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**Co-financing implications for regional policy-making:
A case study for the agri-environmental programme in Saxony-Anhalt**

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Co-financing implications for regional policy-making:
A case study for the agri-environmental programme in Saxony-Anhalt

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Abstract

Financing agri-environmental programmes in the European Union (EU) takes place in a multi-level system with mixed co-financing and shared financial responsibilities. In this paper we analyse how co-financing influences policy-making in regions taking the case of the agri-environmental programme in Saxony-Anhalt. Using an interactive linear programming approach the implications of several co-financing scenarios are analysed. EU co-financing certainly enhances the financial volume for the agri-environmental programme in Saxony-Anhalt; but as regional policy-making is distorted by the scheme of mixed co-financing as compared to unconditional financial transfers, the priorities for measures vary depending on different EU co-financing scenarios.

Keywords: agri-environmental programmes, co-financing, federalism, interactive programming, policy-making

Zusammenfassung

Die Finanzierung von Agrarumweltprogrammen geschieht innerhalb eines Mehrebenensystems mit gemischter Kofinanzierung und geteilter finanzieller Verantwortung. In dieser Arbeit untersuchen wir anhand des Agrarumweltprogramms Sachsen-Anhalts, wie die Kofinanzierung die Politikgestaltung der Regionen beeinflusst. Um die Implikationen verschiedener Szenarien der Kofinanzierung darzustellen, wird ein interaktiver linearer Programmierungsansatz genutzt. Ohne Frage wird das Finanzvolumen für Agrarumweltprogramme durch die Kofinanzierung der EU erhöht; jedoch verzerrt das System der gemischten Kofinanzierung die Politikgestaltung der Region verglichen mit zweckungebundenen finanziellen Transfers. Daher ändern sich die Prioritäten für einzelne Maßnahmen in Abhängigkeit von verschiedenen EU-Kofinanzierungsszenarien.

Schlüsselwörter: Agrarumweltprogramme, Kofinanzierung, Föderalismus, Interaktive Programmierung, Politikgestaltung

1 Introduction

Within the European Union (EU), special institutional settings have been developed such as the system of co-financing structural, agricultural, and rural development policies, shared decision-making, and shared financial responsibilities of different political levels (e.g. EU, Germany, and German federal states 'Länder'), characterising a multi-level system (MEHL and PLANKL, 2001: 173). From a regional perspective, this system certainly provides incentives for a higher allocation of funds to specific policy areas. On the other hand, priority setting for specific measures may be influenced and regional policy-making may be distorted due to co-financing obligations as compared to unconditional financial transfers within the EU.

The EU co-financing system has been criticised, in particular based on the economic theory of federalism (MEHL and PLANKL, 2001: 174; POSTLEP and DÖRING, 1996: 27). The criticism is mainly related to the violation of the principle of fiscal equivalence. This principle postulates that there has to be a congruence between those who benefit from measures and those who have to take the financial responsibility (OLSON, 1969: 483; LAASER and STEHN, 1996: 63). A violation of this principle can lead to oversupply as well as undersupply of goods or special services (RUDLOFF, 2002: 242; OLSON, 1986: 123). According to URFEI (1999: 237) and Rudloff (2002: 246), most of the agri-environmental programmes violate the principle of fiscal equivalence. As a consequence, regional decision-makers tend to concentrate on financial considerations and transfers while other important factors tend to be neglected (OSTERBURG and STRATMANN, 2002: 276).

Hence, it can be expected, that regional policy-making is greatly influenced by the financial framework. In this article, we discuss the implications of different EU co-financing scenarios for designing the agri-environmental programme in Saxony-Anhalt. We show how the volume and the allocation of funds for different measures is influenced by the co-financing scenario. For this purpose, an interactive linear programming approach is used, which has originally been developed for a case study in Saxony-Anhalt.

First, the institutional framework and the linear programming approach are described in chapter 2. Chapter 3 deals with the current EU co-financing scenario in Saxony-Anhalt and, particularly, with the design of the agri-environmental programme and the role of the regional budget. In chapter 4 the implications of different EU co-financing scenarios for policy decision-making and priority setting are analysed.

2   Regional policy-making in a supra-national context

2.1 Institutional framework

EU-funded agri-environmental programmes exist since the MacSharry reform in 1992. The regulations of the AGENDA 2000 proceeded with this policy and strengthened the position of agri-environmental policy. The current institutional framework is defined by the 'Council Regulation (EC) No 1257/1999 of 17 May 1999 on support for rural development from the European Agricultural Guidance and Guarantee Fund (EAGGF) and amending and repealing certain Regulations' (chapter V - less favoured areas and areas with specific environmental restrictions and chapter VI - agri-environmental measures). As a consequence of the mid-term review of the AGENDA 2000, some adaptations were realised ('Council Regulation (EC) No 1783/2003 of 29 September 2003 amending Regulation (EC) No 1257/1999 on support for rural development from the European Agricultural Guidance and Guarantee Fund (EAGGF)'), e.g., within the agri-environmental measures animal protection is a new element and the co-financing rate will be raised by the EU.

For the member states agri-environmental measures are the only compulsory element of the EU rural development policy. These measures are grants for agricultural production methods with the aim of protecting the environment and maintaining rural areas. Farmers can sign up voluntarily to agri-environmental commitments with a minimum duration of five years and receive a grant in return. The commitments must go beyond following 'good agricultural practice'. Due to the calculation of the support on the basis of income losses, additional costs, and the need to provide a financial incentive, grants differ between measures and regions.

The EU contribution covers 75 % of the expenditures for agri-environmental measures in 'objective 1 regions' and 50 % in the other regions. The particular importance the Community attaches to agri-environmental measures becomes clear in view of the fact that the financial contribution will be raised to 85 % in 'objective 1 regions' and to 60 % in other regions, according to the Luxembourg decisions.

In addition, the institutional framework for rural development in Germany is, due to the federal system, subject to the 'Joint Action for Improvement of Agrarian Structures and for Coast Preservation (Gemeinschaftsaufgabe Verbesserung der Agrarstruktur und des Küsten-schutzes, GAK)'. Federal grants are provided for measures which are based on the 'Principles of market-oriented and locally adapted land cultivation (Markt- und standortangepasste Landbewirtschaftung, MSL)'. Federation and federal states share the funding of relevant measures at the ratio of 60 % (federation) to 40 % (federal state).

URFEI (1999: 140) characterised this mixed co-financing system of agri-environmental measures between EU, federation, and federal states as follows:

– The EU has a high financial responsibility and a low impact on the objectives;

– The federation has a strong impact on the objectives and a small share in total financing;

– The federal states have the biggest impact on the objectives, decision-making, and on the development of agri-environmental measures, while the financial responsibility is very small.

Under the conditions of Saxony-Anhalt, which is an 'objective 1' region, the EU covers 75 %, the federation covers 15 % and Saxony-Anhalt covers 10 % of the expenditures on MSL-measures. Other measures, which are not part of the GAK, do not receive federal grants. For these measures, the EU and the federal states share the expenditures at the ratio of 75 % to 25 %. The structure of co-financing and the intergovernmental grants are of no direct importance for farmers taking part in agri-environmental programmes. However, there are important implications for the regional budget and regional policy-making as will be shown in the following chapters.

2.2 A linear programming approach

The method of linear programming is used to maximise a linear objective function being subject to a system of linear equations and inequations with a finite number of variables. The method is well-known in economic analysis; a basic description is given, e.g., by CHIANG (1984). KIRSCHKE and JECHLITSCHKA (2002, 2003) report how to implement the method in MS-Excel$^©$ for its application to the design of structural and agri-environmental programmes. The programming approach delivers the budget volumes for single measures, showing how to allocate the budget under given restrictions in order to reach a maximum value of the objective function.

Under the assumption of constant marginal and average coefficients the following linear objective function can be defined:

$$(1) \qquad Z_1 \;=\; \sum_{i=1}^{n} z_{1i} \cdot B_i$$

with: Z_1 1st Objective

    B_i budgetary expenses for a measure i

    i = 1, ..., n   index of agri-environmental measures considered

    z_{1i} constant marginal and average coefficient of the objective function describing the impact of the budgetary expenses for measure i on the 1st objective.

In practical policy-making there will be more than one objective to be considered. The objective function for a second objective can be formulated similar to (1). An aggregated objective function can be formulated by combining both objective functions using weights:

(2) $Z = (1-\alpha) Z_1 + \alpha Z_2$

with $(1-\alpha)$ and α being weighting factors.

The weighting factors $(1-\alpha)$ and α are the shares of the objectives Z_1 and Z_2 in the aggregated objective function Z. It is advisable to limit oneself to few objectives only for policy decision-making support, otherwise the handling of the problem and of the results would become difficult. More objectives can be considered, e.g., by formulating them as restrictions.

Figure 1:   Structure of the programming approach
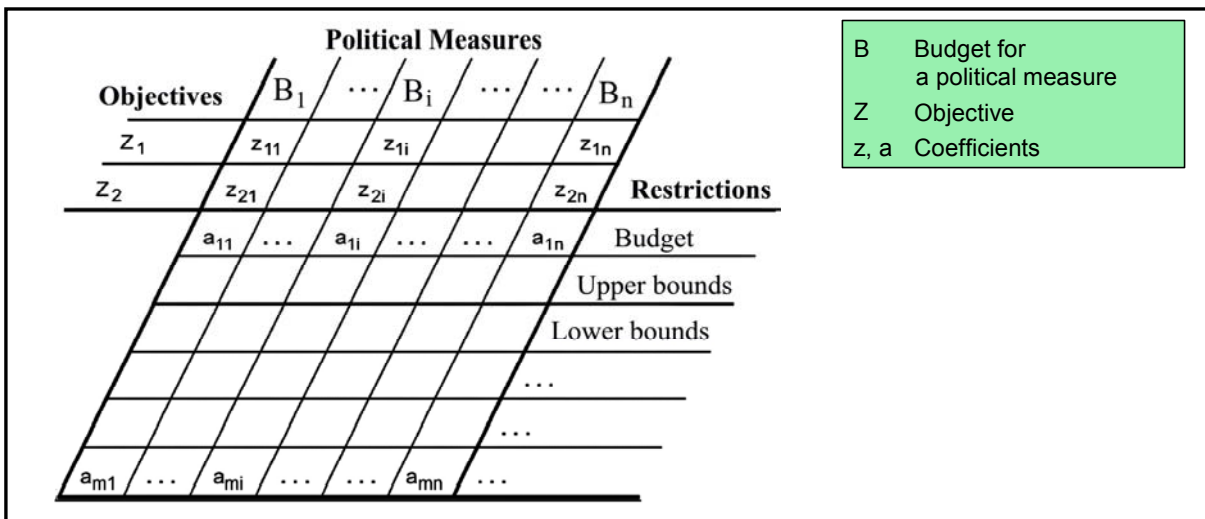
Source: Own illustration

Figure 1 exemplarily shows a matrix describing the approach for two objectives. z_{1i} and z_{2i} represent the constant marginal and average coefficients of the linear objective function and, hence, the impact of the budgetary expenses on the objectives. The conditions of the optimisation problem, such as the level of co-financing or the overall available budget, are defined by the coefficients a_{ri} and the right hand site b_r of the restrictions.

The outlined programming approach can be formulated as follows:

(3) $$\max_{B_1,...,B_n} Z = (1-\alpha) \cdot \sum_{i=1}^{n} z_{1i} B_i + \alpha \cdot \sum_{i=1}^{n} z_{2i} B_i$$

subject to: $\sum_{i=1}^{n} a_{ri} B_i \begin{Bmatrix} \leq \\ = \\ \geq \end{Bmatrix} b_r$ for r = 1, ..., m and $B_i \geq 0$ for i = 1, ..., n

where: r = 1, ..., m   is the index of restrictions (equations or inequations)

a_{ri} is the coefficient of restriction r for measure i

b_r is the right hand side of restriction r.

In order to fill the matrix of figure 1 for a specific problem setting, relevant political measures need to be chosen, consensus about the most important objectives needs to be reached amongst stakeholders, the coefficients of the objective function need to be assessed, and relevant restrictions have to be formulated.

Filling the matrix is no easy task, but it can be tackled step by step in discussion with stakeholders and decision-makers. As long as no detailed and usable system of agri-environmental indicators exists, a practicable way to obtain coefficients for the objective function could be a Delphi-type approach assessing the cost-effectiveness of the measures by experts. On the basis of the jointly formulated model, subsequent calculations and scenarios can be analysed interactively. The description of the specific model for Saxony-Anhalt is subject of the next chapter.

3   Analysing the current EU co-financing scenario

3.1 Designing the agri-environmental programme

The modelling approach, described in general in the last chapter, has been applied to design the agri-environmental programme of Saxony-Anhalt for the financial period from 2004 to 2008. During this case study workshops together with scientists, policy-makers, and administrators have been organised to develop and use the approach in an interactive way. In the following, a brief outline of the specific model structure is given which is illustrated in table 1.

Nine groups of measures have been used as activities in the modelling approach which consist of several single measures each. Thus, the modelling approach has been used to look at the strategic situation on an aggregated level. The measures have been defined as follows:
– General extensive grassland use (including all grassland of the farm) (M1);
– Specific extensive grassland use (single grassland areas and sheep grazing) (M2);
– Specific extensive grassland use (single grassland areas and cattle grazing) (M3);
– Organic farming (M4).

These measures belong to the group called 'Market-oriented and locally adapted land management' (MSL)[1]. Another measure is:

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[1]   MINISTRY FOR AGRICULTURE AND ENVIRONMENT OF SAXONY-ANHALT (2003).

– Environmental protective cultivation of special cultures (vegetables, medicinal and spice herbs, pip, and stone fruit as well as vine and hop) (M5)[2].

And finally, special nature conservation measures (VNS – 'Vertragsnaturschutz')[3] are considered:

– Management of grassland (M6);

– Management of ancient orchards (M7);

– Management of crop land (M8);

– Management of set aside land (M9).

Table 1:   Input matrix of reference situation

1.		Ext.grassl. whole farm (M1)	Ext. grassl. sheep (M2)	Ext. grassl. cattle (M3)	Organic farming (M4)	Spec. crop cultivation (M5)	Environm. manag. grassl. (M6)	Manag. ancient orchards (M7)	Environm. manag. cropland (M8)	Set aside land (M9)	Sum	
2.	Current allocation	23.0 mio. €				1.736 mio. €	20.0 mio. €				44.736	**Current allocation for 2004-2008 (mio. €)**
3.	Optimal allocation	0.000	6.000	10.573	12.000	2.000	15.507	2.000	0.000	0.000	100.0	**Upper bound for overall budget (mio. €)**
4.	**Objective: Agr. labour**	**6.0**	**6.5**	**6.0**	**7.0**	**5.0**	**6.0**	**4.0**	**3.0**	**2.9**		**Objective coefficients for obj. 1 (weight: 0.5)**
5.	**Objective: Environm. quality**	**5.0**	**6.9**	**6.0**	**7.0**	**5.5**	**7.1**	**7.0**	**5.0**	**5.3**		**Objective coefficients for obj. 2 (weight: 0.5)**
6.	**Upper bounds**	**100.0**	**6.0**	**15.0**	**12.0**	**2.0**	**100.0**	**2.0**	**100.0**	**100.0**	**437.0**	**Absolute upper bounds for measures (mio. €)**
7.	**Lower bounds**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**Absolute lower bounds for measures (mio. €)**
8.	**Regional budget**	**0.10**	**0.10**	**0.10**	**0.10**	**0.25**	**0.25**	**0.25**	**0.25**	**0.25**	**7.734**	**Upper bound for regional budget (mio. €)**
9.	**Grassland upper bound**	1785.7	1282.1	1538.5	303.0	0.0	800.0	0.0	0.0	0.0	**40000**	**Upper bound for grassland (ha)**
10.	**Grassland lower bound**	1785.7	1282.1	1538.5	303.0	0.0	800.0	0.0	0.0	0.0	**20000**	**Lower bound for grassland (ha)**

Source: Own illustration and calculations

The next step was the definition of the two main objectives of the programme. After discussion, the stakeholders chose the objectives 'Environmental Quality' and 'Preservation of Agricultural Labour'. In order to assess the coefficients of the objective function, stakeholders have been asked about their estimates of the impact of the different measures on the objectives. For this purpose, questionnaires have been used in which the stakeholders have been asked to give their estimates on a scale between one (very low impact) and nine (very high impact). The results have been subject to discussion after which the slightly adjusted means of the estimates have been used as coefficients.

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[2]   MINISTRY FOR AGRICULTURE AND ENVIRONMENT OF SAXONY-ANHALT (2002a).

[3]   MINISTRY FOR AGRICULTURE AND ENVIRONMENT OF SAXONY-ANHALT (2002b).

The restrictions have been defined in a last step. For the model used in Saxony-Anhalt the subsequent restrictions have been defined:

– Budgetary restrictions, like absolute upper and lower bounds for the budget volumes of single measures (table 1, row 6 and 7) – the absolute upper bounds are oriented at the maximum possible budget for certain measures;

– Restriction for the available regional budget of Saxony-Anhalt (table 1, row 8). The coefficients of this restriction vary according to the different levels of co-financing. It is assumed, that the amount of external co-financing is not limited and thus not binding in the model (table 1, row 3);

– An upper and lower bound for the area of grassland being included in measures, which is based on the existing amount of grassland in Saxony-Anhalt (table 1, row 9 and 10).

Table 1 shows the input matrix of the reference situation. The budget allocation of the last financial period is displayed in row 2. The optimal allocation for $\alpha = 0{,}5$ (formula 3) resulting from the programming approach is displayed in row 3 – this result is explained in the next chapter.

3.2 Results for the base scenario and the role of the regional budget

The budget allocation resulting from the basic model is shown in figure 2. In this situation four absolute upper bounds are binding (M2, M4, M5, and M7), according to the restrictions in Saxony-Anhalt. Furthermore, M3 gets 10.57 mio. Euro (€), M6 15.51 mio. €, and the measures M1, M8 and M9 are not financed at all. The upper bound for the regional budget of Saxony-Anhalt is set at 7.73 mio. €, which is binding and so is the upper bound for grassland. This result is defined as reference situation and is used to analyse the consequences of varying assumptions and different policy scenarios.

Figure 2:   Budget allocation in reference situation
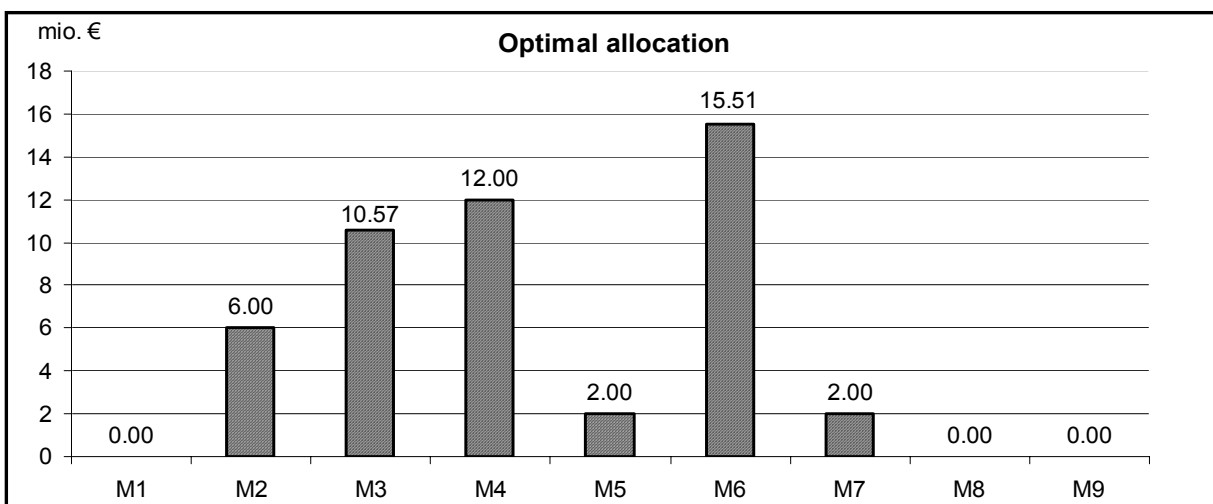
Source: Own calculation

As the regional budget is scarce and very likely to be cut in the future, a question of interest is how a reduced regional budget would affect the resource allocation. Figure 3 displays the resulting allocation after a reduction of the regional budget from 7.73 mio. € to 5 mio. €.

Figure 3:   Budget allocation after cut in the regional budget to 5 mio. €
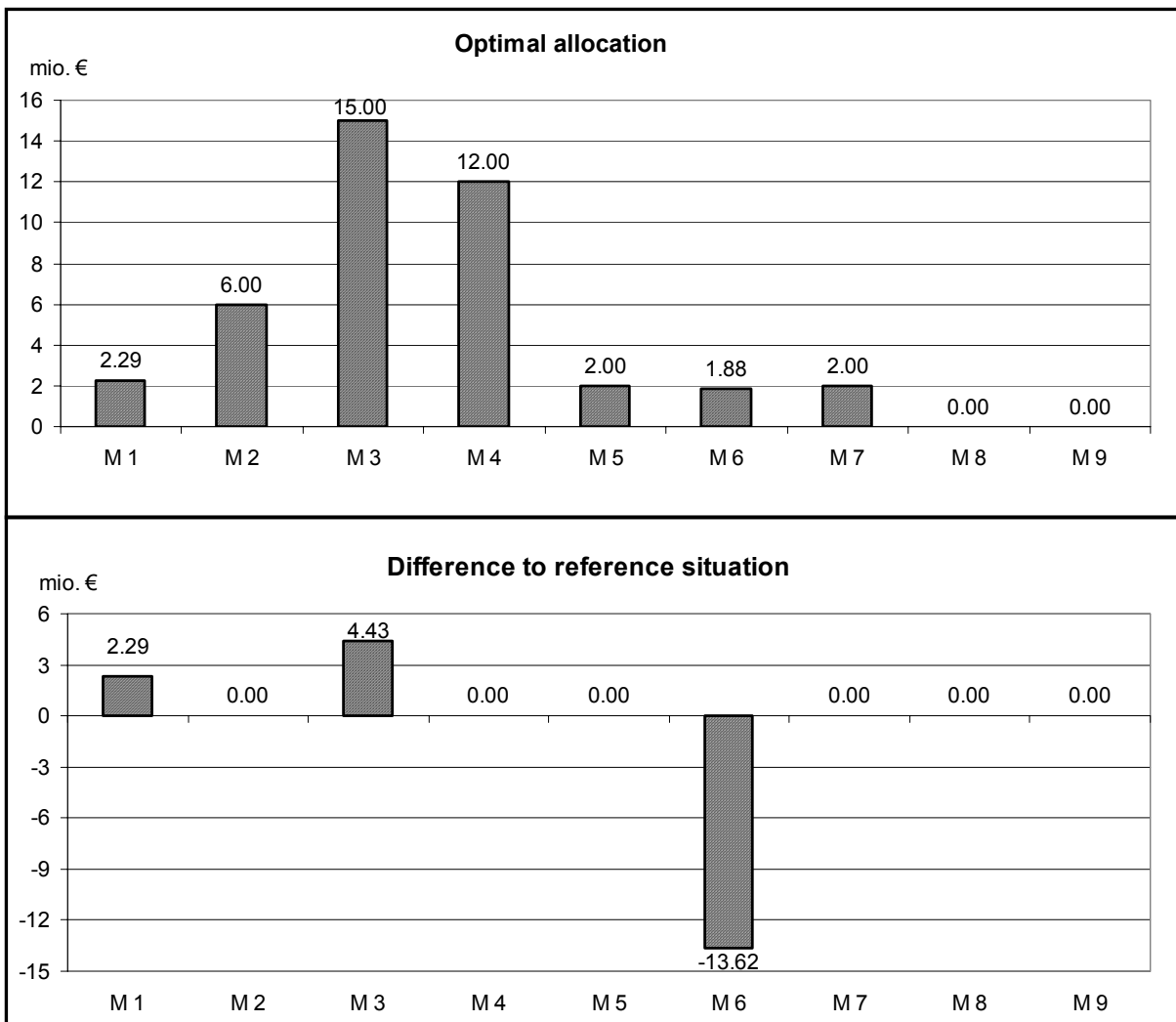
Source: Own calculations

After the cut in the regional budget to 5 mio. € the volume of M6 is reduced by 13.62 mio. € in the optimal solution of the programming approach. In contrast, the volumes of M1 and M3 are increased by 2.29 mio. € (M1) and 4.43 mio. € (M3) respectively, although these measures are characterised by lower objective coefficients (table 1, row 4 and 5). The reason for this budget substitution is the different level of co-financing. As mentioned in chapter 3.1, the first four measures belong to the group called 'Market-oriented and locally adapted land management' (MSL), which is part of the 'Joint Action for Improvement of Agrarian Structures and for Coast Preservation' (GAK) and, therefore, receive an additional grant from

the federal budget. Consequently, the region gets more external funding for each Euro which it spends for the MSL-measures as compared to other measures. When the regional budget is reduced, measures with a higher degree of external co-financing become more competitive.

Table 2 illustrates this point comparing the use of resources before and after the reduction of the regional budget. Thus, the EU budget has decreased by 5.18 mio. €, whereas the federal budget has increased by 1.007 mio. €. After the reduction of the regional budget a higher level of the objective function can be achieved under the new constraints by shifting resources to MSL-Measures.

Table 2:   Budgetary resources after cut in regional budget to 5 mio. €

	Regional budget	Transfer from EU	Transfer from federal budget	Overall available budget (sum)
Reference situation	7.734 mio. €	36.060 mio. €	4.286 mio. €	48.080 mio. €
Scenario: Regional budget cut	5.000 mio. €	30.880 mio. €	5.293 mio. €	41.173 mio. €

Source: Own calculations

In order to examine the relationship between the level of the regional budget and the optimal budget allocation more closely, a parameterisation of the regional budget is carried out. For this purpose, the level of the regional budget is gradually changed in steps between 60 % and 110 % of the original volume (7.73 mio. €).

Figure 4:   Parameterisation of the regional budget
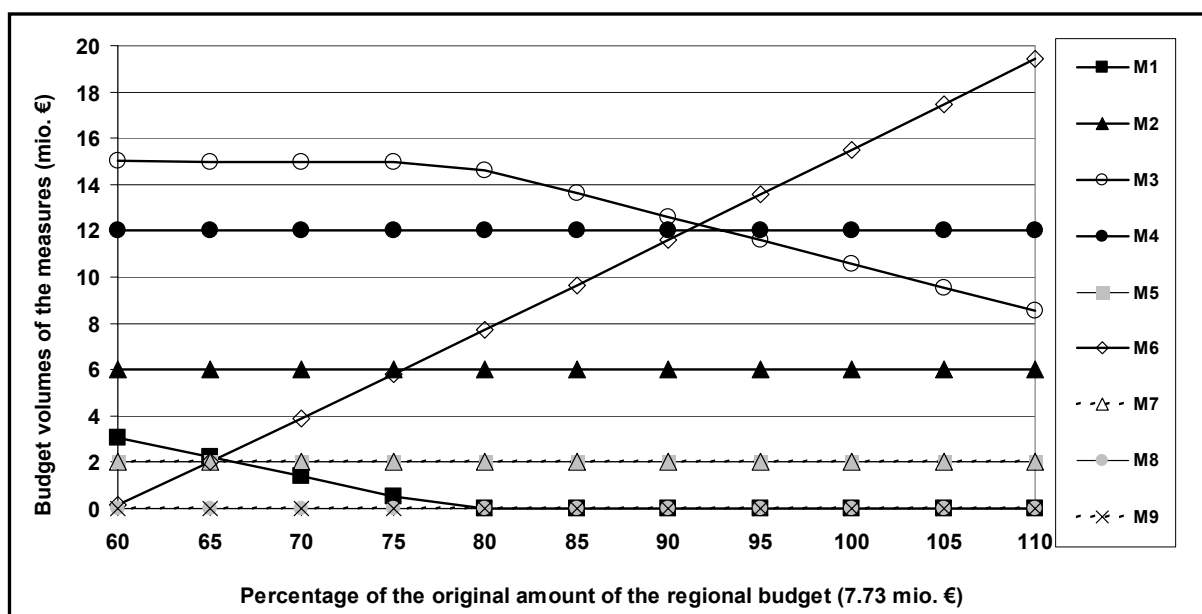
Source: Own calculations

Figure 4 displays the resulting allocations of the overall budget at the respective levels of the regional budget. The results of the parameterisation show a trade-off between M3 and M1 on the one hand and M6 on the other hand. With a decreasing regional budget the financing of M6 is substituted by M3. At about 75 % from the original budget M3 reaches its upper bound of 15 mio. € and further money is now taken away from M6 and transferred to M1.

One reason for this trade-off is the differing level of co-financing. Another reason is the upper bound for grassland. As the premium per hectare (ha) for the MSL-measures is lower than the premium per ha for M6 the amount of supported grassland per Euro is higher for the MSL-measures. Since the upper bound for grassland is binding for all levels of the regional budget, money is transferred to M6 when the regional budget is increased.

4   Implications of different co-financing scenarios

4.1 New co-financing scenarios in the EU

According to the Luxembourg decisions, the Community's contribution to agri-environmental programmes will rise by 10 %, i.e., to 85 % in 'objective 1 regions' and to 60 % in the other regions. In the following the consequences of this new level of co-financing for Saxony-Anhalt will be analysed. Furthermore, two different scenarios will be calculated: In scenario A Saxony-Anhalt keeps its status as an 'objective 1 region', whereas in scenario B Saxony-Anhalt loses this status.

For analysing the scenarios, the restriction for the regional budget has to be adjusted respectively. In scenario A the coefficients as shown in table 3 are used.

Table 3:   **Coefficients of the regional budget restriction after the Luxembourg decisions; Scenario A: Saxony-Anhalt keeps the status as 'objective 1 region'**

	M1	M2	M3	M4	M5	M6	M7	M8	M9
Regional budget	0.060	0.060	0.060	0.060	0.150	0.150	0.150	0.150	0.150

Source: Own calculation

At a Community contribution of 85 % to the expenditures for agri-environmental measures, the share of the regional budget is 15 %. The MSL measures are additionally co-financed from the federation by 60 %. Thus, only 6 % of the total expenditures have to be covered from the regional budget. The higher level of co-financing lowers the difference of external co-financing between MSL and other measures from 15 to 9 percentage points (compare with table 1, row 8).

For scenario B, the loss of 'objective 1' status, the coefficients are calculated respectively. They are shown in table 4. In this case, the difference of external co-financing between MSL and other measures rises from 15 to 24 percentage points.

Table 4:   Coefficients of the regional budget restriction after the Luxembourg decisions; Scenario B: Loss of 'objective 1' status for Saxony-Anhalt

	M1	M2	M3	M4	M5	M6	M7	M8	M9
Regional budget	0.160	0.160	0.160	0.160	0.400	0.400	0.400	0.400	0.400

Source: Own calculation

All other parameters remain unchanged for both scenarios and equal those of table 1. Figure 5 displays the resulting budget allocation of the optimisation approach for scenario A. In addition, table 5 shows the use of resources in this solution of the optimisation approach.

Figure 5:   Budget allocation in scenario A
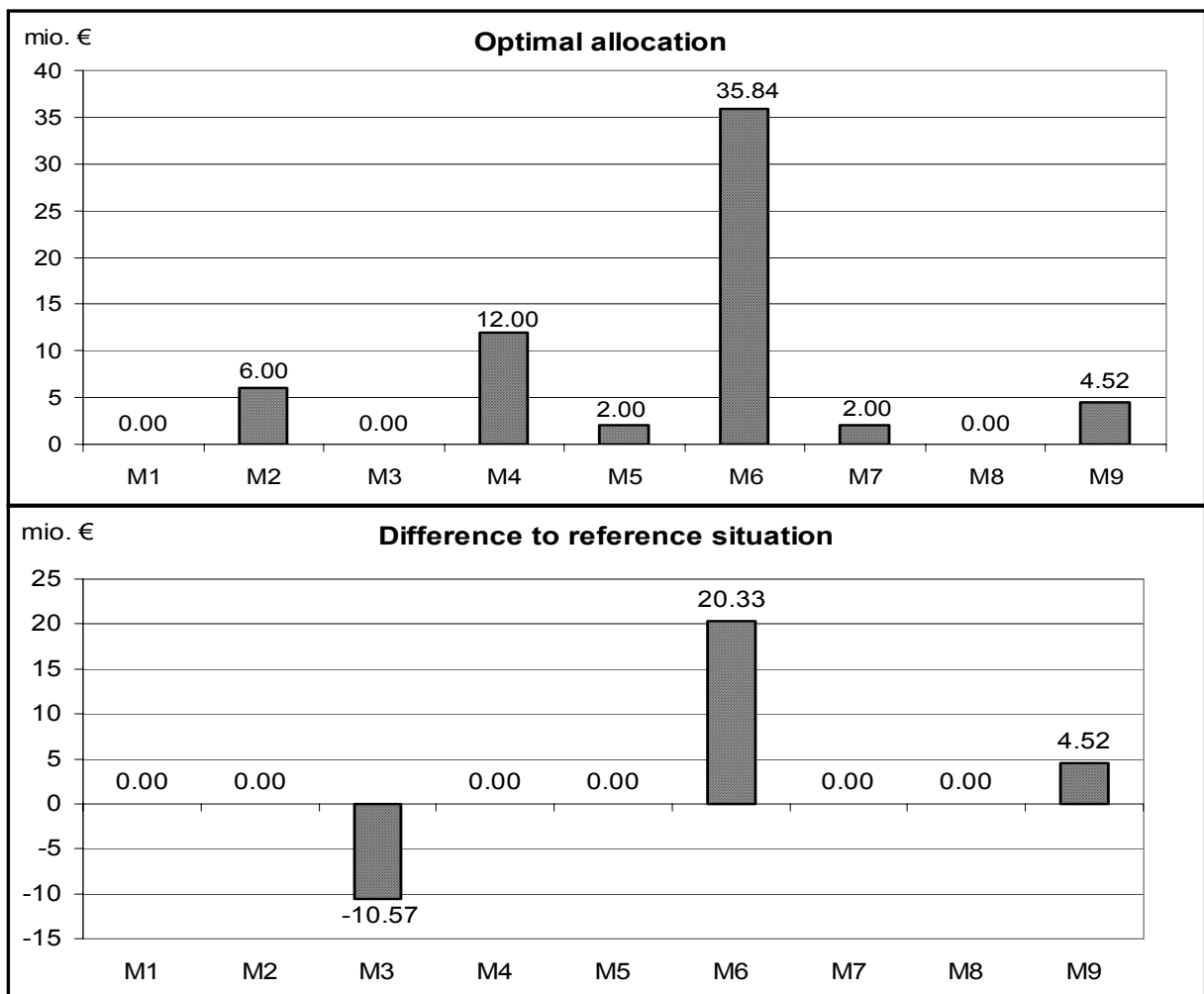
Source: Own calculations

Table 5:   Budgetary resources in scenario A

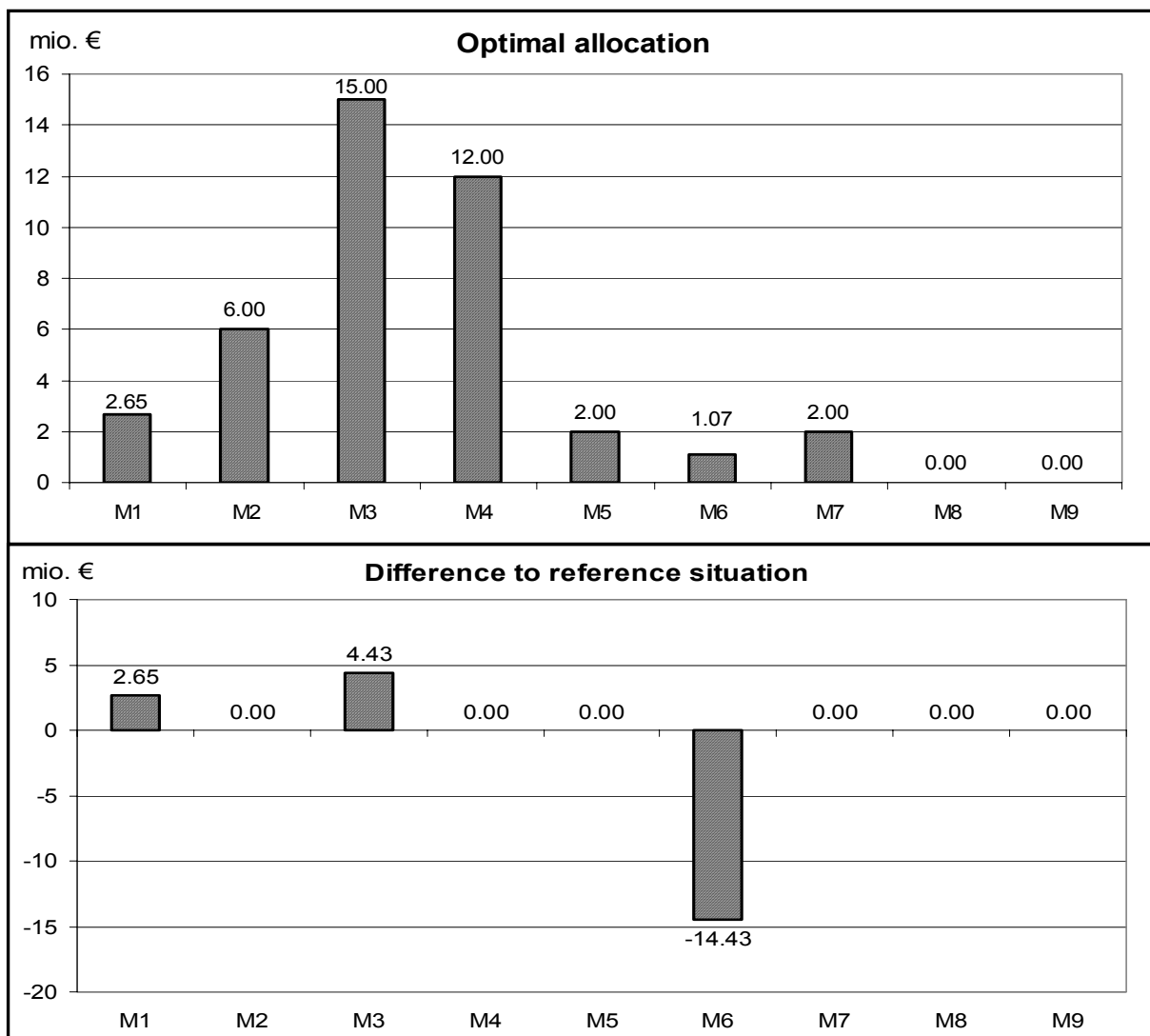|	Regional budget	Transfer from EU	Transfer from federal budget	Overall available budget (sum)
Reference situation	7.734 mio. €	36.060 mio. €	4.286 mio. €	48.080 mio. €
Scenario A	7.734 mio. €	53.006 mio. €	1.620 mio. €	62.360 mio. €

Source: Own calculations

In comparison to the reference situation, the EU budget increases by 16.946 mio. €, while the federal budget decreases by 2.666 mio. €. The overall budget rises by 14.280 mio. € to 62.360 mio. €, while the regional budget remains constant at 7.734 mio. €. Due to the higher level of co-financing after the Luxembourg decisions, the losses of external grants for each Euro going into other measures than to MSL measures are reduced. Hence, the opportunity costs for shifting money to VNS measures are reduced. Therefore, 10.570 mio. € from M3 are substituted by the VNS measures M6 and M9. The budget of M6, which has higher objective coefficients than M3 (table 1, row 4 and 5), is increased by 20.330 mio. €. M9 now receives a budget of 4.520 mio. €, as the upper bound for grassland is binding. M9 does not use any grassland (table 1, row 9), and M9 has higher objective coefficients than M8, which also does not use any grassland.

The budget allocation and the use of resources in the optimal solution of the programming approach resulting from scenario B are displayed in figure 6 and table 6.

In this scenario, the overall budget decreases by 7.354 mio. € in the optimal solution, while the regional budget of Saxony-Anhalt again remains constant. This change of the amount of external funding results from a decrease of the EU budget by 11.624 mio. € and an increase of the federal budget by 4.270 mio. €. In comparison to the reference situation, the budget of M6 decreases by 14.430 mio. €, while the budget of M3 increases by 4.430 mio. € and the budget of M1 increases by 2.650 mio. €. In this situation the importance of MSL measures rises, as the federation is co-financing 60 % of the regional share for MSL measures. The previously financed M6 becomes too costly and is substituted by MSL measures even though these measures have been assed with lower objective coefficients (table 1, row 4 and 5).

As a result, Saxony-Anhalt is faced with two opposite strategic options arising for the case that the 'objective 1' status is kept or lost after the decisions of Luxembourg. If the federal state retains 'objective 1' status, VNS measures would gain priority having a high impact on environmental quality. If the 'objective 1' status is lost, MSL measures would be strengthened diminishing the decline of external EU co-financing.

Figure 6: **Budget allocation in scenario B**

Source: Own calculations

**Table 6:** **Budgetary resources in scenario B**

	Regional budget	Transfer from EU	Transfer from federal budget	Overall available budget (sum)
Reference situation	7.734 mio. €	36.060 mio. €	4.286 mio. €	48.080 mio. €
Scenario B	7.734 mio. €	24.436 mio. €	8.556 mio. €	40.726 mio. €

Source: Own calculations

4.2 The role of supra-national co-financing

In order to examine the relationship between the level of external co-financing and the optimal budget allocation more closely, a parameterisation of the co-financing level is carried out. For this purpose, the coefficients of the regional budget (table 1, row 8) are gradually changed in steps between 0 and 1 for the VNS measures and M5. Respectively they are changed between 0 and 0,4 for MSL measures corresponding to a co-financing level from the EU between 0 % and 100 %.

Figure 7:   Parameterisation of the co-financing level from the EU
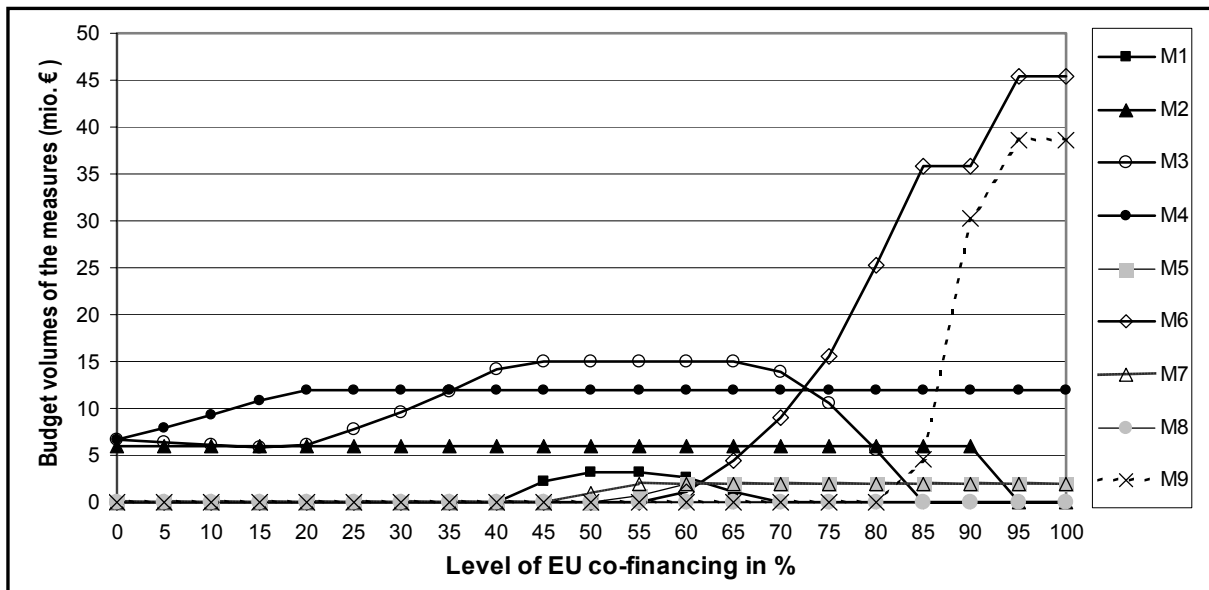
Source: Own calculations

Figure 7 displays the resulting allocations of the overall budget at the respective co-financing levels of the EU, including the allocation of the reference situation at 75 % as well as the allocations of scenario A at 85 % and scenario B at 60%.

In the range between 60 % and 100 % the results of the parameterisation show a clear trade-off between the VNS measures M6 and M9 on the one hand and the MSL measures M1 and M3 on the other hand. Starting from a 65 % EU co-financing level, with increasing external funding M3 is substituted by M6. At about 85 % of EU co-financing level and above, additional money is allocated to M9 due to the binding upper bound of grassland. With a decreasing level of external funding, below 85 % of EU co-financing, M6 is substituted by M3, respectively. When the upper bound of 15 mio. € for M3 is reached at about 65 %, M6 is substituted by M1.

The findings from figure 7 equal those from the parameterisation of the regional budget from figure 4. With higher EU co-financing levels, the federal co-financing system in Germany

and, thus, the MSL measures become less important. At high EU co-financing levels the model prefers the VNS measures M6 and M9, with M6 having high objective coefficients and M9 not using grassland. On the other hand, regional decision-making practically does not reflect any more scarce regional money.

To further analyse the implications of EU co-financing for the region, the level of 'objective achievement' is calculated for each optimal solution. Based on the parameterisation of the co-financing level of the EU in figure 7 the respective values of Z_1 and Z_2 (formula 2) are depicted in figure 8 displaying the objective function values for 'environmental quality' and 'preservation of agricultural labour'.

Figure 8:   Objective values for different levels of co-financing from the EU
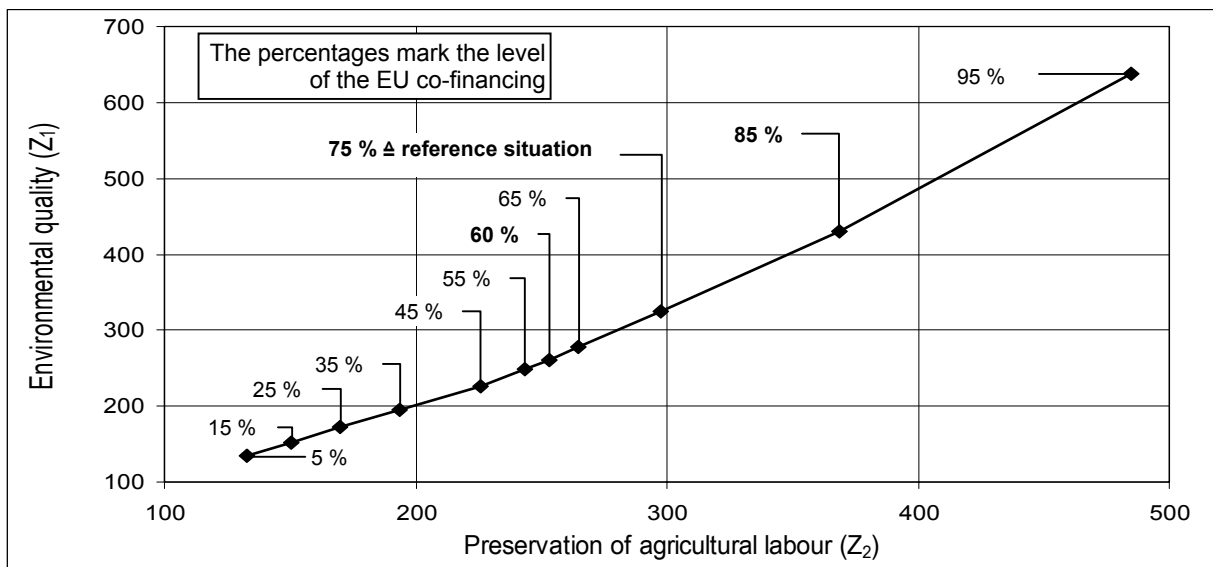
Source: Own calculations

The values of Z_1 and Z_2 are without dimension, as the coefficients of the objective function have been derived by expert judgement. The level of 'objective achievement' is strongly sensitive to the degree of co-financing, due to the definition of the linear objective function (1) as Z(B) and due to the progressive increase of the overall budget for a rising level of co-financing. Figure 8 shows an increase of Z_1 and Z_2 for a rising level of co-financing, with Z1 ('environmental quality') increasing at a higher rate. The value of the objective function for 'environmental quality' responds more to higher financial volumes than the value for 'preservation of agricultural labour'.

4.3 The co-financing bias

It has been demonstrated that the level of EU co-financing has a strong impact on the allocation of funds in a region. Hence, regional policy-making may be distorted as compared

to unconditional financial transfers within the EU. In order to analyse the potential bias due to mixed co-financing, we consider a lump-sum scenario assuming that Saxony-Anhalt would receive external grants for its agri-environmental programme as a lump-sum.

To define and compare such a lump-sum scenario, the coefficients of the regional budget restriction (table 1, row 8) are set to 1 for all measures and the upper bound of the regional budget is set to 48.080 mio. € being the overall budget in the reference situation. Figure 9 displays the resulting budget allocation in the optimal solution of the programming approach and table 7 shows the use of resources.

**Table 7:   Use of resources in lump-sum scenario**

	Regional budget	Budget from EU	Federal budget	Overall budget (sum)
Reference situation	7.734 mio. €	36.060 mio. €	4.286 mio. €	48.080 mio. €
Scenario: lump-sum	48.080 mio. €	0.000 mio. €	0.000 mio. €	48,080 mio. €

Source: Own calculations

There are only three measures in the optimal solution of the programming approach - M2, M4, and M6. Compared to the reference situation, the budgets of M3, M5, and M7 are reduced to zero, while the budget of M6 is increased by 14.57 mio. €. When the lump-sum is adjusted to the amount corresponding to the scenarios A and B, the resulting budget allocations differ only in the budget level of M6. The results indicate, that in the absence of any co-financing scheme M6 would receive the highest priority as compared to other measures.

In order to analyse how the changed priorities under mixed co-financing influence the level of the considered objectives, figure 10 displays the values of the objective function in the reference situation and in the considered scenarios A and B for both variants, with co-financing and with a lump-sum.

As can be seen in figure 10, the objective values of the lump-sum model are higher than those of the co-financing model in all considered scenarios. Corresponding to figures 4 and 7, Saxony Anhalt is closest to an unconditional financial transfer situation in scenario A, having the most financial resources. Therefore, the difference of the objective values between the two variants (co-financing and lump-sum) is the lowest in scenario A.

Figure 9:   Budget allocation (mio. €) in the lump-sum scenario
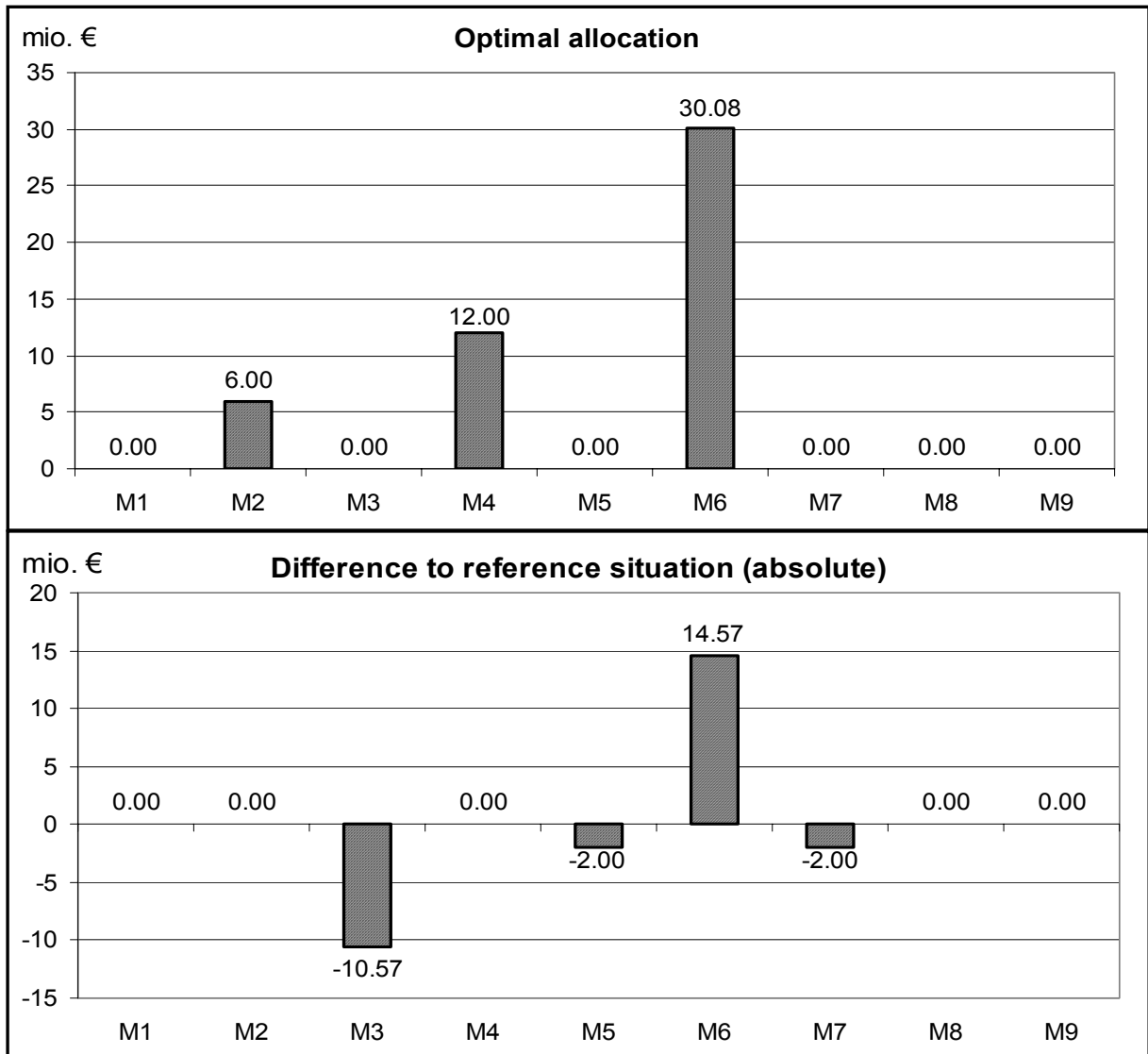
Source: Own calculations

The findings show that budget allocation and priority setting would be different and would lead to higher 'objective achievement', if Saxony-Anhalt received federal and EU grants as a lump-sum. The model is based on assessments of local actors, who, first, can be assumed to have a good knowledge about the impact of agri-environmental measures in a region and, second, are better representatives of local preferences for the provision of public goods than upper political levels. Therefore, the lump-sum scenario shows a best and undistorted allocation of funds from a regional point of view. The results are congruent with the principle of 'fiscal equivalence' and the demand for extended and unbiased local responsibility (OSTERBURG and STRATMANN, 2002: 276; OATES, 1999: 1122) in policy-making.

Figure 10:   Objective function values of the scenarios with co-financing and with a lump-sum
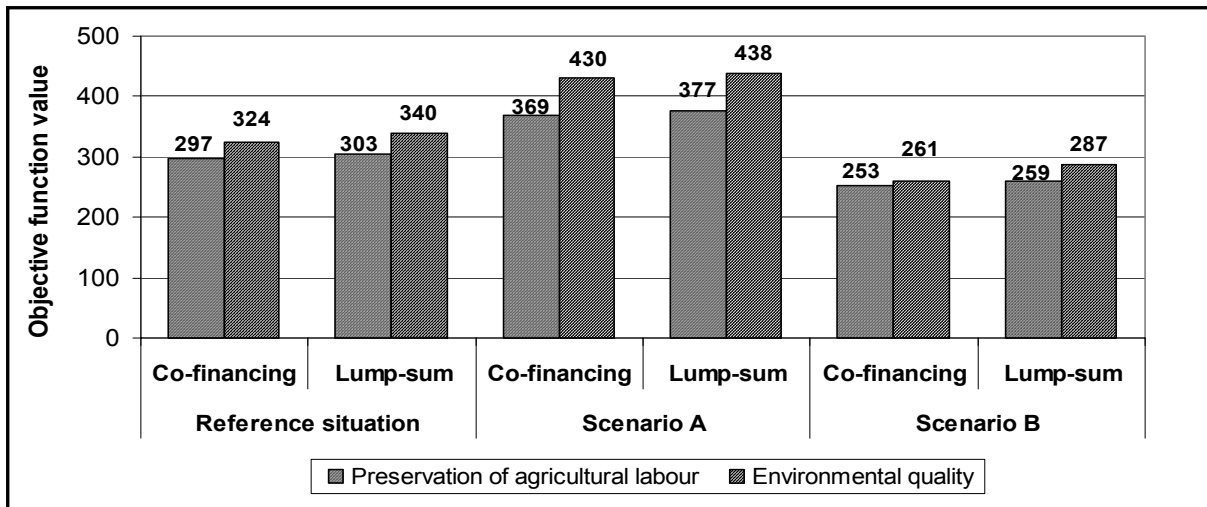
Source: Own calculations

5   Conclusions

Using the results of an interactive programming approach for the case of designing the agri-environmental programme of Saxony-Anhalt it has been shown how regional policy-making is influenced by different mixed co-financing schemes. The implications of co-financing has been discussed for several policy scenarios.

First, the current EU co-financing system for agri-environmental programmes certainly provides an extended financial budget for these programmes.

Second, EU co-financing changes priority setting and the allocation of funds between measures. A region can maximise benefits from external grants by shifting money into measures with higher external co-financing levels. Moreover, measures with higher co-financing levels become more attractive when the regional budget becomes scarce, while the opposite is true when more regional money is available and the local priorities differ from the existing co-financing scheme.

The results show that the impact of mixed co-financing in the German system on regional policy-making will decline when the EU co-financing level is increased, due to a reduced difference of the external co-financing level between measures. Respectively, the impact becomes bigger when the EU co-financing level is reduced. For the case of Saxony-Anhalt there are two opposite strategic options arising. If the 'objective 1' status is lost after the decisions of Luxembourg, MSL measures would be given higher priority. If, on the other hand, Saxony-Anhalt retains 'objective 1' status, VNS measures would gain higher priority,

due to an increased co-financing level. Specifically, the allocation of funds between agri-environmental measures in Saxony-Anhalt would be less dependent on co-financing when the influence of additional external co-financing for MSL measures becomes smaller, due to increased financial resources. Having sufficient resources, either from EU co-financing or from its own budget, VNS measures are preferred over MSL measures.

Third, if the region receives EU and federal grants as a lump-sum, giving the chance of undistorted policy decision-making, the values of the objective function are higher in all scenarios than with co-financing. The findings show how the violation of the principle of 'fiscal equivalence' in the multi-level system of the EU leads to a bias in regional decision-making.

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