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Assessment of Challenge and Opportunity of Artificial Insemination on Dairy Cattle in Case of Sayo District West Wollega Zone, Ethiopia

Mohammed Yousuf[1]* and Getachew Wegari[2]

[1]Department of Animal and Range Science, College of Agriculture and Veterinary Medicine, Dambi Dollo University, Dambi Dollo, Ethiopia
[2]Kellem Wollega Zone of Livestock and Fishery Resource Office, Ethiopia

**Corresponding author*

Abstract

The study was conducted in Sayo district with the objective of assessing challenges and opportunities of artificial insemination on dairy cattle, to document potential opportunities of artificial insemination, to identify the challenges of artificial insemination and to assess the perception of farmers on the AI technology in the study area. Three kebeles, three were taken purposively and 20 households from each kebele were randomly selected. The data were collected using semi structured questionnaires, interview and direct observation. The reproductive and productive data were analysed statistical software (SAS version 9.3.1 where as other data were analysed by simple descriptive statistics. The result of this finding shows that the overall mean of daily milk and lactation length of dairy cows in the Sayo distinct were5.83±0.82L and 240±18.43 days respectively whereas the overall mean of age at first calving, calving interval and number of service in the study area were 968.42±269.83, 449±22.09 days and 1.93±0.71times respectively. The major challenges raised by the farmer were mainly shortage of technician, poor management, lack of awareness toward AI, heat detection problem, semen quality semen, distance from AI center and inability of AI technician whilst the main opportunity for wide AI use were increasing genetic progress by improving the reproductive rate of the cow such as shorten calving interval, increase lactation length, increase milk production and genetic improvement. There should be an effort/collaboration activity with the near institution to enhance the opportunities more than the current status.

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Artificial insemination, Challenges, Opportunities, Reproductive and Productive Performance.

Introduction

Ethiopia is home for a large and diverse livestock resource and good production environments. The vast majority of the rural livestock production. However production and productivity and producers benefits from livestock production are far below expectation. The livestock sector accounts for approximately 30% of the total agricultural GDP and 16% of national economy. The total cattle population for the rural sedentary areas of Ethiopia is estimated to be 43.12 million, of which 55.41% are females (1). Out of the total female cattle population, only 151,344 (0.35%) and 19,263 (0.04%) heads are hybrid and exotic breeds, respectively (2). In spite of the presence of large and diverse animal genetic resources, the productivity (i.e., meat and milk) of livestock remains low in many developing countries including Ethiopia for numerous reasons such as

inadequate nutrition, poor genetic potential, inadequate animal health services, and other management related problems (3). Holstein Friesian and their crosses in central Ethiopia and found out that the highest milk yield 3083 kg for total lactation milk yield and 2678 kg for annual milk yield (4)

The total number of both exotic and hybrid female cattle produced through the crossbreeding work for many decades in the country are quite insignificant indicating unsuccessful crossbreeding work. It is widely believed that AI (Artificial Insemination) service has not been successful to improve production and reproductive performance of dairy industry (5). The problem is more aggravated by lack of recording scheme, wrong selection procedures, and poor management of AI bulls associated with poor motivations and skills of inseminators (6). Selective breeding has been considered as one of the highly effective and sustainable approaches for increasing animal productivity in the long-term. In this regard, Artificial insemination allows a single animal to have multiple progeny, reducing the number of parent animals required and allowing for significant increases in the intensity of selection, and proportional increases in genetic improvement (7). The percentage of pregnancies resulting from AI is the product of cows detected in heat and inseminated fertility level of the herd, semen fertility level and inseminator efficiency (8).Whereas tools of molecular genetics, growing demands for reliable services and quality semen and diversified genetic resource were the good opportunities to use AI widely (9).

Artificial insemination plays a great role in maximizing the genetic potential of local breeds in combination with good management practice. The success of AI in improving the production and reproduction performance of the local breeds, however, is the combination of the inseminator efficiency, availability of infrastructures, and the presence of efficient quality semen for the service. Though, AI was very crucial for genetic improvement especially in dairy cattle breed sit has posed problems in satisfying the need of some producers in contrary with its opportunities. The problem of not using AI was not area limited but also there were dairy breed owners in our district who practiced the service and not practiced it due to various challenges. Besides, most of the dairy sectors were seen in reporting failures of AI service than bull service. However, there was no well documented data that revealed by researchers on the challenges and opportunities of artificial insemination service in the Sayo district in spite of few attempts to quantify the opportunities, constraints and why producers were not using artificial insemination service in other districts. Due to this, there was an information gap to the dairy sectors and other producers on the challenges and opportunities of artificial insemination. Therefore, the present study was initiated to fill this information gap. The objective this study was challenge and opportunity of artificial insemination on dairy cattle in case of sayo district west wollega zone, Ethiopia.

Materials and Methods

Description of the Study Area

The study was conducted in Sayo woreda of Kellem Wollega Zone, Oromia Regional state. The study area is was located in altitude range from 1575 m to 2075 m to 2014 as.1. It has suitable topography for agricultural activities and classified as Dega. Weinadega and Kola. The annual rain fall varies from 1450 to 1775 mm. The mean temperature varies from 17^0C to 24^0C the woreda consists of 26 rural and 2 urban kebeles. The total human population of the woreda is 186320 bottom about 15% among this land area about 35, hectare communal grazing and about 98 hectare is individual grazing land of the woreda people, land use of the woreda shows communal grazing 26.03% private grazing 73.6%.Altitude vegetation and soil of the woreda are slightly different and the woreda categories under mixed farming system agricultural the major crop type cultivated in the woreda are teff, maize, sorghum, wheat, barley, bean etc and considerable size of animal are kept by small holder farmer proving drought power, in come food, manure, saving and socio economic functions. According to the Sayo woreda office of agricultural census report there are 23250 cattle, 36845 sheep, 20450 goats, 2500 horse, 6520 donkeys, 2301 mule and 398, 120 poultry in the woredas (10).

Sampling procedures

One district, namely Sayo district was purposely selected based on accessibility, potential whereas for selection of peasant associations (PAs), availability of high crossbred cattle, agro ecology, and secondary data from agricultural office and accessibility were considered.

Thus based on the above criteria, three PAs were taken strategically for this study. While a total 60 households, (20 households from each Pas) who were interviewed for the survey study were randomly taken by using lottery system.

Methods of data collection

Both primary and secondary data sources were used. The primary data were collected from the farmers through semi structured questionnaires, interview and direct observation. Secondary data such as cattle population, human population, and climatic condition was obtained from published and unpublished available sources, agricultural experts, DA's and administrative office of the PAs. Focus group discussion (FGD) was used to collect data. To this end PA chairman, DAs, model farmers and elders were participated in the FGD.

Data analysis methods

The collected data were analysed statistically using SPSS (version 20) for Windows. The quantitative data were analysed by using compare means method; express in mean such as livestock numbers. While the qualitative data (nominal) were analysed using descriptive statistics, represented in percentage.

Results and Discussion

Household characteristics

The house of interviewed dairy cattle owners is summarized in Table 1**.** As presented in the below table most of the respondents were male (75%) whereas female accounted for 25%. The attitude and participation of male towards AI was higher than female, because females believed the exotic breed consumes more feed so they have not power to manage those breeds by harvesting and buying of feeds.

So that, females need awareness creation/training/ to use AI by development office. Majority of the education status of respondents in the study areas were primary school (36.67%), secondary school (21.67%) and above secondary school (16.66%). The result showed that small portion of the respondents was illiterate (25%) as compare to literate (sum of primary, secondary and above secondary school).

It is believed that literate farmers have better awareness about advantages of AI and improved breed management than illiterate farmers. The below table indicated that 66.67% of the respondents were >35 years old and 23.33% ranged from 25-35 years. This showed that as age increases, the understanding of the farmers towards AI will increase and may easily cope up the challenges and better use the opportunities.

Cattle production system

Production system has influences on AI service and production and reproduction performance of dairy cows. The present result indicated that majority of the households (65%) practiced mixed production system, however, the traditional system accounted for 35%and there was no modern production system. So that this study showed that the type of production system influenced on AI efficiency (productive and reproductive performance) of dairy cattle. The more production system becomes the better the opportunity of AI and the more production and reproduction performance of the dairy cows and the more production system becomes the better decrease the challenges of AI than traditional system.

Management system in the study area

Feed and water

The major source of feed for cattle in the study area is presented in Table 3. Among those hay accounts (43.33%), crop residues (20%), green forage (18.33%),concentrate (13.33%) and few respondent was used Atela (5%).This showed that AI service, production and reproductive performance of dairy cattle were mainly affected by feed source that means when there was good feed source, the AI delivery, production and reproduction system also improved. Several factors related to management play roles in successful pregnancy among which nutritional management contribute the largest proportion (11). The main reason related to lack of improved forage availability in the study area were lack of land and also there was not expansion of improved forage seed from agricultural office. According to the respondent the water use were river source (45%) and pipe water (55%).The use of river source was mainly when there was water shortage. So that, the use of river source causes the cows faced in health problems which directly affect production and reproduction performance of the cows and increase challenges of AI. Most of the respondent gave water to cows two times per day.

Housing system

Most of the respondent (65 %) used separate house with roof from main house and 35% of the respondent use local barn without roof. The purpose of local barn housing in the study area was to protect cattle from theft, hyena and extreme weather conditions**.** Some of milk

producers reported that they keep their cattle breed in not partition of the main building, they keep their cattle breed together with family and others due to lack of capital and land. So this causes disease and which in turn increase challenges on AI.

Common disease in the study area

According to the respondents, the cattle diseases prevailing in the study area were listed in Table 5. In the study area, the prevention method was low because the housing system was very poor, that means there was no separate house between individual animals. So that improving the housing system, supplementing of good water and improved feed is important in preventing disease and decreasing the challenges of AI.

Cross breeding in the study area

Crossbreeding of local breeds with European dairy breeds has been widely used as a tool to improve milk production potential in tropical cattle (12). In the study area cross breeding was done by selection of superior bulls (Natural mating) and by using AI so as to increase milk production and genetic improvement. For genetic improvement semen of HF, Fogera x HF cross bred bulls were selected for natural mating when there is no availability of AI.

Selection parameter of bull and cows for crossbreeding

The selection criteria of bulls for mating in the study area were depending on conformation, growth, libido, size and arrangement of testicles, adaptability and color (red) of the animals. The growth trait and color was the most preferred trait of other entire trait because the size and color of the animal determines the market value. While, selection criteria of cows were depending on conformation, calf growth, calf survival, size of teats, age at sexual maturity, calving interval, milk yield, mothering ability, adaptability and color (red) of the cow.

Breeding system in the study area

The present result shows that 45% of the respondent used AI, 43.33% of the respondent used natural mating and 11.67% of respondent used both AI and natural mating. There was no more difference between both AI and Natural mating, because some respondent believed that the exotic breed consumed high amount of feed, requires high management, high cost and AI service gives high male to female ratio calves, but the free of paid cost and availability of infrastructure and its potential for milk production were facilitate (initiates) the peoples to use AI service in the study area. Artificial insemination has become one of the most important techniques for increase milk production and genetic improvement of farm animals (13).

Effect of AI on production performance of dairy cattle in the study area

Milk production

According to the survey, the milk production of local breed was less than cross breed this was due to the cross breed receives the good trait from exotic breed. The Local breed in the Sayo district gave 316.2 l of milk / per lactation length. But, the indigenous zebu breed produced about 400-680 L of milk/ per lactation period (Mohamed *et al.*, 2004). And also the, F1, F2 and F3 cross breed in the Sayo distinct were 1661.6 L, 2029.4 and 3600 l of milk / per lactation length. This result of F1 and F2 lower than the finding of (4) the Holstein x Boran crosses which was 2369.95±26.04L. The variation was due to breed type and management system. The below table shows that the average DMY of local breed 1.7 $\pm$ 0.41l.This result lower than (4),which was1.76±0.8 of Boran breed, it was due to poor management and breed type, while the average DMY of F1,F2 and F3 breed in Sayo district was, 6.7$\pm$0.95, 7.93$\pm$0.83 and12.0$\pm$0 L, respectively. Also the DMY of F1 is lower than, the (4) DMY of HF X Boran breed which is 7.14±0.06 L, but the DMY of F2 and F3 is higher than the (Million and Tadelle 2004) which was 5.70±0.12 and 5.05±0.31 of HF X Boran breed, respectively. This was due to breed type and level of management. Generally, as the effect of AI increase the daily milk from 1.7 to 6.7 and as the blood level increases the DMY increase from 6.7 to 7.93 in the study area.

The average LL of local breeds in Sayo district was 186$\pm$12.42 days. This result was lower than the (4) LL of Boran breed which was 246.22±3.46 days. But the average LL of F1 breed and F2 breed in Sayo district was, 248$\pm$22.19, 278.6$\pm$14.06 and 300$\pm$0, respectively. This result shows the LL of F_1 and F_2 was lower than, the LL of (4) which was 332.54±2.82, 298.68±5.17days of HF X Boran respectively. The reason was due to breed type and level of management. But the F_3 is higher than LL of (4) which was 299.90±6.46 days. This was also due to management and breed type. According to the

study the lactation length and daily milk yield of the local cows and cross breed cows was highly vary, this was due to the effect of AI by transfer of good trait from exotic breed to local breed and the blood level increases from F1 to F2 and F3 the LL also increase when there was good management and production system.

Reproductive performance of dairy cattle in the study area

Age at first calving

According to the respondent like production performance the age at first calving of local, cross and exotic) breeds was affected by management system (feed, housing, health condition) mainly by feed. That means when the management system become poor the AFC is long and when the management system is good the AFC is short. The above table shows that the average AFC of local breed in Syo distinct was1200±70.52 days. This result is higher than the AFC of (15), which was 1,164 day of Fogera breed; it was due to poor management and breed type in the study area. And the average AFC of F1 breed and F2 breed in Sayo distinct was 971±97.5, 773.13±41.2 day respectively. This result is found to be higher than, the (15) AFC of HF X Zebu breed which was 1041 day, but the AFC of F2 was lower than the Nuradis findings, this was also management, breed type and environmental condition. This finding indicated that the blood level increase AFC decrease and the effect of AI decreases the AFC of 1200±70.52 to 971±97.5 days in the study area.

Calving interval

According to the respondent, the calving interval of local, cross and exotic breed like AFC similarly affected by management system. The average CI of local breed in Sayo distinct was 501±24.76 day, this result was higher than the CI of (16) which was 474 days of Fogera breed. This was also due to poor management and breed type. But the average CI of F1 breed and F2 breed, Sayo distinct was, 426.25±22.52 and 417.5±17.32 days, respectively. This result shows the CI of F1 was higher than, the (15) CI of HF X Zebu breed which was 419 day, but the CI of F2 lower than the Nuradis findings, this difference between the two breed was due to climatic condition, production system and also management system. Generally, when there was good management and production system and the blood level increase the calving interval becomes short.

Number of service per conception

Like the other reproductive performance the number of service per conception was affected by management system, production system and also semen quality. The above table shows that the average NSC local breeds in Sayo district was 2.15±0.74. So it contradicts to the NSC of (17) which was 2 times of Horro breed. This was due to breed type and poor management in the study area. But the average number of service per conception of F1 andF2 was 2±0.78 and 1.56±0.5 times respectively.

The NSC of F1 was higher than the NSC of (17) which was 1.97 times of FH X Horro and the NSC of F2 was lower than (17) findings. This difference was due to nutrition factor, AI technical and poor semen quality. Among those factor nutrition was highly influenced the NSC in the study area. Because in the stud area hay was the dominant feed. Animals fed well balanced feed has high rate of conception rate (18).

Challenges and opportunities of artificial insemination on dairy cattle in the study area

Challenge of artificial insemination

Even if AI was practiced continuously in the study area, they faced problems. Among that oestrus detection, management factor, semen quality, in ability AI technician, absence of AI technician was major challenges. According to the respondent majority of heat detection were performed by heard man information (65%) and 35% of heat detection done by regular following during morning and evening. But herdsman might not recognize cows on heat due to lack of ability and carelessness detecting of cows on heat. In addition to this according to the respondent most of the cows come to heat at night, so this is difficult to detect the cows due to lack of light in the house and lack of regular follow of the farmer. Generally, heat detection problem for AI service accounts about 38.33% loss of time of insemination. Insufficient and/or inaccurate oestrus detection leads to delayed insemination, reduced conception rates and thus extended calving intervals (19). Management factor accounts 15% to the challenge of AI in the study area.

Table.1 Household Characteristics

Demography of households	N	%
Sex		
Male	45	75
Female	15	25
Level of Education		
Illiterate	15	25
Primary school	22	36.67
Secondary school	13	21.67
Above secondary school	10	16.66
Age		
20-25	6	10
25-35	14	23.33
>35	40	66.67

N= number of households %= Percent

Table.2 Cattle production system

	N	**%**
Production system		
Mixed	39	65
Traditional	21	35
Modern	-	-
Total	60	100

N= number of households %= Percent

Table.3 Feed and Water sources in the study area

Type of feed	**N**	**%**	**Rank**
Hay	26	43.34	1
Crop residues	12	20	2
Green forage	11	18.33	4
Concentrate(frushica,wheat bran)	8	13.33	3
Atela	3	5	5
Water source			
River	27	45	
Pipe water	33	55	

N= number of households %= Percent

Table.4 Housing system of dairy cattle in the study area

Type of house	**N**	**%**
Separate house with roof from main House	39	65
Local barn without roof	21	35
Total	60	100

N= number of households %= Percent

Table.5 Common disease of dairy cows in the study area

Common disease	Local name	Scientific name	Symptoms
LSD	citto	-	Point spot on the hide/skin Edema on the limp
Bovine Brucellosis	Rima gataa	*Brucella abortus*	Abortion Retail placenta Vaginadischarge
Mastitis	Dhukuba harma	*Streptococcal mastitis*	Inflammation of udder Blood mixed milk
Milk fever	-	-	Opening of the teat
Pasteurolosis	maramartoo	*Pasteurella multocida*	High respiration rate High salivation

Table.6 Breeding system

Meting system	N	%
AI	27	45
Natural	26	43.33
Both	7	11.67

***number of respondent %= percent

Table.7 Milk yield performance of indigenous cows at different level of HF cross breed cows

	Mean ±SD		
	N	**DMY(L)**	**LL(d)**
Over all	60	5.83±0.82	240±18.43
R^2		0.91	0.79
Breed			
Local	15	1.7±0.41	186±12.42
F1	30	6.7±0.95	248±22.19
F2	14	7.93±0.83	278.6±14.06
F3	1	12.0±0	300±0

DMY (L) = Daily Milk Yield, (LL) = lactation length, SD= standard deviation, N= number of respondent

Table.8 Reproductive performance of indigenous cows and different level of HF cross breed cows

	Mean ±SD			
	N	**AFC**	**CI**	**NSC**
Over all	60	968.42±269.83	449±22.09	1.93±0.71
R^2		32.39	0.75	0.10
Breed				
Local	20	1200±70.52	501±24.76	2.15±0.74
F1	24	971±97.5	426.25±22.52	2±0.78
F2	16	773.13±41.2	417.5±17.32	1.56±0.5

N= number of respondent, AFC= age at first calving CI= calving interval NSC= Number of Service per Conception

Table.9 Challenge of AI

Parameter	N	%	Rank
AI technician	3	5	6
Semen quality	14	23.33	2
Management Factor	9	15	3
AI technician Shortage	4	6.67	5
Lack of awareness	5	8.33	4
Heat detection	23	38.33	1
Distance of AI center	2	3.34	7

***number of respondent %= percent

Management factor (nutrition, disease and housing system) were determinant factor for the success and challenges of AI in the study area. Among those, nutrition factor was highly affecting the success of AI in the study area. Several factors related to management play roles in successful pregnancy among which nutritional management contribute the largest proportion (11).

According to the respondent the majority of the feed consumed by the cow was hay (43.34%), so it affects the number of service per conception of cows. Animals fed well balanced feed has high rate of conception rate (18). Semen handling and storage is important to achieve threshold or above threshold number of sperms to the ovum necessary to maximize fertilization rate and embryo quality, so poor semen quality is one of the constraints (20). Sayo district semen for insemination (HF and Jersey breed semen) was come from Ethiopian NAIC through Nekemte. The semen used for insemination was thawed at temperature of 34^0C. 23.33% of constraint of AI was due to the insemination of abnormal semen. This is due to the inseminator, thawing the semen beyond or below the temperature used (34^0C) which affect the motility of semen. Due to this the number of service per conception (low conception rate) of cows was increase and there was lack of sometimes shortage of semen. In ability AI technician were account 5% to the limited factors of AI. This was inappropriate placement of semen in female reproductive tract (out of cervix) due to not gave attention to the cow's behaviour or less palpate the cows. One of the most significant contributions to the successful application of AI in cattle breeding has been made by the highly trained inseminator (21).

Although professional inseminators palpate the reproductive tract of numerous cows every day, most are not trained to examine the uterus and ovaries. This poses a serious practical limitation to the success of AI (22). Absence of AI technician was accounted 6.67 % to the limited factors of AI. In Sayo district there are only two AI technicians, so they may not address the heated cows. Furthermore, AI technicians went to meeting and on the day Saturday and Sunday they do not found in the AI center (working place). Due to this the cows loss its time of insemination. Even if there is no highly lack of transportation access, distance from AI center had limiting factor (3.34%) in the study area. This is due to low road accessibility especially during night**.** Lack of awareness also a limiting factor in the study area. It accounts 8.33%. Because peoples believes that the exotic breed consumed high amount of feed, requires high management, high cost and also believes that AI service gives high male to female ratio calves. So it limits expansion of AI.

Opportunities of artificial insemination

According to the respondents, there lack of improved bull in the study area, so that opportunities were introduced for the utilization AI to improving dairy cow. The main opportunities of AI rose by farmers in the study area were**:** Artificial insemination have played an important role in increasing milk production in the study area, because the cross breed that got good trait from exotic breed gave high milk than local breed. Artificial insemination has become one of the most important techniques for increase milk production and genetic improvement of farm animals (13). In the study area one great opportunities was created by motivating the farmer to use AI service were not paid per service provided that they get quality semen and reliable service in order to satisfy the demand for increasing AI users. This quality semen had played an important role in increasing genetic progress by upgrading the reproductive rate of the cow

(shorten calving interval and increase lactation length). The growing demands for reliable services and quality semen, in most cases, users of the AI service are willing to pay even higher fees per service provided that they get quality semen and reliable services (23). The percentage of pregnancies resulting from AI is the product of cows detected in heat and inseminated fertility level of the herd, semen fertility level (8). Artificial insemination also increase the selection potential of farmers, because to use AI farmers select the best cows that have good body condition to hold AI (exotic breed) so as to make good pregnancy without difficulty during birth. Selecting superior breed for crossing of local breed has significant important for AI utilization and breed improvement. AI increases the selection intensity since less bull is needed and it is the basis for selection progress (24). The presence of infrastructure in the study area such as water, electricity and communication (telephone and network) in the study area. Furthermore, there are road access and vehicles which were important for AI to apply at the right time. The presence availability of infrastructure like liquid nitrogen, important for keeping of the semen in good condition so as to improve the fertility rate, insemination material were had an important key role in maximizing the success of AI.

The more production system becomes the better opportunity of AI and the more production and reproduction performance of the dairy cow. AI service, production and reproductive performance of dairy cattle were affected by feed source. Cross breeding was done by selection of superior bulls (Natural mating) and by using AI helps to increase milk production and genetic improvement. The overall mean of daily milk yield and lactation length of dairy cows in the Sayo distinct were 5.83±0.82 L and 240±18.43 days respectively whereas the overall mean of AFC, CI and NSC in the study area were 968.42±269.83, 449±22.09 days and 1.93±0.71 times, respectively. The major challenges raised by the farmer were mainly shortage of technician, poor management, lack of awareness toward AI, heat detection problem, semen quality semen, distance from AI center and inability of AI technician whilst the main opportunity for wide AI use were increasing genetic progress by improving the reproductive rate of the cow such as shorten calving interval, increase lactation length, increase milk production and genetic improvement. Generally, breed type, management and technical skills regarding to determining/knowing whether the cows were on heat or not were the limiting factors for artificial insemination in the area, besides the presence of equipment's and provision of quality semen from the center were promoting factor for artificial insemination.

Recommendation

In the study area there was poor disease prevention system due to lack of separate house so the housing system should be separate and the veterinarian should be give advice to the cattle owners how they prevent the disease. Most of the production system were mixed, so that this production system should be improved or change to intensive production system. There should be controlled crossing to achieve human need for milk by improving the genetic potential of local cow. It should be sustainable extension service that address problem of AI service. There should be training given to AI technician. There should be an effort/collaboration activity with the near institution to enhance the opportunities more than the current status.

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