

## Utilization of natural feed resources by goats in smallholding farming system in Bangladesh

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**Abstract** Few heads goats of mixed age are reared per household at subsistence level to supplement income for livelihood. Communal grazing land provides 87% forage and remaining is met from various tree fodder, shrubs and crop residues. Goat production is characterised by small-scale and scavenging systems. Various inexpensive supplements such as tree leaves and bran to goats may benefit from access to essential nutrients and may be the basis to any strategy to improve goat production systems. Adequate supplementation of unconventional feeds are needed to improve utilization of basal feeds for reproductive and growth performances of goats. Smallholding farming system of goats can make efficient utilization of feed, labor and may provide opportunity for generation of farm income. Implementation of simple and sustainable technologies and their promotional services at the farmer's level will improve rearing systems effectively and profitably, all of which add up to making economically viable and biologically sustainable.

**Keywords:** Goats, Farming systems, Feed resources, Production strategies

### Introduction

Conventional livestock rearing in many developing countries like Bangladesh is constrained by scarcity of land for production of livestock feeds. Livestock contributes 3.3% to GDP, 6.5% to national income, 13% to export earning and produces 13.8% milk, 10.6% meat, 80 million MT manure, 10% organic fertilizer, 20% of fuel for the household (BBS, 2000), considered insignificant contribution to income and food production. In the present farming system livestock husbandry and crop production are closely linked with their traditional way of rural life. Majority of the landless, marginal farmers in the country and peri-urban inhabitants rear goats and contribute substantially to the income of the poor farmers, while converting effectively low quality roughages into human usable products. It is unlikely that the present farming system will change and unless demand for cereal and cropping pattern is changed, smallholding farming system that includes livestock rearing is the viable proposition to the farmers.

The majority of goats are raised in crop-cattle-goat-poultry farming systems. Farmers consider goat raising is profitable due to less investment, care and generation of secondary cash income. Availability and accessibility of the forages determines their sustenance and potential productivity in the present farming situation. The Government and NGO,s have taken program on improving livelihood of the resource poor farmers through improved goat rearing. The efficiency depends on overcoming chief constrain of feed and methods that can be applied to exploit potential goat production systems. This paper reviews the potentials of utilization of feed resources for improving small holding systems of goat farming. Part of the current study has been briefly described by Fujihara and Alam (2003).

### REARING SYSTEMS OF GOATS

About 20 million Black Bengal goat having mature weight of 12 kg is reared in small holding system of which landless, marginal and small farmers owns more does for breeding and males are castrated at an early age for meat

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while large farmers rear more wethers until get fattened for higher sale value. In order to get early return from goat small farmers tends to breed female as early as 7 months and consequently contributed to improper endocrine function, low litter size and birth weight of kids, low milk yield and mothering ability (Table 1). Although farmers appear to possess more livestock per unit of land, not due to their numbers but small area of land they hold. Women and children mostly raise goats which otherwise spent idle. Contribution of family labor for goat rearing is ranged from 29 to 65 man-days that accounted as 20% fulltime and 50% part time employment among the different farms. Benefits that the farmers obtain range from reduction of risk of cropping, immediate family needs and insurance against unexpected happening, all of which add up to making economically viable and biologically sustainable. Contribution of goats in net income among the different farm categories ranged from US\$ 36-69, which represents 2.3 to 10.8% of farm income. This contribution is significant among the small farmers. (Alam, 2000; Alam *et al.* 2000).

Goats are tethered and extensive system or combination of the two systems are used for grazing on communal land, waysides, bunds and offered tree leaves, crop residues, kitchen wastes as and when become available. Using the systems goats are closely controlled and nutritional needs are met from natural vegetation. Farmers rank the constraints of rearing livestock in the order of 80%, 77%, and 70% as feed cost, grazing land and diseases, respectively. This is further aggravated by introduction of modern cultivation systems that have reduced employment op-

portunity in farms and therefore, small farmers shifting from rural to urban areas for non farm jobs (Alam *et al.* 2000).

## AVAILABILITY OF FEEDS

In the prevailing cropping intensity more lands is being brought under cultivation to meet increasing demand for agriculture produce leaving less land for grazing. In this situation, improved livestock production systems require sufficient feed supply and their effective utilization. Provision of balanced feeding is determined by the availability of labor for cultivation of green forages and economic benefit of feeding concentrate. On average, a farmer has 12 kg rice straw, 16 kg fresh grass, 3 kg bran, 2 kg oil cakes, 16 kg leaves and 2 kg kitchen wastes to meet feed requirement of mixed species of livestock (Alam *et al.* 2000). Quantitatively these are very insignificant and consequently, share the feed resources among the livestock. Goats are extensively graze and browse as many as 19 different types of naturally grown grasses, shrubs, tree leaves (Table 2) and offered cereal bran and oil cakes when return to farm (Alam, 1993).. Grasses grown in communal lands, roadsides and fallow lands comprises basal diet of all ruminants, which are always overgrazed and availability varies with season. Estimated annual availability of native grass in a hectare of land is ranged from 11 to 33 MT, 4 to 8 MT and 0.5 to 2 MT of fresh, DM and CP, respectively (Alam & Khan, 1992). Goats were found to spend 87% of their grazing time in grazing and browsing of natural vegetation to

**Table 1** Ownership pattern and productivity of goats

Parameters	Landless <0.20ha	Marginal 0.21-0.6ha	Small 0.62-1.01ha	Medium 1.02-2.02ha	Large >2.03ha	Average
No./household	5	4	6	3	4	5.1
Age of 1st mating (month)	7	7	9	8	10	8.2
Average litter size	1.8	1.9	2.3	2.2	2.4	2.1
Milk yield (ml/d)	175	220	250	280	320	263
Lactation period	2.1	1.9	2.2	2.5	2.5	2.3
Lactation period (month)	2.1	1.9	2.2	2.5	2.5	2.3
Rearing percent	90	87	96	113	122	103
Average growth of Young (g/d)	37	40	46	48	49	45
Market age (month)	6	8	9	10	12	9
Market weight (kg)	8	8	9	11	12	10

Source: Alam (2000)

**Table 2** Forages and crop residues offered to goats

Name	Percent use	DM digestibility
<u>Native grasses</u>		
<i>Digitaria sanguinalis</i> , <i>Panicum repens</i> and <i>Cynodon dactylon</i> .	100	55
<u>Leaves</u>		
<i>Artocarpus heterophylla</i> (Jackfruit)	98	54
<i>Mangifera indica</i> (Mango)	87	50
<i>Treblus asper</i> (Shewra)	50	84
<i>Odina wodier</i> (Jiga)	24	48
<i>Ficus bengalensis</i> (Banyan)	21	61
<i>Zizyphus jujuba</i> (Jujube)	20	53
<i>Albezia procera</i> (Rain tree)	16	47
<i>Terminalia catappa</i> (Country almond)	12	51
<i>Musa sapientum</i> (Banana)	12	57
<i>Erythrina indica</i> (Coral tree)	8	61
<i>Eugenia jambolana</i> (Indian Blackberry)	8	53
<i>Moringa oleifera</i> (Morunga)	7	79
<i>Psidium guyava</i> (Guava)	4	55
<i>Bambusa tulda</i> (Bamboo)	3	46
<u>Bran</u>		
<i>Tritium aestivum</i> (Wheat)	60	64
<i>Oryza sativa</i> (Rice)	47	68
<i>Phaseolus mungo</i> (Mash)	25	66
<i>Lathyrus sativus</i> (Khesari)	18	62

Source: Alam (1993)

meet feed requirement. This is further aggravates in dry season and in co-grazing situation when fermentable N intake is expected to be inadequate and in this situation, they may perform better in terms of utilization of natural vegetation per unit area of land (Alam, 1995). Based on the goat population and the available grazing areas, about 86 goats are grazed on a hectare of land per year. Estimated daily DM available is less than 3% of live weight at this high stocking rate. It is unlikely that small reduction of stocking rate and supplementation will have impact on significant improvement of goat rearing unless constraint of feed is met (Table 3). Therefore, strategic supplementation during productive phases would be important in meeting individual requirements. Due to high stocking rate effective supplementation of concentrate may be an alternate proposition for achieving higher productivity (Alam, 1993). There are wide varieties of feeds in the country that can be made available for feeding livestock. The following feeds are im-

**Table 3** Herbage production and live weight gain at different stocking rate

Parameter	6 goats/0.05ha		4 goats/0.05ha	
	Supplement	Control	Supplement	Control
Carrying capacity (goats/ha/year)	118	118	78	78
Total DM yield (MT/ha/year)	13.5	11.3	14.1	10.1
Total DM available (kg/goat/year)	114	96	180	136
DM available (% live weight)	2.5	2.3	3.9	3.4
Total daily live weight gain (kg/ha)	3.2	2.9	2.3	2.0
Live weight gain (MT/ha/year)	1.2	1.1	0.9	0.7

Source: Alam (1993)

portant for minimizing feed shortage and goat production systems in farm.

- i) Various types of forages include naturally grown grasses, leguminous crop, shrubs and tree forages. Their production and availability depends on conservation of communal lands, cultivation in between cereal crops, fallow lands and homestead cropping. Plantation of trees for forage along the boundaries of crop field, communal lands and homestead has potential in small holding farming (Alam, 2002 unpublished data). They are of medium to high quality fodder and good sources of forage for strategic supplementation to basal diet.
- ii) Agro industrial byproducts such as straw and bagasse are low quality feed due to high indigestible fibre and low nutrients content. These bulky feeds are sufficiently produced in the country and rice straw is used mainly for feeding of large ruminants. Due to low nutritive values they cannot meet nutrient requirements and use of various methods of treatments and processing technologies can enhance feeding values.
- iii) Unconventional feeds produced from food industries are rice polish; cereal bran, oil cakes and slaughterhouse, tannery (Alam et al. 2002) and poultry industries byproducts namely, blood meal, meat offal and bone meal. Except crop residues very little information on their availability and nutritive values to ruminants is known. They are of good source of energy, CP and

minerals and can be the source of high quality concentrate supplement to basal diet.

### UTILIZATION OF FEEDS BY GOATS

Efforts for improving goat production systems by supplementation of local feed resources have been made. Those studies were focused on strategic feeding of local forages and concentrate for increasing goat performances. Results of these findings indicated that in the scarce feed resources goats grazing on natural vegetation and supplementation of tree leaves, bran and oil cakes can be used to improve intake of digestible nutrients, growth, reproductive performances, suckling period and reduce mortality of young (Hossain *et al.* 1990; Alam, 1993; Islam & Alam, 1996). Improvement of utilization of basal feed by supplementation of these feeds to goats resulted higher apparent digestion and intake of digestible materials. They also maintained higher  $\text{NH}_3\text{-N}$  and plasma urea-N concentration needed for adequate ruminal digestion of low quality feeds (Alam, 1993). Provision of improved feeding resulted an increase in mothering ability in these does. Supplementation of 100g leaves and 100g bran/d to does grazing naturally grown grasses during pre and post partum period improved 61% live weight (Table 4). Kids from these does were born with 41% higher weight, suckled 22% longer period; attained 86% higher live weight and increased 23% survivability at weaning (Alam, 1996). Feeding of *Sesbania acculeata* foliage and concentrate have improved growth, carcass yield and traits in whether goats (Alam & Wahed, 1980).

**Table 4** Effect of supplementation on performance of does and kids

Parameter	Grazing <i>ad libitum</i> + 100g bran+100g leaves/d	Grazing <i>ad libitum</i>
Live weight gain of does (g/d)	41	25
Average litter size	1.8	1.2
Birth weight of kids (kg)	1.3	0.93
Mean milk yield (ml/d)	145	156
Weaning age (d)	79	65
Growth up to 3 months (g/d)	64	35

Source: Alam (1996)

Content of various forms of phenolic compounds in tree leaves have either deleterious or beneficial effect on ruminants. Utilization of some of the tanniniferous legume foliages contained various levels of tannins and their feeding values by supplementation to basal grass and concentrate diets was investigated (Table 5). Presence of various forms of tannins in foliages would not affect intake, digestion, N balance and microbial N yield and these leguminous forages can be one of the source of protein and can be used for strategic supplementation in goats diet (Alam *et al.* 2001 unpublished data).

**Table 5** Utilization of tanniniferous foliages

Parameter	Grass hay+ Concentrate	Grass hay+ <i>Acacia</i> <i>Nilotica</i>	Grass hay+ <i>Albezia</i> <i>procera</i>	Grass hay+ <i>Sesbania</i> <i>acculeata</i>
Contents (mg/g DM)				
Tannin	—	136.1	66.2	26.0
Condensed Tannin	—	11.8	8.4	4.3
Intake (g/kg LW/d)				
Tannin	—	1.85	0.89	0.73
Condensed Tannin	—	0.16	0.03	0.02
Digestibility percent				
OM	78	53	45	54
N	77	52	46	61
N Balance (mg/kg LW/d)	472	254	197	459
Microbial N yield (g/d)	6.8	6.1	4.7	5.1

Source: Alam *et al.* (2001 unpublished data)

Quantitatively, native grass are the major basal feed and emphasis should be given for the development of feeding systems for their effective utilization and evaluating responses to different supplementation. Live weight gain of goats can be maximized by supplementation at the higher stocking rate. High production potential in goat will probably be achieved in integrated livestock-crop agriculture systems. This requires adaptation of effective feeding systems and the provision of sound husbandry practices. Further investigation on the feed quality and production responses are required for formulation of effective feeding systems.

### POTENTIAL FEED RESOURCES

From the pervious review it is apparent that greater

opportunity exists for utilization of natural feed resources for improvement of goat rearing in small holding farming system for generation of family labor and farm income without change of present farming systems. Cultivation of natural grasses under better pasture management systems can be of good quality and feeding along with concentrate supplement can be further enhanced (Khan *et al.* 1999). Based on the yield, estimated carrying capacity of small ruminants can be increased by 9 to 54% in different seasons. Adaptation of this system may increase grass production in fallow lands and improve animal productivity without changing land use systems (Khan *et al.* 1996)

The unconventional forages and concentrate feeds will provide cheapest source of protein, energy and minerals to the ruminants and provide added value of fence and fuel from fodder trees to the farmers. The value of tree forages for ruminants is greatest in extensive systems in situation where the available feed resources are not able to meet the annual feed requirements of the total animal resources (Norton & Alam, 1996; Alam, 1998). Tree foliage offer opportunity for reducing the cost of feeding. An experiment on multipurpose tree based agroforestry system of forage and livestock production in small holding farming systems is underway in the country. Preliminary results suggests that the advantages of using them are that they can be easily cultivated in and around the farms, homestead, wayside and make accessible to the farmers, provide variety and source of nutrients of high quality, reduced cost of feeding. Additionally these fodder tree supply fuel wood and some of them are good source of adding biomass to the soil (Alam *et al.* 2002 unpublished data)

Improvement of animal productivity is possible through incentive use of the available feedstuffs alone or in combination with others can make major impact on animal output. Problem of progressive feed deficit along with a trend of increasing systems of livestock production necessitates setting priorities, strategy for efficient use of the feeds to achieve as much production as it possible. In this situation unconventional feed resources are the important sources of feeds for reducing the feed deficit. To make improved production impact by use of these feed resources need evaluation of new technologies for improving quality and production systems through on farm testing and demonstrations of the benefits. On farm assessment of inno-

uated systems may justifies wider use and acceptance economically and socially to the farmers as they choose wide variety of component befitting to farming systems and addressing the constraints of adoption to new feeding systems. The information and tasks needed by farmers and advisors are classification and name of the feeds, their availability, feeding values such as contents of nutrients, extend to meet production requirements by strategic supplementation for improved and sustenance of production, feeding system and level of production that can be achieved. There is a need for link across the disciplines of animal scientist, crop scientist and socioeconomic to address all range of on farm activities and demonstrate economic benefit and complementary role of the systems, on farm testing, clear definition of the model and farmers participation. It is essential that all the elements be considered together in objective planning towards demonstration of effective utilization.

## RECOMMENDATION

Smallholding farming systems will prevail in the country and emphasis has to be given for its improvement. Natural feed resources in the farm are not sufficient to raise large numbers of mixed species of livestock. Rearing few numbers of goats will provide opportunity for effective utilization of naturally available feeds and increase rearing capacity of goats in farms with gainful employment and farm income opportunity. Innovation of simple and sustainable technologies and their promotional services at the farm level will improve crop-livestock production system effectively and profitably. Integration of livestock and crop farming system requires a system approach to increase productivity in farms by development of strategic feeding systems for improving production efficiency, processing of cereal crop byproducts for improving feeding qualities and cultivation of forage and tree forage crops in inter, relay or sequential cropping systems without intervention of cereal cropping pattern.

Irrespective of choice of feed acceptable choice of feeding systems are to be simple, practical and within farmer's capacity, convincing and reproducible. It must serve the farmer's need and useful in meeting animal requirement. In this context considerable adoptive research, innovation

and development of program for the need of the farmers are needed.

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