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HOW COULD THE CAP MEASURES IMPACT FAMILY FARMS IN AREAS WITH NATURAL CONSTRAINTS IN SERBIA?

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ABSTRACT

Areas with natural constraints are mountains or other areas where physical landscape results in higher production costs and lower yields. These areas are characterised by undeveloped infrastructure, tendencies to depopulation and resource degradation. The European Union has been providing support for farmers in the areas with natural constraints for the continued use of agricultural land, maintaining the countryside, and promoting a sustainable farming system. The Republic of Serbia is in the process of integration into the European Union and, therefore, seeks to harmonise the national policy to the Common Agricultural Policy. However, the policy toward areas with natural constraints in Serbia does not follow the European model, although it would be recommended given the heterogeneity and number of challenges these areas face. The research aims to examine the effects of different rural development policy measures on production structure, economic results and resource utilisation of family farms in areas with natural constraints in Serbia. A linear programming model has been developed for the dominant farm type in the areas with natural constraints in Eastern and Southern Serbia. The model was used to simulate various policy scenarios based on the Common Agricultural Policy: compensatory payments, decoupled payments, agri-environmental payments and greening payments. Results showed that a combination of different policy measures could increase income and preserve traditional agricultural systems and biodiversity. Considering that there is a lack of empirical research on areas with natural constraints in Serbia, research findings provide guidelines for creating rural development policies that take into account the characteristics of the dominant farm type in these areas.

Key words: areas with natural constraints, linear programming, simulation of policy scenarios, Serbia.

INTRODUCTION

In the European Union (EU), many rural regions are classified as areas with natural constraints (ANC)[1] because they have fragile natural resource base that limits returns to agricultural production and makes yields highly uncertain. These areas are usually characterised by poor market linkages and undeveloped physical infrastructure generating high transaction costs (Ruben & Pender, 2004; Havadi-Nagy et al., 2015). The variety of biophysical and socio-economic constraints leads to migrations and abandonment of agricultural land, having adverse effects on landscape and biodiversity in rural areas (IEEP, 2006). The support to farmers working in ANCs has had more than a thirty-year tradition in the EU. The ANC payment is designed to maintain the continued use of agricultural land, preserve the countryside, and promote a sustainable farming

[1] 55.9% of the total EU area is located in ANC (Eurostat – Farm Structure Survey, 2007).

system. Farmers in ANCs receive compensatory payments for lower income and higher production costs they derive from agriculture production (Council Regulation (EC) No 1305/2013).

Previous research and policy evaluation in the EU mainly show positive effects of compensatory payments on farm income, especially on farms located in mountainous areas (Tamme, 2004; Lososová et al., 2016). However, various studies show that despite the use of the ANC support, farmers leave rural areas, especially those characterised by steep slopes and a high percentage of pastures in utilised agricultural area (UAA). Giesecke et al. (2010) and Zawalinska et al. (2013) could not find a positive relationship between ANC payments and employment in rural areas.

Most authors believe that positive effects on land use, income and maintenance of the population in ANCs cannot be attributed only to compensatory payments. Namely, environmental payments such as agro-ecological payments, Natura 2000, cross-compliance requirements, and greening measures significantly improve biodiversity and landscape in ANCs (Hovorka, 2004; Štolbová & Molčanová, 2009; Klepacka-Kołodziejska, 2010) and positively affect farmers' income in regions where extensive agricultural systems prevail (Czekaj et al., 2013; Wąs et al., 2014).

Research was also focused on the relationship between decoupled payments, farmer's income and production structure in marginal and undeveloped regions. Direct payments based on historical patterns usually result in lower incomes for farmers in mountainous areas and cause a decrease in sheep and cattle production (Gelan & Schwarz, 2008; Morgan-Davis, 2014). Also, analyses show a positive impact of decoupled payments on farm income (Svetlanská & Turčeková, 2016) as well as the same level of production structure under decoupled payments as with coupled payments (EC, 2011).

The authors used several techniques to analyse the impact of agricultural and rural policy measures on income, production structure and labour. According to Louhichi et al. (2013), the most frequently used approaches for formulating models at the farm level are: mathematical programming; econometric approach; econometric-mathematical approach; simulation approach and modelling based on agents. The choice of approach depends on the availability of data; model specifications and research scope (Buysse et al., 2007). However, linear programming (LP) is still one of the most commonly used methods of mathematical programming techniques that has been successfully employed for the estimation of the potential impact of changing agricultural policy (Buysee et al., 2007; Žgajnar et al., 2007; Acs et al., 2010; Morgan-Davis, 2014)

This research aims to examine the effects of various policy scenarios on production structure, economic results and resource utilization on the dominant farm type in ANC in Serbia. Given that Serbia is a candidate country for EU membership, agricultural and rural policy is expected to be reformed and made compatible with the Common Agricultural Policy (CAP). Therefore, the LP model was developed to simulate the various scenarios based on CAP measures: the abolishment of all forms of coupled payments and a switch to a system of decoupled payments; the introduction of compensatory payments; and the introduction of agro-ecological and greening payments.

Analyses of the effect of decoupled payments on gross margin and production structure are important for farmers in Serbian ANCs because they are highly dependent on coupled payments (per head payments and milk premiums). Also, in Serbia, there is no particular measure for farmers in ANCs, and existing agro-ecological measures are not diverse as those in the EU (Bogdanov, 2014; Papić, 2022). Considering that there is a lack of empirical research on areas with natural constraints in Serbia, research findings provide valuable guidelines for evidence-based policy making.

MATERIAL AND METHODS

The initial step in the research was a farm survey to investigate farm characteristics in the ANC mountainous areas of eastern and southern parts of Serbia and to provide inputs to the LP model. The survey was designed and carried out in the summer months of 2018. It comprised 371 farm visits[2]. Farms were chosen based on two selection criteria: 1) rural households had at least three members and 2) one member of the household was younger than 50 years of age (Papić, 2021). Three farm types were identified using the Principal Component and Two-Step Cluster analysis: 1) Farms with intensive mixed livestock production dependent on income from agriculture (197 farms from the sample); 2) Farms with mixed livestock production and income from salaries and pensions (103 of the farms from the sample) and 3) Farms with mixed livestock and crop production and diversified income (70 farms from the sample) (Papić, 2021). The resulting typology was then used to construct real typical farms in the research area on the basis of their similarity to the average farm situations of each cluster. "The similarity between the average farm and the observed farm was computed through the total distance between both, defined as the sum of the squared standardized difference between every variable of the farm and its group average" (Khan et.al, 2000). We have decided to use a real typical farm instead of the average typical farm, considering that this farm is real and the model includes only the activities represented on the farm (Brouwer & van Ittresum, 2010). As for our analysis, the typical farm with intensive mixed livestock production dependent on income from agriculture, comprising 53.2% of farms from the sample, is used as an example to show the effect of agricultural and rural policy measure changes based on the CAP.

Characteristics of the analysed typical farm

The typical farm is situated in the mountainous village, and it cultivates 11.5 hectares of arable land and 7.0 hectares of natural meadows and pastures. Around 50% of UAA includes leased land. The farm is specialised for cow milk production, and products sold on market are milk and male calves. Sheep production is based on grazing on common village pastures and the main products sold on market are sheep's cheese and lambs. The farm produces fattened pigs for the market, as well as piglets intended for household consumption (Table 1).

The share of subsidies in production value is around 20%. The farm uses direct payments for crop production, quality breeding dairy cows, quality breeding sheep, and milk premium. The farm is not eligible for direct payments for lambs, because the largest number of lambs is sold to intermediate buyers not to slaughterhouses, which is one of the preconditions for receiving subsides. The farm holder believes that agricultural production of his farm largely depends on subsidies (direct payments). The farm holder does not use rural development measures and has no clear opinion on whether he will use them in the future (Papić, 2021).

There are 4 household members. Two of them are employed on a farm, and the other two have additional activities outside the farm. The farm does not hire additional labour force (Table 1).

Table 1. Characteristics of the analysed typical farm

Indicators	
Economic indicators	
Gross margin (€)	20,560

[2] One farm was excluded from the sample, considering that the data were incomplete, so the analysis was performed using 370 farms.

Share of subsidies in production value (%)	20.0
Production indicators	
UAA (ha)	18.1
Arable land (ha)	11.5
Maize grain (ha)	3.0
Wheat (ha)	2.0
Oat (ha)	1.0
Maize silage (ha)	0.5
Alfalfa (ha)	4.3
Bean (ha)	0.13
Potato (ha)	0.53
Natural meadow and pastures (ha)	7.0
Leased UAA (%)	55.3
Cattle (structural unit)	10
Sheep (structural unit)	22
Pig (structural unit)	2
Labour force	
Number of household members	4
Ecological indicators	
Nitrogen per ha (kg)	109

Source: Authors' calculation

General approach

The impact of rural development policy scenarios on economic results, production structure and changes in the utilisation of family farm resources was examined using the modelling method. The modelling method is used when it is not possible to experiment on a real system, that is, the subject of research (Hazell & Norton, 1986). Modelling is based on the linear programming method that, despite its simplified linear and normative nature, successfully indicates the behaviour of farmers in changing production conditions (Janeska Stamenovska, 2015).

The mathematical formulation of a standard linear programming model is (Hazell & Norton, 1986):

$$\text{Max}\, Z = \sum_{j=1}^{n} c_j\, x_j$$

Subject to $\sum_{j=1}^{n} a_{ij} x_j \leq b_i, \quad i = 1, \dots, m$

And $x_j \geq 0 \qquad j = 1, \dots, n$

where *Z* refers to the objective function (total gross margin per farm annually); *x* is the vector of activities; *b* is the vector of the available resources; *c* is the total gross margin or costs per activity. The problem is to maximise the value of the objective functions with respect to the resources, constraints and the non-negativity requirements.

For this purpose, a farm model based on mathematical programming has been developed in Microsoft Excel framework. Such a model can be solved using the Excel Solver and it allows for the optimisation of production structure.

The group of activities included in the model were: plant production activities (small grains, fodder plants, legumes, potato, natural meadows and pastures); livestock production activities (cattle, sheep and pig production); lease of land; purchase of livestock feed; selling, consumption and processing of agricultural products and agricultural policy measures. The groups of constraints included in the model were: production capacity constraints (land availability, labour availability, housing requirements); agronomic constraints (crop rotation constraints and livestock feed balance); consumption constraints, agricultural policy constraints (national and EU agricultural criteria that the farmer must fulfil) and balance constraints that connect activities related to the production with sale and consumption activities. Also, an important part of this step is defining the technological coefficients that represent connections of independently variable sizes with limiting resources (Janeska Stamenkovska et al., 2013). Parameters for the models were based on data from the typical farm and adequate literature. Data were validated by the experts in the field of biotechnical sciences (through semi-structured interviews).

The main impacts of simulated scenarios considered were those on farm income, land use and farm resources utilisation. The model provides optimal production structure within the baseline scenario and within the alternative policy scenarios. The effects of the scenarios were analysed in relation to the present situation – the baseline scenario.

Policy scenarios

The developed model included seven scenarios presented in Table 2. Baseline scenario (B), Decoupled payments scenario (SAPS) and No subsidy payments scenario (No S.) were considered individually or in interaction with Compensatory payments (ANC), Agri-environmental payments (AE) and Ecological focus area payments (EFA).

Table 2. Scenarios analysed

No.	Scenario abbrev.	Short description	Simulated amounts of new measures	Requirements for receiving new payments
1.	B+ ANC	Compensatory p. with existing system of direct p.	25€/ha	Payments are intended for all categories of the UAA
2.	B+ANC+AEa	Compensatory p. and agro-ecological p. with the existing system of direct p.	25€/ha+10€/LU	Min. 0.3LU/ha; Max.1LU/ha
	B+ANC+AEb		25€/ha+200€/LU	Min. 0.3LU/ha; Max.1LU/ha
3.	B+EFA	Payments for fallow land with the existing system of direct payments	31 €/ha	Min. 5% of arable land is fallow land
4.	B+EFA+ANC+ AEa	Payments for fallow land, compensatory p. and agro-ecological p. with the existing system of direct p.	31€/ha+25€/ha+10€/LU	Combination of the above-mentioned requirements
	B+EFA+ANC+ AEb		31€/ha+25€/ha+200€/LU	
5.	SAPS	Decoupled payments	115€/ha	Decoupled payments for all UAA categories
6.	SAPS+ANC+AE a	Decoupled p. with compensatory p. and agro-ecological p.	115€/ha+25€/ha+10€/LU	Combination of the above-mentioned requirements
	SAPS+ANC+AE b		115€/ha+25€/ha+200€/UG	
7.	NO S.	Abolition of all forms of subsidies	-	-

Source: Authors' systematisation

The baseline scenario is based on the policy model applicable in 2018in Serbia. Direct payments per hectare were intended for arable crops and permanent crops for maximum 20 hectare (34 €/ha), while direct payments per animal head were granted for quality breeding dairy cows (212 €/head) and quality breeding sheep with registered pedigree (59 €/head). Thresholds for minimum and maximum number of animals were introduced (minimum 2 and maximum 300 for quality breeding dairy cows and minimum 10 for quality breeding sheep in ANC). Dairy premium (0.1 €/litre) was granted for cow milk delivered to dairies, for minimum 1,500 litre per quarter for farmers in ANC.

The SAPS scenario (Simplified Area Payment Scheme) represents a model intended for member states that joined the EU after 2003. This support is based on the eligible hectares declared by farmers (all categories of UAA) and the level of support is the same for all hectares in the country[3]. The simulation of the SAPS scenario in this research was based on the following characteristics:

- The existing forms of coupled payments in livestock farming (per head, per litre) were excluded in the model.
- Amounts for direct payment per hectare increased[4] compared to the current payments.
- Payments per hectare were intended also for all UAA (including meadows and pastures).

The No S. scenario assumed no budgetary support for farms, but also the relaxation of constraints following agricultural policy measures.

The ANC scenario represents compensatory payments according to the EU regulation on rural development policy[5]. In the EU, the amount of ANC payment ranges from 25 euros per ha to 450 euros per ha for mountainous areas. A minimum amount of ANC payment proposed in EU was simulated in this paper. The ANC scenario was based on the following characteristics:

- ANC compensation was paid for eligible hectares of UAA (arable land, permanent crops, pastures and natural meadows).
- Farms, in addition to the direct payments per ha, can use compensatory payments for all categories of UAA (including meadows and pastures).

The AE scenario included measures aimed at preserving of grazing systems, biodiversity and traditional, economically important agricultural products. AE payments for Serbia are determined based on a literature review of AE programs in the EU and in neighbouring countries[6]. Two variants of AE payments for keeping sheep on pasture were simulated. The lower amount was determined in a line with AE payments in neighbouring countries (for example, in Montenegro), and the higher amount was based on the EU practice[7]. The AE scenarios simulated in this paper are based on the following characteristics:

- AE payment was paid per livestock unit (LU)[8] for sheep on pastures.
- Minimum and maximum livestock density per hectare was set and the farmer was obliged to keep sheep on pasture for at least 6 months.
- Farms used additional payments for sheep grazing.

The EFA scenario represents the EU greening payment intended for farms maintaining at least 5% of arable land as an ecological focus area[9]. In the EU, greening payments represent annual payment per hectare calculated as a fixed percentage of basic payment (usually around 70%)[10]. The EFA scenario was based on the following characteristics:

[3] The average payment amount in EU in the period 2015–2017 was 108.1 €/ha (EC, 2009).
[4] The amount per hectare was calculated based on EU SAPS calculation method, i.e., total realised direct payments in Serbia were divided by the total area of UAA for which subsidies were paid in 2018 (Ministry of agriculture, forestry and water management (2019) and Directorate for Agrarian Payments in Serbia – Internal data).
[5] Council Regulation (EC) No 1305/2013.
[6] Council Regulation (EC) No 1305/2013; Cooper et al., 2010; Znaor & Karoglan Todorović, 2015; Jones et al., 2016; Ministry of Agriculture, Forestry and Water Management of Montenegro – MPRR CG, 2018.
[7] Council Regulation (EC) No 1305/2013.
[8] AE payments are paid per LU, and not per ha of pasture used for grazing (which is the case in some EU countries) considering that in researched area common pastures are used for grazing.
[9] fallow land, nitrogen-fixing crops, forested areas, buffer strips, terraces, landscape features and hedges
[10] Council Regulation (EC) No 1305/2013

- 5% of arable land was intended for fallow, which means that some lines of plant production were excluded from production.
- Working hours and costs necessary to maintain fallow were included in the model.
- Payments for fallow were paid per ha (70% percentage of payments per hectare in Serbia).

EU Nitrate directive[11] imposes a limit on organic manure applications. The maximum is set at 170 kg/ha of total nitrogen (N) each year averaged over the agricultural area on the farm. Fertiliser use represents pollution caused by N fertilisation and it is relevant for policy analysis (Manos et al., 2009). Therefore, this limitation was included in all models as a constraint.

RESULTS AND DISCUSSION

Impact on economic farm results

The effects of the applied scenarios on the economic results are shown in Figures 1 and 2. The indexes in Figure 2 are compared with the Baseline scenario that corresponds to index 100.

The results show the increase of gross margins in the first two groups of scenarios, while all SAPS scenarios and No subsidy scenario led to the decrease of gross margin compared to the Baseline. In other words, compared to the Baseline, gross margin increased by around 15% in the scenarios which entail coupled payments with ANC payments and AE payments.

Within EFA scenarios, farm gross margin increased by around 10–11%, which is lower compared to the previous scenarios (B+ANC; B+ANC+AE). This was expected given that the farm received lower amounts of subsidies, and animal feed costs increased within EFA scenarios. Brown & Jones (2013) and Henrich (2012) highlight that leaving land fallow leads to an increase in dairy farms costs.

Within the SAPS scenario, farm gross margin decreased by 8.28%. In this scenario coupled payments were abolished and farm received 80% less subsides compared to the Baseline. When the farm receiving SAPS payments uses ANC and AE payments, gross margin decreases even more (about 10%). This is due to requirements about the minimum number of LU sheep that the farmer should fulfil to receive AE payments. Some previous research also found that decoupling has significantly decreased the income of the farmers (Manos et al., 2009; Manos et al., 2011), especially those from mountainous areas (EC, 2011).

Complete abolition of subsidies, as expected, led to the biggest reduction of gross margin (12.6%). These findings confirm the previous research results. (Žgajnar et al., 2007; 2008; Acs et al., 2010).

[11] Council Directive (EEC) No 676/91.

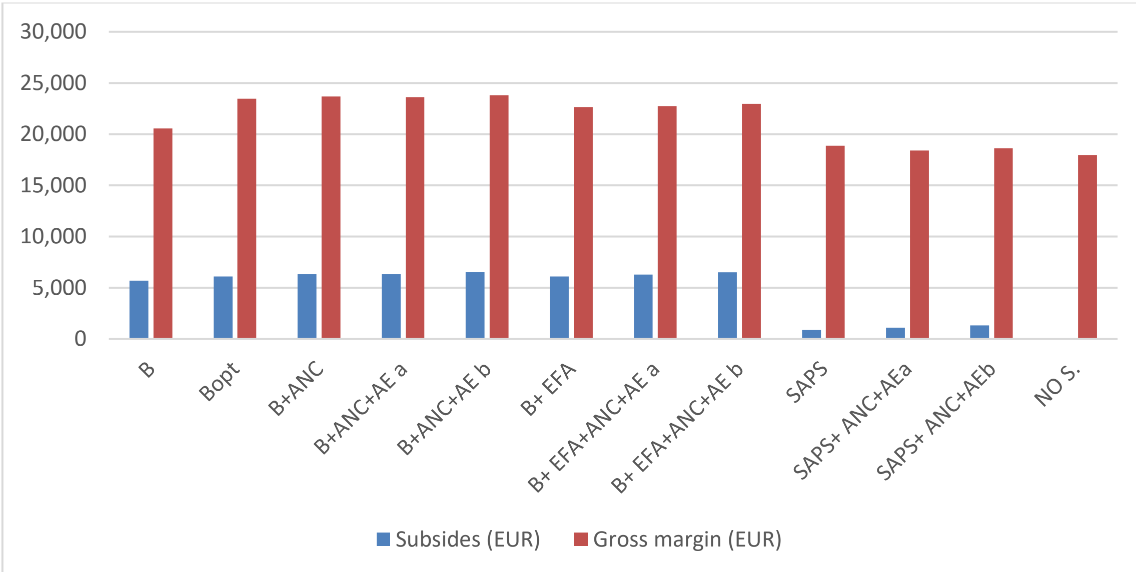

Figure 1. Economic indicators under different scenarios in €
Source: Authors' calculation

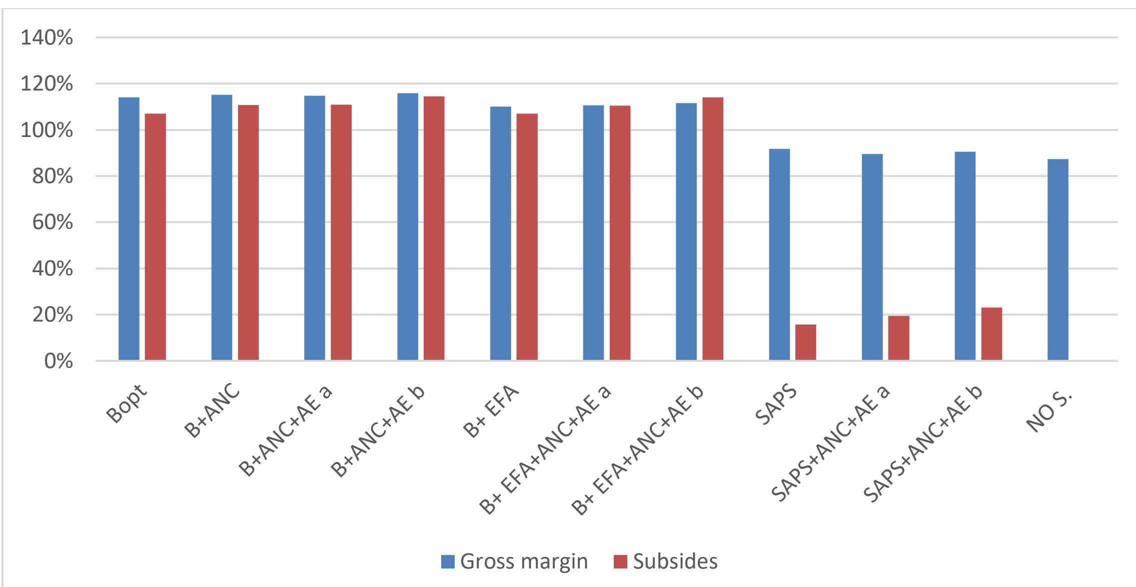

Figure 2. Changes in economic indicators under different scenarios (B=100%)
Source: Authors calculation

Impact on production structure

Optimal production structures under seven groups of scenarios are presented in Table 3. Within the Baseline optimal (Bopt), and within the first and second groups of scenarios (B+ANC; B+ANC+AEa/AEb) cattle production is preferred to the sheep production. Namely, sheep production decreased by more than 50%, while cattle production increased by 15%. It was expected that AE scenario would have a positive effect on sheep production, but in both variants, the farmer kept the number of sheep necessary to realise AE payments. The optimal production structure showed that maize grain was the most competitive crop. Areas under this crop increased, while areas under alfalfa and under maize for silage decreased.

Within all EFA scenarios, the area under maize for silage increased by 116.7%, which is a substantial difference compared to other scenarios that did not include maize for silage in the optimal production structure. Namely, the farm, due to the EFA scenario requirements, needed more arable land to fulfil livestock feeding needs. Gocht et al. (2016) have also found that, under the EFA scenario, changes in production structure are related to the areas intended for livestock feed. Regarding the optimal livestock production structure under EFA scenarios, we can see that results are similar to those in previous scenarios – cattle production was preferred to sheep production.

A switch from coupled to decoupled payments (SAPS) almost excluded sheep production from the optimal solution (sheep production was reduced by 90%). The optimal production structure under SAPS+ANC+AE scenario also decreased sheep production, but less than SAPS scenario, due to the AE constraints which require minimum LU of sheep on the farm. Farmers in mountainous areas of Eastern Serbia are not motivated to engage in sheep production due to the low price of sheep products, a huge number of animals not registered and a lack of slaughterhouses where fattened lambs need to be delivered so that the farmer can receive subsidy (Papić, 2021). Similar results are found in research of Acts et al. (2010), where sheep production under SAPS payments is reduced in uplands of the United Kingdom. The SAPS scenario implies payments per ha, so those plant production lines that were market-oriented are favoured (bean, potato) in optimal production structure.

In the No S. scenario, the optimal production structure was the same as in the scenario in which SAPS payments are introduced. The models within SAPS and No S. scenarios are relaxed of constraints related to subsidies in livestock production since all requirements regarding coupled payments are excluded.

Table 3. Changes in the production structure under different scenarios compared to the Baseline scenario

Scenarios	**Maize grain**	**Maize grain - leased land**	**Maize silage**	**Alfalfa**	**Alfalfa - leased land**	**Potato**	**Bean**	**Pastures**	**Cattle**	**Sheep**	**Fallow**
Bopt	52.4	48.1	-100.0	-24.3	-32.1	36.1	10.3	10.3	15.3	-54.6	/**
1*	52.4	48.1	-100.0	-24.3	-32.1	36.1	-40.8	10.3	15.3	-54.6	/
2	51.6	46.1	-100.0	-23.3	-30.8	36.1	-52.7	10.3	14.4	-50.5	/
3	52.4	128.6	116.8	-61.7	-85.7	-2.7	-73.1	10.3	15.3	-54.6	100.0
4	51.6	127.3	118.9	-61.1	-84.9	-10.0	-73.1	10.3	14.4	-50.5	100.0
5	59.6	65.7	-100.0	-32.4	-43.8	36.1	62.0	10.3	23.2	-90.0	/
6	51.6	127.3	-100.0	-23.3	-84.9	36.1	-52.7	10.3	14.4	-50.5	/
7	59.6	65.7	-100.0	-32.4	-43.8	36.1	62.0	10.3	23.2	-90.0	/

Note: *The numbers in the first column indicate the simulated scenarios as described in Table 2;
**Sign (/) shows that a certain line of production is not represented on farms.
Source**:** Authors' calculation

Impact on labour force and environment

The effects of the applied scenarios on labour utilisation indicate that working hours decreased, particularly in the period from May to October in almost all scenarios (Figure 3). This is especially highlighted under SAPS and No S. scenarios where workforce utilisation was reduced by 42% in some months compared to the Baseline. A reduction in labour force on farm, as a result of application of decoupled payments, is also found in the research of Shrestha et al. (2007), Manos et al. (2009) and Manos et al. (2011). Manos et al. (2009) highlight that decoupling will bring an important increase in unemployment in some regions of Greece.

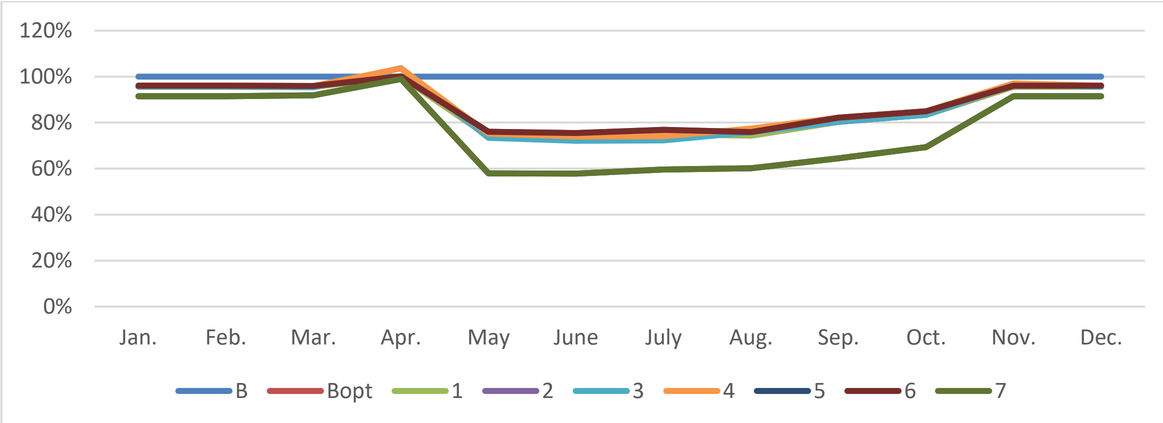

Figure 3. Changes in the use of the hours of labour force per month (B=100%)
Note: The numbers indicate the simulated scenarios as described in Table 2.
Source: Authors' calculation

Demand for fertilizers was used as an indicator of the environmental impact of agriculture, measured in kilograms of N added per hectare (Manos et al., 2009). Within all scenarios, the results show that the use of N per ha did not exceed the limit allowed by the EU Nitrate directive (Figure 4). The use of N per ha was the highest in SAPS and No S. scenarios, because the increase of cattle production in these scenarios was the highest. We can conclude that simulated scenarios can have a positive impact to the environmental pollution.

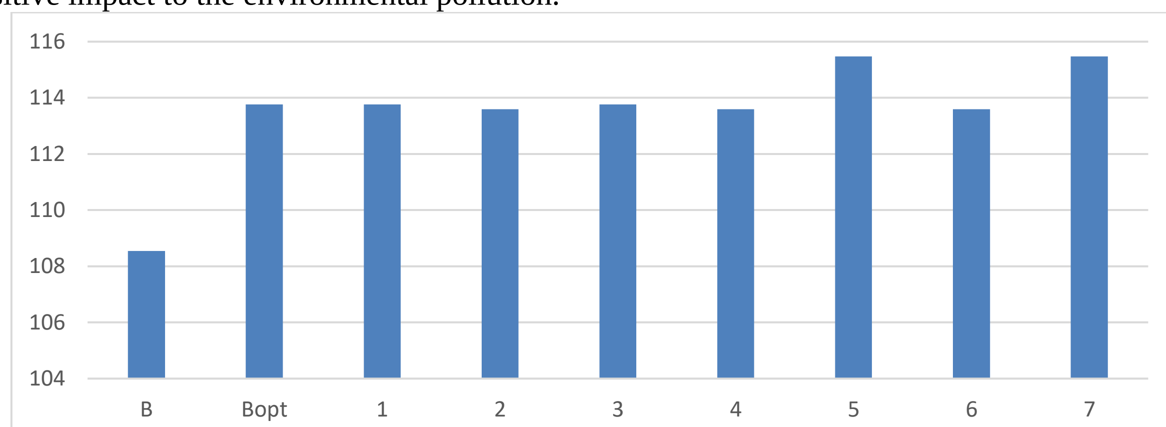

Figure 4. Nitrogen from manure in kg per ha
Note: The numbers indicate the simulated scenarios as described in Table 2.
Source: Authors' calculation

CONCULSION

This research has tested the impacts of different policy scenarios on the farm with intensive mixed livestock production dependent on the income from agriculture, representing the dominant type of farms in the LFA areas of Serbia. The results have shown that different rural development policy scenarios had a prominent impact on the production structure, income, employment and environment in the ANC of Easter and Southern Serbia.

Research results show that ANC payments increased the farm gross margin, but did not cause any changes in the production structure, utilisation of labour force, and the use of N originating from manure. These findings indicate that the ANC payment improved economic farm indicators but did not guarantee the structural transformation of farms. Also, did not empower social fabrics nor did it have a significant impact on ecological objectives in rural areas.

The SAPS scenario was widely applied in the majority of Central and Eastern European countries at the time of joining the EU. However, it decreased farm gross margin in all analysed scenarios in this research. In addition to gross margin, sheep production was also reduced (90.0% or 50.5% depending of scenario), which can negatively impact rural landscape, biodiversity and possibility to gain additional activities on farms in mountainous areas. A decrease in labour force in this scenario negatively impacted the employment in rural areas and can lead to the sector leaving in the future.

The AE scenario increased gross margin with coupled payments, but not with SAPS payments. Regarding the sheep production, we have found that AE payments kept this production on the farm just to the level necessary to fulfil policy requirements and receive agri-environmental payments. We can conclude that AE payments can have a positive impact on pasture preservation, but for better results, it is necessary to improve and adjust this measure to micro-locations.

Research findings show that the EFA scenario was not suitable for farmers in ANCs in Serbia. Namely, farmers in these areas lack arable land for livestock feed. Therefore, maintaining arable land as fallow increased production costs. Hence, we recommend a simulation of other greening measures for farmers in these areas (e.g. maintaining permanent grassland).

The impact of simulated scenarios on the environment seems to be positive because the application of N per hectare did not exceed the maximally allowed limit set by the EU. However, it is important to note that the use of N from manure in these areas is generally low.

Research findings indicate that the current coupled support system in livestock production should be prolonged for farms in ANC in Serbia in the form of a temporary measure and give farmers more time to adjust to the EU policy which favours the abolishment of all coupled payments. Model results also show that ANC and AE supports reduce production costs to some extent, improve livestock production and preserve pastures. Therefore, in analysed circumstances, a scenario that includes coupled payments with ANC and AE payments (B+ANC+AE) can be recommended for farms in mountainous areas of Eastern and Southern Serbia.

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