International Journal of Economic Sciences and Applied Research 2 (1):71-88

Environmental benefit, side effects and objective-oriented financing of agri-environmental measures: case study of Poland

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Abstract

In this paper we investigate how to allocate the available budget for agri-environmental measures to maximise environmental benefits and to minimise potential negative side effects resulting for farmers from the implementation of agri-environmental measures. According to the governmental and EU regulations farmers should be fully reimbursed with compensation payments for the implementation of agri-environmental measures and thus for their environmental services. However, research results from Poland show that negative side effects, such as income losses, were not totally compensated in Poland in the first years after the accession to the European Union. The investigation proves significant dependences between the environmental benefit, side effects resulting for farmers, and an objective-oriented budget allocation for agri-environmental measures in the Subcarpathia region studied.

Keywords: Agri-environmental Policy, Policy Evaluation and Design, Decision-making Support, Linear Programming

JEL classification : Q51, Q57, C61

1. Introduction

Agri-environmental programmes are obligatory political tools for the policy of rural areas in all EU member states; however, they are optional for farmers. According to the EU 1257/99 regulation (European Commission, 1999) which was in force till 2006, farmers were reimbursed for their environmental services and the implementation of agri-environmental measures by means of compensation payments. In these payments an additional premium was also included in order to inspire farmers to participate.[1]

[1] According to the new EU regulation 1698/05, which has been in force since 2007, the compensation payments cover solely implementation costs and income losses resulting from the implementation, and eventually transaction costs, while no simulation incentives are given (European Commission, 2005).

Several studies have been conducted on different political aspects, the importance and appropriate level of compensation payments for environmental services delivered by farmers with the implementation of agri-environmental measures. Most of these studies address the question of the cost-effectiveness of compensation payments (Drechsler et al., 2007; Link et al., 2006; Ulbrich et al., 2008). Drechsler et al. (2005) state however, that little experience is given with regard to this topic, as the estimation of cost-effectiveness of compensation payments requires integrating different ecological and economic aspects. With the aim to address these needs and to combine economic and ecological issues, different models have been developed (Hanley et al., 1998; Johst et al., 2002; O'Carroll, 1994: 72). Glebe (2006) states that the system to support agri-environmental measures based on the ratio of compensation payments and environmental benefits (as already common in the European Union) it is not as much cost-effective as a bid ranking system practised in the United States (see: Latacz-Lohmann and van der Hamsvoort, 1997; Moxey et al., 1999; Willis, 2002; Wu and Babcock, 1996). Wu and Boggess (1999) address the problem of pooling effects of environmental benefit (cumulative effects and interrelations among alternative environmental benefits) which can influence an efficient allocation of budgetary funds for environmental protection (compare also Hajkowicz et al. (2005) and Glebe (2007)).

From the perspective of different approaches to investigate compensation payments for agri-environmental measures, there arises the question of, how far and to what extent compensation payments can cover all realisation costs of agri-environmental programmes and what negative side effects can be expected. The aim of the paper is thus to analyse, in the context of objective-oriented budget allocations for agri-environmental measures in Poland, different relations between the environmental benefit expected by the implementation of the measures and the real effects (income losses resulting for farmers). This paper contributes to the previous research while investigating the question of relations between farmers' objectives and environmental objectives, based on an explorative case study in the region Subcarphatia in South-Eastern Poland.

The paper is structured as follows. The next chapter provides an overview of the development and structuring of agri-environmental programmes in Poland in the last years. In the following section, the case study region is characterised. Next, the research methodology is presented. Following, modelling results of an objective-oriented budget allocation for agri-environmental measures are discussed and scenarios for environmental benefits by different policies (reduction of negative side effects for farmers or else maximisation of environmental benefits) are analysed. Finally, conclusions and policy recommendations are drawn. The results of the study can help to detect negative effects resulting from the agri-environmental policy and to consider them in future development plans to use and implement European and national funds more effectively.

2. Agri-Environmental Measures in Poland

The realisation of agri-environmental programmes has been obligatory for the policy of rural areas in Poland since the accession to the European Union in May 2004. The main objective of agri-environmental programmes is to protect and improve the environment, the landscape and its features, the natural resources, the soil and genetic diversity (European Commission, 1999: 90). The support for agri-environmental activities is granted to farmers who pledged to meet all agri-environmental commitments (exceeding requirements of the "good farming practice") for at least five years. The support is granted annually and should be calculated by the proper national or regional administration offices on the basis of: income losses, additional costs resulting from the commitment given, and - till 2006 - the need to provide an incentive (stimulation premium). Environmental protection in agriculture, in the form provided by the European regulations, it is relatively new in Poland. Before the accession of Poland to the European Union, several measures were undertaken to protect natural resources in agriculture. The first measures were defined in 1990 with the National Environmental Policy"(Ministry of Environmental Protection, Natural Resources and Forestry, 1991). Additional agri-environmental measures were planned within the programme SAPARD (Special Accession Programme for Agriculture and Rural Development) for the period 2000-2006. However, due to political strategy changes and to missing legal rules, the planning and realisation of agri-environmental measures were abandoned under the SAPARD (MRiRW, 2002). The first successful agri-environmental measures were realised in 2000 and 2001 within the EU project Phare99 in the two regions of Poland: Subcarphatia (South-East of Poland) and Warmia-Masuria (North-East). For the first years of membership in the European Union (2004-2006) seven agri-environmental measures were proposed by the Polish Ministry of Agriculture and Development of Rural Areas and approved by the European Commission to be financed within the National Agri-Environmental Programme. The measures are 'Sustainable agriculture', 'Organic farming', 'Extensive meadow farming', 'Extensive pasture farming', 'Soil and water protection', 'Buffer zones', and 'Domestic farm animal species'. The National Agri-Environmental Programme is an integral part of the Plan for Development of Rural Areas and the available budget for agri-environmental measures amounted to 348.9 million € in 2004-2006. The National Agri-Environmental Programme is co-financed by the European Agricultural Guidance and Guarantee Fund (EAGGF) (80%) and by the Polish state budget (20%) (MRiRW, 2004a).

As the agri-environmental measures are new, little experience is given both with regard to financing and design of these measures and with regard to potential negative side effects, such as spillover effects or income losses, which can be generated while the implementation of the measures. There are also no studies known addressing the question how to design agri-environmental policy and how to handle these effects while planning budget allocations. These questions are discussed in this paper.

3. Case Study Region

The discussion in this paper is based on results of a case study conducted in the Subcarpathia region of South-Eastern Poland in 2005. The region was chosen due to its valuable natural resources and specific economic conditions. In the region, 80 nature reserved areas are registered and about 16 % of the region area is acknowledged as landscape parks. Additionally, about 45.5 % of the region area is included in 17 landscape protection areas (Sołtysiak et al., 2002: 21). Most areas in the region are involved in the Euro-region Carpathia (an association of Carpathian regions between five neighbour countries of the Central and Eastern European Countries: Poland, Ukraine, Romania, Hungary, and Slovakia) with the aim to efficiently and sustainably use natural resources in all associated countries. The necessity of an efficient use of natural resources is strengthened by the economic situation in the region which has the third highest number of agricultural farms in Poland (311.855) (Urząd Statystyczny w Rzeszowie, 2003: 20; Główny Urząd Statystyczny, 2003: 171). The employment share in agriculture amounts again to about 26-47 % (Podkarpacki Urząd Wojewódzki, 2004). Thus, the agricultural production has a great effect on the utilisation of natural resources. The average size of agricultural farms in the region amounts to 3.5 ha (Dmochowska, 2003) which is very little in comparison to large-sized farms in other countries of the European Union (17.5 ha on average) (Boschma et al., 2005). The named characteristics of natural and economic conditions in the region help us to emphasise the question of the importance of effective financing of agri-environmental programmes and the need to diminish potential side effects for farmers.

4. Methodology of The Case Study: Analytic Hierarchy Process And Linear Programming Approach

We study to what extent negative side effects of agri-environmental policy such as income losses resulting for farmers from the implementation of agri-environmental measures and spillover effects can influence budget allocations for agri-environmental measures and the environmental benefit. Spillover effects are defined as negative effects appearing in situations when farmers' incomes from compensation payments for the realisation of agri-environmental programmes exceed their realisation costs of these programmes. This means positive economic effects for farmers but no environmental improvement. In the opposite case (realisation costs > compensation payments), income losses for farmers are presumed as a subsequent effect which is potentially realistic due to the immeasurable character of the realisation costs (e.g. additional individual labour input of farmers and their families not calculated in compensation payments). In the past years spillover effects were not very relevant and, therefore, they have not been widely discussed either in political or scientific debates. However, the limited availability of the European funds requires undertaking a thorough revision and control of potential negative effects in the agri-environmental policy. This problem indicates also the question of relations between farmers' interests to secure productivity and to improve economic situation of their farms and political interests to improve environmental benefits by agri-environmental programmes. In this paper, we undertake this question

and concentrate our analysis on implications of negative side effects (spillover effects and income losses) on budget allocations for agri-environmental measures in Poland, after the accession to the European Union, based on results of a case study conducted in the Subcarpathia region in September 2005. As political decisions regarding agri-environmental policy in Poland are taken centrally by the Ministry of Agriculture and Development of Rural Areas in Warsaw, regional preferences in this term are not considered in political decision-making processes. In this paper, the importance and necessity to analyse such problems separately on the regional level are stressed, in order to improve objective-oriented priority setting in agri-environmental policy. Taking into account the named aspects, the methodological objective of the paper is to model and simulate financing strategies for agri-environmental measures with the aim to minimise income losses resulting for farmers from the implementation of agri-environmental measures and/ or to maximise environmental benefits (environmental quality). Additionally, preferences of different stakeholders can also widely influence decisions on financing of agri-environmental measures. Therefore, three stakeholder groups were interviewed in the Subcarpathia region and their estimations incorporated in the model:

a) 8 agricultural administration experts in the Marshal Agency [2] in Rzeszów in the Division for Agriculture and Rural Development responsible for administrative issues on rural development in the region.
b) 26 agri-environmental advisors from all counties in the region responsible for delivering of information and support for farmers in terms of environmental protection in agriculture.
c) 100 farmers chosen from all 21 counties in the region as a random sample. The choice was adapted to the requirement to include farmers participating in each form of agri-environmental measures.

Using the Analytic Hierarchy Process (AHP) according to Saaty (1990) the interviewed stakeholders estimated the importance of the seven agri-environmental measures. The estimation has been conducted in pairwise comparisons between all measures by means of the scale 1-9, where 1 = the compared measures have the same importance and 9 = the first compared measure is dominantly more important than the second measure. Following measures were pairwise compared: 'Sustainable agriculture', 'Organic farming', 'Extensive meadow farming', 'Extensive pasture farming', 'Soil and water protection', 'Buffer zones', and 'Domestic farm animal species'. The importance of the measures was estimated with regard to the three environmental objectives ('Protection of natural resources', 'Protection and conservation of biodiversity', and 'Conservation of cultural landscape') defined in the National Agri-environmental Programme 2004-2006. This estimation allowed to define ratio relations, recommended in cases where no reference criteria are known for environmental benefits. The estimated parameters were

[2] Marshal Agency is a governmental regional administration unit responsible for public affairs in the region.

normalised and priority vectors were estimated which reflect the assessed importance of the measures and can be expressed as the relation of environmental benefits (environmental quality) per one monetary unit (1 €) of the respective agri-environmental measures. These vectors were further incorporated in the Linear Programming approach (LP) according to Kirschke and Jechlitschka (2002). The vectors were used as objective coefficients (table 1, line 6-8) with the aim to investigate scenarios for an objective-oriented budget allocation for agri-environmental measures while basing on previous experience with policy modelling and design (Kirschke et al., 2004, 2007). For this reason an aggregated objective function was defined which reflects environmental benefit expected from the implementation of the agri-environmental measures. The objective function was defined as a sum of objective functions for each environmental objective: 'Protection of natural resources', 'Protection and conservation of biodiversity', and 'Conservation of cultural landscape' (formula 1).

$$(1) \qquad \max_{BA_1,\ldots,BA_n} Z = \alpha_1 \sum_{i=1}^{n} z_{1i}\ BA_i + \alpha_2 \sum_{i=1}^{n} z_{2i}\ BA_i + \alpha_3 \sum_{i=1}^{n} z_{3i}\ BA_i$$

with: Z – aggregated objective function,
$i = 1, \ldots, n$ – index for the agri-environmental measures,
$z_{1i,\ 2i,\ 3i}$ – constant objective coefficients (for the three objectives respectively) of one monetary unit of the measure i,
BA_i – budget expenses for the measure i,
α – weighting factor for the objectives,
and $\alpha_1 = \alpha_2 = \alpha_3 = 1$.

The objective function for each objective was defined as a sum product of the estimated objective coefficients and budget expenses for the respective agri-environmental measures. For each objective, objective weights of 1 were considered in the objective function, which denotes the same importance of the objectives in the basis scenario. Additionally, three constraints were defined and included in the LP model such as total available budget for agri-environmental measures (formula 2), restriction for income losses resulting for farmers from the implementation of agri-environmental measures (formula 3), and maximal possible farming area under agri-environmental programmes (formula 4). These constraints were defined in order to consider regional environmental and economic conditions in the Subcarpathia region as well as to define feasible solution space for the objective function.

$$(2) \quad BA_1 + BA_2 + BA_3 + BA_4 + BA_5 + BA_6 + BA_7 \leq 2\ 500\ 000$$

$$(3) \quad a_1 * BA_1 + a_2 * BA_2 + a_3 * BA_3 + a_4 * BA_4 + a_5 * BA_5 + a_6 * BA_6 + a_7 * BA_7 \leq 2\ 500\ 000$$

$$(4) \quad b_1 * BA_1 + b_2 * BA_2 + b_3 * BA_3 + b_4 * BA_4 + b_5 * BA_5 + b_6 * BA_6 + b_7 * BA_7 \geq 20\ 000$$

with:

$BA_{1\text{-}7}$ – budget expenses for the measures,
$a_{1\text{-}7}$ – coefficients for the income losses constraint,
$b_{1\text{-}7}$ – coefficients for the farming area constraint.

The budget constraint (formula 2) denotes that the sum of the budget expenses for all measures cannot exceed 2.5 million €. The restriction reflects the situation of budget scarcity and a budget cut of 20 % (3.1 million €) compared to the total available budget in the Subcarpathia region in 2005. We simulate the budget scarcity to analyse the objective-oriented budget allocation in terms of the future changes in the European policy which expects budget cuts for different political tools and activities.

The income losses constraint (formula 3) denotes that the sum product of the budget expenses (BA_{1-7}) and the coefficients for this constraint (a_{1-7}) may not exceed 2.5 million € which is equal to the budget restriction for the agri-environmental measures. The constraint coefficients were estimated as the index of the total costs resulting for farmers from the implementation of agri-environmental measures and the budget transfers to farmers (compensation payments). The total costs resulting for farmers from the implementation of agri-environmental measures were estimated as a product of direct costs and the farming area under the respective agri-environmental measures in the region Subcarpathia. The direct costs were estimated on the basis of calculations from the Ministry of Agriculture and Development of Rural Areas in Warsaw (MRiRW, 2004b). According to the Ministry, the following parameters were included for the calculation of direct costs:

– Farmers' income losses which would not appear in case of conventional production activities e.g. losses in harvest amount.
– Additional costs (e.g. additional labour force, additional protection activities – regular mowing, soil tests, preparation of fertilization balance, implementation of machines for protection activities, seed purchase, new feeding ratios for animals).
– Additional benefits (measured as savings from environmental activities such as reduction of fertilization costs, reduction in applied production factors, improvement of soil quality, and additional incomes from the product sale).

The farmers' income losses and additional costs were summed and minimised by additional benefits in order to avoid an offset of costs and benefits.

Additionally, the constraint of farming area was considered (formula 4). The left side of the constraint was defined as a sum product of the constraint coefficients (b_{1-7}) and budget expenses (BA_{1-7}) for the respective measures. The coefficients were calculated as a ratio of one monetary unit (here: 1,000 €) and the compensation payment rates for the respective measures in 2004-2006. The right side of the constraint was set to 20,000 ha and estimated with regard to the minimal farming area (19,000 ha) which guarantees the maximal environmental benefit in the defined LP approach. From an ecological point of view, the farming area under agri-environmental programmes should be enlarged to maximise the environmental benefit. Therefore, the restriction was set to 20,000 ha exceeding the minimal farming area to be supported to maximise the environmental benefit. Moreover, a non-negativity constraint was assumed in order to exclude negative budget allocations.

The coefficients for the model constraints as well as other variables in the basis scenario are presented in table 1.

Table 1: Coefficients for the agri-environmental measures and model variables in the basis situation for the region Subcarpathia

		Sustainable agriculture	Organic farming	Extensive meadow farming	Extensive pasture farming	Soil and water protection	Buffer zones	Domestic farm animal species	Sum	
1.										
2.	Current allocation	143,7	733,7	1435,9	142,8	571,3	1,1	56,3	3084,8	Current allocation (Thousand €)
3.	Optimal allocation - experts	48,3	79,8	1114,4	0,0	1142,6	2,2	112,7	2500,0	Upper bound for total budget (Thousand €)
4.	Optimal allocation - agri-environmental advisors	207,1	110,0	2182,9	0,0	0,0	0,0	0,0	2500,0	Upper bound for total budget (Thousand €)
5.	Optimal allocation - farmers	287,3	105,4	2107,3	0,0	0,0	0,0	0,0	2500,0	Upper bound for total budget (Thousand €)
6.	Objective coefficients - experts	**12,4**	**16,7**	**12,7**	**12,5**	**16,9**	**14,8**	**13,9**		Objective coefficients (aggregated)
7.	Objective coefficients - agri-environmental advisors	**15,2**	**22,8**	**21,1**	**18,6**	**7,8**	**6,3**	**8,2**		Objective coefficients (aggregated)
8.	Objective coefficients - farmers	**18,4**	**22,9**	**18,1**	**16,2**	**10,2**	**6,8**	**7,5**		Objective coefficients (aggregated)
9.	Upper bounds	287,3	1467,4	2871,7	285,6	1142,6	2,2	112,7	6169,6	Total upper bound for the measures (Thousand €)
10.	Lower bounds	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	Total lower bound for the measures (Thousand €)
11.	Income loses	1,0	4,1	0,8	0,8	0,9	0,8	0,9	2500,0	Upper bound for income loses (Thousand €)
12.	Farming area	29,4	5,3	6,1	12,6	9,9	0,0	0,0	20000	Lower bound for the farming area (ha)

Source: Author's calculation

In line 2-5, current (2005) and the calculated optimal (objective-oriented) budget allocation are displayed followed by the objective coefficients (line 6-8), upper and lower bounds (line 9, 10), coefficients for income losses (line 11), and coefficients for farming area (line 12). On the right side, restrictions for the constraints are defined.

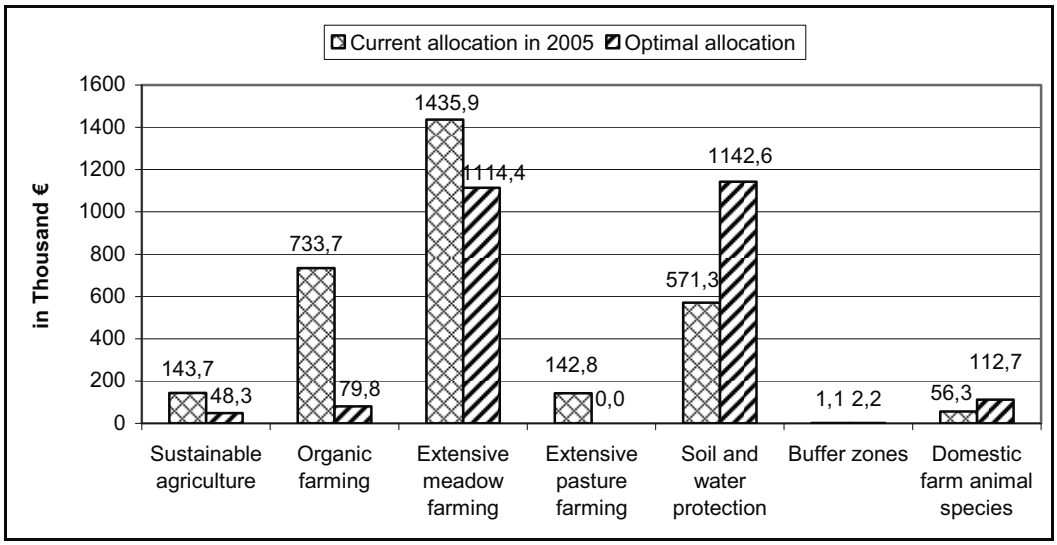
The current allocation in 2005 (line 2) was estimated on the basis of farmers' applications for agri-environmental measures in 2005. The upper budget bounds were defined as 200 % of the current allocation for agri-environmental measures which creates a realistic limitation of the possible solution space for the objective function. The lower budget bounds were set to 0 which indicates that no restrictions in terms of the minimal required financial support for agri-environmental measures were defined by national regulations. It can be explained by the fact that the participation in agri-environmental programmes is voluntary for farmers. Under the given restrictions the aggregated objective function (formula 1) was maximised and the optimal budget allocation was calculated in the basis scenario.

5. Financing Agri-Environmental Measures Subject to Environmental Benefit and income Losses Resulting for Farmers

The methodological analysis of this paper addresses the question of how to allocate the available budget for agri-environmental measures in order to maximise environmental benefits and/ or to minimise negative side effects (potential income losses) resulting for farmers from the implementation of these measures. The optimal (objective-oriented) budget allocation (figure 1) for the named situations was estimated for agricultural administration experts who are defined as political representatives of national decision-makers on a regional level. The optimal budget allocation is estimated for constant

compensation payments for the period 2004-2006 and for farmers participating in the Agri-environmental Programme in the region Subcarpathia in 2005.

Figure 1: Objective-oriented budget allocation for agri-environmental measures for the region Subcarpathia in the basis situation



Source: Author's calculation

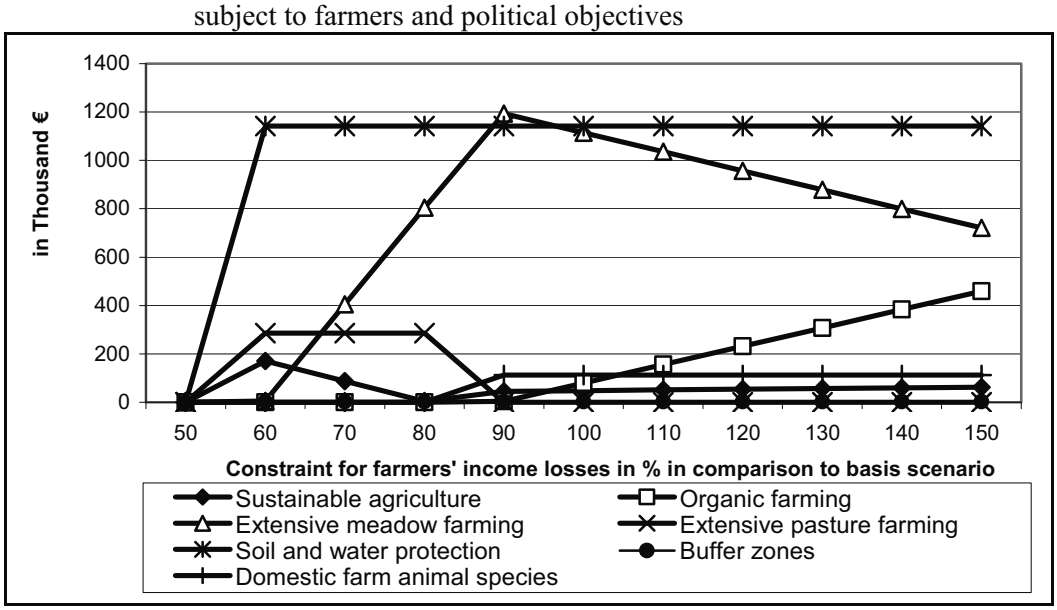
According to the objective-oriented budget allocation in the basis scenario, the measures 'Extensive meadow farming' and 'Soil and water protection' should be financed at the highest level of more than 1.1 million €. Other measures such as 'Domestic farm animal species', 'Organic farming', 'Sustainable agriculture', and 'Buffer zones' should be financed on a relatively low level between 48.3 thousand € and 112.7 thousand €, while the measure 'Extensive pasture farming' should not be supported. With regard to differences between the current and the optimal allocation, in order to maximise the environmental benefit reflected with the objective function, the budget should be extended for only three measures: 'Soil and water protection', 'Buffer zones', and 'Domestic farm animal species'. All other measures should be reduced.

The presented budget allocation shows basis scenario analyses. In order to prove the sensitivity of the integrated model variables, we analyse the question of how changes of different variables (and thus changes of economic and ecological conditions in the Subcarpathia region) would influence the objective-oriented budget allocation. For this reason, we parameterise the constraint of income losses and analyse how a differentiation of political objectives to maximise the environmental benefit with agri-environmental measures and farmers objectives to minimise potential negative effects such as income losses can influence an optimal budget allocation and financing of

agri-environmental measures in the region. At this point there arises the question of the willingness of farmers to implement agri-environmental measures if negative effects of their participation in the programmes can be expected. The potential negative effects resulting for farmers (which should be reimbursed with compensation payments) do not disturb the participation as they cannot be predicted and qualitatively measured. For example, the individual labour input of farmers and their families (much more exceeding the standard desk calculations made by the Ministry of Agriculture and Rural Development) can in many cases not be covered by compensation payments. Additionally, the estimation of the total benefit of agri-environmental measures is not possible due to missing data and intangible (immeasurable) character of these variables. As both variables are quantitatively immeasurable, we assume that the willingness of farmers to participate in agri-environmental programmes is not distorted by this fact.

In order to investigate the named relations, we simulate and calculate objective-oriented budget allocations with regard to the analysed questions of maximising the environmental benefit or minimising potential negative effects for farmers. For this reason, the right side of the constraint in the basis scenario (2.5 million €) was parameterised (weighted) between 50 % and 150 %. The weight of 100 % represents the basis scenario. Weighting the restriction between 100 % and 50 % means that we tend to minimise negative effects for farmers (minimisation of income losses), while weighing the restriction between 100 % and 150 % indicates that we tend to maximise the environmental benefit (apart from side effects for farmers) (figure 2).

Figure 2: Objective-oriented budget allocation for agri-environmental measures subject to farmers and political objectives



Source: Author's calculation

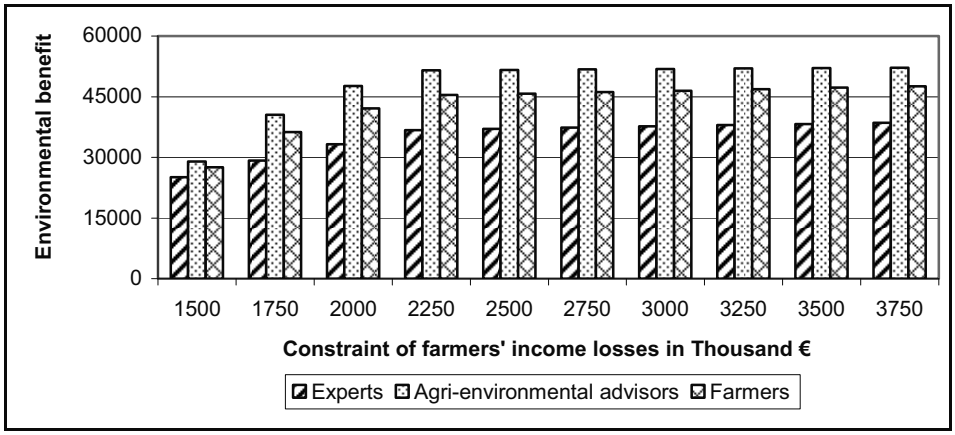
According to the results, the objective-oriented budget allocation in the basis scenario is very sensitive to changes of the analysed restrictions. Setting out from the basis point of 100 % we parameterise the restriction of income losses between 100 % and 150 % and thus simulate the situation of growing importance and maximisation of the environmental benefit. The results show that in such a case the financing of the measure 'Extensive meadow farming' should be reduced, while the measure 'Organic farming' should be simultaneously extended. Thus, a visible trade-off between these measures can be clearly stated. The parameterisation has no considerable effect on financing of other measurers such as: 'Soil and water protection', 'Buffer zones', and 'Domestic farm animal species' while the support for the measure 'Sustainable agriculture' is increasing only to a very limited extent. The measure 'Extensive pasture farming' is not supported.

The results prove that the political and farmers objectives to improve the environmental benefit and to protect farmers from potential negative effects are in a large contradiction to each other and with regard to an optimal budget allocation for the agri-environmental measures.

6. Environmental Benefit of Agri-Environmental Measures Subject to Income Losses of Farmers

The estimated changes of the budget allocation at different levels of income losses are directly correlated with the environmental benefit expressed with the objective function. We analyse the relations between these two variables for all interviewed stakeholder groups in order to emphasise divergences of the environmental benefit from different perspectives in the region. Taking into account opinions of different stakeholders we strive to consider more completely regional preferences and priorities with regard to environmental protection in agriculture in the Subcarpathia region. For this reason we analyse the objective function values by different restriction values of the constraint of income losses. Setting out from the basis restriction value of 100 % (2,500,000 €) the results show that a policy focused on minimising negative effects resulting for farmers (objective function values between 1,500,000 € and 2,500,000 €) leads to a gradual decrease of the environmental benefit reflected with the objectives 'Protection of natural resources', 'Protection and conservation of biodiversity', and 'Conservation of cultural landscape' (figure 3). This tendency is common for all stakeholder groups.

Figure 3: Environmental benefit of agri-environmental measures subject to income losses from the point of view of different stakeholders

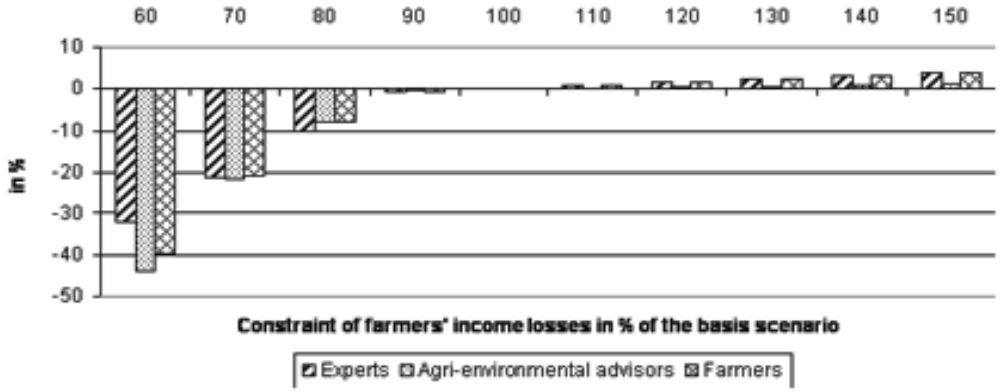


Source: Author's calculation

While minimising negative effects for farmers by each 10 % (starting from the point of 2,250,000 €) the environmental benefit should decrease by 10-13 % proportionally.

Another policy focused on maximising the environmental benefit, apart from negative effects resulting for farmers, would lead to a very slight increase of the environmental benefit. For both policies (maximising environmental benefit and minimising negative effects for farmers) the highest environmental benefit can be achieved according to the assessments given by agri-environmental advisors and farmers. In order to make statements about relative changes of the environmental benefit while realising the discussed policies, the objective function values were expressed in percentage compared to the basis scenario. The changes are presented in figure 4.

Figure 4: Changes of environmental benefit at different levels of the constraint of farmers' income losses



Source: Author's calculation

According to the results, the target to minimise negative effects for farmers by 20 % brings about a decrease of the environmental benefit by approximately 10 % from the point of view of all interviewed stakeholders. However, much more protective policy and minimising the negative effects (reducing income losses) by 40 % results in a decrease of the environmental benefit by 32 % from the point of view of experts, by 43 % from the point of view of the agri-environmental advisors, and by 40 % from the point of view of farmers. Thus, minimising negative effects resulting for farmers and thus protecting farmers' economic interests requires a strong limitation of environmental benefit expressed with the objectives 'Protection of natural resources', 'Protection and conservation of biodiversity', and 'Conservation of cultural landscape'. In contrast, a promoting policy for the environmental benefit (apart from negative effects for farmers) indeed helps to improve 'Protection of natural resources', 'Protection and conservation of biodiversity', and 'Conservation of cultural landscape', however, the increase of the environmental benefit is insignificant. The maximal value of the environmental benefit by the constraint level of farmers' income losses of 3.75 million € is higher by only 4 % (from the experts' and farmers' viewpoint) compared to the basis scenario and by only 1 % from the point of view of agri-environmental advisors.

7. Conclusions and Policy Recommendations

With the accession of Poland to the European Union new chances and development prospects for the Polish agri-environmental policy have been established. The membership in the European Union created new possibilities for protection of natural resources in the Polish agriculture as well as new challenges regarding an effective evaluation and financing of agri-environmental policies. In this paper, relations and dependencies between the environmental benefit of agri-environmental measures and potential negative effects for farmers are investigated and an optimal (objective-

oriented) budget allocation for agri-environmental measures is estimated. As agri-environmental measures are acknowledged as farmers' services for the environment and the society, the implementation of the measures is reimbursed from public funds (European and national funds) in order to cover all costs and to motivate farmers to participate. However, the results of the study in Poland proved that negative effects (such as income losses) result for farmers. Thus, a contradiction between farmers' objectives to secure their income and the political objectives of agri-environmental measures to improve the environmental benefit were found for Poland in the first membership years 2004-2006.

The results of the investigation prove significant dependencies between the level of negative effects for farmers and an objective-oriented budget allocation for agri-environmental measures in the region Subcarpathia studied. Depending on the strategy to minimise negative effects for farmers or promoting the environmental benefit, visible trade-offs between the agri-environmental measures were found. Minimising negative effects for farmers requires to reallocate the budget and reduce financing of 'Extensive meadow farming' and extend 'Extensive pasture farming' and 'Sustainable agriculture'. Again, maximising the environmental benefit (apart from negative effects for farmers) the budget should be shifted from the measure 'Extensive meadow farming' to 'Organic farming'.

The changes of the budget allocation for the agri-environmental measures are also reflected in the environmental benefit which is strongly dependent on the discussed strategies. Maximising the environmental benefit does not substantially contribute to an improvement of the objectives 'Protection of natural resources', 'Protection and conservation of biodiversity', and 'Conservation of cultural landscape'. The maximal increase of the environmental benefit of 4 % compared to the basis scenario is very slight and must be compensated by high losses of farmers' incomes of 50 %. Thus the strategy to accept high negative effects for farmers with the aim to maximise the environmental benefit is not recommendable from the economic and ecological point of view. Another strategy – minimising negative effects for farmers by 40 % would result in a decrease of the environmental benefit by similarly 40 % compared to the basis scenario. Thus, if farmers' objectives to protect their economic situation were considered, the essential objective of the agri-environmental policy to maximise the environmental benefit would be significantly limited. Therefore, in case of Poland where compensation payments do not fully cover farmers' expenses and inputs, political discussions are necessary to balance the relations of the discussed issues.

The results of this study can be useful for political stakeholders in Poland and other EU member states in applying scientific methods to evaluate and design agri-environmental policy, especially in an interactive decision-making process. This would help to deliberate possible difficulties in agri-environmental policies and to find out most suitable solutions both for the environment and for farmers.

The presented case study of Poland is an example showing how to use methodical approaches to support political decision-making processes while planning political programmes. The methodology can be also used for solving more or less difficult questions in planning, evaluation and budget allocations in other countries of the European Union and of the world. For this, case studies with representatives of ministries and political decision-makers are necessary. In order to wholly exploit the possibilities of the approach, it should be used in an interactive way with stakeholders and experts. The interactive implementation covers working seminars and plenary forums as well as elicitation of preferences reflected with priority vectors, upper bounds or other vectors and variables in the LP approach. An interactive working can be organised in a form of round tables and discussions realised e.g. by means of the Delphi method. Due to the short experience with agri-environmental policy in Poland, an interactive implementation of the model was not reasonable on this evaluation stage. This is however recommended for other case studies while transferring the results for research questions in other countries. Additionally, the availability of data should be taken into account while planning the methodology transfer, which is unavoidable to define and specify model restrictions and constraints. The transfer of the presented results and methodology for other EU member states would be helpful in extending the current existing evaluation of agri-environmental programmes in the European Union. Thus, it would be helpful in more effective allocation of the EU funds on the European level.

8. Limitations and Outlook

While discussing advantages of the presented approach, also limitations should be mentioned. One of them is the static character of the model which means that it can be applied for precisely defined current, past or future time periods thus providing a methodological basis for ex-post, mid-term, and ex-ante evaluations. However, while conducting an ex-ante evaluation, long-term changes in the agri-environmental policy (both changes of environmental resources and of budget availability) cannot be predicted for the future development and implementation of the programmes and thus, they cannot be easily considered as variables in the model. Therefore, an integration of other approaches such as indicators in the LP model is recommended for further research on the methodology. It would be also helpful to include dynamic aspects in long-term investigations.

Another limitation of the model is the difficulty in receiving quantitative and qualitative information necessary for the definition of constraints and model vectors which is disadvantageous for an easy implementation and for benefiting from the potentials of the model. Thereby, also further methodology development is in some way hindered. Further case studies and modelling of current policy issues in the new financing period 2007-2013 as well as an integration of other approaches in the LP model are the next steps to diminish the mentioned shortcomings and limitations.

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