



TECHNOLOGICAL PRECONDITIONS IN DAIRY FARMS

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ABSTRACT

The paper presents the impact of the applied technologies on milk yield of cows in dairy farms. The scope of the research covered technical equipment used in the dairy cattle breeding and milking in 50 farms on the area of Grajewo Province in Podlaskie Voivodeship. The studies were carried out in 2016 with the diagnostic survey method based on the interview questionnaire developed for this purpose. The studies proved that 68% of the respondents from Grajewo Province maintain cattle in a stanchion-tide stable system and the remaining 32% in a free stall system. The group (48%) of the surveyed farmers maintain animals on a deep litter and 34% of them use shallow litter. In case of 18% of the investigated farms, animals are maintained on a slatted floor. In case of 68% of the investigated farms their owners feed cattle in the TMR system while the remaining 32% do it traditionally. The analysed farms in milk production use mainly pipeline milking machines (38%) and bucket milking machines (36%). 22% of the investigated farms have a milking parlour and 4% own a milking robot. A statistical analysis proved a significant correlation between the maintenance system of animals, number of lairs in a cow shed, TMR feeding of cattle, manner of obtaining milk and milk yield of cows.

Introduction

Application of modern technologies is a significant factor which influences the efficiency of milk production (Gal et al., 2013; Chabuz, 2013). When selecting devices for milk production one should mainly include: the maintenance system and the herd size, milk yield of cows, frequency and milk collection system (Kupczyk and Gaworski, 2006).

The full use of the potential of technical devices and technological solutions is justified in all zones of a shed. It also includes the system of collecting and using milk (Lipiński 2009), removal and collection of manure (Fiedorowicz et al., 2011), preparation and feeding (Gancarz 2010), access to water as well as shaping microclimatic conditions in inventory premises (Kamphuis and Steeneveld 2016; Litwińczuk and Grodzki 2014; Fiedorowicz and Mazur 2011). The maintenance systems of dairy cattle in agricultural farms may be divided with regard to: breeding method, milking, feeding place and maintenance of animals (Borusiewicz et al., 2015, Romaniuk, 2010).

Selection of relevant devices e.g. which are used for feeding, used in relation to milk yield of cows and the composition of mixture is important in milk production (Marczuk, 2010).

In order to facilitate milk production, computer fodder stations for automatic cow feeding equipped with electronic transponders may be used. The use of a fodder station decreases the time consumption of work and enables dosing of the determined amount of rich fodder for a particular animal (Gancarz, 2010; Khanal et al., 2010).

Profitability of milk production considerably depends on the correct milking. Milking and its hygiene significantly influence the hygienic quality of the obtained milk and thus its price in the collection point (Malaga-Toboła, 2012). Introduction of new technologies in farms, such as the use of robots and milking parlours influences the quality improvement and the amount of the obtained milk (Głowacka-Wołoszyn et al., 2010; Daniel and Mastyj, 2005).

Objective, scope and methodology of research

The objective of the paper was to analyse the impact of the applied technologies on milk production yield in dairy farms. The scope of the research covered technical equipment used in the dairy cattle breeding and milking in 50 farms on the area of Grajewo Province in Podlaskie Voivodeship. The study was carried out in 2016 with a diagnostic survey method based on the interview questionnaire developed for this purpose, which comprised two parts.

The first part of the questionnaire concerned information on the farm owner and general information on a farm, and the other part of the questionnaire consisted of eight questions with regard to technical equipment used in dairy cattle breeding.

The investigated farms were evaluated including:

- farm area criterion: up to 10 ha, 11-20 ha, 21-40 ha and above 40 ha of agricultural land;
- farm owners age: below 24 years, 25-30, 31-40, 41-50 and above 51;
- experience in running a farm and education.

Research results and discussion

The research included 50 farms and their owners from Grajewo Province, out of which 46% were women and the remaining 54% were men. Almost half of the investigated persons i.e. 46% were people aged 31-40. Next group consisted of people aged 25-30 which constituted 22% of the total number. Respondents aged 41-50 constituted 16% of the investigated group. Among the respondents the smallest group consisted of people aged 51 and more (8%) and people aged 24 and less which constituted 4% of the entire group of investigated people.

The investigated people had mainly vocational education (38%) and secondary (36% of the surveyed farm owners). People with higher education constituted 14% of the entire group and the lowest interest was in case of people with junior high school education (8%) and primary education (4%).

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A decisive majority, since as much as 76% of the investigated people, lived in a rural area with more than 200 people. While 18% of the respondents were from a rural area inhabited with 50-200 people. The smallest group, since only 6%, comes from a rural area with less than 50 people.

The research showed that more than a half (54%) of respondents have a farm with the area of 21-40 ha while 26% among them are owners of farms above 40 ha. Farms with the surface area between 11 and 20 ha are run by 16% of the questioned farmers and 4% of them has a farm with the surface area up to 10 ha.

The research proved that the analysed farms are quite mechanized. Each of them is equipped with go-devils, windrower tedders, ploughs, harrows, manure spreaders, rolling presses, mowers and loaders. A majority of farms (96%) has shredders and cultivators, while 78% is equipped with cisterns. 72% of farms have silos and in case of 68% – fodder cars. In case of tractors, 68% of farms have power within 40-80 kW and 54% use tractors with the power above 80 kW, 34% of the investigated farms have tractors with the power up to 40 kW and only 4% of respondents owns a harvester (Table 1).

Table 1.
Machines in the investigated farms

Vehicles/Machines	Number of farms	Interest of farms with vehicles/machines
Tractors (up to 40 kw)	17	34%
Tractors (40-80 kw)	34	68%
Tractors (above 80 kw)	27	54%
Go-devils	50	100%
Combine harvesters	2	4%
Tedders	50	100%
Ploughs	50	100%
Harrows	50	100%
Cultivators	48	96%
Manure spreaders	50	100%
Cisterns	39	78%
Rolling presses	50	100%
Mowers	50	100%
Silos	36	72%
Fodder cars	34	68%
Loaders	50	100%
Shredders	48	96%

In case of 38% of the investigated farms, owners maintain 26-40 pieces of cattle and 24% of them have more than 60 pieces of cattle. Herds with 41-60 pieces of cattle occur in case of 20% of the investigated farms and 14% of them maintain 11-25 pieces of cattle. 4% of the surveyed farms have less than 10 pcs of cattle (Fig. 1).

Based on the investigations which were carried out it was reported that 80 kW tractors occurred only in farms above 40 ha. Tractors with power up to 40 kW and within 40-80 kW occurred in all groups of the investigated farms.

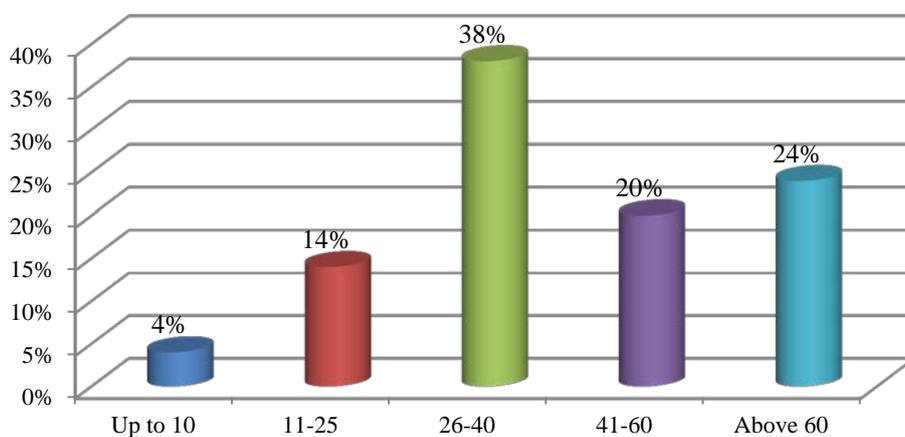


Figure 1. Structure of investigated farms on account of headage of cattle

A decisive majority of the surveyed farms (92%) breeds dairy cattle while 6% of them maintain meat cattle and 2% of them carry out a mixed activity (Fig. 2).

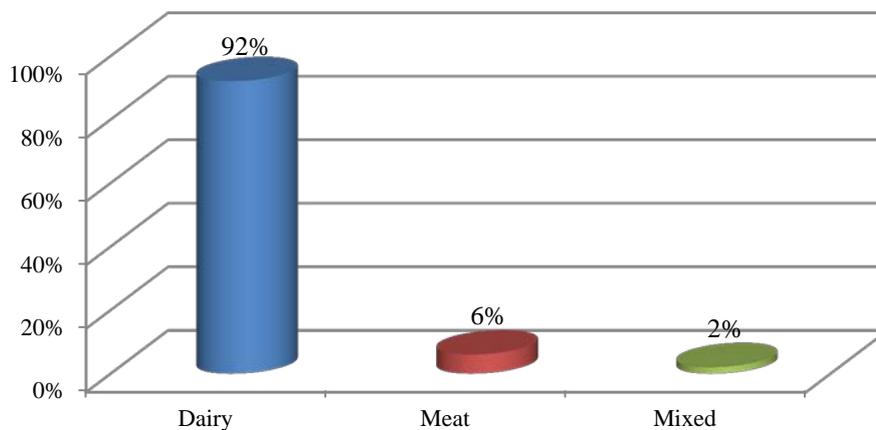


Figure 2. Structure of investigated farms on account of cattle production trend

Studies proved that 68% of the respondents maintain cattle in a stanchion-tide stable and the remaining 32% applies a free-stall system.

The group (48%) of the questioned farmers maintain animals on a deep litter and 34% among them uses shallow litter. In case of 18% of the surveyed farms, animals are maintained on a slatted floor which is presented in figure 3.

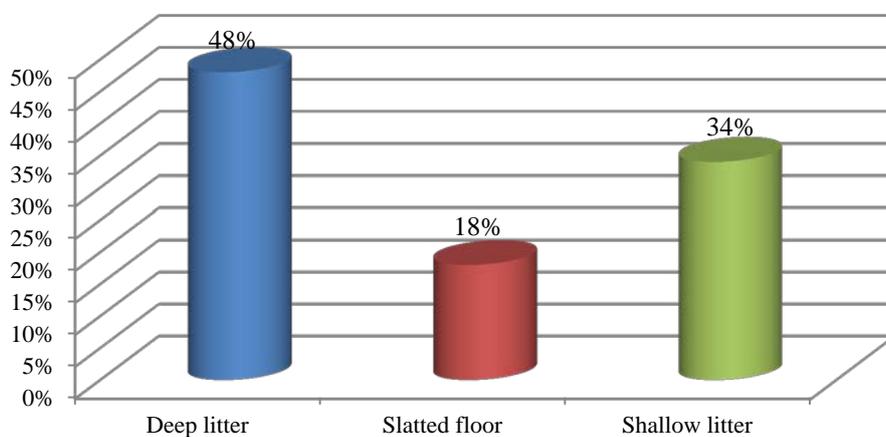


Figure 3. Manner of maintaining animals in the investigated farms

In case of 38% of the investigated farms, the number of stalls in a shed is 26-40 while 24% of the investigated farms have more than 60 stalls in a shed. Number of stalls within 41-60 is in 20% of the investigated farms and 14% of them has 11-25 stalls. The smallest group of the investigated farms (4%) comprised of those with 10 stalls in a shed (Fig. 4).

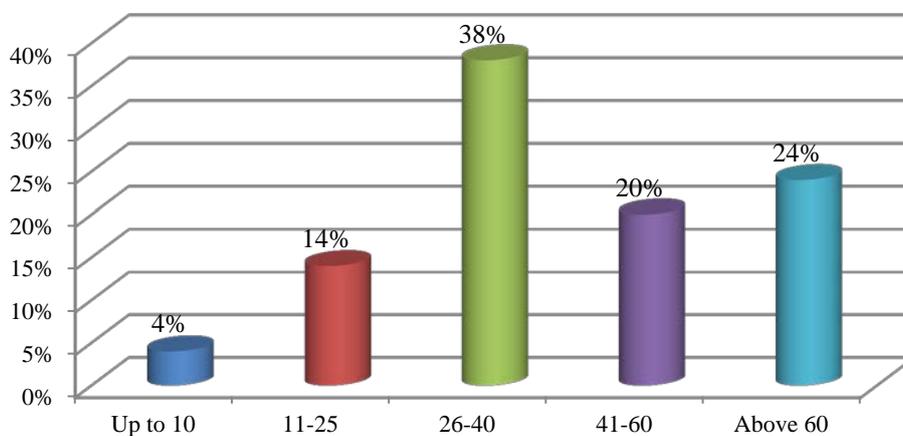


Figure 4. Structure of investigated farms on account of the number of stalls in a shed

Studies showed that all farms are equipped with mechanical milking machines and milk coolers. The investigated farms in milk production use mainly pipeline milking machines (38%) and bucket milking machines (36% of farms). 22% of the investigated farms have a milking parlour and 4% of them have a milking robot (Fig. 5).

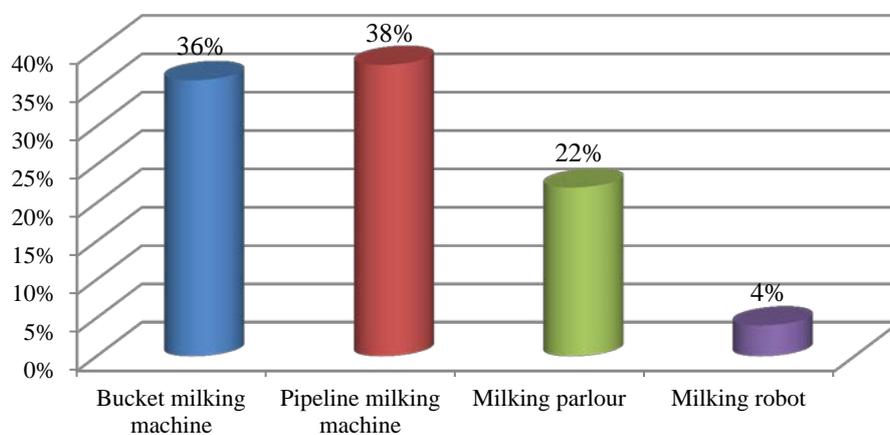


Figure 5. Structure of the investigated farms on account of the manner of obtaining milk

A decisive majority of the questioned owners (88%) uses cold breeding of calves in hutches and 10% own calf sheds. In case of 2% of the surveyed breeders breed calves in delivery rooms (Fig. 6).

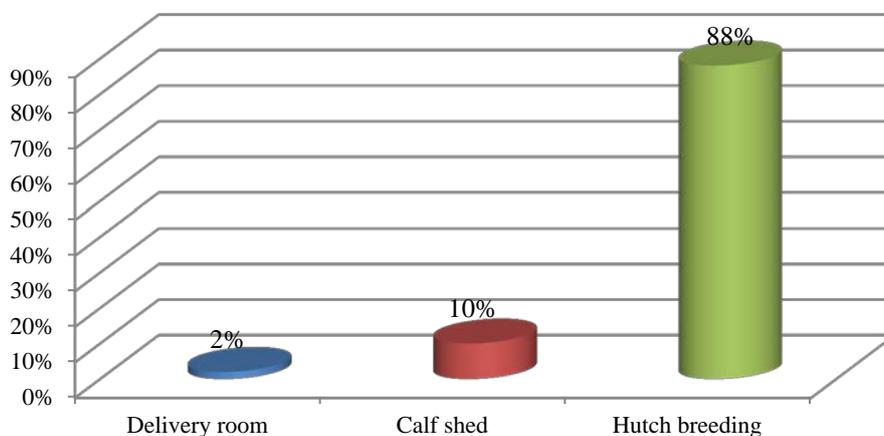


Figure 6. Cattle breeding system in the investigated farms and their percentage share

In case of 68% of the investigated farms, their owners feed cattle in the TMR system while the remaining 32% feeds their animals traditionally. Research concerning milk yield of dairy cows proved that in case of 38% of the analysed farms annual yield was within

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7.5 and 7.9 kilo of milk per year while 36% of the investigated farms proved 7-7.4 thousand kilo. A low interest (12%) of the investigated herds achieved milk yield between 6.5-6.9 thousand kilo and 8% of them shows 6-6.4 thousand kilo of milk yield. Among the investigated farms, 4% achieved efficiency above 8 thousand kilo of milk per a year and 2% only 4-6 thousand kilo. Any of the investigated farms did not achieve milk yield above 4 thousand kilo (Fig. 7).

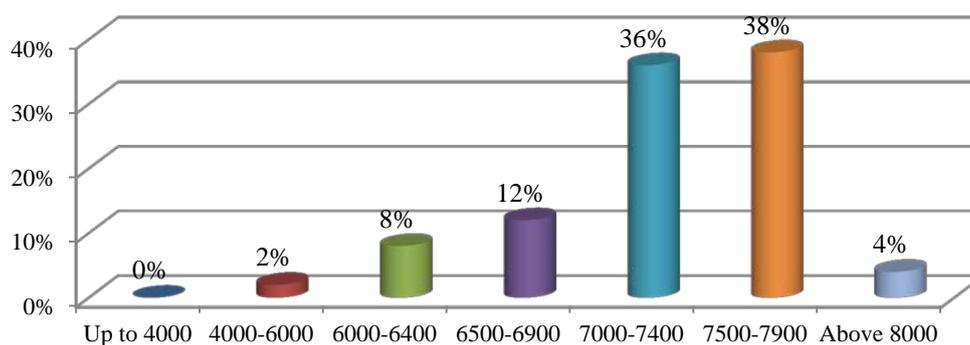


Figure 7. Percentage participation of farms, which includes criterion of milk yield of the maintained cows (kg-year⁻¹)

A statistical analysis proved a significant correlation between the maintenance system of animals, number of lairs in a cow shed, TMR feeding of cattle, manner of obtaining milk and milk yield of cows (Table 1). It proved that maintenance of milk cows on slatted floor, number of stalls, method of feeding and method of collecting milk has a direct impact on milk yield of cows. A correlation index for these relations was respectively $r=0.899$, $r=0.912$, $r=0.82$, $r=0.978$ (Table 2).

Undoubtedly, one of the most important factors which affect the dairy cows yield is their relevant feeding, application of modern TMR feeding systems which enables rational feeding with rich and volumetric fodders (Ziętara, 2007). The research showed that the majority of the surveyed farmers from Grajewo Province use modern feeding systems of dairy cattle. According to many authors (Butler et al., 2013; Malaga-Toboła, 2012; Kupczyk and Gaworski, 2006) in modern dairy cattle breeding, it is important to properly select devices for milk production which mainly includes the following: maintenance system, herd size, milk efficiency of cows, frequency and milk collection system. Authors' own studies showed that all farms from Grajewo Province are equipped with mechanical milking machines and milk coolers.

Table 2.
Correlation index between the investigated variables concerning the selected environmental factors and milk yield

Specification	Milk yield of cows (kg·year ⁻¹)					
	4000-6000	6000-6400	6500-6900	7000-7400	7500-7900	More than 8000
Maintenance of milk cows						
Deep litter	0.678	0.465	-	-	-	-
Slatted floor	-	0.567	0.799	0.871	0.867	0.899
Shallow litter	0.675)	0.718	0.765	0.791	0.794	-
Number of stalls for dairy cows						
< 11	0.955	0.678	-	-	-	-
11-25	0.898	0.865	0.647	-	-	-
26-40	-	0.874	0.878	0.893	-	-
41-60	-	-	0.788	0.793	0.889	0.899
> 60	-	-	-	0.798	0.822	0.912
Cow feeding						
in TMR technology	-	-	0.655	0.658	0.785	0.982
traditionally	0.828)	0.754	0.547	-	-	-
Milk collection						
bucket milking	0.877)	0.654	0.662	-	-	-
pipeline milking	0.872)	0.789	0.871	0.688	0.701	-
milking parlour	-	-	-	0.854	0.886	0.978
milking apparatus	-	-	-	0.784	0.879	0.965

Conclusions

1. Statistical analysis proved a significant correlation between the investigated environmental factors and milk yield of cows. The highest performance (above 8000 kilo of milk annually) were obtained from farms where dairy cows were kept on slatted floor in herds above 40 pieces of dairy cows fed in TMR technology where milking was carried out with the use of milking parlour or a milking apparatus.
2. Research proved that 32% of farms have a free-stall system. In case of 18% of the investigated farms, animals are maintained on a slatted floor. A milking parlour occurs in 22% of the investigated farms, and 4% own a milking robot.
3. The research concerning dairy cows yield proved that in case of 38% of the analysed farms, annual efficiency was within 7.5 and 7.9 thousand kilo of milk, 36% of the investigated farms declared cows' yield at the level of 7-7.4 thousand kilo, only 4% of the investigated farms achieved yield exceeding 8 thousand kilo.

References

- Borusiewicz, A., Drożyner, P., Marczuk, T. (2015). Zmiany stanu wyposażenia gospodarstw rolnych w środki mechanizacji stosowane w produkcji mleka. *Problemy Inżynierii Rolniczej*, 23(1), 69-77.
- Butler, D., Holloway, L., Bear, Ch. (2013). The impact of technological change in dairy farming: robotic milking systems and the changing role of the stockperson. *Journal of the Royal Agricultural Society of England*, 173, 1-6.
- Chabuz, W. (2013). Efektywność chowu bydła i produkcji mleka w gospodarstwach utrzymujących rasy lokalne i wysokoprodukcyjne z uwzględnieniem systemu utrzymania. *Roczniki Naukowe Polskiego Towarzystwa Zootechnicznego*, (2), 9-21.
- Daniel, Z., Mastyl, A. (2005). Analiza struktury pracy dojarza podczas doju krów. *Inżynieria Rolnicza*, 6, 97-103.
- Fiedorowicz, G., Mazur, K. (2011). Mikroklimat pomieszczeń w oborach wolnostanowiskowych w okresie wiosenno-letnim, cz. I. *Problemy Inżynierii Rolniczej*, 1, 123-134.
- Fiedorowicz, G., Romaniuk, W., Wardal, W. (2011). Metoda oceny ekonomiczno- technologicznej rozwiązań ciągu funkcjonalnego usuwania i magazynowania nawozu naturalnego z obór. *Problemy Inżynierii Rolniczej*, 4, 105-116.
- Gal, T., Nagy, L., David, L., Vasa, L., Balogh, P. (2013). Technology planning system as a decision support tool for dairy farms in Hungary. *Acta Polytechnica Hungarica*, 10(8), 231-244.
- Gancarz, F. (2010). Koszty wyposażenia i eksploatacji linii do przygotowywania i zadawania pasz w różnych systemach żywienia krów. *Problemy Inżynierii Rolniczej*, 3, 85-93.
- Głowacka-Wołoszyn, R., Winnicki, S., Jugowar, J.L. (2010). Krotkość doju krów z zastosowaniem robota VMS firmy DeLaval. *Nauka Przyroda Technologie*, 4, 1-8.
- Kamphuis, C., Steeneveld, W. (2016). Precision dairy farming 2016. *Conference Proceedings*, ISBN 978-90-8686-283-2.
- Khanal, A. R., Gillespie, J., MacDonald, J. (2010). Adoption of technology, management practices and production systems in US milk production. *Journal of Dairy Science*, 93(12), 6012-6022.
- Kupczyk, A., Gaworski, M. (2006). Analiza wskaźników technicznego wyposażenia gospodarstw mlecznych w Polsce. *Inżynieria Rolnicza*, 3, 211-216.
- Lipiński, M. (2009). Trendy rozwojowe konstrukcji maszyn przeznaczonych dla obór mlecznych. *Prace i Materiały Zootechniczne*, 67, 37-150.
- Litwińczuk, Z., Grodzki, H. (2014). Stan hodowli i chowu bydła w Polsce oraz czynniki warunkujące rozwój tego sektora. *Przegląd hodowlany*, 6, 453-460.
- Marczuk, A. (2010). Dobór środków technicznych do zadawania pasz w obiektach inwentarskich dla bydła. *Inżynieria Rolnicza*, 3(121), 119-125.
- Małaga-Toboła, U. (2012). Wyposażenie techniczne wybranych gospodarstw ekologicznych ukierunkowanych na produkcję mleka. *Inżynieria Rolnicza*, 2(137), 185-192.
- Romaniuk, W. (2010). Kierunki zrównoważonego rozwoju technologii i budownictwa w chowie zwierząt. *Problemy Inżynierii Rolniczej*, 4, 121-128.
- Ziętara, W. (2007). Ekonomiczne i organizacyjne problemy produkcji mleka przy wysokiej wydajności mlecznej krów. *Roczniki Nauk Rolniczych, G – Ekonomika Rolnictwa*, t. 93, z. 2, 27-36.

UWARUNKOWANIA TECHNOLOGICZNE W GOSPODARSTWACH SPECJALIZUJĄCYCH SIĘ W PRODUKCJI MLEKA

Streszczenie. W pracy przedstawiono wpływ stosowanych technologii na wydajność mleczną krów w gospodarstwach specjalizujących się w produkcji mleka. Zakresem badań objęto wyposażenie techniczne wykorzystywane w chowie bydła mlecznego oraz doju w 50 gospodarstwach rolnych na terenie powiatu grajewskiego w województwie podlaskim. Badania przeprowadzono w 2016 roku metodą sondażu diagnostycznego na podstawie opracowanego w tym celu kwestionariusza wywiadu. Badania wykazały, że 68% ankietowanych gospodarzy z powiatu grajewskiego utrzymuje bydło w systemie uwięziowym, a pozostałe 32% stosuje system wolnostanowiskowy. Grupa (48%) ankietowanych rolników utrzymuje zwierzęta na głębokiej ściółce, a 34% z nich stosuje płytkie ściółkowanie. W przypadku 18% badanych gospodarstw zwierzęta są utrzymywane na podłodze szczelinowej. W przypadku 68% badanych gospodarstw ich właściciele żywią bydło w systemie TMR, natomiast pozostałe 32% żywi zwierzęta tradycyjnie. Analizowane gospodarstwa w produkcji mleka stosują przede wszystkim dojarki przewodowe (38%) oraz dojarki bańkowe (36%). Halę udojową posiada 22% badanych gospodarstw, natomiast 4% z nich posiada robota udojowego. Analiza statystyczna wykazała istotną dodatnią korelację między systemem utrzymania zwierząt, liczbą stanowisk legowiskowych w oborze, żywieniem bydła TMR, sposobem pozyskiwania mleka a wydajnością mleczną krów.

Słowa kluczowe: produkcja mleka, gospodarstwa rolne, technologia