

## **SOYBEAN ACREAGES NEEDED TO SATISFY CONSUMPTION OF BASIC LIVESTOCK PRODUCTS IN SERBIA**

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### **Abstract**

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Despite the fact that Serbia is a significant producer and exporter of soybean, the import of soybean and soy meal is still higher than the export. Taking into consideration the advantages of domestic production, especially if knowing that in Serbia only non-genetically modified soybean cultivation is allowed, one can say that there is a need for soybean acreages (and production) increase. This applies both to the present (low) level of livestock products consumption and even more if consumption per capita achieves the consumption level reached during 1990s or even that recorded in the EU-27. The aim of this paper is to point out the needed soybean acreages in Serbia, starting from the quantity of soy meal necessary for the production of the most important livestock products (milk, meat and eggs), at different levels of their consumption. The determined area has been compared with the current one and evaluated in terms of bio-technological feasibility.

*Key words:* Soybean, acreage, consumption, livestock products

### **Introduction**

Modern nutrition of livestock, particularly pigs and poultry, is focused on satisfying the nutritional requirements of farm animals. Proteins in the farm animal diet nowadays are provided from the nutrients of plant origin. In this regard, soybean and its products have a significant role. According to Tielen (2007), soy meal is the main source of protein used for animal feeding in the EU (65% in 2005/2006). Soybean was (Kovcin et al., 1988) and still is the main source of protein in the diet of all farm animals in Serbia, too.

Due to high protein content (35-50%) (Clarke and Wiseman 2000, Miladinovic et al., 2008) and its efficient use, worldwide consumption of soybean for livestock feeding has reached 160 million tons, which is about 2/3 of the total amount of all products used as a

protein source in farm animal nutrition (Anonymous, 2011).

Soybean and soy products, particularly soybean meal, have become increasingly important commodities. China and EU have the dominant place in the total soybean world import (47% and 22%, respectively) (Anonymous, 2011), while EU accounts for 44% of the total soybean meal import.

Taking into account the above mentioned, self-sufficiency in soybean production is very important for Serbia, especially thanks to the fact that there is no significant difference in the conversion of domestic and imported soybean meal (Supic and Pejcin, 1989; Kovcin et al., 1988). If one takes into account the constant controversy about the origin of imported soybean and soybean meal and the fact that, for now, the cultivation of genetically modified soybean is prohibited in Serbia,

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satisfying the need for soybean meal from domestic production is additionally justified.

In this paper, the soybean acreages needed to provide the amount of soybean meal, which is sufficient for the production of the basic livestock products (milk, meat and eggs) at different levels of consumption in Serbia will be calculated and compared to the current soybean area in the country.

## Material and Method

For the analysis of soybean production and its export-import, the database of the Statistical Office of the Republic of Serbia (<http://vebrsz.stat.gov.rs>) has been used. Data on consumption of basic livestock products has been taken from published scientific papers.

Three different levels of consumption have been considered: the current level of consumption, the consumption during 1990s (when it was higher than today), and the average consumption in the EU -27.

The starting point for determining the needed acreages is equivalent of soybean and soybean meal. Data on the quantity of soybean meal, which could be obtained from the extraction of 1 000 kg of soybean, vary in the range of 750 kg (Furman et al., 2002) to 780 kg (Lucic and Krstic, 2000). For the purposes of this study, the equivalent proposed by Van Gelder et al. (2008) has been used (1: 0.771), as well as their figures for soybean meal needed per unit of basic livestock products (Table 1).

Based on the established equivalents, the needed soybean area has been calculated, for different levels of basic animal products consumption and compared to the current soybean area in the country.

**Table 1**  
**Soybean meal needed for production of one unit of the most important livestock products**

Type of livestock products	Necessary amount of soybean meal
Beef	232 g/kg
Pork	648 g/kg
Poultry meat	967 g/kg
Milk	21 g/l
Eggs	32 g/peace

Source: Van Gelder et al., 2008.

Since only a few percent of soybean in Serbia is used for food products, the assumption in this paper was that 100% of soybean is used in animal compound feed.

## Results and Discussion

### *Acreage, production and export-import of soybean in Serbia*

Soybean production in Serbia has had a strong expansion in the last half of century (Bosnjak and Rodić, 2006, Zivkovic et al., 2006, Bosnjak and Rodic, 2010a). From 1955 to 2005 soybean acreage increased 88 times, the yield 2.6 times and the total production 230 times.

Positive trends have continued during the last decade (2000-2009). A significant growth of acreages (growth rate 3.84%) and yield (growth rate 4.39%) in this period has been determined. Consequently, the total production has been also increased (growth rate 8.40%). Thus, Serbia's current average soybean production is 296 749 tons (Table 2).

Simultaneously with the production, the consumption of soybeans in the industry has increased. The average growth rate of soybean consumption in the period 2000–2009 was 7.09%.

Serbia exports and imports significant quantities of soybean and soy products. However, soybean import in the analyzed period was much higher than soybean export *i.e.* trade balance was negative (Table 3).

This indicates the necessity of further development of soybean production and its processing. If we bear in

**Table 2**  
**Acreages, yield and production of soybean in Serbia**

Time period	Acreages, ha	Yield, t/ha	Production, t
1955	1475	1.08	1590
1965	1933	1.28	2480
1975	9683	2.16	20930
1985	79036	1.63	128775
1995	52123	2.06	107242
2005	130936	2.81	368023
2000-2009			
Average	130033	2.29	296749
Growth rate, %	3.84	4.39	8.40
Coeff.of variation, %	17.02	21.92	27.66

Source: <http://webrz.stat.gov.rs/axd/poljoprivreda/> and authors' own calculation

mind that about 32% of Brazilian, 25% of Argentinian and 23% of Canadian soybean production ends up in the EU (Anonymous, 2009), one can say that there are significant unexploited possibilities both on Serbian and EU market, which could be treated as an additional driving force for the increase of soybean area.

### **Soybean meal production and its conversion into animal feed**

Animal feed is an essential input in livestock production. Share of feed expenditures in the total costs of livestock production is high. It ranges between 40 and 54% in milk production (Jovanovic and Mutavdzic, 2002), about 43% in pig and up to 57% in poultry production (Curovic and Vuckovic, 1997).

Soybean and soy products are an increasingly important component of animal feed. The average share of soybean meal in animal feed at the EU-27 level has been estimated at 24.3% (Van Gelder et al., 2008).

There is no reliable data on the production of soybean meal in Serbia. The largest part of the produced soybean is processed by Sojaprotein company (230 107 tons in 2007) This processor is mainly focused on the

production of animal feed, which accounts for about 70% of the total installed capacity (Anonymous, 2011a). There are, however, certain small processing facilities, whose output is not included in the official records. Basic et al. (2007) estimate that the total installed capacities for soybean processing in Serbia are about 745 000 tons annually, but their utilization is insufficient.

Potential production of soybean meal can be calculated by translating soybean into soybean meal using the appropriate equivalent. Starting from the previously referred soybean - soy meal equivalent<sup>1</sup>, and taking into account the average annual production of soybeans in Serbia (Table 2) and exported and imported quantities (Table 3) an average potential of soybean meal production in Serbia could be calculated at a level of 231 464 tons.

The present level of basic livestock products production on one hand, and consumption of soybean meal per unit of livestock products on the other hand (Table 4), show that the required amount of soybean meal is 335 292 tones, which is 46% more than produced. This indicates the need for further increase of soybean area in Serbia in order to provide self-sufficiency.

**Table 3**  
**Serbia's soybean export and import**

Year	Soybean				Soybean meal and other solid residues			
	Import		Export		Import		Export	
	t	Index 2005=100	t	Index 2005=100	t	Index 2005=100	t	Index 2005=100
2005	4203	100	2024	100	76162	100	5261	100
2006	11947	284	2264	112	93142	122	2536	972
2007	3084	73	4148	205	33303	44	2288	877
2008	2992	71	1738	70	52409	69	1992	763
2009	48118	1145	2322	115	26624	35	1660	636
Average	13979	-	2499	-	56328	-	1747	-

Source: <http://webrzs.stat.gov.rs/axd/spoljna/> and authors' own calculation

**Table 4**  
**The average production of basic livestock products in Serbia and needed soybean meal**

Livestock products	Average production <sup>1</sup> (2000-2009)	Soybean meal per kg of animal product <sup>2</sup>	Total soybean meal need
Beef (000 t)	94.9	232 g/kg	22 017
Pork (000 t)	262.8	648 g/kg	170 294
Poultry meat (000 t)	68.6	967 g/kg	66 336
Milk (mill.l)	1585	21 g/l	33 285
Eggs (mill.)	1355	32 g/peace	43 360
Total	-	-	335 292

Sources: <sup>1</sup> <http://vebrsz.stat.gov.rs7axd/poljoprivreda/> <sup>2</sup> Van Gler et al, 2008

<sup>1</sup> 1000 kg of soybean provide 771 kg of soybean meal; in other words, to produce one ton of soybean meal, 1297 kg of soybean is needed.

### Consumption of primary livestock products

Consumption of the most important livestock products, especially meat, is determinate by many factors. Vlahovic (1999) states the following most significant factors: income level, *i.e.* purchasing power of consumers, achieved level the production, retail prices of different kinds of meat, eating habits and religious issues.

Unlike meat consumption in Serbia during 1990s, when it was slightly more than 60 kg per capita, today's consumption has dropped to 46 kg per capita. That is significantly less than the consumption in the EU-27, where the observed average consumption is about 76% higher (Table 5). The current level of milk and eggs consumption in Serbia lags behind the consumption registered in the EU-27, too.

In addition to the level of consumption, the structure of consumption of different meat types in Serbia has been significantly changed in the period observed (Table 5). In 2008, the share of poultry meat in the total meat consumption was significantly higher in comparison to 1996, since it has been a substitute for the more expensive beef.

Changes in both the level and structure of consumption affect the differences in the need for protein compounds. If soy or soybean meal is used as a protein source, it is certain that the changes in consumption of basic livestock products are reflected in the needed volume of soybean production.

Starting from the amounts of soy meal needed to produce one unit of the most important livestock products (Table 4), as well as soybean - soy meal equivalent, and the level of consumption of the most important livestock products (Table 5), it is possible to estimate the necessarily/needed amounts of soybeans. If self-sufficiency is the goal (and it is), an appropriate area under the soy has to be provided.

Calculation shows (Table 6) that the amount of 391 743 tons of soybean is needed to meet soybean meal needs for consumption of livestock products registered in Serbia in 2008. Assuming that the level and structure of consumption registered in 1996 were reached, the required amount of soybeans would be slightly higher (393 013 t). However, for the structure and level of consumption of livestock products achieved in the EU-27 significant changes in the soybean amount would be

**Table 5**  
Consumption of primary livestock products per capita

Livestock products	Level of consumption of livestock products		
	Serbia		EU – 27
	1996 <sup>1</sup>	2008 <sup>4</sup>	2007 <sup>6</sup>
Meat (total)	61.5	46.0	80.9
- Beef (kg)	23.5	8.0	17.6
- Pork (kg)	27.0	20.0	41.8
- Poultry meat (kg)	11.0	18.0	21.5
Milk* (l)	160.0 <sup>2</sup>	180.0	225.5
Eggs (peaces)	175.0 <sup>3</sup>	160.0 <sup>5</sup>	266.0

\* Consumption of milk products calculated in milk equivalent

Sources: <sup>1</sup> Vlahović i Puškarić, 2006; <sup>2</sup> Vlahović, 1999; <sup>3</sup> Statistical yearbook of the Republic of Serbia;

<sup>4</sup> Vlahović, 2010; <sup>5</sup> Rodić et al., 2010; <sup>6</sup> Van Gelder et al., 2008;

**Table 6**  
Soybean acreages needed to satisfy different levels of consumption of basic livestock products

Indices	Level of consumption of livestock products		
	Serbia		EU- 27
	1996	2008	2007
Required amount of soybeans (t)	393 013	391 743	620 241
The needed acreages (ha)	171 621	171 067	270 847
Share of the arable land in Serbia (%)	5.1	5.1	8.08

Source: Authors' own calculation

required. For such consumption, about 620 241 tons of soybeans would be needed.

In Serbia, the average annual production of soybean is 296 749 tons (Table 1). This level of domestic soybean production is not sufficient to meet the needs of both existing and possible increased level of consumption of the most important livestock products, *i.e.* Serbia has a significant deficit in soybean. The missing amount has been provided from imports. In conditions of high country's indebtedness and the negative trade balance on the one hand, and excellent natural conditions for soybean production, on the other hand, one can say that increase of soy production is necessity.

To satisfy soybean needs for the consumption level from both 1996 and 2008, having in mind the current level of intensity of production (average yield achieved in the last ten years is 2.29 tons per hectare (Table 1)), soybean acreages should be increased by about 32%, which means that soy should be grown on more than 171 000 ha yearly (Table 6). To reach the level of consumption of an EU-27 resident, more than 270 000 ha of soybean would be required, which is twice more than achieved in the period 2000-2009. Consequently, the participation of soybean in the sowing structure would be increased to 8% (Table 5), which is acceptable in terms of proper crop rotation.

According to (Basic et al., 2007), there are insufficiently used capacities for soybean processing in Serbia of about 745 000 tons annually. This is an additional reason for the above-mentioned statement that there is stillroom for increasing of soybean production, regardless of the fact that the soybean acreages has already increased by 88 times in the last 50 years. Many researches conducted in the last ten years (Zivkovic et al., 2006; Bosnjak and Rodic, 2010b; Bosnjak and Rodic, 2010c; Muncan et al., 2010) have showed that there is strong economic motivation for the farmers to grow soybeans, which is an important factor when the structure of crop production or arable land use changes are in question.

## Conclusion

Soybean in Serbia is grown on 130 000 ha, with an average yield of 2.29 tons per hectare, which provides

production of about 297 000 tons of soybeans. The achieved soybean production is not sufficient to satisfy either the present or the future potentially increased level of consumption of basic livestock products.

Soybean acreages should increase by 32% in order to obtain self-sufficiency for both the current level of basic livestock products consumption, as well as if the level and structure of consumption from the nineties would be reached (thanks to changes in the consumption structure, *i.e.* significant reduction in beef consumption).

If consumption of the basic livestock products in Serbia increased to the EU-27 level, soybean acreages should be doubled and soybeans grown on about 270 000 hectares (8% of arable land), which is acceptable both in terms of proper crop rotation and technical capacities for its processing.

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