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# Empowering Tribes through Sustainable Goat Farming: KVK's Intervention in West Godavari District of Andhra Pradesh, India

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## ABSTRACT

Small ruminants, especially goats, are important in the activities of small and marginal farmers in India due to their low maintenance, rapid breeding and early maturity. The purpose of this study is to assess effects of interventions made between 2017-18 and 2021-22 under the ICAR-Tribal Sub-Plan (TSP) scheme on income generation and empowerment of goat farmers in Buttaigudem and Polavaram tribal mandals of West Godavari district Andhra Pradesh. The study used semi structured interviews with 75 beneficiary farmers. The findings showed that there was significant improvement in the adoption of scientific management practices and the production and reproductive performance of non-descriptive breed goats that were crossed with Osmanabadi breed goats. The results as expected show changes in the targets of generation of income and benefits offered by the TSP scheme interventions to tribal goat farmers which demonstrates the importance of the TSP interventions in terms of strategic intervention to their sustainable livelihood development to hilly and tribal communities.



## INTRODUCTION

The livestock sector in India has undergone a significant transformation, transitioning from a subsidiary component of farming to a vital source of livelihood in various regions across the country. This sector is increasingly recognized for enhancing the livelihoods of rural populations and peri-urban livestock keepers (Nirmala *et al*., 2023). The 20th Livestock Census of India, conducted in 2019, provides a comprehensive overview of the country's diverse livestock population. As of the census date, India boasts a total of 536.76 million livestock, representing a significant segment of the national agricultural landscape. This includes 193.46 million cattle, 109.85 million buffalo, 74.26 million sheep, 148.88 million goats, and a significantly higher poultry population of 851.81 million. Lastly, the swine population is noted to be 9.06 million. The total Goat population in the country has increased by 10.1% over the previous census (BAHS, 2022). Andhra Pradesh consisted of 4.6 million, 6.22 million, 17.63 million and 5.52 million of cattle, buffalo, sheep and goat population, respectively. The goat population in Andhra Pradesh increased from 4.82 M in 2007 to 5.5 M in 2019 (Radha and Kumar, 2022).

In South Asia, a region housing roughly 29% of the world's goats, these animals play a vital role in supporting the economic well-being of poor rural communities. Notably, they are increasingly becoming a tool for social and economic advancement, particularly for small and marginal farmers, landless individuals, and women. Goats quickly adapt to the various environmental conditions and investment is minimal (Siddiky, 2017). It is often called the cow of the poor (Das *et al*., 2017). In rainfed areas characterized by unpredictable crop production and scarcity of feed and fodder, goats emerge as particularly

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suitable livestock species. Compared to other animals, goat rearing offers distinct economic and managerial advantages due to its lower initial investment, minimal resource requirements, high reproductive capacity, early maturity, and readily accessible market demand. Moreover, their inherent adaptability to harsh environments allows them to thrive on available vegetation like shrubs and trees, thereby minimizing resource dependence (Siddiky, 2017).

In India, goats are raised to generate supplementary revenue and safeguard against financial setbacks resulting from crop failure. Furthermore, impoverished individuals residing in tribal areas who lack the financial means to sustain a cow or buffalo consider goats as the most viable alternative for generating additional income and obtaining milk. Due to their significant socio-economic importance, the goat population in our country has been steadily increasing. Since achieving independence, the Indian government has confronted the enduring challenge of ensuring equitable social justice for scheduled tribes (STs) through the improvement of their socioeconomic conditions. The tribal sub plan (TSP) represents a comprehensive and strategic framework adopted by the government to address the welfare and development aspirations of ST communities across the nation. Comprising distinct population groups explicitly recognized by the Constitution of India (1950), STs are enumerated within the document's First Schedule, encompassing 744 tribes distributed across 22 states. Within Andhra Pradesh, 33 diverse ST communities reside in 8 districts, constituting approximately 6.6 percent of the state's overall population. Predominantly inhabiting hilly and forested regions, ST communities exhibit unique characteristics, including indicators of ancestral practices, distinct cultural heritages, and an inclination towards privacy. However, their geographical isolation and historical marginalization have contributed to a development gap compared to mainstream society. Recognizing this disparity, both central and state governments have implemented various programs and schemes since 1951 to uplift ST communities. The establishment of the Ministry of Tribal Affairs in 1999 further amplified efforts towards their inclusive development, particularly within Andhra Pradesh. Despite these initiatives, significant challenges persist. These include limited literacy levels, high school dropout rates, inadequate access to healthcare services, nutritional deficiencies, extreme poverty, and implementation bottlenecks associated with existing schemes. These hurdles continue to impede their progress towards achieving economic and social prosperity. By strategically addressing these concerns and effectively utilizing the TSP framework, policymakers can create a more just and equitable future for ST communities in Andhra Pradesh. Continued research and evaluation are crucial to identify and implement evidence-based interventions that empower ST communities and bridge the development gap (Subramanyachary, 2013).

In the present context, the role of tribal youth could be vital in India's much anticipated transformation of farming systems. Tribal youth are the most vulnerable and active stakeholders in the design of agri entrepreneurship and they can sustainably transform tribal communities. In recent years, nondescript goats are less preferred, due to their low productivity as compared to improved goat crosses. For the genetic improvement of goats, selective breeding within the native breeds is popular among the goat herds (Patil *et al*., 2021). However, improving the non-descriptive goats by crossing with improved breeds (Osmanabadi/Sirohi/Jamunapari/Black Bengal breed) is being commonly practiced by the progressive goat farmers in recent times, expecting a significant increase in production within a short period.

The Osmanabadi breed, identified by ICAR–National Bureau of Animal Genetic Resources (NBAGR) as INDIA GOAT 1100 Osmanabadi 06017, is one of the 34 distinct goat breeds recognized by ICAR-NBAGR in 2020. The primary purpose of rearing the Osmanabad goat is for its high-quality meat, with milk production being a secondary consideration. The breed is highly adapted to arid and semi-arid regions. It is widely recognized for its excellent meat and milk production, as well as its high rate of giving birth to twins and triplets and early sexual maturity. In addition, this breed is well adapted to various rearing systems, with the semi-intensive system (combining grazing and closed enclosure) being the most favorable. Studies have shown that this system yields higher production than extensive grazing systems and intensive zero-grazing systems (ICAR-NBAGR, 2020). Devi *et al*. (2020) state that the semi-intensive system entails restricted grazing for a duration of 6-8 h, with the remaining time spent stall-feeding on supplementary feed, which is dependent on factors such as time, labor, and feed availability. This system involves the integration of small ruminants with crop production, where agricultural byproducts or crop residues are used as feed. As a result, the dung and urine produced by the animals are returned to the land, thereby enhancing soil fertility (Devendra, 1986).

This study focused on the implementation of the TSP activity to attract the rural youth and effective scientific management practices in goat rearing by implementing the technological interventions in goat farming of tribal mandals (Buttaigudem and Polavaram) of West Godavari district for additional income generation and empowerment of tribal farmers.

## MATERIALS AND METHODS

The study period included a total of five years (2017-18 to 2021-22). Knowledge of farmers is a prerequisite for the adoption of goat farming practices (Meena *et al*., 2023). Consequently, both on-campus and off-campus training programs were conducted for 375 tribal farmers, focusing on scientific management practices. Along with training programmes, method demonstrations and exposure visits were also conducted in coordination with the Department of Animal Husbandry and ITDA, K.R. Puram. Under frontline demonstrations, concentrate mixture was formulated from locally available feed ingredients and supplied to farmers to offer @ 250 g/doe/day during the last trimester of pregnancy and creep feed to offer @ 50 g/kid (from the 10$^{th}$ day of age to the 90$^{th}$ day). Concentrate feed mixture was prepared using ingredients such as maize (30%), deoiled rice bran (11%), rice bran (20%), gram chuni (10%), ground nut oil cake (16%), cotton seed cake (10%), mineral mixture (2%), and common salt (1%). After completion of capacity building programmes, 75 tribal farmers from Buttaigudem and Polavaram mandals of West Godavari district were selected for consecutive five years (2017-18 to 2021-2022) because of economic condition, interest towards goat rearing and experience in goat farming. Each farmer was provided one unit of improved Osmanabadi goat (one buck and two doe) of age group around 6 months, concentrate feed mixture, legume fodder seed (Cowpea, Pillipesara, Hedge lucerne), goat feeders, health supplements and mineral salt licks under Tribal Sub Plan (TSP) scheme. Regular deworming was done thrice a year against endoparasitic infections and vaccination against prevalent infectious and contagious diseases (ET, HS, PPR etc.) was also completed. Regular training sessions were conducted covering goat housing, feeding, and breeding management to equip farmers with essential knowledge and practices. These sessions aimed to optimize animal health, production, and reproduction. Expertise was delivered directly by trained specialists or through collaboration with veterinary assistants. Additionally, comprehensive animal health camps were organized, ensuring the well-being of goats and all livestock in the target area. Following these interventions, semi-structured interviews were conducted with participating farmers to gather crucial data. The ex-post-facto research design was adopted to assess the impact. The data generated were statistically analysed using SPSS version 24.00.

## RESULTS AND DISCUSSION

*Socio-economic profile of respondents*

The majority of respondents (76%) fall under the category of middle adulthood aged between 35 to 50 years, as shown in Figure 1. However, 16% of young adults were less than 35 years of age, while 8% were much older adulthoods (> 50 years). Most (72%) of the respondents had a medium family size of 4-6 members with the nuclear family system (84%), while agriculture was the primary occupation (81.33%), with livestock farming as a subsidiary occupation. In the study area, the majority (52%) of respondents were educated up to primary to high level, followed by illiterates (30.67%) and graduation level (10.67%). The rest of the youths (06.66%) had intermediate education. Most of the farmers, i.e., 81.33%, were male, while 18.67% were female. Das *et al*. (2022) indicated that a significant proportion of goat farmers were male (59.65%) and had attained education up to the 1$^{st}$ to 5$^{th}$ grade (56.14%). Many respondents (81.34%) had medium goat flock size (5-15) followed by low (<5) (09.33%) and high (>15) (9.33%). However, Nandi *et al*. (2011) observed that the majority of goat farmers managed a flock size ranging from 1 to 4 goats (56%). In the present study, almost all the respondents (72.00%) have medium farming experience (7.34 to 20.20 years), whereas 14.67% of farmers have more than 20.20 years of experience. However, 13.33 percent of respondents have less than 7.34 years of experience in goat farming. Half of the respondents (52%) have 0.48 to 1.82 hectares of land. Meena *et al*. (2023) reported that majority of respondents (72.6%) had 3 to 8 years of farming experience, whereas 17.81% of youth were having less than three years of experience.

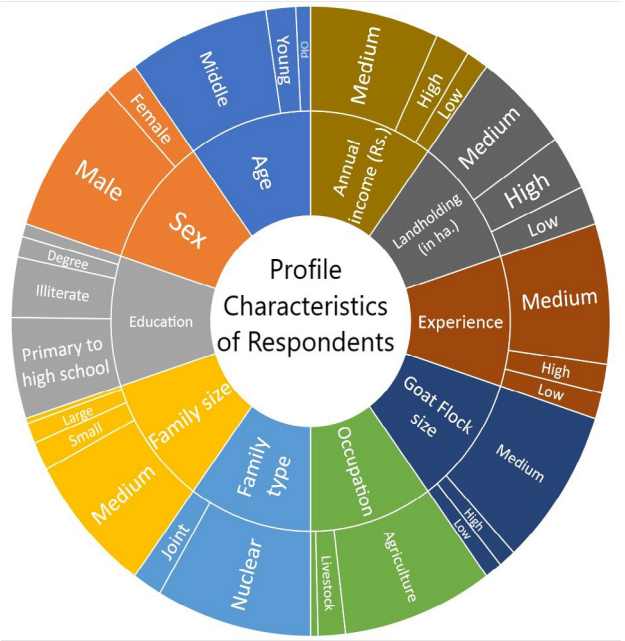


Fig. 1. Profile characteristics of respondents.

However, 9.59% of respondents had more than eight years of experience in farming. It was also revealed that the majority of respondents (98.63%) owned 1 to 3 hectares of land. The yearly income of most respondents (69.33%) ranged from Rs. 55863.62 to Rs. 127671.04. Only 18.67 percent of respondents have more than Rs.1,27,671.04 income. In a similar study, Das *et al*. (2022) reported that the average total income of farmers from agriculture at the onset of the program was Rs. 15,180. However, after four years of raising Osmanabadi goats under the TSP program, tribal women farmers earned an average income of Rs. 50,565, while still retaining 12 goats in their herds. Meena *et al*. (2023) also reported that the annual income of the most respondents (93.15%) were ranged from Rs. 44,000 to Rs. 1,41,000. Only 5.48% of respondents have more than Rs.1,41,000 income.

*Implementation of scientific management techniques in goat farming*

*Feeding management*

A semi-intensive management system was implemented, whereby the goats were permitted to forage in the forest or communal land from 9:00 to 10:00 till 17:00 to 18:00 clock and were then confined to sheds during the night. Relying exclusively on grazing may be insufficient to achieve optimal live weight gain and reproductive performance in goats. However, by implementing enhanced feeding and management practices, it is possible to increase production levels with minimal investment. Most farmers were uninformed about the necessity of providing concentrate feed to goats. Consequently, the kids do not receive adequate nutrition, leads to subpar growth rate and cause financial losses to farmer (Kumar and Pandian, 2020). Basically, goats are herbivores that exhibit a browsing feeding habit, showing a preference for consuming the tender leaves of herbs, shrubs, and small trees (Skerman, 1977). According to Silanikove (1997) they have a high capacity to efficiently break down low-quality fiber. Goats exhibit remarkable adaptability in their feeding habits when faced with varying environmental conditions (Zobel *et al*., 2018).

Flushing is a temporary feeding strategy that provides diets with high protein and calorie content before, during, or after mating to enhance nutrition and health management and overall, it contributes to the production system. The concentrate feed mixture was provided to goat rearers, and demonstrating the technique resulted in an increase in the adoption of this practice from 8% to 46.67%. The flushing strategy helps in the improvement of the production system (Berhane and Eik, 2006). According to Rekik *et al*. (2012) their study involving goats and sheep found that changing their diet in the short, medium, and long term can impact reproductive parameters. When sheep were kept on pasture with low-quality dry herbage and given nutritional supplements, they observed that ewes that were deprived of nutrition during the flushing period gained weight efficiently and rapidly (Naqvi *et al*., 2011). Similarly, the research findings indicate that nutrition plays a significant role in regulating reproduction (Smith and Akinbamijo, 2000). Providing additional feed to enhance nutrient intake, especially before mating (known as flushing), has been shown to improve reproductive performance by influencing ovulation rate through the effects of nutrition (Kusina *et al*., 2001).

**Table I. Impact of training on feeding management practices adopted by tribal goat rearers (N=75).**

| S. No. | Management practices | Pre-training | Post training |
|---|---|---|---|
| 1. | Creep feeding to kid | | |
| | Yes | 04 (05.33%) | 46 (61.33%) |
| | No | 71 (94.67%) | 29 (38.67%) |
| 2. | Concentrate feeding during breeding season (Flushing) | | |
| | Yes | 06 (08.00%) | 35 (46.67%) |
| | No | 69 (92.00%) | 40 (53.33%) |
| 3. | Concentrate feeding during pregnancy | | |
| | Yes | 15 (20.00%) | 56 (74.67%) |
| | No | 60 (80.00%) | 19 (25.33%) |
| 4. | Concentrate feeding for lactating does | | |
| | Yes | 08 (24.00%) | 31 (41.33%) |
| | No | 67 (76.00%) | 44 (58.67%) |
| 5. | Mineral salt licks supplementation | | |
| | Yes | 0 (0.00%) | 28 (37.33%) |
| | No | 75 (100.00%) | 47 (62.66%) |

Figures in parentheses indicate percentage.

Prior to training, a significant majority of goat rearers did not provide creep feed mixture to kids (94.67%), and concentrate feed to breeding does (92%), pregnant does (80%), and lactating does (76%) as shown in Table I. The study demonstrates a notable shift in adopting feeding practices following the training. Following the training, 61.33 % of goat rearers offered creep feed to kids, while 46.67% provided concentrate feed to breeding does, 74.67% to pregnant does, and 41.33% to lactating does. Mineral salt licks can enhance feed consumption, leading to enhanced production. Despite participating in the training, only 37.33% of goat rearers gave their goats mineral salt licks. This could be due to the lack of mineral salt licks nearby. Similar findings were reported by Singh *et al*. (2007). A notable study by Chowdhary *et al*. (2002) investigated the effects of semi-intensive management on Black Bengal goat rearing and revealed a significant influence of dam nutrition on kid mortality. Their findings

demonstrated that dams fed at a higher nutritional level experienced significantly lower rates of kid mortality than those subjected to a lower plane of nutrition. The results were comparable to those obtained by Rai and Singh (2004).

*Health management*

Regular deworming was performed by a smaller proportion of respondents (30.67%) who engaged their animals prior to training. However, 82.67% of respondents have implemented regular deworming practices following their training programs on scientific rearing. These findings are in accordance with the findings of Ambhore *et al*. (2021), Pankaj *et al*. (2014), and Nirmala *et al*. (2017). Initially, only 16% of respondents vaccinated their animals regularly to protect them from diseases. However, after receiving training, this percentage increased to 72%. Singh *et al*. (2013) observed a significant increase in illness and death rates among non-adopted flocks. Conversely, they found no outbreaks in adopted villages, encouraging goat rearers to implement a health care calendar. The studies conducted by Hossain *et al*. (2017), Nirmala *et al*. (2017), and Sangameswaran and Prasad (2016) yielded comparable results. The vast majority of goat farmers (90.67%) did not adhere to the application of any ectoparasiticide to control ecto parasites, such as ticks, mites, lice, mosquitoes, and flies. However, after training, the percentage of respondents who are now applying ectoparasiticides has increased by 60%. Ambhore *et al*. (2021) reported that only 33.33 percent of respondents used ectoparasiticides to control goats' external parasitic burden.

*Breeding practices*

Male goats, known as bucks, are capable of breeding starting at nine months of age. They can be utilized for breeding purposes for a period of 6-8 years, but it is recommended to rotate them out of a herd after two years. Acquiring a breeding buck requires a substantial financial commitment, and it is crucial for farmers to prioritize maximizing their productivity and lifespan. Inadequate management can lead to bucks that are either unsuitable for breeding or are culled prematurely before reaching the end of their productive lifespan. Effective oversight is imperative to guarantee the reproductive triumph of every goat group and to optimize the productive lifespan of male goats (Ridler *et al*., 2012). Supplementing bucks with a concentrate mixture is necessary during the breeding season, in addition to grazing. However, despite the implementation of training programs to raise awareness, only a small percentage (16%) of respondents were observed to be actively providing concentrate mixture to breeding bucks during the breeding season. The findings of Nirmala *et al*. (2017) and Singh *et al*. (2013) are consistent. The possible cause for this could be attributed to the exorbitant expense of the concentrate feed mixture and the abundant availability of green fodder in the study region. The breeding practices employed by tribal goat keepers indicated that a significant majority of respondents (80%) were utilizing uncontrolled mating in their goat herds (Table II). Every male buck from nearly every group in the villages can breed with any female goat in the grazing area, and possibly even at home. The current study found that the majority of respondents (88% before training and 58.67% after training) used their own flock bucks for breeding purposes. However, Gebreyesus *et al*. (2013) found that most participants with a small flock relied on additional sources, such as relatives, neighbors, and communal resources, besides their own flock, for breeding bucks. In their respective studies, Deshpande *et al*. (2009) and Tanwar *et al*. (2007) also found that introducing male goats into the flock comes from external sources.

**Table II. Breeding practices adopted by tribal goat rearers (N=75).**

| S. No. | Particulars | Pre training | Post training |
|---|---|---|---|
| 1. | Breeding method employed | | |
| | Uncontrolled | 75 (100.00%) | 60 (80.00%) |
| | Controlled | 0 (0.00%) | 15 (20.00%) |
| 2. | Feeding of concentrate mixture to bucks during breeding season | | |
| | Yes | 0 (0.00%) | 12 (16.00%) |
| | No | 75 (100.00%) | 63 (84.00%) |
| 3. | Source of breeding bucks | | |
| | Own | 66 (88.00%) | 44 (58.67%) |
| | Others | 9 (12.00%) | 31 (41.33%) |

Figures in parentheses indicate percentage.

*Productive and reproductive performance of goat*

The goats were housed in a partially enclosed shed constructed from locally sourced materials such as bamboo or wood, with a roof made of galvanized iron sheets or thatched, and an earthen floor. Several farmers constructed wooden platforms to prevent moisture from affecting the floor. Some farmers constructed enclosures using bamboo, which are connected to sheds, to allow goats to roam and exercise, thereby improving their health and productivity. Body weight and growth rate serve as reliable measures of physical well-being and economic profitability during various stages of growth. The birth weight of kids is a determining factor for their growth into goat and is also influenced by scientific management techniques. The study found that the average birth weights of T0 and T1 kids were 1.92±0.11 and 2.25±0.07 kg,

respectively. The average weight of kid at three months of age was 9.82±0.54 in T0 and 11.16±1.07 in T1. The mean body weight of kids in the T0 group at 6 months of age was 16.15±1.63, while in the T1 group it was 20.77±2.005. The mean weights of the goats exhibited a significant increase ($P< 0.05$) to 26.98±1.19 and 30.30±1.23 at the conclusion of 9 months in the T0 and T1 groups of goats, respectively, as shown in Figure 2 of the present study. Das *et al*. (2022) found that the average birth weight of Osmanabadi kids was recorded as 2.607±0.234 kg. Similarly, the mean birth weight of female Osmanabadi kids was 2.57±0.49 kg and that of male kids was 2.58±0.48 kg (Rathode and Dixit, 2021). Patil *et al*. (2021) reported the average birth weight of local and Sirohi x non-descript goat kids as 1.87±0.17 kg and 2.85±0.29 kg and at 3 months of age was 10.13±1.15 kg, while Sirohi cross goats weighed 12.18±1.79 kg on average. Nevertheless, Birari *et al*. (2012) highlighted that the average birth weight of males was 1.92±0.03 kg, while for females it was 1.69±0.04 kg. Similarly, the birth weight of Osmanabadi goat kids in the Konkan region of Maharashtra was found to range from 2.20 to 2.38 kg in various housing systems, as reported by Bharambe and Shinde (2014). Akmal *et al*. (2010) found that the offspring of Beetal crosses had a 40% higher body weight at 6 months of age compared to local non-descriptive goats. In another study by Rathod and Dixit (2021), the body weights of female and male Osmanabadi goats at six months of age were recorded as 23.04±3.33 and 27.93±2.29; at nine month were 31.30±4.48 kg and 41.55±0.91 kg, respectively. In addition, multiple studies on these findings (Harikrishna *et al*., 2013; Kharkar *et al*., 2017; Kumar and Pandian, 2020; Rathod *et al*., 2018) have found that various factors, such as management practices, variety, feeding, and season of birth, have a significant impact on the birth weight of kid. These factors aid in determining the optimal age at which young animals can be sold for maximum economic gain and superior carcass quality (Mule *et al*., 2014; Rathod and Dixit, 2021).

In the current study, the average age at which puberty occurred was documented as 447.60±24.89 and 344.38±22.81 in the T0 and T1 groups, respectively as shown in Table III. Bijurkar *et al*. (2015) reported that the average age at puberty was 349.8±6.9 days, while Patil *et al*. (2021) documented a mean age at puberty of 331.41±11.53 days. Conversely, Rathod and Dixit (2021) have discovered that the average age at which puberty occurs is 212.32±2.83 days. This could be attributed to variations in breed and the methods used for managing them. Age at first kidding refers to the age at which female goats give birth for the first time. The study found that the average age at first kidding in Osmanabadi x non-descript cross goat was 465.21±26.53 days, which is lower than that of non-descriptive goat (593.16 ± 30.88 days). Conversely, Rathod and Dixit (2021) reported an earlier onset of first kidding in Osmanabadi goats, averaging 266.55± 18.38 days (range: 8-10 months). Abraham *et al*. (2019) observed a later age at first birth, specifically 415.1±9.01 days, under semi-intensive management. Similarly, Raskar *et al*. (2018) observed that the age at which Osmanabadi goats first give birth ranged from 523 to 535 days. This phenomenon can be attributed to the fact that female offspring of Osmanabadi goats, raised under semi-intensive management and provided with superior nutrition, experience accelerated growth and reach sexual maturity at an earlier stage. Consequently, these goats are younger when they give birth for the first time. The single-born kid achieved their first pregnancy earlier compared to twins and triplets. The earlier sexual maturation of female offspring born as single, as compared to those born as twins or triplets, may be attributed to the adequate nourishment provided by their mother during the pre-weaning stage, which facilitates the early development of their reproductive organs. In this study, the average interval between kidding in non-descriptive breed goat and Osmanabadi x non-descript cross was found to be 371.52 ±15.83 and 236.48±19.91 days, respectively (Table III). Rathod and Dixit (2021) discovered that the

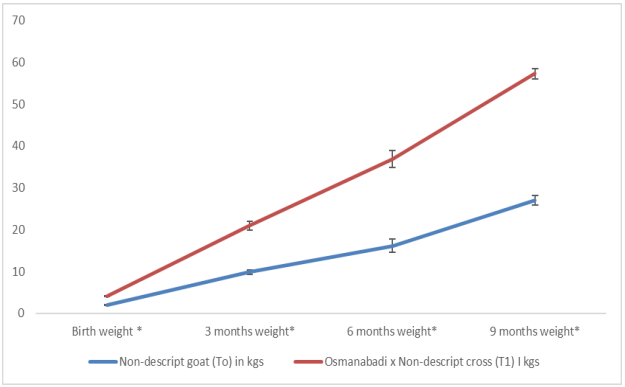


Fig. 2. Mean body weights of goat at different ages with standard error.

**Table III. Mean reproductive performance of does.**

| Stage | Non-descript goat (To) | Osmanabadi × non-descript cross ($T_1$) |
|---|---|---|
| Age at puberty (days) | 447.60 ±24.89 | 344.38±22.81 |
| Age at first kidding (days) | 593.16 ± 30.88 | 465.21±26.53 |
| Gestation length (days) | 151.64 ±2.11 | 154.72 ±2.89 |
| Kidding interval (days) | 371.52 ±15.83 | 236.48±19.91 |

average kidding interval in Osmanabadi does is 195.09 ± 5.65 days. In contrast, ICAR-NBAGR, Karnal has recorded a kidding interval ranging from 205 to 235 days. In addition, Abraham *et al*. (2019) discovered a kidding interval of 238.8±22.04 days in Begait goats. Amin *et al*. (2001) and Raskar *et al*. (2018) also found similar results, while Chowdhury *et al*. (2002) and Hassan *et al*. (2015) reported a shorter kidding interval in Black Bengal goats. The variations observed could be attributed to the impact of diverse management strategies, nutritional factors, and genetic composition on the potential for inducing re-conception following childbirth (Abraham *et al*., 2019; Faruque *et al*., 2010; Gbangboche *et al*., 2006). The average values for reproductive performance exhibited a noteworthy enhancement in terms of age at puberty, age at first kidding, and kidding interval among improved does (Table III).

*Employment generation*

This study assessed the employment generated by goat rearers in various activities, including grazing, feeding, shed cleaning, watering, healthcare management, and kid care. The data was analyzed on a relative basis. The average employment generation is 292 days for males and for females is 145 days. This translates to a relative gainful employment to the unemployed youth potentially improving livelihoods for resource-poor individuals. Previous studies by Misra *et al*. (2000) also highlight the potential of goat rearing, reporting employment generation ranging from 180 to 330 man-days depending on flock size.

*Economics of goat rearing*

The findings from Table IV inferred that the average nine months expenditure of Rs. 2750 was incurred per goat. A dressing yield of 50 percent and goat meat of Rs. 450/kg were considered to arrive at the benefit and cost (B:C) ratio. The gross profit worked out to be Rs. 6070.50 and Rs. 6826.50 for the non-descript breed goat and Osmanabadi x non-descript cross. The net return per goat at market age of 9 months was Rs. 4,076.5 for Osmanabadi x non-descript crosses, compared to Rs. 3,320.5 for non-descript breed goats. This suggests a profit increase of Rs. 756 per goat through the improvement of local non-descript breed goats with Osmanabadi goats. Similarly, Patil *et al*. (2021) in his study reported Rs. 588 profit per goat on the improvement of desi goats with Sirohi goats. The net income obtained was Rs.6744 goat/annum in a study conducted by Kochewad *et al*. (2023). While, Kumar *et al*. (2014) reported that the net return worked was Rs. 6895 per goat/annum. The B:C ratio for T0 and T1 is having 2.20 and 2.48, respectively, whereas, Shivakumara and Siddaraju (2019) revealed that the benefit-cost ratio in an intensive goat-rearing system is 2.1.

**Table IV. Economics of local non-descript breed goat and Osmanabadi × non-descript cross.**

| Particulars | Non-de-script goat (To) | Osmanabadi × non-descript cross ($T_1$) |
|---|---|---|
| Gross cost (Rs.)/goat for 275 days (@Rs. 10/day/goat) | 2750.0 | 2750.0 |
| Average 9 months weight (kg) | 26.98 | 30.35 |
| Dressing yield (kg) (@ 50%) | 13.49 | 15.17 |
| Gross return from meat (@Rs. 450/kg) | 6070.5 | 6826.5 |
| Net returns (Rs/goat) | 3320.5 | 4076.5 |
| Benefit: Cost ratio | 2.20 | 2.48 |
| Difference in net profit (Rs/ goat at 9 months of age) | 756.0 | |

Field days were organized at farmers goat sheds, allowing farmers from neighboring villages to observe the beneficial transformations resulting from the introduction of Osmanabadi goats, which led to the improvement of non-descript breed goat. This led to the horizontal dissemination of technology in eight additional villages of the West Godavari district during the specified time frame. The study demonstrated that the introduction of Osmanabadi goats into the local population resulted in enhanced growth and reproductive capabilities of the crossbred goats in the agricultural systems of this district. Consequently, farmers can expect to achieve higher economic returns. Therefore, it is recommended to enhance the quality of local goats by crossbreeding them with Osmanabadi bucks in the agro-ecosystems of West Godavari district. The goat rearers have also recognized the advantages of implementing the recommended cost-effective measures, not only in the study villages but also in the adjacent villages. Nevertheless, it is crucial to guarantee the accessibility of vaccines and the proper management of cold chain systems at the block/tehsil level, as well as the provision of micro-credit and community-based natural resource management, in order to ensure the sustained acceptance of these measures.

*Concluding remarks and way foreword*

The present study found that the adoption of scientific practices in feeding, breeding, and health management among tribal goat rearers increased as a result of capacity-building programs, such as training programs, frontline demonstrations, and other extension activities.

Additionally, the support provided by ICAR-Krishi Vigyan Kendra, Venkataramannagudem (West Godavari 2) under the Tribal Sub Plan (TSP) scheme also contributed to this increase. It generates additional income and promotes self-employment, specifically benefiting rural and tribal communities in India. This study has also emphasized a notable enhancement in the production and reproduction performance of non-descript breed goats following the introduction of Osmanabadi goats into the flocks of tribal villages. The implementation of the TSP scheme, along with technological interventions in goat farming in the West Godavari district of Andhra Pradesh, has greatly benefited the tribal beneficiaries. The farmer's income has increased because of goat rearing and the implementation of scientific management practices, ultimately leading to an improvement in livelihood. Therefore, it is imperative to enhance these practices to a significant degree in tribal areas by integrating different government initiatives with a stronger focus on skill development, establishing advanced goat breeding units, and facilitating market access through institutions such as KVKs, ITDAs, and State Animal Husbandry Departments which can greatly benefit the rural communities.

## DECLARATIONS

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*Statement of conflict of interest*

The authors have declared no conflict of interest.

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