



## Stall feeding of sheep and goats: An alternative system to traditional grazing on community lands

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### ABSTRACT

Sheep and goats in the country are mostly raised on grazing resources. But these resources are gradually shrinking over the periods both in term of areas under them and also in yield and quality. On the contrary, populations of sheep and goat are increasing rapidly to meet the demand of meat. This is resulting in overstocking and overcrowding on available grazing lands and sharp deterioration of grazing resources. The intensive system (stall feeding) as an alternative to traditional grazing and semi-intensive system, may be useful to maintain pace with growing meat demand in the changing scenario of grazing resources in the country. Studies have shown that lambs and kids on stall feeding with adequate nutrition and management attain faster growth, attain slaughter weights at an early age and produce heavier carcass weights, more dressing yield and desirable lean, fat and bone contents. Although initially intensive system seems costly due to more feed cost and more capital investment, but this is justified by higher economic returns to farmers. Therefore, it can be concluded that intensive feeding system for sheep and goats is better than extensive system and at par or better than semi-intensive system for lamb and kid fattening purpose from 3–6 months of age. This review article also discusses the possibility of economic viability of sheep and goats rearing under stall feeding.

**Keywords:** Goat, Intensive, Meat, Production, Semi-intensive, Sheep, Stall-feeding

Sheep and goats with their multi-facet utility play an important role and acts as financial cushion in the livelihood of small and marginal farmers and landless labourers particularly in ecologically fragile areas like arid, semi-arid and hilly areas of the country (Karim and Shinde 2010). Sheep is popularly called as “Automatic Teller Machine (ATM) for poor” and goat is known as “Poor Man’s Cow” as they help in fulfilling household’s emergency cash needs and best utilization of family labour. Farmers with less than 2 ha of land (marginal and small) possess more than 76% goats and 70% of sheep in the country (Dixit *et al.* 2017). India has 65.06 million sheep and 135.17 million goats. Sheep contributed 7.94% (602.82 million kg mutton) and goat 13.74% (1042.93 million kg chevon) to the total meat (7.7 million tonnes) production (DAHD 2018) in India. Total wool production of country is 41.5 million kg, out of it, 34.5% is produced by Rajasthan (first rank) and 18.1% by J&K (second rank). Goat milk has traditionally been known for its medicinal properties and goat contributes about 3.5% (6.16 million tonnes) to total milk production of the country (DAHD 2018). Small ruminants are reared mainly on common property resources, supplemented with top feeds and agricultural residues for meeting their feed and fodder requirements but these resources are declining

day-by-day (Shinde and Sejian 2013). The forage supply from these resources is decreasing due to higher grazing pressure and stocking density. In India, the average carcass yield obtained from sheep is low (12 kg/animal) in comparison to world average (15.6 kg/animal) because farmers mostly rear the animals on community lands without any supplementation (Singh *et al.* 2004, Girish *et al.* 2012). Hence, possible alternative system of small ruminants rearing for meat purpose can be stall-fed system on a commercial scale (Kumar and Pant 2003) in areas where pasture lands are shrinking. The rising demand of meat and meat products makes intensive production of small ruminants an increasingly attractive enterprise for smallholder farmers (FAO 2018). Therefore, considering small ruminant’s critical importance for poor farmers and changing grazing resources scenario, this review summarized research work carried out regarding stall feeding of sheep and goats in the country.

### Sheep and goat production systems

Production systems for sheep and goat have been developed on the basis of climatic conditions, agriculture patterns, region, utility and economic conditions of the farmer. Three types of system for small ruminants are generally practiced in the country, viz. extensive (free range), intensive (stall feeding), and semi intensive (grazing

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+ supplementation) (Mohini *et al.* 2018). Small ruminant production systems are characterized by more adaptability to harsh environment conditions, low inputs and capital investment, less management needs, less space, poor feed resources, high efficiency and high fertility and fecundity and mostly of nomadic and transhumant type (Devendra 2005).

*Extensive system:* This system is most commonly adopted by farmers in India and is characterized by grazing of animals on available grazing resources, including marginal land, uncultivated land, in migratory pattern either permanent or periodical for 6–9 months to the neighbouring states. Family labour is main input and animal production is compromised because of poor nutrition. Previous studies have established that goat is 2.5 times more economical (Swain 1982) than sheep under extensive system because they have more flexible habits like grazing from ground and browsing of tree leaves from height. But goats are normally non-migratory except when they are kept in mixed flocks of sheep and goats and maintained mostly on natural vegetation and tree leaves.

*Semi-intensive system:* It 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 crops production and used stubbles, agricultural byproducts and crop residues in feeding of goat and sheep which in turn return dung and urine to the land for improving soil fertility.

*Intensive system/stall-fed system:* The intensive system includes complete stall feeding on cultivated fodders, crop residues and concentrates or compounded feeds and animals are maintained indoors. This system has been developed for getting maximum weights of lambs and kids at an early age with higher feed efficiency. It is highly labour and capital-intensive system and constitutes less than 5% of the small ruminant production in the country (Sahoo *et al.* 2015). This system is mostly coming up in peri-urban areas driven by better market access to cater the growing demand for meat. The cost of meat production in intensive system is more as compared to other systems because of increased cost of feed and management but it is compensated by higher body weights at an early age and higher price in the market.

*Tethering:* It is mainly used when animals are grazed over a controlled, waste grazing areas to allow self-feeding on remaining crop residues to prevent animals wandering over main cropping areas. Tethering is commonly followed in villages for *in-situ* feeding of goat on crop residues and kitchen waste etc. This system is common in intensive cropping areas.

#### *Grazing land scenario in India*

Grazing resources include barren agriculture land, uncultivable lands, cultivable wastes, permanent pastures, stubbles, lands under miscellaneous trees, crops, periphery of forest lands, village's common land and other fallow lands (Shinde and Sejian 2013). Permanent pastures have declined from 11.98 million ha in 1980–81 to 10.36 million

ha in 2007–08 (Department of Economics and Statistics 2009) in the country. There is no well-defined pasture land for animals having quality grasses in terms of quantity and nutritional quality and are continuously decreasing (Jodha 1992). The areas under common property resources (CPRs) has decreased from 82.1 million ha to 43.3 million ha during last three decades mainly due to large-scale privatization, land reclamation for conventional agriculture, land fragmentation, land reforms and erratic rain patterns (Pradhan and Patra 2011). Area under green fodder production has decreased from 8.70 million ha (2001–02) to 8.14 million ha in 2007–08 (Land Use Statistics 2010). The decline of grazing area is the most serious problem faced by sheep and goat farmers. From 1950 to 2007, grazing land availability per sheep declined from 2.1 to 0.76 ha and stocking density per hectare has increased from 0.47 to 1.31 (Shinde and Sejian 2013). The grazing pressure on the resources is increasing which has seriously damaged them to a great extent. Therefore, there is need to explore stall-feeding system as alternative system of sheep and goat rearing especially for meat production.

#### *Growth performance of lambs and kids under stall-fed system*

In India, information on short-term studies for lambs and kids fattening in feed-lot experiments are available but long-term studies under stall feeding of sheep and goat are scanty. There is considerable difference between performance and production levels of sheep and goats in different feeding systems (Porwal *et al.* 2006, Kumar 2007, Bharambe and Burte 2012). Feed intake, body weight gain and feed efficiency are higher in intensive system in weaner lambs as reported by many studies (Table 1). Animals under stall-feeding experienced less stress, saved more energy for growth (about 40% energy spent on movement in grazing is saved), fed more energy dense diet (concentrate feeding), spent more time on resting and less time on body movements. Indian breed's lambs can attain average daily gain of 150–170 g during post-weaning stage (3–6 months) (Table 1). Shinde *et al.* (1995) reported lambs grow faster than kids under stall feeding while kids grow faster than lambs under semi-intensive system (grazing and concentrate supplementation). Complete feed block of roughage and concentrate fortified with minerals and vitamins are beneficial in rearing of lambs under intensive system to avoid excess fat deposition. Generally, lamb from native sheep attained 16–18 kg at 6 months of age under grazing conditions in field (Sahoo *et al.* 2015). The lambs attained target weight of 33–35 kg at 6 months of age under intensive feeding (if ration is fortified with balanced ingredients) (Bhatt *et al.* 2015, Cilek and Gotoh 2015). Porwal *et al.* (2006) showed negative effects of stall-feeding system on growth of lambs in comparison to semi-intensive system. Karim and Verma (2001) reported that the average daily gain of 95±4.4 g in grazing with supplementation group and 79±4.4 g in intensively feeding group and concluded that growth response in Malpura weaners lambs was better

Table 1. Performance of lambs under different production systems

Breed/crosses	Parameter	Intensive system	Semi-intensive system	Extensive system	References
Malpura	3 months wt. (kg)	14.8			Santra and Karim (2001)
	6 months wt. (kg)	25.1			
	Av. daily gain (g)	133			
	Feed conversion ratio	6.5			
Awassi × Malpura	3 months wt. (kg)	15.9			
	6 months wt. (kg)	25.0			
	Av. daily gain (g)	141			
	Feed conversion ratio	6.1			
Bharat Merino	3 months wt. (kg)	16.2	15.6		Karim <i>et al.</i> (2004)
	6 months wt. (kg)	26.3	22.6		
	Av. daily gain (g)	98	78		
Kheri	Av. daily gain (g)	136	161	73	Porwal <i>et al.</i> (2006)
Kheri	3–4 months wt. (kg)	16.34	16.56	16.80	Karim <i>et al.</i> (2007)
	6–7 months wt. (kg)	28.57	31.04	23.34	
	Av. daily gain (g)	136	161	73	
Bharat Merino	3 months wt. (kg)	16.0			Tripathi <i>et al.</i> (2007)
	6 months wt. (kg)	30.0			
	Av. daily gain (g)	154			
	Feed conversion ratio	6.6			
Malpura	3 months wt. (kg)	11.5			Bhatta <i>et al.</i> (2007)
	6 months wt. (kg)	19.2			
	Av. daily gain (g)	110			
	Feed conversion ratio	6.9			
Muzaffarnagri	3 months wt. (kg)	13.83			Mandal <i>et al.</i> (2007)
	6 months wt. (kg)	23.20			
	Av. daily gain (g)	105			
	Feed conversion efficiency (%)	12.24			
Malpura (Conc. + ardu leaves)	3 months wt. (kg)	13.7			Bhatt <i>et al.</i> (2011)
	6 months wt. (kg)	24.7			
	Av. daily gain (g)	122			
	Feed conversion ratio	5.45			
Malpura (with coconut oil Supplementation)	3 months wt. (kg)	13.7			Bhatt <i>et al.</i> (2011)
	6 months wt. (kg)	23.9			
	Av. daily gain (g)	114			
	Feed conversion ratio	5.12			
Deccani	3 months wt. (kg)	14.95	14.92	15.0	Bharambe and Burte (2012)
	6 months wt. (kg)	18.4	17.52	17.02	
	Av. daily gain (g)	38.33	28.29	22.50	
Nellore	Av. daily gain (g)	80		117	Reddy <i>et al.</i> (2013)
Lohi	Av. daily gain (g)	62.59	83.33	98.14	Nasrullah <i>et al.</i> (2013)
Nellore	3 months wt. (kg)	10.23			Venkateswarlu <i>et al.</i> (2014)
	6 months wt. (kg)	21.33			
	Av. daily gain (g)	62			
	Feed conversion efficiency (%)	11.17			
Malpura (Khejri + conc.)	3 months wt. (kg)	17.0			
	6 months wt. (kg)	25.6			
	Av. daily gain (g)	94			
Malpura (Conc. with 2% Ca- soap + Khejri leaves)	3 months wt. (kg)	16.8			
	6 months wt. (kg)	27.2			
	Av. daily gain (g)	114			
Malpura	3 months wt. (kg)	20.1			Bhatt <i>et al.</i> (2018)
	6 months wt. (kg)	37.4			
	Av. daily gain (g)	194			
	Feed conversion ratio	4.33			

Table 2. Performance of kids under different production systems

Breed	Parameter	Intensive system	Semi-intensive system	Extensive system	References
Marwari	3 months wt. (kg)	9.92	9.46	10.58	Shinde <i>et al.</i> (2000)
	8 months wt. (kg)	19.71	23.90	21.77	
	Av. daily gain (g)	71	102	81	
Local	Av. daily gain (g)	52	47	45	Sastry and Thomas (2012)
	Av. daily gain (g)	49.62	66.29	82.59	
Osmanabadi	3 months wt. (kg)	13.65		13.64	Patil <i>et al.</i> (2014)
	6 months wt. (kg)	21.55		17.01	
Jamunapari	3 months wt. (kg)	15.15	11.54		CIRG (2016)
	6 months wt. (kg)	21.63	15.64		
	9 months wt. (kg)	32.26	20.63		
	12 months wt. (kg)	42.07	25.82		
Barbari	3 months wt. (kg)	15.24	15.04		CIRG (2019)
	6 months wt. (kg)	29.70	27.55		
	Av. daily gain (g)	75	65		

under grazing with 300 g concentrate supplementation compared to intensive feeding. Kochewad (2015) conducted a study on performance of Deccani sheep lambs (3–12 months age) in intensive, semi intensive and extensive farming system and reported ADG (43.53, 38.51, 34.70 g), average body weight gain (11.75, 10.40, 9.36 kg) and feed conversion efficiency (14.43, 14.87, 15.12%). So, most of the studies obtained better growth in intensive system although few studies found semi-intensive system more appropriate for lamb growth and weight gain.

In goats, growth was inconsistent, some studies reported higher growth in semi-intensive system while others in intensive system (Table 2). Because, goats need more flexibility in feeding habits to attain early slaughter weight and they are more sensitive animals. When the surface vegetation sources for browsing are becoming inadequate, concentrate feeding with browsing (semi-intensive) is the system of choice for goat rearing (Agnihotri and Raj Kumar 2001). Chellapandian and Balachandran (2003) reported average daily gain of 79 g in intensive system and 35 g in semi-intensive system because of adequate nutrition management under intensive system. The lactating goat gained higher body weight during pregnancy and lactation (3 to 6 months) in intensive system (Patel *et al.* 2009). However, the semi-intensive system has been found better in terms of significantly ( $P < 0.01$ ) higher body weight ( $17.66 \pm 1.78$  kg) and body weight gain/day ( $66.22 \pm 0.73$  g) than intensive system and extensive system for Barbari goat (Paramsivam *et al.* 2002). The study conducted at CIRG (2019) proved that Barbari goat can be successfully reared under stall feeding for meat production without any green forage, they attained higher weight gains under stall feeding system in comparison to semi-intensive system. So, both the systems; intensive and semi-intensive can be used for goat rearing but small sized goats like Barbari, Black Bengal can perform equally good under stall-fed system. As it goat is primarily a browsing animal, perform better when browsed on a variety of shrub vegetation and supplemented with concentrate thereby semi-intensive system is most suitable for goats.

#### *Production and reproduction of sheep and goats*

There are many investigations available about what type of feeding system is better for growth and body weight gain purpose but productive and reproductive performances of sheep and goat have been less studied under different rearing systems. Although previous studies have reflected the importance of concentrate feeding on productivity of goats and sheep. Khan *et al.* (2000) reported 206.25 days service period in Balochi ewes (under semi-intensive system) and Adhikari *et al.* (2014) reported 179.35 days post-partum estrus period (under grazing conditions). Kumar (2011) reported that average age of Patanwadi ram lambs (raised under intensive management system) at the time of first ejaculation was 199 days (ranging from 181 to 259 days). Studies related to production and reproduction performance under different systems are given in Table 3 but there was no any significant difference between intensive and semi-intensive systems.

#### *Carcass traits and meat quality of lambs and kids*

Majority of lambs are sold in the market at 3–4 months of age when they hardly attain body weights of 12–14 kg. Farmers sold them at early age because of scarcity of feed resources, fear of mortality losses, better price and demand in the market and household requirement of money (Shinde and Sankhyan 2010). Full potential of lambs is not used which cause huge nation loss. Carcass traits are important in meat animals and their merit is most influenced by fat which is primary factor in evaluating the carcass grade/cutability (ratio of lean meat/fat) and eventual value to the consumers (Priolo *et al.* 2002, Cilek and Tekin 2004, Hanekom 2010). Studies reported that lambs reared under intensive system are superior to semi intensive system with respect to mutton production in terms of dressing yield, fat and bone contents due to better nutrition (Table 4). Most desirable edible offal's content increased with the increasing amount of concentrate supplementation, but much higher fat is also not preferred by consumers, therefore the concentrate feeding @ 300 g daily in addition to grazing is most ideal and appropriate to obtain desired quantity and

Table 3. Production and reproduction of sheep and goats under different production systems

Species	Parameter	Intensive	Semi-intensive	Extensive	References
Deccani sheep	Greasy fleece yield (kg)	1.35	1.34	0.93	Bharambe and Burte (2012)
Deccani sheep	Puberty age (day)	338	315	290	Kochewad (2015)
	Puberty wt. (kg)	16.3	16.7	17.6	
	Conception rate (%)	66.6	58.3	75.0	
Black Bengal goat	Milk yield (ml/day)	460	212	225	Moniruzzaman <i>et al.</i> (2002)
	Lactation length (days)	56	37.75	32.5	
	Postpartum estrus (days)	68	81.5	85.25	
Marwari goat	Milk yield (90 days)	53.30	65.15	49.08	Shinde <i>et al.</i> (2004)
	Milk yield (150 days)	75.44	86.13	64.97	
	Lactation length (days)	200	207	197	
	Peak yield (g/d)	771	1095	878	
Salem Black goat	Lactation wt. loss (kg)	3.13	2.73		Chinnamani <i>et al.</i> (2018)
	Service period (days)	94.0	97.5		
	Kidding rate (%)	100	100		
	Kidding interval (days)	245.34	248.27		

quality of the dressed carcasses from the lambs (Singh *et al.* 2003).

It is also important to evaluate the effect of intensive production system on meat quality because feeding strategy significantly affects meat quality parameters like colour, visible fat, tenderness, juiciness and flavour which affects the consumers perception (Kandeepan *et al.* 2009). Animals reared under intensive production systems produce carcasses with a higher fat content (positively correlated to sensory juiciness) due to the consumption of a high energy diet. It is also noted that lambs reared under stall-fed conditions have a lower acetate/propionate ratio in the rumen due to feeding of more concentrate diets and this can be a reason for their higher growth rate and more intramuscular fat deposition (Lobley 1998, Banskalieva *et al.* 2005). The feeding system did not significantly affect the total lean content in the carcass (Atti *et al.* 2015).

Intensive management system of lambs improved feed efficiency, slaughter weight, dressing yield, carcass quality and sensory panel tenderness making sheep more suitable for rearing under stall feed conditions than goats. New approaches for restructuring meat to produce desired quality meat by addition of feed additives in the ration need to be explored for producing desirable quality meat.

Fat tailed sheep grow rapidly and attain 30 kg body weights at 3 months of age and 55–60 kg at 6 months of age. They produced a carcass of 30 kg at 6 months of age with dressing yield of 54.18%, lean 56.98%, fat 20.98% and bone 20.68% and fat tail of 9.74% (Shinde *et al.* 2018). Ewes after completing the productive life are sold at lower price for slaughter purposes. About 40% of sheep slaughtered in India fall under category of cull animals with low body score, dressing yield and carcass fat content. Short-term feeding improved the body condition of cull

Table 4. Carcass characteristics of lambs and kids under different production systems

Species	System	Carcass wt. (kg)	Dressing yield (%) on LW	Lean (%)	Fat (%)	Bone (%)	References
Muzaffarnagari lambs	Intensive	15.05	48.49	63.92	10.19	24.08	Pal <i>et al.</i> (1997a)
	Semi-intensive	11.71	44.61	65.22	7.10	25.98	
Malpura lambs	Intensive	12.43	56.95	54.12	17.04	25.13	Gadekar <i>et al.</i> (2014)
Deccani lambs	Intensive	10.13	51.20	63.43	8.00	58.56	Kochewad (2015)
	Sem-intensive	8.72	47.64	61.36	6.76	31.86	
	Extensive	8.19	48.79	61.16	6.56	32.26	
Sirohi kids	Intensive	10.90	50.70	61.60	10.30	19.50	Singh and Sahu (1997)
	Semi-intensive	10.20	47.50	61.10	5.30	22.80	
Marwari kids	Intensive	9.06	43.63	71.04	6.74	23.69	Shinde <i>et al.</i> (2000)
	Semi-intensive	11.20	44.78	74.38	6.71	18.88	
	Extensive	9.53	41.86	76.39	5.20	18.37	
Sirohi kids	Intensive	20.08	48.91				Agnihotri and Rajkumar (2001)
	Semi-intensive	14.00	42.21				
	Extensive	9.24	44.00				
Barbari kids	Intensive	11.07	52.23				Agnihotri and Rajkumar (2001)
	Semi-intensive	9.50	46.43				
	Extensive	6.96	41.80				

ewes. After 90 days of feeding of cull ewes on complete feed block (65% concentrate, 30% roughage and 5% molasses) on stall improved carcass weight from 12.28 to 19.11 kg with dressing yield of 48.52 vs 51.94%, lean 47.16 vs 53.34%, fat 9.94 vs 19.90% and decrease bone 36.95 vs 24.05% (Bhatt and Sahoo 2017).

*Behaviour of sheep and goats*

It is important to know behaviour patterns of sheep and goats so that we can create a management system which allows animals to express their natural behaviours and remain healthy with a good quality of life under stall fed conditions (Lawrence and Dwyer 2000). Generally, goats are more reactive, aggressive and express more exploratory behaviour than sheep, whereas sheep are more fearful and shyer animal (Houpt 2005). Shinde and Singh (2002), Van (2006), Chand (2016) observed more aggressive and agonistic behaviour in confined goats than free range. In confinement system, feed can be a limiting resource or when the available space in the feeder or manger is not sufficient for all animals to feed. The average agonistic time (min/day) spent on aggressive interactions of goat has found more which may be due to the competition for getting more quantity of feed in confined area. Dominant animals generally have priority of access to these resources while low rank animals in order to avoid conflict with high rank animals remain deprived of such resources (Shinde and Singh 2002), consequently, the growth and milk production of these animals deteriorate in long term. Therefore, while grouping animals for stall feeding, dominance behaviour, age, size, stocking density, space requirements, feeding behaviour of individual animals must be considered.

*Diseases of sheep and goats*

Management system is an important factor which affects disease occurrences, frequency and patterns in young ones of sheep and goats (Swarnkar *et al.* 2019). Thus, it is important to have an effective disease control programme on the farm because sheep is extremely vulnerable to parasitic diseases and there is more rapid spread of pathogenic infections like ET through a flock. Ectoparasitism has found to be common in all management

systems; with 84–95% in tethered, 77–95% in stall-fed and 37–98% in extensive system (Kusiluka *et al.* 1998). They reported significantly ( $P < 0.05$ ) higher prevalence of diarrhoea and gastrointestinal parasitism in stall-fed goats and respiratory infections were more common in pastoral than stall-fed and tethered animals. The mortality incidences were 5.3%, 15.8% and 34.6% in tethering, semi-intensive and extensive system respectively under semi-arid conditions. Minor causes of mortality were dermatophilosis, footrot, mange, strangulation and bloat. The high prevalence of GI parasites and diarrhoea in stall-fed animals may be attributed to poor house hygiene leading to frequent contamination of feed and water troughs with infected faeces (Blood 1994). The accumulated manure in animal houses can result in increased warmth and humidity which will favour proliferation of parasites (Dipeolu and Ayoade 1982). A study conducted at CSWRI (2012) has proved that the management system also affected the prevalence of blue tongue diseases (BTD) as its prevalence was found higher in migratory flocks (63.29% in sheep and 84.84% in goats) as compared to stationary flocks (35.03% in sheep and 72.88% in goats). Environmental extremes affect animals more in extensive system than stall-feeding system as Munir *et al.* (2007) observed no mortality in intensive system and semi-intensive system but 16.7% lamb mortality in extensive system. The frequent cleaning and hygiene maintenance are most important management interventions in intensive system to prevent incidences of external parasitic diseases like coccidiosis and foot-rot problems in sheep and goat (Turton 2002, Anonymous 2016).

*Cost and return analysis of sheep and goat rearing*

As the intensive rearing system involves high initial capital investment and high cost of production which can be compensated by higher productivity of animals (Karim *et al.* 2004). Large goat farms in the country are increasing and has been found equally rewarding under both intensive and semi-intensive systems of management (Kumar 2007). Meat production contributes to 70–80% of total income from small ruminant farming (Sahoo *et al.* 2015). Stall-feeding system is costly but can be economically viable and sustainable if managed properly. In sheep and goat

Table 5. Diseases incidences of goats under different production systems

	Infection (%)	Intensive system	Semi-intensive system	Extensive system	
Black Bengal	Fasciola	3.33	7.50	23.33	Moniruzzaman <i>et al.</i> (2002)
	Paramphistomum	7.50	0.00	13.33	
	Trichuris	1.0	11.67	22.50	
	Coccidia	11.0	0.83	0.33	
	Strongylus	1.67	33.33	23.33	
Jamunapari	Infection (%)	Stationary system		Migratory system	Rawat <i>et al.</i> (2015)
	Diarrhoea	21.7		24.5	
	Pneumonia	7.1		9.6	
	Parasitic	5.5		7.8	
	Nutritional	10.6		12.8	
	PPR	11.5		13.7	
	ET	8.4		10.1	

rearing, the cost of feed and fodder has been found maximum, followed by veterinary care, hired labour and interest on capital (Suresh *et al.* 2008). In intensive feeding system, Malpura lamb weight reached to 33 kg with limited grazing and *ad lib.* concentrate feeding (Bhatt *et al.* 2009) and while same Malpura lamb reached to 24.44 kg in extensive system under field conditions at 6 months of age (Gowane *et al.* 2015). Kochewad (2015) conducted a study to compare the cost of meat production in three farming systems, i.e. intensive (T1), semi-intensive (T2) and extensive (T3). The cost of meat production per kg was ₹ 289.24, 271.70 and 265 in T1, T2 and T3 group respectively because of more feed cost involved in T1 group due to more concentrate feeding, but they found significant ( $P < 0.05$ ) difference in body growth and weight of lambs in T1 and other two groups, i.e. T2, T3 group. So, there are chances of getting more live weight of lambs which will help to increase the income. The FCR in lambs is 2.8–3.0 during pre-weaning phase (0–90 days), 4.5–5.0 during post-weaning phase (3–6 month) and start to decrease afterwards (Sahoo *et al.* 2015). Therefore, the lamb feeding under stall-fed system for finishing purpose is economical up to 6 months. According to an estimate (Sahoo *et al.* 2015), the input cost of feeding comes to ₹ 1170 per lamb (65 kg concentrate mixture at ₹18/kg) and receipt accounts to ₹ 2,720 (17 kg extra live weight @ ₹ 160/kg live weight) from the sale of live animals or the net return of ₹ 1,550 per lamb. Therefore, it can be a profitable revenue if taken up logically by farmers and entrepreneurs in the country.

### Conclusion

From different studies discussed above, it can be inferred that stall-feeding system can be one good option in the future for fulfilling the increasing meat demands of country because the present scenario indicates that natural grazing resources are declining continuously. From the growth, production, health and sustainability perspective, intensive feeding system has been found better than extensive system and at par with semi-intensive system for lamb and kid fattening for slaughter purpose. Practically, this system seems to be more expensive for farmers in the initial stage, but more return per unit of input in the long run can counter this problem. There is need of long-term comparative studies on feeding behaviour of sheep and goats kept under intensive system.

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