positive externalities, i.e. enhancement of biodiversity, the maintenance of nutrient balance and genetic resources calculated 3 types of costs: opportunity, prevention and restoration cost of farming. The opportunity costs were calculated as income loss from lower production intensity in comparison with intensive farming; prevention costs as farming income, which would be lost by ensuring some benefits as pollution prevention by exclusion of fertilizers and pesticides; restoration cost as future expenditure for renewal of degraded meadows and pastures. Scientists (Pretty et al., 2000) notice that calculation of such „future“ costs gives a lot of uncertainties, therefore to avoid these difficulties of evaluation they suggest calculating only the financial costs of agriculture.

Pretty et al., 2000 assessing the total external costs of UK agriculture have estimated two types of damage costs: treatment or prevention costs (those incurred to clean up the environment and restore human health to comply with legislation or to return these to an undamaged state); administration and monitoring the costs (those incurred by public authorities and agencies for monitoring environmental, food and health parameters). They have included external costs only, (i.e. the costs incurred by the rest of society for the actions by farmers) disassociating from additional private costs borne by farmers themselves, such as from increased pest or weed resistance from pesticide overuse, or for training in pesticide use, storage and disposal. Therefore, the authors have estimated only the externalities that cause financial costs. Based on the methods applied by Pretty et al. (2000), another study was carried out to estimate monetary values of external costs of agricultural and dairy production in the United States. Tegtmeier and Duffy (2004) estimated external cost per cropland. The authors calculated technical externalities with public good features.

Cost calculation helps avoiding gaps in valuation comparing with, for example, willingness to pay for public goods principle. First, this limits a part of determinants that make valuation difficult; second, it helps to avoid uncertainties related to arising cost in a specific situation in agriculture. This method does not allow determining the value of externality, as it evaluates the social cost of the specific externality only. However, estimation of external cost is a very complicated process, requiring lots of diverse statistical information from various institutions, which is very difficult to obtain.

Krumalova (2002) emphasizes that evaluating externalities invoking different methods (for example, the landscape by contingent valuation, other by replacement cost and etc.) it would not be appropriate to sum all values to one indicator. First, the value of externalities could be deputized or be to a part of other externality, second, the value of the benefit or damage of the same externality could differ subject to the methods invoked. In this case, the aim of one indicator does not have the meaningful interpretation.

Following the review of valuation methods on agricultural public goods, it should be noted that the valuation and analysis of externalities occur on two levels. On the first level, by invoking different valuation methods, as environmental evaluation and cost calculation, the cost or benefit is estimated, which

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### Table 3

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<th>Evaluation methods</th>
<th>Aim of evaluation</th>
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<td><strong>Opportunity costs</strong> Krumalova (2002)</td>
<td>Evaluation of possible cost or income loss due to implementation of agri-environmental schemes. The value of the positive externality estimated as an income loss from lower production intensity in comparison with intensive farming in average.</td>
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<td><strong>Prevention costs</strong> Krumalova (2002) Pretty et al. (2000) Tegtmeier and Duffy (2004)</td>
<td>Those incurred to clean up the environment and restore human health to comply with legislation or to return these to an undamaged state.</td>
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<tr>
<td><strong>Restoration costs</strong> Krumalova (2002)</td>
<td>Determination of the price which was paid for the changes or improvement of providing public goods damaged ecosystem.</td>
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could be used for developing policy strategies. On the second level, policies, programs and projects are being created or the effectiveness of the policy is analysed in the context of integrated externalities.

The stated preference methods are commonly used for determination of positive externalities, i.e. contingent valuation and choice modelling in scientific research. The main reason for choosing this group of methods is estimation of all values of public goods. The most limited methods are travel cost and hedonic pricing methods, which are suitable only for the evaluation of public goods related to recreation or leisure. For evaluation of negative externalities, external costs of agricultural activity are calculated after defining the types of costs and disassociating them from certain factors. Estimation of external cost is a very complicated process, requiring lots of diverse statistical information from various institutions. Therefore, cost-based measures, which include other approaches, like the restoration or replacement costs, should not be used to measure positive externalities because they do not reveal any link with the individuals’ preferences for these benefits.

Conclusions
1. Agriculture, by its primary function of production of marketable goods and services, creates externalities in the form of uncompensated damage or benefit to third parties not related to that activity. Extensive farming provides public goods for the society, while intensive farming usually stipulates creation of negative externalities.
2. Externalities which assert as agricultural public goods are being evaluated invoking stated preference, revealed preference and benefit transfer methods, where the main information source is consumers’ questionnaire.
3. Stated preference methods are commonly used for determination of positive externalities, i.e. contingent valuation and choice modelling. The main reason for choosing this group of methods is estimation of all values of public goods. The most limited methods are travel cost and hedonic pricing methods, which are suitable only for the evaluation of public goods related to recreation, or leisure.
4. Cost calculation helps avoiding gaps in valuation comparing with, for example, willingness to pay for public goods principle. First, this limits a part of determinants that make valuation difficult; second, it helps to avoid uncertainties related to arising cost in a specific situation in agriculture.
5. Cost methods do not allow determining the value of externality, as it evaluates the social cost of the specific externality only. However, estimation of external cost is a very complicated process, requiring lots of diverse statistical information from various institutions, which is not easily available.

References


