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3-D CLASSIFICATION OF AGRICULTURAL AREAS OF TURKEY USING MAMMALIAN LIVESTOCK EXISTENCE

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Abstract: Animal production is valuable importance for human being and countries in terms of both economic and human nutrition. To increase the value of benefits from the livestock sector, there are many attempts to make policies. In this study, 26 different agricultural areas of Turkey according to their agricultural properties were clustered by using mammalian livestock existence such as cattle, water buffalo, sheep, goat and horse. For this aim 3-D clustering was applied using R software with FactoMineR and factoextra packages. The results showed that the number of 26 agricultural areas were clustered in four clusters. TR83 area including Samsun, Tokat, Çorum and Amasya cities was formed in a cluster lonely. The second cluster included agricultural areas of TRA2, TRC2 and TRB2 that these areas consist of the cities Ağrı, Kars, Iğdır, Ardahan, Şanlıurfa, Diyarbakır, Van, Muş, Bitlis and Hakkari. TRC3, TR62 and TR61 agricultural areas formed the third cluster including the cities of Mardin, Batman, Şırnak, Siirt, Adana, Mersin, Antalya, Isparta and Burdur. The other agricultural areas were included in the fourth cluster. These results are also important for traders' financial and human capital and trading practices such as the use of brokers and regular suppliers and customers had varying effects on margins and costs of animal trade. It is also amenable to public policy to improve the market environment and marketing efficiency.

Keywords: Mammalian, Livestock, Türkiye, Agricultural areas, 3-D clustering

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1. Introduction

Mammalian livestock has been important components of rural life and human nutrition and also still play a substantial role in the livelihood of farmers. In Turkey, animal production plays an important role in the livestock sector because of the country's geography and climate, as well as social, cultural, and economic structures (Şen et al., 2021a). Although Turkey is among the leading countries in the world in terms of goat and sheep assets, almost all of the small ruminant population consists of local breeds with low yield potential, but good adaptation to different climatic conditions (Şen et al., 2021b). Also, water buffalo and horse breeding are valuable for the Turkey economy.

In Turkey small ruminant population is about 57.5 million head consisting of 45.2 million head of sheep and 12.3 million head of goat. Turkey's cattle population is about 17.9 million head, the water buffalo population is 66215 and the horse population is 83718 according to TUIK (2021). Turkey has 26 different agricultural areas according to their agricultural properties (Table 1).

Among these areas animal existences can be so different to produce policies. This imbalance brings some hardness for policy making for agricultural areas (Önder, 2019; Tirink et al., 2019).

In this study, it was aimed for 3-D clustering the agricultural areas according to mammalian livestock existence for producing information useful for policy makers.

2. Material and Methods

The data was taken from the Turkish Statistical Institute (TUIK, 2021) for the year 2021. To classify the agricultural areas, a hierarchical clustering algorithm was used with the nearest neighborhood method with Euclidean distance. Hierarchical clustering analysis according to the factor scores was derived from principal component analysis. Tree-based hierarchical clustering of individuals to define clusters of similar populations according to interested traits was strongly suggested. A dendrogram is structured where the root corresponds to a cluster containing all data points and the leaves correspond to the n input data points.

Each internal node of the dendrogram corresponds to a cluster of the data points in its sub-tree. The clusters (internal nodes) become more refined as the nodes are lower in the tree. The goal is to construct the tree so that the clusters deeper in the tree contain points that are

relatively more similar. All analysis was executed using R software with *FactoMineR* and *factoextra* packages (Şen et al., 2021a).

Table 1. Agricultural areas of Türkiye

Area Code	Cities
TR62	Adana, Mersin
TR51	Ankara
TR61	Antalya, Isparta, Burdur
TR32	Aydın, Denizli, Muğla
TRA2	Ağrı, Kars, Iğdır, Ardahan
TR22	Balıkesir, Çanakkale
TR41	Bursa, Eskişehir, Bilecik
TRA1	Erzurum, Erzincan, Bayburt
TRC1	Gaziantep, Adıyaman, Kilis
TR63	Hatay, Kahramanmaraş, Osmaniye
TR82	Kastamonu, Çankırı, Sinop
TR72	Kayseri, Sivas, Yozgat
TR42	Kocaeli, Sakarya, Düzce, Bolu, Yalova
TR52	Konya, Karaman
TR71	Kırıkkale, Aksaray, Niğde, Nevşehir, Kırşehir
TRB1	Malatya, Elazığ, Bingöl, Tunceli
TR33	Manisa, Afyonkarahisar, Kütahya, Uşak
TRC3	Mardin, Batman, Şırnak, Siirt
TR83	Samsun, Tokat, Çorum, Amasya
TR21	Tekirdağ, Edirne, Kırklareli
TR90	Trabzon, Ordu, Giresun, Rize, Artvin, Gümüşhane
TRB2	Van, Muş, Bitlis, Hakkari
TR81	Zonguldak, Karabük, Bartın
TR10	İstanbul
TR31	İzmir
TRC2	Şanlıurfa, Diyarbakır

3. Results and Discussion

When the cluster analysis results were examined (Figure 1), the number of 26 agricultural areas were clustered in four clusters. TR83 area including Samsun, Tokat, Çorum and Amasya cities was formed in a cluster lonely. The second cluster included agricultural areas of TRA2, TRC2 and TRB2 that these areas consist of the cities Ağrı, Kars, Iğdır, Ardahan, Şanlıurfa, Diyarbakır, Van, Muş, Bitlis and Hakkari. TRC3, TR62 and TR61 agricultural areas formed the third cluster including the cities of Mardin, Batman, Şırnak, Siirt, Adana, Mersin, Antalya, Isparta and Burdur. The other agricultural areas were included in the fourth cluster. According to PCA results 80.4% of the total variance was explained.

These results indicated that different policies can be used for the mammalian livestock sector for Samsun, Tokat, Çorum and Amasya cities including in the TR83 agricultural area. For this area the featured by the existence of water buffalo (Atasever, 2022). For TRA2, TRC2 and TRB2 small ruminants based policies can be conducted (Ertaş, 2019). Mardin, Batman, Şırnak, Siirt, Adana, Mersin, Antalya, Isparta and Burdur cities included in TRC3, TR62 and TR61 agricultural areas can be suitable to make policies on small ruminant especially on goats (İşler and Ünlü Ören, 2021; Tarhan, 2021). The fourth cluster including the other 19 agricultural areas had a higher cattle number (URL1).

These findings can be used to make animal production related policies by the policy makers. Even though the country has 26 different agricultural areas, these areas can be evaluated in four clusters to make improvements and deciding for mammalian livestock.

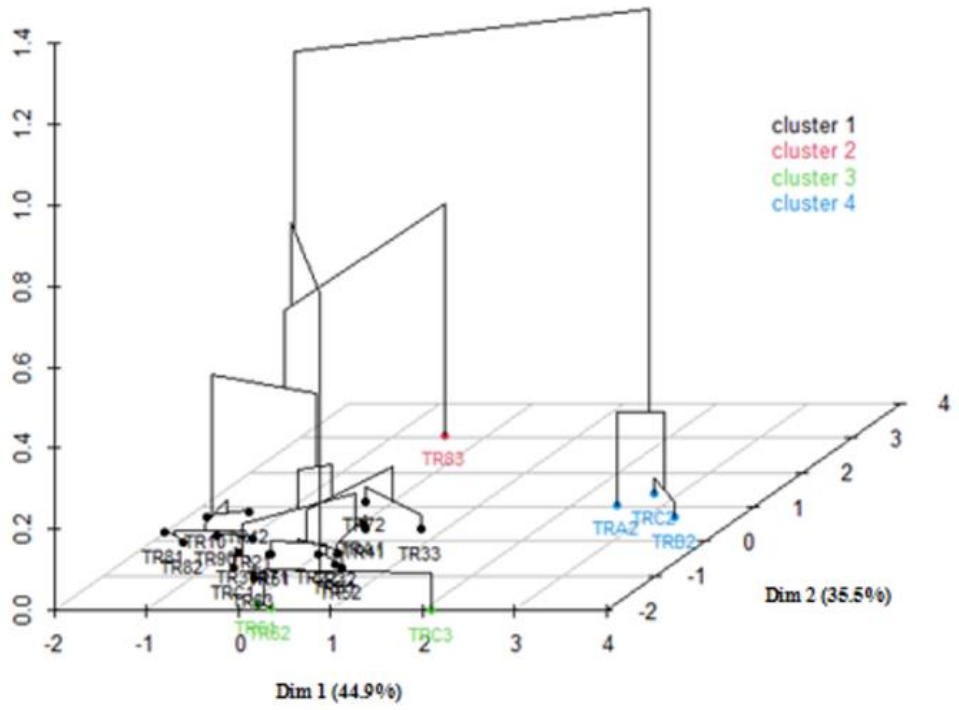

Figure 1. Hierarchical clustering on the factor map.

4. Conclusion

According to the results it can be offered for policy makers that the four clusters had different needs of policies. For these four clusters pastures may be improved, and heath protection should be differentially planned for these agricultural areas. Animal associations should give special importance to these agricultural areas. These results are also important for traders' financial and human capital and trading practices such as the use of brokers and regular suppliers and customers had varying effects on margins and costs of animal trade. It is also amenable to public policy to improve the market environment and marketing efficiency.

Author Contributions

H.M.Y (100%) the data collected. B.K. (100%) data analysis. H.Ö. (40%) and C.T. (60%) the manuscript writing up. H.Ö. (40%) and C.T. (60%) submission and revision. All authors reviewed and approved final version of the manuscript.

Conflict of Interest

The author declared that there is no conflict of interest.

Ethical Consideration

Ethics committee approval was not required for this study because of there was no study on animals or humans. The used data was taken from Turkish Statistical Institute.

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