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Subsidies' Impacts on Technical–Economic Indicators in Large Crop Farms

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Abstract: The objective of the analysis is to quantify the impact of subsidies on the activity of two large farms of 600 ha and 3000 ha, respectively. The innovative solution from this analysis is to create a model that can be used at the macroeconomic level, showing the possible ways in which these large farms can secure their incomes. To study the use of these subsidies, the methods of technical–economic analysis, economic–financial analysis and statistical analysis of the data were used. Descriptive statistics, visual inspection and basic comparative methods were used to determine the statistical patterns of subsidy impact and variation for each crop. In this context, this is evidence of the possibility of probable expansion of crop income and profitability. The results were different for the two arable farms studied. The results for the 600 ha arable farm suggested that the statistical model was inconclusive due to the annual adjustment of the cropping plan and the impossibility of making viable forecasts, especially since the ecological performance fluctuated (in 2020 the farm was on the verge of profitability), although the positive impact of subsidies was evident in loss-making years. For the 3000 ha arable farm, the statistical model was relevant because it highlighted crops (corn and soybeans) that consistently contributed to good and increasing income and economic performance, as well as highlighting the significant impact of subsidies. The conclusions of the study emphasize the indispensability of subsidies for large farms and the contribution of crops to income generation. These conclusions provide a valuable source of information for relevant policy decisions and can guide future research aiming to increase the profitability of these farms and allocate resources appropriately and efficiently in the agricultural sector.

Keywords: crop farms; profitability; income; subsidies; descriptive statistics

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1. Introduction

In Romania, agriculture is an important branch of the national economy [1], both when considered as a whole, and as economic entities with different objects of activity, and which ensure their income from activities dependent on the object of activity.

On the other hand, the financial results obtained by agricultural holdings in Romania depend on the subsidies received, which can make for a major leap in terms of profitability.

To a greater or lesser extent, farmers in countries where agriculture holds a key place in the economy benefit from subsidies. Specialists in the field argue that the granting of subsidies directly contributes to increasing food security, stimulating traditional production and stability in the pricing of agricultural products [2–4]. Over time, food security has been prioritized by policy-makers, justifying agricultural subsidies in various regions and countries [5]. In the United States, the European Union, Japan, Canada and in other regions, a wide range of subsidies have been adopted to help increase agricultural production in order to cover the needs of the domestic market and for export [6].

It should be noted that investments and subsidies are important instruments which can effectively contribute both to poverty alleviation in rural areas in various countries and to agricultural development [7]. Widespread use of subsidies, especially in agriculture, is imperative, as the agricultural sector is a central element in the transition to sustainability.

However, there are specialists who claim that the use of subsidies produces inefficiency and negative effects in the economy [8–11]. Research on the impact of subsidies in agriculture has also shown that these grants may contribute to reduced productivity [12].

On Norwegian cereal farms, studies have shown that subsidies have had a positive impact on technical efficiency [13]. Similar situations in terms of technical efficiency have been reported for dairy farms in Denmark and Sweden [14]. However, other studies on dairy farms in the European Union have shown that the influence of subsidies on technical efficiency can be specific to individual farms and can be negative, null, or positive [15].

Taking into account the sizes of farms, research in the European Union has shown that the influence of subsidies on the economic efficiency of farms is greater in larger farms [16].

Currently, the sizes of farms in Romania are in continuous ferment; the dynamic trend they are registering being the result of the synergy of several factors such as subsidies, payment schemes, measures by which non-refundable funds are allocated, high-performance technologies implemented, varying inputs used, etc. Through the accumulation of these factors and through their synergistic effects, the premises are created, in large crop farms in Romania, for the increase of cultivated areas and the co-farming of land.

Statistical data show that, compared to 2010, in 2020, in Romania, the number of farms decreased by 972 thousand (25.2%), reducing to 2887 thousand holdings (the used surface was 12.8 million hectares of agricultural land, 4.1% lower than in 2010). The decrease in the number of farms, especially the very small ones, led to an increase of 28% in the average agricultural area per farm, while the average used agricultural area held by a farm with legal personality was 194.78 ha (2020), compared to 190.78 ha (2010) [17]. The study shows that the efficiency of the use of subsidies is especially evident in large crop farms that have a large area and that offer predictability in the cropping plan; in this sense, a recommendation addressed to political actors is the promotion of land consolidation and the increase of cultivated areas on each farm. Considering the trend confirmed by the statistical data, combined with the measures within the PNS 2023–2027, it is obvious that in the near future, the areas of large crop farms will continue to increase, with the economic point at which subsidies are justified occurring only for those with larger areas.

Other research carried out on crop farms in EU member countries has shown that a low share of subsidies contributes to a reduction in competitiveness by increasing the degree of wear and tear and the difficulties incurred in increasing the degree of renovation of machinery [18]. Of course, these aspects can be presented by different analysis models, but referring here to a crop farm of 3000 ha and a crop farm of 600 ha, it is necessary to carry out an analysis supported by statistical–economic models. In countries in the European Union, subsidies had a less favorable influence on productivity recorded at the farm level before the implementation of the decoupling reform [19].

Other studies have highlighted the positive effect of decoupled subsidies on farm-level productivity [20]. But so far, it has not been possible to give a clear answer to the question of how subsidies impact farm productivity in the European Union, even given all the studies performed so far [21,22].

However, on any crop farm, there is, without question, a close correlation between turnover, subsidy income received, and profitability, and at the crop level, the income each crop generates contributes differently to the farm's overall profitability. Where turnover is higher, and more balanced the expenditure incurred, this directly influences profitability. Because agriculture remains an essential sector at the EU level, it is recommended to redirect subsidy payments and to increase the efficiency of the monitoring of payments granted under the Common Agricultural Policy [23].

But the performance of farms is conditioned by a series of variables with different contents, namely, natural factors, economic factors and financial factors, as well as by various incentives for farmers [24–26].

For crop farms in Romania, financing plays a special role, as it contributes both to business development through the funds received, and to the covering of losses caused by increasingly evident climate change [27].

In Romania's National Strategic Plan (NSP) for 2023–2027, the stability budget for subsidies was EUR 15.88 billion. Of this, the budget allocated to EAGF (European Agricultural Guarantee Fund) direct payments of EUR 9.98 billion; the budget for EAGF sectoral interventions was EUR 0.21 billion, and the budget for rural development has two components: the public allocation is EUR 5.68 billion, of which EUR 4.84 billion is the EAFRD contribution (Figure 1).

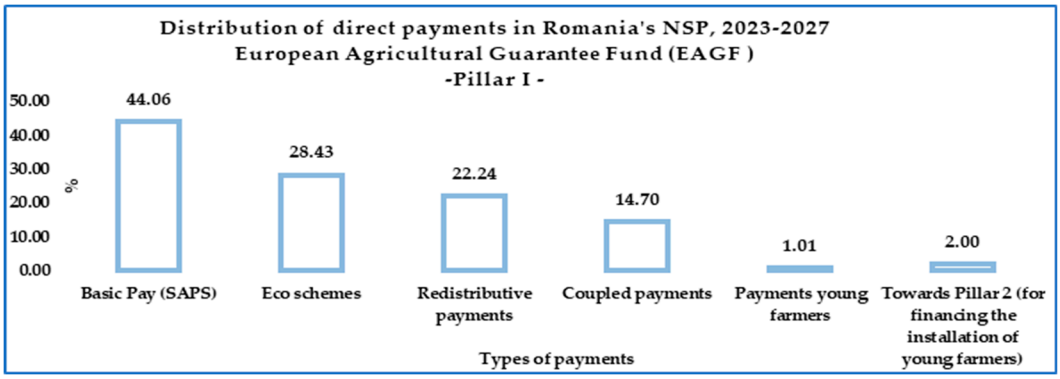


Figure 1. Distribution of direct payments in Romania's NSP, 2023–2027.

Complementary redistributive income support for sustainability has an allocation of 10% of the indicated financial allocations for interventions in the form of coupled income support and is limited to a maximum of 13% of the annual amounts of direct payments [28] (Figure 1).

Research carried out at the level of farms specializing in certain crops in Romania has highlighted the positive but differentiated impact of subsidies and other forms of financial support [29].

Some studies do not find that subsidies have a positive impact on all types of farms in Romania, as they do not uniformly contribute to increased productivity, but only do so on medium-sized dairy farms [30,31]. Another example is farms which would otherwise incur losses [32].

In the current research, using descriptive statistics, visual inspection and comparison methods, this study highlights the model determined for the period 2019–2021 related to the two farms in Romania under study; in the determination of the parameters for the next period, the model highlighted that there was a link between subsidies and profitability, so that the projection of the activity at the microeconomic level could be rigorously organized [33–35].

The present study adds value to the current research regarding the impact of the subsidies allocated in agriculture according to technical–economic indicators. The profitability of crops at the farm level is directly influenced by the application of subsidies, a fact highlighted by the results obtained in this research. In this context, the main decision-makers at the macroeconomic level must have as an objective for future agricultural policies appropriate measures regarding the granting of subsidies in such a way as to contribute to the viability of large crop farms.

2. Materials and Methods

The present research performed an analysis of two large crop farms of 600 ha and 3000 ha, respectively, based on selected data series, applying at the same time methods

used by descriptive statistics, visual inspection and comparison of environments in order to highlight the impact of subsidies on the technical–economic indicators of farms. The use of descriptive statistics, through its method of summarizing and describing a particular data set, provided an overview of the information [33–35]. This strategy involves discovering measures of central tendency (i.e., mean, median and mode), measures of dispersion (i.e., range, variance and standard deviation) and measures of shape (i.e., kurtosis and skewness). The reasoning applied underpins the understanding of key issues such as dispersion and distributional characteristics, and, together with central location, enables the determination and prediction of future strategies in crop farms. The use of descriptive statistics is essential due to their ability to detect any anomalous observations or trends in the data. The visualizations generated by these methods reveal numerous patterns, trends and relationships between variables, while also highlighting outliers. Some visual tools, which allow for clearer communication through the use of images, and visual inspections provided an improved way of understanding the datasets through attractive presentations alongside conventional research items. A key analytical technique used is to compare data between different categories to recognize any differences or similarities by using different methods, including calculation of means; additionally, hypothesis tests, such as *t*-tests, ANOVA and chi-square, can be run on larger data sets to establish statistical significance. Using this approach facilitates exploration of how variables affect outcomes, such as the profitability of existing crops on the crop farms included in the study, guiding decisions based on sound evidence. Through the recorded results, the study aims to carry out a preliminary analysis of these aspects, in order to evaluate and extend the analysis to other large crop farms, with the aim of creating a probabilistic model based on simple linear regression which will justify, for each culture, the relevance of the link, from the statistical point of view, of the profit with subsidies. The resulting model was relevant only for the crop farm of 3000 ha; in the case of the crop farm of 600 ha, the model was not representative. But the present analysis is important for the appreciation of how large crop farms with different forms of organization and physical dimensions can obtain economic benefits by using the same level of subsidy per hectare. The methodology used is the basis of the optimization of the economic–financial results of large crop farms, specifically, adjusting the crop plan starting from the revenues obtained from subsidies and those from the sold production, considered equally.

3. Results and Discussions

The crop farms considered in this study are located in Romania, in Ialomița County; one of them is located in Mihail Kogălniceanu commune and was established in 1994, having in exploitation 2930.32 ha in 2022, and the second one is located in Mărculești commune, having been established in 1992 and having in exploitation 614.98 ha in 2022. Ialomița County has a sufficient pedological and climatic potential, with high fertility and traditionally agrarian cultures, both holdings having their main activity the cultivation of cereals and oil plants. The location of the crop farms in Ialomița County is an advantage for high-yield agriculture. For the areas of land they own or lease, crop farms benefit from various forms of subsidies in the form of direct payments granted by the Romanian Agricultural Payments and Intervention Agency (APIA), as well as an excise duty subsidy for diesel (Figure 2).

To obtain the results, a series of steps were taken to properly consider the data when missing values occurred (such as crops in the rotation in certain years of the study period), and crops could not be analyzed, as in the case of the 600 ha farm. The model was not conclusive, since in the linear regression model created, the independent variable was the level of subsidies and the dependent variable was the value of production, but the inconsistency of growing the same crops for the reasons presented in the paper led to the conclusion that the model created may be more sensitive to extreme values than to the relationship between the variables. For the 3000 ha farm, the study was relevant and it was possible to build a linear regression model to minimize the difference between

the observed values and the future prediction of these values, leading to the conclusion that predictability from a statistical point of view was only possible in farms with large crops with very large areas and with a balanced cropping plan from one agricultural year to another.

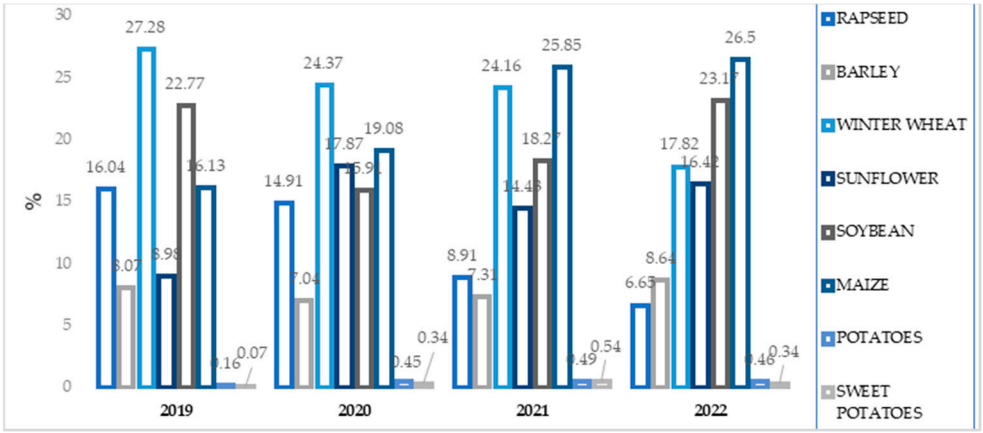


Figure 2. Land areas owned by the two arable farms.

3.1. Analysis of the Technical Indicators for the Crop Farm of 3000 ha

In the crop farm of 3000 ha, the subsidy granted by the APIA in 2019 had a value of RON 3,455,808, which increased by 3.78% in 2020 and decreased by 3.78% in 2021 compared to 2020. The subsidy for diesel excise tax was RON 349,033. In 2020, compared to 2019, this tax increased by 3.75% and it decreased in 2021 (compared to 2020) by 42.03%. Existing crops were: rapeseed, barley, winter wheat, sunflower, soybean, maize, potatoes and carrot (Figure 3).

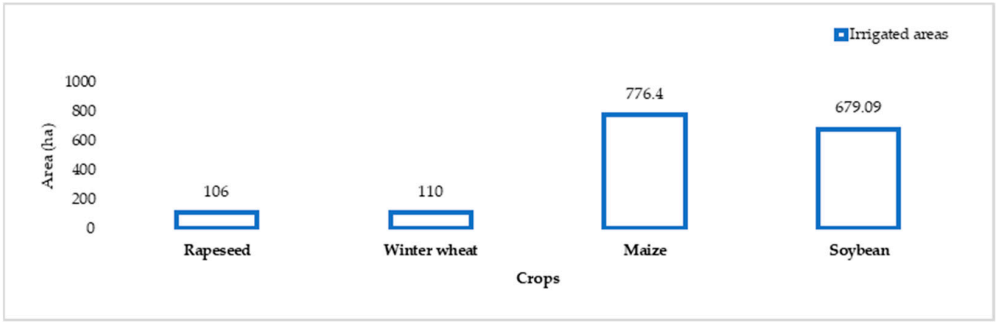


Figure 3. Crop structure on the 3000 ha crop farm.

For the rapeseed crop, the data highlighted a decrease in cultivated areas as follows: by 7.55%, representing 36.3 ha, in 2020 compared to 2019; by 40.67%, representing 179.31 ha, in 2021 compared to 2020; and by 25.53%, representing 66.79 ha, in 2022 compared to 2021.

In barley an oscillation stood out in the cultivated areas: In 2019, the cultivated area was 240.11 ha. In 2020, compared to 2019, it decreased by 13.31%, and in 2021, compared to 2020, the area increased by 3.18%, followed by another increase of 17.89% in the next year.

In the winter-wheat crop, a decrease was highlighted in the cultivated area: In 2019, the area was 811.24 ha. In 2020, compared to 2019, it decreased by 11.17%, in 2021, compared to 2020, it decreased by 1.52% and in 2022, compared to 2021, it decreased by 26.41%.

In the sunflower crop, an oscillation stood out in the cultivated areas: in 2020, compared to 2019, it increased by 97.81%, and in 2021, compared to 2020, it decreased by 19.79, followed by a further decrease of 13.55% in the following year.

For the soybean crop, it was observed that there was a fluctuation in the area cultivated: In 2020, compared to 2019, it decreased by 30.53%. Since 2020, we observed an increase

in the area cultivated: in 2021 it increased by 14.08% compared to 2020, and in 2021, there occurred a further increase of 26.54%, as compared to the previous year.

In the maize crop, the analysis highlighted that there was an increase in cultivated areas: In 2020, compared to 2019, it increased by 15.91%, in 2021, compared to 2020, by 34.58% and in 2022, compared to 2021, by 2.28%.

In the potato crop, an oscillation of cultivated areas was observed in the period under analysis, which is highlighted in the following: In the period 2019–2021, the cultivated area increased from year to year; specifically, in 2020, compared to 2019, it increased by 178.48% and in 2021, compared to 2020, by 10.07%. In the year 2022 we notice a decrease in the cultivated area compared to the previous year of 7.43%.

For the sweet potato crop, the oscillation of cultivated areas stood out: in 2020, compared to 2019, the area increased by 400%; in 2021, compared to 2020, we note an increase of 60%, followed by a decrease in area in 2022, as compared to the previous year, of 37.5%.

For the carrot crop, the cultivated areas in 2019 are 4.71 ha. The average production of the main agricultural crops realized by the crop farm of 3000 ha in 2019–2021 is quantitatively respectively higher than the county, regional, or national average production [36,37]. The results recorded by this farm were based on the favorability of natural conditions, the soil quality in the presented agricultural area (e.g., climatic factors and edaphic factors), the technology used, the type of inputs used (i.e., seed, fertilizers and plant protection products), the time of year and their application. The 3000 ha crop farm practices conservation farming: strip-tillage (sowing in prepared strips without intervening on the inter-row interval) and minimum tillage (sowing after shallow soil preparation without turning the furrow), as well as crop diversification and rotational sowing to conserve organic matter in the soil and crop irrigation (Figure 4).

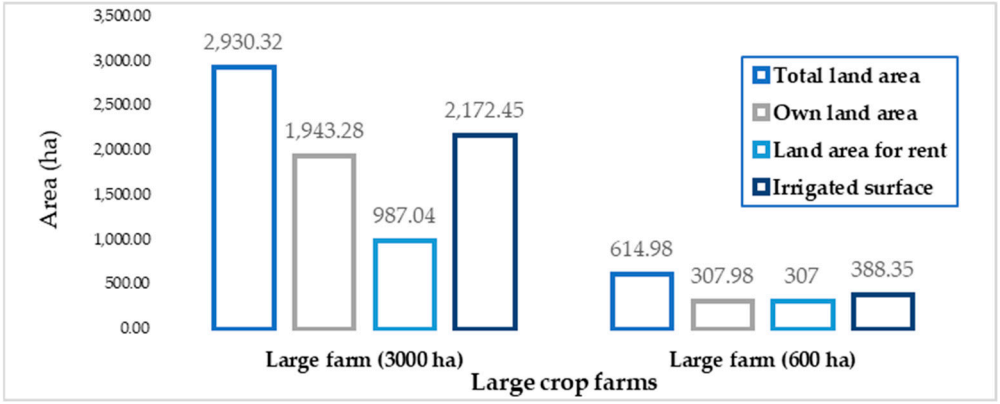


Figure 4. Irrigated areas on the 3000 ha crop farm.

The irrigated area has increased annually, highlighting that in 2022, it had 1671.49 ha irrigated, specifically: 106 ha (rapeseed), 110 ha (winter wheat), 776.4 ha (maize) and 679.09 ha (soybean) (Figure 4).

As regards the winter-wheat crop, in 2019, the average yields achieved increased compared to the yields recorded at national level by 30.55%, compared to the regional level by 27.65% and compared to the county level by 16.69%. The agricultural year of 2020 was an unfavorable agricultural year, and for the winter-wheat crop, the average production represented 61.57% of the average winter-wheat production recorded in Romania. The year 2021 brought increases in average winter-wheat production for the farm analyzed, which was higher than the national average by 136.95% and higher than the regional average by 43.84%.

Analyzing the barley crop, we find that, in 2019, average yields increased compared to the national yields, and were a total of 51% higher. In the 2020 crop year, barley production was 7.39% below the average production recorded at the national level. The year 2021

brought increases in average barley production for this farm, which was higher than the national average by 138.39%.

In the sunflower crop, in 2019, average yields increased compared to yields recorded at national level by 29.36% and compared to yields at the regional level by 51.01%. In the 2020 crop year, yields for this crop were below the average yield recorded at the national level, specifically, 11.91% lower. The year 2021 brought increases in average production, which was higher than the national average by 65.37% and higher than the regional average by 26.48%.

The absolute record recorded by the farm under study is the maize crop, of which the average yields have increased substantially compared to the average yields recorded at the national level (by 101.48% in 2019, 89.61% in 2020 and 313.58% in 2021), the regional level (118.37% in 2019, 219.34% in 2020 and 130.95% in 2021), and the county level (76.03% in 2019, 434.29% in 2020 and 59.64% in 2021).

Another crop that has brought this farm high average yields and economic benefits is the soybean crop. The data review highlighted that, in all the years included in the analysis, the average yields achieved have shown substantial increases compared to the average soybean yields at the national level (by 71.10% in 2019, by 44.70% in 2020 and by 150.29% in 2021) and at the regional level (by 58.51% in 2019, by 141.22% in 2020 and by 74.37% in 2021), but also compared to the county level (by 50.70% in 2019, by 127.05% in 2020 and by 46.52% in 2021).

3.2. Analysis of Technical Indicators for Crop Farm of 600 ha

In the crop farm of 600 ha, the review of the data highlighted a slight decrease in the amount of subsidies received during the analysis period; thus, the subsidies granted by the APIA decreased by 9.33% in 2020 compared to 2019, and by 3.66% in 2021, compared to 2020. The subsidy for the diesel excise tax increased by 9.69% in 2020, compared to 2019, and decreased by 33.81% in 2021, compared to 2020.

Winter wheat and maize are the predominant crops in 2019 and 2020, together occupying 68.73% (2019) and 67.41% (2020) of the cultivated area. From 2021 onwards, maize and soybean crops become predominant, together accounting for 64.25% of the cultivated area, and the farmer chose to progressively decrease the areas cultivated with winter wheat (by 32.67% in 2020, compared to 2019, by 45.23% in 2021, compared to 2020, and by 39.54% in 2022, compared to 2021) and the cultivation of rapeseed was abandoned. From 2022 onwards, barley and oats are no longer cultivated, and the lucerne crop increases slightly in 2021 (9.47%) and 2022 (11.61%) (Figure 5).

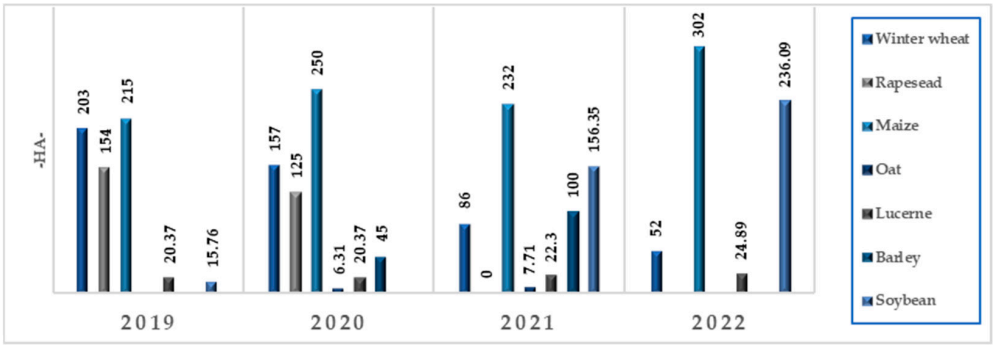


Figure 5. Crop structure on the 600 ha crop farm.

Crop rotation is practiced annually, and, from 2021, irrigation for maize and soybean crops has been introduced to increase yields [38]. The farm practices conservation farming.

As for the winter-wheat crop, in 2019 and 2021, the average yields increased compared to the yields recorded at the national level by 29.06% (2019) and 142.65% (2021). The agricultural year of 2020 was a poor agricultural year for winter-wheat cultivation, with an average production/ha of 4.81% of the average winter-wheat production recorded in

Romania, which led the farm to reduce the areas cultivated with straw and to introduce crop irrigation in 2021 for maize and soybean crops (Figure 6).

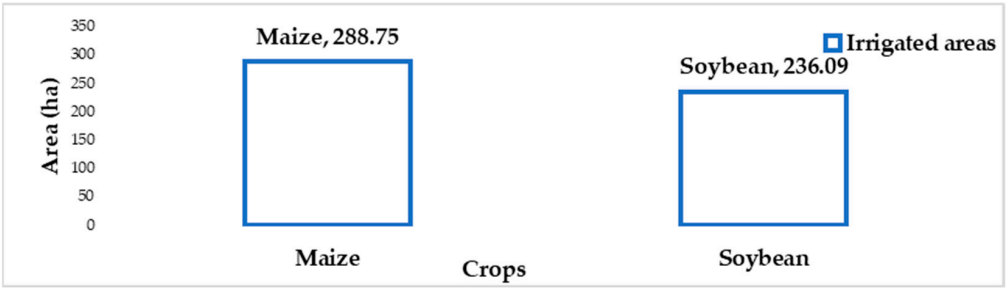


Figure 6. Irrigated areas in the 600 ha crop farm.

For barley, the analysis highlighted that this crop is found in the 2020 and 2021 plantings, and that the average yields were, in 2020, below those recorded at the national (23.35%), regional (40.85%) and county (76.40%) level, and above them in 2021 (by 134.35% compared to the national level, 60.22% compared to the regional level and 33.73% compared to the county average).

In the oat crop data, it was observed that this crop was introduced in the crop plan of the years 2020 and 2021, and the average yields were lower than those recorded at the national (in 2020: 26.89%, in 2021: 95.07%), regional (in 2020: 30.30%, in 2021: 95.98%) and county (in 2020: 35.93%, in 2021: 55.20%) levels. In view of these aspects of the situation, the farm stopped growing oats in the 2022 agricultural year.

In the maize crop data was highlighted the following situation: in 2019, the average production achieved was close to that recorded at the national level. The agricultural year of 2020 was an unfavorable one for maize crop, the farm being below the average production in Romania (by 47.39%) and the South-Muntenia Region (by 11.39%). The record average production of maize in 2022, i.e., 14,309 kg/ha, in the year in which the crop farm introduced irrigation to this crop, was much higher than the average production recorded in Romania (by more than 341.64%), which led the 600 ha farm to increase the area under maize cultivation.

In Romania, in the South-Muntenia Region, as for soybean crops, irrigation is necessary for crop production, and cultivation of late and semi-late soybean varieties is recommended. The vegetable farm cultivated soybean in 2019 and 2021. As regards this crop, a decrease in the average production was highlighted in 2019 compared to the average production recorded in Romania (34.90% lower). But in 2021, after the introduction of irrigation of this crop, the average production was significantly higher than that recorded at the national level (139.56% higher), in the South-Muntenia Region (66.89% higher) and in Ialomița County (40.24% higher).

The climatic conditions in the South Muntenia Region, and implicitly, in Ialomița County, are favorable for rapeseed cultivation. In a rapeseed crop, the best pre-seeding plants are those that release the soil early and, as the seed is small, it must be well-chopped [39]. The farm cropped rapeseed in 2019 and 2020, years in which the average yield exceeded the average yield recorded at the national level by 17.89% (2019) and 16.28% (2020), as well as the regional (by 12.95% in 2019 and 14.42% in 2020) and county (by 17.32% in 2019 and 25.63% in 2020) levels. However, as of 2021, the farm has excluded rapeseed crop from the cropping plan.

The economic efficiency of farms, regardless of size, plays a key role in decision making, representing an important criterion in terms of assessing economic activity [40,41]. Considering that its financial performance is a goal for each farm, its measurement requires the use of a series of representative indicators [42,43]. The analysis of the profitability of farm activity aims to determine rates of return, highlighting the extent to which capital, in its entirety, generates profit. These rates, determined as the ratio between output indicators (profit or loss) and indicators reflecting a flow of activity or stock (net turnover

or resources consumed, total assets or equity), provide information on the extent to which capital generates profit, and are considered the most synthetic indicators for highlighting teconomic efficiency.

3.3. Analysis of Income and Profitability for the Crop Farm of 3000 ha

Analyzing the income structure of the crop farm of 3000 ha, it was highlighted that the share of turnover in total income in 2020 and 2021 was 70.34%, and next to it, we note the existence of income related to stocks of products held, with a share of 8.11% in 2020. In 2021, we note the decrease in the value of the stock of products compared to the beginning of the period, as well as the contribution of income from subsidies to the formation of total income, with shares of 16.17% in 2018, and 10.10% in 2021 (Figure 7).

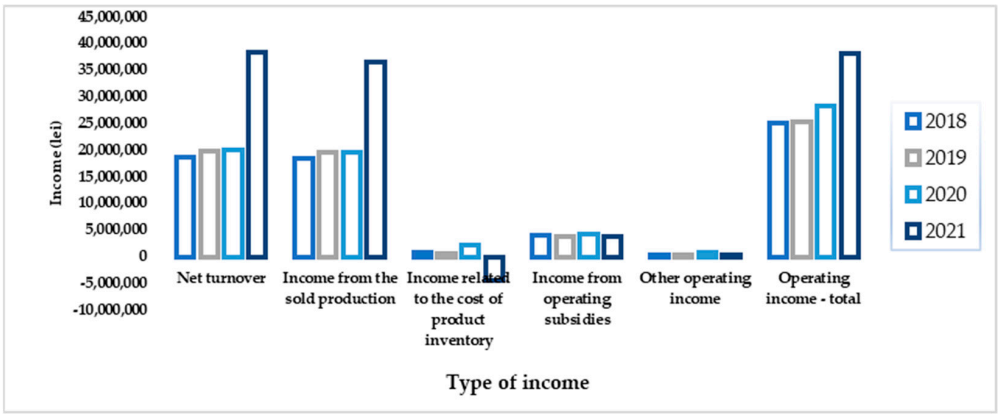


Figure 7. Income on the 3000 ha crop farm.

In order to validate the efficiency of the management of the activity on the farm of 3000 ha, the commercial profitability rate was determined as an increase in the market presence of the large-scale farm. The values of this indicator have been increasing, except in 2019, in which a decrease is noted, as follows: in 2018, 29.92%; in 2019, 27.81%; in 2020, 30.7%; and in 2021, 31.32%. We note the year 2021 as demonstrating the highest value of commercial profitability for this farm in the analysis period.

The economic rate of return, another analyzed indicator, which reflects the ratio between the gross operating surpluses or deficits and the economic means employed to obtain them, is independent of the financial structure of the crop farm, the state tax policy for taxing profits and the policy on depreciation of fixed assets. This rate had a value of 9.08% in 2020, but in 2021, the situation recovered, and the value of the indicator was 15.52%.

The financial rate of return expresses the efficiency of the associates' capital investments and how they are maintained, taking into account the net result of the financial year and the equity held. This rate assessed the position of the farm on the market, as for the targeted segment, as follows: the activity in the years 2018–2021 was financially profitable, with a slight downward trend of this indicator in the period 2018–2020, but a recovery was felt in the year 2021, when the value was 19.92%.

The consumption of resources is accounted for by recording them in the expenditure accounts and, in order to assess their efficiency, the balances of these accounts are compared with the results obtained. In the case of this farm, the rate of return on resources consumed or costs (an indicator directly influenced by the financial result of the operating activity) with fluctuating trends over the period under analysis has positive values, which indicates the profitability of the operating expenditure incurred (Figure 8).

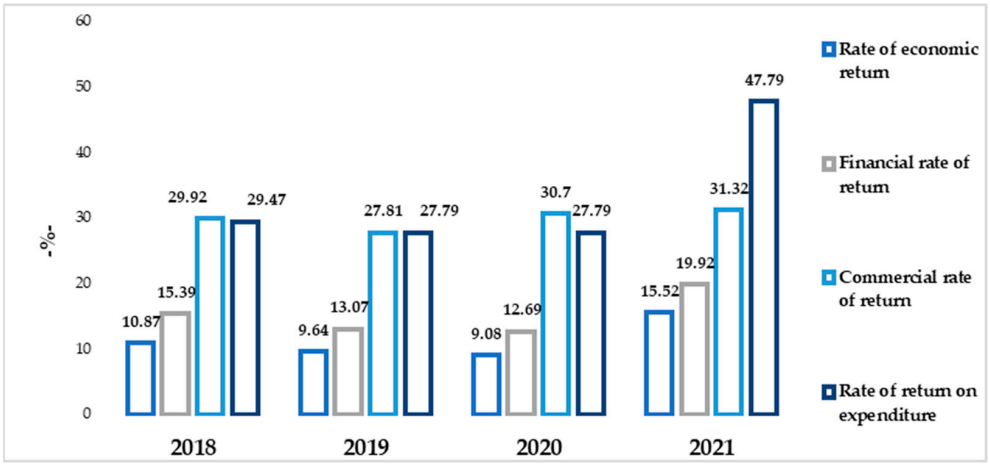


Figure 8. Rates of return for the 3000 ha farm.

3.4. Income and Profitability Analysis for Crop Farm of 600 ha

In the crop farm of 600 ha, total income is made up of turnover, income from stocks of products held and income from subsidies, the last term having a share of 23.03% in 2019 and 16.35% in 2021 (Figure 9).

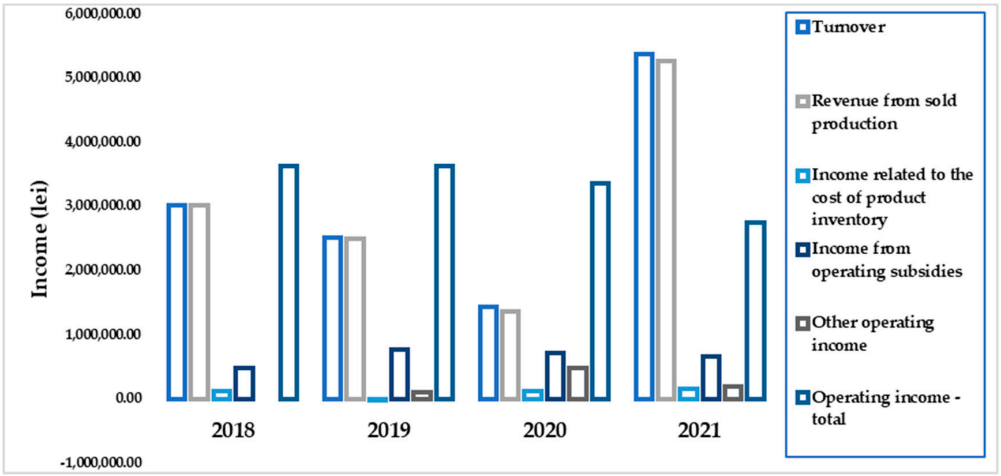


Figure 9. Income structure on the 600 ha crop farm.

In order to assess the management of the activity on this farm, the commercial profitability rate was determined, which were found to be 25.75% (2018) and 40.46% (2021), high values for this indicator. This indicator decreased, by 12.80% (2019) and 0.13% (2020); the commercial activity was less profitable, a situation imposed by the recording of losses. The year 2021 highlighted the increase of the farm's presence in the specific activity sector (Figure 9).

The economic rate of return at the level of this crop farm has positive values, specifically, 13% (2018) and 17.85% (2021), with favorable connotations in the use of total assets held, while in the following period, i.e., financial years 2019 and 2020, the return on the use of economic assets held for gross operating surplus decreases: 5.51% (2019) and 0.03% (2020).

The financial rate of return helps to identify the position of this farm on the market as follows: the activity is profitable throughout the analysis period. This level was both more favorable, with 50.81% (2021) and 27.01% (2018) on the back of the increase in both net profit and equity held, and less favorable in 2019 (13.28%) and especially in 2020 (0.09%). The increase in return on invested capital facilitates access to new financial resources, due to the confidence of the associates in reinvesting in the business. This aspect is also due to

the attraction of other potential investors, with implications for the future development of the crop farm.

The rate of return on costs shows the following values: 27.70% (2018), 10.71% (2019), 0.07% (2020) and 53.76% (2021); these highlight a profitable operation that covered its expenses, but the low value in year 2020 denotes that the crop farm hardly met the operating expenses incurred (Figure 10).

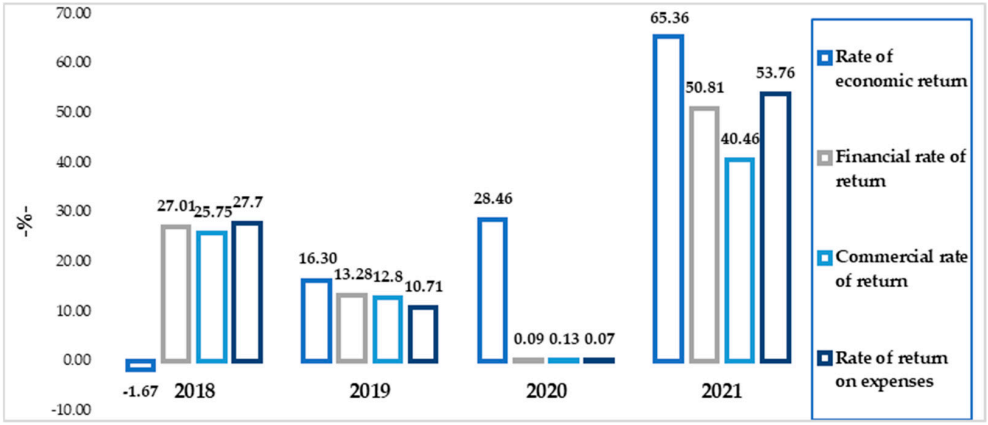


Figure 10. Rates of return on the 600 ha crop farm.

3.5. Presentation of the Statistical Model for the 3000 ha Crop Farm

In order to highlight the valuable contribution of production to the income of the 3000 ha crop farm, specific information on each crop is presented, highlighting the impact of subsidies on the profitability of the various crops in the farm's own farming environment. The analysis complements the wider assessment of the effect of subsidies on techno-economic indicators for farms of different sizes, providing a deeper understanding of how the income from different crops is supplemented by subsidies in order to make a profit.

Following the principles of methodological consistency, the analysis presents a reliable approach, using descriptive statistics, visual inspection and basic comparison as means of investigation. By integrating these methods into the study, the validity of the overall findings is increased. By providing empirical evidence indicating the influence of subsidies on crop profitability, the research contributes to the main objective of the article, namely, to examine how subsidies affect the main techno-economic indicators in crop farms of different sizes. Further inclusion of such findings will strengthen the suggestions and conclusions of the research conducted. Identifying the impact of subsidies on crop profitability through a crop-level analysis can be an essential benchmark for decision-makers (farm managers at the microeconomic level and the relevant ministry through its policy at the macroeconomic level). Integrating this analysis into the present research can facilitate better policy-making in terms of agricultural support policies and equitable resource allocation.

The expected outcome of the analysis is the quantification of the contribution that subsidies bring to the farm under study to achieve positive financial results. In this context, the objective of the present study was achieved.

The result obtained presents descriptive statistics for the value, in lei (RON), of production for five existing crops on this farm, namely, winter wheat, barley, maize, soybean and sunflower, in the years 2019, 2020 and 2021. The statistics are based on three data points for each crop. Analysis of this data reveals the following: maize has the highest average production value (RON 6,728,054.35), followed by soybean (RON 4,835,731.11), winter wheat (RON 3,641,743.34), sunflower (RON 2,303,467.85) and barley (RON 1,075,598.16). Maize also shows the highest variability in production value, with a standard deviation of RON 3,287,849.93. Barley has the lowest variability, with a standard deviation of RON 341,911.58. The range of production values is highest for maize (from RON 4,334,721.88 to RON 10,476,960.18) and lowest for barley (from RON 763,114.56 to RON 1,440,811.32) (Table 1).

Table 1. Value of production for individual crops on the farm of 3000 ha.

Specify	N	Minimum	Maximum	Mean	Standard Deviation
		-Lei (RON)-			
Production value of winter-wheat crop	3	1,815,912.00	5,337,052.02	3,641,743.34	1,764,194.96
Production value of barley crop	3	763,114.56	1,440,811.32	1,075,598.16	341,911.581
Production value of maize crop	3	4,334,721.88	10,476,960.18	6,728,054.35	3,287,849.93
Production value of soybean crop	3	3,808,520.32	5,822,761.00	4,835,731.10	1,007,721.31
Production value of sunflower crop	3	1,442,178.00	3,159,554.56	2,303,467.85	858,700.10
Valid N (listwise)	3				

This analysis presents the results of descriptive statistics for the value, in lei (RON), of subsidies received by the farm for the same five different crops, namely, winter wheat, barley, maize, soybean and sunflower, for the years 2019, 2020 and 2021. The analysis of the results points to the following: winter wheat has the highest average subsidy (RON 1,008,970.66), followed by maize (RON 815,266.06), soybean (RON 754,313.76), sunflower (RON 556,553.92) and barley (RON 298,238.25). Barley has the lowest variability in the value of the subsidy, with a standard deviation of RON 14,061.08, while sunflower has the highest variability, with a standard deviation of RON 211,730.27. The range of variation in the value of the subsidy is highest for maize (from RON 627,514.75 to RON 998,474.95) and lowest for barley (RON 282,525.70 to RON 309,637.22) (Table 2).

Table 2. Value of subsidies on the crop farm of 3000 ha.

Specify	N	Minimum	Maximum	Mean	Standard Deviation
		-Lei (RON)-			
Amount of subsidies for winter-wheat crop	3	933,404.20	1,047,361.87	1,008,970.66	65,445.29
Amount of subsidies for barley crop	3	282,525.70	309,637.22	298,238.25	14,061.07
Amount of subsidies for maize crop	3	627,514.75	998,474.95	815,266.05	185,521.81
Amount of subsidies for soybean crop	3	683,735.73	873,305.65	754,313.76	103,644.17
Amount of subsidies for sunflower crop	3	344,403.86	767,861.88	556,553.92	211,730.26
Valid N (listwise)	3				

The analysis of the results presents the descriptive statistics for the value of the net income, in lei (RON), of the five different crops existing in the analyzed farm, namely, winter wheat, barley, corn, soybean and sunflower, in the years 2019, 2020 and 2021 (Table 3). Maize has the highest average net income (RON 3,182,893.05), followed by soybean (RON 2,243,242.55), sunflower (RON 544,577.82), winter wheat (RON 175,151.69) and barley (RON 50,248.32). Winter wheat has the highest variability of net income, with a standard deviation of RON 1,196,288.54, while soybean has the lowest variability, with a standard deviation of RON 677,588.92. The range of net income values is highest for winter wheat (from RON −1,139,219.57 to RON 1,200,341.95) and lowest for barley (from RON −88,453.84 to RON 190,846.89) (Figure 11).

Determining the impact of subsidies for each crop contributes to the understanding of the use of these non-reimbursable revenues in order to generate profit. The ratio of subsidy for each crop to net-profit-made revealed the following: in 2019, in maize cultivation, subsidies contributed 30% to gross profit, in soybean cultivation, 42%, and in sunflower cultivation, 80%; 30% of the profit made by maize cultivation is due to subsidies; 42% of

the profit made by soybean cultivation is also due to subsidies; and 80% of the profit made by sunflower cultivation is due to subsidies.

Table 3. Value of net income/deficit for the crop farm of 3000 ha.

Specify	N	Minimum	Maximum	Mean	Standard Deviation
		-Lei (RON)-			
Net income/deficit value of winter-wheat crop	3	−1,139,219.57	1,200,341.95	175,151.69	1,196,288.53
Net income/deficit value of barley crop	3	−88,453.84	190,846.89	50,248.32	139,660.02
Net income/deficit value of maize crop	3	2,088,882.43	4,661,668.70	3,182,893.04	1,328,849.27
Net income/deficit value of soybean crop	3	1,652,523.38	2,982,916.09	2,243,242.55	677,588.91
Net income/deficit value of sunflower crop	3	151,261.82	1,050,025.49	544,577.82	459,754.46
Valid N (listwise)	3				

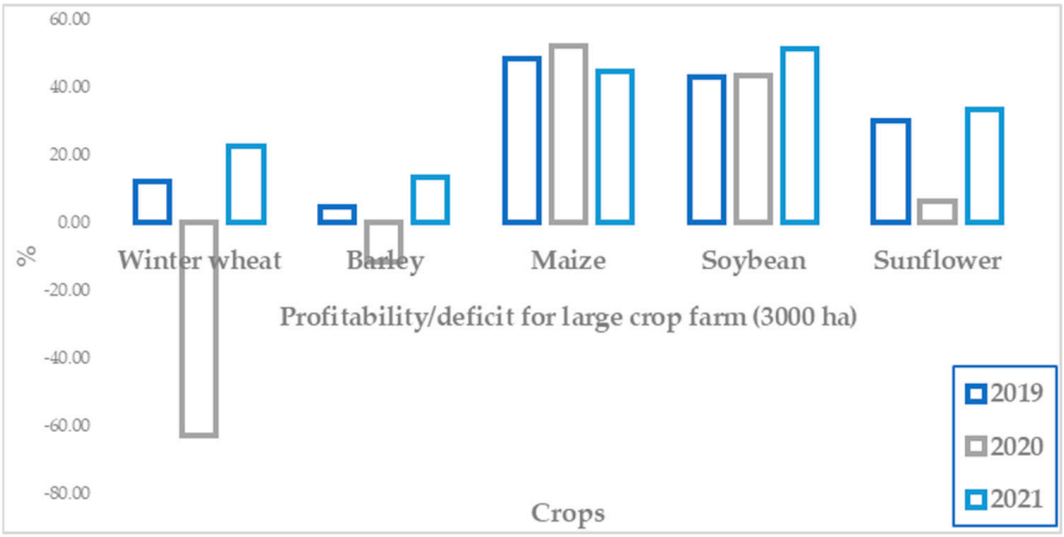
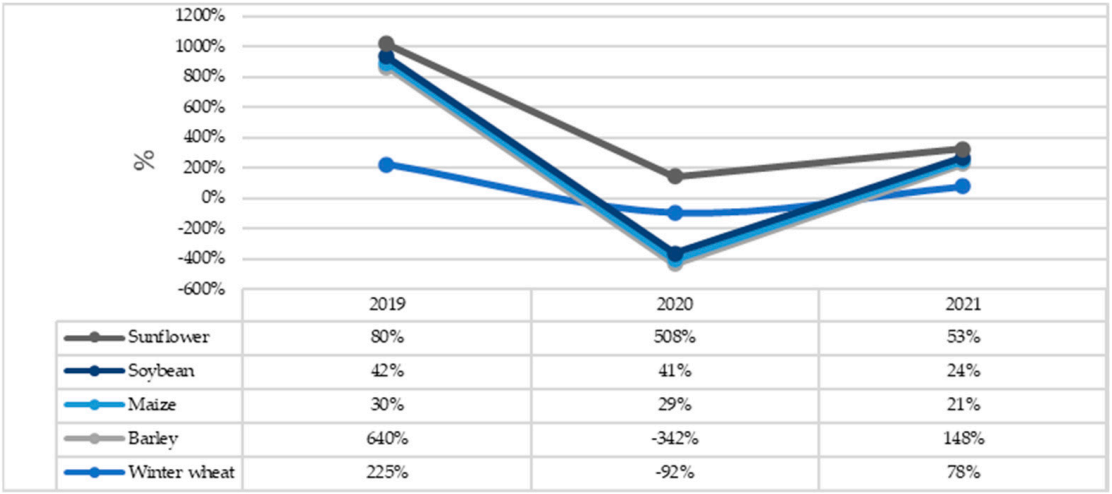


Figure 11. Net income/deficit for the crop farm of 3000 ha.

Analyzing the profitability of the crops, the following can be noted: barley had the highest share, in 2019 (640%), and the lowest, in 2020 (−342%); sunflower had a considerable share of subsidies in the profit obtained in 2020 (508%); maize had relatively stable values in the three years considered, 30%, 29% and 21% in 2019, 2020 and 2021, respectively; winter wheat had a significant negative value in 2020 (−92%) and a significant positive value in 2021, with a share of 78%. Soybean had relatively stable shares in 2019 and 2020 (42% and 41% respectively) and a lower value in 2021 (24%) (Figure 12).

Determining the profitability of each crop, based on the net profit margin as a percentage of total revenue, identified the crop with significant profitability, which is information needed in the decision-making process for future cropping plans and resource allocation. From the analysis of the returns and the impact of subsidies on profit, the crops that generate the relevant profits are maize, soybean and sunflower (Figure 13).

The results highlighted that, for each crop, during the analysis period, there is an upward trend in terms of income from the valorization of production as well as income from subsidies received. For maize, the correlation between these types of income stands out.



	2019	2020	2021
Sunflower	80%	508%	53%
Soybean	42%	41%	24%
Maize	30%	29%	21%
Barley	640%	-342%	148%
Winter wheat	225%	-92%	78%

Figure 12. Profitability of existing crops on the crop farm of 3000 ha.

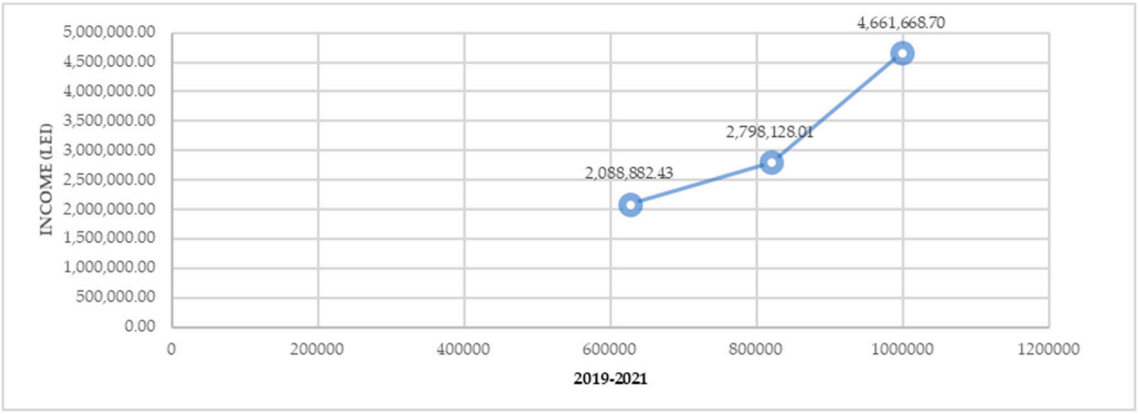


Figure 13. Correlation of income from the valorization of production and income from subsidies received on the 3000 ha crop farm in the period 2019–2021.

4. Conclusions

The analysis of the impact of subsidies on key techno-economic indicators conducted on two farms of different sizes and the inclusion of statistical analysis were critical to understanding the impact of subsidies on crop profitability by providing a comprehensive perspective on the broader impact of subsidies on agricultural activities:

- Within the large crop farm of 3000 ha, the economic performance during the analyzed period was favorable, which has been determined to lead to a profitability of the activity. It is necessary to specify that in 2021, the best results were recorded, as follows: 15.52% economic return and 19.92% financial return. The production value of the crops included in the annual crop plan recorded significant fluctuations in the period 2019–2022. The maize culture stood out for the significant increase in production values in the 2020 and 2021 agricultural years, because it exceeded the national, regional and county averages. The results underline the fact that subsidies had a significant role in determining the gross product of each crop, and sometimes, these non-reimbursable incomes contributed overwhelmingly to the determination of a positive value for this area of net income achieved. The analysis of these three agricultural and financial years has highlighted the fact that the corn and soy crops were consistent in their achievement of farm income, for which the gross product and net income were high, despite the yearly fluctuations in average production. Although there are fluctuations in the production values of different crops, the net

corn revenues continued to be high, and even increasing, recording an average of RON 3,182,893.05.

- Within the large crop farm of 600 ha, the economic performance was fluctuating in the period 2019–2021, having the ability to generate constant profit. But it was found that in 2020, the results recorded placed the farm close to the profitability threshold. That year, the revenues from operating subsidies tipped the balance towards achieving positive financial results, highlighting their role in supporting agricultural activity. This farm had, in 2019 and 2021, good profitability from the economic and financial points of view. The year 2021 stood out, with a good return from the economic (65.36%), financial (50.81%) and employed-costs (53.76%) points of view. For this farm, the statistical model was inconclusive, because the culture plan is optimized annually, depending on agrometeorological predictions, the level of subsidies and market trends. The change of crops from one year to another precludes the estimation of the measure in which each crop could consistently contribute to maintaining the financial balance. Although the subsidies impacted the value of the net income, it was not possible to quantify their contribution.

The statistical analysis carried out contributed to the consolidation of conclusions, identifying trends and models in agriculture, and can serve as a source of information for relevant and impactful political decisions in the future regarding the efficient allocation of resources.

In conclusion, we can say that subsidies are indispensable and beneficial for large crop farms, because the practice of agriculture involves a series of risks that cannot be borne financially by agricultural operators [44].

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