ECONOMIC ANALYSIS OF TRITICALE PRODUCTION: A CASE STUDY OF CORUM PROVINCE, TURKEY

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Abstract

This study aims to determine the production costs and profitability of the farmers' triticale production in Corum province. Because it is an important region in Turkey, Corum province was selected as the research area in triticale production. The study's data were determined by the stratified random sampling method obtained by the questionnaire method from 53 farms producing triticale in the Sungurlu district of Corum province. The production data set includes data for the 2019 year. According to the research findings, the average production cost per decare was calculated to be 290.85 TRY. The share of variable costs was 58.55% within the production costs, and the share of fixed costs was 41.45%. It was determined that the unit sale price of triticale was 0.87 TRY. The gross production value (GPV) of triticale in the region was calculated as 356.44 TRY/da, gross profit 185.73 TRY/da, and net profit 65.16 TRY/da. The unit cost of triticale in the region was 0.84 TRY. The relative profit was determined as 1.22 unit. As a result of the research, as the triticale production areas increase, the fixed costs per decare increase, and the variable costs decrease. The profitability indicators per decare and kilogram sales price increased with the triticale groups' with.

Key words: triticale, economic analysis, production cost, profitability, Turkey

INTRODUCTION

Triticale is a type of grain that combines the high yield of wheat with the durability of rye. It can adapt to very different climatic and soil conditions. It is more productive than other grain types in arid conditions. This feature is an important product for regions where annual rainfall and irrigation are limited [2]. Triticale grain is mostly used as a feed for ruminants and poultry as it is a source of protein, amino acids, and B vitamins [8] [19]. It is also used as grain, roughage, silage and straw [13].

The aim of agricultural enterprises is to increase productivity in production. This is possible by maximising the production volume in agriculture or minimising the costs of producing a certain product [4].

There are many studies on triticale cultivation in the literature [14] [9] [11] [7] [3] [15], but the study on the economic analysis of triticale production is limited.

This research aimed to carry out costs and profitability analysis for triticale production located in Corum province. Besides, technical information such as foliar fertiliser, nitrogen and phosphorus applications, and soil and leaf analysis applications were interpreted for triticale producers according to farms groups.

MATERIALS AND METHODS

The research's primary material consisted of original data obtained by a face-to-face questionnaire applied to farmers involved in triticale production farms at Sungurlu district of Corum province. In the 2019 production year, Corum province has 26.47% triticale production area and 26.78% triticale production of Turkey [17].

Besides, the data obtained from similar research studies conducted by the relevant persons and institutions were also used. Survey data included the 2019 production period. The research area was given in Figure 1.
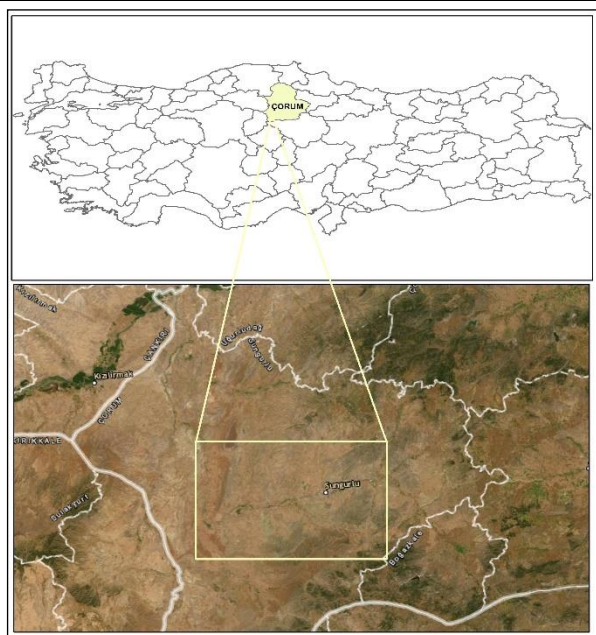
Fig. 1. Location map of the study areas
Source: Own calculation.

The sample size in the research was determined using the Neyman Method. The number of farms to be interviewed was calculated with the formula given below [18].

$$n = \frac{(\sum N_h S_h)^2}{N^2 D^2 + \sum N_h S_h^2}$$

where:
n- Sample size,
N- Total number of units in the population,
N_h- Number of units in group h,
S_h- Standard deviation of group h,
S_h^2- Variance of group h,
D^2- d^2/z^2,
d^2- Allowed error from population average,
z^2- Value of the allowed safety limit in the distribution table.

The farms' triticale land size was different, divided into different groups to ensure homogeneity. According, the farms were classified three groups as group 1 (15 decares and less; 18 farms), group 2 (15.01-25.00 decares; 16 farms) and group 3 (>25.01 decares; 19 farms). The average triticale area of the farms in the groups was determined as 13.06 decares for I group farms, 21.25 decares for II group farms, 45.79 decares for III group farms and 27.26 decares for all farms.

Profitability indicators were calculated to determine the success level of farms producing triticale. The triticale production quantity was multiplied by the sales price, and the production value was calculated. The gross profit was calculated by subtracting the total variable cost from the triticale production value in the studied farms. Net profit was calculated by subtracting total production costs from the triticale production value. Relative profit was calculated by dividing triticale production value by production costs [1] [6].

Fertilisation cost, machine rental cost, seed cost, labour cost, pesticide cost, other variable costs and working capital interest within the content of variable costs. The working capital interest was calculated by taking half of the interest rate applied by Ziraat Bank (4%) for crop production. Fixed costs were calculated as general administrative expenses (3% of variable costs) and land rent [1] [6]. The exchange rate for 2019 was 1 ($) dollar = 5.67 (TRY) Turkish Lira. One decare of land is equal to 0.1 hectares of area.

RESULTS AND DISCUSSIONS

Table 1 presents some technical information about triticale production. The average of farms applying soil analysis farmers was 72.22% in the I farm group, 68.75% in the II farm group, 68.42% in the III farm group and 69.81% in all farms. The lowest soil analysis application was at the III farm group, and the highest soil analysis application was at the I farm group. The average of farms applying leaf analysis farmers was determined as 22.22% in the I farm group, 25.00% in the II farm group, 26.32% in the III farm group and 24.53% in all farms. The lowest leaf analysis application was at the I farm group, and the highest leaf analysis application was at the III farm group. The average of farms using foliar fertilisers farmers was 55.56% in the I farm group, 68.75% in the II farm group, 47.37% in the III farm group and 56.60% in all farms. The lowest foliar fertilisers use was at the III farm group, and the highest foliar fertilisers use was at the II farm group. The average of farms with non-operating agricultural income

was 77.78% in the I farm group, 75.00% in the II farm group, 57.89% in the III farm group and 69.81% in all farms. The lowest non-operating agricultural income was at the III farm group, and the highest non-operating agricultural income was at the I farm group. The average of farms with non-agricultural income was 72.22% in the I farm group, 62.50% in the II farm group, 63.16% in the III farm group and 66.04% in all farms. The lowest non-agricultural income was at the II farm group, and the highest non-agricultural income was at the I farm group.

The amount of seed use of the farmers was calculated. It was determined that 19.04 kg of seed were used per unit area in the farms. It was determined that as the triticale production areas increased, the amount of using seed increased. Fertiliser usage amounts of the farmers were calculated as 8.92 kg N (nitrogen) and 17.53 kg P (phosphorus) per decare pure substance in triticale production.

Table 1. Technical information about triticale production

Indicators	Farm groups (da)			Farms average
	I	II	III	
Soil analysis (%)	72.22	68.75	68.42	69.81
Leaf analysis (%)	22.22	25.00	26.32	24.53
Foliar fertiliser (%)	55.56	68.75	47.37	56.60
Non-operating agricultural income (%)	77.78	75.00	57.89	69.81
Non-agricultural income (%)	72.22	62.50	63.16	66.04
The seed used amount per decare (kg)	18.88	19.07	19.17	19.04
The N used amount per decare (kg)	8.19	9.60	9.05	8.92
The P used amount per decare (kg)	7.07	7.71	7.82	7.53

Source: Own calculation.

The production costs of farms producing triticale were examined under two separate items as fixed and variable costs. Fixed costs are the costs that exist in the enterprises, whether production is made or not. In other words, this cost item does not depend on the production volume. Variable costs occur when production is made and may vary depending on the volume of production. In other words, this cost item may increase or decrease according to the production volume [12].

Fixed costs of triticale producing farms include land rent and general administrative expenses. The average fixed costs of triticale producing farms were calculated as 3,286.93 TRY. This value varied between 1,607.25 TRY and 5,489.03 TRY in the groups. Land rents cost (3,147.64 TRY) has the highest share among the fixed costs. This was followed by general administration expenses (139.29 TRY).

Table 2. Production costs in farms (TRY/farms)

Production Costs	Farm groups (da)			Farms average
	I	II	III	
Fertilisation cost	658.06	1,034.38	2,190.53	1,321.04
Machine rental cost	601.11	924.38	1,888.16	1,160.09
Seed cost	307.98	505.5	1,095.5	649.93
Labour costs	323.33	481.88	1,061.58	635.85
Pesticide cost	290.28	437.50	905.26	555.19
Other variable costs	98.64	160.54	412.33	229.78
Working capital interest	45.59	70.92	151.21	91.10
Total variable cost (A)	2,324.99	3,615.08	7,704.57	4,642.98
Land rent	1,537.50	2,453.13	5,257.89	3,147.64
General administration expenses	69.75	108.45	231.14	139.29
Total fixed cost (B)	1,607.25	2,561.58	5,489.03	3,286.93
Total production costs (A+B)	3,932.24	6,176.66	13,193.60	7,929.91

Source: Own calculation.

Fertilisers, machinery rents, seedlings, labour costs, pesticides, other variable costs and working capital interest constituted the variable costs elements. The average variable costs of triticale producing farms were calculated as 4,642.98 TRY. This value varied

between 2,324.99 TRY and 7,704.57 TRY in the groups. Fertilisation cost (1,321.04 TRY) has the highest share among the variable costs. This was followed by machine rental cost (1,160.09 TRY), seedling cost (649.93 TRY), labour costs (635.85 TRY), pesticide cost (555.19 TRY), other costs (229.78 TRY) and the interest of working capital (91.10 TRY).

According to the farms' size groups, total production costs were calculated as an average of 7,929.91 TRY. This value was calculated as an average of 3932.24 in the I group, 6,176.66 TRY in the II group, and 13,193.60 TRY in the III group (Table 2).

According to the per decare, total production costs were calculated as an average of 290.85 TRY for all group. This value varied between 288.14 TRY and 301.19 TRY in the groups. The share of fixed costs was 41.45% in total

production. This value was calculated as 40.87% in the I group, 41.47% in the II group and 41.60% in the III group. The most important cost elements among fixed costs were the land rent cost (39.69%) and general administration expenses cost (1.76%). The variable production cost was amounted to be 170.30 TRY per decare for all group. This value varied between 168.26 TRY and 178.08 TRY in the groups. The share of variable costs was 58.55% in total production. This value was calculated as 59.13% in the I group, 58.53% in the II group and 58.40 % in the III group. It was determined that as the triticale production area increased, the share of variable costs in total costs decreased. The most important cost elements among variable costs were the cost of the fertilisation (16.66%), machine rental cost (14.63%) and seedling cost (8.20%) (Table 3).

Table 3. Production costs per unit area in farms

Production Costs	Farm groups (da)			Farms average
	I	II	III	
Cost (TRY per decare)				
Fertilisation cost	50.40	48.68	47.84	48.45
Machine rental cost	46.04	43.50	41.24	42.55
Seed cost	23.59	23.79	23.92	23.84
Labour costs	24.77	22.68	23.18	23.32
Pesticide cost	22.23	20.59	19.77	20.36
Other variable costs	7.56	7.55	9.00	8.43
Working capital interest	3.49	3.34	3.30	3.34
Total variable cost (A)	*178.08*	*170.12*	*168.26*	*170.30*
Land rent	117.77	115.44	114.83	115.45
General administration expenses	5.34	5.10	5.05	5.11
Total fixed cost (B)	*123.11*	*120.54*	*119.88*	*120.56*
Total production costs (A+B)	301.19	290.67	288.14	290.85
The share in the production costs (%)				
Fertilisation cost	16.73	16.75	16.60	16.66
Machine rental cost	15.29	14.97	14.31	14.63
Seed cost	7.83	8.18	8.30	8.20
Labour costs	8.22	7.80	8.05	8.02
Pesticide cost	7.38	7.08	6.86	7.00
Other variable costs	2.51	2.60	3.13	2.90
Working capital interest	1.16	1.15	1.15	1.15
Total variable cost (A)	*59.13*	*58.53*	*58.40*	*58.55*
Land rent	39.10	39.72	39.85	39.69
General administration expenses	1.77	1.76	1.75	1.76
Total fixed cost (B)	*40.87*	*41.47*	*41.60*	*41.45*
Total production costs (A+B)	100.00	100.00	100.00	100.00

Source: Own calculation.

In another study [16] conducted in 2016 in Bursa province, the total variable cost per decare in triticale production was found to be 193.77 TRY (64.08%) and total fixed cost 108.63 TRY (35.92%). They calculated the

total production cost of triticale as 302.40 TRY per decare. According to the study of [12], the total production cost was amounted to be high in our study. This is because of the different working periods.

Some success criteria indicate the success of farms and allow them to make their plans accordingly. The farms' success criteria, such as production costs of farms, gross product value, gross profit, net profit, and relative profit, were compared according to farm groups. The profitability status of triticale production is shown in Table 4.

The triticale's gross production value was calculated by multiplying the triticale yield by per kilogram selling price. This value was calculated as 301.92 TRY in the I group, 300.59 TRY in the II group, 302.17 TRY in the III group and 299.69 TRY per decare average of farms. Triticale farms have income from by-products and agricultural supports. This by-product was sold in bales after the triticale was harvested. The by-product value was calculated as 30.58 TRY on average of farms. This value was 30.49 TRY in the I group, 31.16 TRY in the II group, and 30.37 TRY in the III group.

Table 4. Cost and profitability in triticale production

Production Costs	Farm groups (da)			Farms average
	I	II	III	
1. Triticale GPV (TRY/da) *(9x11)*	301.92	300.59	302.17	299.69
2. By-products value (TRY/da)	30.49	31.16	30.37	30.58
3. Agricultural support (TRY/da)	29.02	27.35	24.94	26.17
4. Total GPV (TRY/da) *(1+2+3)*	361.44	359.10	357.48	356.44
5. Variable cost (TRY/da)	178.52	170.54	168.67	170.71
6. Gross profit (TRY/da) *(4-5)*	182.91	188.56	188.81	185.73
7. Total production costs (TRY/da)	301.64	291.09	288.56	291.28
8. Net profit (TRY/da) *(4-7)*	59.79	68.00	68.92	65.16
9. Yield (kg/da)	348.89	347.81	340.53	345.57
10. Per kilogram cost (TRY) *(7/9)*	0.86	0.84	0.85	0.84
11. Per kilogram selling price (TRY)	0.86	0.87	0.89	0.87
12. Per kilogram net profit (TRY) *(11-10)*	0.00	0.03	0.04	0.03
13. Relative profit *(4/7)*	1.20	1.23	1.24	1.22

Source: Own calculation.

Agricultural products should be supported for the sustainability of agricultural production and to increase the production per unit area [5]. In this context, triticale farms benefited from diesel-fertiliser support of 27 TL per decare, which were determined by the state [10].

Agricultural supports value was calculated as 26.17 TRY per decare average of farms. This value was 29.02 TRY in the I group, 27.35 TRY in the II group, and 24.94 TRY in the III group. It was determined that as the triticale production areas increased, the rate of benefiting from agricultural supports increased. The total triticale gross production value was calculated by adding the by-product value and agricultural support value to the gross production value and amounted to be 356.44 TRY per decare average of farms. This value was calculated as 361.44 TRY in the I group, 359.10 TRY in the II group, and 357.48 TRY in the III group. It was determined as the triticale production area was increased, the total production value per decare decreased. The gross production value, by-product value, agricultural support value, gross profit, net profit, relative profit, kilogram cost and profit margin per kilogram were calculated to reveal the farms' cost and profitability. The gross profit calculated by subtracting the variable costs from the triticale production value was calculated as 185.73 TRY per decare average of farms. This value was calculated as 182.91 TRY in the I group, 188.56 TRY in the II group, and 188.81 TRY in the III group. Net profit was calculated by subtracting the total costs from the triticale production value. The farms' average net profit per decare was amount to be 65.16 TRY. This value was calculated as 59.79 TRY in the I group, 68.00 TRY in the II group, and 68.92 TRY in the III group. It was determined that as the triticale production areas increase, the net profit also increases. The average net profit per decare of the group I of farms was low. Because the sales price of triticale per decare of farms in the first group was low, and the total costs per decare were high.

The kilogram cost of triticale was calculated by dividing the production costs by the yield. Accordingly, the average kilogram cost of the farms was calculated as 0.84 TRY. This value was 0.86 TRY per kilogram in the I group, 0.84 TRY per kilogram in the II group, and 0.85 TRY per kilogram in the III group. Kilogram sales prices were calculated as 0.87 TRY on average of farms. This value was 0.86 TRY per kilogram in the I group, 0.87 TRY per kilogram in the II group, and 0.89 TRY per kilogram in the III group. It was determined that as the triticale production areas increase, the kilogram sales prices also increase. The relative profit was calculated by dividing triticale production value by production costs, and calculated as 1.22 per decare average of farms. This value was calculated as 1.20 in the I group, 1.23 in the II group, and 1.24 in the III group. Relative profit value refers to the production value of 1.22 unit in return for 1.00 unit expenditure for triticale production. It was determined that as the triticale production areas increase, the relative profit value also increase. Besides, relative profit calculated, excluding agricultural support value, was calculated as 1.13 per decare average of farms. This value was calculated as 1.10 in the I group, 1.14 in the II group, and 1.15 in the III group. It was determined that the relative profit calculated without the agricultural support decreased by 7.06%, and therefore agricultural support was significant for triticale producers.

Figure 2 presents relative profit values according to farms sizes. It was determined that the relative profit values vary according to the size of the triticale production areas. Relative profit values vary between 1.10 units and 1.35 units according to the size of the farms. Although the relative profit values followed a fluctuating course, it was determined that they showed an increasing trend. The triticale production areas of the farms vary between 8 decares and 200 decares. It was determined that the production costs were high, and the sales price to triticale was low in farms with low relative profit value.
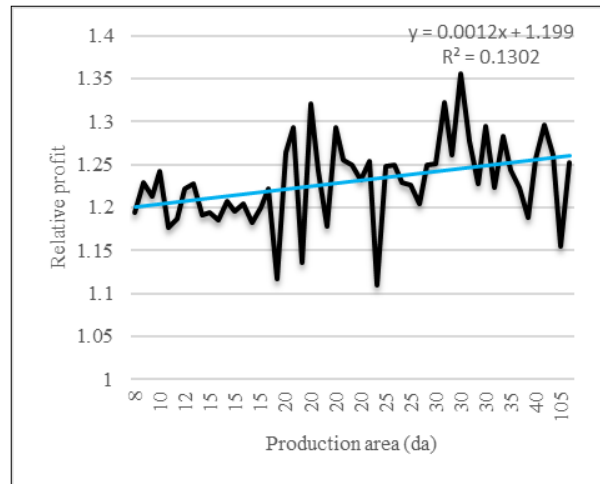

Fig. 2. Relative profit values according to triticale production areas
Source: Own calculation.

CONCLUSIONS

This study was conducted in Corum, which was important in Turkey triticale production. Production costs of triticale, which was economically significant in the research area, was calculated. The data were obtained through face-to-face interviews with farmers through a questionnaire. It was determined that the farms' total production costs, 58.55% were variable, and 41.45% were fixed costs. Of the variable costs, 16.66% was fertiliser costs, 14.63% was machinery rental costs, 8.20% was seed costs, 8.02% was labour costs, 7.00% was pesticide costs, 2.90% other variable costs, and 1.15% was working capital interest expense. Of the fixed costs, 39.69% was land rent costs, and 1.79% was general administration expenses. It was determined that as the farms' size increases in the farms' groups, the variable costs per decare decrease, and the fixed costs increase. Besides, it was determined that as the farms' size increased, gross profit, net profit and relative profit increased. It was calculated that the farms earned of the total triticale gross production value 8.58% from by-product income and 7.34% from agricultural support income.

By-product income and agricultural support income are important for triticale producers. It is thought that if agricultural supports are increased, triticale production will improve, and farmers will gain more income.

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