

ANALYSIS OF PERFORMANCE CHARACTERISTICS OF BROILER FARMS IN TÜRKİYE USING MULTIDIMENSIONAL SCALING (MDS) METHODS

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Abstract

Poultry farming is an important sector in terms of meeting the need for animal protein for human health, realizing production in a short time and converting feed into meat in the best way. In this study, it was aimed to analyze the performance characteristics of broiler farms in Turkey. The main material of the study consists of data obtained from face-to-face interviews with 139 producers for the production period of 2022. Multidimensional Scaling (MDS) analysis was used to determine the similarities and differences between farms in terms of performance characteristics. The following variables were used in the analysis: duration of training, experience in broiler rearing, production period, mortality rate, chick entry weight, live weight, number of veterinary visits and feed intake per chick. The farms were divided into three groups according to their capacities and analyzed. According to the results of the research, it was determined that the similarities and differences changed as the size of the farms changed. Since there is a close relationship between education level and breeding experience and live weight of broiler chickens, it is thought that extension activities should be increased for producers on broiler breeding. In addition, a heterogeneous structure emerged due to the difference between the chick weights given by the companies among the farm size groups. For this reason, it is thought that producers should form an agricultural organization that will enable them to be strong in the face of the companies they contract with.

Key words: Broilers, performance characteristics, Multidimensional analysis, Türkiye

INTRODUCTION

It is important for producers and consumers to increase the production of broiler meat due to its high nutritional value, the best use of a small area, fast production process, efficient feed use and low-cost advantages [2].

Broiler production is also increasing in the world thanks to the increasing population, changing consumer preferences and technological developments in production [12].

As of 2022, there are 26 billion chickens in the world, while Turkey ranks 11th in the world with a share of 1.4% and 361 million chickens. Chicken meat production, which has an important share in the white meat group, has entered a continuous and rapid increasing trend in the world since 1960, and chicken meat production was realized as 124 million tons in 2022. In the same period,

Turkey ranked 9th in the world with 2.42 million tons of chicken meat production [10].

In Turkey, the production activity of the sector started in the 1970s, mostly in the form of small family farming, and with the structural changes in the 1980s, the integration process was started and contracted production was started. In addition, the implementation of the "Resource Utilization Support Fund", which entered into force in 1986, pioneered large-scale investments. In the 1990s, the number of modern facilities and production capacity increased rapidly with new investments in the sector [6, 16].

In the 2000s, investments continued and production at European standards became widespread. Today, the poultry sector is an important production branch that can make its own production planning and meet a large part of the country's animal protein requirement. With its current technological infrastructure, the sector produces at European

Union (EU) standards and is in a position to compete. In Turkey, poultry farming has a distinct and important place among other animal production industries because it provides cheap, healthy and high-quality animal protein, facilitates R&D studies in breeding and nutrition, and contributes to rural development. The sector also contributes to the development of feed industry, production of tools and equipment such as cages, drinkers and feeders, vaccine and pharmaceutical industry and food industry [21].

There are many studies in the literature (Yeni [26], Tandogan [22], İkikat Tümer et al. [12], Cimrin [5], Yeni and Dagdemir [27], Karaman et al. [15], Sarica [20]) in which the current situation and problems of broiler farms are revealed. However, the use of the MDS analysis method in animal husbandry is limited and there are no studies based on original data in broiler breeding.

Dogan [8] analyzed the growth traits of lambs belonging to two breeds raised in Eastern and Central Anatolia Region according to birth type and sex variables by MDS. Celik [4] analyzed the similarities and differences of livestock breeding in 81 provinces with MDS based on the number of animals by species. Gevrekci et al. [11] analyzed the structural characteristics of sheep breeding in 11 provinces in the Western Anatolia Region with MDS analysis according to seven variables. Mastrangelo [17] tried to reveal similar and different aspects of endangered sheep breeds with MDS analysis. Adanacioglu [1] made a comparison of the goat breeding economy in Turkey according to regions with MDS according to five different variables. Kandemir et al. [14] revealed the similarities and differences of some regions in Turkey in terms of live sheep and mutton prices with MDS analysis. Fabbri [9] made a clear distinction between breeds with clusters related to production purposes with population structure and genetic differences, principal components and multidimensional scaling analyses.

Deri et al. [7] in their MDS analysis of the situation of animal husbandry in rural Izmir province according to four variables;

similarities and differences were revealed in the neighborhoods in rural Bornova, and neighborhoods with advantages in terms of animal husbandry were determined.

The performance status of broiler farms in Türkiye was evaluated by MDS analysis according to eight variables (training period, broiler experience, production period, mortality rate, chick entry weight, live weight, number of veterinary examinations and feed consumption per chicken). In this study, it is aimed to reveal the similarities and differences in the performance characteristics of farms according to farms size groups. Similarities and differences according to the variables at hand were examined by visualizing them on a coordinate plane with MDS analysis.

MATERIALS AND METHODS

Materials

According to TSI [24] data, the regions selected as the research area account for 57.12% of Türkiye's total meat chicken presence. It can therefore be said that the research area has the qualifications to represent the farms that are engaged in meat chicken farming in Türkiye.

The Neyman Method is a layered sampling method used to determine the number of samples to be applied to the survey [25]. The number of samples is calculated using equation number 1.

$$n = \frac{(\sum Nh Sh)^2}{N^2 D^2 + \sum Nh Sh^2} \dots\dots\dots (1)$$

In the formula: n: sample size, N: population size, Nh: h. The number of units in the layer, Sh: h. The standard deviation of the layer Sh^2 : h. shows the variance of the layer, D: $d / z d$: the amount of error permitted from the main mass average, (%5 deviation from the average) z : the value of the permitted safety limit in the distribution table (%2.58 for the 99% confidence limit).

The number of samples to represent the main audience using equation 1 has been calculated as 139. Farms to be surveyed were randomly selected. Since the number of meat chickens

own vary, it has been decided that to bring the population to a homogeneous state, meat poultry should be examined in layers. The farms that are engaged in chicken breeding are divided into three layers according to the distribution of frequency, taking into account the number of chickens. Equation 2 was used in the distribution of operations to layers [25].

$$n_h = \frac{N_h S_h}{\sum N_h S_h} * n \dots\dots\dots(2)$$

In the formula; n_h : represents the number of specimens selected for each layer, n : the total number of samples.

According to equation 2, farms with 0-15,000 chickens (37 farms) are classified as group I, farms having 15,001-30,000 chicks (65 farms), group II, 30,001 and more chicks (36 farms) as group III.

Methods

Multidimensional Dimensional Scaling (MDS) is included in classification and grouping analyses [23;18] MDS n is a method that aims to obtain the representation of objects in a k-dimensional ($k < p$) space based on the distances determined by the p variable between individual objects (individual-observation) or units, thereby determining the relationships between objects. The general objective of MDS analysis is to reveal the structure of objects as close to their original shape, using distance values, with as few dimensions as possible [19; 26]. In MDS, the stress value is calculated to indicate the difference between a multi-dimensional (p-dimension) real shape and a shape cut in k-dimensional space. So, the measure that measures the compatibility between the original distances and the display distances is called a stress measure. The stress value for non-metric scaling is as below. It is desirable that the stress value should be close to zero [13; 23].

Considering the performance characteristics of the broiler breeding farms, MDS analysis was applied separately in each group and explained with a graphical representation. Euclidean distance was used for similarity/distance calculations during MDS analysis. Z-value conversion method was used

to standardize the data. Stress values were also interpreted to examine the fit after MDS analysis (Table 1).

Table 1. Stress values and compatibility

Stress value	Compatibility
>0.2	Incompatible notation
$0.1 < \text{stress value} < 0.2$	Low compliance
$0.05 < \text{stress value} < 0.1$	Good compliance
$0.025 < \text{stress value} < 0.05$	Perfect compliance
$0.000 < \text{stress value} < 0.025$	Exact compliance

Source: Borg and Groenen (2005) [3].

RESULTS AND DISCUSSIONS

General Information on Broiler Farms in Türkiye

The average age of poultry farmers was 47.87 years, and the average age for small farmers in group 1 (48.18) was relatively higher than for other farms groups.

The educational levels of farmers in poultry farming were estimated at an average of 8.31 years, and the educational level was higher for those in group 3 (10.28). On average, farmers had 21.33 years of experience in agriculture, and farms in group 3 (22.86) had higher experience in farming than other farm groups. The average broiler breeding experience of the producers was determined to be 16.63 years. When analyzed according to the farming groups, it was determined that the broiler breeding experience decreased as the farming group increased.

The average mortality rate of the farms throughout the year was found to be 4.40%. No significant difference was observed between farm size groups. Accordingly, the average mortality rate of the farms in the first group was calculated at 4.20%, in the second group at 4.67%, and in the third group at 4.29%.

According to the farm groups, chick entry weights were between 40.46 g and 40.64 g, and the general average was 40.51 g.

When producers looked at the population of households, they found an average of 3.31 people, and the group of with the highest household population was found to be in Group 3 (3.75).

When looking at receiving meat chicken training, it was found that 51.08% of farmers received training from the Ministry of Agriculture and Forestry or from the integrated facilities to which they are affiliated. Again, farms in Group 3 (66.67)

have a higher percentage than other farms groups. It has been determined that all undertakings have a record of their production activities as they are subject to contractual production (Table 2).

Table 2. General information about broiler producers and farms in Türkiye

	Farm groups			Average
	I. Group	II. Group	III. Group	
Age (years)	48.18	47.83	47.61	47.94
Education (years)	7.53	8.51	10.28	8.31
Agricultural experience (year)	21.68	20.75	22.86	21.33
Broiler experience (year)	17.45	16.22	15.62	16.63
Production time (day/period)	42.79	42.49	42.78	42.63
Mortality rate (%)	4.20	4.67	4.29	4.40
Chick weight (gr/chick)	40.46	40.52	40.64	40.51
Live weight (kg/broiler)	2.65	2.58	2.60	2.61
Number of meetings with the veterinarian	18.36	24.60	31.94	21.48
Feed consumption (kg/broiler)	4.40	4.19	4.18	4.27
Family population (person/family)	3.24	3.11	3.75	3.22
Receiving education (%)	50.00	43.08	66.67	51.08
Record keeping (%)	100.00	100.00	100.00	100.00
Non broiler farm (%)	26.32	36.92	58.33	39.57

Source: Own calculation.

Table 3 is considered, a negative correlation coefficient of 0.504 was calculated between the level of education of the producers and their experience in broiler breeding, and it is seen that while one of the characteristics increases, the other decreases. This is due to the fact that people with higher education

level start broiler farming at an older age and have less experience.

The degree of this decrease is also statistically significant ($p < 0.01$). There was a positive correlation between the number of meetings with the veterinarian during the one-year production period and the level of education.

Table 3. Correlation coefficients of variables

Pearson correlation	Education (year)	Experience (year)	Production time (day/period)	Mortality rate (%)	Chick weight (gr/chick)	Live weight (gr/broiler)	Number of meetings with the veterinarian	Feed consumption (kg/broiler)
Education (year)	1	-0.504**	-0.095	0.119	-0.014	0.035	0.231**	-0.102
Experience (year)	-0.504**	1	0.107	-0.019	0.005	-0.043	-0.014	-0.017
Production time (day/period)	-0.095	0.107	1	-0.034	0.214*	0.312**	-0.016	0.107
Mortality rate (%)	0.119	-0.019	-0.034	1	0.182	-0.191*	0.003	-0.182*
Chick weight (gr/chick)	-0.014	0.005	0.214	0.182	1	0.062	0.041	0.022
Live weight (kg/broiler)	0.035	-0.043	0.312**	-0.191*	0.062	1	-0.005	0.686**
Number of meetings with the veterinarian	0.231**	-0.014	-0.016	0.003	0.041	-0.005	1	-0.310
Feed consumption (kg/broiler)	-0.102	-0.017	0.107	-0.182*	0.022	0.686**	-0.310	1

** : $p < 0.01$, * : $p < 0.05$

Source: Own calculation.

The correlation coefficient of the relationship was calculated as 0.231 and it was determined that when one of the characteristics increased, the other also increased. There has been a statistically significant increase in this amount ($p < 0.05$). The live weight of a chicken that was ready for sale and the amount of time it took to produce it were found to have a positive linear connection. The relationship's correlation coefficient was 0.312, which was statistically significant ($p < 0.01$). The correlation coefficients of the association between the mortality rate, live weight, and feed consumption were found to be 0.191 and 0.182, respectively, and were statistically significant ($p < 0.05$). The relationship was found to be negative. Additionally, feed consumption and live weight features showed a positive linear association, with a degree of 0.686 and statistical significance ($p < 0.01$) discovered in the relationship.

Analysis of Performance Characteristics of Broiler Farms in Turkey by Multidimensional Scaling Method

When the coordinate values in Table 4 obtained as a result of the MDS analysis in terms of the traits in the broiler holdings in Group 1 and Figure 1, which shows the two-dimensional graph, it is seen that mortality rate, chick entry weight and live weight, education level and feed consumption traits are close to each other in terms of dimension 1. These first two traits (chick entry weight and mortality rate) were more distant from the other three traits (live weight, education level and feed consumption).

Table 4. Coordinates of 1st group broiler farms calculated in terms of characteristics

Characteristics	Dimension 1	Dimension 2
Education (year)	0.477	0.065
Experience (year)	-0.306	-0.477
Production time (day/period)	-0.592	0.526
Mortality rate (%)	-0.590	-0.150
Chick weight (gr/chick)	-0.678	0.152
Live weight (kg/broiler)	0.700	0.318
Number of meetings with the veterinarian	0.233	-0.488
Feed consumption (kg/broiler)	0.756	0.053

Source: Own results.

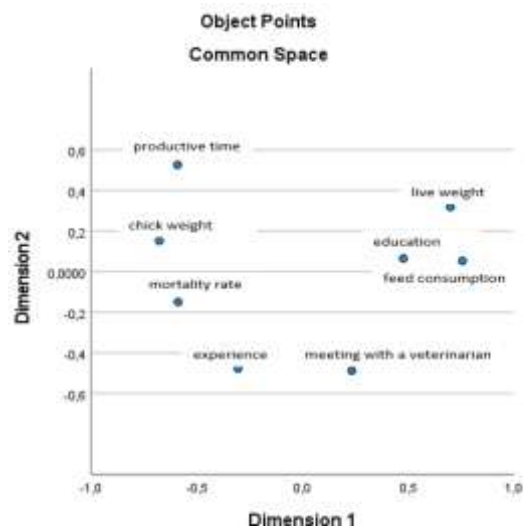


Fig. 1. Coordinates of 1st group broiler farms calculated in terms of traits
 Source: Own results.

In terms of Dimension 2, the characteristics of production period and the characteristics of broiler farming experience and number of meetings with the veterinarian can be interpreted as distant from each other.

It was found that the mortality rate, live weight, and feed consumption characteristics were further apart in terms of dimension 1 when Table 5 and Figure 2, which include the coordinate values obtained as a result of the MDS analysis in terms of the characteristics of the broiler farms in the second group, were examined. It was determined that the production period and the number of consultations with the veterinarian were closer to each other. In terms of dimension 2, it is seen that the two most distant traits are feed consumption and education.

Table 5. Coordinates of 2nd group broiler farms calculated in terms of characteristics

Characteristics	Dimension 1	Dimension 2
Education (year)	0.675	-0.648
Experience (year)	-0.438	0.371
Production time (day/period)	-0.121	0.059
Mortality rate (%)	-0.873	-0.107
Chick weight (gr/chick)	-0.175	-0.519
Live weight (kg/broiler)	0.674	0.177
Number of meetings with the veterinarian	-0.205	0.006
Feed consumption (kg/broiler)	0.462	0.660

Source: Own results.

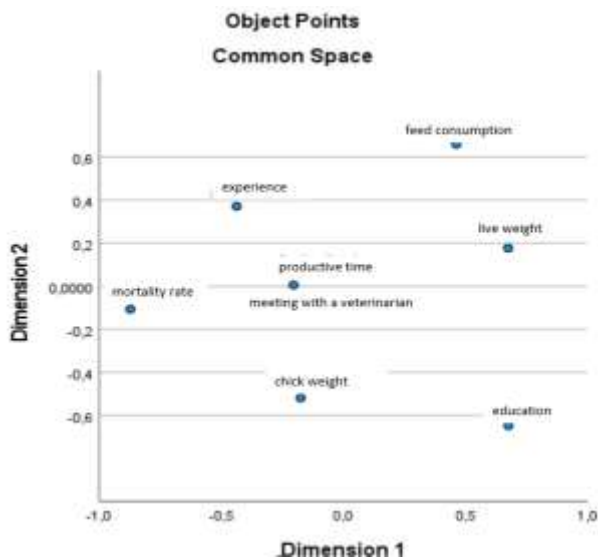


Fig. 2. Coordinates of 2nd group broiler farms calculated in terms of traits
 Source: Own results.

When Figure 3 and Table 6, which include the two-dimensional graphs obtained as a result of the MDS analysis in terms of the characteristics of the broiler farms in Group 3, it was found that in terms of dimension 1, the characteristics of broiler experience and production time, live weight and feed consumption, and live weight and breeding experience were close to each other. It was determined that the number of meetings with the veterinarian and chick entry weight characteristics were farther away from the other characteristics.

Table 6. Coordinates of 3 rd group broiler farms calculated in terms of Characteristics

Characteristics	Dimension 1	Dimension 2
Education (year)	0.677	0.569
Experience (year)	-0.455	-0.212
Production time (day/period)	-0.276	-0.441
Mortality rate (%)	0.101	0.451
Chick weight (gr/chick)	0.664	-0.203
Live weight (kg/broiler)	-0.679	0.052
Number of meetings with the veterinarian	0.542	-0.541
Feed consumption (kg/broiler)	-0.574	0.324

Source: Own results.

In terms of Dimension 2, education level and number of meetings with the veterinarian were found to be far from each other. The

reason for this is that the producers in this group have higher education levels and they employ veterinarians or veterinary technicians in their farms, so if they encounter any problems, they can solve the problems themselves without consulting the veterinarians of the contracted farms.

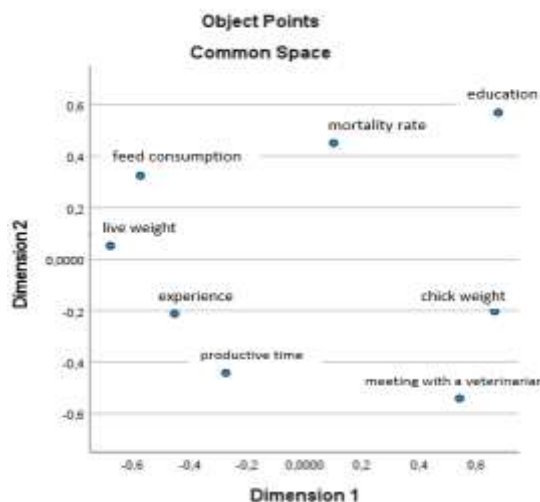


Fig. 3. Coordinates of 3rd group broiler farms calculated in terms of traits
 Source: Own results.

CONCLUSIONS

It was determined that the average age of the farmers engaged in broiler breeding activities in Türkiye was 48 years, their education level was 8.31 years, and their broiler breeding experience was 16.63 years. The average mortality rate of the farms throughout the year was found to be 4.40%. According to the average of all farms, the average live weight of broiler chick entry weight was 40.51 g and the average live weight of broiler chick ready for sale was 2.61 kg. It was found that farmers and veterinarians met an average of 22 times a year to discuss matters pertaining to broiler breeding. It was found that the broiler chicks consumed 4.27 kg of feed on average.

It was determined that all the farms kept records because of contracted production, but approximately half of them (51.08%) received training on broiler breeding.

In group 1 broiler breeding farms, mortality rate, chick entry weight and live weight, education level and feed consumption are close to each other in terms of dimension 1. These first two traits (chick entry weight and

mortality rate) are more distant than the other three traits (live weight, education level and feed consumption). In terms of dimension 2, the characteristics of production period, broiler breeding experience and number of meetings with veterinarians were found to be distant from each other. In group 2, according to the results of MDS analysis in terms of the characteristics of broiler farms, it was determined that mortality rate, live weight and feed consumption characteristics were more distant from each other in terms of dimension 1. Production time and number of veterinary consultations were found to be closer to each other. In terms of dimension 2, it was seen that the two most distant characteristics were feed consumption and education, while education level and live weight characteristics were very close to each other. In the 3rd group, broiler experience and production period, live weight and feed consumption, live weight and breeding experience were found to be close to each other in terms of size 1. It was found that the chick entry weight and the number of veterinarian meetings were more disassociated from the other characteristics. The number of meetings with veterinarians and education level were shown to be dissimilar in Dimension 2.

As a result of this study, it was determined that similarities and differences in terms of characteristics changed as the size of the farms changed.

As expected, live weight and feed consumption were found to be close to each other in all 3 farming groups. In the 1st and 2nd group farmers, the level of education and live weight characteristics were found to be close, while in the 3rd group farms, the experience of the producers in broiler breeding and live weight characteristics were found to be close. Accordingly, it is thought that studies should be carried out to increase the extension activities related to broiler breeding to producers.

It was determined that the mortality rates and live weight characteristics of the chicks obtained from the contracted companies from which the farms procured chicks differed due to the inhomogeneity in terms of entry weights. When these results are evaluated, it

is thought that an effective and strong agricultural organization should be established to defend their rights in order to act more fairly between contracted firms and farmers.

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