STATISTICAL ANALYSIS ON VALORIZATION THE ROMANIAN LIVESTOCK FROM THE MOUNTAIN REGIONS

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Abstract. *The paper develops a descriptive analysis (ANOVA) and forecasting regarding cattle, sheep, goats and pigs in Romania. The data simulated in SPSS, taken from Eurostat, show that these numbers will continue to decrease considerably, both in the Bucharest-Ilfov region and in the Romanian mountain regions. The general situation of mountain agriculture shows similar trends to Romanian agriculture. At the national level, the arable surface has been reduced in stages in the last three decades, a decrease mainly due to the change of extensive agricultural methods (grazing, spontaneous flora) with intensive ones (stable, controlled flora). Following the national agricultural trend, mountain agriculture after 1990 changed its structure and dimensions (such as cattle, production and mountain producers, mountain entrepreneurship, etc.). Some aspects remained quantitatively unchanged, such as the large number of individual holdings and the high share of agricultural land use. In this context, public and private entities must act jointly for the valorization of mountain ecosystems by controlling the pollution caused by the numerous individual exploitations. The mountain ecosystems in the Romanian area influence the national agricultural productivity, valuing the mountain product at the highest levels. Whether it is alpine meadow ecosystems, including coniferous forests and interpenetration zones between high and mid-mountains, low-mountain ecosystems, or high- and mid-hill ecosystems, the ultimate goal of pollution reduction research and action must be the same, respectively protecting the mountain area.*

1. Introduction

The Romanian herd is of major importance in the context of its negative fluctuation over the last 30 years. From 1990 to the present, the Romanian livestock has been constantly reduced by decreasing cattle and pig herds, while goats and sheep have maintained a positive linear development. In the mountain area, the Romanian livestock decreased much more sharply in all studied

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categories. The decrease in animal numbers in the mountainous area of Romania is due to several deficiencies, such as: the abandonment of mountain localities by the young population and the migration to the urban areas of the country or abroad; the lack of jobs; lack of counseling for young farmers who took over the farm from their parents; the lack of vocational schools with an agricultural profile in the mountainous area, which would prepare the future generations of farmers; poorly equipped mountain farms and improper mechanization, leading to higher energy, labor and additional costs; reduced possibilities of valorization of the products obtained on the farm. [4, 10, 11, 12, 13]

Regarding pigs, the main herd reduction occurred in the period 2017-2019. Romania was considerably affected by the African swine fever of that period, and the reduction of herds in the last decade was correlated with the negative change in the mountain regions. The supply-production-sale chain in Romania is still heavily affected by the mentioned period, and the market continued to decrease under the pressure of imported pork products. Due to its specific type, swine fever affected domestic livestock more than wild boar herds. The management of the crisis was achieved with difficulty, the implementation of safety being the main problem in the loss of many pig herds. While some experts believe we are facing a steady natural decline, others point to the relatively slow spread of swine fever as the main cause. Recent facts indicate that in just one year nearly 5 million pigs were lost to the outbreak of swine fever in Asia. After its first insertion into Europe through a Black Sea port in Georgia from East Africa in 2007 and its wide-ranging signaling in the EU in 2014, swine fever quickly spread to all the Baltic states and Poland, then the Czech Republic, Hungary, Bulgaria, Romania (2017), etc. [1]

Regarding the sheep and goat population, it should be remembered that it was practically halved between 1990-2001, after which (with the exception of 2010) the number of sheep increased constantly, reaching 10 million heads at the end of 2017. After this period, the sheep herd increased even more, mainly through the campaign of the Ministry of Agriculture and Rural Development which provided for the promotion of the consumption of mutton called "Choose sheep!". This campaign was supported by sheep breeders in Romania, who wanted to get consumers more interested in mutton and mutton products. The goal was to capitalize on sheep agri-food products, to increase the value of processed products, to attract labor in the processing of sheep meat, but also to preserve the traditions of the culinary products of this species, especially in mountainous areas. The campaign ran nationally for three months, with the aim of encouraging the consumption of meat and sheep meat products throughout the year, not just at Easter. Domestic consumption was also supported by the considerable exports traditionally made by Romania to countries in the Middle East, Libya, the

Palestinian territories, Jordan, Lebanon, Turkey and Italy. The number of goats also increased in the period 2011-2017, especially against the background of a lower financial need to maintain goats than sheep. A goat farm of about 30 heads generates enough income in a year to cover the investments and make a small profit. Moreover, the price of goat's milk and cheese is significantly higher than that of sheep or cattle [2].

Regarding the number of cattle, we are witnessing a continuous decrease after 2014. The supply of milk on the market increased in 2017 by approximately 9.9% compared to 2012 due to the doubling of imports. Beef production was slightly decreasing in the period 2012-2014, after which it began to increase, reaching 127.1 thousand tons in 2016. In 2017, there was a decrease in production of approximately 3.3% compared to 2016. At the territorial level, most farms with cows and heifers are located in the counties of Suceava, Maramureș, Botoșani, Argeș, Iași. Also, these counties occupy the first places in terms of herds. The fewest cows and heifers are in the counties of Ilfov, Călărasi, Gorj, Tulcea, Sibiu, Timiş. The distribution of livestock according to the size class of the farms shows that in almost all counties the size class 1-2 heads prevails. However, there are dairy farms in Romania that exceed the production of the largest producers of cow's milk in the EU. These few farms do not have the power to ensure sustainability of national indicators, which are overwhelmingly influenced, over 83%, by small individual holdings with low yields, determining policies and allocations of factors that disadvantage developed farms [3].

2. Materials and Methods

The paper analyzes the evolution of the Romanian livestock through the prism of its development in the period 1995-2021 and the forecasted trend for the year 2028. The data were extracted from Eurostat, processed in Excel and SPSS, the analysis was carried out using ANOVA - frequency-specific descriptive statistics, and the forecast through forecasting techniques [9].
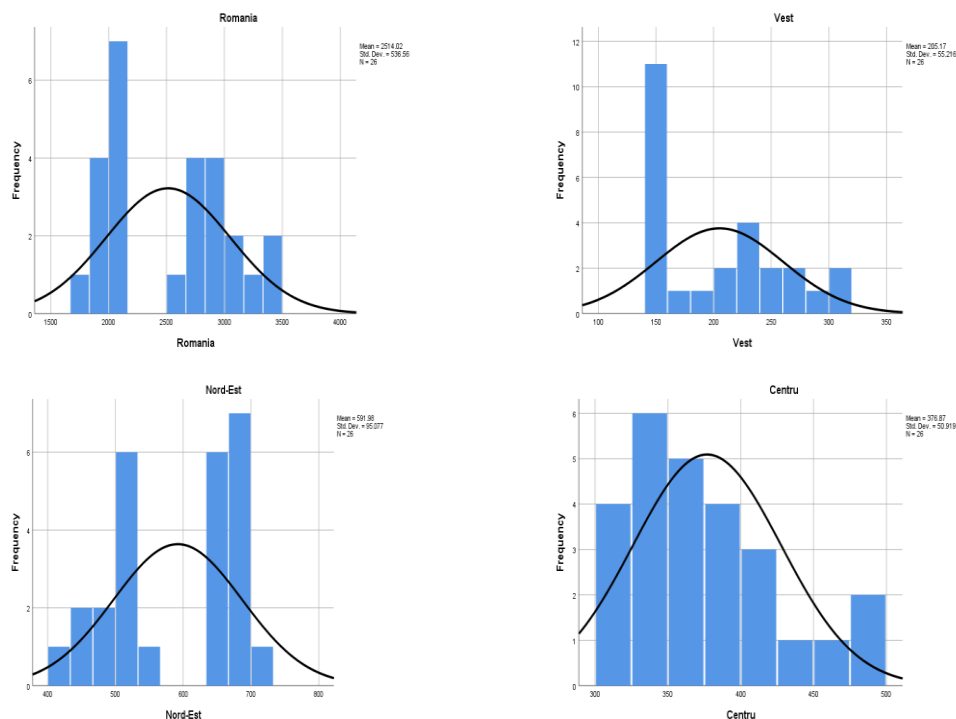
For the descriptive frequency analysis, the mountain areas of Romania were taken into account - each area separately, as well as the national area as a whole. The analysis framework was performed for standard deviation, variance, minimum, maximum, mean, median, skewness and kurtosis. The histograms were made using the standard - normal variant, as for the analyzed cases, it is considered that they all returned valid data. The number of variables is 26 (N=26: 1995-2021), the unit of measurement being thousands of heads. The standard errors fell within accepted margins, being Std. Error of Mean, Std. Deviation, Std. Error of Skewness, Std. Error of Kurtosis. The percentiles on which the analyzes were performed were 25, 50 and 75 [5, 6, 7, 8].

For trends, the forecasting technique used in modeling was Time series model. The forecast framework was RMSE (root mean squared error), MAPE (mean absolute percentage error), MAE (mean absolute error), MAXAPE (maximum absolute percentage error), MAXAE (max absolute error), NORMBIC (bayesian information criterion), RESIDACF (residual analysis autocorrelation function). LCL (lower control limit) and UCL (upper control limit) were used for prediction. The model type was ARIMA (Autoregressive Integrated Moving Average) and EXSMOOTH (smooth trend). Cases considered for statistical and predictive analysis returned valid values. [5, 6, 7, 8]

3. Results and Discussions

The results of the descriptive frequency analysis and the forecasting one confirm the reduction of the Romanian livestock, the improvement being realized in the following period. The analyzes show that by 2028, under certain investment and socio-economic conditions, Romanian livestock can once again represent an important asset for the development of Romanian agriculture.

The number of cattle in Romania was located in the analyzed period, according to the descriptive frequency analysis, at an average of 2,514.02 thousand heads (the standard unit of measurement of the work) (Fig. 1) [5].
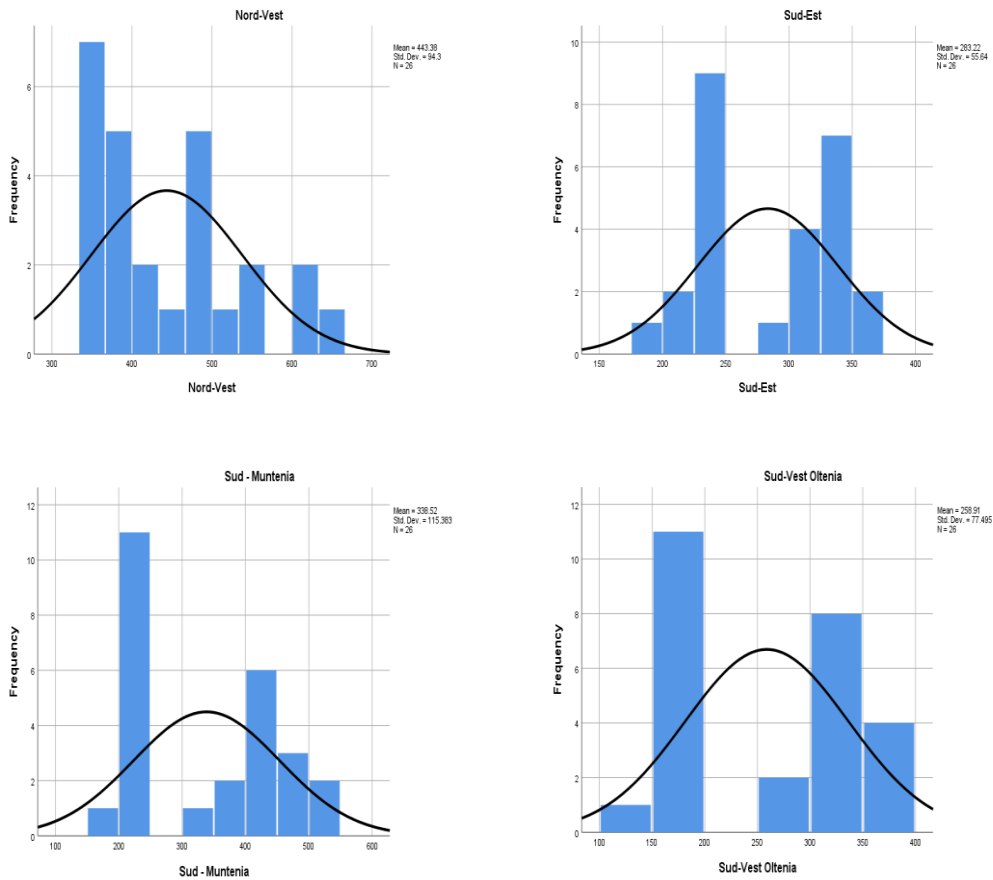
Fig. 1. Descriptive frequency analysis for the cattle herd for the period 1995-2021, Romania and the mountainous areas of Romania

The standard error of the mean is 105.22, the median is 1,067.20, the standard deviation is 408.35, the variance is 166,755.21, the skewness is .045, the standard error of skewness is .456, the kurtosis is -1.830, the standard error of kurtosis is of .887, range of 1,105, minimum of 525, maximum of 1,630, values on the 25th percentile of 649.05, the 50th percentile of 1,067.20 and the 75th percentile of 1,450.93. The prediction analysis for the mean shows a static R-squared of 2.837E-16, dynamic R-squared of .926, RMSE of 28.86, MAPE of 5.04, MaxAPE of 30.39, MAE of 19.78, MaxAE of 98.97 and Normalized BIC of 5.90 (Fig. 2).
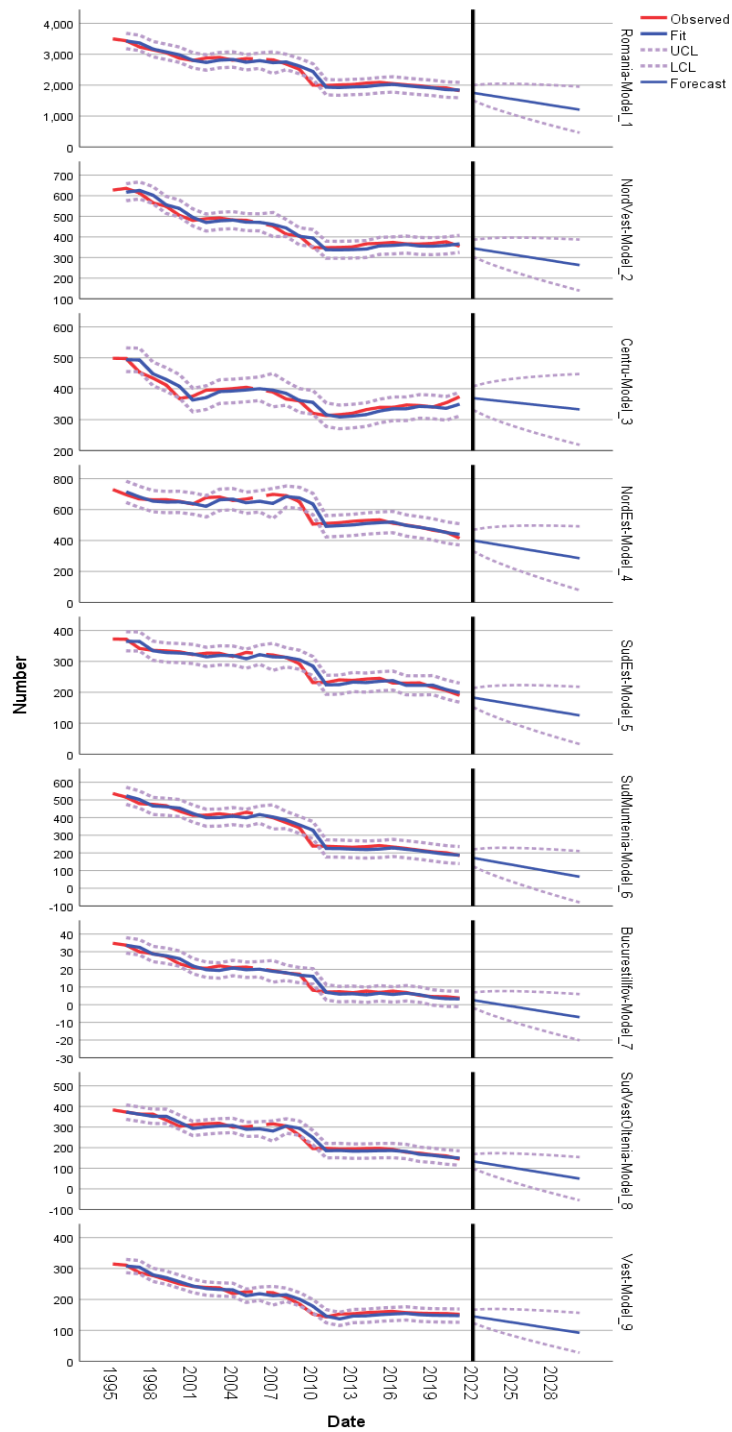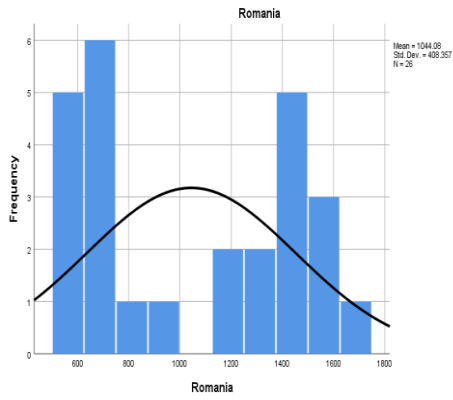
Fig. 2. Forecast 2028 for the cattle herd, Romania and the mountainous areas of Romania

Regarding the goat herd in Romania, the descriptive frequency analysis shows that the average was 1044.08 thousand heads (Fig. 3). [7].
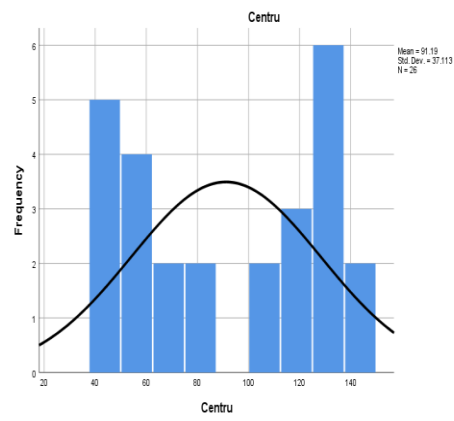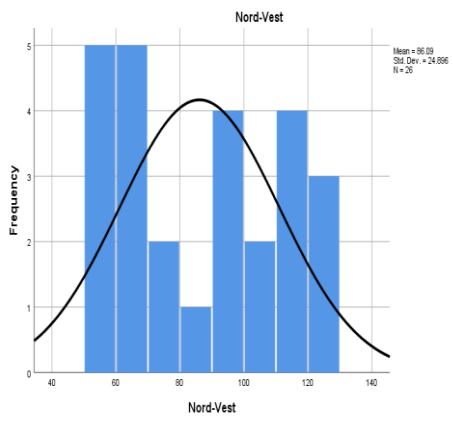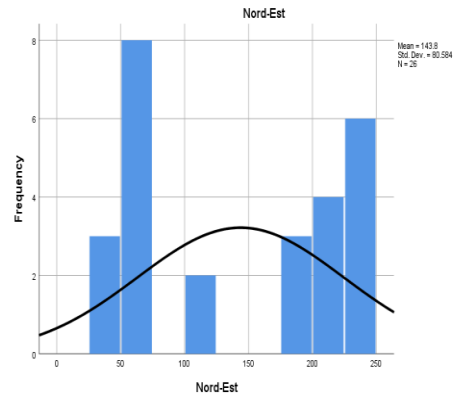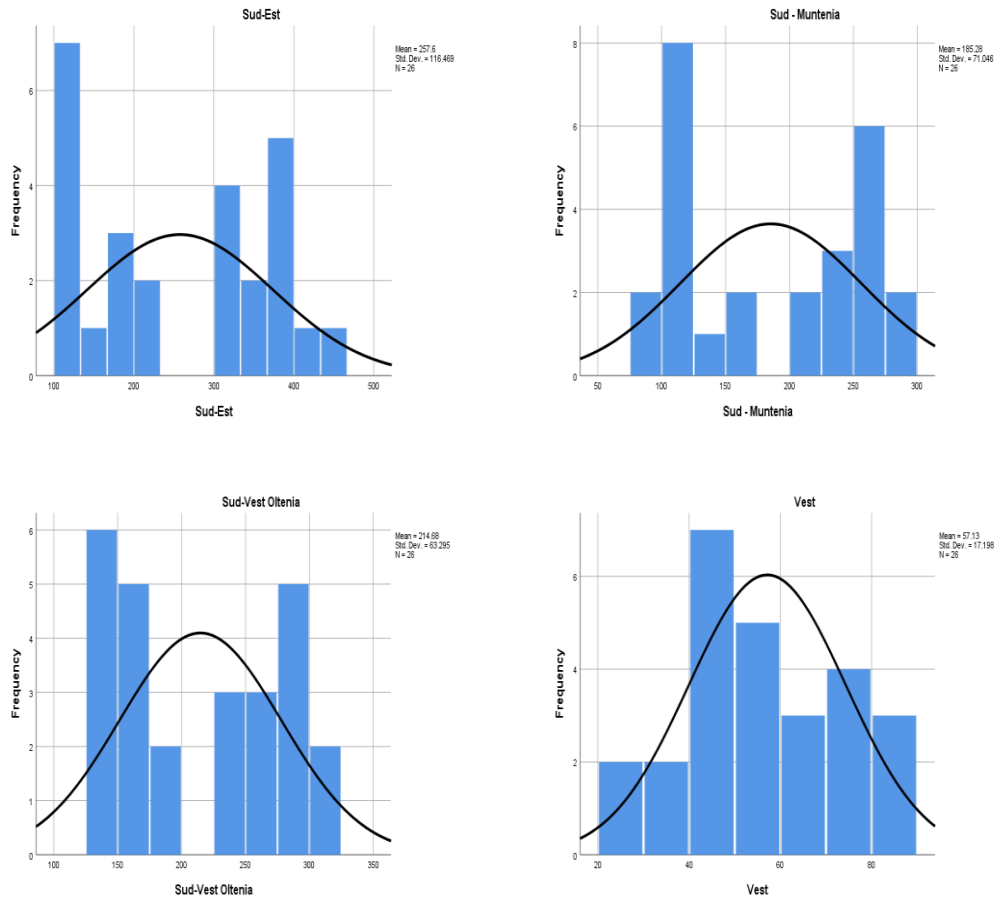
Fig. 3. Descriptive frequency analysis for the goat herd related to the period 1995-2021, Romania
and the mountainous areas of Romania

The standard error of the mean is 80.08, the median is 2,597.95, the standard
deviation is 536.56, the variance is 287,896.83, the skewness is .266, the standard
error of skewness is .456, the kurtosis is -1.387, the standard error of kurtosis is of
.887, range of 1,677, minimum of 1,819, maximum of 3,496, values on the 25th
percentile of 2,007.10, the 50th percentile of 2,597.95 and the 75th percentile of
2,882.63. The prediction analysis for the mean shows a static R-squared of .181,
dynamic R-squared of .855, RMSE of 27.76, MAPE of 9.35, MaxAPE of 58.65,
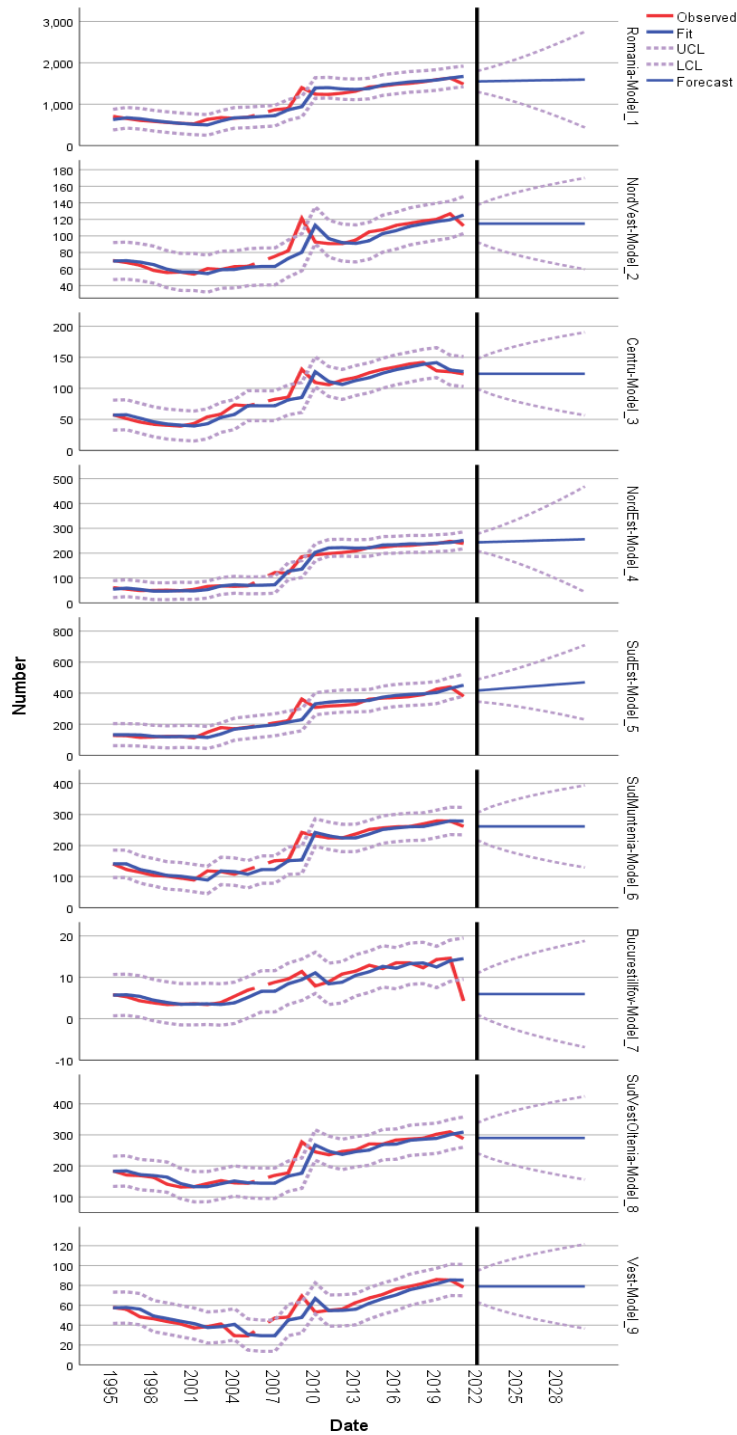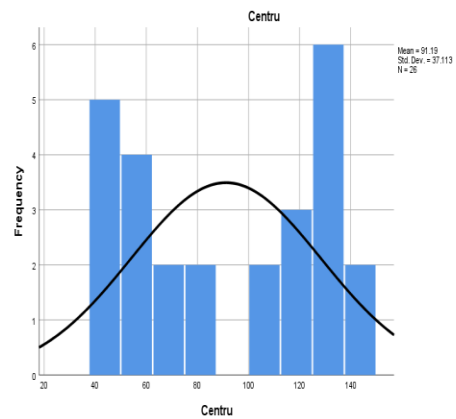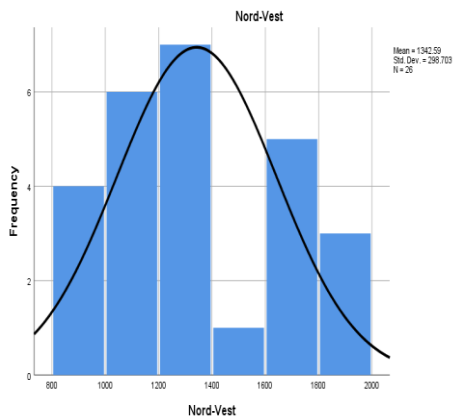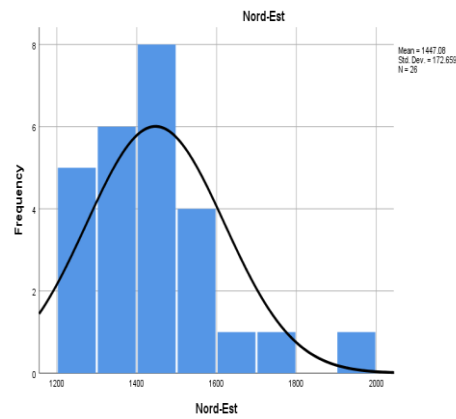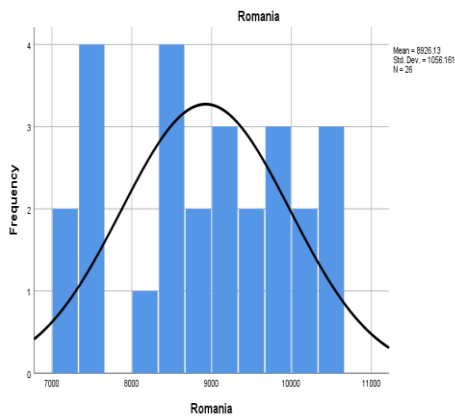MAE of 16.48, MaxAE of 105.35 and Normalized BIC of 5.71 (Fig. 4).

Fig. 4. Forecast 2028 for the goat herd, Romania and the mountainous areas of Romania

The descriptive frequency analysis for the Romanian sheep population shows an average of 8,926.13 (Figure 5). The standard error of the mean is 207.13, the median is 8,994.75, the standard deviation is 1,056.16, the variance is 1,115,475.23, the skewness is -.162, the standard error of skewness is .456, the kurtosis is -1.265, the standard error of kurtosis is -. of .887, range of 3,213, minimum of 7,251, maximum of 10,646, values on the 25th percentile of 8,004.95, the 50th percentile of 8,994.75 and the 75th percentile of 9,902.08 [8].
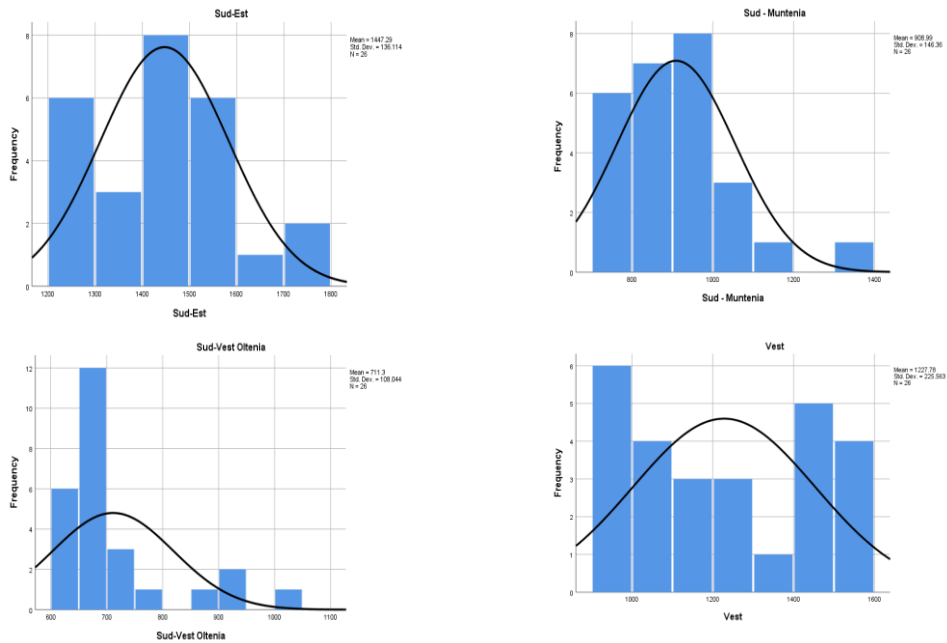
Fig. 5. Descriptive frequency analysis for the sheep population related to the period 1995-2021, Romania and the mountainous areas of Romania

The prediction analysis for the mean shows a static R-squared of .047, dynamic R-squared of .794, RMSE of 91.50, MAPE of 5.17, MaxAPE of 26.04, MAE of 66.58, MaxAE of 251.75 and Normalized BIC of 8.21 (Figure 6).
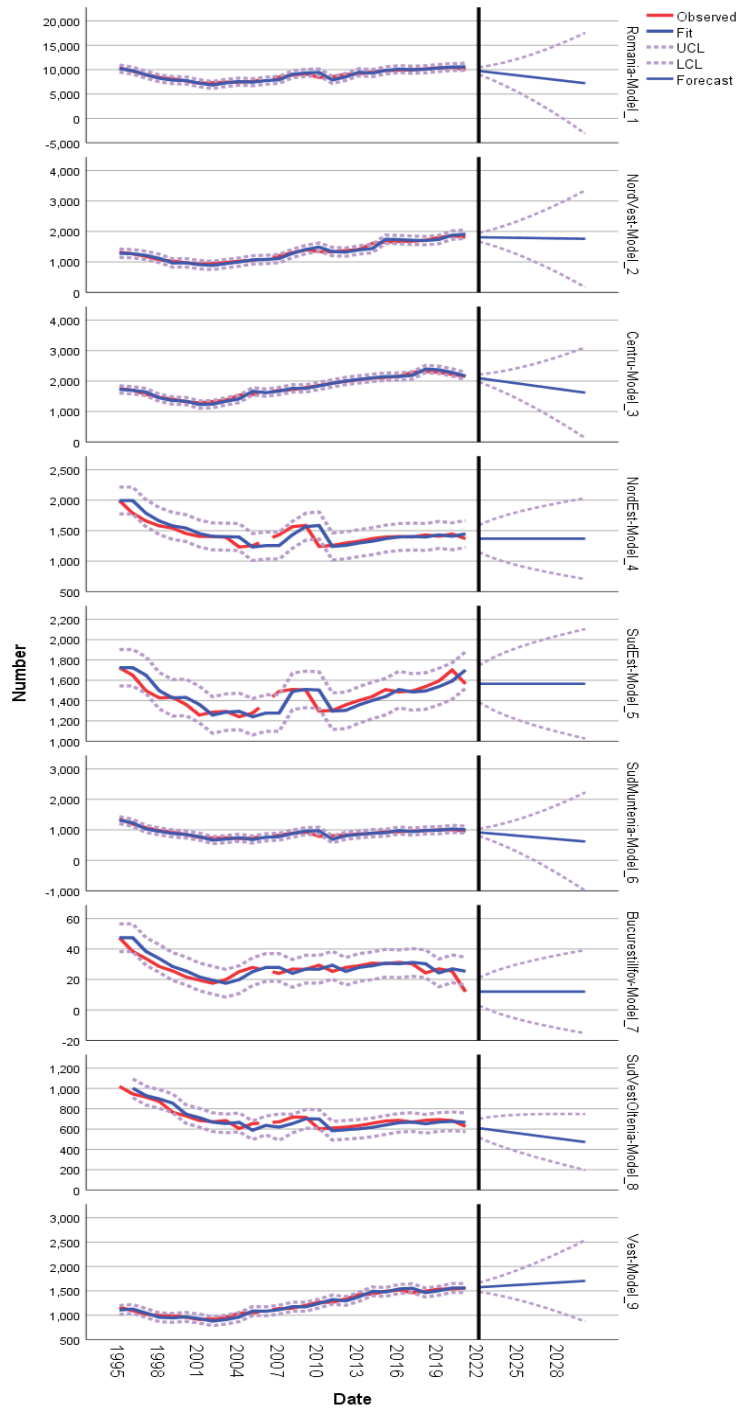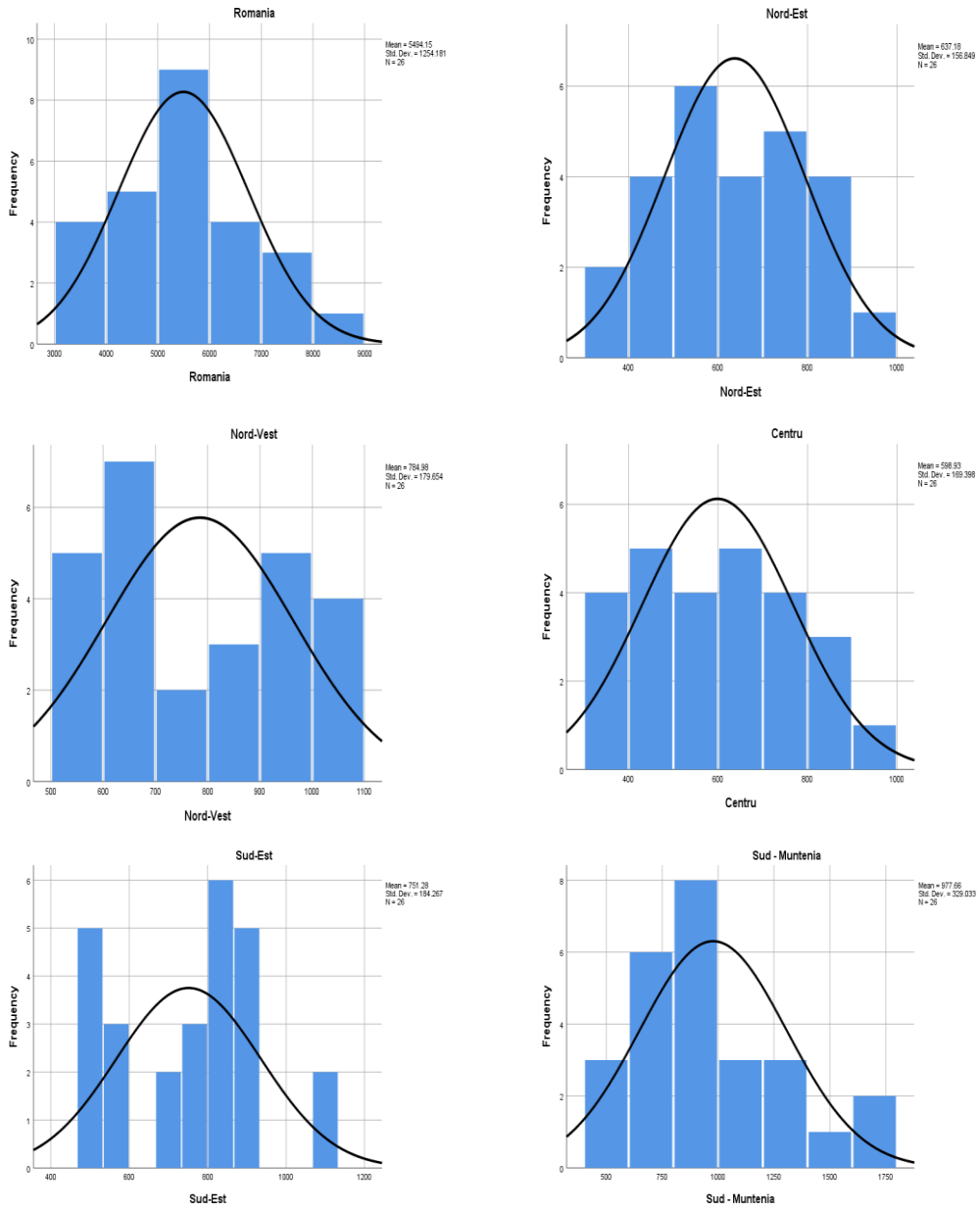
Fig. 6. Forecast 2028 for the sheep population, Romania and the mountainous areas of Romania

The number of pigs in Romania, according to the descriptive frequency analysis, was in the analyzed period at an average of 5,494.15 (Figure 7) [6].
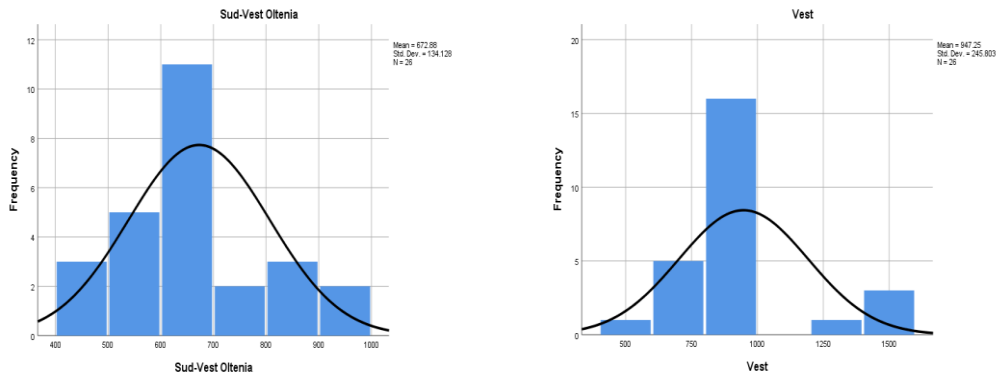
Fig. 7. Descriptive frequency analysis for the pig herd related to the period 1995-2021, Romania and the mountainous areas of Romania

The standard error of the mean is 245.96, the median is 5,207.25, the standard deviation is 1,254.18, the variance is 1,572,968.91, the skewness is -.540, the standard error of skewness is .456, the kurtosis is -.290, the standard error of kurtosis is of .887, range of 4,615, minimum of 3,620, maximum of 8,235, values on the 25th percentile of 4,642.48, the 50th percentile of 5,207.25 and the 75th percentile of 6,512.25. The prediction analysis for the mean shows a static R-squared of .009, dynamic R-squared of .791, RMSE of 134.08, MAPE of 8.67, MaxAPE of 37.20, MAE of 85.24, MaxAE of 393.36 and Normalized BIC of 9.13 (Fig. 8).
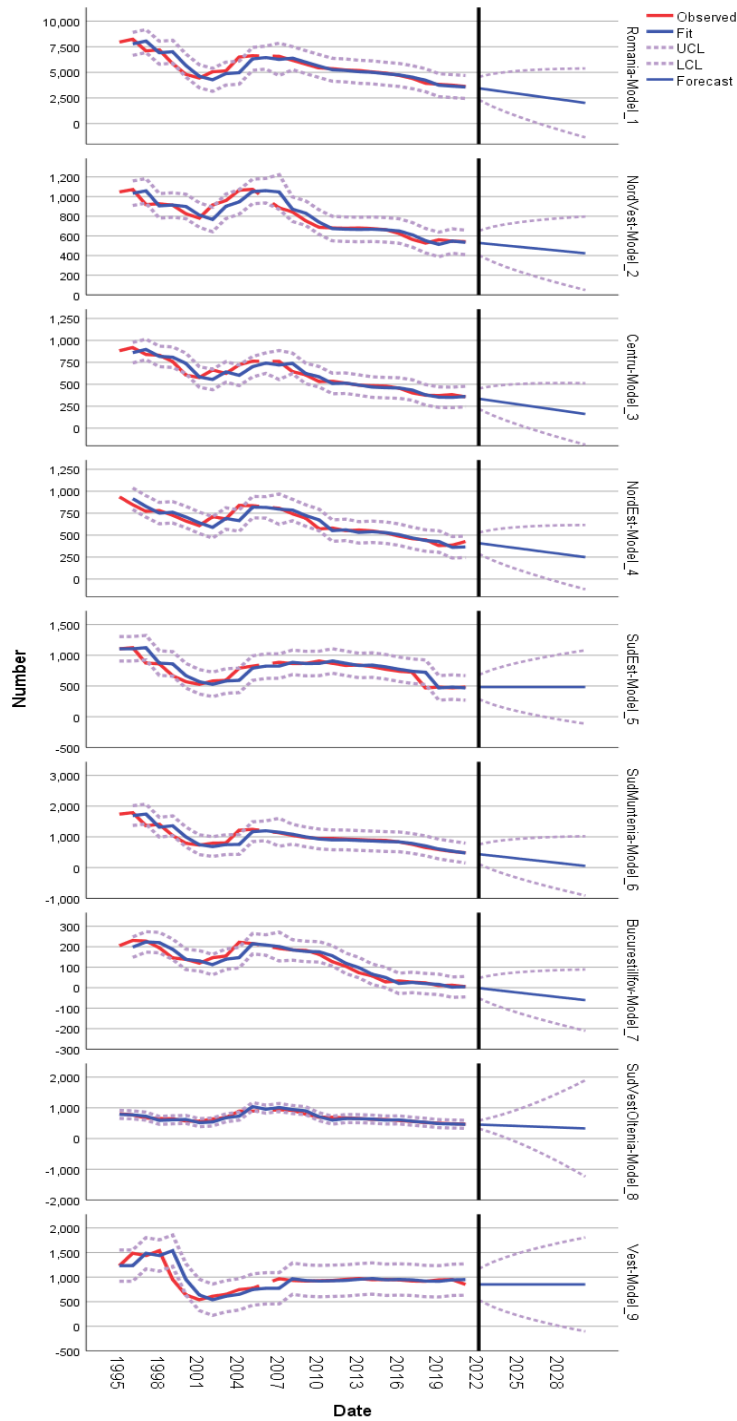
Fig. 8. Forecast 2028 for the pig population, Romania and the mountainous areas of Romania

Conclusions

(1). The analysis in the paper shows that the livestock in Romania with a considerable reduction, cattle and pigs, require massive investments in the next period. The sustainability of the Romanian livestock will be achieved by ensuring a sustained support for the categories of cattle and pigs, being the most profitable branches of the Romanian livestock. Livestock categories with linear growth, goats and sheep, require moderate investment in the next period.

(2). The forecast analysis confirms that 2028 is the year in which effective growth could be reached in all livestock categories in Romania, if current investments are carried out properly.

(3). The innovative solutions for all the presented categories can ensure the sustainability of the Romanian livestock, by ensuring competitiveness in front of imported products; the development of protected areas for grazing in common mountain areas; ensuring protected natural ecosystem conditions for agriculture; development of environmental conditions for protected natural spaces for agriculture; support for the sale of mountain production in large stores.

R E F E R E N C E S

[1] Beciu, S., Arghiroiu, G. A., Panait, R. Did the pork sector in Romania reach the maximum decline? Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development 20(1): 61-65 (2020).

[2] Băneş, A., Raicov, M., Orboi, M. D. Analysis of the evolution and influence of the number of meat animals in Romania. Journal on Processing and Energy in Agriculture 23(2): 101-104 (2019).

[3] Chetroiu, R. Dynamics of the Bovine Products Markets in Romania-Milk and Beef in Kuzman, B., & Prdić, N. 2018. Sustainable agriculture and rural development in terms of the Republic of Serbia strategic goals realization within the Danube region. Strategic significance of wholesale markets in agricultural products sale. Institute of Agricultural Economics Belgrade 716-732 (2018).

[4] Ciocan-Alupii, M., Maciuc, V. Considerations regarding the mountainous area of Romania: present and perspectives in relation to the breeding activity of cattle. Scientific Papers. Series D. Animal Science 63(1): 301-305 (2019).

[5] Covaci, B., Covaci, M. Bovine analysis and forecasting for 1995-2028 period. Mountain Journal Perspectives 2/2022: 2-8 (2022a).

[6] Covaci, B., Covaci, M. Swines analysis and forecasting for 1995-2028 period. Mountain Journal Perspectives 2/2022: 9-15 (2022b).

[7] Covaci, B., Covaci, M. Goats analysis and forecasting for 1995-2028 period. Mountain Journal Perspectives 2/2022: 16-22 (2022c).

[8] Covaci, B., Covaci, M. Sheep analysis and forecasting for 1995-2028 period. Mountain Journal Perspectives 2/2022: 23-29 (2022d)

[9] Eurostat. Animal populations by NUTS 2 regions [agr_r_animal]. (2022).

[10] Leonte, E., Chiran, A., Jităreanu, A. F., Robu, M., Matei, D., Sofone, N., Delibaș, C. Study on the Development of Romanian Agriculture after Accession to the European Union. Scientific Papers, "Ion Ionescu de la Brad" University of Agricultural Sciences and Veterinary Medicine, Iasi, Agronomy Series 61(1): 97-100 (2018).

[11] Rey, R. 'Mountain Product', of High-biological Quality. Meadows' Polyflora, Organic Fertilizer and a Sustainable Mountain Economy. Proceedings Economics and Finance 8:622-631 (2014).

[12] Soltani, M., Soltani Nejad, N., Taheri Azad, F., Taheri, B., Gannon, M.J. Food consumption experiences: a framework for understanding food tourists' behavioral intentions. International Journal of Contemporary Hospitality Management 33(1):75-100 (2020).

[13] Wilk, R. Paradoxes of Jews and their Foods. Jews and their Food Ways 231-246 (2015).