

Review Article

**EFFECT OF GOAT REARING ON ENVIRONMENT AND RURAL
PROSPERITY IN INDIA**

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Man, Animal and Nature are in symbiotic relationship for their survival and sustenance. The balance maintained among the three for several millennia has been disturbed by over exploitation of natural resources for meeting the demands of increasing population of men and animals. The gravity of the situation can be gauged from the fact that India, with about 2.30% of land area of the world, is maintaining nearly 16.65 of the world's human population and about 20.00% of the livestock. The livestock in general and the goats in particular have been held responsible by the foresters and environmentalists for causing ecological degradation and desertification in Asian continent. This paper describes the impact of goat rearing on environment and rural prosperity with different systems of feeding management in India. This explains why goat farmers seldom consider the possibilities of increasing production through either crossbreeding or artificial insemination. A very important aspect in this regard is the awareness of risk by resource-poor farmers and their emphasis on minimizing it (Singh and Sharma, 2016). Goats play a vital socio-economic role in Asian agriculture, particularly for resource-poor people living in harsh environments. Goat being a multipurpose animal produces meat, milk, skin, fibre and manure. The country is endowed with large and biologically diverse population of goats (Singh and Sharma, 2016). Animals reared in intensive production systems consume a considerable amount of protein and other nitrogen-containing substances in their diets (Singh et al 2017). Small ruminants have a large impact on the economy and food supply of people in subtropical and tropical countries. This benefit is often not shown in national statistics because of informal trading and slaughtering (Singh and Sharma, 2017).

GOAT POPULATION

The world total numbers of goats and sheep were 861.9 and 1078.2 million, respectively, *i.e.* there is about one goat to approximately 1.25 sheep in the world. The total number of goats in the world increased by 146% of the total number (590.1 million) encountered in 1990. Number of goats in the world has been increasing since 1990 by about 1% to 4% each year (FAOSTAT, 2008). While the goat population has increased in Asian and African regions it decreased in America, Europe and Russia during the last over three decades. The over all world growth rate, however, has been almost uniform during the last about 25 years. The growth rate in India varied from 0.94 to 5.13% with an over all average of 3.05% during 1951-2001. More than 100 breeds of goats have been identified and described world over. India is endowed with 20 descript breeds of goats although a very large number is non-descript due to indiscriminate breeding and inter-mixing of the breeds. India is endowed with a significant share of the world's livestock population growing steadily and continuously. Buffalo is predominantly animal of poor countries with very high density of livestock and human population and with poor feed recourses. In tropical and subtropical regions dairy cattle usually depend exclusively on native or introduced pastures as their only source of nutrients, and in particular, during critical periods of the year, such as the winter or dry season, the animals cannot fulfill their nutrient requirements because forage is either scarce or of low quality (Singh, G. 2019). The goat is thought to have been the earliest domesticated ruminant and of all the species of domesticated animals except dog, has the widest ecological range. Originating in Asia, goats have spread over all the continents and inhabit almost all - climatic zones from arctic - circle to the equator (Singh, G. 2024).

GOAT PRODUCTION

In India about 41% of the total population of goats are slaughtered for meat every year. The per capita annual availability of goat meat in India was 505 g. Goats around the world contributed only 2.12% of the total meat and 1.60% of the total milk production from all species. Thus Asian region among the world and India among the Asian countries contributed highest quantities of all the important goat products. There is a large commercial chicken industry that provides us with eggs and meat. A major constraint to poultry production is the high value placed upon crop production rather than livestock production. Over recent decades the poultry industry has made tremendous adjustments to meet the increasing demand for inexpensive and safe supply of meat and eggs (Singh, G. 2019). Milk-secreting tissues and various ducts throughout the udder can be damaged by bacterial toxins, and sometimes

permanent damage to the udder occurs. Severe acute cases can be fatal, but even in cows that recover there may be consequences for the rest of the lactation and subsequent lactations (Singh and Singh, 2020). Livestock has become an integral part of all interventions aimed at reducing rural poverty and enhancing food and nutrition security. The dairy livestock owners who raise cattle and buffaloes are yet ignorant with scientific management practices (Singh and Somvanshi, 2020).

GOATS AND ECOLOGY

There has been a lot of controversy over the role of goats in ecological degradation and in desertification especially in India. Of the domesticated animals, no animal has suffered from so much abuse as the goat due to this rather wrong conception. Two conflicting views prevail on the goat's role in land use (i) The goat is the major cause of deforestation, rangeland destruction and soil erosion, and as such, its propagation should be checked, and (2) Goat acts as regenerator of vegetation through dispersal of seeds in its droppings and vegetative propagation through browsing. It is undoubtedly true that an uncontrolled population of goats roaming in open can be extremely harmful to the growth and development of vegetation especially where new reseedling/plantation has been done. But it is just as true that any over grazing by any other ruminant will have similar consequence. The high pressure on and shrinking of the grazing lands, especially in view of their low carrying capacity results in their over use and depletion of natural vegetation. The man to land ratio in the arid and semi-arid zones is fast declining. The livestock population is increasing due to low farm incomes from marginalization of land holdings and increased dependence on livestock, leading to over exploitation of the shrinking grazing lands. In addition, indiscriminate felling of trees and deforestation, removal of shrubs, bushes and roots for fuel purposes, use of mechanical powers for cultivation and continuous neglect of the grazing lands are the real reasons causing damage to the ecology. Most of the deteriorated rangelands have been caused by over grazing by cattle and sheep. The scrub vegetation left behind could only be utilized by goats and goats may have stayed in such degraded ecologies when other species have already left. Sheep because of their bifid upper lip are able to graze closer to the ground than cattle and goats and in doing so in dry weather and on loose soils, frequently uproot the small grass species and thereby permanently damage the soil. The cattle with their large size hooves and heavier body weights cause more loosening of the soil rendering it susceptible to water and wind erosion. When the sheep move towards the water points or night shelters, they follow each other in a row because of the flocking instinct and generate tracks, which

become free of vegetation and subject to erosion. These habits of sheep and not of the goats are distinctly destructive to the rangelands (Acharya and Singh, 1992). Prajapati et al. (1988) reported that intensity of grazing of 2-4 goats/ha had no effect on run off and soil loss in hot arid regions of Rajasthan in normal rainfall years. Stocking rate of 3 sheep or goats per hectare produced satisfactory performance especially of goats and no deterioration in the physical and chemical properties of the soil was observed for 3 years.

Goats also help in dispersal of grass, bush and tree seeds. They consume grass and bush seeds and fodder tree pods while grazing/browsing and defecate hard coat undigested seeds especially of pod-bearing and xerophytic trees after providing acid treatment while passing through digestive system and fortifying with nutrients in the form of the faecal pellets and spread more uniformly all over the grazing land. These seeds germinate in large number as soon as soil moisture conditions are favourable. Such grazing lands would require only protection from grazing for 3-4 years to develop into a high class three-tier silvi-pasture for livestock grazing. The goat saliva left on the bitten foliage adds nitrogen directly to the plant cells inducing quick regrowth. Saliva is also said to detoxify the high tannin available in many of the tree leaves found in the desert areas. The biting of tender leaves and twigs by goats also induce tillering and faster luxuriant regrowth of both branches and foliage. Sharma and Ogra (1987) reported that vegetative regeneration was found to be 27% more in goat paddocks comprising *C. ciliaris*, *D. nutans* and *L. leucocephala* as compared to sheep paddocks.

The habits and behaviours of goats are generally studied in relation to sheep to justify that there is no or very little competition in the two species for available feed resources. Goats work as leaders and the sheep act as followers while moving in a mixed flock. Goats move with their heads up and the sheep keep their heads down most of the time. Goat walks longer distances than sheep during a given time in search of their choice feed. Flocking instinct is much high in sheep as compared to goats. Sheep prefer to graze together but goats scatter all over the available grazing land. Goats prefer browsing on bushes, shrubs and lower branches of trees and sheep like grazing on surface vegetation close to the ground. Goats are much more selective than sheep. Browse and tree leaves are highly relished by goats and not so much by sheep. Goats, unlike sheep, prefer variety of feeds. Taste sensation is more discerning in goats as compared to sheep. Goats can distinguish between bitter, sweet, salty and sour tastes and show a higher tolerance for bitter substances. Goats tend to consume their diet less quickly and to take more meals as compared to sheep. Goats are able to obtain more

nutrients from the environment in all seasons than sheep. Jamnapari (or Jamunapari) is a breed of goat originating from Indian subcontinent. Since 1953 they have been imported to Indonesia (popular as Etawa goat, and its mixture with a local goat called "PE", *peranakan Etawa* or Etawa mix) where they have been a great success. It is bred for both milk and meat. The name is derived from the rivers Yamuna, Jamuna (West Bengal) and Jamuna (Bangladesh) of India and Bangladesh. There is a great variation in coat colour, but the typical coat is white with small tan patches on head and neck. The typical character of the breed is a highly convex nose line with a tuft of hair, yielding a parrot mouth appearance (Singh et al 2017). The consequence of domestication was a change in the phenotypic characteristics of wild goats, which resulted in the development of a multiplicity of goat breeds or types. These breeds or types were distributed across the world as a result of the migration and translocation of humans, usually due to changing climatic conditions and natural resources (Singh and Sharma, 2017). Goats play a vital socio-economic role in Asian agriculture, particularly for resource-poor people living in harsh environments. Non-cattle milk accounts for approximately 15% of the total milk consumption by humans worldwide. Asia contributes approximately 59% to world goat milk production (Singh et al 2018).

SOCIO-ECONOMIC GAINS OF GOATS

The socio-economic importance of goats in India is evident by the sharp increase in their numbers and contributions during the last about 30 years. Goats contribute milk, meat, fibre, skins and manure to the subsistence of small holders and landless rural poor. They play an important role in income generation, capital storage, employment generation and house hold nutrition. Importance of goats lies in the fact that human population is increasing very rapidly creating increasing demands for animal protein foods on the one hand and the feed resources for increasing large ruminants are decreasing due to shrinkage of grazing lands on the other. This demand can, therefore, be met with by increasing population of goats. It is easier to increase the population of goats than cattle and buffaloes because the capital investment is relatively low, land requirements per animal are small, reproductive rates are higher both due to shorter breeding interval and high prolificacy and they can be managed by spare family labour and do not require any serious housing facilities and management skills. There is much less risk in goat farming in drought prone areas where large mortality occurs due to frequent droughts. The goats act as an insurance against disaster under pastoral and agriculture subsistence system. Goats have religious and ritualistic importance in India. They are offered as sacrificial animals both by Muslims on Id and by Hindus especially the

worshippers of Goddess Kali. They are worshipped for their creative and generative powers and sexual virility. There are no religious taboos against consumption of goat meat. Goat meat is preferred over sheep meat as it is more leaner. Goat milk is easily digestible because of small sized fat globules. It has much less allergic problems than the milk of other livestock species. It also has medicinal value and can ward off many diseases as the goats browse on variety of plants including medicinal ones. Goats can be milked as often as required unlike cows and buffaloes and are, therefore, called moving refrigerator. The goatskins are highly valued and have large export potential both in the processed form and as products. The value addition in goat skin processing is much larger than other products. The bones of slaughtered and dead goats are also utilized for bone meal manufacture. A goat produces about 150 kg of dry manure per year for use in crop production and gardening. Goat browsing accelerates growth of trees, shrubs and surface vegetation. They also act as seeding machines. They are much less prone to the adverse effects of toxic plants. They have higher dry matter and fibre digestibility and can subsist on poor woody vegetation. Goats are able to obtain more nutrients from the given environment in all seasons than other livestock species and are often the last species to leave the ecology during severe and continuous drought conditions.

A study on economics of goat production conducted at CIRG, Makhdoom with different sections of farmers revealed a net income of Rs. 212/- per goat per year from 10 heads and Rs. 250/- per goat per year from 50 heads (Sharma et al. 1982). The results of a socio-economic survey in Rajasthan conducted by Ahuja and Rathore 1987) have revealed that the number of goats increased 3 times between 1951- 1983 and goats accounted for 28-31% of the value of the livestock assets and for 16-19% of the gross receipts from crops and livestock. Some studies have revealed that the goats contributed up to 50-55% to the total cash income of a farm family in the hot arid region of the country. There are growing scientific evidences to suggest that goat keeping is more economical in drier regions which are not suitable for water spreading and dry land grain or fodder cropping (Govt. of India, 1987). Devendra (1992) reported that the value of annual contributions of goats to the Indian economy exceeded US \$ 1.6 billions and of this the value of meat accounted for 79.3%, skins 12.9% and offals 7.3% in 1990. It is thus evident that goats make very sizeable economic contributions to the economy of India. It is therefore, important that development programmes should focus on the efficient use of these renewable resources as well as explore ways and means of increasing the current level of production (Singh et al 2017).

GOAT PRODUCTION SYSTEMS

A brief description of these three systems is presented below -Extensive System: Goats are generally reared under extensive system and play only a secondary role to crop as well as other livestock production. This system includes migratory, transhumance, free range, pasture and range grazing management of goats. It is most common system throughout the Asian region because the small size of goats has distinct advantages over other livestock species to contribute significantly to the sustainability of small farm situations which predominate in this region. The goats usually owned by small farmers and landless labourers are grazed together and tend to be herded over long distances in search of feed and water. The flock sizes are larger and goats belonging to several owners are run together. A low level of unpaid family labour represents the main input. The system is principally one of low resource use and a low level of productivity emerges from poor nutritional availability. Goats require feed all the year round. If, on the other hand, it is short or of the wrong kind only for a month or two there is less milk, less kids and less meat. The greatest limitation in our range lands and natural pastures is on the availability of adequate energy throughout the year and adequate amounts of protein for more than half the year. During the period from January to June the problem of energy is very acute and the intake is much less than even the maintenance requirements. Although the grazing on the range lands is considered to be the cheapest method for goat production, the migration of the animals and over grazing of available lands is causing serious problems of soil erosion and degradation leading to desertification. Due to long and dry summers, erratic rains and light textured soils deficient in organic content having tendency to salination, the natural potential of these lands falls short of the nutritional requirements of goats. The adult body weights, reproduction rates and milk production are lower and morbidity and mortality rates are higher. The birth, weaning and slaughter weights and dressing percentage are poor and bone: meat ratio is narrow in kids maintained solely on grazing on the degraded lands. The common grazing/ rangelands can hardly carry one goat per hectare per year when unprotected and two when protected from biotic factors. There is great prospect of improving these natural rangelands. Reseeding with *Cenchrus ciliaris* and *Lasiurus indicus* perennial grasses increased the grass yield from 0.5 ton to 1.5- 2.0 ton per hectare per year. Intercropping of cowpea in *Cenchrus ciliaris* pasture increased the dry matter yield by three times. Introduction of *Dolichos lablab* legume improved the nutritive value and increased the dry matter yield from 1-1.5 ton to 2.5-3.0 ton per hectare. Such a grass-legume pasture could carry five goats per hectare for five years. Plantation of 50 fodder

trees of *Prosopis cineraria*, *Ailanthus excelsa* and *Leucaena leucocephala* had no adverse effect on the pasture growth and provided an additional yield of one ton dry matter when fully grown and lopped twice a year. Areas in arid and semi-arid regions that can not support cattle and buffaloes may be identified and utilized for small ruminant production with low investment. Rural common grazing lands should be improved through reseedling with nutritious, perennial and high yielding grasses and legumes. Large scale fodder tree plantations should be taken up on pasture lands, waste lands, on river banks and road sides and bunds of ponds, canals and agriculture fields (Singh and Sharma, 2016).

Semi-intensive System: A kind of compromise between extensive and intensive systems is referred to as semi-intensive system of goat management. It is a combination of limited free range grazing and stall feeding. Integration of goat rearing with arable cropping and tree cropping is also included where either the goats are tethered or cut or carry system of available fodder is employed. The children and women often tend the goats in this system. Animals belonging to several owners may be combined for grazing which is mostly done morning and evening for 4 to 6 hours. The animals are supplemented with kitchen wastes, concentrate mixtures, crop residues, green and dry fodders and tree leaves etc. as per the availability. Thus goats utilize all available feed resources including natural grasses, shrubs, bushes, tree leaves, crop residues, stubbles, weeds, cultivated fodders and concentrates etc. under this system. The level of nutrition is just optimum or low but surely better than that under extensive system. Production performance depends on the quantity and quality of grazing/browsing availability and supplementary feeding provided (Shen, et al 2024).

Studies have shown that the natural range/grazing lands available in Rajasthan can not support growth of kids for commercial meat production and additional supplementation with concentrate mixture and/or leguminous fodders and tree leaves is recommended. Supplementation of additional energy and protein through concentrates has been advantageous in increasing the growth rate and attaining the desired slaughter weights at relatively younger age. It has been found that the kids fed on 50 concentrate: 50 roughage ration @ 4% of body weight attained 25 kg live weight at about 6 months of age. If the roughage portion of the diet can be made available from grazing, the remaining 50% of the diet has to be supplemented through concentrate mixture (Jiang, et al, 2023).

Ad-libitum supplementation of concentrate, hay and green between 91 to 180 days of age to the Sirohi kids browsing on available range land resulted in an increase of 44.8% in pre-slaughter weights, 65.1% in carcass weights and 14.3% in dressing over the browsing alone.

A growth rate of 19.4, 41.7, 111.0 and 108.2 g/h/d was obtained in Beetal weaner kids from 91 to 180 days of age on ad-lib. browsing, browsing + green, browsing + concentrate mixture and browsing + concentrate mixture + green respectively. It is seen that although the goats are primarily browsing animals but a marked improvement in kidding rates, milk yield, live weight gains and quantity and quality of meat production can be achieved by grazing/browsing the goats on developed two-tier pastures and supplementing with concentrate mixtures and/or cultivated leguminous fodders and tree leaves at appropriate levels (Luo, et al 2024).

Although goats prefer to browse as compared to grazing, they are quite capable of making efficient use of cultivated pastures for meat and milk production similar to sheep. Stocking rates of 16 to 60 goats per hectare are feasible depending on the type of grass, level of fertilization and the presence and absence of legumes and fodder trees. This system requires high labour and capital investment and is suitable for only intensive meat production from goats. In addition to providing better milk, growth and carcass quality it removes pressure from the grazing lands. Several studies have been conducted on fattening of indigenous and crossbred kids under ad-lib. The male kids weaned at 2-3 months age and fed under feedlot achieved slaughter weights of 25 kg at 5 to 6 months age with a dressing % of 48 to 51. The kids maintained under semi-intensive system reached the target live weight of 25 kg earlier than those under intensive system. The kids under semi-intensive required less feed for a kg of gain than those under intensive feeding. The dressing % was superior under intensive. The bone and lean % was higher under semi-intensive and fat % under intensive system (Singh and Sahu, 1997). The daily gains, milk intake, meat quantity and quality and feed efficiency were found superior in the Sirohi, Marwari and Kutchi kids maintained under semi-intensive as compared to those maintained under intensive or extensive system. The total confinement and complete stall feeding of goats has, however, proved to be detrimental some times. Integration of goats with tree cropping especially with reseeding area among rows of trees with shade loving nutritious perennial grasses and legumes has considerable potential. The value of goats is also very significant in the wider context of massive agro-forestry programmes taken up in our country. Since liberal use of crop residues and agro- industrial by-products has to be made for compounding feedlot rations, efforts to identify and utilize them should be intensified. Production and consumption of balanced goat feed mixtures based on maximum use of by-products should be developed in a coordinated manner. Cereal

straws are an important roughage resource and their nutritive value can be improved with nitrogen-supplementation, ammoniation, urea solution and chemical treatments.

SUMMARY AND RECOMMENDATIONS:

Current world population of goats is about 703 million. Asian region has the highest and over 60% goats of the World. India possessing more than 17.5% of the world and more than 26.5% of the Asian population ranks first. The goats in India are largely reared by small and marginal farmers and landless labourers and greatly contribute to their livelihood and economy. Small size of goats has distinct economical, managerial and biological advantages over other livestock species. Most of the goats in India are maintained under extensive system which includes migratory, transhumance, free range grazing management on natural vegetation of community grazing lands and stubbles of cropped lands supplemented with crop residues and tree loppings. But the large areas so far available for goat grazing are now being put under cereal production and density of livestock per unit grazing area is increasing resulting in ecological degradation and desertification. There are two conflicting views regarding goats role in lands use (a) the goat is a major cause of deforestation, range land destruction and soil erosion and as such its propagation should be checked (b) goat acts as regenerator of vegetation through dispersal of seeds in its droppings and vegetative propagation through browsing. But the controversy over goats role does not appear to have settled so far. It is, not possible to obtain optimum production from goats managed under free range grazing management. The extensive management system should be gradually replaced by semi-intensive or intensive system and new technological changes should be adopted to improve the productivity of indigenous goats. Appropriate systems of management for different purposes may be identified. Production performance and economics of goats vis-a-vis other livestock species may be studied. The areas in arid and semi-arid regions that can not support cattle and buffaloes may be identified, developed through reseeding with perennial grasses and legumes and plantation of fodder trees and utilized for goat production with low investment. There is very good scope for commercial meat production from goats through semi-intensive and intensive feeding management. Efforts to identify and utilize the locally available crop residues and agro-industrial by-products for compounding complete rations and supplementary concentrate mixtures should be intensified. Feed compounding plants capable of incorporating crop residues, tree leaves and natural vegetation in the feed mixtures should be set up in the rural areas. Breed improvement and prophylactic health cover programmes may be taken up to improve the efficiency of goat management systems.

Goat farmers may be provided remunerative price of their produce through organized marketing system.

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