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Regional and socioeconomic profile-level differentiation among cattle farms in Türkiye

Diferenciación regional y según perfiles socioeconómicos entre las explotaciones bovinas de Türkiye

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ABSTRACT

This study examined the demographic, activity, financing, and economic-perception characteristics of cattle producers in different geographical regions of Türkiye and considered together regional differences and producer profiles that recur across regions. Data were obtained from a survey of 512 producers in 12 major cattle-producing provinces in 2023 and were analyzed using regional comparisons and MCA-Ward analysis. Regional differences were more pronounced for the input cycle, credit use, activity type, participation in TARSİM, and payment method, whereas perceived profitability and ability to cope with costs appeared to be more closely associated with producers' socioeconomic and economic-perception profiles. Four producer profiles were identified: high perceived cost pressure combined with low insurance and credit participation; a young, educated, and diversified activity structure; relatively favorable economic perceptions; and unfavorable perceptions of sales prices and profitability despite high use of financial instruments. The presence of all four profiles in different regions indicates that geographical location alone does not account for the heterogeneity among farms. The findings suggest that regional policy and advisory measures may be more effectively targeted when differentiated according to producers' education, financing, insurance participation, and economic perceptions.

Key words: Cattle farming; regional differences; socioeconomic profile; multiple correspondence analysis; economic perception

RESUMEN

Este estudio examinó las características demográficas, productivas, financieras y relacionadas con las percepciones económicas de los productores de ganado bovino en diferentes regiones geográficas de Turquía, y evaluó conjuntamente las diferencias regionales y los perfiles de productores que se repiten entre regiones. Los datos se obtuvieron mediante una encuesta aplicada en 2023 a 512 productores de 12 provincias con producción bovina intensiva y se analizaron mediante comparaciones regionales, análisis de correspondencias múltiples y agrupamiento de Ward. Las diferencias regionales fueron más pronunciadas en el ciclo de suministro de insumos, el uso de crédito, el tipo de actividad, la participación en TARSİM y la modalidad de pago. En cambio, la rentabilidad percibida y la capacidad para afrontar los costos estuvieron más estrechamente relacionadas con los perfiles socioeconómicos y de percepción económica de los productores. Se identificaron cuatro perfiles: elevada presión percibida de los costos combinada con una baja participación en seguros y créditos; productores jóvenes y con mayor nivel educativo que desarrollaban actividades diversificadas; percepciones económicas relativamente favorables; y percepciones desfavorables sobre los precios de venta y la rentabilidad, pese al elevado uso de instrumentos financieros. La presencia de los cuatro perfiles en diferentes regiones indica que la ubicación geográfica por sí sola no explica la heterogeneidad existente entre las explotaciones. Los resultados sugieren que las políticas regionales y los servicios de asesoramiento podrían orientarse de manera más eficaz si se diferenciaran según el nivel educativo, el comportamiento financiero, la participación en seguros y las percepciones económicas de los productores.

Palabras clave: Ganadería bovina; diferencias regionales; perfil socioeconómico; percepción económica; análisis de correspondencias múltiples

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INTRODUCTION

Livestock production is a central component of Türkiye's economy because it contributes to food supply, rural employment, income generation, and the provision of raw materials to agro-industries [1, 2]. Within this sector, cattle farming is a principal source of milk and red meat. Nevertheless, high input costs, price uncertainty, scale-related constraints, limited use of technology, and differences in farm management make it difficult to translate production capacity into economic outcomes [2, 3, 4, 5, 6]. These constraints do not affect all farms in the same way; producers' age and education, activity mix, access to finance, insurance participation, and perceptions of market conditions may combine to produce different adaptation behaviors.

Research on cattle farms in Türkiye has predominantly been conducted within a single province or region, with producer characteristics, farm structure, production economics, and marketing problems generally examined through separate indicators [4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16].

These studies have established a substantial body of knowledge on the socioeconomic and structural characteristics of cattle farms in Türkiye. However, the geographical distribution of farm characteristics and the multivariable patterns formed by these characteristics have rarely been evaluated within the same analytical framework. Regional analyses describe distributions across geographical areas, whereas profile-based analyses examine how different characteristics co-occur among farms. Combining these two approaches may provide a more comprehensive assessment of heterogeneity among farms.

Farm typologies summarize joint patterns formed by numerous structural, managerial, and socioeconomic indicators, thereby enabling the identification of distinct farm groups and the development of advisory and policy options tailored to them.

For categorical data, multiple correspondence analysis (MCA) represents response categories in a common lower-dimensional space, and cluster analysis of farm coordinates in that space groups farms with similar combinations of characteristics. Blanco-Penedo *et al.* [17] applied this approach to organic dairy farms in four European countries, whereas Rangel *et al.* [18] used it for small dual-purpose cattle farms in Mexico. These studies demonstrate that heterogeneity among farms can be examined through multivariable profiles rather than by assuming a single average farm.

This study aimed to examine the demographic, activity, financing, and economic-perception characteristics of cattle producers in different geographical regions of Türkiye and to evaluate jointly the regional differentiation of these characteristics and the socioeconomic and economic-perception profiles that recur across regions. Regional and profile-based approaches were therefore treated as two complementary levels for assessing differences among farms.

MATERIALS AND METHODS

Study design and sampling

This cross-sectional field study was conducted in 2023 in the Mediterranean, Aegean, Marmara, Central Anatolia, Black Sea, Eastern Anatolia, and Southeastern Anatolia regions. Provinces were purposively selected to cover all seven regions and to include major cattle-production centers within each region. The sample comprised the owners or managers of 512 cattle farms located in Adana (n=41), Amasya (n=23), Ankara (n=39), Balıkesir (n=42), Diyarbakır (n=41), Erzurum (n=53), İzmir (n=48), Kırklareli (n=35), Konya (n=80), Samsun (n=29), Şanlıurfa (n=40), and Van (n=41). This selection provided analytical coverage for comparing different production ecologies and input-supply and market environments. One owner or manager was interviewed per farm; therefore, respondent- and farm-level counts were identical.

Fieldwork in each province was directed toward districts with substantial cattle production.Lists obtained from Provincial Directorates of Agriculture and Forestry, breeders' associations, TARSİM loss adjusters, and local veterinary clinics were combined to form an accessible district-level sampling frame, from which farms were randomly selected. Farms that could not be contacted or declined participation were replaced through a new random selection from the same district frame. Because the provinces and districts with substantial cattle production were selected purposively, whereas farms were randomly selected within the constructed frame, the design constituted multistage mixed sampling. This structure enabled regional comparison of the principal production, input-supply, and market conditions across the seven geographical regions.

All interviews were completed during the 2023 calendar year, and the findings were interpreted as a cross-sectional view of socioeconomic characteristics and economic perceptions during that period. Age, education, and activity mix represent more slowly changing characteristics, whereas the economic-perception items reflect assessments under the market conditions prevailing in 2023.

Data-collection instrument and variables

The structured questionnaire was developed on the basis of national and international literature, sector reports, and the opinions of experts in Veterinary Medicine and Biostatistics. A pilot study involving 30 farms that were not included in the main sample assessed the clarity of the wording, interview duration, category structure, and operation of the web-based data-entry system. The final data was collected through face-to-face interviews with the farm owner or manager and recorded in a web-based form containing mandatory fields and logical-consistency checks.

Economic-perception items were administered using 7-point Likert-type responses. To reduce sparse categories and retain interpretable MCA profiles, responses were converted, according to a prespecified rule, into three categories: scores of 1–3 were classified as insufficient, 4 as undecided, and 5–7 as adequate. These items were not subdimensions of a single psychometric scale; instead, they represented separate assessments of profitability, the input cycle, support, sales prices, market dynamism, and the

ability to cope with costs. The 12 active variables in the main MCA model and their overall distributions are presented in TABLE I.

Statistical analysis

Categorical variables were summarized using frequencies and percentages. Associations between region and mutually exclusive responses were evaluated using Pearson's chi-square test and Cramér's V. For contingency tables in which more than 20% of expected cell counts were below 5 or any expected count was below 1, P values were estimated using 100,000 fixed-margin Monte Carlo samples. The Benjamini-Hochberg false discovery rate adjustment was applied across the 12 regional comparisons. Because the number of categories varied among tables, V values were not assigned to fixed qualitative classes but were interpreted using their exact values and the study context [19].

The MCA included 12 active variables: age, education, activity type, TARSİM insurance, payment method, credit use, and six economic or market-perception variables. There were no observations missing for the active variables. Region and the butcher, livestock trader, acquaintance, and livestock-market indicators were supplementary variables that did not contribute to cluster formation. The cooperative channel was reported by only seven farms, and animal-sourcing region showed no discriminating variation in the analytical dataset; these variables were therefore not included in the profile model. Following the generalized Benzécri correction, the first three MCA dimensions, which together explained at least 80% of the cumulative corrected inertia, were retained.

Agglomerative hierarchical clustering was applied to the retained farm coordinates using Euclidean distance and Ward's minimum-variance criterion. The MCA and Ward clustering procedures were implemented following established multivariate typology and cluster-analysis frameworks [20, 21, 22]. Candidate solutions from k=2 to k=10 were compared by jointly considering the fusion structure in the dendrogram, principal internal-separation metrics, resampling stability, and the requirement that every cluster contain at least 20 farms and 5% of the sample. The midpoint of the fusion interval that yielded four clusters (5.064–7.249), corresponding to 6.157, was displayed as the dendrogram cut height. Clusters were described using within-cluster percentages and adjusted standardized residuals (ASRs) greater than +1.96. Because the active variables were used to construct the clusters, these residuals were interpreted as profile markers rather than confirmatory tests.

A leave-one-variable-out analysis was used to compare regional and profile-level associations while avoiding circularity. Each of the 12 active variables was removed in turn from the MCA and clustering procedure, and four profiles were reconstructed from the remaining 11 variables using the same Benzécri dimension-selection rule and Ward method. The association of the omitted variable with geographical region was defined as region V, its association with the newly derived profile membership as profile V, and their difference as ΔV=region V-profile V. A positive ΔV indicated a higher region V, whereas a negative ΔV indicated a higher profile V; no fixed threshold was applied to the difference. Cramér's V values were compared descriptively, and the observed differences were not used to infer the superiority of either level.

The association between region and the main four-profile solution was examined using the chi-square test and Cramér's V, whereas marketing channels were examined in separate 2x4 tables. Data management and analyses were conducted using IBM SPSS Statistics 25.0 and Python.

Ethical considerations

Participation in the study was voluntary. Prior to data collection, participants were informed about the purpose of the study; no personal identifying information was collected, and all data were analyzed anonymously. The study was conducted in accordance with ethical research principles in the social sciences and national data protection regulations.

RESULTS AND DISCUSSION

Sample structure and regional differences

Of the farms examined, 23.2% were located in Central Anatolia, 18.4% in Eastern Anatolia, 15.8% in Southeastern Anatolia, 15.0% in Marmara, 10.2% in the Black Sea region, 9.4% in the Aegean region, and 8.0% in the Mediterranean region. The overall distribution indicated widespread pressure across the economic-perception indicators: 78.7% of farms rated support as insufficient, 78.5% rated their ability to cope with costs as insufficient, and 72.9% rated sales prices as insufficient. In contrast, 49.2% gave an adequate response for perceived profitability and 68.6% for the input cycle (TABLE I). This pattern shows that the same farm could respond positively to one indicator and negatively to another, limiting the usefulness of single-variable classifications.

The demographic structure was also heterogeneous. In the total sample, the 41–50–year age group (26.6%) and the 31–40–year age group (24.8%) had the largest shares, whereas primary-school graduates constituted the largest education category (38.1%). However, producers aged 61 years or older (35.4%) and primary-school graduates (58.3%) were prominent in the Aegean region; the 31–40–year age group (33.6%) and university graduates (28.6%) were prominent in Central Anatolia; and high-school graduates (31.2%) were prominent in Marmara.

The predominance of middle-aged and older producers with low to moderate educational attainment has also been reported for cattle farms in different provinces of Türkiye [4, 7, 8, 15, 23, 24]. The present study shows that this general pattern was not equally pronounced across regions. In the dairy literature, higher educational attainment has been positively associated with the adoption of multiple technologies, whereas older producer age has been negatively associated with high-intensity technology adoption [25, 26]. The age and education structure of this sample therefore highlights the importance of tailoring programs on digital recordkeeping, innovation adoption, farm management, training, and extension to specific target groups.

Ten of the 12 characteristics differed significantly among regions (BH-adjusted q<0.05); no regional association was supported for the adequacy of support and incentives (q=0.077) or perceived profitability (q=0.591). The highest regional Cramér's V was observed for the input cycle (χ^2=95.05; df=12; Monte Carlo *P*<0.001; V=0.305). The input cycle was rated as insufficient by 60.6% of farms in Eastern

TABLE I
Active Variables Included in the MCA and Their Overall Distributions (n = 512)

Conceptual domain	Variable	Categories, n (%)
Producer	Age group	18–30: 89 (17.4%)
		31–40: 127 (24.8%)
		41–50: 136 (26.6%)
		51–60: 107 (20.9%)
		61+: 53 (10.4%)
Producer	Education	Illiterate: 15 (2.9%)
		Literate: 16 (3.1%)
		Primary school: 195 (38.1%)
		Middle school: 85 (16.6%)
		High school: 99 (19.3%)
		University: 91 (17.8%)
		Postgraduate: 11 (2.1%)
Activity structure	Activity type	Livestock production only: 110 (21.5%)
		Crop and livestock production: 263 (51.4%)
		Crop and livestock production plus an additional occupation: 139 (27.1%)
Risk and financing	TARSİM insurance	Not insured: 285 (55.7%)
		Insured: 227 (44.3%)
Risk and financing	Payment method	Cash: 270 (52.7%)
		Cash plus deferred: 225 (43.9%)
		Deferred: 17 (3.3%)
Risk and financing	Credit use	Did not use credit: 253 (49.4%)
		Used credit: 259 (50.6%)
Economic perception	Perceived profitability	Insufficient: 220 (43.0%)
		Undecided: 40 (7.8%)
		Adequate: 252 (49.2%)
Economic perception	Input cycle	Insufficient: 145 (28.3%)
		Undecided: 16 (3.1%)
		Adequate: 351 (68.6%)
Economic perception	Support and incentives	Insufficient: 403 (78.7%)
		Undecided: 28 (5.5%)
		Adequate: 81 (15.8%)
Market perception	Satisfaction with sales prices	Insufficient: 373 (72.9%)
		Undecided: 30 (5.9%)
		Adequate: 109 (21.3%)
Market perception	Market dynamism	Insufficient: 310 (60.5%)
		Undecided: 39 (7.6%)
		Adequate: 163 (31.8%)
Economic perception	Ability to cope with costs	Insufficient: 402 (78.5%)
		Undecided: 25 (4.9%)
		Adequate: 85 (16.6%)

n: number of farms. %: percentage of the total sample. MCA: multiple correspondence analysis. TARSİM: Agricultural Insurance Pool

Anatolia, compared with 2.1% in the Aegean region and 4.9% in the Mediterranean region. This difference indicates the need to investigate regional conditions such as input access, transport distance, continuity of supply, and local market infrastructure.

The identification of high feed prices as a major problem in Selim [4], together with reports of high costs, low product prices, and expectations of support in other field studies from Eastern Anatolia [7, 11, 23], is consistent with this interpretation; however, the previous studies differed in their samples and question wording.

The association between activity type and region was V=0.225. Livestock production only accounted for 43.9% of farms in the Mediterranean region and 38.3% in Southeastern Anatolia, whereas combined crop and livestock production reached 66.7% in the Aegean region. Previous studies in Eastern Anatolia, the Black Sea region, the Aegean region, and Marmara have also reported the prevalence of mixed crop-livestock systems [4, 13, 24, 27, 28].

Such systems may create complementarities through on-farm feed production and the use of crop residues and manure [29]. Although diversification may facilitate resource sharing across activities and support production continuity during price or climatic fluctuations, the simultaneous planning of crop and livestock activities may require greater managerial knowledge, labor coordination, and systems thinking [30].

Participation in TARSİM (V=0.209), credit use (V=0.199), and payment method (V=0.176) also differed among regions. TARSİM participation was 58.4% in Marmara and 24.4% in the Mediterranean region; credit use in these regions was also 58.4% and 24.4%, respectively. Cash payment was reported by 68.8% of farms in the Aegean region, whereas combined cash and deferred payment was reported by 66.7% in Southeastern Anatolia.

The TARSİM participation rate of 44.3% in the present sample was higher than the approximately 30% previously reported in a joint assessment of cattle and small-ruminant farms [10]. This difference may be associated with the focus of the present study on major livestock-production centers and with the expansion of state-supported agricultural insurance over time [31].

In addition, banking practices requiring insurable assets pledged as collateral for agricultural loans to be insured may contribute to the co-occurrence of credit use and insurance participation [32].

The regional pattern of economic perceptions was not unidirectional. Although a high proportion of farms in the Aegean region rated the input cycle as adequate, assessments of sales prices, market dynamism, and the ability to cope with costs were markedly unfavorable. Dissatisfaction with milk and slaughter prices and general market conditions in Southeastern Anatolia [8], as well as pressure from high costs and low prices in Eastern Anatolia [4, 11, 23], has been reported previously.

The present findings are consistent with these problems while also showing that farms within the same region did not respond in the same direction to all economic indicators. Regional averages should therefore be complemented by an examination of the socioeconomic characteristics with which these perceptions co-occur.

MCA structure and four socioeconomic and economic-perception profiles

Following the Benzécri correction, the first three MCA dimensions accounted for 46.36%, 26.42%, and 9.50% of the corrected inertia, respectively, and 82.29% in total. Education (13.39%), satisfaction with sales prices (10.73%), perceived profitability (10.12%), TARSİM participation (9.77%), credit use (9.39%), and the ability to cope with costs (8.98%) made the largest weighted contributions (FIG. 1).

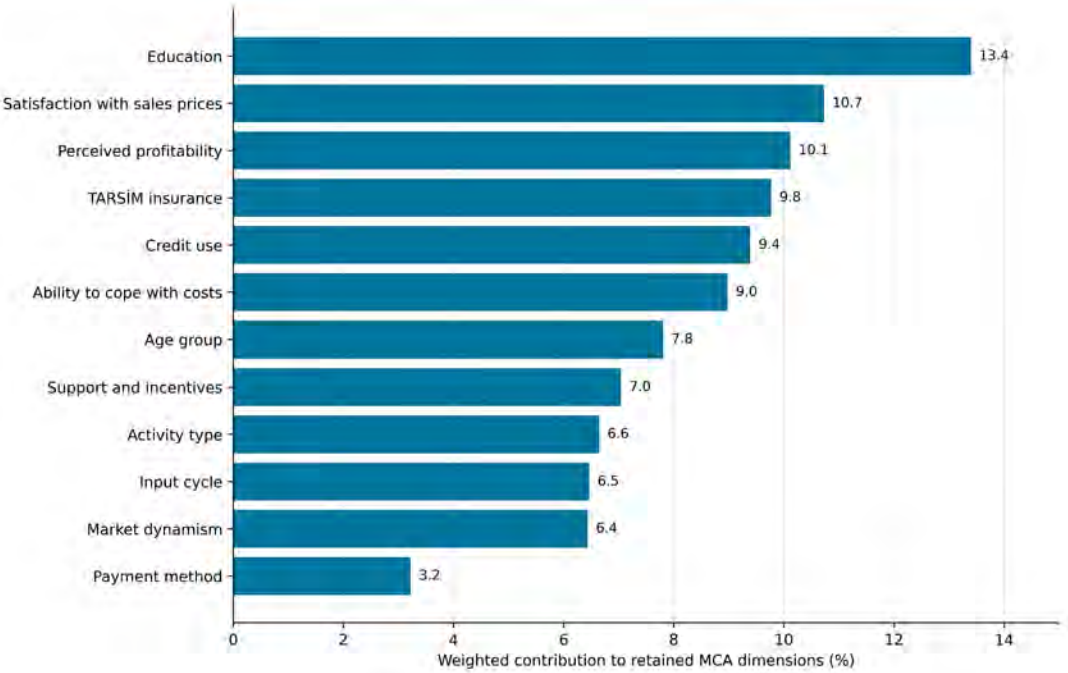


FIGURE 1. Weighted Contributions of Active Variables to the Retained MCA Dimensions. Note: Bars show the weighted relative contribution of each variable to differentiation in the retained MCA space. Values do not represent causal effects. % = percentage. MCA = multiple correspondence analysis

more visible than individual indicators [17, 18], while the broader typology literature emphasizes that the resulting classes depend on the study purpose and the variables selected [34, 35].

Cutting the Ward dendrogram at a height of 6.157 produced four main branches (FIG. 2). The resulting solution comprised balanced clusters of 164 (32.0%), 123 (24.0%), 118 (23.0%), and 107 (20.9%) farms. Solutions from k=2 to k=4 met the requirement of at least 20 farms and 5% of the sample per cluster; among these, k=4 jointly yielded the highest Calinski-Harabasz value (179.44), the lowest Davies-Bouldin value (1.172), the largest relative fusion jump (0.431), and the highest resampling ARI (0.393).

The silhouette value of 0.235 indicated partial overlap among the profiles and supported an exploratory interpretation of the solution. Because six of the 12 variables in the main model represented economic or market perceptions, the four clusters were termed socioeconomic and economic-perception profiles.

Differentiation in the sample was therefore based neither solely on demographic structure nor solely on economic perceptions; human capital, institutional risk-management instruments, and market assessments all contributed. The purpose of multivariable typologies is not to create a separate class for each farm but to provide interpretable comparison groups for farms with similar combinations of constraints and resources [33].

Previous cattle-farm typologies have shown that combinations of characteristics can make advisory and management needs

The distribution of farms in the first two MCA dimensions showed that the clusters had distinct centers, although their concentration areas overlapped, particularly at the boundaries (FIG. 3). This visual pattern is consistent with the partial overlap indicated by the internal-validation values. Blanco-Penedo *et al.* [17] likewise reported that within-cluster variance could remain greater than between-cluster variance in organic dairy-farm typologies.

The scientific value of the profile solution therefore lies less in classifying every farm without error than in identifying recurrent combinations of characteristics that are interpretable for policy purposes.

The principal categories distinguishing the clusters and their adjusted standardized residuals are summarized in TABLE II.

In Cluster 1, the largest profile, nonparticipation in TARSİM (89.6%), nonuse of credit (78.7%), primary-school education (67.1%), and insufficient assessments of support and the ability

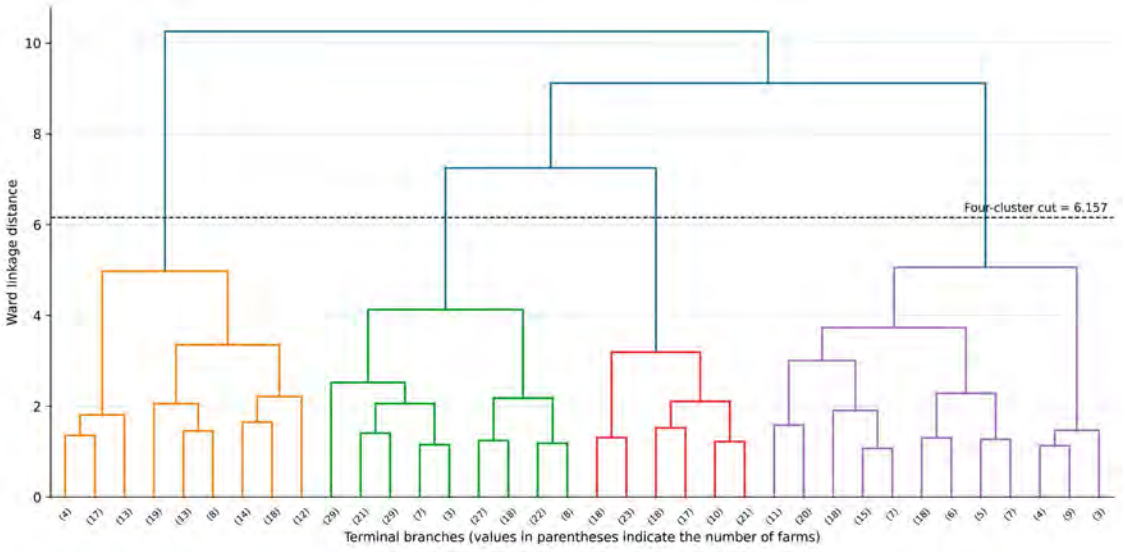


FIGURE 2. Ward Hierarchical Clustering Dendrogram Based on MCA Coordinates. Note: The dashed line indicates the four-profile cut height of 6.157. Branch colors represent the four profiles, and values in parentheses indicate the number of farms. MCA = multiple correspondence analysis

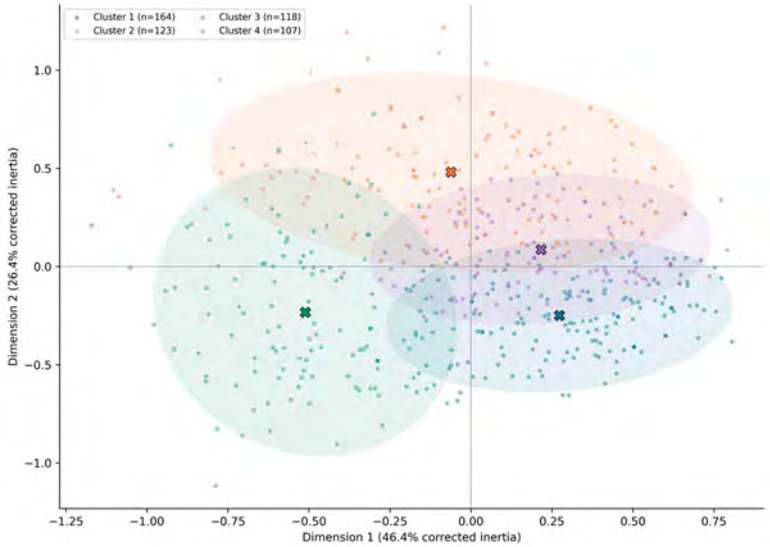


FIGURE 3. Distribution of Farm Profiles in the First Two MCA Dimensions. Note: Points represent farms, X symbols indicate profile centroids, and ellipses show approximate 95% concentration regions rather than confidence intervals. MCA = multiple correspondence analysis

to cope with costs (93.3% for both) were concentrated together (TABLE II). The share of producers aged 61 years or older was also higher than expected. Field studies in Türkiye have previously reported high proportions of cattle producers with low educational attainment and in middle-aged or older age groups [7, 8, 15, 23]. This co-occurrence indicates that insurance nonparticipation appeared in the same profile as lower education and older age, although the direction or cause of the relationship cannot be determined from cross-sectional data. Nonuse of credit and insurance may reflect financial exclusion, low indebtedness, low exposure to insurable risk, or a deliberate choice. This profile was therefore defined as a group with low participation in institutional financing and risk-management instruments and high perceived cost pressure.

Mat *et al.* [10] likewise reported that participation in livestock life insurance was shaped jointly by producer and farm characteristics. Extension strategies integrating recordkeeping, cost monitoring, financial literacy, and insurance coverage could be designed for this group while considering the capacity to pay premiums, perceived suitability of coverage, and access to services.

Cluster 2 was characterized by university education (57.7%), an age of 18–30 years (39.8%), an additional occupation alongside

crop and livestock production (53.7%), and participation in TARSİM (64.2%). This combination is consistent with human-capital attributes associated in the literature with technology adoption and the evaluation of innovations. In dairy farms, educational attainment has been positively associated with the adoption of multiple technologies, whereas producer age has been negatively associated with high-intensity technology adoption [25, 26].

TABLE II
Socioeconomic and Economic-Perception Profiles Identified Using MCA-Ward Analysis

No	n (%)	Profile	Principal categories represented more frequently than expected
1	164 (32.0%)	Low insurance/credit participation and perceived cost pressure	TARSİM insurance – Not insured: 89.6% (ASR=10.62) Education – Primary school: 67.1% (ASR=9.27) Credit use – Did not use credit: 78.7% (ASR=9.09) Ability to cope with costs – Insufficient: 93.3% (ASR=5.59) Support and incentives – Insufficient: 93.3% (ASR=5.53) Age group – 61+: 20.1% (ASR=4.98)
2	123 (24.0%)	Young, educated, and diversified activity structure	Education – University: 57.7% (ASR=13.30) Activity type – Crop and livestock production plus an additional occupation: 53.7% (ASR=7.58) Age group – 18–30: 39.8% (ASR=7.54) Ability to cope with costs – Undecided: 14.6% (ASR=5.76) TARSİM insurance – Insured: 64.2% (ASR=5.09) Input cycle – Undecided: 9.8% (ASR=4.85)
3	118 (23.0%)	Relatively favorable economic perceptions	Satisfaction with sales prices – Adequate: 61.0% (ASR=12.02) Ability to cope with costs – Adequate: 50.8% (ASR=11.40) Perceived profitability – Adequate: 92.4% (ASR=10.69) Support and incentives – Adequate: 46.6% (ASR=10.45) Market dynamism – Adequate: 59.3% (ASR=7.31) Input cycle – Adequate: 92.4% (ASR=6.35)
4	107 (20.9%)	High use of financial instruments and unfavorable economic perceptions	Credit use – Used credit: 90.7% (ASR=9.32) TARSİM insurance – Insured: 83.2% (ASR=9.09) Education – Middle school: 32.7% (ASR=5.04) Satisfaction with sales prices – Insufficient: 91.6% (ASR=4.90) Perceived profitability – Insufficient: 59.8% (ASR=3.96) Payment method – Cash plus deferred: 59.8% (ASR=3.72)

Note: No: profile number. n: number of farms. % in the n (%) column: percentage of the total sample. Category percentages: within-profile percentages. ASR: adjusted standardized residual. MCA: multiple correspondence analysis. TARSİM: Agricultural Insurance Pool

However, the greater-than-expected prevalence of undecided responses regarding the ability to cope with costs, the input cycle, profitability, and market dynamism shows that youth and education do not eliminate economic uncertainty. Although mixed production and additional employment may diversify income sources and create options for farm development, managing integrated systems requires additional planning and coordination [29, 30]. This profile may be a priority group for extension initiatives focused on digital recordkeeping, investment planning, activity-based income and expense monitoring, and financial decision support.

In Cluster 3, 92.4% rated profitability and the input cycle as adequate; 61.0% were satisfied with sales prices, 59.3% rated market dynamism as adequate, 50.8% considered their ability to cope with costs adequate, and 46.6% considered support adequate. This consistent response pattern indicates a more favorable perceived economic position than in the other clusters. High feed costs, low product prices, and inadequate support have been widely reported in different parts of Türkiye [4, 8, 11, 23].

The concentration of favorable assessments in Cluster 3 nevertheless suggests that farms operating in the same economic environment may differ in market access, input planning, cost control, or management practices. The profile therefore provides a comparison group for future studies of farm and management characteristics that accompany more favorable economic assessments. Its occurrence across different regions further supports evaluating producer diversity through farm-level combinations of characteristics in addition to regional averages.

Cluster 4 combined high credit use (90.7%), TARSİM participation (83.2%), and cash-plus-deferred payment (59.8%) with concentrated insufficient responses for sales prices (91.6%) and perceived profitability (59.8%). This combination clearly shows that credit and insurance use are not synonymous with economic security. Insurance may reduce specific production risks but does not eliminate risks associated with input prices, sales prices, or debt servicing. Because the cross-sectional design cannot distinguish whether credit use contributed to economic pressure or whether farms under pressure sought credit, recommendations for this group should be supported by detailed financial records covering debt burden, maturity structure, cash flow, and realized sales prices.

This profile also shows that farm indicators cannot be reduced to a unidirectional axis of 'advancement.' Credit and insurance use reflect access to institutional instruments, whereas perceptions of sales prices and profitability represent a distinct dimension of the farm's position under market conditions. Economic analyses in Eastern Anatolia have previously demonstrated the importance of feed and other variable costs for farm outcomes [3, 11]. Participation in financial instruments can therefore be regarded as a performance indicator only when the purpose of credit, debt servicing, insured value, claims experience, and realized margins are monitored jointly.

Considered together, the four profiles show that similar expressions of economic difficulty may co-occur with different institutional behaviors. In Cluster 1, cost pressure was accompanied by low credit and insurance participation, whereas in Cluster 4 it occurred alongside high credit and insurance use. This contrast shows that the same policy instrument cannot be expected to resolve the same problem across all farms.

The recommendation of differentiated advisory and policy approaches for different farm groups in previous typology studies [17, 18, 33, 35] is consistent with this finding; however, because the present study did not evaluate intervention effects, the practical implications should be treated as testable hypotheses.

Comparison of regional and profile-level differentiation

The direct association of an active variable with the main clusters may be structurally inflated because that variable contributed to cluster construction. Twelve separate MCA-Ward solutions were therefore fitted, each excluding one target variable. Because changes in profile labels do not affect Cramér's V, label matching was not performed; k=4 was held constant to preserve the same level of detail as the main solution.

For the input cycle, region V was 0.305, profile V was 0.179, and ΔV was 0.126 (TABLE III; FIG. 4). Together with the high rate of insufficient responses in Eastern Anatolia, this finding supports detailed regional investigation of input access, transport distance, continuity of supply, and local market infrastructure.

Region V was higher for credit use (region/profile V=0.199/0.101; ΔV=0.098), activity type (0.225/0.139; ΔV=0.085), TARSİM participation (0.209/0.130; ΔV=0.079), and payment method (0.176/0.104; ΔV=0.072). This pattern suggests that the differences observed in these characteristics may be more likely to be associated with regional institutional and production conditions than with the socioeconomic profile.

For perceived profitability, region V was 0.100, profile V was 0.233, and ΔV was -0.132; for the ability to cope with costs, the corresponding values were 0.157, 0.237, and -0.081. These values suggest that producers' socioeconomic and economic-perception profiles may be more prominent than regional location in assessments of perceived profitability and the ability to cope with costs.

Region V was higher for age (ΔV=0.046) and education (ΔV=0.017), whereas profile V was higher for market dynamism (ΔV=−0.015), satisfaction with sales prices (ΔV=−0.031), and perceived support (ΔV=−0.036). Because the absolute ΔV values for these variables were lower than for the other characteristics, interpretation of whether regional or profile-level association might predominate is limited; the values were therefore treated as similar descriptive associations.

Regional distribution of profiles and marketing

This section examines the regional distribution of the four profiles and differences in marketing-channel use among them.

TABLE III
Regional and Leave-One-Variable-Out Profile-Level Cramér's V Values

Characteristic	Region V	Profile V	ΔV
Input cycle	0.305	0.179	0.126
Credit use	0.199	0.101	0.098
Activity type	0.225	0.139	0.085
TARSİM insurance	0.209	0.130	0.079
Payment method	0.176	0.104	0.072
Age group	0.176	0.130	0.046
Education	0.161	0.144	0.017
Market dynamism	0.160	0.175	−0.015
Satisfaction with sales prices	0.178	0.209	−0.031
Support and incentives	0.139	0.175	−0.036
Ability to cope with costs	0.157	0.237	−0.081
Perceived profitability	0.100	0.233	−0.132

Note: V: Cramér's V; Region V: association with geographical region; Profile V: association with profiles reconstructed after excluding the relevant variable; ΔV: Region V − Profile V

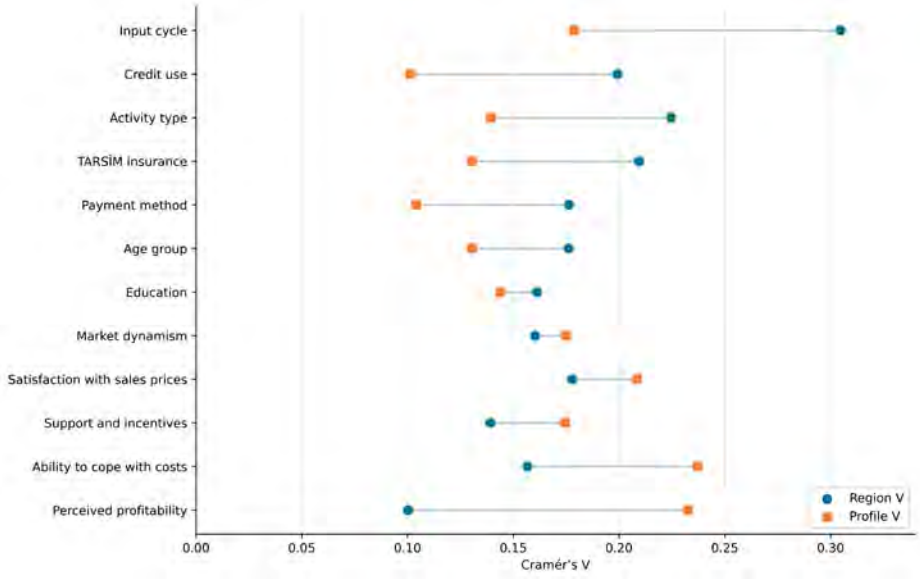


FIGURE 4. Comparison of Regional and Leave-One-Variable-Out Profile-Level Cramér's V Values. Note: Circles indicate Region V and squares indicate Profile V. Connecting lines pair values for the same characteristic. Profile V was calculated after excluding the corresponding variable. V = Cramér's V

The association between geographical region and profile membership was statistically significant (χ^2=66.37; df=18; *P*<0.001; V=0.208). Cluster 1 accounted for 43.8% of farms in the Aegean region, 40.7% in Southeastern Anatolia, and 40.4% in Eastern Anatolia; Cluster 2 accounted for 35.3% in Central Anatolia and 33.8% in Marmara; Cluster 3 accounted for 46.3% in the Mediterranean region; and Cluster 4 accounted for 29.6% in Southeastern Anatolia and 29.2% in the Aegean region. The presence of all four profiles in every region shows that geography alone did not determine producer profiles (TABLE IV; FIG. 5).

This finding is conceptually similar to the identification of shared typologies across countries by Blanco-Penedo *et al.* [17]: geographical and institutional context matters but does not explain all variation among farms. The literature on the use of farm typologies in policy assessment likewise recommends considering geographical classifications together with farm-management indicators [33, 35]. Regional policy design should therefore be complemented by farm-level targeting that accounts for differing information, financing, insurance, and market needs within the same region.

TABLE IV
Distribution of Socioeconomic and Economic-Perception Profiles Within Regions

Region	n	Cluster 1 (%)	Cluster 2 (%)	Cluster 3 (%)	Cluster 4 (%)
Mediterranean	41	34.1	12.2	46.3	7.3
Aegean	48	43.8	12.5	14.6	29.2
Marmara	77	32.5	33.8	15.6	18.2
Central Anatolia	119	15.1	35.3	26.9	22.7
Black Sea	52	28.8	25.0	30.8	15.4
Eastern Anatolia	94	40.4	25.5	16.0	18.1
Southeastern Anatolia	81	40.7	8.6	21.0	29.6
Türkiye	512	32.0	24.0	23.0	20.9

Note: n: number of farms; %: percentage within each region

Marketing channels

Marketing channels that were not used to construct the profiles were examined separately. Butchers (55.3%) and livestock traders (44.7%) were the main sales channels in the overall sample; livestock markets accounted for 19.3%, sales through acquaintances for 13.1%, and cooperatives or unions for 1.4%. A single channel was used by 73.0% of farms. Differences among profiles were limited: butcher use ranged from 47.6% to 65.3%, livestock-trader use from 34.7% to 52.4%, and livestock-market use from 12.2% to 24.4% (V=0.134–0.141).

Regionally, butcher use was highest in Marmara (79.2%), livestock-trader use in the Mediterranean region (63.4%), sales through acquaintances in Eastern Anatolia (30.9%), and livestock-market use in Southeastern Anatolia (66.7%). Previous studies in Türkiye have likewise reported local variation in producer organization and livestock-marketing structures, including cooperative participation and intermediary-based channels [36, 37]. Because these indicators did not measure realized prices or bargaining power, they were not interpreted as evidence of economic advantage [23, 24, 38, 39].

Time frame and limitations

The data provide a cross-sectional view of the year in which fieldwork was completed, 2023. Structural characteristics such as age, education, and activity mix change more slowly, whereas economic perceptions reflect the market conditions prevailing in 2023. The findings should therefore be interpreted within the relevant fieldwork period, and changes over time should be monitored through repeated studies [40, 41].

Although the provinces were selected from major cattle-production centers covering all seven geographical regions, the purposive selection of provinces and differences in sample size among regions are limitations of the study.

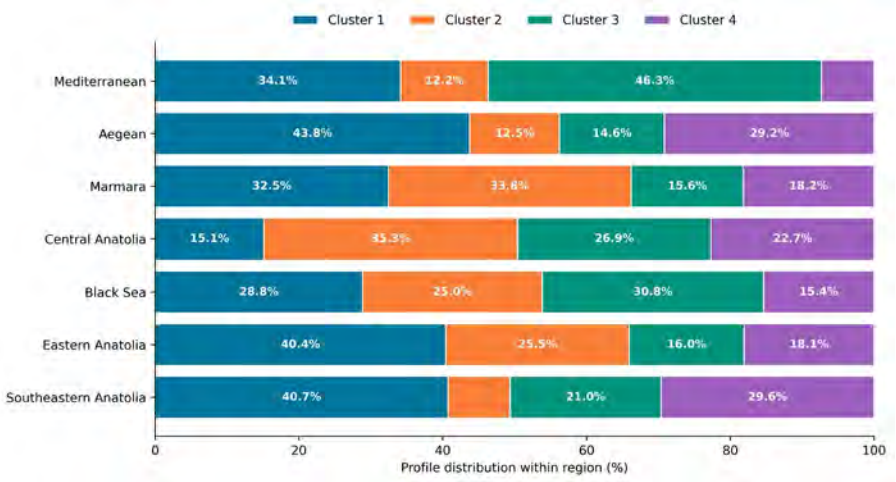


FIGURE 5. Distribution of Socioeconomic and Economic-Perception Profiles within Regions. Note: Stacked bars show the percentage distribution of profiles within each region; therefore, each bar totals 100%. % = percentage

The active model did not include herd size, production orientation, land and feed production, yield, labor, capital, unit cost, or realized income. The clusters are therefore socioeconomic and economic-perception profiles rather than structural farm types or performance classes. In particular, Cluster 3 represents the joint concentration of favorable economic responses, not technical superiority or realized profitability. Validation of the profiles in independent samples and with objective technical and financial indicators is a priority for future research.

CONCLUSION

Among the 512 producers assessed, region V was higher for the input cycle, credit use, activity type, TARSİM participation, and payment method, whereas profile V was higher for perceived profitability and the ability to cope with costs. The clearest difference was observed for the input cycle. These Cramér's V comparisons are descriptive findings indicating regional and profile-level research priorities rather than intervention effects.

MCA-Ward analysis produced four exploratory profiles characterized by perceived cost pressure accompanied by low insurance and credit participation; young and educated producers with diversified activities; relatively favorable economic perceptions; and unfavorable perceptions of sales prices and profitability despite high use of financial instruments. The presence of these profiles in all regions supports complementing regional approaches with applications responsive to producer characteristics. The findings also support the development of policy and advisory approaches that integrate regional targeting with producer needs identified at the profile level.

In practical terms, regional conditions and producer profiles should be considered jointly, particularly for indicators related to input procurement and access to financial instruments, and for perceptions of profitability and the ability to cope with costs. Differentiating region-based support according to education, recordkeeping, insurance participation, credit structure, and market perceptions may provide a basis for more targeted policy and extension interventions. The effects of this approach should be tested in future monitoring studies that include objective technical and financial indicators.

Availability of data and materials

The data that support the findings of this study are available from the corresponding author (B. Barit) on reasonable request.

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Declaration of Interests

The authors have no conflicts of interest to declare.

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