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THE ALLOCATION OF POLISH RURAL DEVELOPMENT PROGRAM FUNDS. THE OPTIMIZATION APPROACH¹

Summary: Polish Rural Development Program 2007-2013 amounts to 17 billion EUR, from which over 76% is derived from the EU budget. The allocation of these funds takes place at the country level, with multiple conflicts of interest arising among the stakeholders. The pivotal problem is how the rural development budget can be best allocated in order to promote the economic growth of the agricultural sector, the sustainable development of rural areas, and the preservation of natural resources. In this paper, I apply a restricted weighted sum model to optimize the resource allocation of Rural Development Program 2007-2013. The modeled results are compared with the actual allocation performed by the Ministry of Agriculture and Rural Development in Poland.

Keywords: allocation, rural development, MCDA.

1. Introduction

After many years of a strong emphasis of the EU's Common Agriculture Policy on market intervention, recent reforms provide an increased support for sustainable development of agriculture and rural areas. This policy shift involves a transformation of price support into direct payments for farmers and a marked enhancement of structural rural-development policy programs. For each Financial Perspective of the EU (a 7-year budget period), Member States are entitled to submit their structural rural-development programs to the European Agricultural Fund for Rural Development (EAFRD). The programs are prepared based on the EU's strategic guidelines that offer a range of possible policy measures to be implemented. The government of each member country selects the key measures to be included in the budget allocation.

Poland selected the total of 22 measures from those proposed by the Council Regulation No. 1698/2005. The total budget allocated to implement these measures

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amounts to over 17 billion EUR. The multi-objectivity of the program and the diversity of the proposed measures raise many conflicts over priority-setting among potential beneficiaries and country-level decision-makers. Moreover, the allocation decisions are complicated by the lack of the commonly accepted indices of rural development. Thus, the emerging question is how to provide the best support for country-level decision-makers to set the priorities and allocate structural budgets with multiple objectives.

The problems that involve multiple, usually conflicting objectives can be tackled using Multiple Criteria Decision Analysis (MCDA) methods. Quantitative models have provided substantial benefits to corporations and governments over the past half century. Recently, they gained on importance also in social sciences, where the decision problems are often based on the subjective preferences of the decision-makers [Kacprzyk, Węglarz 2002]. Kirschke, Jechlitschka [2002, 2003] propose an interactive linear and parametric programming approach to support the budgeting of structural policies. Wegner and Kiryluk [2008] demonstrate how multi-objective linear programming can be used for the region-specific budgeting for sustainable rural development policy.

The purpose of the paper is to assess the allocation of Polish Rural Development Program (PRDP) for years 2007-2013, using MCDA methods. The assessment is based on the comparison of the actual allocation performed by the Ministry of Agriculture and Rural Development (MARD) with several scenarios of the model allocation. Different weighting coefficients for the objectives of the Program are set up in the modeling approach and the results of the simulations are compared with that actual allocation.

2. Method

According to the Council Regulation No. 1698/2005, Polish Rural Development Program for years 2007-2013 comprises three official objectives: improving the competitiveness of agriculture and forestry, improving the environment and the countryside, and improving the quality of life in rural areas.

Weighted sum approach was applied in the paper in order to optimize the resource allocation of Rural Development Program 2007-2013. It seeks the combination of activities (rural development policy measures) that maximizes the total benefit of Polish Rural Development Program without exceeding the given budget. The weighted sum method converts the multi-objective problem of maximizing the objectives into a scalar one by constructing a weighted sum of all the objectives. Hence, the programming approach can be formulated as follows:

$$\text{Max } C = \alpha \cdot \sum_{i=1}^n z_{1i} \cdot B_i + \beta \sum_{i=1}^n z_{2i} \cdot B_i + \gamma \sum_{i=1}^n z_{3i} \cdot B_i$$

with: $\alpha, \beta, \&$ weighting coefficients of objectives,
 B_i budgetary expenses for measure i ,
 $i = 1, \dots, n$ index of considered measures,
 z/i a verage coefficient of the objective function describing the impact of the budgetary expenses for measure i on the 1st objective;

subject to: $\sum_{i=1}^n a_{ri} \cdot B_i \left\{ \begin{array}{l} \leq \\ = \\ \geq \end{array} \right\} b_r$ for $r = 1, \dots, m$ and $B_i \geq 0$ for $i = 1, \dots, n$

where: $r = 1, \dots, m$ is the index of restrictions (equations or inequations),
 a_{ri} is the coefficient of restriction r for measure i .

Weighting coefficients ($\alpha, \beta, \&$) are real values that express the relative importance of three official objectives of the program and balance their involvement in the overall utility measure. Coefficients for the objective function (z/i) were obtained from expert's assessments survey.

A survey was conducted among the group of 25 researchers from universities and research institutes in the field of agricultural economics and rural development in Poland. Being local specialists in the field, the experts are assumed to have a broad understanding of the CAP and are aware of the long-term objectives of the rural development measures. In the survey, the responders were asked to assess the contribution of measures to the Program's three main objectives, with an assumption that each measure has got an impact on each objective. The assessment was done in the scale from one (low impact) to nine (high impact), proposed by Saaty [1980]. The scores were then averaged for each objective. The average score value is a universally used aggregation function in practice although other procedures have also been suggested [Matsatisinis *et al.* 2005; Balinski, Laraki 2007].

Eighteen measures were taken into account in the modeling approach. Due to their specificity, the LEADER² measures were not implemented in the model. The final sum of the allocation does not enclose also the liabilities for the period 2004-2006 for the measure support for semi-subsistence farms and technical assistance. The total budget allocated to implement these 18 measures amounts to 15.774 billion EUR.

Lower and upper bounds as well as the minimum and maximum possible budget for each measure were assessed with respect to the possibilities of funds absorption. The upper bounds are calculated using publicly available data, under the assumption that all eligible beneficiaries would apply for a specific measure. The lower bound was implemented in order to assure that all selected measures receive at least minimal support. The lower bound was defined as 20% of the upper; however, for some

² The main aim of the LEADER is to build social capital through the mobilization of rural population and the contribution to the creation of new jobs in rural areas, as well as the improvement of the management and valorization of local resources.

measures (early retirement, agri-environmental program, and afforestation), it had to account for previous commitments of the program, such as the continuation of the policy that falls under the measure³. For the Less Favored Areas (LFA) measure, the budget is fixed (the upper and lower bounds are equal). The objective of this measure is to prevent the depopulation of mountainous and less-favored rural areas. The LFA payments constitute compensation for incurred costs and lost income as a result of farming in these areas. The payment is provided per unit of land in these areas and the unit of payment had been negotiated with the European Commission; thus, the total budget for this measure cannot be changed. The results are presented in Table 1.

Table 1. Lower and upper bounds for Polish Rural Development Program 2007-2013 budget allocation

Measure	Lower bound	Upper bound
Training for the persons employed in agriculture and forestry	9.6	48.0
Setting up of young farmers	103.3	520.0
Early retirement	1 880.0	4 800.0
Advisory services for farmers and forest owners	100.0	500.0
Modernization of agricultural holdings	920.0	4 608.0
Increasing the added value to basic agricultural production	300.0	1 500.0
Improvement of infrastructure related to the development of agriculture	96.0	765.0
Participation of farmers in food quality schemes	40.0	207.0
Information and publicity	7.2	36.0
Producer groups	26.0	168.0
Less-favored areas (LFA)	2 449.0	2 449.0
Agri-environmental program	1 240.0	3 860.0
Afforestation of agricultural and non-agricultural land	237.0	545.1
Restoring forestry production potential damaged by natural disasters	28.0	140.0
Diversification into non-agricultural activities	101.4	506.9
Establishment and development of micro-enterprises	420.0	2 100.0
Basic services for the economy and rural population	860.0	4 300.0
Village renewal and development	246.0	1 230.0

Source: author's own calculations on the basis of data from PRDP 2007-2013.

The actual allocation performed by the Ministry of Agriculture and Rural Development (MARD) is compared with different scenarios of a model allocation.

³ For description of PRDP's measures, see *Rural Development Program 2007-2013*.

First, the actual allocation is compared with the model allocation, assuming the maximization of each of the three objectives separately. The maximal weighting coefficients are alternately assigned to each of three objectives: improving the competitiveness of agriculture and forestry, improving the environment and the countryside, and improving the quality of life in rural areas. The results of the model simulations show how to allocate the budget in order to maximize the effectiveness of the allocation with respect to each objective separately. Second, the actual allocation is compared with the model one, assuming equal importance of all three objectives ($\alpha = \beta = \&$).

3. Results

Table 2 presents the actual and model allocation of PRDP assuming the maximization of each of the three objectives separately. The results of the model simulations show that the maximization of objective 1 – improving the competitiveness of agriculture and forestry – requires the largest budget increase for such measures as: the modernization of agricultural holdings (2759 million EUR), increasing the added value to basic agricultural production (568 million EUR), advisory services for farmers and forest owners (282 million EUR), and the participation of farmers in food quality schemes (127 million EUR). The budget for the modernization of agricultural holdings, advisory services for farmers and forest owners, and the participation of farmers in food quality schemes would need to be about 2.5 times higher than actually planned. The decrease of financing would affect the majority of other measures.

Maximizing objective 2 ($\beta = 1$) – improving the environment and the countryside – requires the increase of the financing of six measures: advisory services for farmers and forest owners, the modernization of agricultural holdings, the improvement of infrastructure related to the development of agriculture, agri-environmental program, the afforestation of agricultural and non-agricultural land, and restoring forestry production potential damaged by natural disasters. The largest increase comparing with actual allocation would concern the modernization of agricultural holdings (1558.3 million EUR) and agri-environmental program (1545 million EUR).

With maximal weight for objective 3 ($\& = 1$) – improving the quality of life in rural areas – the financing of diversification into non-agricultural activities, the establishment and development of micro-enterprises, basic services for the economy and rural population, and village renewal and development needs to be increased. The largest increase in financing affects basic services for the economy and rural population (2560 million EUR) and the establishment and development of micro-enterprises (1077 million EUR). If decision-makers wanted to stress the importance of this objective, the financial support for all other measures should be decreased.

Table 2. The actual and “model” budget allocation of PRDP 2007-2013, with the assumption of the maximization of three objectives separately (million EUR)

Measure	Actual allocation	Model allocation maximising		
		Objective 1	Objective 2	Objective 3
Training for the persons employed in agriculture and forestry	40.0	48.0	9.6	9.6
Setting up of young farmers	420.0	520.0	103.3	103.3
Early retirement	2549.6	1880.0	1880.0	1880.0
Advisory services for farmers and forest owners	218.0	500.0	500.0	100.0
Modernization of agricultural holdings	1849.1	4608.0	3407.4	920.0
Increasing the added value to basic agricultural production	932.0	1500.0	300.0	300.0
Improvement of infrastructure related to the development of agriculture	637.5	211.3	765.0	96.0
Participation of farmers in food quality schemes	80.0	207.0	40.0	40.0
Information and publicity	30.0	36.0	7.2	7.2
Producer groups	140.0	168.0	26.0	26.0
Less-favored areas (LFA)	2449.0	2449.0	2449.0	2449.0
Agri-environmental program	2315.0	1640.3	3860.0	1640.3
Afforestation of agricultural and non-agricultural land	514.0	237.0	545.1	237.0
Restoring forestry production potential damaged by natural disasters	100.0	28.0	140.0	28.0
Diversification into non-agricultural activities	345.6	215.7	101.4	506.9
Establishment and development of micro-enterprises	1023.6	420.0	420.0	2100.0
Basic services for the economy and rural population	1541.3	860.0	860.0	4101.0
Village renewal and development	589.6	246.0	360.3	1230.0
Sum	15 774.3	15 774.3	15 774.3	15 774.3

Source: author's own calculations.

In the next step of the analysis, the equal weighting coefficients were set up for the objectives ($\alpha = \beta = \&$). Figure 1 presents the difference in the allocation of the PRDP between the results of this simulation and actual allocation. Positive values indicate the need to increase the financing accordingly to model allocation, conversely negative values indicate a need for cuts in financing. The results show that the financing of modernization of agricultural holdings and agri-environmental measures needs to be increased respectively by 2758 and 1500 million EUR.

The modernization of agricultural holdings is intended to support investments in holdings in order to improve their effectiveness and adjust to the conditions of the EU Single Market. It is one of the most important measures for Polish farmers because it provides them with capital for restructuring of their farms. Recent data from the implementing agencies demonstrate that the budget allocated to this measure was indeed insufficient and the funds were exhausted in the middle of the budget period.

Agri-environmental programs provide payments in compensation for extra costs to those farmers who voluntarily accept extended agri-environmental requirements. The large financing of this measure is consistent with the idea of the sustainable development of agriculture and rural areas proclaimed by the EU.

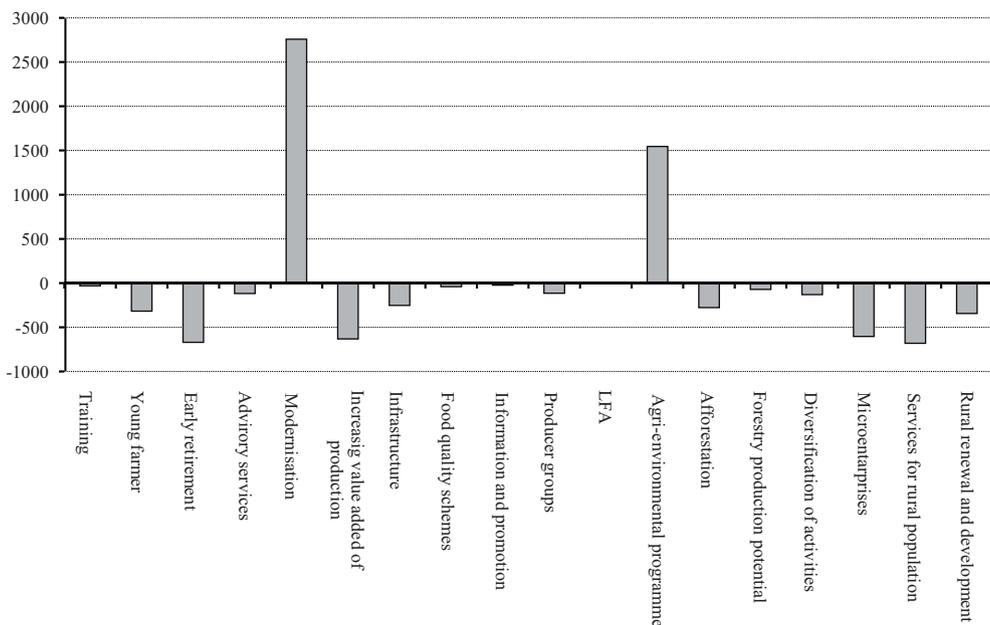


Fig. 1. The difference between the model ($\alpha = \beta = \gamma$) and the actual allocation of the PRDP (million EUR)

Source: author's own calculations.

Given limited PRDP's budget, the financing of the other measures needs to be decreased. The biggest absolute reduction would concern: early retirement, increasing the added value to basic agricultural production, the establishment and development of micro-enterprises, and basic services for the economy and rural population. It should be underlined that early retirement measure receives only the lower bound of financing in every analysed scenario of allocation. The measure is designed to support agricultural producers that decide to stop their agricultural activity for the

purpose of transferring the holdings to younger agricultural producers. It is criticized by agricultural economists [Rowiński, Wigier 2005], primarily for its social character and anticipated low effectiveness. According to the actual allocation by MARD, this measure receives almost 14% of the analyzed budget. The proposed allocation would only satisfy the lower bounds of this measure.

4. Discussion and conclusions

Multiple Criteria Decision Making (MCDM) assumes that a decision-maker is to choose among a number of alternatives that he or she evaluates on the basis of several criteria. MCDA method can be a useful tool in the public sector to provide decision-makers with a structured and practical framework for making decisions. De Agostini [2006] underlines the importance of MCDA in decision-making concerning environmental resources, such as agriculture and forestry planning.

The method presented in the paper provides the optimal (under initial restrictions and weighting coefficients of objectives) budget allocation of PRDP's resources. It offers insights into the problem structure and explores trade-offs between objectives. Applying maximal weighting coefficients alternately for each of the objectives demonstrates how to allocate budget if decision-makers intend to stress the importance of one of the objectives.

The results of the study on PRDP show that the total difference between the actual allocation and the model one, while maximizing one of the objectives is the highest in the case of objective 3 – improving the quality of life in rural areas. It amounts to 4438 million EUR. While maximizing the first and the second objective, the differences are smaller (3878 million EUR in the case of improving the competitiveness of agriculture and forestry and 3552.8 million EUR in the case of improving the environment and the countryside). Thus, the actual allocation better reflects the need for increasing competitiveness of agriculture with respect to ecological requirements than the general living conditions of rural habitants. Given that political measures designed to improve living conditions in rural areas are also financed by other EU's structural programs, this direction seems to be justified. Moreover, the results of model allocation with equal weighting coefficients for objectives suggest that the allocation should be concentrated on financing of investments in agricultural holdings and agri-environmental programs.

Literature

- Balinski M., Laraki R., *A Theory of Measuring, Electing, and Ranking*, "PNAS" 104, No. 21, 2007.
De Agostini P., *Identifying the best combination of environmental functions using multi-criteria analysis*, [in:] *Integrated Assessment and Public Management of Public Resources*, ed. J.C. Cooper, F. Perali, M. Veronesi, Edward Elgar 2006.

- Kacprzyk J., Węglarz J., *Badania operacyjne i systemowe wobec wyzwań XXI wieku. Modelowanie i optymalizacja*, Akademicka Oficyna Wydawnicza ELIT, Warszawa 2002.
- Kirschke D., Jechlitschka K., *Angewandte Mikroökonomik und Wirtschaftspolitik mit Excel*, Vahlen, München 2002.
- Kirschke, D., Jechlitschka, K., *Interaktive Programmierungsansätze für die Gestaltung von Agrar- und Umweltprogrammen*, "Agrarwirtschaft" 2003, No. 52(4).
- Matsatsinis N.F., Grigoroudis E., Samaras A., *Aggregation and disaggregation of preferences for collective decision-making*, "Group Decision and Negotiation" 2005, No. 14.
- Rural Development Program 2007-2013*, Ministry of Agriculture and Rural Development, Warsaw 2007.
- Rowiński J., Wigier M., *Wsparcie rozwoju obszarów wiejskich ze środków UE w latach 2000-2013 – terażniejszość i oczekiwania*, "Wspólnoty Europejskie" 2005, No. 7/8.
- Saaty T.L., *The Analytic Hierarchy Process Planning. Priority Setting. Resource Allocation*, Mac Graw-Hill, New York 1980.
- Wegener S., Kiryluk E., *Regional Aspects of Decision-Making Support for Rural Development in Poland*, "People, Food and Environment. Global Trends and European Strategies", 12th Congress of the European Association of Agricultural Economists – EAAE Ghent 2008.

ALOKACJA FUNDUSZY POLSKIEGO PROGRAMU ROZWOJU OBSZARÓW WIEJSKICH. PODEJŚCIE OPTIMALIZACYJNE

Streszczenie: Całkowity budżet Programu Rozwoju Obszarów Wiejskich na lata 2007-2013 przekracza 17 mld euro, z czego 76% pochodzi ze środków unijnych. Dobór działań programu oraz alokacja budżetu dokonywane są na poziomie krajowym. Jest to proces niezwykle istotny z punktu widzenia rozwoju wsi i rolnictwa w Polsce. W artykule dokonano oceny alokacji budżetu programu przy wykorzystaniu metod programowania wielokryterialnego. Aktualną alokację Ministerstwa Rolnictwa i Rozwoju Wsi porównano z wynikami symulacji modelowych zakładając kolejno różne wagi poszczególnych celów programu.