RESEARCH REGARDING THE CORRELATION BETWEEN AVERAGE PRODUCTION AND GROSS MARGIN FOR WHEAT AND MAIZE CROPS

CERCETARI PRIVIND CORELATIA DINTRE PRODUCTIA MEDIE SI MARJA BRUTA LA CULTURA GRAULUI SI PORUMBULUI

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Abstract: *The paper aimed to determine the correlation between average production, gross product, variable cost and gross margin for wheat and maize crops cultivated in 4 farms situated in the Southern Plain of Romania in the agricultural year 2010-2011. The correlation between wheat yield and gross margin was a strong one, r_{XY}=0.598 and in case of maize r_{XY} = 0.862 showing a very strong connection. According to "Student Test" for DL=3, the values of the calculated r_{XY} were higher both for P=99% and P=95% showing a significant relationship between the analyzed indicators.*
As a conclusion, for increasing gross margin, farmers have to grow up gross output coming from marketed production and reduce variable cost.

Key words: *correlation, yield, gross margin, wheat, maize*

INTRODUCTION

Wheat and maize are the main cereal crops cultivated in Romania. In 2009, the surface cultivated with these two crops was 4,487.6 thousand ha, representing 56.92 % of the total cultivated area in the country. The grain production coming from wheat and maize counted for 13,175.8 thousand tons with a share of 88.58 % in the total cereal production. Therefore, wheat yield counted for 2,421 kg/ha and maize grains obtained from a ha for 3,409 kg (11).

Because consumers needs and also animal feeding requirements for cereals are still very high, these crops will continue to be cultivated and a higher performance and profitability are expected in cereal cropping.

Economic efficiency is determined by gross output and the related production cost. Standard gross margin is the barometer of efficiency at crop level allowing the comparison between various production targets in vegetal and animal sectors of the EU agriculture. Gross margin is proportionally influenced by gross product and reverse proportionally by variable cost (2, 4, 5, 7, 8).

In this context, this study aimed to estimate the relationship between average production, gross product, variable cost and gross margin for wheat and maize crops based on the correlation coefficient method (1,6, 9, 11, 12).

MATERIALS AND METHODS

The paper was based on the data collected for wheat and maize crops from four vegetal farms, situated in the Southern Romania: F1-SC Agri Sol SRL, F2-SC Smart Agro Global SRL, F3-SC Agriprod Beiu SRL and F4-SC Apic Impex SRL. For each crop, the average production, gross output, variable cost and gross margin were determined for the agricultural year 2010-2011. All the calculations are made per surface unit. For each economic indicator mentioned before, the following statistical parameters were determined:

-***Statistical Average*** ***($\overline{X}$),*** according to the formula :

$$\overline{X} = \frac{X_1 + X_2 + ...X_n}{n} \quad ,$$

where n = the number of farms , $\overline{X}$ =average level of the studied indicator, X_1, X_2 etc the variables of the studied series of data;

-***Dispersion (S^2),*** according to the formula :

$$S^2 = \frac{\sum_{i=1}^{n}(X_i - \overline{X})}{n-1} \quad ,$$

-***Standard Deviation, S,*** according to the formula:

$$S = \left(\sqrt{\frac{\sum_{i=1}^{n} (X_i - X)^2}{n-1}} \right)$$

-***Variation Coefficient***, $V_{\%,}$ according to the formula :

$$V_{\%} = \frac{S}{\overline{X}} \text{ x } 100$$

-Correlation Coefficient between X and Y variables, according to the formula :

$$r_{xy} = \frac{n\sum xy - \sum x \sum y}{\sqrt{(n\sum x^2 - (\sum x)^2)(n\sum y^2 - (\sum y)^2)}} \quad ,$$

The interpretation of the values for r_{xy} was made as follows: r_{xy} =0.5-1 very strong correlations, r_{xy} =0.2-0.5 strong correlations and r_{xy}= 0-0.2 weak correlations.

-"T"Test for correlation coefficient , according to the formula :

$$t = r\frac{\sqrt{n-2}}{\sqrt{1-(r)^2}} \quad .$$

The calculated values have been compared to the "t" values mentioned in tables for a the corresponding DL=3 for the probability 95% and 99%.

RESULTS AND DISCUSSIONS

Wheat Yield, Gross Product, Variable Cost and Gross Margin as empirical data. Concerning wheat crop, average yield varied between 4,000 kg/ha in Farm F2 and F3 and 5,500 kg/ha in F4.Gross product ranged from Lei 3,090/ha for F2 and Lei 4,320/ha for F4. Variable cost varied between Lei 1,467/ha for F3 and Lei 1,614 for F1. Gross margin varied between Lei 1,302/ha for F2 and Lei 2,781 for F4. Therefore, the best financial results were registered by the farm F4 (Table 1).

Regarding maize crop for grains, average production varied between 4,200kg/ha for F3 and 8,200 kg/ha for F1.Gross product ranged from Lei

3,963 /ha for F3 and Lei 6,548/ha for F1. Variable cost varied from Lei 1,047/ha for F2 and Lei 2,435/ha for F4. Gross margin varied between Lei 2,820/ha for F3 and Lei 4,586/ha for F1. Therefore, in case of maize crop, the highest production and financial performances were registered by the farm F1 (Table 2).

Table 1. Wheat Yield, Gross Product, Variable Cost and Gross Margin for Wheat Crop in the year 2010

Farm	Yield-kg/ha	Gross Product Lei/ha	Variable Cost-Lei/ha	Gross Margin Lei/ha
F1	4,900	4,074	1,614	2,460
F2	4,000	3,090	1,788	1,302
F3	4,000	3,203	1,467	2,622
F4	5,500	4,320	1,539	2,781

Table 2. Wheat Yield, Gross Product, Variable Cost and Gross Margin for Maize Crop in the year 2010

Farm	Yield-kg/ha	Gross Product Lei/ha	Variable Cost-Lei/ha	Gross Margin Lei/ha
F1	4,900	4,074	1,614	2,460
F2	4,000	3,090	1,788	1,302
F3	4,000	3,203	1,467	2,622
F4	5,500	4,320	1,539	2,781

Statistical Parameters reflects the average wheat production, average gross product, average variable cost and average gross margin also their dispersion, standard deviation and variation coefficient for the sample of 4 farms included in the experiment.

In case of wheat, average production was 4,600 kg/ha, gross income Lei 3,674.25/ha, variable cost Lei 1,602/ha and standard gross margin Lei 2,291.25. The low values of the variation coefficients for these four statistical parameters ranging between 3.67 % and 8.11 % showed a distribution of variables close to the average (Table 3).

In case of maize, average production registered 6,600 kg/ha, gross income Lei 5,292.75/ha, variable cost Lei 1,646.75/ha and gross margin Lei 3,646/ha. The values of the variation coefficient was 9.91 % for gross

margin showing a small dispersion of the values around the average (Table 4).

Table 3.Statistical Average, Standard Deviation, Dispersion and Variation Coefficient for Wheat Economic Indicators

Parameter	$\overline{X}$	$S_{\overline{X}}$	S^2	V%
Yield	4,600	367.42	734.84	7.98
Gross product	3,674.25	298.15	596.30	8.11
Variable cost	1,602	68.88	137.76	4.30
Gross margin	2,291.25	336.19	672.39	3.67

Table 4.Statistical Average, Standard Deviation, Dispersion and Variation Coefficient for Maize Economic Indicators

Parameter	$\overline{X}$	$S_{\overline{X}}$	S^2	V%
Yield	6,600	941.62	1,883.25	11.27
Gross product	5,292.75	608.40	1,216.80	11.49
Variable cost	1,646.75	333.43	666.87	20.24
Gross margin	3,646	362.04	724.09	9.92

For all the other indicators, yield, gross income and variable cost, the variation coefficient varied between 10 and 20 %, meaning that the average is good and the distribution of the values around the average is a middle one.

Correlation Coefficients. In case of wheat, the correlation coefficient between yield and gross income was very high, r_{xy}=0.980, because gross product depends on marketed production multiplied by sale price. Therefore, the higher yield and the higher sale price, the higher gross product.The correlation coefficient between average production and variable cost was a weak and a negative one, r_{xy}=-0.275, showing that between these two indicators there is a reverse dependence relationship. The correlation coefficient between average production and gross margin was a positive and a very strong one, r_{xy}=0.598, reflecting how much gross margin depends on yield. Therefore, the higher wheat yield, the higher gross margin. The correlation between gross product and variable cost was a negative and a low one, r_{xy}=-0.393, showing that an increase of gross product could determine a decrease of variable cost per ha. The correlation between gross

income and gross margin was r_{xy}=0.650, a positive and strong relationship meaning that the higher gross product, the higher gross margin. Finally, taking into account variable cost and gross margin, the correlation coefficient was a negative and strong one, r_{xy}= -0.926, showing that the higher the variable cost, the lower gross margin in wheat cropping (Table 5).

Table 5. Matrix of the Correlation Coefficients between Yield, Gross Product, Variable Cost and Gross Margin for Wheat Crop

Indicator	Gross Product	Variable cost	Gross Margin
Yield	0.980	-0.275	0.598
Gross product	-	-0.393	0.650
Variable cost	-	-	-0.926

In case of maize crop, the correlation coefficient between yield and gross product was a positive and a very strong one, r_{xy}=0.975, showing that a higher yield is a key factor for increasing gross product. The correlation coefficient between yield and variable cost was also a positive and a strong one, r_{xy}=0.843, meaning that for increasing average production more variable costs are required. The correlation between maize yield and gross margin was also a positive and a strong one, r_{xy}=0.862, showing that the higher average production, the higher gross margin. The relationship between gross income and variable cost was a positive and a very strong one, r_{xy}=0.863, showing that in case of maize, a higher gross product could be related to a higher level of variable cost. Between gross income and gross margin, as in case of wheat, the correlation coefficient was a positive and strong one, r_{xy}=0.885, reflecting that the higher the gross product, the higher the gross margin. Finally, the correlation coefficient between variable cost and gross margin was a positive and strong one, r_{xy}=0.527 (Table 6).

Table 6. Matrix of the Correlation Coefficients between Yield, Gross Product, Variable Cost and Gross Margin for Maize Crop

Indicator	Gross Product	Variable cost	Gross Margin
Yield	0.975	0.843	0.862
Gross product	-	0.863	0.885
Variable cost	-	-	0.527

The significance of the correlation coefficient. The values of "t" from statistical tables for 3 degrees of freedom were higher at the 95 % level, t=3.18 and at 99 % level of probability, t=5.84 in comparison with almost all the calculated " t "values. Therefore, we may conclude that there is no evidence of a real correlation at the both levels of significance, except the correlation between yield and gross product (Tables 7 and 8).

Table 7.Significance of Correlation Coefficients ("T" Student Test), Wheat

Correlation type	Calculated value of "t"	Interpretation
Yield x Gross Product	6.978	High significance
Yield x Variable cost	-0.402	No significance
Yield x Gross margin	1.052	No significance
Gross product x Variable cost	-0.602	No significance
Gross product x Gross margin	1.205	No significance
Variable cost x Gross margin	-3.452	No significance

Table 8. Significance of Correlation Coefficients ("T"Student Test), Maize

Correlation type	Calculated value of "t"	Interpretation
Yield x Gross Product	6.161	High significance
Yield x Variable cost	2.208	No significance
Yield x Gross margin	2.401	No significance
Gross product x Variable cost	2.407	No significance
Gross product x Gross margin	2.681	No significance
Variable cost x Gross margin	0.874	No significance

CONCLUSIONS

In case of wheat crop, the correlation coefficients showed a strong and positive relationship between: yield x gross product, yield x gross margin, but a negative and low relationship between yield x variable cost.

In case of maize, the values of the correlation coefficients have proved a positive and strong relationship between yield x gross product, yield x variable cost and yield x gross margin.

Yield is the key factor for increasing gross margin both for wheat and maize crop.Farmers have to manage in a better way wheat and maize yield but also they have to pay attention to variable cost too.

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