Original scientific paper
UDC 636.2.034.085.52:637.12.05(497.115)"2019/2020"

DIFFERENCES IN MILK PRODUCTION FROM FARMS THAT USE SILAGE AND FORAGE IRRIGATION TO THOSE THAT DO NOT USE, THE CASE STUDY IN KOSOVO

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Abstract

Silage and fodder irrigation create high benefits in milk production on farms and make high differences in production and efficient production. The purpose of the research was to analyse the use of silage in feeding dairy cows and watering fodder concerning milk production in different farms operating in Kosovo.

The research includes 237 farms with a random sample throughout the territory of Kosovo and all the farms subject to this research are market-oriented. The research was conducted from January to October 2021 and includes the period for the years 2019/2020. For the quantitative data, a questionnaire was used and the data were collected through face-to-face interviews with the farmers, while the qualitative data were collected through discussions with the farmers, and observations on farms.

In 2020 and 2019, out of 237 farms, 198 used silage in feeding dairy cows, while 39 farms did not use silage. Out of 237 farms, 80 of them had access to and irrigated fodder, while 157 farms did not have access to irrigation and did not irrigate fodder at all. In farm-based analyses, the average milk production in 2020 of farms that used corn silage was 80,237.12 litters of milk or 5,861 litters per cow, while the average milk production of the farms that did not use silage was 25,726.29 litters of milk or 1,879.19 litters per cow. The average milk production in 2019 of all farms that used silage was 81,704.83 litters or 5,733.6 litters per cow, while the average milk production of farms that did not use silage was 29,468.07 litters of milk or 2,067.9 litters per cow. The farms that had access to irrigation in 2020 produced an average of 106,700.9 litres of milk or 7,794 litres per cow**.** On the other hand, farms that did not have access to irrigation produced 53,211.4 litters of milk on average per farm or 3,889.8 litters per cow. The differences in milk production for farms that used silage and had access to irrigation were high when compared to farms that did not use silage and did not have access to irrigation.

Advisory services should inform and train milk producers about the role and importance of fodder, especially for silage and irrigation of fodder. Finally, institutions should allocate more funds for the irrigation of agricultural systems.

***Key words**: Milk Production, Farm, Silage, Fodder Irrigation, Kosovo.*

1. Introduction

Cattle are the most important category within agriculture and account for 47.5% of the total farm heads, while in the cattle structure, dairy cows account for 51%. Bovine milk dominates raw milk production. About 133,916 dairy cows produce 281 thousand tons of milk in Kosovo [1].

The livestock sector is one of the most important subsectors in agriculture, as it provides about 98% of milk and 60.4% of meat [2].

The purpose of the research was to observe the differences between farms that use silage and those that do not use silage, as well as farms that irrigate forage with those that do not irrigate forage. The ultimate goal was to observe the amount of milk produced on farms and the differences in milk production that may occur between farms based on the differences given between farms that use silage and irrigation versus those that do not use silage to feed cows and do not apply forage irrigation.

Milk production is considered an activity of significant nutritional, social and economic importance in Kosovo. Therefore, the Ministry of Agriculture, Forestry and Rural Development of Kosovo considers milk as a priority sector, providing support with direct payments and investment support for dairy farmers to improve the competitiveness of milk production, and improve food safety and health standards of animals [3].

According to research on the impact of nutritional factors on the cost of milk production by Krasniqi *et al.*, [4], the production cost of maize silage in Kosovo was 0.03 - 0.05 euro/kg, while that of grass silage was 0.05 - 0.07 euro/kg.

Kosovo has over 470,000 ha of agricultural land, while there is only a little land under the irrigation system, with a total area of 20,980 ha. Irrigation of crops, in addition to increasing yields per area and quality of food, also has a great impact on reducing animal feed production costs [5].

The research conducted by Bernardes and do Rêgo [6], in Brazil on 250 surveyed farms showed that 82.7% use maize alone or combined with other types of forage as a food base.

Knaus *et al.*, [8], in an analysis of the role and importance of silage in Austria, found that 85% of milk came from farms using silage, while only 15% of it came from farms not using silage. All lactations performed in the province of Tyrol between 2004 and 2006 are included in the analysis. 44,729 lactations were based on a ration without silage and 77,095 lactations were recorded with silage included in the ration. On average, standard lactation performance using silage was 6,281 kg milk per lactation, while feeding without silage resulted in 5,877 kg milk per lactation (a difference of 404 kg less milk on farms not using silage or at a 99% probability; $P < 0.001$).

According to research conducted on 150 farms in Southwestern Uganda by Ntakyo *et al.*, [7], farmers who used silage were 71.3% and those who had a permanent water source were 85.3%. Data on milk yields and values in four farms showed a positive change in milk production with about 725.5 litres per day more in the farms where silage was used.

In the experiments in the district of Hai by Waziria and Uliwa, [9], they found a significant increase in milk yields with 25% and 50% of origin from the influence of silage. The lowest milk production per individual farm was 5 and the highest was 10 litres/day before the experiment, while at the end of the experiment, the milk yield increased by 50% per dairy cow from 10 to 15 litres/day/cow.

Brar *et al.*, [10], conducted research to evaluate the effect of feeding maize silage on the milk production performance of Holstein Friesian dairy cows on six commercial dairy farms in Punjabi, India. This research showed that in 100 early lactation dairy cows, an average of 65 days in milk (animals fed with green forage (40 - 45 kg/day) the average milk yield varied from 20.0 kg/head/day to 28.0 kg/head/day with the overall average of 24.8 kg/head/day.

In the study of the effects of grain-to-forage crops (Shukun *et al.*, [11] China's farmer income conversion program on farmers in Hebei and Henan provinces based on a survey of 495 households and five farms with at least 100 cows. The average income of farmers who plant silage maize has increased to a very high level, by a very significant margin, increasing farmers' income by 26.3% per month.

In a study conducted by Nagy [12] on the effect of maize irrigation, it was observed that irrigation also improves the natural nutrients of maize.

Experiments done with maize irrigation for silage by Simsek *et al.*, [13], in 2004 and 2005 show that the maximum yield increased to 88.9 t/ha in the control treatment for both years. When data for 2004 and 2005 were combined, irrigation had a better relationship with silage yield showing a correlation with silage yield and irrigation levels.

To study the effect of irrigation methods and water quality on maize yield and water use efficiency, Irfan *et al.*, [14], used six different treatments conducted at the Postgraduate Agricultural Research Station (PARS), Faisalabad, Pakistan: drip irrigation with good quality water; drip irrigation with marginal quality water; drip irrigation with poor quality water; raised bed irrigation with good quality water; raised bed irrigation with water of marginal quality; and raised bed irrigation with poor quality water. In three replications of each treatment, the irrigation method and water quality positively affected the plant level. In these terms, maize production and water use efficiency increased maize grain yield to 8,487 kg/ha.

In this research, we present the advantages of using silage in feeding dairy cows and forage irrigation in the differences that appear in terms of milk production at the level of farms in Kosovo for the years 2019 and 2020.

2. Materials and Methods

An observation of domestic and international literature was used to observe levels of silage feed use and forage crop irrigation of dairy producers during 2019 -

2020. Also, interviews were conducted with employees of the Ministry of Agriculture, and with producers' associations, as well as with employees of the advisory service at the municipal level. Initially, we tested the questionnaire in 10 pilot farms to see if the producers had difficulties in answering the questions, but since there were no difficulties, then other producers were also interviewed throughout the territory of Kosovo (Table 1).

Table 1. Number of farms in the study

Region	No of farms by region	Percentage of farms by region (%)
Ferizaj	22	9.3
Gjakova	26	11.0
Gjilan	39	16.4
Mitrovica	25	10.5
Peja	43	18.1
Pristina	37	15.7
Prizren	45	19.0
Total farms N°	237	100%

The interviews were carried out through the direct interview model and the completion of the questionnaire by the authors, which allows asking for additional explanations regarding the answers to the questions. A survey was conducted to collect primary data. For quantitative data, a structured questionnaire method was used with a face-to-face interview by the authors (Figure 4), while qualitative data was also collected from interviews with questionnaires through personal discussions with farmers, such as observation of farm buildings, infrastructure inside and outside the farm, cow breeding systems, breed structure, types of feed used with a focus on silage, welfare, environment, agricultural mechanization, soil, irrigation water use systems, stable hygiene, etc. (Figures 1, 2, 3, 5, and 6).

Figure 1. Crops without irrigation

Figure 2. Crops with irrigation

Figure 3. Feeding dairy

Figure 4. View from interview

Figure 5. Irrigation channel

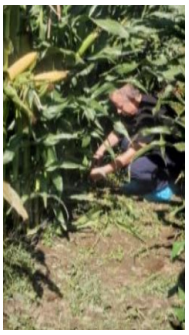

Figure 6. Drip irrigation

Interviews for 237 farms of different sizes with a random sample breeding dairy cattle were conducted during January - October 2021 to look at the levels of feed use with a focus on silage and access to irrigation of forage, land etc. In the impact it will have on milk production in Kosovo farms for the years 2019 and 2020. The statistical processing of the data was done through Statgraphics and SPSS programs.

3. Results and Discussion

3.1 Results

The number of farms in the research was N = 237, and the average number of dairy cows on the farm for 2019 was 14.25 cows and 13.69 cows for 2020 with a standard deviation of 13.45 for 2019 and 12.78 for 2020 respectively (Table 2).

Farms that used silage to feed cows in relation to milk production for 2020 were 198, while those that did not use silage in feeding cows were 39 farms (Table 3).

To test the importance of silage in milk production, we conducted an independent sample test of the amount of milk production in litres in 2020 for farms that used silage (1) and those that did not use it (0). The result is statistically significant (p = 0.001), with a confidence level of 95% (Table 4).

Farms that used silage in feeding cows in 2019 were 198th and produced 81704.83 litres of milk, while farms that did not use silage in feeding cows were 39th and produced 29468.07 litres of milk (Table 5).

To test the importance of silage in milk production, an independent sample test was performed on the amount of milk production in litres in the year before the 2019 pandemic for farms that used silage (1) and those that did not use it (0) (Table 6).

Table 2. Descriptive statistics for variables of interest for tests/hypotheses

Parameters	N	Minimum	Maximum	Mean	Std. deviation
Milk_Cow2019	237	2	100	14.25	13.454
Milk_Cow2020	237	2	110	13.69	12.782
Valid N (listwise)	237				

Table 3. Farms that used silage and those that did not use silage in feeding cows in relation to milk production for 2020

	Silage	N	Mean	Std. deviation	Std. error mean
Milk_ produced2020	1	198	80237.1237	100778.34370	7162.00502
	0	39	25726.2949	16410.70718	2627.81624

Legend: * (1) Farms that use silage; *(0) farms that do not use silage; *N = Number of farms.

Table 4. Independent samples test

Parameters	t-test for equality of means						
	T	Df	Sig. (2-tailed)	Mean difference	Std. error difference	95% Confidence interval of the difference	
						Lower	Upper
Milk_Produced2020							
Equal variances assumed	3.364	235	0.001	54510.82887	16206.28713	22582.65951	86438.99822
Equal Variances not assumed	7.145	231.830	.000	54510.82887	7628.87503	39480.04162	69541.61611

Table 5. Farms that use silage in feeding cows and farms that do not use silage in feeding cows vs milk production for 2019

	Irrigation system	N	Mean	Std. deviation	Std. error mean
Milk_ produced2019	1	198	81704.8308	102020.75634	7250.29945
	0	39	29468.0769	17431.33354	2791.24726

Legend: * (1) Farms that use silage; *(0) farms that do not use silage; *N = Number of farms.

Table 6. Independent samples test

Parameters	t-test for equality of means						
	T	Df	Sig. (2-tailed)	Mean difference	Std. error difference	95% Confidence interval of the difference	
						Lower	Upper
Milk_Produced2019							
Equal variances assumed	3.183	235	.002	52236.75389	16410.29417	19906.66821	84566.83956
Equal Variances not assumed	6.724	233.170	.000	52236.75389	7769.03490	36930.27809	67543.22968

From the above results, we can see a statistically significant difference (p = 0.002) with a confidence level of 95%.

The farms that irrigated fodder in 2020 were 80 and produced 106,700.94 litres of milk, while the farms that did not irrigate fodder were 157 and produced 53211.46 litres of milk in 2020 (Table 7).

To test the importance of access to an irrigation system on milk production, we conducted an independent sample test on the amount of milk production in 2019 for farms that have access to an irrigation system and those that do not (0). From the above results, we can see a statistically significant difference (p = 0.000) at the 95 % confidence level (Table 8).

The farms that used forage irrigation in 2019 were 80 farms and produced 106316.25 litres of milk, while the farms that did not use forage irrigation were 157 and produced 56187.97 litres of milk (Table 9).

To test the importance of access to an irrigation system on milk production, we conducted an independent sample test on the amount of milk production in 2019 for farms that have access to an irrigation system (1), and those that do not have (0). From the above results, we can see that there is a statistically significant difference (p = 0.000) (Table 10).

3.2 Discussion

Our research is an exploratory study which aims to evaluate the differences in the amount of milk

Table 7. The effect of forage irrigation vs milk production for 2020

	Irrigation system	N	Mean	Std. deviation	Std. error mean
Milk_ produced2020	1	80	106700.9438	145179.00958	16231.50672
	0	157	53211.4682	43199.72639	3447.71350

Legend: * (1) Farms that use silage; *(0) farms that do not use silage; *N = Number of farms.

Table 8. Independent samples test

Parameters	t-test for equality of means						
	T	Df	Sig. (2-tailed)	Mean difference	Std. error difference	95% Confidence interval of the difference	
						Lower	Upper
Milk_Produced2020							
Equal variances assumed	4.268	235	.000	53489.47560	12532.94059	28798.20322	78180.74797
Equal Variances not assumed	3.223	86.201	.002	53489.47560	16593.62946	20503.52660	86475.42459

Table 9. The effect of forage irrigation vs milk production for 2019

	Irrigation system	N	Mean	Std. deviation	Std. error mean
Milk_ produced2019	1	80	106316.2500	147006.97973	16435.87999
	0	157	56187.9713	44608.83360	3560.17250

Legend: *(1) Farms that use silage; *(0) farms that do not use silage; *N = Number of farms.

Table 10. Independent samples test

Parameters	t-test for equality of means						
	T	Df	Sig. (2-tailed)	Mean difference	Std. error difference	95% Confidence interval of the difference	
						Lower	Upper
Milk_Produced2019							
Equal variances assumed	3.968	235	.000	50128.27866	12728.41299	25051.90415	75204.65317
Equal Variances not assumed	2.981	86.491	.004	50128.27866	16817.04431	16699.80732	83556.75001

production in Kosovo farms to see as clearly as possible the advantages that milk producers have in feeding with silage and forage irrigation with farms that do not use silage in the feeders of cows and farms that do not irrigate forage with a focus on maize for silage. The case study included all regions of Kosovo. Despite the restrictive measures during COVID-19 and financial constraints, the findings can be considered representative of Kosovo as a whole, since the entire territory of the country is covered.

In 2020 and 2019, 198 out of 237 farms used silage for feeding dairy cows, while 39 farms did not use silage for feeding (Table 2). Speaking in percentage, silage to feed dairy cows is used by 83.54% of farms, which is similar to the situation in Austria (85% according to research done by Knaus *et al.*, [8]), Brazil (82.7% according to research done by Bernardes and do Rêgo [6]), and South Western Uganda (71.3% according to a research done by Ntakyo *et al.*, [7]).

The average milk production in 2020 of farms that used maize silage was 80,237.12 litres (Table 3), or 5,861 litres per cow (Table 2). The average production of 5,861 litres of milk per head of cow was obtained by dividing the average production of milk at farm level 80237.12 : 13.69 heads (Table 2). This is close to the milk production on Austrian farms of 6,281 kg of milk per lactating cow (Knaus *et al.*, [8]). The average milk production in 2020 from farms that did not use silage was 25,726.29 (Table 3) or 1,879.20 litres per cow (Table 2).

The average production of 1,879.19 litres of milk per head of a cow was obtained by dividing the average production of milk at the farm level of 25,726.29 : 13.69 heads (Table 3 and Table 2).

Based on the average milk production of all farms in 2019 (Table 5), the milk production of farms that used silage was 81,704.83 litres, which is 52,236.7 litres less compared to the average production of farms that use silage, while the average milk production at the farm level according to the average number of cows on the farm was 5733.6 litres (Table 2).

The average production of 5733.6 litres of milk per head of cow was obtained by dividing the average production of milk at farm level 81,704.83 : 14.25 heads (Table 5 and Table 2).

Based on the average milk production of all farms in 2019 (Table 5), the milk production of farms that did not use silage was 29,468 litres, which means 52,236.7 litres less compared to farms that used silage. The average milk production at the farm level according to the average number of cows was 2,067.9 litres/cow/farm (Table 2), which is a big difference compared to the farms using silage.

To test the importance of silage in milk production, an independent sample test was conducted on the amount of milk production in litres in the year before the 2019 pandemic (Table 5) for farms that used silage (1) and those that did not use silage (0). From the results (Table 6) it is clear that farms that use silage produce on average 52,236.7 litres of milk per year more than farms that do not use silage, this difference is statistically significant ($p = 0.002$ (Table 6) - out of 237 farms (Table 7), 80 of them had access to irrigation and irrigated forage, while 157 did not irrigate and did not have access to irrigation. 33.75% of farms irrigated forage while 66.24% did not.

When comparing the average milk production for all farms that had access to irrigation (Table 7) with the average number of cows on farms (Table 2) with milk production for 2020 (Table 7), the average production is 7,794 litres of milk per cow and is attributed to forage irrigation and feeding with silage, based on the observations on the farms we noticed that most of the farms that used silage also gave more concentrate, better hygiene, and higher well-being.

The average production of 7,794 litres of milk per head of cow was obtained by dividing the average production of milk at farm level: 106700.9438 : 14.25 heads (Table 7 and Table 2).

When we compare the average milk production for all farms that did not have access to irrigation (Table 7) with the average number of cows on farms (Table 2) with milk production for 2020 (Table 7), the average milk production was 3,889.8 litres of milk per cow, which means 3,904.2 litres of milk less per cow compared to farms that had access and did irrigation.

Average milk production in 2020 (Table 2) at the farm level for farms that used maize silage averaged 80,237.12 litres, while farms that did not use maize silage produced an average of 25,726.29 litres, with a difference of 54,510 litres more in advantage of farms using silage.

The average milk produced in 2019 (Table 4), at the farm level for farms that used maize silage on average was 71,704.07 litres, with a difference of 52,236.7 litres in favour of farms that used silage.

To test the importance of silage in milk production, an independent sample test was performed on the amount of milk production in litres in the year before the 2019 pandemic (Table 4) for farms that used silage (1) and those that did not use silage (0). From the

results (Table 5), it is clear that farms that use silage produce an average of 52,236.7 litres of milk per year more than farms that do not use silage. This difference is statistically significant (p = 0.002) (Table 5) and is comparable to the research done by Knaus *et al.*, [8], on the role and importance of silage in milk production in Austria where farms using silage produced 6,281 kg of milk in lactation per head of cow, while without silage they produced 5,877 kg of milk in lactation per head of cow - 404 kg less milk in lactation per head.

Of 237 farms (Table 6), 80 of them had access to irrigation and irrigated forage, while 157 of them did not use irrigation and did not have access to irrigation. In terms of percentage, 33.75% of farms have irrigated forage and 66.24% have not.

To test the importance of access to irrigation on milk production, an independent sample test was conducted on the amount of milk production, in the year before the 2019 pandemic, for farms with access to irrigation (1) and those without access to irrigation. (0). From the results (Table 8) it is clear that farms that have access to irrigation produce an average of 53,489.48 litres of milk per year more than farms that do not have access to irrigation. This difference is statistically significant (p = 0.000), (Table 9) which proves our hypothesis that forage irrigation directly affects the increase in forage yields, which corresponds to the research done by Simsek *et al.*, [13]. In 2004 and 2005, the yield of maize for silage with irrigation reached 88.9 t/ha and indirectly increased milk production on farms because farmers were getting more food, better quality and more efficient forage irrigation.

Differences in milk production of farms using silage and having access to irrigation were high in our 95% Confidence interval of difference findings (Table 8), which are comparable to the findings of Ntakyo *et al.*, [10], or more specifically: on farms where silage and irrigation were used, milk production was 725.50 litres per day, while on farms where silage and irrigation were not used, milk production was 434.56 litres per day. This means a difference of 290.94 litres (40.10 %) less milk in farms where silage and irrigation were not used.

4. Conclusions

- Dairy producers should plan to plant forage, especially maize for silage and those cultivars that give more yield and are of better quality. They also need to invest in irrigation infrastructure for forage to be profitable in production and competitive in the market.
- Producers and associations of milk production should be as active as possible and ask the Ministry of Agriculture, Forestry and Rural Development to increase investment funds for irrigation of agricultural lands.
- Advisory services should inform, advice, and train milk producers about the role and importance of forage and their irrigation in milk production. At the same time, study visits should be organized between farms in different regions both at home and abroad to closely observe the results achieved by farms using silage and forage irrigation in milk production.

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