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# EVALUATION OF GENETIC POTENTIAL OF SHEEP IN DIFFERENT PRODUCTION SYSTEMS

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Invited paper

**Abstract:** Evaluation of phenotypic value of most present sheep breeds in Serbia is carried out as well as those populations which should have greater significance in the future. In this way, clear picture was obtained of strength and potentials of sheep production in different rearing systems, which will serve better defining of the direction of genetic-selection activities in the future. Researches have shown that there is high variability of traits depending on the observed factors. It is indicative that in the intensive system sheep breeds are forces of production direction meat and meat-wool, whereas in semi-intensive and extensive systems, predominant are breeds of tripartite direction. The best results in intensive rearing system were obtained in Mis sheep. In semi-intensive system, there is huge difference in body mass between Pirot improved sheep and Tsigai sheep, as well as between all investigated breeds in this system in regard to milk traits. Tsigai lambs realized higher body mass at the age of 90 days. Lipska sheep was dominant in regard to quantity of milk in lactation, but its fertility was the lowest. Mass of fleece was the lowest in sheep of Pirot improved population. There were no significant differences in regard to variability of the quantitative traits between sheep in extensive system, except in final body mass of lambs, where Svrljig and Pirot population were behind in comparison to Sjenica sheep.

**Key words:** sheep, rearing system, genetic potential

## Introduction

In the World, today, there are many sheep populations and different rearing systems, which are conditioned by natural and economical factors and sheep producing tradition in certain countries or regions. Therefore, there is no general model which could apply for all farms and conditions *(Osamu et al., 2005, Petrovic, 2007)*. Researchers are facing the responsibility to define existing systems and point out to directions of future development of sheep breeding *(Almahdy et al., 2000, Vizard and Niven, 2002, Ugarte, 2007)*. In modern sheep production, desire of every farmer is to increase the income, and this is possible

only if improvement of sheep is continuous process and main component of the production technology, and organizational forms of selection are modern and up to date *(Notter, 2001, Petrović et al., 2003; Hanford et al., 2002, 2003, 2005; Weerf van Der, 2004)*. Diversity of breeding goals, different rearing systems, level of farm organization, level of inclusion of government institutions in the development, implementation and maintenance of selection process, are some of the factors which influence the development and progress of sheep breeding in one country *(Snowder, 2002)*. Objective of the selection in sheep breeding is to improve traits of economical importance from generation to generation by genetic procedures. Therefore, first step towards the progress is in defining of breeding goals, adequate technique and methodology for measuring of production performance of animals. Success in this activity is influenced mainly by: efficiency of controls and recording of production performance, procedure of evaluation of genetic parameters and estimation of breeding value of animals and organization of the system for diffusion of genetic material. Special attention in selection is focused on development of software and genetic information systems on relation science – selection service – farm *(Vries et al., 2004; Safari et al., 2005)*. In sheep production in Serbia, in the last several decades, there have been some changes in the sheep rearing system. Conditions of nutrition and care have been improved, and local populations have been improved not only through selection measures but also planned or unplanned crossing with foreign breeds. Also, foreign breeds have been imported, and some of them succeeded to adapt to new conditions and are reared in pure breed, but their production potential hasn't been adequately expressed. Finally, new domestic, more productive breeds were obtained: Mis sheep and Pirot improved population, which should have more significant role in sheep breeding in Serbia, and which haven't been comparatively presented. Objective of this paper is to evaluate phenotypic value of the breeds most present in Serbia as well as those populations which should be more significant in the future. In this way we would get clear picture of strength and potentials of sheep breeding in Serbia in different rearing systems and more clearly define direction of future genetic-selection activity.

## Materials and Methods

Research was done in period from 2004-2009 in following three production systems: intensive, semi-intensive and extensive. In every rearing system, three sheep breeds were selected which are most often reared or are of interest for development of sheep breeding in Serbia. Controls of production performance were done according to standard methodological procedures, based on which data bases were formed. Of each sheep population, for processing 300 heads

were selected. Analysis of data relating to investigated traits was done using linear methods *(Harvey, 1991)*, whose model hast the following expression:

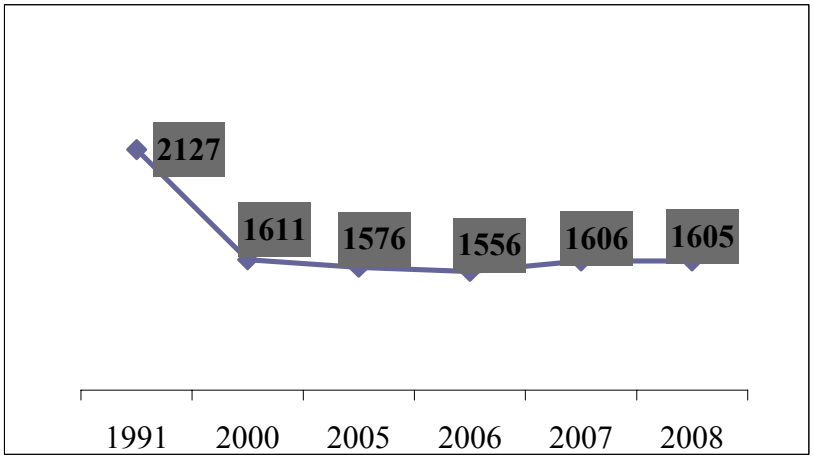
$$Yijklm = \mu + Bi + Gj + Sk + Fl + Mm + b1\ (x - \bar{x}_1) + eijklm,$$

where:

Yijklmn - Value of the trait of **y** individual animal, of **i** breed, in **j** year, **k** region, of **l** sire and **m** dam,
μ - General average in equal number of repetitions per classes
Bi - Fixed effect of breed
Gj - Fixed effect of year
Sk - Fixed effect of rearing system
Fl - Fixed effect of sire
Mm - Fixed effect of dam
b1 - Linear regression coefficient of age at first conception
$\bar{x}$ - Average value of age at first conception
eijklm - Other non-determined effects

## Results and Discussion

In order to have insight into situation of the sheep breeding in Serbia, first information necessary is sheep inventory i.e. number of heads of sheep reared in Serbia and what was the trend over the last two decades (Graph 1).




**Graph 1. Trend of number of heads of sheep in Republic of Serbia per year (in 000 heads)**

It is obvious based on presented graph that number of heads of sheep in Serbia decreased drastically during the nineties of the last century, after the disintegration of Yugoslavia. However, in the period from 2000 to 2008, the

number of sheep stabilized and it varied around the average value of 1.6 million heads. According to our research, it is estimated that number of sheep in Serbia will remain in the future at the level of approx. 1.5 million heads. Beside number of sheep, important role in improvement of sheep breeding at a sustainable level has genetic potential of populations which are reared, as well as production system *(Petrović, 2000, Vizard and Niven, 2002, Osamu et al., 2005)*. In the following tables, results of average values obtained in our research are presented.

Based on results presented in Table 1, high variability of traits depending on the observed factors in noticeable. It is indicative of the intensive system that sheep breeds are forced of meat or combined type, production direction meat and meat-wool, whereas in semi-intensive and extensive system sheep breeds of tripartite direction are predominant, meat-milk-wool. In intensive rearing system, the best results in regard to fertility and body mass of sheep was obtained in case of Mis sheep, slightly lower potential was exhibited by breed Ile de France, whereas Merinolandschaf was significantly behind. Differences between Merinolandschaf and other two populations were also statistically very significant in regard to fertility ($P<0.01$) and significant in regard to body mass ($P<0.05$), whereas significance of differences between Mis sheep and Ile de France was at the level of $P<0.05$. No great differences in regard to wool yield were established, so statistical significance of these differences was at the level of $P> 0.05$. Results of these researches are ain accordance to data stated for the same breeds by *Petrović (1992, 2006)* and *Mekić (1994)*.

**Table 1. Variability of quantitative traits of sheep depending on the environment and genetic factors**

| Rearing system | Sheep breed | Trait (LSM±SE) | | | |
|---|---|---|---|---|---|
| | | Body mass, kg | Fertility,% | Milk yieldt,kg | Wool yield,kg |
| Extensive | Svrljig | 56±2.05 | 118±0.03 | 84.12±4.11 | 2.54±0.03 |
| | Sjenica | 58±3.01 | 120±0.05 | 82.25±3.95 | 2.52±0.08 |
| | Pirot | 55±3.12 | 117±0.03 | 78.16±3.48 | 2.47±0.06 |
| Semi-intensive | Tsigai | 70±4.21 | 128±0.06 | 131.23±4.08 | 3.78±0.09 |
| | Lipska sheep | 68±4.11 | 120±0.04 | 149.52±4.25 | 3.82±0.07 |
| | Pirot improved | 65±3.89 | 125±0.05 | 76.12±3.58 | 3.33±0.06 |
| Intensive | Ile de France | 74±5.04 | 150±0.07 | 67.82±3.21 | 4.14±0.05 |
| | Mis | 77±5.85 | 154±0.07 | 69.25±3.16 | 4.09±0.03 |
| | Merinolandschaf | 70±4.98 | 131±0.06 | 65.41±3.09 | 3.91±0.07 |

In semi-intensive system, there was very significant difference ($P<0.01$) in regard to body mass between Pirot improved sheep and Tsigai, as well as between all investigated breeds in this system in regard to milk production, where Lipska sheep was dominant in regard to quantity of milk in lactation. On the other hand,

fertility of this sheep breed was the lowest and compared to other two breeds it was significantly different (P<0.01). Mass of fleece was the lowest in Pirot improved sheep and this was statistically significant (P <0.05). Extensive sheep breeding was mainly present in mountainous regions of Serbia, where three strains of Pramenka are dominant: Svrljig, Sjenica and Pirot strains. In Table 1. we see that there are no huge differences between observed populations of sheep. However, Sjenica sheep showed slightly better production performance in regard to body mass and fertility, whereas Svrljig sheep had better milk yield. Yield of wool of all three populations was very similar and was approx. 2.50 kg. By statistical analysis it was confirmed that there is no significance of differences in regard to variability of quantitative traits of sheep in extensive rearing system (P> 0.05).

**Table 2. The effect of environmental and genetic factors on trend of body mass of lambs from birth to age of 90 days**

| Rearing system | Sheep breed | Body mass (kg) | | |
|---|---|---|---|---|
| | | At birth LSM±SE | 30 days LSM±SE | 90 days LSM±SE |
| Extensive | Svrljig | 3.47±0.07 | 9.93±0.31 | 22.81±0.89 |
| | Sjenica | 3.85±0.13 | 10.15±0.40 | 23.50±0.96 |
| | Pirot | 3.43±0.11 | 9.65±0.33 | 21.13±0.93 |
| Semi-intensive | Tsigai | 4.12±0.07 | 11.98±0.42 | 27.43±0.97 |
| | Lipska sheep | 4.21±0.08 | 11.49±0.40 | 25.94±0.99 |
| | Pirot improved | 4.03±0.09 | 11.46±0.36 | 25.61±0.98 |
| Intensive | Ile de france | 4.34±0.12 | 12.02±0.38 | 32.09±1.12 |
| | Mis | 4.49±0.11 | 12.21±0.36 | 33.21±1.06 |
| | Merinolandschaf | 4.29±0.10 | 12.11±0.43 | 28.39±1.03 |

From data presented in table 2 we can see that body mass of lambs at birth varied depending on the system of rearing and breed. Body masses at birth, at the age of 30 and 90 days, were the lowest in extensive system and the highest in intensive system, which was expected. Existing differences are also statistically significant (P<0.01 and P<0.05). However, for these researches, more important is genetic potential of individual breeds, more precisely, the trend of body mass during growth for the purpose of realization of final or commercial body mass at the age of 90 days. The highest final body mass was realized by lambs in intensive rearing system –Mis population (33.21±1.06kg), followed by Ile de France (32.09±1.12kg), whereas Merinolandschaf was significantly behind (28.39±1.03kg). Differences between Merinolandschaf and other two populations were statistically very significant (P<0.01), whereas the difference between Mis sheep and Ile de France was significant (P<0.05). In semi-intensive rearing system, dominant were lambs of Tsigai breed with body mass of 27.43±0.97kg, and

difference between this breed and other two populations in the same system was significant (P<0.05). In extensive system of rearing, the highest body mass at the age of 90 days was realized by lambs of Sjenica sheep population (23.50±0.96kg), whereas Svrljig and Pirot sheep populations were considerably behind (P<0.05). Results of these researches are in concordance with those stated by *Petrović (1992, 2006)* and *Mekić (1994*). Slightly lower values for body mass of lambs of Sjenica population were obtained by *Mekić at al. (2008)*, which indicates that there are differences within one system of rearing which are mainly consequence of nutrition.

# Conclusion

Based on carried out research, processed and presented results, the following can be concluded:

There are differences in genetic potential of sheep in different production systems. In intensive system breeds of meat or combined type are forces, production direction meat and meat-wool, whereas in semi-intensive and extensive system dominant are tripartite breeds, production direction meat-milk-wool.

In intensive system of rearing, the best results in regard to fertility, body mass and gain of lambs were established for population of Mis sheep, slightly lower potential was exhibited by breed Ile de France, whereas Merinolandschaf sheep was significantly behind.

In semi-intensive system there is very significant difference in body mass between Pirot improved sheep and Tsigai, as well as between other investigated breeds in this system in regard to milk production, where Lipska sheep was dominant in regard to amount of milk in lactation. On the other hand, fertility of this breed was the lowest, whereas the fleece mass was the lowest in Pirot improved sheep. In this system, lambs of Tsigai breed were dominant.

Extensive rearing of sheep is mainly present in mountainous regions of Serbia, where three Pramenka strains are dominant: Svrljig, Sjenica and Pirot sheep strains. Results of the research showed that there were no significant differences in regard to variability of quantitative traits in observed sheep populations, with exception of body mass of lambs at the age of 90 days, where slightly higher values were established for Sjenica sheep population.

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# Procena gentskog potencijala ovaca u različitim proizvodnim sistemima

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## Rezime

Različiti sistemi gajenja ovaca, raznovrsnost ciljeva, nivo organizacije farmi, stepen uključivanja vladinih institucija u razvoju, implementaciji i održavanju procesa selekcije, su neki od faktora koji utiču na razvoj i napredak ovčarstva jedne zemlje. Stoga se prvi korak ka napretku sastoji od definisanja rasa, odgajivačkih ciljeva, odgovarajuće tehnike i metodologije za merenje proizvodnih osobina životinja. Na uspeh u ovom poslu najveći uticaj imaju: efikasnost kontrola i evidencije proizvodnih osobina, procedura procene genetskih parametara i odgajivačke vrednosti životinja i organizacija sistema za difuziju genetskog materijala. U ovčarstvu Srbije poslednjih nekoliko decenija je nastala vidna promena u sistemu gajenja ovaca, pre svega poboljšanjem ishrane. Pored toga sprovođeno je i oplemenjivanje lokalnih populacija selekcijom, planskim ili neplanskim ukrštanjem sa inostranim rasama. Takođe, neke uvožene rase adaptiravši se na nove uslove, gaje se u čistoj rasi, ali njihov proizvodni potencijal nije uvek adekvatno predstavljen. Konačno, dobijene su i nove domaće produktivnije rase: Mis ovca i Pirotska oplemenjena populacija. Cilj ovog rada je da izvrši procenu fenotipske vrednosti najzastupljenijih rasa ovaca u Srbiji kao i onih populacija koje bi trebale imati veći značaj u budućnosti. Time bi se dao doprinos sticanju prave slike o snazi i potencijalima ovčarstva Srbije u različitim sistemima gajenja i bolje definisao pravac daljeg genetsko selekcijskog rada. Istraživanja su pokazala da postoji visoka varijabilnost osobina u zavisnosti od svih posmatranih faktora. Indikativno je da se u intenzivnom sistemu forsiraju rase ovaca mesnatog ili kombinovanog tipa, smer meso i meso-vuna, dok u poluintenzivnom i ekstenzivnom sistemu dominiraju rase trojnog smera proizvodnje, meso-mleko-vuna. U intenzivnom sistemu gajenja, najbolje rezultate je pokazala populacija Mis ovce. U poluintenzivnom sistemu postoji vrlo značajna razlika u masi tela između pirotske oplemenjene ovce i cigaje, kao i između svih ispitivanih rasa ovog sistema u pogledu mlečnosti. Jagnjad cigaje su ostvarila najveću masu tela sa 90 dana. Lipska ovca po količini mleka u laktaciji dominira. Sa druge strane plodnost lipske ovce je najmanja, dok je masa runa najmanja kod ovaca pirotske oplemenjene populacije. Ekstenzivno gajenje ovaca je najviše zastupljeno u planinskim krajevima Srbije. Nema značajnih razlika u pogledu varijabilnosti kvantitativnih osobina između svrljiške, sjeničke i pirotske ovce,

osim u završnoj masi tela jagnjadi, gde su Svrljiška i Pirotska populacija u zaostatku u poređenju sa sjeničkom ovcom.

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