Farm model and analysis at aggregate level, case of beef sector in Slovenia

Jaka Žgajnar and Stane Kavčič[1]

***Abstract* - In this paper farm model applied to analyse beef sector in Slovenia is presented. Approach is prepared to support national Strategic plan of the CAP and to support further simulations of reform scenarios. It is based on bottom-up approach, enabling analysis from the level of the production plan at the farm level to the aggregate sector level. Mathematical programming with limited optimization is applied. The analysis includes 12 typical representative farms for cattle sector, defined using statistical and other available data. According to the results, 7% of beef fattening farms contribute only 4.4% of the total revenue generated in Slovenian agriculture. The results show that these farms on average achieve poor economic results, mainly due to low prices and high costs. In terms of labour input they are not very demanding. Average beef farm achieve only 5.9 € gross margin per working hour involved and on 84% farms even less than 4 €. The importance of subsidies is also pronounced, reaching more than 80% of GM at the aggregate level, and even exceeding the achieved GM on many smaller farms.**

INTRODUCTION

Recently there has been an increasing emphasis on models that allow simulation at the level of agricultural holdings or at the level of selected aggregate. It is a type of micro-simulation models, commonly referred to as farm models. Such models allow us to better understand decision-making and management at the level of agricultural holdings, and on the other hand give policy makers a better insight into what is happening on individual types of agricultural holdings, thus enabling them to make better fact-based decisions (Langrell et al., 2013).

As the policy impacts vary between types of agricultural holdings, the application of models that provide more reliable estimates is very important. It should be emphasized that both the possibility and the reasonableness of analysis carried out at individual farm level are practically impossible. Instead, it makes sense to classify agricultural holdings into groups with common characteristics, referred to as typical agricultural holdings (TAH).

Until recently, general and partial equilibrium models were used for sectoral and aggregate analyses, but in the last years more and more attempts have been made with farm models, as the approach presented in this paper.

MATERIAL AND METHODS

Farm model

The Farm model applied in this study is a tool based on a mathematical programming and allows for diverse analyses at the level of the farm's production plan and also aggregate analysis at the sector level. It is based on a modular approach in the form of spreadsheets in MS Excel and linked with a complex system of Model calculations prepared by Agricultural institute of Slovenia (AIS, 2021) as a key reference source of analytical and economic data at the level of production activities. It is a tool that follows modern trends in agro-economic analysis in this area and allows analysis at the TAH level (Žgajnar et al., 2022).

In the given model version, deterministic linear programming is used. The developed matrix of production possibilities is an example of production planning in which we focus on finding the optimum GM considering different production constraints, attempting to reflect the situation in the field. The price-cost ratio refers to the period 2018-2020.

Typical beef agricultural holdings

The analysis for beef sector was performed on 12 typical beef farms, which are representatives for different numbers of farms in each size group in Slovenia (Table 1). They were determined on the basis of an in-depth analysis of available statistical data, SO analysis, and other sources on workshops with different experts (Žgajnar et al., 2022). According to national data, there are 3,630 predominantly beef farms in Slovenia, without those breeding also suckler cows and without the part of fattening that is carried out on dairy farms.

It is a fairly diverse group of farms, both in terms of size (No of beef), natural resources (available land and share of fields and permanent grassland), intensity and quality of forage produced, as well as intensity of breeding (with daily gain ranging from 850 g/day up to 1,400 g/day). Most of them (97%) are small agricultural holdings, where a part time labour input is required (<0.5 FTE). With the exception of the last farm (TAH12), where in addition to fattening cattle they have also hops production, all other farms are typical fattening farms.

[1] Zgajnar J. is working at the University of Ljubljana, Slovenia (jaka.zgajnar@bf.uni-lj.si).
Kavcic S. is working at the University of Ljubljana, Slovenia (stane.kavcic@bf.uni-lj.si).

Table 1. Typical agricultural holdings specialised in beef farming in Slovenia

TAHs	Farms	Beef	FTE	Arable land	Grass/Lucerne mixtures	Barley	Corn	Permanent grass
	(No)	(No)	(1800 h)	(ha)	(ha)	(ha)	(ha)	(ha)
TAH1	600	1	0.13	0.00				1.00[c]
TAH2	600	2	0.15	0.00				1.54[c]
TAH3	600	3	0.17	0.00				2.02[c]
TAH4	400	6	0.20	1.27	0.25[a]	0.25	0.76	1.84[c]
TAH5	400	8	0.22	2.38	0.48[a]		1.90	0.92[c]
TAH6	450	12	0.24	3.49	0.70[a]		2.79	0.92[c]
TAH7	250	17	0.32	5.29	1.06[a]		4.23	0.92[c]
TAH8	250	25	0.41	6.91	1.38[b]		5.53	1.38[d]
TAH9	30	60	0.54	6.13		2.45	3.68	9.90[d]
TAH10	30	75	0.82	19.54	3.91[b]	4.88	10.75	3.68[d]
TAH11	18	150	1.33	42.00	8.40[b]	6.57	27.03	5.52[d]
TAH12[e]	2	150	1.85	42.00	8.40[b]	6.57	27.03	5.52[d]
Total	**3,630**	**32,145**	**796**	**7,689**	**1,501**	**453**	**5,735**	**5,341**

[a]Three-cut silage-bale, [b]Four-cut silage-silo and bale [c]Three-cut grass (silage bale, hay bale), [d]Four-cut grass (silage bale & silo, hay bale), [e]Includes also 5 ha of hops production.

Results and Discussion

90% beef farms are smaller than average Slovenian farm in terms of available land. Small herds predominate. Therefore, poor economic results on these farms were expected. As illustrated in table 2, only farms with more than 25 beef achieve GM better than 10 €/h. On very small farms (accounting for 84% Slovenian beef farms), with less than 0.3 FTE GM is usually below 4 €/h (Fig.1). According to the results achieved, the last farm producing also hops, stands out in all economic indicators. This is a type of farm typical for one region in Slovenia. The rest we can find all over Slovenia.

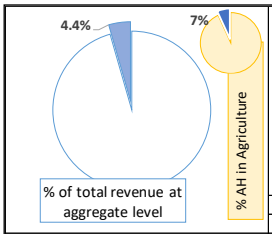
Table 2. Selected economic indicators by each TAH.

	TR[a]	BP[b]	VC[c]	GM	GM/ha	GM/FTE	GM/h
	(EUR)	(EUR)	(EUR)	(EUR)	(EUR)	(EUR)	(EUR)
TAH1	1,688	309	1,426	262	262	1,978	1.1
TAH2	3,344	537	2,461	883	575	5,802	3.2
TAH3	4,970	809	3,626	1,344	667	8,055	4.5
TAH4	9,749	1,478	8,634	1,115	358	5,599	3.1
TAH5	12,736	1,833	11,015	1,721	522	7,958	4.4
TAH6	18,250	2,520	15,704	2,546	578	10,579	5.9
TAH7	27,754	3,826	22,822	4,933	794	15,378	8.5
TAH8	40,347	5,258	32,211	8,136	982	20,022	11.1
TAH9	94,512	7,779	88,539	5,973	373	11,031	6.1
TAH10	122,715	14,143	104,905	17,810	767	21,730	12.1
TAH11	244,355	27,987	210,852	33,504	705	25,251	14.0
TAH12	318,436	30,088	243,035	75,401	1,436	40,802	22.7

[a]TR – total revenue, [b]BP – budgetary payments, [c]VC – variable costs

According to the results obtained, farms with arable land achieve better GM per ha. On average it exceeds 826 €/ha. At the same time, especially smaller farms, where all or most of the fodder is produced on permanent grassland, achieve significantly lower GM per ha (446 €/ha). As a result, there is also more intensive fattening with higher daily weight gains (over 1000 g per day) on farms with arable land producing maize silage. This ratio can also be clearly seen in the Fig. 1, where the share of utilized arable land (39.4%) is significantly lower compared to grassland (79.6%) on TAH's with FTE below 0.3.

The importance of subsidies is pronounced on beef farms. Budgetary payments present more than 80% of GM at the aggregate level, and even exceeding the achieved GM on many small farms (Table 2). The amount of budgetary payments per hectare usually increases with increasing herd. This is on larger farms especially a result of historical payments and higher payments for arable land compared to permanent grassland, and can achieve twice the payments on smaller farms. This indicates also expected negative forecasts with the planned abolition of payment entitlements.



		Gross margin	Gross margin per FTE	Gross margin per working hour	Gross margin per working hour	Gross margin per working hour
		(EUR)	(EUR)	(EUR/h)	(EUR/h)	(EUR/h)
		Total sector			<0.3 FTE*	< 1.0 FTE**
Minimum		262	1,978	1.1	1.1	1.1
Average		2,344	10,692	5.9	3.8	5.6
Maximum		75,401	40,802	22.7	5.9	12.1
Number of agricultural holdings	(%)			100	84.0	99.4
Arable land of the sector	(%)			100	39.4	89.1
Perament grass land of the sector	(%)			100	79.6	97.9
FTE of the sector	(%)			100	68.6	96.5

Figure 1. Summary of selected indicators for the beef sector

Conclusions

The approach used has proven to be effective, as it allows simulations both at the TAH's level and at the sector level. Both physical aggregates and key economic indicators show satisfactory coverage with comparable values in national statistics. Therefore, we can conclude that the model can be applied for monitoring development trends in Slovenian beef sector. This also makes it possible to support a CAP strategic plan and further simulations of different CAP scenarios for beef sector.

In the case of analysed sector, the importance of budgetary payments is significant. Not so much in terms of revenue as in terms of GM. The latter reflects the extremely high share of variable costs in fattening, based on the purchase of calves.

Acknowledgement

The research is financially supported by the project CRP V4-1809.

References

AIS (2021). Model calculations. Agricultural Institute of Slovenia, Ljubljana.

Langrell, S., Ciaian, P., Espinosa, M., Gomez Paloma, S., Heckelei, T., Louhichi, K., Sckokai, P., Thomas, A., Vard, T. (2013). Farm level modelling of CAP: a methodological overview. Joint Research Centre Scientific and Policy Reports. Luxenbourg: European Union.

Žgajnar J., Kavčič S., Tomšič M., Zagorc B., Brečko J., Hiti Dvoršak A., Moljk B., Verbič J., Bedrač M., Kožar M., Cunder T., Jerič D. (2022). Development of a model for systematic monitoring of the economic situation and analysis of the impact of agricultural policy at the level of typical agricultural: final report. Ljubljana: Biotechnical faculty, 437 p. (in Slovene)