ECONOMIC EFFICIENCY OF BREEDING TSIGAI SHEEP IN THE CENTRAL AND SOUTH – EAST EUROPE

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ABSTRACT

Tsigai is an indigenous sheep breed present in entire Central and South-East Europe. Due to its low meat and milk production number of Tsigai sheep is in a sharp decline. But, there is a strong need to preserve valuable genetic resources of this breed. Therefore, the goal of this research is to evaluate economic performance of Tsigai breeding and to define strategies for its future use. In the paper profitability of Tsigai breeding is determined as well as economic efficiency of investments in Tsigai farms (using Net Present Value and Internal Rate of Return). To perform the analysis in risky circumstances authors applied sensitivity and decision tree approach. The results indicated that breeding of Tsigai sheep requires state subsidies to be profitable and economically efficient. Decision tree approach resulted in calculation of expected NPV. Investments in Tsigai farms proved to be economically efficient, but associated with high level of risk.

Introduction

Tsigai breed originates from Asiatic Ural, and it is "triple-purpose breed reared for wool, milk and meat" (Savić et al., 2000). Origin and relations between Tsigai and some other indigenous Balkan sheep breeds are discussed in details by Draganescu (2007), as well. Tsigai breed is present in many countries in the Central and South – East Europe but the most important breeder countries are Serbia, Romania, Hungary and Slovakia.

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Taking into account variability of Tsigai sheep, it is very important to study genetic differences among various Tsigai populations, in order to determine and maintain their genetic diversity. Such type of research was performed by Savić et al. (2000) and Ćinkulov et al. (2008) for Tsigai sheep in Serbia, by Kusza et al. (2009) for Slovak population of Tsigai, by Kusza et al. (2010) and Annus et al. (2015) for Tsigai sheep population in Hungary, and by Zăhan et al. (2011) for Tsigai sheep in Romania. The same issue was discussed by Kusza et al. (2011) for local sheep breeds in Southern and Eastern Europe (Romania, Albania, Croatia, Turkey and Serbia). Research carried out by Vlaic et al. (2015) emphasized importance of preservation of genetic Tsigai sheep resources because of possible increased demand concerning international exchange of sheep genetic resources due to climate changes. Petrović et al. (2011) emphasized importance of traditional breeds noticing that genetic improvement increased productivity of domestic animals, but "animals selected for high and efficient production are exposed to greater risk" which primarily assumes "physiological and immunological problems".

Although Romanian word Tsigai means soft, fine wool, nowadays production of wool is not the main goal of Tsigai breeders. The reason is low price of wool and decreasing trend in total wool production worldwide. According to Lescheva and Ivolga (2015) as a result of such a negative trend, proportion of wool in the manufacture of all textile fibers in the world in 2012 was only 1.3%, while proportion of artificial fibers was 67.1%. According to the results of European Food Safety Authority (EFSA) panel (2014) Tsigai breed is "selected for survival and production under local environmental circumstance" and it is "often multi-purpose traditional breed", while wool production is "seldom primary breed criteria". Although Tsigai sheep is an indigenous breed with rather low productivity there were some cases in which Tsigai sheep was successfully used to improve the traits of some other local sheep breeds, for example in Ukraine (Sedilo et al., 2016).

Despite the fact that Tsigai sheep could be used for production of wool, milk and meat, Vrdoljak et al. (2007) stated that in Croatia meat production is the most important one. Similarly, due to low wool prices Tsigai breeders in Romania shifted their interest from wool production to meat or milk production (Ilişiu et al., 2013). In Serbia, general trend in sheep production is also oriented towards meat production (Petrović et al., 2011), while the same trends are noticeable in Hungarian sheep production (Kukovics, Németh, 2011).

Because the Tsigai is a traditional multipurpose sheep breed with rather low level of productivity, the question arises how to stop decreasing trend in number of Tsigai sheep and preserve valuable genetic resources. Besides, it should be mentioned that there are other significant benefits for the entire society from Tsigai breeding (not only preservation of genetic resources). Considering importance of preservation of Tsigai breed, but at the same time bearing in mind very low level of its productivity, the goal of this paper is to analyze economic efficiency of production using Tsigai breed as well as to determine possible directions of future use of this breed.

Materials and methods

Tsigai sheep is present in number of countries across Central and South – East Europe, but each country has a bit different production environment. To conduct the research authors primarily used data describing real production conditions in Serbia. Nevertheless, production potential of Tsigai breed is estimated not only on the basis of research conducted in Serbia (Gutić et al., 2006; Mekić et al., 2007; Petrović et al., 2009) but also in Romania (Dărăban, 2008; Ghita et al., 2010; Cighi, 2016; Ilisiu et al., 2018) in Slovak Republic (Makovický et al., 2013; Margetin et al., 2013; Polák et al., 2013) in Hungary (Budai et al., 2013; Marley, 2014; Gavojdian et al., 2015) and in Croatia (Antunović et al., 2008; Mioč et al., 2011; Antunović et al, 2012; Antunović et al., 2013).

Additional data were gathered through interviews and monitoring of 20 farms specialized in Tsigai sheep breeding in Serbia, which flock size was between 50 and 200 ewes. All the producers are situated in the Province of Vojvodina where Tsigai breed is commonly used. The area is located in the northern part of Serbia bordering Romania, Hungary and Croatia where breeding of Tsigai sheep is also traditionally present. Data related to production performance of Tsigai breed are also acquired through interviews with employees of Serbian agricultural advisory service.

Revenues and costs are calculated on bio-economic model of Serbian family farm specialized in Tsigai sheep production having 150 ewes. The farm is performing meat – wool type of production, which is in line with results presented by Petrović et al. (2009) who stated that in future Tsigai breed in Serbia should be used for meat production (due to body mass of adult animals and body mass of lambs). The size of state subsidies for quality breeding ewes and sold lambs is determined on the basis of appropriate Serbian regulations. Relevant information regarding prices of outputs and inputs are provided by STIPS database (System of Agricultural Market Information of Serbia) which is operated by Serbian Ministry of Agriculture, Forestry and Water Management.

To discover economic efficiency of investments, authors used the most important capital budgeting indicators such as Net Present Value (NPV) and Internal Rate of Return (IRR). Sensitivity analysis is performed to determine crucial factors affecting profit, NPV and IRR. Decision tree method for evaluation of investments in risky circumstances was applied to calculate expected NPV.

Results and Discussions

The research is based on an assumption that a farmer invests in modern building and equipment for accommodation of 150 ewes and appropriate number of other categories of sheep. The highest percentage of initial cash outlay is related to the construction of a completely new building (*Table 1*). Financing of the investment is supposed to be 50% from equity funds (interest rate for opportunity costs is 1%) and 50% from loan (interest rate is 6.5%). Therefore weighted average cost of capital (WACC) used for discounting is 3.75%

Table 1. Investment for establishment of Tsigai farm

Item	Total investment (EUR)	Participation in total investment (%)
Buildings	29,750.00	44.75
Equipment	3,150.00	4.74
Breeding heard	22,500.00	33.84
Working assets	11,080.00	16.67
Total	66,480.00	100.00

Source: Authors' calculations

Profit in sheep production (based on data from year 2019 regarding prices of final products, prices of raw material and level of subsidies) is calculated starting from two possibilities (*Table 2*). First possibility is that farmer uses all available subsidies for Tsigai production in Serbia, while other possibility is that farmer does not use subsidies at all (because he is not registered with the appropriate agency which is in charge of payment of state subsidies). In both cases the most important revenue originates from sold lambs (52.35% or 85.47% if subsidies are not used). On the other hand, costs are dominated by feed costs (73.63% if farmer uses subsidies or 78.07% without use of subsidies). Having in mind difficulties to estimate opportunity costs for labor of family members at the farm, labor costs are not included in the calculation. Instead, reimbursement for family labor and management skills would be made from profit (all labor is performed by family members as regular or custom labor). The results indicate that sheep farms dealing with Tsigai breed are profitable only if they are subsidized.

These results are in line with findings reported by other authors. Investigating economic efficiency of extensive sheep and goat farming in Serbian conditions using indigenous breeds (not only Tsigai sheep but also Pramenka sheep and Balkan goat breed) Ivanović (2018) determined that such production is economically efficient, but it is less profitable than intensive livestock production. It was also determined that this type of production is not profitable without state subsidies. Similar conclusion was made by Krupová et al. (2014) for multi-purpose extensive local sheep breeds in Slovakia, determining that such production was profitable only with existing governmental subsidies and EU payments. Data reported by Niżnikowski et al. (2006) indicated that sheep production in majority of countries of Central and Eastern Europe has low or mediate profitability, or that they are even not profitable (depending on type of costs involved in calculations). De Rancourt et al. (2006) reported similar results concerning economic efficiency of sheep production in Mediterranean area. Authors found out that dependence of meat production systems and extensive production systems on subsidies is higher than dependence of milk production systems on subsidies. On the other hand, milk production systems have higher income, but they are more sensitive to changes of market prices of milk products. Discussing relations between Common Agricultural Policy and conservation of rare sheep and goat breeds, Canali (2006) stated that some breeds are rare because in short run they provide lower level of profitability, and that their survival is essentially dependant on the level of EU subsidies.

Table 2. Profit in sheep production using Tsigai breed (EUR)

Item	With subsidies	Without subsidies
Total revenue	28,915.00	17,710.00
Sold lambs	15,137.50	15,137.50
Culled ewes	2,310.00	2,310.00
Wool	262.50	262.50
Subsidies for quality breeding ewes	8,700.00	-
Subsidies for sold lambs	2,505.00	-
Total expenses	26,343.88	24,843.88
Feed costs	19,394.86	19,394.86
Bedding	1,400.00	1,400.00
Other material costs	760.00	760.00
Veterinary services, medicine and hygiene costs	550.00	550.00
Registration costs for sheep	1,500.00	-
Maintenance of buildings and equipment	91.00	59.50
Depreciation	1,058.75	1,058.75
Interest	1,589.27	1,589.27
Profit	2,571.12	-7,133.88
Profit per ewe	17.14	-47.56

Source: Authors' calculations

It is evident that existence and level of subsidies is the key issue for profitability of Tsigai sheep breeding. In this case, total amount of state subsidies paid to farmer is 11,205.00 EUR (sum of subsidies for quality breeding ewes and subsidies for sold lambs), while participation of subsidies in total revenue is very high (38.75%). Minimal amount of subsidies needed to break-even is 8,633.88 EUR, which means that present level of subsidies could decrease only 22.95%. Otherwise the production would not be profitable, which is an important indicator for policy makers.

On the other hand, the state has no influence on the level of lamb prices (in the calculation authors used lamb price 2.5 EUR/kg of live weight), because they are formed on free market. But it is necessary to bear in mind that revenue from sold lambs dominates in total revenue (52.35% of total revenue), and that price decrease of only 16.80% leads to zero profit, which means that the lower acceptable lamb price (assuming that the level of other elements of calculation is unchanged) is 2.08 EUR/kg. It is also necessary to point out that the state has no influence on the level of production costs, which are dominated by feed costs, so that the increase of feed costs of only 13.26% would lead to zero profit. These results indicate that, although without state subsidies Tsigai production is not sustainable, even greater risks for this production originate from variability of lamb prices and feed costs (*Table 3*). The same conclusion could be reached if change of 10% for each factor is analyzed (*Table 4*).

Table 3. Sensitivity of profit in Tsigai production to the most important factors

Factor affecting profitability	Maximal acceptable change (increase or decrease) of the factor
Feed costs	Increase 13.26%
Lamb price	Decrease 16.80%
Total subsidies	Decrease 22.95%

Source: Authors' calculations

Table 4. Sensitivity of profit in Tsigai production assuming 10% factor variation

Factor affecting profitability	Factor variation	Output (profit) variation
Feed costs	10%	75.43%
Lamb price	10%	58.88%
Total subsidies	10%	43.58%

Source: Authors' calculations

In such a situation farmers should keep their costs as low as possible, searching at the same time for the ways of lamb price increase. Taking into consideration that Tsigai is an indigenous and endangered breed, there are following ways for improvement of its revenues:

- Production of premium (organic) products, production of products with geographic origin, improvement of marketing based on the use of endangered local breed (Ilişiu et al., 2013).
- Integration of production, processing and marketing in cooperative associations (Drăgănescu, 1998).
- Krupová et al. (2014) suggested that "economic sustainability of multi-purpose sheep farms in marginal areas can be reached mainly by the exhaustion of the reserves in the biological potential of the current breeds". Authors also considered that an "increase of the proportion of milk processed to cheese on farms" could improve profitability, while possible problems regarding possibility to sell additional quantities of cheese should be taken into account.
- Niżnikowski et al. (2006) enlisted solutions such as development of local market for sheep products, improvement of direct sale to reduce related costs, common approach of several countries to European market and alike.

To get the better insight into economic performance of Tsigai breeding further analysis addresses economic efficiency of investments in Tsigai farms. On the basis of an average net cash flow and appropriate discount rate (3.75%), it was determined that the investment in establishment of Tsigai farm is economically efficient (net present value is positive and internal rate of return is higher than the discount rate) only if subsidies are used (*Table 5*). On the other hand, without subsidies an average yearly net cash flow is negative as well as net present value and internal rate of return.

Table 5. Economic efficiency of investments in Tsigai farm (EUR)

Item	With subsidies	Without subsidies
Initial investment (cash outlay)	66,480.00	66,480.00
Cash inflow	28,915.00	17,710.00
Cash outflow	23,695.86	22,195.86
Net cash flow	5,219.14	-4,485.86
Salvage value after 10 years	55,892.50	55,892.50
Net present value	15,062.43	-64,642.67
Internal rate of return	6.68%	negative

Source: Authors' calculations

Having in mind that the NPV is the most important indicator of economic efficiency of investments, it is analyzed how certain factors influence NPV of farms that receive subsidies. The results led to the conclusion that (similarly to sensitivity analysis of profit) the most influential factor on NPV is feed costs (*Table 6*). It is also important to point out that the NPV is more sensitive (comparing to profit) to changes in the observed factors. Therefore, minimal lamb price needed to have zero profit is 2.08 EUR/kg while minimal lamb price which leads to zero NPV is 2.20 EUR/kg.

Table 6. Sensitivity of NPV in Tsigai production to the most important factors

Factor affecting NPV	Maximal acceptable change (increase or decrease) of the factor
Feed costs	Increase 9.46%
Lamb price	Decrease 12.00%
Total subsidies	Decrease 16.37%

Source: Authors' calculations

Analysis could be extended to other factors influencing NPV (such as discount rate and amount of initial investment – cash outlay) and IRR (while height of discount rate does not affect IRR). The results indicated that amount of NPV is less influenced by initial investment and discount rate, comparing to other factors (*Table 7*). Changes of discount rate (cost of capital) have the smallest effect on the size of NPV. Besides, variation of observed factors has greater effect on NPV than on IRR.

Table 7. Sensitivity of NPV and IRR in Tsigai production to the most important factors

Factor affecting profitability	Input variation	Output (NPV) variation	Output (IRR) variation
Feed costs	10%	105.75%	46.05%
Lamb price	10%	82.54%	36.18%
Total subsidies	10%	61.10%	26.76%
Initial investment	10%	44.14%	20.84%
Discount rate	10%	14.89%	No influence

Source: Authors' calculations

Taking into consideration that investments in Tsigai breeding are very risky (rather small changes of observed factors are causing negative NPV), it is necessary to discuss

possibilities to lower required investments in this production. The most convenient solution is to avoid investments in new housing capacities. Instead, existing premises (buildings) could be used which would lead to a significant decrease of total level of investments. This approach is based on results of research presented by Radivojević (2014), as well as Marković et al. (2014) who determined that existing capacities for livestock housing in Serbia are not used enough in the production, and the same conclusion could be made for feed storages for livestock production.

This is a result of many factors such as a long term decreasing trend in number of livestock in Serbia, depopulation of villages, downfall of big agricultural enterprises which existed in socialism etc. If farmers used existing premises (buildings) instead of investing in the new ones, total investment would decrease by 44.75% (from 66,480 EUR to 36,730 EUR). Such an approach is possible because Tsigai sheep is an indigenous sheep breed adapted to local conditions and does not require up to date accommodation facilities. The effects of such business decision (with and without subsidies) are presented in *Table 8*.

Table 8. Economic effects of decreased investments in Tsigai farm (EUR)

Item	With subsidies	Without subsidies
Initial investment (cash outlay)	36,730.00	36,730.00
Cash inflow	28,915.00	17,710.00
Cash outflow	23,695.86	22,195.86
Net cash flow	5,219.14	-4,485.86
Salvage value after 10 years	33,580.00	33,580.00
Net present value	29,371.73	-50,333.37
Internal rate of return	13.76%	negative

Source: Authors' calculations

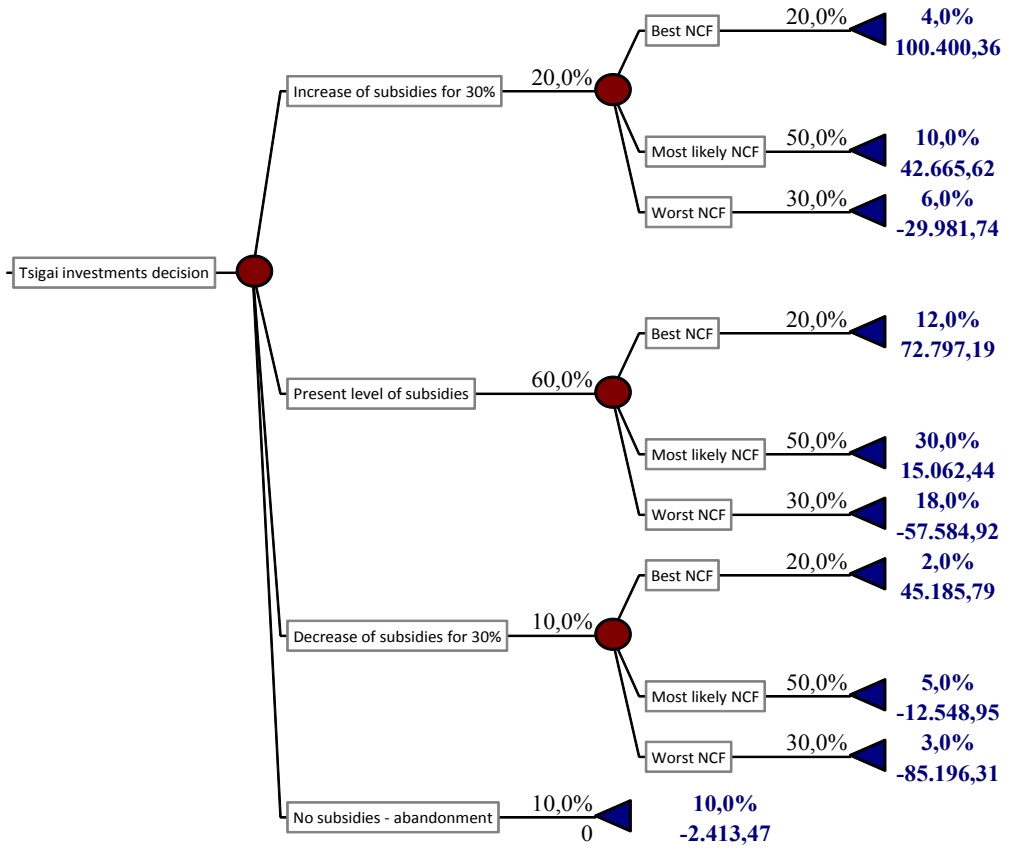
As a result of total investments decrease NPV and IRR significantly increased if subsidies are used (value of these indicators approximately doubled). On the other hand, if subsidies are not used investment in sheep production remains economically inefficient, due to negative net cash flow which has not been affected by the decreased level of total investment.

Sheep production faces many risks related to all above mentioned factors, so it is possible to predict a lot of scenarios for future business environment, which could be presented by the use of a decision tree (*Figure 1*). The analysis started from the following assumptions:

- After the initial investment has been made, in the first year of the project it is possible to predict level of revenues and costs with certainty. On the other hand, it is not possible to know the level of subsidies with certainty. Therefore, four scenarios (with appropriate probabilities) for state subsidies are assumed. If there is no subsidies the investments will be abandoned after the first year (the project will be sold according to its accounting value).

- From year two to the end of the observed period (total analyzed period is 10 years) three levels of net cash flow (NCF) are predicted. They are the best, the most likely and the worst scenario. In these scenarios NCF is influenced not only by the level of subsidies but also by more or less favorable values of lamb prices and feed costs.
- For each scenario probability of occurrence is estimated and NPV is calculated.

Figure 1. Decision tree for evaluation of investment in Tsigai breeding



Source: Authors' calculations

Taking into account NPVs of all ten scenarios and their probabilities, expected NPV for this investment is calculated. The expected NPV of the investment is positive (6,851.81 EUR), so it could be concluded that the investment is economically efficient, although expected NPV is lower than initially calculated NPV (which was determined for expected business condition, without taking risk into account). Nevertheless, there is 42% probability that this investment will have negative NPV.

At the same time, standard deviation of expected NPV is 46,477.46 EUR, which provides an idea of how far above or below the expected value the actual value of NPV is likely to be. Coefficient of variation of this investment is determined to be 6.78 indicating risk per unit of NPV and considering at the same time level of risk and effects of the investment. Therefore, it should be considered that this is a high risk investment, but final decision (whether to invest in Tsigai breeding or not) depends primarily on farmers' risk preference.

Conclusions

This analysis, as well as other research conducted to evaluate economic efficiency of Tsigai sheep production (or other indigenous multi-purpose traditional sheep breeds), proved that it is not profitable without subsidies. Similarly, investments in Tsigai breeding are economically efficient only if farmers use subsidies. Also, such investments are related to high level of risk caused by fluctuations of feed costs and lamb prices. Therefore, policy makers in all the states of South – East Europe have great responsibility when deciding on the level of appropriate subsidies. It is determined that farmers' actions should be directed towards costs reduction followed by efforts to improve marketing of Tsigai products resulting in an increase of their prices. General conclusions of this analysis could be used in all countries across the region dealing with Tsigai sheep production.

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Conflict of interests

The authors declare no conflict of interest.

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