Modelling the impact of EAFRD policies on rural development and structural change*

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Abstract:

Policies for rural areas have become an important but complex policy field in the European Union`s Common Agricultural Policy. In this paper we present a programming approach to analyse the EAFRD budget allocation in Saxony-Anhalt. The approach has been interactively developed with representatives from our partner Ministry. The model is used to analyse and discuss optimisation potentials and the effects of reduced budget availabilities facing Saxony-Anhalt. The results obtained reveal a rather high optimisation potential and reflect the importance of the co-financing modalities within the EAFRD and the GAK context. Budget cuts would severely affect the allocation of funds and the financing mode.

Keywords: rural development, interactive programming, EAFRD, multi-level co-financing, Saxony-Anhalt

1. Introduction

Rural development (RD) has become an important policy field in the European Union's (EU) Common Agricultural Policy (CAP). Within the current financial period 2007-2013 a broad variety of policy instruments is supported by the European Agricultural Fund for Rural Development (EAFRD) and up to 96.3 billion Euro are provided in total (EC, 2009). These funds are transferred to the respective member states or regions which draw up their Rural Development Programs (RDPs). In the way policy-makers design these RDPs and decide about the allocation of funds to specific measures, they influence the development in rural areas, and thus, structural change in rural economies and the agricultural sector.

The RD programming process is a challenging and highly complex task for a number of reasons. On the one hand, complexity arises from the multi-sectoral nature of the RD policy field. RD policy-makers are confronted with multiple (often conflicting) objectives, various actors and interest groups and numerous alternatives which produce multiple and uncertain consequences. Whereas these features are to some extent generally associated with public policy decision-making (c.f. Boots and Lootsma, 2000, Nutt, 2005, Walker, 2000), particular complexity arises from the embedment of the policy-field in the multi-level system of the EU. The resulting interlocked system of target setting, implementation and financing as well as the associated current regulatory framework have been intensively discussed in the literature (e.g. Grajewski and Mehl, 2008 for the case of Germany). The various financing options in combination with the co-financing modalities and particular regulatory requirements such as the minimum contribution of EU funds to the four priority axes might be the most prominent features to exemplify the complexity associated with the RD budgeting process.

The objectives of this paper are twofold. On the one hand, we present a particular programming approach which has been developed to facilitate the RD budget allocation process at the regional level. The focus is on the current financial period 2007-2013 and the budget administered under the umbrella of the European Agricultural Fund for Rural development (EAFRD). The model has been interactively defined together with RD policy-makers from the Ministry of Agriculture and the Environment in Saxony-Anhalt, Germany (MLU)[1]. In the future, it is to be interactively used together with decision-makers (DMs) of the MLU to analyse and explore relevant policy options for Saxony-Anhalt. Within this paper, we show how the current regulatory framework can be translated into a linear optimisation model and present the data obtained to define it. On the other hand, we use the model to present some first model results. We analyse potential improvements for the allocation of funds and discuss the implications of reduced budget availability facing Saxony-Anhalt. In doing so, we show how severely the budgeting of RD measures is affected by the predetermined financial framework and how this – in turn – could affect RD in Saxony-Anhalt.

The remaining part of this paper is organized as follows: Section 2 gives an overview of the institutional framework for RD policy-making in the EAFRD context and describes the present allocation of funds for Saxony-Anhalt 2007-2013. In section 3, the methodological approach and the data used are presented. In section 4, we will present and discuss the model results with respect to an optimisation of the current allocation and reduced budget availability facing Saxony-Anhalt. The paper will finish with some concluding remarks in section 5.

2. Policy-making for rural areas in the EAFRD context

2.1 Institutional framework

The current European RD policy framework is based on a three-level programming process. Central means of legislation is Council Regulation 1968/2005 on support for RD by the

[1] We would like to express our gratitude to the staff members of the MLU who participated in the case study. Especially, we would like to thank Hans-Jürgen Schulz and Volker Rost from the paying agency as well as Ralf Müller and Constanze Elz from the managing authority of the Ministry for their support and the time devoted to the case study.

EAFRD (c.f. Council of the European Union 2005). Here, the overall frame is outlined, financial modalities are specified and a set of measures eligible for EU funds is provided. In addition, the EU has set general priorities via so called Strategic Guidelines (c.f. Council of the European Union 2006). On the second level, each member state develops a National Strategy Plan (NSP) coherent to the council regulation itself and to the EU guidelines. The NSPs are intended to link and improve the coordination between European, national and regional priorities and actions. The actual implementation of RD policy in the EU member states is set out in RDPs. These RDPs are either developed by the member states for the whole country or for regions in the member state by regional authorities. The RDPs as well as the NSPs need to be submitted to the European Commission for approval.

The overall objectives of the European RD policy are set out in the EAFRD regulation and are implemented via measures grouped into four priority axes. These are: (1) improving the competitiveness of the agricultural and forestry sector (14 measures)[2], (2) improving the environment and the countryside (12 measures), and (3) improving the quality of life in rural areas and diversification of the rural economy (12 measures). The purpose of the methodological axis 4 is to integrate the concept of the former community initiative Leader into the second pillar policy.

In order to reach a certain balance between the stated objectives and the methodological Leader approach, the EAFRD regulation demands a minimum contribution of EU funds to the axes. At least 10% of the overall EAFRD contribution to a RDP needs to be assigned to axis 1 and axis 3, respectively. The minimum contribution to axis 2 is 25% and at least five percent of the overall EAFRD funds need to be assigned to Leader implementations.

Unlike the EU funds supplied in the first pillar of the CAP, all EAFRD funds provided have to be co-financed, meaning that all EAFRD funds need to be supplemented by further national public expenses.[3] The EAFRD contribution differs with respect to the economic status of a region (convergence or non-convergence region of the EU) and the corresponding axis of a measure. In the case of axis 1 and 3, 50% of the eligible public expenditures are financed by the EU in non-convergence regions and 75% in convergence regions. In the case of axis 2 and 4 the figures are 55% (non-convergence regions) and 80% (convergence regions).

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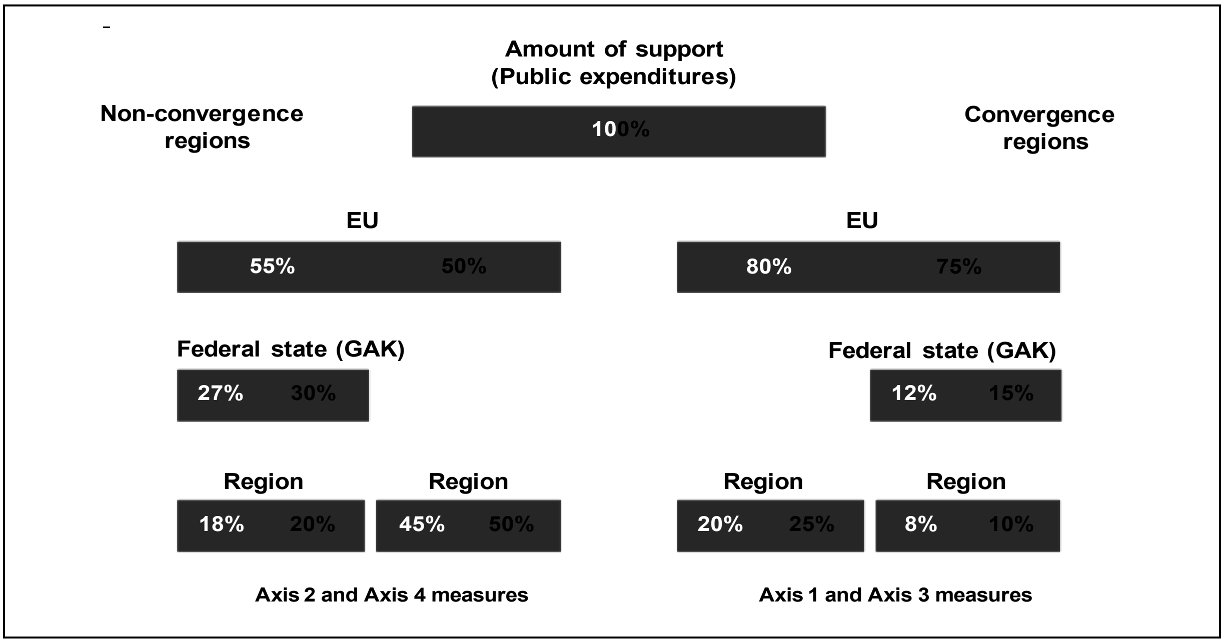
2 Number of measures according to the measure codes defined in Commission Regulation (EG) No 1974/2006 (c.f. EC 2006).

3 National public co-financing can comprise federal, regional, communal and/or expenses by other public entities. Additional (private) expenses from the beneficiaries are necessary for those measures with public support rates of less than 100%.

Germany receives 9.08 billion Euro of the overall EAFRD budget (EC 2009) and distributes this overall budget to the Bundesländer (regions) which are responsible for the development of regional RDPs and the subsequent implementation of these programs. A specific feature of the German federal system is that the institutional RD framework in this country is not only subject to the EAFRD regulation but also to the 'Joint Action for Improvement of Agrarian Structures and for Coast Preservation (Gemeinschaftsaufgabe Verbesserung der Agrarstruktur und des Küstenschutzes, GAK)'. Public budget expenses for all measures under the GAK framework are shared between the federal state and the regions in a ratio of 60 to 40%. Since Germany uses the GAK as a National Framework[4] for the regional RDPs there is a three-level co-financing system including financial contributions from the EU, the federal state and the regions. Figure 1 depicts the different co-financing modalities for RD measures in Germany. Accordingly, the regional co-financing share for RD measures can vary between 50% (axes 1 and 3 in non-convergence regions) and 8% (axes 2 and 4 in convergence regions).

Figure 1: Co-financing modalities in Germany`s three-level system



Source: Modified from Grajewski and Mehl (2008: 289).

It is important to note, however, that the depicted shares in figure 1 apply only if the additional expenses by the beneficiaries are defined as private expenses. Since 2003, communal expenses are defined as public expenses (c.f. Council of the European Union 2005, article 2i). Hence, in the case of communes as beneficiaries of specific measures, they take over the respective share of the national co-financing.

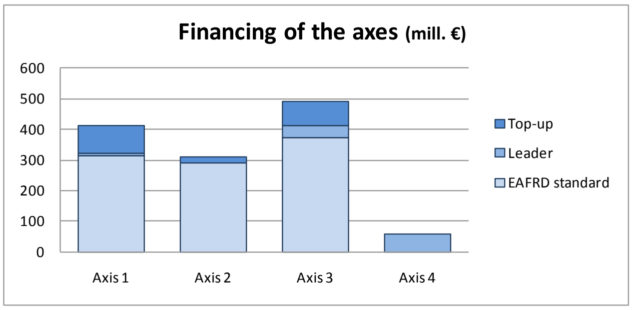
4 According to the EAFRD regulation, member states with regional programming processes can choose to submit a National Framework that contains common elements for the regional RDPs. This provision is meant to make regional programming easier and more coherent.

In addition to the outlined financing modalities for measures using EAFRD funds, member states or regions can allocate further funds to a measure. These additional national expenditures are called top-ups and can receive funds from the GAK if GAK measures are concerned. Top-ups are part of the RDPs and, thus, subject to approval by the European Commission even though no EAFRD funds are used.

2.2 The rural development program of Saxony-Anhalt (2007-2013)

Within the institutional context described, Saxony-Anhalt has developed its RDP (c.f. MLU 2009 for the most recent version). An overall volume of 1.246 billion Euro public expenditures is assigned to 39 measures comprising 809.02 mill.€ EAFRD funds. Further 246.61 mill.€ public national co-financing expenses are shared between the federal state (73.23 mill.), the region (114.79 mill.), the communes (55.09 mill.) and other entities (3.51 mill.). The remaining expenses of 190.49 mill.€ are top-ups to which the federal state contributes 85.03 mill.€ and the region 105.46 mill.€. Figure 2 depicts how these funds are currently allocated to the axes. The figure underlines the predominance of the EAFRD standard financing scheme (EAFRD funds plus national co-financing expenses without Leader) but also shows the importance of top-ups. The expenses planned for Leader implementations consist of expenses for Leader activities in axes 1 and 3 and expenses for the measures 421 and 431. Saxony-Anhalt currently plans to allocate 289.41 mill.€ within the standard EAFRD mode towards measures in axis 2 compared to 313.08 and 374.27 mill.€ to be allocated to axis 1 and axis 3, respectively. In comparison with the minimum use requirements of EAFRD funds in the axes, this allocation reveals a prioritisation of axis 1and axis 3 (cf. figure 2).

Figure 2: Current financing of the EAFRD axes in Saxony-Anhalt (2007-2013)



Minimum contribution of EAFRD funds to the axes (mill. €)

Axis 1	234.81	>=	80.90
Axis 2	231.53	>=	202.25
Axis 3	280.70	>=	80.90
Axis 4	45,22	>=	40.45

Source: Own compilation based on MLU (2009) and current financial schemes of the MLU.

Table 1 presents the current allocation of funds to individual measures.

Table 1: RDP measures and funding in Saxony-Anhalt (2007-2013), mill.€

Code	*Measure*	*Total*	*of which EAFRD standard**	*of which Leader*	*of which Top-ups*
111	Vocational training and information actions	1.05	1.05		
121	Modernisation of agricultural holdings:				
121/I	Agricultural investment support programme	55.98	41.98		14.00
121/II	Revolving Loan Fund for innovative investments in agriculture	14.04	14.04		
123	Adding value to agricultural and forestry products	36.99	36.99		
124	Cooperation for development of new products, processes and technologies in the agricultural and food sector	3.68	3.68		
125	Improving and developing infrastructure related to the development and adaptation of agriculture and forestry:				
125/I	Land consolidation	93.14	48.08	6.25	38.81
125/II	Construction of farming roads	14.20	12.01	2.19	
125/III	Construction of forestry roads	4.56	2.81		1.75
125/IV	Improvement of water management infrastructure	20.00	20.00		
126	Restoring agricultural production potential damaged by natural disasters and introducing appropriate prevention actions	167.45	132.45		35.00
Axis 1		**411.08**	**313.08**	**8.44**	**89.56**
212	Payments to farmers in areas with handicaps, other than mountain areas	51.81	51.81		
213	Natura 2000 payments and payments linked to Directive 2000/60/EC	13.28	13.28		
214	Agri-environmental payments:				
214/I-a	Market-oriented and site adapted land management: extensive production practices	38.12	38.12		
214/I-b	Market-oriented and site adapted land management: extensive grassland management	55.06	55.06		
214/I-c	Market-oriented and site adapted land management: organic farming	70.61	70.58		0.03
214/II	Voluntary Natura 2000 commitments	33.73	33.75		
214/III	Conservation of genetic resources in agriculture	1.72	1.72		
214/IV	Voluntary water protection commitments (reduction of nitrogen surplus)	7.82	7.82		
221	First afforestation of agricultural land	7.30	6.36		0.95
223	First afforestation of non-agricultural land	1.16	1.16		
227	Support for non-productive investments in forestry areas	31.11	9.77		21.34
Axis 2		**311.73**	**289.41**	**0.00**	**22.31**
311	Diversification into non-agricultural activities	8.43	8.43		
312	Support for the creation and development of micro-enterprises	4.73	4.73		
313	Encouragement of tourism activities	10.60	9.33	1.26	
321	Basic services for the economy and rural population (**s**mall scale infrastructure):				
321/I	Sewerage	108.63	65.63		43.00
321/II	Drinking water	6.20	0.40		5.80
321/III	Investments in small schools	64.56	64.56		
321/IV	Investments in childcare	21.54	21.54		
321/V	Renewable energy supply (local biogas and community heating systems)	6.67	6.67		
321/VI	Broadband internet	6.67	6.67		
322	Village renewal and development	148.36	82.45	37.61	28.30
323	Conservation and upgrading of the rural heritage				
323/I	Drawing-up of protection and management plans relating to Natura 2000 sites and other places of high natural value	60.35	60.35		
323/II	Development of semi-natural water bodies	42.11	42.11		
323/III	Conservation of the rural landscape of hillside vineyards in winemaking areas in Saxony-Anhalt	0.70	0.70		
323/IV	Environmental awareness actions	0.42	0.42		
341	Skills acquisition and animation with a view to preparing and implementing a local development strategy	1.79	0.28		1.51
Axis 3		**491.76**	**374.27**	**38.87**	**78.61**
421	Transnational and inter-regional cooperation	0.46		0.46	
431	Running the local action group, acquiring skills, animating the territory	8.75		8.75	
511	Funding technical assistance	22.33	22.33		
RDP		**1246.12**	**999.10**	**56.52**	**190.49**

* EAFRD funds plus the national co-financing expenses without Leader.

Source: Own compilation based on MLU (2009) and current financial schemes of the MLU.

The table shows the multitude of options for RD programming in a region in the EAFRD context. Actually, many of the measures applied in Saxony-Anhalt receive only little funding whereas a few measures get a high financial share of the overall budget. Amongst them is most notably measure 126 which in Saxony-Anhalt is primarily implemented by supporting levee constructions and rerouting of levees. Moreover, village renewal and development (code 322), the support of sewerage infrastructure (code 321/I) as well as payments for land consolidations (code 125/I,) receive a substantial amount of the overall funds. Expenses for Leader implementations are only budgeted for within four measures of axis 1 and 3. These are the infrastructure related measures 125/I and 125/II, the encouragement of tourism activities (code 313) and village renewal and development (code 322). According to Ministry representatives, these measures are particularly suitable for Leader groups and (based on experiences of the previous funding period) applications for other measures are highly unlikely even though they are generally possible. In addition to the four measures within axis 1 and axis 3, Saxony-Anhalt intends to allocate 0.46 and 8.75 mill.€ to the Leader measures 421 and 431.

3. Methodological approach and data

3.1 Underlying philosophy

The modelling approach used in this paper comprises two main features: An interactive model definition with real decision-makers in RD policy-making and the use of a linear optimisation model implemented in Excel. On the one hand, this approach is based on what Milan Zeleny (1980: 2) called the evolving 'interactive philosophy of mathematical programming'. On the other hand, it reflects the growing concern over the 'black-box' character of modelling as it has been raised by the agricultural modelling community (c.f. Brockmeier et al., 2008, Happe and Kellermann, 2008).

The interactive model definition was executed in an iterative procedure in which dialogue phases (actively involving the DMs) alternated with phases of computation and model development (done by the analyst). Such an interactive procedure is strongly supported by the literature for a number of reasons. The most important ones might be that it improves the initial formulation and structuring of the decision problem and that through dialogue it is possible to effectively set the focus on critical points (e.g. Hajkowicz and Higgins, 2008, Kok, 1986, Roy, 2005). Thus, interactive approaches represent a two-way learning process that permits both sides to better understand the system being analysed. Especially to support decision-making in the public sector, Munda (2004) and Walker (2000) recommend the use of simple, clearly defined and flexible models.

Given the multi-objective environment of RD policies and the quite large number of different measures which are implemented to reach these objectives, we are facing a classical multi-criteria decision analysis (MCDA) problem where a number of different alternatives (in our case: measures) are to be defined and evaluated against a set of criteria. Since in our case the focus lies on an optimised budget allocation of a set of policy measures, we face a continuous solution space, and thus, apply a classical multi-objective decision method (MODM) for the overall performance aggregation - a linear optimisation model.

3.2 Linear optimisation model

Following Kirschke and Jechlitschka (2002, 2003) the generalized mathematical parts of the model are sketched out in the following.

Given the assumption of constant marginal and average coefficients, a linear objective function

(1) $$Z_1 = \sum_{i=1}^{m} z_1^i \, x^i$$

with objective one Z_1, x^i the budget expenses for measure i and z_1^i the constant marginal and average coefficient of the objective function describing the impact of the budget expenses for measure i on objective 1 can be defined. In a multi-objective environment, we consider j objectives and introduce a weighting factor α_j (with $\sum_{j=1}^{m} \alpha_j = 1$) for each of the objectives under consideration. Thus, we construct a single aggregated objective function with the weighted linear sum of the objectives and generate only one non-dominant 'compromise solution' for each particular set of weights. The resulting optimisation approach can then be defined as follows:

(2) $$\max_{x^i,\dots,x^n} Z = \sum_{j=1}^{m} \alpha_j \sum_{i=1}^{n} z_j^i \, x^i$$

subject to:

$$\sum_{i=1}^{n} a_r^i \, x^i \begin{Bmatrix} \leq \\ = \\ \geq \end{Bmatrix} b_r \quad for \;\; r = 1,\dots,k$$

and: $x^i \geq 0 \quad for \;\; i = 1,...,n$,

where the index r = 1,…,k describes constraints which can take the form of equations or inequalities, a_r^i are the coefficients of constraint r for measure i, and b_r denotes the right hand side of constraint r. Thus, in order to fully determine such a model, the objectives Z_j and the measures x^i need to be defined and the coefficients (z_j^i, a_r^i, b_r) for all values of the indices i, j and r must be specified. This model definition took place in several meetings and workshops with Ministry representatives using either informal or more formalized focus group discussions. Furthermore, a two-step Delphi approach was executed in which Ministry representatives estimated the impacts of the considered measures on the defined objectives (c.f. Schmid et al., 2010 for a more detailed report on the methodological approach pursued).

With respect to objectives, it was agreed upon considering the two official objectives of Saxony-Anhalt originally formulated in the planning process for the European Structural Funds and the EAFRD (c.f. MLU, 2009: 104ff.): Economic development of rural areas (Z_1), and the creation of employment opportunities in rural areas (Z_2). The third objective of environmental protection and nature conservation (Z_3) is a cross-sectional objective in the official planning process of Saxony-Anhalt. Given the debate about ever increasing administrative burdens, mainly due to the EU's Integrated Administration and Control System (IACS), we considered as a fourth objective administrative efficiency (Z_4) indicating the administrative burden to implement the measures.

With respect to measures, 39 different measures or groups of measures are considered (c.f. table 1). As explained in the previous section, the considered set of measures x^i consists of several subsets since all measures can be grouped either into axis 1 (A1), axis 2 (A2) and axis 3 (A3) or belong to (R) which comprises the remaining rest of axis 4 (measures 421 and 431) and the technical assistance (measure 511). Thus, consider the set of i for the x^i as follows:

(3) $M := \{1,...,39\} = A1 \cup A2 \cup A3 \cup R$

with $A1 := \{1,...,11\}, A2 := \{12,...,21\}, A3 := \{22,...,36\}$, and $R := \{37,...,39\}$.

The overall amount of funds assigned to the x^i can comprise expenses under the standard EAFRD mode (k=1), the Leader implementation mode (k=2) and top-ups (k=3). To account for the different financial modalities associated with these options, a further disaggregation for each measure has taken place. With

(4) $$x^i := x_1^i + x_2^i + x_3^i = \sum_{k=1}^{3} x_k^i \quad for \quad i \in M$$

we now arrive at a set of 117 decision variables whereas the methodological axis 4 represents a subset of M and can be defined as follows:

(5) $$A4 := \left\{ x_2^i \;\; for \;\; i \in M \right\}.$$

With respect to constraints we consider three different kinds of lower and upper bounds (LUB):

(6) LUB I: $$l^i \;\le\; \sum_k x_k^i \;\le\; u^i \qquad for \quad \forall i$$

(7) LUB II: $$l_k^i \;\le\; x_k^i \;\le\; u_k^i \qquad for \quad \forall i, \forall k$$

and

(8) LUB III: $$l_{act}^i \;\le\; \sum_k x_k^i \;\le\; u_{act}^i \qquad for \quad \forall i$$

with $l_{act}^i := (1-\beta) \sum_k x_{k\,act}^i \quad and \quad u_{act}^i := (1+\beta) \sum_k x_{k\,act}^i$

whereas $x_{k\,act}^i$ represent the current budget allocation as set out in the RDP of Saxony-Anhalt and β presents the allowed deviation (in percent) from this current allocation.

The LUB I, on the one hand, reflect the potential range of the budget volume allocated to a measure as a whole. These constraints were a major outcome of one of the workshops at the Ministry and are based on considerations and estimations of the decision-makers. The LUB II, in contrast, restrict the budget allocated to the different financing and implementation options x_k^i. Hence, it is possible to account for, e.g., the financial commitments under the previous programming period (which have to be financed by the standard EAFRD mode k=1) or to restrict the budget allocation to a measure under the Leader implementation option k=2. Furthermore, through the LUB II it is possible to integrate specific requirements of the EAFRD regulation such as the requirement to allocate a maximum of four percent of the EAFRD funds to the measure 511 (c.f. Council of the European Union 2005, article 66).

Like the LUB I, the LUB III are bounds for the budget volume aggregated to a measure as a whole. Thus, dependant on the actual values, one of them is always redundant. The LUB III reflect the allowed deviation from the tentative allocation as set out in the official RDP and can be set for all measures at once. Thus, an allowed deviation of ten percent results in a measure-specific LB of 90% and an UB of 110% of the current allocation. Past interactive modelling sessions revealed that it is a good strategy to start the modelling exercise by allowing for various deviations from the current solution. Thus, developing a realistic structure of the constraints (LUB I) step by step.

Major other constraints relate to the minimum contribution of EAFRD funds to the four axes and to budget constraints on the different levels of the EU (r=1), the federal state (r=2), the region (r=3), the communes (r=4) and other entities (r=5).[5] Mathematically speaking, we defined for each measure x^i a matrix C^i which comprises the financial contribution rate c on the level r for measure component x_k^i. As outlined above, the overall amount of the national co-financing obligation for a certain x_k^i depends on a particular axes-specific EU co-financing rate and, thus, on c_{1k}^i. The national co-financing obligation is then derived by subtracting the EU contribution from the overall public expenses ($1 - c_{1k}^i = \sum_{r=2}^{5} c_{rk}^i$) and can be disaggregated according to the eligibility of a measure to be supported under the frame of the GAK as well as the type and ratio of beneficiaries. The specification of these two criteria has taken place for all c_{rk}^i.

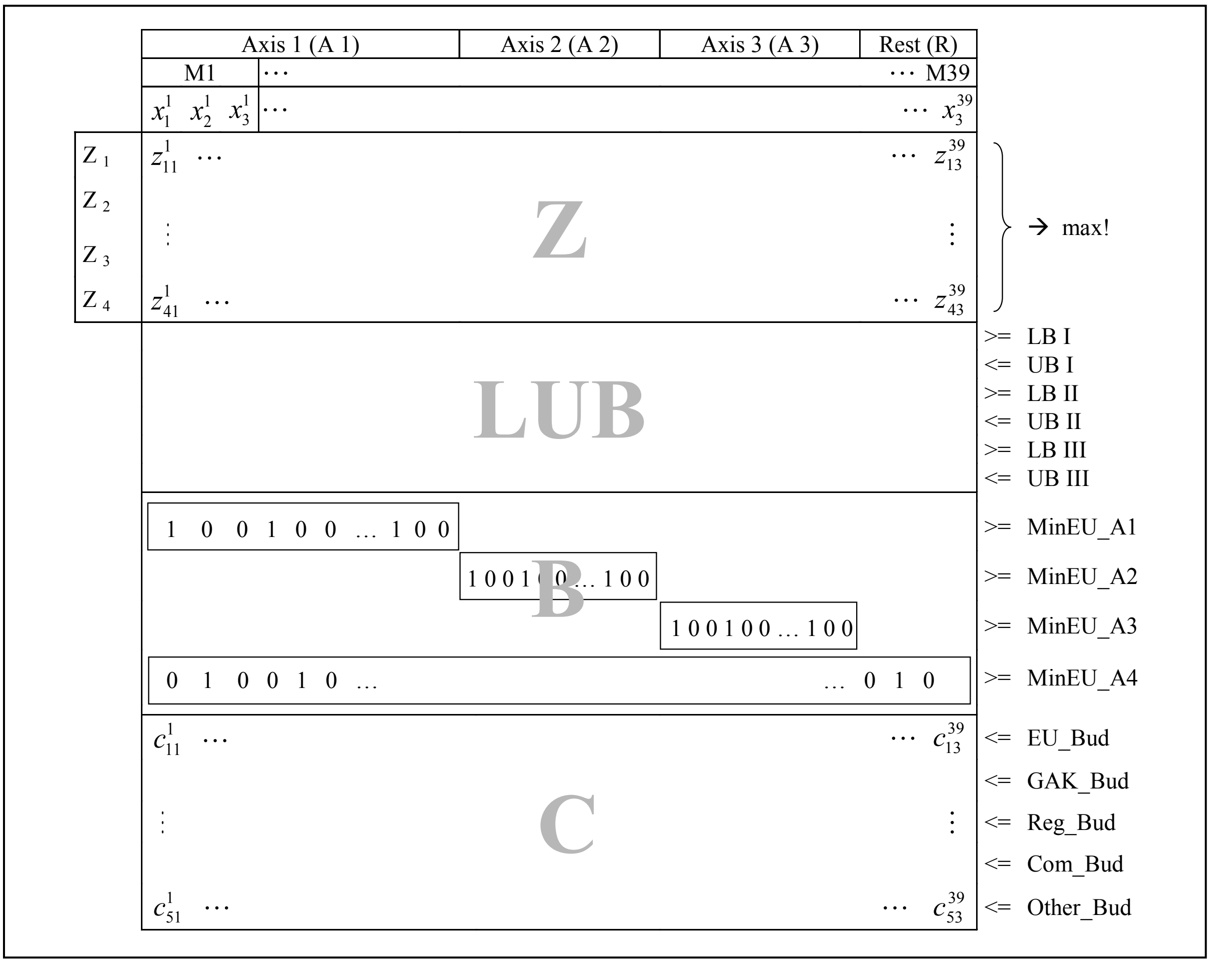
Altogether we get a set of five budget constraints of the following form:

(9) $$\sum_{i \in M} \sum_{k} c_{rk}^i \, x_k^i \quad \leq \quad b_r \qquad .$$

An overview of the model structure is presented in figure 3. Where Z and C are the matrices for the impact parameters z_{jk}^i and the financial contribution rates c_{rk}^i, LUB and B are particular 0-1-matrices where the relevant variables for the respective constraint may take the values one or zero.

5 These 'other entities' refer solely to measure 125-I (Revolving Loan Fund for innovative investments in agriculture). Here, the EU co-financing is distributed to a particular loan fund. The national co-financing obligation is in this case borne by the investment bank holding the fund. For further specifications see article 71 of the EAFRD regulation, chapter 4 sub-section 3 of Commission Regulation 1974/2006 (EC, 2006) and the detailed implementation rules outlined in the RDP of Saxony-Anhalt (MLU, 2009: 210ff.).

Figure 3: Model structure



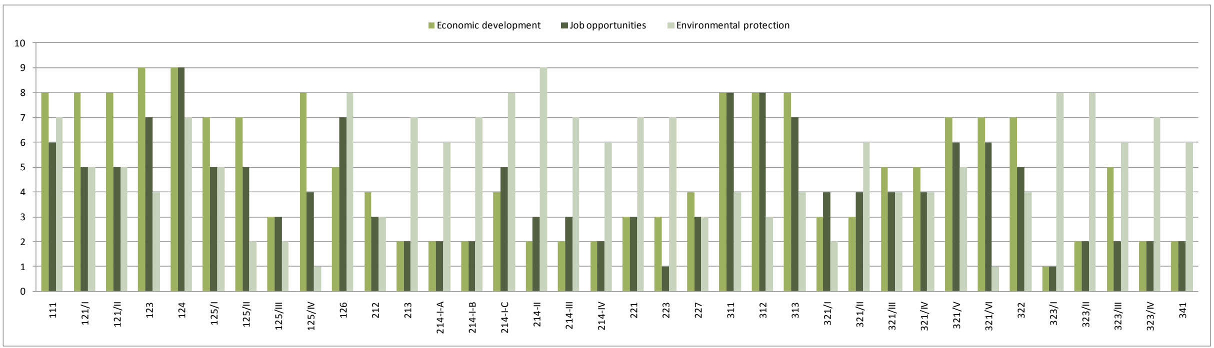
Source: Own compilation.

3.3 Impact parameters

With j = 1, 2, 3, 4 as the index for the four objectives, we generated the objective coefficients z^i_{jk} indicating the impact of a specific measure on the objective considered. We used a direct scoring method along a one-to-nine scale. The scores between one and three represent low target contribution and scores between four and six and seven and nine represent medium and high impact estimations, respectively. In a first round representatives from 14 RD departments of the MLU estimated the impacts of the considered measures on an individual base using emailed scorecards (c.f. Schmid et al., 2010: 18ff.). In a subsequent workshop Ministry representatives discussed the derived parameters and agreed upon final estimates.

The results of the impact estimates for objective 1 to 3 are presented in figure 4. According to the figure, Ministry representatives assign high impact values with respect to objective 1 (economic development) and medium to high values with respect to objective 2 (the creation of employment opportunities) to axis 1 measures. With respect to objective 3 (environmental protection) the values are rather high for axis 2 measures, with the exception of the payments to farmers in areas with handicaps (code 212) and the support of non-productive investments in forestry areas (code 227). Both measures get low scores for objectives 2 and 3 and a lower medium score for objective 1. Organic farming (code 214/I-c) is the only measure in axis 2 with medium impact values for objectives 1 and 2 as well as a high value for objective 3.

Figure 4: Impact parameters for RD policy objectives 1 to 3 in Saxony-Anhalt

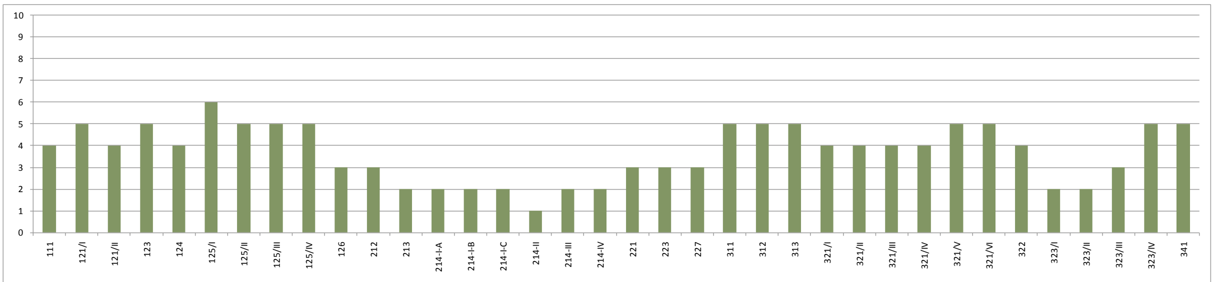


Source: Own compilation.

The impact estimates for axis 3 measures present a mixed picture. As highly beneficial for economic development and job creation are regarded the diversification measures (codes 311, 312, 313) as well as the infrastructure measures renewable energy supply and broadband internet (codes 321/V, 321VI) and village renewal and development (code 322).

With respect to the fourth objective, the impact values obtained were generally low to medium, i.e. all of the measures considered in the model are regarded to impose rather high administrative burdens (figure 5).

Figure 5: Impact parameters for RD policy objective 4 in Saxony-Anhalt



Source: Own compilation.

These low impact parameters are predominantly an expression of the general opinion and dissatisfaction with the IACS of the EU. The Ministry representatives argue that this system causes disproportionate administrative efforts. However, according to the MLU, it may be differentiated whether area or animal based measures or investment measures are considered. The former are associated with high administrative efforts (impact parameters between 1 and

3); while the payments to farmers in areas with handicaps (code 212) get a low score, Natura 2000 and agri-environmental payments get even lower values. According to the MLU the voluntary Natura 2000 commitments (code 214-II) impose the highest administrative costs. This is because in addition to the obligatory monitoring also time consuming risk analyses are required. Just like area based measures the investment based measures may also be differentiated. While they generally cause slightly lower administrative costs particular measures may be associated with additional efforts. E.g. in the case of vocational training (code 111) single farmers are the applicants which implicates a comparatively high effort for this measure. For the measures 321/I to 321/IV (Basic services for the economy and rural population) additional efforts are caused by the need for coordination with other agencies and authorities.

For the EAFRD standard mode and the top-up option the impact coefficients were considered to be equal but different for the Leader implementation mode. After an intensive discussion in the working group, the Ministry representatives finally agreed to a 'plus/minus ten % rule' as a starting point for the modelling exercise. With respect to objective 1 to 3 the Leader-related impact coefficients were assumed to be ten percent higher as compared to the 'normal' implementation of the measures whereas they were assumed to be ten percent lower with respect to administrative efficiency. This assessment mainly results from a lack of experience and skills of Leader managers requiring substantial administrative efforts with regard to additional instructions and considerable post-processing.

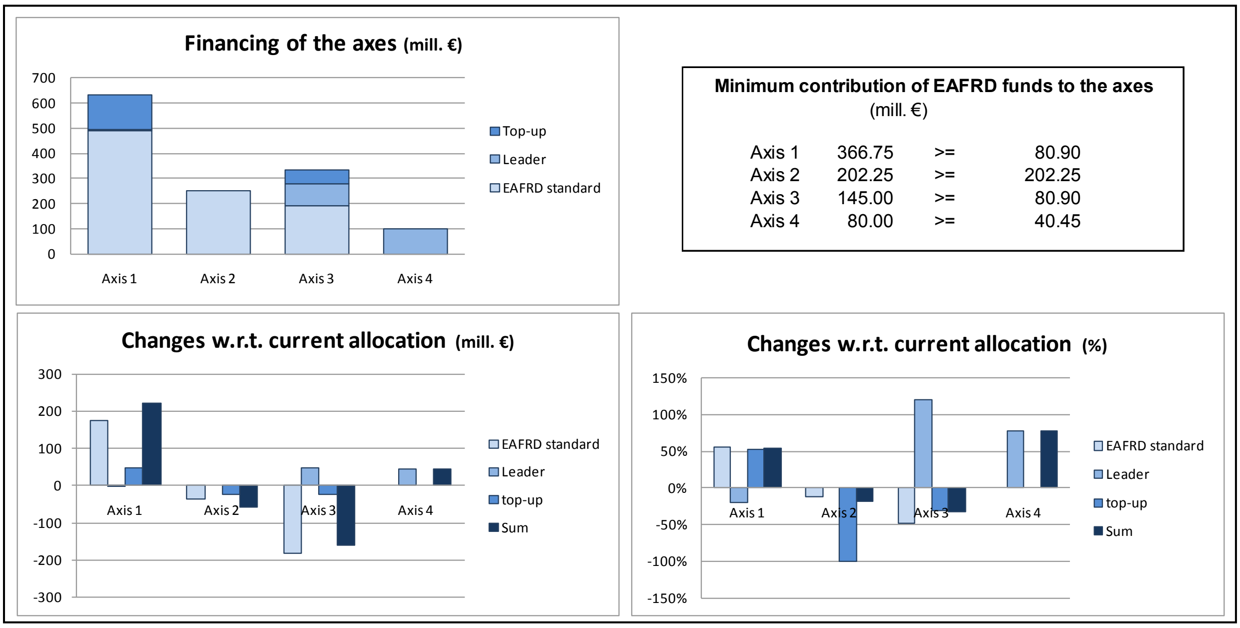
4. Results

4.1 Optimising the RD policy budget allocation

The formulated model has been used in a first step to optimise the current budget allocation. Hence, we are looking for an optimal allocation of funds to the measures that maximises the objective function within a given financial framework. For this calculation we consider the two equally weighted official regional objectives of economic development (Z_1) and the creation of employment opportunities (Z_2) only. Furthermore, we set the values for the maximal deviation from the current solution to 100% and introduce an upper bound for the overall amount of Leader expenses of 100 mill.€. All other parameters and constraints are set according to the current EAFRD framework.

The results of this optimisation can be summarized as follows: First of all, the value of the aggregated objective function increases from 5638.15 to 6758.28 (a plus of 19.87%). Hence, if major shifts in the allocation of funds to measures of up to 100% are possible, this could considerably improve the realisation of Saxony-Anhalt's RD objectives. Second, all budget constraints are binding meaning that the financial resources are fully used. Third, the overall amounts of funds directed to the fulfilment of the co-financing obligation and to top-ups are almost the same as in the current allocation, but differ with regard to the respective fractions provided by the federal state budget and the regional budget. This indicates that the relatively large increase of the objective function value is not only due to a modified allocation of funds for the measures x^i , but also to substantial shifts at the x_k^i specific financing of the measures. Fourth, a considerably large shift of budgets from axis 2 and axis 3 towards axis 1 and axis 4 occurs. These shifts are further explained in figure 6. While the diagram in the upper left part of the figure shows the total amount of funds assigned to the axes, the lower two diagrams depict the changes which occurred with respect to the current allocation. Additionally, the table in the upper right part shows the contribution of EU funds to the axes.

Figure 6: Optimal financing of the EAFRD axes in Saxony-Anhalt (2007-2013)



Minimum contribution of EAFRD funds to the axes (mill. €)

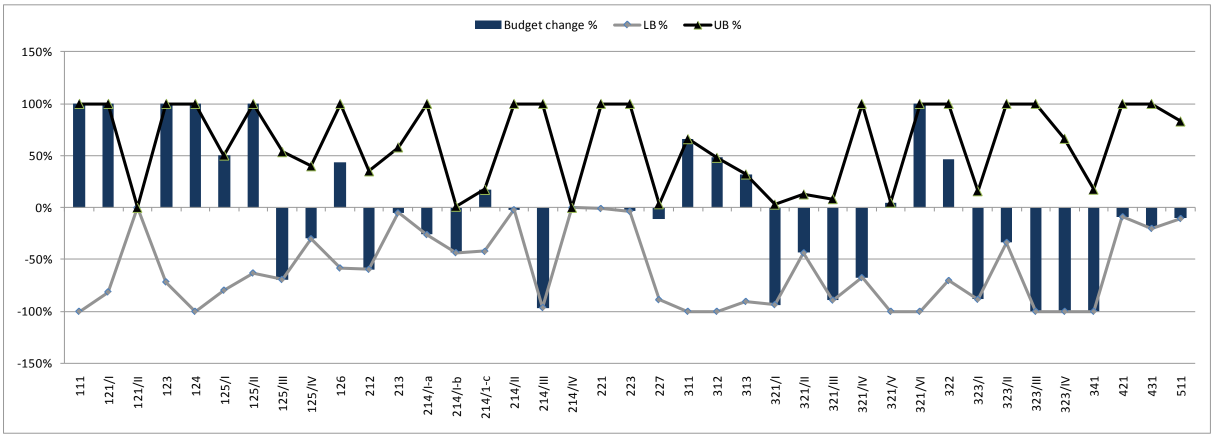
Axis 1	366.75	>=	80.90
Axis 2	202.25	>=	202.25
Axis 3	145.00	>=	80.90
Axis 4	80.00	>=	40.45

Source: Own compilation.

In the optimal solution axis 1 receives substantially more funds than at present. The additional 221.85 mill.€ comprise predominantly EAFRD funds plus the national co-financing (EAFRD standard). In the case of axis 2, the EU minimum contribution constraint is binding meaning that the EU funds to axis 2 measures decrease to 202.25 mill.€. The overall amount of funds assigned to axis 3 measures also decreases, but here only to 332.94 mill.€. Thus, the EU minimum contribution constraint is not binding which is predominantly due to the increase of Leader funds assigned to measures in axis 3. The general shift of funds to the first axis also takes place with regard to top-ups. Whereas in case of axis 2 all top-ups are reallocated to axis 1, this shift is also apparent in case of axis 3 even though to a lesser extent (decrease of 31.6%).

It has to be noted, however, that figure 6 just shows one optimal solution whereas other optimal allocations can result in shifts of up to 40 mill.€ of funds between axis 1 and 3. This is due to the fact that the Solver yields a stable solution for most of the measures considered but several solutions for a few measures.[6] For the solution considered, figure 7 shows the measure-specific changes in percent for each measure x^i within the relevant lower and upper bounds in percent.

Figure 7: Optimal RD measure-specific financing in Saxony-Anhalt (2007-2013), changes w.r.t. current allocation (%)



Source: Own compilation.

Following this solution, the upper bounds are binding for twelve measures which receive substantially more funding than before. This applies to all measures in axis 1 with the exception of the infrastructure related measures of forestry road construction (code 125/III) and water management infrastructure (code 125/IV) as well as measure 126 (levee construction and rerouting). Whereas the Solver yields unstable solutions for the latter two measures, measure 125/III got by far the lowest impact scores in axis 1 with respect to both objectives under consideration. Hence, it is now financed at its lower bound. All measures in axis 2 received notably low scores (between one and five) for the objectives under

6 A stability check of the obtained solution revealed that the programming approach finds several optimal solutions for three measures which received an overall score of 12 with respect to the sum of the two objectives under consideration. Under the given scenario, this refers to the measures 125/IV, 126 and 322 resulting in an unstable measure-specific fund allocation in these cases. Furthermore, the programming approach yields unstable results for two measures in axis 2. Here, measure 212 and measure 227 got exactly the same objective coefficients (summing up to seven) and co-financing parameters. Thus, the Solver is indifferent whether it should allocate resources to measure 212 or to measure 227 in order to fulfill the EU minimum contribution constraint.

consideration. Here, the minimum contribution of EU funds is a binding constraint. As a result, the measure with the highest scores (organic farming, code 214/I-c) receives additional funds to fulfil this restriction. All other measures are financed at their lower bounds with the exception of two measures for which the programming approach yields unstable results due to equal objective coefficients and co-financing parameters. This concerns either the non-productive investments in forestry areas (code 227) or the less-favoured area payments (code 212).

The measure-specific changes in axis 3 generally also reflect the corresponding impact parameters. The diversification measures 311, 312 and 313 target the creation of non-agricultural jobs and off-farm income opportunities and the measures 321/V and 321/VI represent infrastructure investments in broadband internet and renewable energy supply. All of these five measures were regarded as highly beneficial for the economic development and job creation (impact scores between six and eight). Thus, they are now financed at their upper bounds even though these are highly restrictive as captured in figure 7. With the exception of funds provided for village renewal and development projects (code 322), all other measures receive less funding and the lower bounds are binding.

Taking a closer look at the depicted LB reveals that obviously no LB I and LB II have been defined for a number of measures (codes 111, 124, 311, 312, 321/V, 321/VI, 323/III, 323/IV, 341) since in these cases the LB equal the LB III. Hence, all of these measures for which the LB is a binding constraint are not financed at all. This applies exclusively to measures in the third axis (323/III, 323/IV, 341) and would mean that they do not stay in the program.

As mentioned above, the optimal solution yields a modified composition of the overall amount of funds provided for the co-financing under the standard EAFRD mode and the top-ups. Table 2 shows that in the current allocation 29.7% of the national co-financing obligation is borne by the federal state and 46.6% is provided by the region. In the optimal solution the figure increases to 34.7% for the federal share whereas the regional budget share decreases to 41,5%. The opposite holds true for the composition of the top-up budget.

Table 2: Aggregated financing situation for RD funding in Saxony-Anhalt (2007-2013), mill.€

	Current allocation		Optimal allocation	
EARFD co-financing (total)	*246.61*		*246,15*	
thereof federal state	73.23	(29.7%)	85,42	(34.7%)
thereof region	114.79	(46.6%)	102,13	(41.5%)
thereof communes	55.09	(22.3%)	55,09	(22.4%)
thereof others	3.51	(1.4%)	3,51	(1.4%)
Top-up (total)	*190.49*		*190,95*	
thereof federal state	85.03	(44.6%)	72,83	(38.1%)
thereof region	105.46	(55.4%)	118,12	(61.9%)

Source: Own calculation.

Hence, the programming approach reallocates EAFRD funds towards GAK measures and top-ups towards non-GAK measures. In the optimal solution, all non-GAK measures are solely financed by top-ups regardless of the measure-specific co-financing and impact parameter.

4.2 Implications of budget cuts

The financial framework for RD policy making in Germany is very important for the regions since their overall financial situation is (with a few exceptions) increasingly tight. This holds particularly true for Saxony-Anhalt being at the top rank of all German regions (excluding the city states of Berlin, Bremen and Hamburg) with respect to public debts (c.f. Federal Statistical Office 2009: 595) and a prospect of a dramatic decline of revenues in the long run (LMF 2009). Probably, the available regional budget for RD will have to be reduced in the future. Moreover, the expected loss of the convergence region status will result in substantially less funding volumes in the EAFRD context.

It is against this background that we analysed two further scenarios for RD planning in Saxony-Anhalt: Decreasing regional budgets (scenario A) and the loss of the convergence region status (scenario B). For scenario A, we set all model parameters according to the optimal allocation, but gradually decrease the available regional budget in three steps. In scenario A1 we assume a regional budget of 75% of the currently used regional budget (165.19 mill.€) whereas the scenarios A2 and A3 depict a decrease of 50% (110.12 mill.€) and 75% (55.06 mill.€) respectively. The results of these scenarios for the aggregated financial situation are shown in table 3.

Table 3: Aggregated RD funding in Saxony-Anhalt (2007-2013) after budget cuts, mill.€

	Optimal allocation	Scenario A1 (Reg. budget: -25%)	Scenario A2 (Reg. budget: -50%)	Scenario A3 (Reg. budget: -75%)	Scenario B Loss of convergence region status
EAFRD budget	809.02	809.02	809.02	565.19	484.51
Fed. budget (total)	158.26	158.26	131.05	51.22	158.26
Reg. budget (total)	220.25	165.19	110.12	55.06	220.25
Com. Budget	55.08	55.08	55.08	55.08	55.08
Other budget	3.51	3.51	3.51	3.51	7.02
Nat. co-financing	246.15	246.15	246.15	164.87	440.61
thereof fed. budget	85.42	98.81	98.88	51.22	158.26
thereof reg. budget	102.13	88.75	88.68	55.06	220.25
Top-ups (total)	190.95	135.89	53.62	0.00	0.00
thereof fed. budget	72.83	59.45	32.17	0.00	0.00
thereof reg. budget	118.12	76.44	21.45	0.00	0.00
Total available budget	1246.12	1191.05	1135.99	1080.93	966.47
Total bud used	1246.12	1191.05	1108.78	730.06	925.12
Budget not used	0.00	0.00	27.21	350.87	41.35

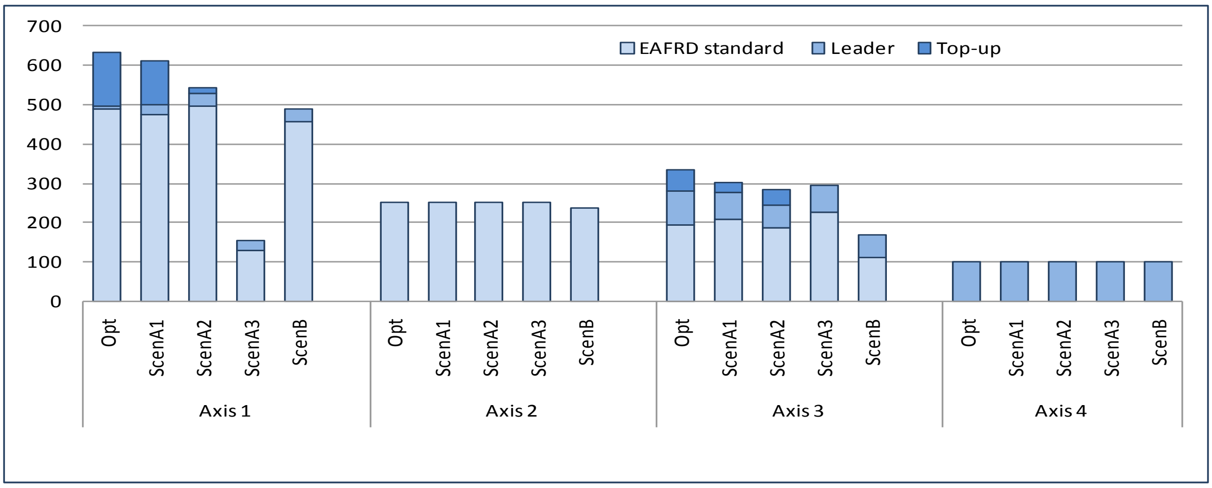
Source: Own calculation.

Regional budget cuts according to scenario A have several interesting consequences. First, the A1 scenario with a 25% decrease results in a situation where the entire federal budget and the EU funds can still be utilised. In this scenario changes occur with respect to the financing options for measures. While the overall co-financing volume for EAFRD standard and Leader remains stable, the expenses for top-ups are driven down. Furthermore, the share of the national co-financing obligation borne by the federal state increases whereas it decreases in case of the regional share –indicating the favourable financing of GAK measures and/or measures for which the communes bear the national co-financing obligation. Second, a further decrease of the available regional budget of 50% (scenario A2) and 75% (scenario A3) leads to a situation in which the available federal budget (A2 and A3) and the EU budget (A3) can no longer be fully utilised. Consequently, the overall amount of available resources for RD declines. Obviously, the amount of unutilised funds increases with a lower regional budget. In scenario A2 Saxony-Anhalt would lose additional 0,25€ federal budget for each Euro lost in the regional budget. This ratio increases to a loss of 2,12€ of federal and EU funds in scenario A3. Third, along with the reduction of available regional funds, the expenses for top-ups are gradually driven down to zero. Thus, the federal budget and the remaining regional budget is increasingly used for the co-financing of EAFRD funds.

With regard to the measure-specific budget allocation, the implications of regional budget cuts are rather straightforward. As a first consequence, all measures with aggregated impact coefficient of 12 (125/I, 125/II, 125/IV, 126, 322) receive less funding even though at random (scenario A1). A further decline of the regional budget (scenario A2) yields a situation in which the non-GAK measures without communal contributions subsequently receive less funding. Hence, even though the support of vocational training and information actions (code 111) received relatively high impact coefficients for the two objectives under consideration ($z_{11}^{1} = 8,\ z_{21}^{1} = 6$) it drops out of the program under scenario A2. Moreover, measures for which the communes take over the share of the regional co-financing obligation receive increased funding. While the infrastructure related measure 125/II received unstable and random funding under scenario A1, it is now financed at its upper bound due to the fact that the national co-financing is borne by communes.

Finally, with a rather low regional budget of 55.06 mill.€ under scenario A3, all but ten measures are financed at their lower bounds. Among these ten measures are three measures in axis 2. Since the minimum EU contribution constraint was already a binding constraint in the reference scenario, no changes occurred under scenario A. In the other axes, the remaining funds are allocated towards the four non-GAK measures with the highest impact scores and/or for which the communes take over a substantial amount of the national co-financing obligation. This holds for the measures 125/II, 313, 321/VI and 322. In order to tie-up the remaining federal funds, the three GAK measures with the highest impact scores are financed above the lower bound (measures 123, 311 and 312). Figure 8 shows the aggregated financial allocation to the axis for the different scenarios.

Figure 8: Funding of EAFRD axes in Saxony-Anhalt (2007-2013) after budget cuts, mill.€



Source: Own calculation.

According to scenario B, Saxony-Anhalt would lose its convergence region status. Thus, scenario B is defined by different co-financing parameters on all administrative levels depending on the modified axes-specific EU contribution rates (50% in case of axis 1 and 3 and 55% in case of axis 2 and 4). Furthermore, the EAFRD budget amounts to 525.86 mill.€ representing 65% of the EAFRD budget available in the previous scenarios.[7] All other model parameters are set according to the optimal allocation in the reference scenario.

The results of this scenario B with respect to the resource use are depicted in table 3. One of the most obvious implications is that the total available budget for the development of rural areas in Saxony-Anhalt decreases to 966.47 mill.€ representing only 78% of the support volume compared to the reference scenario.

The reduced overall budget translates itself to the overall amount of funds assigned to the axes as visualized in figure 8. Accordingly, the implications for axis 2 are small compared to the losses in axis 1 and axis 3. The minimum contribution rate of EAFRD funds to axis 2 now amounts to 131.47 mill.€ (compared to 202.25 mill.€ in the previous scenarios) and is again a binding constraint. Consequently all expenditures exceeding this minimum contribution leave the axis. Furthermore, since all public national expenditures are needed to co-finance the EAFRD funds, top-ups are driven down to zero in scenario B as in scenario A3.

At the level of the measure-specific financing some interesting changes occur. Due to the decreased EU co-financing rates for non-convergence regions, the national co-financing

[7] This figure reflects the different EAFRD contributions for convergence and non-convergence regions and a phasing-out period which is not known. Hence, we assume a future budget share of 65% of the present EAFRD contribution.

budgets become scarce. In particular, the amount of available GAK funds as well as the communal co-financing volume effect the financing of measures. In axis 2, for example, the EAFRD minimum contribution constraint is now met by additional funds assigned to the measures 214/II (payments for voluntary Natura 2000 payments) and 214/III (support for projects to conserve genetic resources in agriculture). Even though both measures received notably small scores for the two objectives under consideration, they now receive the funds which have been in the optimal allocation allocated to the GAK measures 221 and 227.

Summarizing the scenario calculations, budget cuts for Saxony-Anhalt obviously require major changes in the allocation of funds for RD measures and their financing mode in order to keep objective losses as small as possible. For a 25% regional budget cut (scenario A1) the value of the aggregated objective function decreases by 4.9% and by 12.2% for a 50% regional budget cut (scenario A2) and even by 49.9% for a 75% cut (scenario A3). The loss of the convergence region status, on the other hand, reduces the objective value by 28.5%.

5. Concluding remarks

In this paper we presented a modelling approach to facilitate regional RD programming and we used this approach to analyse the EAFRD budget allocation 2007-2013 in Saxony-Anhalt. The formulated linear optimisation model captures the various features and framework conditions for RD policy making that have to be considered in the multi-level EAFRD context. Particular emphasis has been put on the complex financial framework and the various co-financing requirements and options. Hence, the model allows for a detailed analysis of these complex modalities.

The results obtained with the programming approach reveal a rather high optimisation potential for RD budget allocation in Saxony-Anhalt as compared to the current allocation. Focussing on the two official economic objectives only, the optimisation of the current allocation suggests to generally put more emphasis on axis 1 and underline the importance of so called top ups.

The programming results are severely affected by the co-financing modalities within the EAFRD and the GAK context. Regional budget cuts would initially make GAK financed measures more important and finally leads to a situation in which the GAK (and later on the EU) funds can no longer be fully utilised. In general, the same holds true for the calculation of scenario B (loss of the convergence region status). Hence, two major implications occur. On the one hand, the overall amount of available RD funds decreases and this results in a reduced realisation of RD objectives. On the other hand, both scenarios will potentially lead to adjustments of the RDP towards an even strengthened orientation along the framework provided by the GAK.

The scenario calculations so far give valuable insights in the complex nature of RD policy making but still have to be extended to result in a flexible policy-making support tool. This refers, on the one hand, to the critical issue of generating reliable impact parameter in a rather limited time span. One the other hand, more experience is needed to fully understand the complex allocation process of RD funds and to deal with optional solutions for several measures with equal impact parameters. This will be a challenging perspective for the future interactive process with the Ministry representatives.

References

BMF – Bundesministerium der Finanzen (2008): Bund / Länder - Finanzbeziehungen auf der Grundlage der Finanzverfassung, Issue 2008, Berlin. Available at: http://www.bundesfinanzministerium.de/nn_4478/DE/BMF__Startseite/Service/Broschueren__Bestellservice/Finanz__und__Wirtschaftspolitik/40210,templateId=raw,property=publicationFile.pdf. (25.01.2010).

Boots, P.W.G., Lootsma, F.A. (2000): Decision Support in the Public Sector. In: Journal of Multi-Criteria Decision Analysis 9 (1-3): 1-6.

Brockmeier, M., Kleinhanss, W., Offermann, F. (2008): The challenges of model based policy advice. In: Agrarwirtschaft 57 (8): 386-390.

Council of the European Union (2006): Council decision of 20 February 2006 on Community strategic guidelines for rural development (programming period 2007 to 2013) (2006/144/EC). In: Official Journal of the European Union L 55/20.

Council of the European Union (2005): Council Regulation (EC) No 1698/2005 of 20 September 2005 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD). In: Official Journal of the European Union L 277/1.

EC – European Commission (2009): Commission Decision of 22 October 2009 amending Decision 2006/636/EC fixing the annual breakdown by Member State of the amount for Community support to rural development for the period from 1 January 2007 to 31 December 2013 (2009/782/EC). In: Official Journal of the European Union L 278/62.

EC – European Commission (2006): Commission Regulation (EG) No 1974/2006 of 15 December 2006 laying down detailed rules for the application of Council Regulation (EC) No 1698/2005 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD). In: Official Journal of the European Union L 368/15.

Federal Statistical Office (2009): Statistical Yearbook 2009 for the Federal Republic of Germany, Wiesbaden. Available at: http://www.destatis.de/.

Grajewski, R., Mehl, P. (2008): Variable Politik trotz wachsender Verflechtung. Netzwerkgovernance am Beispiel der Politik zur Entwicklung Ländlicher Räume. In: Scheller, H., Schmid, J. (eds.): Föderale Politikgestaltung im deutschen Bundesstaat. Variable Verflechtungsmuster in Politikfeldern. Nomos Verlagsgesellschaft, Baden-Baden: 284-310.

Hajkowicz, S., Higgins, A. (2008): Comparison of multiple criteria analysis techniques for water resource management. In: European Journal of Operational Research 184 (1): 255-26.

Happe, K., Kellermann, K. (2008): Diese Modelle sind zu komplex! – Oder doch nicht?: Experimentelles Design und Metamodellierung als möglicher Weg, das Kommunikationsproblem agentenbasierter Modelle in der Politikanalyse zu lösen. Schriften der Gesellschaft für Wirtschafts- und Sozialwissenschaften des Landbaues e.V. 43: 439-449.

Kirschke, D., Jechlitschka, K. (2003): Interaktive Programmierungsansätze für die Gestaltung von Agrar- und Umweltprogrammen. In: Agrarwirtschaft 52 (4): 211-217.

Kirschke, D., Jechlitschka, K. (2002): Angewandte Mikroökonomie und Wirtschaftspolitik mit Excel. Vahlen, München.

Kok, M. (1986): The interface with decision makers and some experimental results in interactive multiple objective programming methods. In: European Journal of Operational Research 26 (1): 96-107.

LMF – Landesministerium der Finanzen (2009): Mittelfristige Finanzplanung des Landes Sachsen-Anhalt 2009-2013, Magdeburg.

Meyer, M.A., Booker, J.M. (2001): Eliciting and Analyzing Expert Judgment. A Practical Guide. ASA-SIAM Series on Statistics and Applied Probability. Philadelphia, USA.

MLU – Ministerium für Landwirtschaft und Umwelt des Landes Sachsen-Anhalt (2009): Entwicklungsprogramm für den ländlichen Raum des Landes Sachsen-Anhalt (EPLR), Förderzeitraum 2007-2013. Stand: 16.07.2009. Available at: http://www.sachsen-anhalt.de/LPSA/fileadmin/Elementbibliothek/Bibliothek_Politik_und_Verwaltung/Bibliothek_Europa/Publikationen/09_07_16_EPLR.pdf (01.03.2010).

Munda, G. (2004): Social multi-criteria evaluation: Methodological foundations and operational consequences. In: European Journal of Operational Research 158 (3): 662-677.

Nutt, P.C. (2005): Comparing Public and Private Sector Decision-Making Practices. In: Journal of Public Administration Research and Theory 16 (2): 289-318.

Renn, O., Webler, T., Rakel, H., Dienel, P., Johnson, B. (1993): Public participation in decision-making: A three-step procedure. In: Policy Sciences 26: 189-214.

Roy, B. (2005): An overview of MCDA Techniques today - Paradigms and Challenges. In: Figueira, J., Greco, S., Ehrgott, M. (eds.) (2005): Multiple Criteria Decision Analysis: State of the Art Surveys. Springer, New York: 4-24.

Schmid, J., Häger, A., Jechlitschka, K., Kirschke, D. (2010): Programming rural development funds – An interactive linear programming approach applied to the EAFRD program in Saxony-Anhalt. DFG-Forschergruppe 986, SiAg Working Paper 7. Berlin, Humboldt-Universität zu Berlin, Landwirtschaftlich-Gärtnerische Fakultät,Department für Agrarökonomie. Available at: http://edoc.hu-berlin.de/series/siag-working-paper/2010-7/PDF/7.pdf (04.03.10).

Walker, W.E. (2000): Policy Analysis: A Systematic Approach to Supporting Policymaking in the Public Sector. In: Journal of Multi-Criteria Decision Analysis 9 (1-3): 11-27.

Zeleny, M. (1980): Multiple Objectives in Mathematical Programming: Letting the Man in. In: Computers and Operations Research 7: 1-4.