**Role of Sheep Milk in Livelihood Security of Shepherds in Semi-arid Tropical India**

**Abstract**

**Purpose:** Indian sheep that are formerly intended for wool are now regarded as meat type animals. Therefore, in those areas of India where maximum vegetarian people reside, the declining economic profitability from sheep has reduced the interest of shepherds in continue their traditional occupation.

**Research Methodology and Data Collection:** This study was conducted in Malpura Tehsil of Tonk district in semi-arid Rajasthan, India to elucidate the functional contribution of sheep rearing in livelihood of shepherds. The sample size was limited to 72 participants in initial part of the study. Cluster analysis and multidimensional technique were used for the data analysis and further results & discussion.

**Findings:** The result of the study revealed that sheep husbandry was primarily regarded as a financial liquidity rather than to satisfy the nutritional and farm needs of shepherds. They preferred to sell the lambs and adult sheep to middlemen and brokers as and when required on age basis even without profit. The sustainable outputs of sheep i.e. sheep manure, sheep milk and wool were given least priority by them as their local demand is low. Sheep milk was either used for limited household purposes or is adulterated with cow milk and sold to the local market due to unavailability of specific market for commercial procurement of sheep milk.

**Implications:** The study concluded if shepherds get an exclusive market in this region for sheep produce, especially milk in addition to meat, then sheep rearing can provide sustainable livelihood security.

**Keywords:** Sheep, Shepherds, livelihood security, sheep milk, semi-arid Rajasthan

**Introduction**

Agriculture plays a significant role in the livelihood security of the rural populationin India (Khatri *et al*., 2023); but in certain areas where drought is a common phenomenon, livestock rearing at the home premises is an alternative option for survivability of the poor. In drought prone semi-arid and arid regions of India; crop failure, water scarcity, feed and fodder deficit add to the misery of people. Rajasthan is the largest state of India with semi-arid and arid climate. Farmers need a sustainable approach to carry out their livelihood by overcoming erratic rainfall and water scarcity that cause a significant negative impact on the cropping system (Kumar *et al*., 2015). Sheep, as a livestock, survives and support the farming communities due to their adaptive capability since time immemorial (Suresh *et al.,* 2007). They can convert low quality fodder to valuable produce comfortably and efficiently unlike other livestock (Begam *et al.,* 2024). Their higher reproductive rate, small reproductive cycles, hardy nature, easier management, low-cost involvement, small space requirement, and drought resistant ability over large ruminants (Wodeyar and Kadam, 2017) make them a suitable livestock for this region. Shepherds consider sheep as a shock absorber at the times of drought and financial crisis (Devi *et al*., 2020). Regional people consider sheep as a zero-input animal as well as a moving ATM i.e. any time money. The socio-economic importance of sheep farming for providing nutritional and financial security to the poor farmers of these regions is extremely significant (Kumar and Roy, 2013).

Progressive shrinkage of natural vegetation and climate change made sheep rearing extremely difficult. Again, in semi-arid regions of India, particularly in Rajasthan and Gujarat, about 75 per cent people are following a vegetarian diet (Natrajan and Jacob, 2018). Lack of organised market for effective marketing of live sheep, undefined pricing structure, incompetent market intelligence and involvement of many middlemen force the shepherds to go for distress sale (Ramesh *et al*., 2012). Theadvent of synthetic and others commercial fibres reduced the demand of the traditional sheep wool in the market. It is observed that Rajasthan’s Bikaner wool market, which was considered Asia’s one of the largest wool market a decade ago, is now losing its market dynamics. Shepherds are now vacillating between the options whether to continue or not, their traditional business of sheep rearing. Therefore, although there was a 14 per cent increase in sheep population of India in latest census, yet Rajasthan recorded 13 per cent decline in sheep population. While the global demand for sheep produce is increasing, the number of people quitting their traditional sheep rearing practices in this region is increasing consistently. It is now high time to identify and promote multifaceted utility in sheep rearing and establish a sustainable sheep farming model in this region; without which sheep farming will become an unproductive entity for the shepherds. In contrary, the increased demand of organic animal produce unlatched a great opportunity for Indian shepherds globally. Many developing countries like Turkey, China, Greece, and Syria, sheep husbandry has been immensely flourishing due to growing demand of animal products; particularly the milk. In northern America and northern Europe the demand of sheep milk has been increasing due to the consumer awareness about its high nutritional value over cow milk ([Voutzouraki](https://sciprofiles.com/profile/945570) *et al.,* 2021). Present days consumers are also more leaned towards food safety. So Indian sheep that primarily rely on greens (organic rearing) can provide a suitable product when food standards and human health implications are concerned (Chikwanha et al., 2018). Therefore, sheep milk can be an option to explore so that livelihood security and ancestral occupation of shepherds in future can be safeguarded.

This study is an attemptto delineate an absolute sketch of shepherds in semi-arid tropical regions of India, to find the rank of different sheep produce in their livelihood security. By understanding their working ecosystem, it becomes easier for the policy makers and extension workers to implement suitable interventions. This study has its own significance in semi-arid tropical region of India by identifying target sheep rearers through cluster analysis techniques and further a perceptual map creates the picture of the stakeholder’s mindset that has paramount importance in sheep rearing and trading.

**Methodology**

**Study area and data collection**

This benchmark study was conducted in majority of villages of Malpura Tehsil in Tonk District of Rajasthan (Figure 1), located at longitude 75° 28′ E, latitude 26° 26′ N and altitude 320 m above mean sea level. The average annual maximum and minimum ambient temperature ranges between 12℃ and 46 °C and mean annual relative humidity (RH) ranges from 20 to 85 per cent round the year. The annual rainfall has erratic distribution varying from 200 - 400 mm. Randomly 2-3 respondents from 33 villages of this Tehsil were selected (72 respondents). Data were collected using personal interview technique with the help of a pre-tested, reliable and valid questionnaire. Sheep owners were interviewed on different demographic variables like, age, gender, educational status, family size along with their herd status for understanding their detailed involvement in sheep rearing and trading. They were also asked about milking prominence of sheep. Data collection measurements were considered both as categorical and metric one for different variables.

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**Figure 1:** The study area

Cluster analysis technique has been carried out for studying the homogeneity among the sheep rearers. It is a multivariate analysis technique mainly used to classify the population or cases into different homogenous groups or segments. This technique stands good in explorative research (Malhotra and Dash, 2013). The data was analysed using SPSS 20.0 statistical package programme. This technique follows three to four steps depending upon the variables listed below:

1. Identification of numbers of clusters either through dendrogram methods or agglomerative techniques (It is more a subjective way of identification)
2. Generating ANOVA table for understanding any variables that have more significant impact on cluster formation
3. Making the cluster groups by split cases methods
4. Making the clusters according to different demographic variables for proper understanding of group behaviours for further multivariate analysis techniques where predictor variables will impact on criterion variables in different research.

Multidimensional scaling techniques were used in this study to generate perceptual mapping among different output of sheep on which shepherds were depending on. Perceptual mapping is a practice to create a picture of different factors on producer’s mind set which has long term impact of acceptance among stakeholders irrespective of their different ways of products utilization.

**Results and Discussion**

The present study was categorized into three different sections:

1. demographic profile of sheep rearers,
2. ii) identification of groups and their intrinsic group behaviors towards sheep trading and rearing, and
3. iii)perceptual map of output that develops an idea that sheep milk is how admissible for shepherds.

**Demographic profile of the shepherds**

The demographic profile of shepherds has been depicted in Table 1. The survey result showed the average flock size reared by famers was 50. Farmer’s had an average flock size of 72 in the year 2007 (Suresh et al., 2007). As per census of Rajasthan sheep population of this state has declined from 9.6 to 7.9% between 2012 and 2019 (Ministry of Fishery, Animal Husbandry and Dairying, 2019). As per a survey report of 2014, majority of the human population of Rajasthan is vegetarian (about 74%). Therefore, traditionally farmers rear sheep for wool in Rajasthan. Declining value of wool is a constraint to let the shepherds get the actual price of wool. This might be the cause behind declining sheep population in Rajasthan and thus a decrease in flock size of famers has been observed.

Table 1 Demographic profile of the sheep rearers

 **(mention sample size here)**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Sl. No.**  | **Age** |  **Per cent (%)** | **Education** | **Per cent (%)** | **Family Size** | **Per cent (%)** | **Flock Size reared** | **Per cent (%)** |
|  | **Young (Below 30)** | 7 | **Illiterate** | 70 | **Small (Below 5)** | 25 | **Small (Below 25)** | 10 |
|  | **Middle Aged (30-60)** | 80 | **Primary** | 25 | **Medium (5-10)** | 45 | **Medium (25-50)** | 50 |
|  | **Old (≥60)** | 13 | **Secondary and Above** | 5 | **Large ≥10** | 30 | **Above ≥50** | 40 |

The study reveals that majority of sheep rearers in the region have a flock size of 25-50 sheep (50.00%) (Table 1). They are middle aged i.e. 30 to 60 years (80.00%), majorly illiterate (70.00%) and their family size is 5-9 (45.00%) followed by those who have a family size≥10 (30.00%) (Table 1). This table showed

 that the prime constraints amongst the shepherds are illiteracy and large family size. To know how different sheep produce contributes to the livelihood security of shepherds i.e. in the form of product marketing or live animal trading positional matrix was plotted.

**Positioning Matrix from Rearing to Trading**

When a perceptual map was developed through a multi-dimensional scaling technique (Figure 2), it was observed that sheep in this region are not reared for nutritional security rather it provides financial security to shepherds. As shepherds are consistently under financial crunch they prefer to sell their lambs to get immediate cash for their livelihood. Next to lambs they prefer to sell adult and large sized sheeps. Sheep manure is an excellent source of N, P and K (Elouear *et al*., 2016). Manure trading was also very prominent in the study area although demand was not as high as lamb and adult sheep. Milk demand was higher than for wool. As global demand of sheep milk in the functional food market has been increasing (Balthazar *et al*., 2017) our questionnaire addressed a few questions on sheep milk production and its uses. Again, from the positional matrix, it was clear that milk competes with wool in the same segment and in future also, it is milk that replaces the market demand of wool and will provide an option for the shepherd’s livelihood.



**Figure 2** Positioning Matrix from Rearing to Trading

**Identification of groups and their intrinsic group behaviors**

Cluster identification is a systematic practice; more as an art than science. From all total respondents in this study, three clusters were identified for taking any decision by agglomeration technique (Figure 3).



Fig 3 Cluster formations through agglomeration methodology

Clusters were made from variables like sheep numbers, their milking status, per day milking schedule, quantity of milk per milking, and usage pattern after post milking surpluses (Table 2).

**Table 2** Different variables and their significance in cluster decision making process

|  |  |
| --- | --- |
| **Variables undergoing cluster making** | **Sig.** |
| Sheep Number | 0.189 |
| Milking Status | 0.137 |
| Milking Per Day | 0 |
| Quantity in ml | 0 |
| Usage Pattern | 0 |

Before forming any cluster (here it is 3), it was observed that sheep number and milking status have no significance in cluster formation whereas per day milking schedule, quantity of milk per milking, and usage after milking have significant impact on group formation. Milking status here signified whether shepherds prefer to milk the sheep or not. Majority of shepherds milked their sheep in the study area. Per day milking schedule included milking the sheep once or twice in a day.

**Table 3: Importance of variables and contribution in different clusters**

|  |  |  |
| --- | --- | --- |
|   | Cluster | Sig. |
| 1 | 2 | 3 |
| Sheep Number | 25-50 | 25-50 | 25-50 | 0.189 |
| Milking Status | Not milking | milking | milking | 0.137 |
| Milking Per Day | no | twice | twice | 0 |
| Quantity ml/milking/ewe (ml) | 0 | 314 | 222 | 0 |
| Usage Pattern | 0 | Both domestic and marketing | Only domestic use | 0 |

Parenthesis highlighted Sheep number 2 (= 25 to 50), Milking status 0 and 1 means no milking and milking by shepherds, milking per day 0 and 2 means no milking and two times milking respectively, usage pattern one indicateshousehold consumption) and 2 indicates marketing)

It was observed that there was a practice of milking sheep twice daily in the study area as in cluster number 2 and 3 (Table 3). From figure 3 i.e. number of cases per cluster it was clear that majority of shepherds here go for household uses of sheep milk. They were more intended to sell the lambs and hence they desired that milk of sheep must be preferably taken by lambs for their better growth and higher body weight gain. The leftover milk after given to lamb was utilized for household consumption. Cluster 2 produced more milk in comparison to cluster 3 and this surplus milk was also channelized to market after the household consumption and preferably sold in local market by adulterating milk of other milch animals. It was prominent that all the respondents in cluster 1 reared sheep for trading purpose only. Therefore, they did not milk the sheep. The demographic variables like age, family members and education have very negligible significant effect in cluster formation as there is no separate identity of populace in sheep rearing.

An important and peculiar characteristic is the topical use of sheep milk by shepherds for many health implications like sprain, and joint pain. This use is mainly anecdotal. However, internationally sheep milk is accepted as both consumable and non-consumable products like world class cheese, an ultimate source to deliver probiotics (by yogurt), and also different skin care product (lotions, soap and creams) formulations (Mohapatra *et al*., 2019). Sheep milk prebiotics and probiotics functional food are developing new market and is gaining economic importance in food industries due to human health benefit with scientific claim.

Most Indian farmers are ignorant and unaware of expanding prominence of sheep rearing; so, they perform traditional unorganised sheep farming (Suresh *et al.*, 2007) and many of them have transformed themselves from rearer to traders. As suggested by Mohapatra *et al*. (2020) although in India, sheep are non-dairy type yet sheep are kept in a flock and a farmer with 20 lactating ewes’ can get 8-10 litres of milk per day if they do two times milking in a day. Subsistence rearing to commercialisation of commodities can only be possible by prior identification of populations who have been rearing sheep from time immemorial. Major demographic variables like age, family members, and educational status of rearers have no significant contribution in sheep rearing practices. Quantity of milk obtained from sheep per day decides whether rearers will go for marketing or use as household consumption. It was observed that majority of shepherds use sheep milk for their home consumption. In nutshell, sheep rearing in the study area is under the helm of illiterate, middle aged shepherds large family size.

**Conclusion**

Sheep rearing is based on the output on which producers decide whether to go for rearing or trading. Changing market scenario and frequent cash crunch among livestock owners push them to opt for lamb production over other entities like wool and milk production. As most of the people in the study area were vegetarians, the shepherds sell live animals to middle-men/traders at an unreasonably low price. The sold lamb is either transported to other states within India or exported abroad. Therefore, promoting sheep milk may contribute as a sustainable livelihood option for traditional sheep rearers of semi-arid region; but considering sheep as a livestock meant for milk over meat and wool is another challenge. Unlike large livestock (Cow, Buffalo), milk production from sheep is very minimal (in millilitres). So it is very difficult to market the milk in the same pattern as for cow milk marketing. It needs channel innovation, institutional integration and collectivisation of resources to harness the profit for the ultimate stakeholders. Additionally aided advances in sheep rearing technologies like estrus synchronisation, artificial insemination, cost effective complete feed pellets, and adoption of sheep health calendar and selection of production traits for producing the genetically improved sheep breeds will be the way forward for commercial sheep farming. Stake holders, farmers and shepherds need to be made aware of the importance of human health benefits of sheep milk and its value addition through farmer trainings, fairs and field schools. Utilization of bioactive potential of sheep milk in the line of functional foods of next generation will be an opportunity to secure national and international market. This approach can significantly contribute to uplifting the socioeconomic status of sheep rearers and traders to exporters by creating a nexus between quality product generations and secure market facility.

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