



The impact of farm size, production type, and incentives allocated on the productivity and profitability of agricultural enterprises in the Republic of Srpska

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Abstract

This paper investigates the impact of farm size, production type, and incentives allocated on the productivity and profitability of agricultural enterprises in the Republic of Srpska. Using a sample of approximately one hundred enterprises from financial reports and agricultural databases between 2020 and 2024, the study employed variance analysis (ANOVA) and regression analysis to examine variations in the total factor productivity (TFP), the partial factor productivity (PFP), and profitability metrics. Results have indicated that neither the farm size nor the production type significantly affected productivity, with larger enterprises having generally shown higher profitability per hectare. Future research should explore specific factors influencing productivity, such as management practices and access to technology. This study contributes to a deeper understanding of agricultural dynamics in the Republic of Srpska, emphasizing the need for comprehensive databases and tailored policies that address the diverse needs of agricultural enterprises to enhance economic viability and growth.

Key words: Agricultural productivity, Farm size, Production type, Profitability, Incentives.

Introduction

Higher agricultural productivity is crucial for several reasons, such as increased food security, economic growth, and environmental sustainability.

Also, efficient agricultural production improves a country's competitiveness in the global market (Latruffe, 2010).

Agricultural productivity refers to the efficiency with which agricultural inputs (land, labour, capital, etc.) are transformed into outputs (crops, livestock, etc.). Bureau and Antón (2022) identified two main approaches to productivity. A microeconomic approach defines the total factor productivity (TFP) as the ratio of aggregate quantities of goods and services produced (outputs) to the aggregate quantities of all factors used in the production (inputs). This differs from the partial factor productivity (PFP), which focuses on the ratio of output to a single input. In a macroeconomic approach, the TFP growth is measured as the portion of output increase not explained by input growth. This is often formalized using a production function representing technology, with technological progress reflected in the partial derivative of the production function concerning time. It can also be measured using dual representations such as cost, profit, or revenue functions (Bureau and Antón, 2022).

Many authors discuss the complex relationship between the farm size and productivity with contrasting findings. Some studies suggest a positive correlation, with larger farms exhibiting higher productivity due to economies of scale and access to resources. Other authors find an inverse relationship, where smaller farms demonstrate higher productivity, often attributed to factors like better land quality and management intensity. A U-shaped relationship is also suggested, with productivity first decreasing and then increasing at very large farm sizes (Foster & Rosenzweig, 2017).

Demsetz (1973) offered industrial organization perspectives, proposing that the firm size correlates with profitability due to either market power or greater efficiency. Adamopoulos and Restuccia (2014) confirmed that larger farms tend to be much more productive compared to smaller farms which contributes to the overall productivity gaps observed between richer and poorer economies. In their opinion, misallocation of resources due to policies that favour small farms could explain a significant part of this disparity. Arcas et al. (2011) found a statistically significant positive relationship between several measures of cooperative size and efficiency (as measured by Data Envelopment Analysis - DEA). Specifically, larger sales, total assets, material fixed assets, handling surface area, and the number of permanent and temporary employees were all associated with higher efficiency scores. Bojnec and Fertő (2013) compared the technical efficiency (TE) of Slovenian farmers with and without non-agricultural income, considering the impact of the farm size, subsidies, and the organization of family farms. They concluded that the farm size positively affected the TE, while subsidies had a negative impact. Čechura et al. (2022) and Svobodová et al. (2022) analyzed the extent to which the farm size and product orientation affected productivity and profitability in the Czech agriculture. Both studies

revealed a positive correlation between the farm size and economic performance. The smallest producers significantly lagged behind the largest due to the effects of economies of scale, as well as their disadvantaged position in adopting technology (Čechura et al., 2022).

Barraclough and Collarte (1973); Berry and Cline (1979), and Cornia (1985) are authors of earlier influential papers that have demonstrated the universality of the inverse relationship between the productivity and farm size in developing countries. Van Zyl et al. (1996), Heltberg (1998), Deininger et al. (2003), Ladvenicová and Miklovičová (2015) represent more recent works that have confirmed the existence of the inverse relationship. Van Zyl et al. (1996) analyzed whether large, mechanized farms in Poland were indeed more efficient than smaller, family farms due to the existence of economies of scale, using an aggregate productivity indicator (TFP) and the DEA analysis. The research showed that large farms were not significantly more efficient than smaller farms in terms of the total factor productivity, although smaller farms were relatively more labour intensive than large farms. There is also a paper by Kagin et al. (2016) that has provided new evidence from Mexico regarding the inverse relationship in the efficiency, emphasizing the importance of considering multiple factors when analyzing the inverse relationship between the farm size and productivity. The authors suggested that smaller farms might have a sustainable advantage in terms of technical efficiency and that policies should focus on improving access to markets and technologies for small farms.

The researchers showed that the relationship between the productivity and farm size is context-specific, affected by factors like country-specific conditions, policies (incentives), and the type of agricultural production. Hughes (2000) focused his research on three CEEC countries (Czech Republic, Hungary, and Slovakia), comparing the TFP across different farm structures (individual private farms, agricultural enterprises, and production cooperatives). His findings varied from country to country. In the Czech Republic, production cooperatives had the highest total factor productivity, followed by agricultural enterprises, and finally individual private farms. In Hungary, individual private farms exhibited significantly higher total factor productivity compared to agricultural enterprises. The farm size emerged as a significant factor explaining productivity differences, rather than the organizational form. Regarding economies of scale, effects were observed in crop production for all three countries, but not in livestock production. Scandizzo and Savastano (2016) emphasized the importance of geographic factors, such as farmers' location, proximity to markets and main roads, and land quality in regards with productivity. They also noted differences in this relationship between countries, underscoring the need for country-specific considerations in agricultural productivity assessments. Adamopoulos and Restuccia (2014) concluded that

aggregate factors, like capital and land, can only explain about a quarter of the observed discrepancies, indicating that policies play a significant role in misallocation. Their findings suggest that specific farm-size policies, such as land reforms and progressive land taxes, can lead to substantial changes in size and productivity, highlighting the importance of understanding the implications of farm-size distributions in agricultural policy.

This paper focuses on several indicators which are used to measure agricultural productivity and profitability.

The total factor productivity (TFP) is a comprehensive measure reflecting overall efficiency and there are different methodologies for calculating it (Bureau and Antón, 2022). However, our analysis is based on a methodology compliant with the FADN standards, using financial statements and the Ministry of Agriculture data (Neumaierová and Neumaier, 2002; Svoboda and Novotna, 2011; Svobodová et al., 2022; Čechura et al., 2022).

The partial factor productivity (PFP) measures the output per unit of a single input. It is a simpler measure than the TFP, but it provides valuable insights into specific input efficiencies. The PFP usually includes agricultural land productivity (output per unit of land); labour productivity (output per unit of labour); capital productivity (output per unit of capital investment) (Svobodová et al., 2022).

Profitability measures like profit/loss per hectare, total assets profitability (ROA), and the profitability revenue ratio (ROR) indicate the economic success of agricultural operations (Svoboda and Novotna, 2011; Stojanović, 2019, 2024; Svobodová et al., 2022). These are linked to productivity but also include market factors.

The aim of this research is to analyze the relationship between the productivity and profitability of agricultural enterprises in the Republic of Srpska, on the one hand, and their sizes, types of production, and the amount of incentives allocated, on the other.

Material and Methods

Given the limited scope and availability of data on the operations of agricultural enterprises in the Republic of Srpska, the analysis was conducted on a sample of approximately one hundred enterprises. The total population of active agricultural enterprises (legal entities) submitting financial reports to the APIF database averaged at around 240 entities annually during the observed period. The sample selection was based on the intersection of two datasets: the enterprises with available financial reports (APIF) and those registered for incentives (the Ministry's database). While the Ministry's database included approximately 400 beneficiaries, a significant portion were family farms (natural

persons) that did not produce full financial statements required for this analysis. Consequently, the final sample of approximately one hundred enterprises covered roughly 42% of the total corporate agricultural sector in the Republic of Srpska, ensuring a high degree of representativeness.

Financial data (revenue, assets, profit) and classification of production type (crop, livestock, mixed) were obtained from the APIF. Physical data (utilized agricultural area in hectares) were obtained from the Ministry of Agriculture's database of registered agricultural holdings and incentives realized. The time period covered by this analysis spanned four years, from 2020 to 2024.

Variance analysis (ANOVA) was used to test the variations of the TFP, PFPs, ROAs, and RORs among enterprises of different sizes and types of production. To determine the impact of the factors of size, type of production, and the amount of incentives paid on the indicators of productivity and profitability, regression analysis was applied. Microsoft Excel and the Data Analysis Tool Pack were used to apply these statistical methods.

Regarding the calculation of productivity indicators (TFP and PFP), a methodology adapted for enterprises with available financial reports (Neumaierová and Neumaier, 2002; Svoboda and Novotná, 2011) and data on the size of agricultural land utilized (Svobodová et al., 2022) were applied. In order to calculate return on assets (ROA) and return on revenue (ROR), generally accepted formulas commonly applied in profitability analysis were used (e.g. Meigs & Meigs, 1999; Bragg, 2002; Wheeling, 2008).

The approach for TFP calculation was used and adjusted to the data from publicly available financial statements (balance sheet and income statement). In this approach, the TFP was calculated as follows:

$$TFP = \frac{\text{Total revenue}}{\text{Total cost} - \text{Interest} + \text{Tax} + \text{Tax Shield} + (\text{WACC} * (\text{Equity} + \text{Bank Loans} + \text{Bonds}))}$$

where

Total revenue – refers to all revenues presented in the income statement;

Cost – refers to all costs presented in the income statement;

Tax – refers to income tax presented in the income statement;

Tax shield – refers to the product of interest expense and the tax rate in the income statement;

WACC – weighted average capital cost rate¹;

¹Due to the lack of reliable and consistent data on which to calculate the WACC for agricultural enterprises in the Republic of Srpska, we used the methodology and approximation of the WACC value developed by Aswath Damodaran (adamodar@stern.nyu.edu) for the Farming/Agriculture sector in emerging markets (https://pages.stern.nyu.edu/~adamodar/New_Home_Page/dataarchived.html). This

Equity, Bank Loans and Bonds – refers to the balance sheet items representing sources of financing.

For the purpose of our analysis, PFP indicators were calculated as follows:

$$\text{Land Productivity} = \frac{\text{Total revenue}}{\text{Utilized Agricultural Area (in ha)}}$$

$$\text{Labour Productivity} = \frac{\text{Total revenue}}{\text{Number of employees}}$$

$$\text{Capital Productivity} = \frac{\text{Total revenue}}{\text{Long – term Assets}}$$

Profitability indicators are calculated as follows:

$$\text{Profit (Loss)/ha} = \frac{\text{Net Profit (Loss)}}{\text{Utilized Agricultural Area (in ha)}}$$

$$\text{ROA} = \frac{\text{EBIT}}{\text{Total Assets}}$$

$$\text{ROR} = \frac{\text{Net Profit (Loss)}}{\text{Total Revenue}}$$

Results and Discussion

Productivity and profitability indicators for enterprises of different size

In the Republic of Srpska, enterprises are classified into four categories: micro, small, medium, and large. The classification criteria are prescribed by law and are based on the size of the total revenue, the average annual value of assets, and the average number of employees. Micro enterprises are those with a total annual revenue of up to BAM 500,000. Small enterprises have a total annual revenue below BAM 2,000,000. Medium-sized enterprises have total annual revenues of up to BAM 8,000,000, while large enterprises are those with revenues exceeding this amount.

The following table (Table 1) presents the key productivity and profitability indicators for enterprises of different sizes (micro, small, medium, and large):

methodology allows for additional adjustments for the domestic currency by incorporating official inflation rates for the given years.

Tab. 1 - Average productivity and profitability indicators for enterprises of different size (2020-2023)

| Indicator | Enterprise Size | | | | |
|--|-----------------|---------|---------|---------|----------------|
| | Micro | Small | Medium | Large | Average |
| No of Enterprises | 21 | 63 | 15 | 6 | 105 |
| Size of Agricultural Land Utilized per Enterprise (ha) | 16.26 | 96.45 | 244.46 | 913.04 | 317.55 |
| No of Employees per 100 ha | 5.57 | 5.49 | 6.26 | 6.77 | 6.02 |
| TFP | 0.91 | 0.91 | 0.97 | 0.93 | 0.93 |
| Land Productivity (in BAM) | 4,314 | 8,808 | 27,444 | 28,566 | 17,283 |
| Labour productivity (in BAM) | 56,092 | 120,584 | 398,823 | 219,162 | 198,665 |
| Capital Productivity | 1.25 | 0.83 | 1.65 | 0.89 | 1.16 |
| Net Profit (Loss) per ha (in BAM) | 56 | 515 | 1,429 | 1,691 | 923 |
| ROR | 6.4% | 4.8% | 3.7% | 6.6% | 5.4% |
| ROA | -0.2% | 2.2% | 3.0% | 3.4% | 2.1% |

As expected, larger enterprises operated on significantly more land, with large enterprises using an average of 913.04 ha, compared to only 16.26 ha for micro-enterprises. The average utilized land size across all enterprises was 317.55 ha. The number of employees per 100 ha remained relatively stable across all enterprise sizes, ranging between 5.49 and 6.77 employees per 100 ha. Medium and large enterprises employed slightly more workers per 100 ha than micro and small ones. The TFP values remained relatively stable across all enterprise sizes, ranging from 0.91 to 0.97. Medium-sized enterprises had the highest TFP (0.97), indicating slightly better efficiency in using inputs compared to others. Land productivity increased with enterprise size. Large enterprises achieved the highest productivity (28,566 BAM/ha) compared to micro-enterprises (4,314 BAM/ha), indicating that larger farms may benefit from economies of scale. There was a substantial increase in labour productivity with the enterprise size. Medium enterprises had the highest labour productivity (398,823 BAM per employee), significantly outperforming small (120,584 BAM per employee) and micro enterprises (56,092 BAM per employee). Large enterprises showed a lower labour productivity (219,162 BAM per employee) than medium-sized ones, which may suggest inefficiencies in labour utilization at the highest scale. Capital productivity was the highest in medium enterprises (1.65), while the lowest value was found in small enterprises (0.83). This

suggests that medium-sized enterprises might be the most efficient in utilizing capital resources.

Large enterprises generated the highest net profit per hectare (BAM 1,691), while micro-enterprises had the lowest (BAM 56). The average net profit per hectare across all enterprises was 923 BAM. ROR was relatively stable, with large (6.6%) and micro (6.4%) enterprises having the highest values. ROA improved with the enterprise size, ranging from -0,2% (micro enterprises, indicating losses) to 3.4% (large enterprises). Negative ROA for micro-enterprises indicates that they were struggling to generate returns on their assets.

It can be seen that medium-sized enterprises seem to be the most efficient in terms of labour and capital productivity, though large enterprises perform better in land utilization and profitability. Larger enterprises were generally more profitable and had higher ROA values. Micro-enterprises faced significant challenges, as indicated by their negative ROA and low profitability per hectare. Small enterprises appeared to be the least efficient in capital utilization, with the lowest capital productivity value.

Productivity and profitability indicators for enterprises of different type of production

Although agricultural enterprises in the Republic of Srpska are registered for various types of agricultural production (e.g., cultivation of cereals, vegetables, different types of fruits, and herbs; breeding of various animal species, etc.), each with its own specific characteristics, for the purposes of our analysis, they were classified into three main groups: crop production, livestock production, and mixed production.

The following set of tables presents the previously mentioned indicators, now classified by types of production and enterprise sizes within each of the three categories.

Tab. 2 - Average TFP by production types and enterprise size (2020-2023)

In BAM

| Type of Production | Enterprise Size | | | | |
|----------------------|-----------------|-------|--------|-------|---------|
| | Micro | Small | Medium | Large | Average |
| Crop Production | 0.96 | 0.89 | 0.91 | 0.90 | 0.91 |
| Livestock Production | 0.83 | 0.94 | 1.00 | N/A | 0.93 |
| Mixed Production | 0.94 | 0.89 | 0.91 | N/A | 0.91 |

Livestock production showed the highest average TFP (0.93), with medium-sized enterprises reaching full efficiency (1.00). Crop and mixed production had similar productivity levels (0.91 on average), with micro-enterprises in crop production achieving slightly higher TFP (0.96). Large

enterprises were absent in livestock and mixed production categories, due to data limitations. Micro-enterprises performed relatively well in crop and mixed production but struggled in livestock production. Small enterprises in crop and mixed production had the lowest TFP values (0.89), suggesting possible inefficiencies in resource utilization.

The analysis of variance did not reveal a statistically significant difference in the TFP either between enterprises of different sizes (P-value = 0.06) or between enterprises of different types of production (P-value = 0.14). Additionally, regression analysis did not also indicate a statistically significant impact of the factors of size and type of production on the TFP indicator, as shown in Table 3.

Tab. 3 - TFP regression statistics

| <i>Regression Statistics</i> | | ANOVA | | | | | | |
|------------------------------|---------------------|-----------------------|---------------|----------------|------------------|------------------|------------------|-----------------------|
| Multiple R | 0.315 | | | | | | | <i>Significance F</i> |
| R Square | 0.099 | | <i>df</i> | <i>SS</i> | <i>MS</i> | <i>F</i> | | <i>F</i> |
| Adjusted R Square | 0.055 | | Regression | 5.000 | 3.037 | 0.607 | 2.254 | 0.055 |
| Standard Error | 0.519 | | Residual | 102.000 | 27.485 | 0.269 | | |
| Observations | 108.000 | | Total | 107.000 | 30.522 | | | |
| | <i>Coefficients</i> | <i>Standard Error</i> | <i>t Stat</i> | <i>P-value</i> | <i>Lower 95%</i> | <i>Upper 95%</i> | <i>Lower 95%</i> | <i>Upper 95%</i> |
| Intercept | 1.463 | 0.172 | 8.510 | 0.000 | 1.122 | 1.804 | 1.122 | 1.804 |
| Micro | -0.402 | 0.177 | -2.273 | 0.025 | -0.753 | -0.051 | -0.753 | -0.051 |
| Small | -0.367 | 0.145 | -2.528 | 0.013 | -0.655 | -0.079 | -0.655 | -0.079 |
| Large | -0.342 | 0.249 | -1.371 | 0.173 | -0.836 | 0.153 | -0.836 | 0.153 |
| Crop production | -0.267 | 0.141 | -1.897 | 0.061 | -0.547 | 0.012 | -0.547 | 0.012 |
| Livestock production | -0.238 | 0.169 | -1.407 | 0.163 | -0.573 | 0.097 | -0.573 | 0.097 |

Multiple R (0.315) is a correlation coefficient which indicates a weak positive correlation between the predictors and the dependent variable. R Square (0.099) has shown that approximately 9.9% of the variance in the dependent variable is explained by the model (enterprise size and type of production). The F-statistic (2.254) and its corresponding Significance F (0.055) suggest that the model is marginally significant at the 5% level, as the P-value was just above 0.05. Only "Micro" and "Small" were significant at the 0.05 level. While the model showed some relationship between the predictors and the dependent variable, its explanatory power is limited, and only two of the five predictors appear to be statistically significant.

Tab. 4 - Average land productivity by production types and enterprise size (2020-2023)

In BAM

| Type of Production | Enterprise Size | | | | |
|----------------------|-----------------|--------|---------|--------|---------|
| | Micro | Small | Medium | Large | Average |
| Crop Production | 5,460 | 8,489 | 9,912 | 16,884 | 10,186 |
| Livestock Production | 4,166 | 12,492 | 391,917 | N/A | 136,192 |
| Mixed Production | 5,906 | 5,437 | 48,796 | N/A | 20,046 |

In most cases, land productivity increases with the enterprise size, although data for large enterprises in livestock and mixed production were not available. Crop production had data for all enterprise sizes and showed a steady increase in productivity as the size increased. Micro enterprises had the lowest productivity at BAM 5,460, while large enterprises had the highest productivity at BAM 16,884. Livestock production showed the highest overall productivity, likely due to the high medium enterprise value (BAM 391,917), which was approximately 47.05 times higher than the average productivity of micro and small enterprises combined. Mixed production showed more variability across enterprise sizes. Small enterprises have slightly lower productivity (BAM 5,437) than micro enterprises (BAM 5,906) and there is a notable increase for medium enterprises at BAM 48,796.

According to the regression analysis, production types and enterprise sizes, as independent variables, explain 20% of the variance in land productivity. The model is statistically significant (P-value = 0.02), with three out of five predictors showing significant effects. The size of the enterprise (Micro and Small) seems to have a negative impact on the dependent variable, while livestock production has a positive impact.

Tab. 5 - The Scheffe's post-hoc test: land productivity

| Comparing Pairs | | Fs | FsCV |
|-----------------|--------|--------------|-------------|
| Micro | Small | 0.18 | 8.10 |
| Micro | Medium | 9.74 | |
| Micro | Large | 0.00 | |
| Small | Medium | 11.41 | |
| Small | Large | 0.04 | |
| Medium | Large | 4.11 | |

The Scheffe's post-hoc test (Table 5) shows that there were statistically significant differences in land productivity between micro and small enterprises, on one hand, and medium enterprises, on the other. The differences in productivity were not as significant when comparing micro and small enterprises, or when comparing any of these sizes with large enterprises. Interestingly, there was no statistically significant difference in land productivity between micro and large enterprises.

Tab. 6 - Average labour productivity by production types and enterprise size (2020-2023)

In BAM

| Type of Production | Enterprise Size | | | | |
|----------------------|-----------------|---------|---------|---------|---------|
| | Micro | Small | Medium | Large | Average |
| Crop Production | 58,411 | 116,084 | 231,499 | 215,655 | 155,412 |
| Livestock Production | 48,908 | 149,215 | 527,073 | N/A | 241,732 |
| Mixed Production | 65,918 | 115,081 | 657,359 | N/A | 279,453 |

In all production types, labour productivity generally increased with the enterprise size, although data for large enterprises in livestock and mixed production was not available. Medium enterprises consistently showed the highest productivity across all production types. Mixed production showed the highest peak productivity for medium enterprises (BAM 657,359) and the highest average (BAM 279,453). Livestock production had higher average productivity than crop production. Micro enterprises in mixed production had higher productivity than micro enterprises in other types. These data suggest that there were significant economies of scale in agricultural labour productivity, especially evident in the jump to medium-sized enterprises across all production types.

The regression analysis has shown that the production types and enterprise sizes explained about 26% of the variance in labour productivity, which is a moderate level of explanatory power. The model was statistically significant (P-value = 8.27E-05), with the enterprise size being the main driver of differences in labour productivity. Medium-sized enterprises appear to have performed best, followed by large, then small, and finally micro enterprises. The type of production (crop, livestock, or mixed) did not seem to significantly affect the dependent variable in this model. However, given that the available data included only registered employees and no data was available on seasonal workers, these results have limited significance.

Tab. 7 - Average capital productivity by production types and enterprise sizes(2020-2023)

| Type of Production | Enterprise Size | | | | |
|----------------------|-----------------|-------|--------|-------|---------|
| | Micro | Small | Medium | Large | Average |
| Crop Production | 1.16 | 0.93 | 0.77 | 0.73 | 0.90 |
| Livestock Production | 0.76 | 0.68 | 2.40 | N/A | 1.28 |
| Mixed Production | 2.85 | 0.85 | 1.55 | N/A | 1.75 |

It is important to note that capital productivity is typically measured as a ratio of output to capital (long-term assets) input. A higher number indicates that more output is being produced per unit of capital invested. These data suggest that in crop production, smaller enterprises were more efficient with their capital use, while in livestock production, medium enterprises were significantly more capital-efficient than smaller ones (2.40 to 0.68 and 0.76). Mixed production showed the highest overall average productivity (1.75) and micro enterprises were exceptionally efficient in terms of capital use (2.85), but this efficiency dropped dramatically for small enterprises (0.85) before rising again for medium ones (1.55).

When it comes to capital productivity, the analysis of variance did not show a statistically significant difference between enterprises of different sizes or different types of activities.

Tab. 8 - Average ROR by production types and enterprise size (2020-2023)

| Type of Production | Enterprise Size | | | | |
|----------------------|-----------------|-------------|-------------|-------------|-------------|
| | Micro | Small | Medium | Large | Average |
| Crop Production | 8.8% | 4.9% | 6.3% | 7.6% | 6.9% |
| Livestock Production | -3.1% | 6.5% | 3.7% | 1.5% | 2.1% |
| Mixed Production | -0.5% | 4.3% | 2.6% | 4.7% | 2.8% |
| Total | 6.4% | 4.8% | 3.7% | 6.6% | 5.4% |

The data from Table 6 suggests that the overall trend did not show a consistent relationship between the enterprise size and ROR. Crop production consistently showed positive ROR across all enterprise sizes and outperformed both livestock and mixed production in terms of average ROR (6.9%). Micro enterprises in crop production were particularly profitable (8.8%), while they struggled in livestock (-3.1%) and mixed production (-0.5%). The relationship between the enterprise size and profitability varied significantly depending on the type of production. Livestock production showed the highest variability in ROR across enterprise sizes, while mixed production showed less variability compared to livestock, but more than crop production. Overall, the agricultural sector showed a positive average ROR of 5.4%, indicating that it was generally profitable across all types and sizes.

The regression model explained 10.9% of the variability of the ROR, as dependent variable, and it was on the borderline of statistical significance (P-value = 0.072). The only statistically significant variable was "Micro enterprises," which had a negative impact on the ROR. Other variables did not have a statistically significant impact on the dependent variable.

Tab. 9 - Average ROA by production types and enterprise size (2020-2023)

| Type of Production | Enterprise Size | | | | |
|----------------------|-----------------|-------------|-------------|-------------|-------------|
| | Micro | Small | Medium | Large | Average |
| Crop Production | 1.6% | 2.2% | 3.9% | 3.0% | 2.7% |
| Livestock Production | -0.5% | 2.1% | 3.6% | 3.2% | 2.1% |
| Mixed Production | -3.0% | 2.4% | 1.2% | 5.0% | 1.4% |
| Total | -0.2% | 2.2% | 3.0% | 3.4% | 2.1% |

As can be seen, larger enterprises generally achieved better returns on their assets across all production types. Crop production had the highest average ROA among the three production types (2.7%) and it consistently showed positive ROA across all enterprise sizes. Livestock and mixed production showed negative ROA for micro enterprises (-0.5% and -3.0%, respectively) suggesting that these smaller operations faced significant challenges in utilizing their assets efficiently to generate returns. Livestock production showed a consistent increase in ROA with the increasing enterprise size, while mixed production showed the highest variability in ROA across enterprise sizes. The overall agricultural sector showed a positive average ROA of 2.1%, indicating that it was generally efficient in using assets to generate returns across all types and sizes.

The regression model explained only 4.5% of the variability of ROA as a dependent variable, which means that the model as a whole was not statistically significant (P-value = 0.54). None of the independent variables (sizes of the enterprise and types of production) had a statistically significant impact on the ROA.

Tab. 10 - Net profit/loss per ha of utilized agricultural land by production types and enterprise size (2020-2023)

| Type of Production | Enterprise Size | | | | |
|----------------------|-----------------|------------|--------------|--------------|------------|
| | Micro | Small | Medium | Large | Average |
| Crop Production | 170 | 475 | 657 | 1,412 | 678 |
| Livestock Production | -192 | 1,012 | 23,729 | 272 | 6,205 |
| Mixed Production | -240 | 296 | 1,753 | 2,574 | 1,096 |
| Total | -51 | 480 | 1,464 | 1,658 | 888 |

In BAM

These data suggest that larger enterprises generally achieve better profitability per hectare across all production types. More specifically, micro enterprises struggled to generate profits, often operating at a loss, especially the in livestock and mixed production (an overall loss of 51 per hectare). As can be

seen, livestock production can be extremely profitable at certain scales, notably medium enterprises (BAM 23.729), but also carries higher risk (the highest variability). Cop production, while not achieving the highest profits, showed the most consistent profitability across all enterprise sizes. Large enterprises had the highest overall profit at 1,658 per hectare and the total average profit across all types and sizes was 888 per hectare.

All the above presented trends in productivity and profitability could be influenced by various factors such as economies of scale, access to technology and resources, market conditions, input costs, management practices, the intensity of land use in different types of agricultural operations, and possibly regional or climatic factors not visible in this data set. Statistical analyses have shown that the existing data available in the official financial statements were insufficient to create a regression model that would enable the prediction of productivity in agricultural enterprises, and thus the effective management and improvement of their productivity and performance. We believe that without introducing the FADN system it is not possible to obtain the indicators necessary for both micro-level management and macro-level policymakers.

Incentives allocated

Besides the size of the enterprise and the type of agricultural production, this paper aimed to examine the relationship between productivity and profitability indicators and the amount of incentives allocated. The following two tables display the nominal and relative amounts of these incentives allocated to enterprises of different sizes and types of activities.

Tab. 11 - Average incentives allocated by enterprise size (2020-2023)

| Indicator | Enterprise size | | | | |
|--|-----------------|-------|--------|-------|---------|
| | Micro | Small | Medium | Large | Average |
| Total subsidies per ha of agricultural land utilized | 1,185 | 1,039 | 1,913 | 514 | 1,163 |
| Share of subsidies in the total revenue | 15% | 11% | 7% | 3% | 9% |

Source: The authors' calculation based on the Ministry of Agriculture's data

The average incentives across all enterprise sizes amounted to 1,163 BAM/ha. The incentives per hectare were the highest for medium-sized enterprises (1,913 BAM/ha) and the lowest for large enterprises (514 BAM/ha). The share of incentives in the total revenue was inversely related to the enterprise size, with smaller enterprises relying more heavily on incentives. Micro enterprises had the highest share of incentives in the total revenue at 0.15 or 15%,

while large enterprises had the lowest share at 0.03 or 3%. On average, incentives accounted for 9% of the total revenue across the agricultural sector.

These findings suggest that smaller (micro and small) agricultural enterprises relied more heavily on incentives as a source of revenue compared to larger enterprises. Medium-sized enterprises received the highest incentives per hectare, potentially indicating that this size of enterprises were the most viable in terms of production investments and production intensification as a prerequisite for higher incentives allocation. The decreasing share of incentives in the total revenue as the enterprise size increased implied that larger enterprises were less dependent on incentives and may be more self-sustaining.

Tab. 12 - Average share of incentives in the total revenue by production types and enterprise size (2020-2023)

| Production Type | Enterprise size | | | | |
|----------------------|-----------------|-------|--------|-------|---------|
| | Micro | Small | Medium | Large | Average |
| Crop production | 0.18 | 0.09 | 0.08 | 0.03 | 0.09 |
| Livestock production | 0.21 | 0.14 | 0.07 | 0.04 | 0.12 |
| Mixed production | 0.12 | 0.15 | 0.07 | 0.02 | 0.09 |

Across all production types, the share of incentives in the total revenue was the highest for micro enterprises and decreased as the enterprise size increased. Livestock production had the highest average share of incentives in the total revenue at 0.12 or 12%, followed by crop production and mixed production at 0.09 or 9% each. The difference in the share of incentives between micro and large enterprises was significant, ranging from 15 percentage points in crop production to 17 percentage points in livestock production.

These findings suggest that smaller (micro) enterprises, regardless of production type, rely more heavily on incentives as a source of revenue compared to larger enterprises. Livestock production appears to be the most subsidized sector, with micro enterprises in this sector receiving the highest share of incentives in the total revenue. The decreasing share of incentives as enterprise size increases indicates that larger enterprises are less dependent on incentives and may be more self-sustaining.

The regression analysis indicates that there was a very weak correlation between the productivity indicators, both the TFP (Multiple R = 0.17) and the PFP (Multiple R for land was 0.08, and for labour it was 0.14), and the incentives disbursed. Furthermore, the correlation between the incentives disbursed and profitability indicators was also not significant. The correlation coefficient for ROR was 0.19, and for ROA, it was 0.08.

The variation in the share of incentives across production types and enterprise sizes has highlighted the targeted nature of subsidy policies and the potential need for differentiated support mechanisms. Understanding these patterns can inform policy decisions and support mechanisms aimed at ensuring the long-term sustainability and competitiveness of the agricultural sector, particularly for smaller enterprises and specific production types. These findings have been confirmed by other publications, such as the SWG (Regional Rural Development Standing Working Group in South Eastern Europe) study on agriculture policy development in pre-accession countries, where the analysis of budget support to the agricultural sector at the level of both B&H entities has shown uneven support in favour of direct payments, insufficient understanding of the importance of structural and rural development measures among decision makers and evident unwillingness for more serious reforms in the context of harmonization with the EU CAP (dominated by output-based payments that do not exist in the EU) (SWG, 2024).

Conclusion

This paper highlights the complex interplay between the farm size, production type, and incentives in determining productivity and profitability. The study reinforces the idea that the relationship between the farm size and productivity is multifaceted and context-dependent. While some literature indicates that larger farms may benefit from economies of scale, the evidence from this research has suggested that smaller farms can also be efficient, particularly in certain types of agricultural production.

The variance analysis and regression results have indicated that there were no statistically significant differences in productivity indicators (TFP) based on the size or type of production among enterprises in the Republic of Srpska. This suggests that other factors, potentially including management practices, technologies, and access to resources, may play a more critical role in influencing productivity than the farm size alone. There has also been a disparity in profitability across different enterprise sizes and types of production. Larger enterprises generally achieve better profitability per hectare, while micro-enterprises tend to face challenges and operate at a loss in certain production sectors. This underscores the importance of strategies tailored to various enterprise sizes and their unique challenges in achieving economic viability. The impact of incentives allocated appears minimal, suggesting further investigation into policies to support all enterprise sizes and types.

Given the findings on productivity and profitability, there is a clear need for agricultural policies and support mechanisms that would consider specific needs of different farm sizes. Programs aimed at improving access to markets,

technology, and financial resources could be pivotal in enhancing the productivity and profitability of smaller enterprises. It is also important to acknowledge limitations in the available data, particularly concerning the lack of a comprehensive FADN data basis encompassing all farms in the Republic of Srpska, which hinders the development of robust predictive models.

The study suggests that additional research is needed to explore the underlying factors affecting agricultural productivity and profitability further. This includes examining the specific types of production, local contexts, and the impact of external factors such as market dynamics and agricultural policies.

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Утицај величине, врсте производње и исплаћених подстицаја на продуктивност и профитабилност пољопривредних предузећа у Републици Српској

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Сажетак

Ово истраживање испитује утицај величине газдинства, типа производње и додијелених подстицаја на продуктивност и профитабилност пољопривредних предузећа у Републици Српској. Користећи узорак од приближно стотину предузећа из база финансијских извјештаја и пољопривредних база података од 2020. до 2024. године, студија примјењује анализу варијансе (ANOVA) и регресиону анализу да би испитала варијације у укупној факторској продуктивности (TFP), парцијалној факторској продуктивности (PFP) и показатељима профитабилности. Резултати показују да ни величина фарме, ни тип производње не утичу значајно на продуктивност, при чему већа предузећа генерално показују већу профитабилност по хектару. Будућа истраживања треба да истраже специфичне факторе који утичу на продуктивност, као што су управљачке праксе и приступ технологији. Ова студија доприноси дубљем разумевању пољопривредне динамике у Републици Српској, наглашавајући потребу за свеобухватним базама података и прилагођеним политикама које одговарају разноврсним потребама пољопривредних предузећа како би се побољшала економска одрживост и раст.

Кључне ријечи: пољопривредна продуктивност, величина фарме, тип производње, профитабилност, подстицаји

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