



## Effect of improved management practices on productive and reproductive performance of Osmanabadi goats under semi-intensive rearing systems

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### ABSTRACT

In the present study, an attempt was made to study the salient characteristics, viz. age at first kidding (AFK), weight of kid at birth (WKB), kidding interval (KI), kidding, twinning and triplet percentages, etc. during June, 2018 to March, 2020. The study was conducted using standard format developed by ICAR-National Bureau of Animal Genetic Resources (NBAGR), Karnal (Haryana) with some adaptations to capture additional information. Scientific management practices were followed in the farm to enhance the productive and reproductive performance of Osmanabadi goats under semi-intensive system. The study generated data on average age at first kidding ( $266.55 \pm 18.38$  days), gestation period (148–153 days), kidding interval ( $195.09 \pm 5.65$  days), age at puberty ( $212.32 \pm 2.83$  days), average litter size (1.62), average dressing percentage (53%), average milk yield (1.26 kg per doe per day), birth weights of kids ( $2.57 \pm 0.48$  kg), twinning (35.59%) and triplet percentages (13.56%). Further, the kidding details indicated significant difference among the durations. The data thus generated revealed that the semi-intensive rearing practices were superior to the methods followed in earlier studies including those of ICAR-NBAGR, Karnal. It can be concluded that meticulous adoption of scientific management practices would enhance the productive and reproductive performance of goats in general, and Osmanabadi goats in particular under semi-intensive rearing system.

**Keywords:** ICRISAT, Kidding percentage, Osmanabadi goats, Semi-intensive rearing

The overall efficiency of any goat breed is judged not only on the basis of milk, meat or fiber yield but also on the basis of their growth and development. Body weight and growth rate are the indicators of physical health and economic viability at different growth periods which help to determine the right marketable age of kids for higher economic return and carcass quality (Mule *et al.* 2014). Also, other parameters like kidding details, age at first kidding and others are essential for profit, and higher productive and reproductive efficiency, better survivability and faster genetic improvement by decreasing generation interval and increasing replacement rate (Singh *et al.* 2009). The body weight implies fair idea about future performance of kids; and in addition, it also helps goat growers in computing ration, medical doses, deciding proper breeding, market slaughter age and weight; as well as to evaluate the animal at particular age.

The Osmanabadi breed recognized by ICAR–National Bureau of Animal Genetic Resources (NBAGR) with the accession number INDIA\_GOAT\_1100\_Osmanabadi\_06017 is among 34 different goat breeds (ICAR-NBAGR,

2020). The breed is a native of Osmanabad district of Maharashtra and reared mainly for its meat and rarely for milk. The Osmanabadi goat's breeding tract extends to Latur, Ahmednagar, Solapur, Parbhani and other neighboring districts of Maharashtra besides the north-eastern districts of Karnataka state (ICAR-NBAGR, 2020). The breed is well suited to arid and semi-arid regions and renowned for its good meat and milk production, higher kidding percentage of twins and triplets and early puberty. Furthermore, this breed is suited to all types of rearing systems, the most ideal being the semi-intensive system (grazing and closed enclosure), where higher production has been observed compared to extensive (grazing system) and intensive systems (zero grazing system) (ICAR-NBAGR 2020). According to Devi *et al.* (2020), semi-intensive system involves limited grazing (6–8 h) and stall-feeding on feed supplements depending on the availability of time, labour and feed. In this system, small ruminants are integrated with crop production and use stubbles, agricultural byproducts, crop residues etc. in feeding which in turn return dung and urine to the land for improving soil fertility (Devendra 1986).

Although, Osmanabadi goat breed is known for its early maturity, prolificacy and good dressing percentage (ICAR-NBAGR 2020), recorded evidence pertaining to productive and reproduction potential by following scientific

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management practices under semi-intensive conditions is very scanty. Further, it is also important to note that scientific management practices would enhance the productive and reproductive performance of goats (Rathod *et al.* 2020). Hence, an attempt was made to study the productive and reproductive potential of Osmanabadi goats under semi-intensive condition.

## MATERIALS AND METHODS

The present study was undertaken at ICRISAT, Patancheru Goat Farm which was initiated with 20 does and 02 bucks in June, 2018. The study area is located at ICRISAT (17.50°N 78.26°E and altitude 545 m) with semi-arid climate having an average rainfall of 898 mm, of which about 781 mm rainfall is distributed over June to October (autumn season) and about 87 mm distributed over November to April (spring season). Maximum and minimum temperature may reach up to 43°C and 5°C during May and December respectively.

The study has recorded the characteristics of 96 kids born in the farm during June, 2018 to March, 2020 as per the standard format developed by ICAR-National Bureau of Animal Genetic Resources (NBAGR), Karnal (Haryana) with a little modification to accommodate additional information. Data in the study were collected for age at first kidding (AFK; days), weight of kid at birth (WKB; kg), kidding interval (KI; days) and gestation period (GP; days) during the above mentioned period. Moreover, the kidding details were studied on quarterly basis to know the total number of kids born, kidding percentage, twinning and triplet percentages during different quarters of the study period. The body weight was recorded with the help of 150 kg table top weighing balance at regular intervals, viz. at the time of birth, at 3, 6 and 9 months of age for both male and female kids. The study could not continue the weighing of the males after this period, since they were removed from the flock for breeding/sale to avoid overcrowding, while the females reached the stage of sexual maturity and entered into gestation period before 12 months of age. The study utilized two bucks which were procured for initial 9–10 months and were culled. Later, two bucks which were born in this farm were used for breeding. All the goats in the farm were tagged for identification and regular data collection. The data generated were statistically analysed by using relevant statistical tools, viz. mean, SD and t-test using SPSS version 16.0 package. Also, the data on traits were statistically analyzed after square root transformation. The results so obtained are interpreted and discussed accordingly.

*Scientific management practices:* As per ICAR-NBAGR, Karnal studies, Osmanabadi breed is suited to all types of rearing systems, the most ideal being the semi-intensive system (grazing and closed enclosure), where higher production has been observed compared to extensive (grazing system) and intensive systems (zero grazing system). The goats under study were reared under semi-intensive system with regular feeding based on NRC

calculated requirements, housing, management and health care practices including deworming and vaccination with the help of local veterinarian. The animals were allowed to graze freely during day time (6–8 h) and were confined to sheds during night time. In the campus, the goats could graze in the forest bushes, sesbenia trees, acacia trees, crop residues of pigeon pea, chick pea, ground nut, crop harvested fields etc. Later, the adult goats were fed with 250 to 300 gm of concentrate diet by splitting it for two times a day (150 gm each) which consisted of 15% crude protein (CP) and 65% total digestible nutrients (TDN) as per book values. It was prepared using the ingredients like maize (30%), ground nut cake (5%), soya bean (5%), green gram chuni (10%), rice polish (5%), wheat bran (40%), limestone (2%), mineral mixture (1%) and salt (2%) (Rathod *et al.* 2018). The proximate analysis of the concentrate feed included moisture (9.39%), DM (90.61%), Ash (7.26%), EE (3.96%), CP (15.44%), CF (7.86%) and NFE (56.09%) as per AOAC (2005) method. Further, the kids were supplemented with mother's milk or foster mother's milk. The feeding also included licks of urea mineral mixture blocks. No other feeding practices were followed in the shed. The goats were housed in an elevated shed with rearing of pregnant does, breeding bucks, kids etc. separately to avoid any physical injury. The flooring of the sheds was made of thick plastic slates. Further, natural breeding was practiced by using pure breed bucks which were maintained in this flock.

## RESULTS AND DISCUSSION

*Salient productive and reproductive characteristics:* Osmanabadi breed is known for its early maturity, prolificacy and good dressing percentage (ICAR-NBAGR, 2020). Table 1 depicts salient characteristics of Osmanabadi goats considered for the study.

*Age at first kidding:* The age at first kidding was found currently to be  $266.55 \pm 18.38$  days with a range of 8–10 months (Table 1), while ICAR-NBAGR, Karnal had the recommendation of 12–13 months for the age at first kidding. Further, Bijurkar *et al.* (2015) have revealed that mean age at first kidding was determined as  $494.4 \pm 8.1$  days similar to the reports in other breeds (Rao and Pattnayak, 2007) while, Raskar *et al.* (2018) recorded that age at first kidding in Osmanabadi goat was 523–535 days.

*Gestation period:* The present study has recorded 148–153 days of gestation period range (Table 1). In another previous study, Bijurkar *et al.* (2015) reported average gestation period of  $152.24 \pm 0.24$  days with a range of 137 to 158 days in Osmanabadi goats while, Asdell (1929) revealed that average gestation period in goats was 147–155 days.

*Kidding interval:* The mean kidding interval in Osmanabadi does in the present study was recorded as  $195.09 \pm 5.65$  days with the range of 165 to 244 days (Table 1), while ICAR-NBAGR, Karnal has documented the kidding interval of 205 to 235 days. Moreover, Bijurkar *et al.* (2015) have revealed  $232.62 \pm 5.45$  days and ranged

Table 1. Salient characteristics of Osmanabadi goats

Characteristic	No. of observations	Findings
Average age at first kidding	18	8–10 months (266.55±18.38 days)
Gestation period range (days)	18	148–153
Kidding Interval	26	5.5–7.6 months (195.0909±5.65 days)
Age at puberty (days)	18	212.32±2.83
Average litter size	35	1.62
Average dressing percentage	25	53
Average milk yield (two months)	15	76 kgs (1.26 kg per doe per day)
Average birth weight of kids (kg)	88	2.575±0.48 (Range: 1.6 to 3.8 kg)
Twinning (%)	59	35.59
Triplets (%)	59	13.55

Table 2. Means (±SD) of body weights of Osmanabadi goats at ICRISAT farm

Sex	Weight of goats at different age groups (kg)			
	Birth weight of kids (n=88)	Weight at 3 months (n=66)	Weight at 6 months (n=48)	Weight at 9 months (n=32)
Male	2.58±0.48	16.58±2.13	27.93±2.29	41.55±0.91
Female	2.57±0.49	14.02±2.23	23.04±3.33	31.30±4.48

between 181 to 310 days, while Raskar *et al.* (2018) recorded 214 days kidding interval. A similar finding was also reported by Markendeya and Devanagare (1997) as well as Raja and Mukundan (1977) in Osmanabadi does.

**Age at puberty:** The mean age at puberty in the present study was recorded as 212.32±2.83 days (Table 1). However, previous studies have highlighted different age at puberty due the reasons behind differences in breed and management practices at that farm. On the other hand, Bijurkar *et al.* (2015) have recorded average age at puberty as 349.8±6.9 days with the range of 180–510 days.

**Litter size:** The present study has recorded average litter size of 1.62 in Osmanabadi goats (Table 1). However, ICAR-NBAGR, Karnal has found litter size of 1.6, while, a report by ICAR-AICRP on goats has documented the litter size of 1.79 in Osmanabadi goats during 2017–2018 (ICAR-AICRP 2018).

**Dressing percentage:** The current study has recorded average dressing percentage of 53 (Table 1). which is in line, with those reported by ICAR-NBAGR, Karnal (50%) in these goats.

**Milk yield:** Osmanabadi goats are well known for their meat and milk purpose. In the present study, the milk was mostly used for feeding the kids. However, the milk yielded of does was measured using the weigh–suckle–weigh method in limited number of goats (n=15) for a period of

two months. The study reported the average milk yielded of 76 kg for two months, which indicates the average daily milk yield as 1.26 kg per doe (Table 1). However, it was also observed that the milk yield of does increased with the increasing in the number of kids. Similarly, Raskar *et al.* (2018) recorded average daily milk yield of 700–1500 g with lactation length of 130–150 days under farm conditions, while, Banerjee (2006) has reported an average daily milk yield of 0.5 to 1.5 kg for a lactation period of four months. Further, scientists in Osmanabadi Field Unit of ICAR-AICRP on goats have documented mean 90–day milk yield to be 110 kg including 1398 records (ICAR-AICRP 2018). Similar study has also observed that Osmanabadi breed is among the top five dairy goat breeds in India.

Other characteristics, viz. average birth weights of kids (2.575 kgs), twinning (35.59) and triplet percentages (13.55) are also discussed in Table (2 and 3).

**Body weights of Osmanabadi goats:** The body weight was recorded with the help of 100 kg table top weighing balance on regular intervals of time, viz. at the time of birth, at 3, 6 and 9 months of age for both male and female kids. The age and sex-wise body weights of Osmanabadi goats are presented in Table (2). The birth weight of kids determines the growth to adults and also depends on scientific regular farm management practices. The overall birth weight of males and females were 2.58±0.48 and 2.57±0.49 kg respectively with a range of 1.6 to 3.8 kg indicating that males had higher body weight at birth than the females (Table 2). The weight at birth in the current study superseded the data recorded by ICAR-NBAGR reports (weight range of 1.7 to 2.1 kg). Further, in a similar study, Harikrishna *et al.* (2013), documented average birth weight of Osmanabadi female kids as 2.35±0.01 kg and in male kids as 2.60±0.01 kg. However, Birari *et al.* (2012) pointed out that overall birth weight of males (1.92±0.03 kg) was higher than females (1.69±0.04 kg). Comparatively, higher body weights at birth in males (2.01±0.04 kg) and females (1.87±0.05) were reported by Koratkar *et al.* (1998) in Osmanabadi goats at organized farm. The effect of sex on the body weight may be attributed to the anabolic effect of male sex hormones like testosterone (Hafez, 1962 and Chandra *et al.* 2009), which influences growth factor during pre-natal development. Further, several workers have reported that birth weight was significantly affected by several factors like management practices, season of birth etc. (Kumar *et al.* 2007 and Rathod *et al.* 2018).

The overall body weight of males and females recorded at 3 months of age in the present study were 16.58±2.13 kg and 14.02±2.23 kg, respectively (Table 2). The earlier report on body weight at 3 months (Bhoite and Koratkar 1997) showed superiority in male (9.90±0.39 kg) and female (8.76±0.38 kg) kids of Osmanabadi goats under organised farm. However, Birari *et al.* (2012) recorded overall body weights of males and females as 7.29±0.01 and 6.92±0.04 kg, respectively at 3 months of age. In another study, Bansode *et al.* (2017) documented a mean weight of

7.60±0.33 kg and 8.71±0.21 kg, respectively at 3 months of age under conventional and loose housing system.

The mean body weight of males and females recorded at 6 months of age in the present study were 27.93±2.29 kg and 23.04±3.33 kg, respectively. Similarly, Birari *et al.* (2012) indicated that overall body weight at 6 months of age was higher in males (14.46±0.02 kg) than females (14.02±0.03 kg). Significantly higher body weight at 6 months of age for males (14.93±0.53 kg) and lower for females (13.63±0.49 kg) were reported by Bhoite and Koratkar (1997). In a similar study, Raskar *et al.* (2018) recorded a body weight of 15.49±0.57 kg in Osmanabadi kids at 6 months of age. Interestingly, Patil *et al.* (2014) and Devi *et al.* (2020) found body weight of 13.65 kgs and 21.55 kg at 3 months and 6 months of age respectively under intensive system. It is worthy to mention that good management practices under semi-intensive system can supersede the performance of other systems in Osmanabadi goats.

The overall body weight of males and females were 41.55±0.91 kg and 31.30±4.48 kg, respectively at 9 months of age in the current study. The study could not continue the weighing of the males after this period, since they were removed from the flock for breeding purpose, marketing etc. to avoid over crowding, while the females reached the stage of sexual maturity and entered into gestation period before 12 months itself. Interestingly, these data are superior to several previous studies conducted at different stages by different authors. Birari *et al.* (2012) indicated that overall body weight at 12 months of age in females (20.61±0.03 kg) were significantly ( $P<0.01$ ) higher than males (19.80±0.03 kg). The reason for higher significance might be due to undetected pregnancies. In contrast, Bhoite and Koratkar (1997) observed higher body weights in males (24.76±0.64 kg) than in females (16.71±0.04 kg) at 12 months of age for Osmanabadi goats. Further, Raskar *et al.* (2018) recorded body weight of 19.56±0.92, 29.50±0.64 and 32.77±0.60 kg for Osmanabadi goats at 12, 24 and 36 months of age respectively. The present study has clearly indicated that regular scientific management practices would enhance the productive and reproductive performance of goats.

**Kidding details and twinning ability in Osmanabadi goats:** The kidding and twinning rates are the most important parameters to investigate the reproductive efficiency of goat breeds. It is a measure of production and profitability in organized and unorganized sectors of goat farming, which is dependent on several factors. Table (3) showed kidding details of ICRISAT goat farm during the study period. The current kidding percentage was recorded to be 50.84% single births, while the twinning and triplet percentages were 35.59 and 13.55% respectively. Similarly, Bijurkar *et al.* (2015) have reported that majority of kidding resulted in single births was 87.27% and with only 12.73% of multiple births. Further, Sahare *et al.* (2009) observed that kidding percentage in Osmanabadi goat was found to be 55.87±4.26 with the range of 27.27 to 76% while, Raskar *et al.* (2018) recorded 30% twinning rate and 2% triplets/

quadruplet in Osmanabadi goats. However, the higher kidding and multiple births expressed in this present study indicates that Osmanabadi goats have potential to show better reproductive efficiency, which could be optimized by providing excellent managerial practices.

In general, the sex ratio does not deviate significantly from 50%. However, there are some unknown factors, which might favour or affect the deviation of the sex ratio. In the present study, male to female sex ratio were 52.09 to 47.91% which is almost similar to the findings of Kharkar *et al.* (2017) who recorded male to female ratio of 56.59 to 43.41% in Osmanabadi goats. This was similar to findings of Kale and Tomar (1997) reported (54.56:45.55%) in Alpine × Beetal goats, Soundrarajan and Sivakumar (2006) in Kanni goats (57.71:42.29) and Sivakumar and Soundrarajan (2007) in nondescript goats (55.43:44.57%).

In the present study, highest number of kidding was found during April–June, 2019, October–December, 2019 and January–March, 2020 (Table 3). This might be due to the reason that goat is polyestrous and adult female shows estrous cycle every 20–21 days interval with standing heat period ranging from 12 to 24 h, and these goats were reared with the breeding bucks under semi-intensive system. Also, these goats were provided with good grazing land, concentrate feed and mineral mixture, which might have improved the reproductive performance in these goats. Further, the kidding details indicated significant difference among the durations at  $P<0.001$  (Table 3). However, with regards to the season, majority of the goats comes into oestrous after rainy season by June–July months, and hence, more number of births are recorded in winter season particularly during the months of November to June. In a similar study, Perumal *et al.* (2019) reported that highest kidding rate was observed in monsoon/wet season (April to November) and lowest in dry season (December to March) while, Bijurkar *et al.* (2015) found that 69.29% Osmanabadi doe's kidding occurred between the month of November to February and Hari Krishna *et al.* (2013), recorded most of the births during November (28%) followed by October (16.4%), February (12.6%) and March (11.2%). It was also reported by Kale and Tomar (1997) and Kumar *et al.* (2010), that the major kidding season was in November to April for North-western India.

**Interventions for enhancing productive and reproductive potential:** Based on the existing practices, it was found that Osmanabadi goats have very good productive and reproductive potential in terms of kidding interval, body weight of goats, milk yield, kidding percentage etc. which indicates that data recorded in this farm has superseded other studies in majority of the parameters under study. Further, studies conducted by Gopala *et al.* (2010), SFAC (2014), NAIP (2014), Rathod *et al.* (2018), Perumal *et al.* (2019) and Veeranna and Rathod (2019) have also revealed that effective implementation of scientific interventions would improve the productive and reproductive performance of small ruminants in general, and Osmanabadi goats in particular ultimately leading to improvement of farmers income.

Table 3. Kidding details in Osmanabadi goats at ICRISAT farm

Duration	Total No. of Kidding***	No. of Kids born***	No. of female kids***	No. of male kids***	Single kids born (No.)***	Singlets (%)	Twin kids born***	Twins (%)	Triple kids born***	Triplets (%)
July–Sept. 2018	5	6	2	4	4	80.00	1	20.00	0	0
Oct.–Dec. 2018	9	13	5	8	5	55.56	4	44.44	0	0
Jan.–Mar. 2019	3	5	3	2	1	33.33	2	66.67	0	0
Apr.–June 2019	15	22	10	12	10	66.67	3	20.00	2	13.33
July–Sept. 2019	5	8	3	5	2	40.00	3	60.00	0	0
Oct.–Dec. 2019	9	19	10	9	3	33.33	2	22.22	4	44.44
Jan.–Mar. 2020	13	23	13	10	5	38.46	6	46.15	2	15.38
Total						50.85		35.59		13.56
Mean±SE	8.43±1.67	13.71±2.89	6.57±1.65	7.14±1.35	4.29±1.11	50.85	3.00±0.62	35.52	1.14±0.59	13.56

Note: \*\*\*Indicates significant difference among the durations at P<0.001.

The current study recorded averages of age at first kidding (266.55±18.38 days), gestation period (148–153 days), kidding interval (195.09±5.65 days), age at puberty (212.32±2.83 days), litter size (1.62), dressing percentage (53%), milk yield (1.26 kg per doe per day), birth weights of kids (2.57 kgs), twinning rate (35.59%) and triplet percentages (13.56%) which indicated that these findings are superior to several other previous studies including the findings of ICAR-NBAGR, Karnal which might be due to the adoption of regular scientific management practices followed in the ICRISAT goat farm under semi-intensive systems. Further, the kidding details indicated significant difference among the durations at p <0.001. The study concluded that meticulous adoption of scientific regular management practices would enhance the productive and reproductive performance of goats in general, and Osmanabadi goats in particular under semi-intensive system. Hence, a need-based research and extension strategy by concered organizations is essential to emphasize on the need for adoption of scientific management practices for improving the livelihood of the farmers in arid and semi-arid regions of India.

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