



# **Farmers' Perceptions of the Effects of Plant Diseases on the Yield and Nutritive Value of Crop Residues used for Peri-Urban Dairy Production on the Deccan Plateau: Findings from Participatory Rural Appraisals**



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## Abstract

Plant diseases influence the quantity and quality of groundnut and sorghum crop residues used as fodder for ruminants. The present socio-economic study assessed farmers' perceptions, their awareness, and the relative importance and impact of plant diseases in farmers' livelihood systems. Case studies were carried out in four villages in the state of Andhra Pradesh in the Deccan Plateau with the help of participatory rural appraisal (PRA) techniques. The results from PRAs suggest that sorghum and groundnut crop residues constitute a major source of fodder, and predominantly provide 'feed security' to the ruminants during summer, as few alternatives are available to farmers in dryland areas. The problem of foliar diseases cannot be viewed in isolation, as farmers' concerns are more on the cumulative effects of pests and diseases. Farmers believe that diseases reduce the quality of crop residues that leads to feed refusal by, and poor health of ruminants. The effects on the quality of crop residues are more seriously perceived in groundnut as farmers report 50% losses in foliage and fodder yield. In sorghum, the perceived losses are 10-30%, but low price offered by traders for disease-affected fodder reduce earnings of the poor from fodder sale. Commercial markets exist for fodder transactions of sorghum stover while no such markets are reported for groundnut crop residues. The poor are the link to the sorghum fodder market. Therefore, validation of fodder-related technologies through the poor is necessary to increase cash incomes from fodder sale. Genetic improvement of feed-quality of crop residues without compromising on essential yield traits is critical for farmers' acceptance of new sorghum and groundnut varieties. Research on inexpensive and easy-to-use pest and disease management options is necessary to improve the quantity and quality of crop residues of sorghum and groundnut.

## Résumé

Les maladies des plantes ont une influence sur la quantité et la qualité des résidus de l'arachide et du sorgho, utilisés comme fourrage pour les ruminants. La présente étude socio-économique a évalué les perceptions des paysans, leur prise de conscience, l'importance relative et l'impact des maladies des plantes sur les moyens de subsistance des paysans. Des études de cas ont été réalisées dans quatre villages de l'Etat d'Andhra Pradesh, sur le Plateau du Deccan en utilisant des techniques de l'évaluation participative rurale (EPR). Les résultats de l'EPR indiquent que les résidus de l'arachide et du sorgho constituent une importante source de fourrage et assurent surtout, aux ruminants, une "sécurité alimentaire" pendant l'été, puisque les paysans ont peu d'alternatives dans les zones arides. Le problème des maladies foliaires ne peut pas être abordé de manière isolée, puisque les paysans sont davantage préoccupés par les effets cumulés des ravageurs et des maladies. Les paysans pensent que les maladies réduisent la qualité des résidus de culture, ce qui entraîne leur refus par les animaux et la mauvaise santé de ces derniers. Selon les paysans, les effets sur la qualité des résidus de l'arachide sont plus graves, puisqu'ils font état de 50 % de pertes sur les rendements de feuilles et du fourrage. Pour le sorgho, les pertes perçues vont de 10 à 30 %, mais les prix bas que les commerçants proposent pour le fourrage touché par la maladie réduisent les gains que les pauvres tirent de la vente du fourrage. Il existe des marchés où se déroulent des transactions commerciales sur les tiges de sorgho alors que de ces types de marché n'ont pas été signalés pour les résidus de l'arachide. Les pauvres constituent le lien avec le marché du sorgho. Par conséquent, il est nécessaire de valider les technologies relatives au fourrage par l'intermédiaire des pauvres afin d'accroître les revenus en espèces tirés de la vente de fourrage. L'amélioration génétique de la qualité alimentaire des résidus de culture sans compromettre les principaux traits relatifs au rendement est essentielle à l'acceptation par les paysans de nouvelles variétés de sorgho et d'arachide. Il est nécessaire de mener des recherches sur des options peu coûteuses et faciles à utiliser, en matière de lutte contre les ravageurs et les maladies afin d'améliorer la quantité et la qualité des résidus de sorgho et de l'arachide.

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**K Rama Devi, R Bandyopadhyay, A J Hall,  
S Indira, S Pande, and P Jaiswal**

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**ICRISAT**

**International Crops Research Institute for the Semi-Arid Tropics**

Patancheru 502 324, Andhra Pradesh, India

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# Introduction

Increased milk production in peri-urban areas of India will require greater amounts of higher quality crop residues. On the Deccan Plateau, in the state of Andhra Pradesh, the most important crop residues are sorghum and groundnut. The purpose of this project is to assess the impact of plant diseases on the quantity and quality of crop residues and to develop management strategies to eliminate deleterious effects.

The need for this study arises as sorghum and groundnut crop residues are used widely in India for feeding dairy cattle and buffalo. During the growing season, these crops are attacked by plant diseases that are likely to affect the quantity and nutritive value of the crop residues, as well as grain yield, resulting in reductions in milk production. Furthermore, there is evidence that diseased residues fetch low prices in the fodder markets. Sales of crop residues by farmers to peri-urban milk producers account for substantial income from cropping in rural areas. No hard evidence exists either on the effects of diseases on crop residue yields and quality or the economic consequences for rural producers.

A socio-economic study has been initiated to fill this gap within the project framework. The study will contribute to -

- Improved understanding of the incidence and severity of foliage and stalk diseases on sorghum and groundnut residues destined for ruminant feed (farmers' perceptions)
- Increased awareness of the effects of plant diseases on the price of crop residues (farmers' perceptions, fodder market behavior)
- Improved understanding of the effects of plant diseases on the utilization of crop residues by large ruminants (feeding pattern, animal preference, health, and nutritive value)

The socio-economic study forms part of a larger study that evaluates the effects of diseases of sorghum and groundnut on the quantity and nutritive value of crop residues used as fodder for large ruminants. The present study, therefore, aims to record the perceptions of farmers in order to assess the relative importance and impact of plant diseases in the livelihood systems of small-scale farmers, and suggest areas of focus for further research to reduce this problem.

# Methodology

Case studies were carried out, between August and October 1999, in four villages in two districts of Andhra Pradesh state on the Deccan Plateau. Participatory rural appraisal (PRA) techniques were used to understand the effects of foliar diseases on yield and nutritive value of sorghum and groundnut crop residues as perceived by male and female farmers. PRAs were undertaken in four villages to cover sorghum- and groundnut-based cropping systems. Two villages were chosen for each cropping system to represent two different situations with regard to the importance of livestock, linkages with fodder markets and the intensity of dairy activities.

PRA methods were used to collect the required data through village-level case studies to ensure effective participation of men and women from the sites selected. This approach facilitated direct interaction with rural people to understand and analyze their perceptions regarding sorghum/groundnut crop residues and the effects of foliar diseases on the nutritive value of the fodder.

The main aim of PRAs was to assess the scenario related to:

- The relative importance of crop residues as fodder in the crop-livestock systems in the sorghum and groundnut growing areas.
- Awareness and perceptions of male and female farmers regarding the effects of plant diseases on fodder quantity, nutritive value and their influence on the relative prices of fodder in the market.

A set of PRA tools and techniques was used to satisfy the required data needs. The techniques included social mapping; wealth ranking; focus group discussions; the construction of annual calendars of ruminant feeding practices; matrix scoring of varieties; and village time-line and household case-studies with fodder merchants, milk vendors and fodder users. The procedures followed for each technique and details of the data collected appear in Appendix I.

Although the tools and techniques used were common for all four villages (and two crops), slight variations were allowed to facilitate the convenience, willingness, and limitations (time, ease of discussion, group participation) of the communities to participate in the research process.

Participation of men and women were envisaged during the process, either collectively or separately, depending upon the type of information required, as



both were considered active partners in the sorghum/groundnut-based crop-livestock systems. Separate exercises exclusively with women were not possible to the desired extent, as women were extremely busy with crop management operations during the study period. However, the perceptions of women were incorporated for the most crucial aspects of the study. Furthermore, their joint participation with the men was organized whenever separate meetings were not possible.

## **Selection process for sorghum**

Two villages, Machinenipalli and Siddyyapalli (a hamlet of Amistapur) were selected from Vangur and Bhootpur Mandals in Mehboobnagar District for conducting the PRAs. Machinenipalli had intensive commercial dairy activities but weak links with the fodder markets, as the sorghum residues were not usually sold outside the village. Siddyyapalli had less dairy activities; milk was produced informally and the volume of milk for sale was less than in Machinenipalli. However, dry sorghum fodder from Siddyyapalli was supplied to markets in Hyderabad and Mehboobnagar by families that did not own large ruminants. Selection of villages was based on the advice of the Indo-Swiss Project of Andhra Pradesh (ISPA) and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT).

## **Selection process for groundnut**

After discussions with scientists from the ISPA and the ICRISAT, it was decided to focus the PRAs on the Madanapalli Division of Chittoor. This area has two milk-chilling centers, and intensive-dairy activities are reported in the villages. Selection was made finally on the advice of a local non-government organization (NGO), the Rural Reconstruction Society (RRS), and staff of the Department of Animal Husbandry at Madanapalli.

Two villages, Tettu and Pichelavandlapalli, were selected to cover groundnut areas reflecting the two different situations mentioned above. Tettu represents a situation where several individual farm households sell milk to collection centers or nearby towns, and infrastructure for dairy activities is well developed. The commercial dairy activities in Pichelavandlapalli are informal and on a much smaller scale, but groundnut residues are used for feeding the cattle and milk is used generally for home consumption. Both villages are in Kurubulakota Mandal and located 25 km from Madanapalli town.

## Characteristics of selected villages

The characteristics of the four selected villages are summarized in Table 1.

**Table 1. Characteristic off sorghum and groundnut villages where dairy activities are performed at varying levels.**

Characteristics	Sorghum		Groundnut	
	Siddayyapalli (low-dairy village)	Machinenipalli (intensive-dairy village)	Pichelavandla- palii (low-dairy village)	Tettu (intensive- dairy village)
Name of district and mandal	Mehboobnagar, Bhootpur	Mehboobnagar, Vangur	Chittoor, Kurubalakota	Chittoor, Kurubalakota
Soils	White sandy, red	Sandy, black	White, red and sandy, black	White, red and sandy, black
Main crops	Sorghum, castor, pigeonpea (intercrop), paddy, cotton, finger millet, groundnut, maize	Sorghum, castor, pigeonpea (intercrop), paddy, maize, groundnut, sunflower, fodder crops	Groundnut, mulberry, paddy, vegetables, sorghum- pigeonpea- cowpea intercrop	Groundnut, paddy, veg- etables, finger millet, sunflower, sorghum- pigeonpea- cowpea intercrop
Irrigation sources	Wells, bore-wells, two tanks	Wells, bore-wells	Wells, bore-wells, tanks	Wells, bore-wells
Type of livestock	Buffalo, cows, bulls	Buffalo, cows, bulls, goats, sheep	Cows, bulls, goats, sheep	Cows, bulls, goats, sheep
Infrastructure for dairy production	Nil. Individual households sell milk to consum- ers in nearby town, veterinary assistance	Milk sellers Co- operative, crossbred milk animals, milk collection center, veterinary doctor	Nil. Individual sale, within village or nearby town	Vendors collect milk to sell in Madanapalli town, crossbred milk animals, veterinary hospital
Average quantity of milk sold day <sup>-1</sup> (L)	Approx. 40-50	150	Approx. 30	150

Contd.

**Table 1. continued**

Characteristics	Sorghum		Groundnut	
	Siddayyapalli (low-dairy village)	Machinenipalli (intensive-dairy village)	Pichelavandla- palli (low-dairy village)	Tettu (intensive- dairy village)
No. of house holds	73	113	46	193
Wealth categories	Rich, medium, poor	Rich, medium, poor	Rich, medium, poor	Rich, medium, very poor
Proportion of sorghum/ groundnut residues in total crop residues (as reported by farmers)	Sorghum: 40% (dry stover)	Sorghum: 30% (dry stover)	Groundnut: 80% (dry)	Groundnut: 40% (dry)
Methods of sale of sorghum/ groundnut fodder	a) to middlemen linked to Hyderabad and Mehboobnagar markets b) direct sale	a) sale within the village (common) b) middlemen from Hyderabad (less common)	No sale	Sale within village (by few households)

## Crop-livestock systems

The two villages selected are within the same district and have the same general socio-economic pattern of livelihoods. Soil types are generally sandy with smaller areas covered by black or red soils. Sorghum is considered as the 'mother crop' in these villages, and is grown by a large percentage of households. It is treated as a dual-purpose crop and, hence, is equally important for human food and animal fodder. The crop is cultivated during the rainy season (*Kharif*) under rainfed conditions. Local varieties are most favored and are referred to as yellow and white sorghums. Yellow sorghum is more widely grown compared to white sorghum. Paddy rice (irrigated), castor, pigeonpea (as an intercrop with sorghum and castor), cotton, finger millet and maize are also grown during the *Kharif*. Paddy rice and groundnut are the major crops grown during the post-rainy (*Rabi*) season under irrigation. Finger millet, sunflower and maize are also grown, but on very small areas.

Both large and small ruminants are components of the crop-livestock systems in the villages. Cattle, buffalo, goats and sheep are all important. Milk production is a

part of the general activities in these villages. However, in Machinenipalli, dairy production is a significant activity and will be referred to as an "intensive-dairy village" hereafter. A Milk Producers Cooperative Society is at the helm of the dairy activity. About 150 L milk is produced and sold daily by the 58 households (51% of the total households) belonging to different wealth categories.

Much less milk is sold in Siddayyapalli village and there is no formal establishment for the sale of milk. Individual households sell the product informally to consumers in a nearby town (Mehboobnagar). This village will be referred to as a "low-dairy village" hereafter.

Households that own ruminants depend on sorghum crop residues as the main source of fodder. Its extensive use was indicated during discussions with farmers. The fodder is either purchased or sometimes grown on leased lands when their own production is insufficient to meet requirements. On the other hand, some farmers cultivate sorghum to sell as fodder. The sale is usually made within the "intensive-dairy village" to needy farmers and, occasionally, to traders from Hyderabad. Traders or their agents visit the villages in search of sorghum fodder. Hence, farmers do not have to travel outside their village in search of a market for their fodder. However, it is also usual that fodder stocks left over from the previous year are sold at the beginning of the new Kharif season.

## **Sorghum**

### **Social stratification**

The villagers classified the households of the village into distinct wealth categories based on a set of criteria mutually agreed amongst themselves. The main criteria used for wealth classification are size of landholding, quantum of livestock, volume of milk sale and the type of labor used (hired labor or family labor) for carrying out agricultural operations in the "intensive-dairy village" scenario. Size of landholding and land ownership were used as the wealth criteria in "low-dairy village" scenario.

### **Feeding systems and fodder-use patterns**

- Dry sorghum stover is a major source of fodder in both types of dairy villages.
- Dry sorghum stover is the most valuable fodder in the ruminant diet in the summer months.

- Animals prefer rice straw in the "low-dairy village" during the *Kharif* season.
- Grasses and weeds complement crop residues in the animal diet during the monsoon period. This is the planting time for sorghum, and stover is unavailable.

## Seasonal calendar of feeding practices and role of sorghum fodder

The types of feeds used in ruminant diets at different times are presented in Table 2.

**Table 2. Feeds used in ruminant diets and length of feeding periods (months year<sup>1</sup>) in sorghum-based crop-livestock systems.**

Feeds	"Low-dairy village" (months year )	"Intensive-dairy village" (months year )
Dry fodder		
Yellow sorghum stover	8(A) <sup>1</sup>	7(A) <sup>2</sup>
Paddy rice straw	12(A)	7(A)
Finger millet stover	3(A)	No reported usage
White sorghum stover (but see footnote 2)	8(A)	No reported usage
Groundnut hay	7(B)	4(A)
Maize stover	7(A)	No reported usage
Pearl millet stover	No reported usage	7(A)
Horsegram and pigeonpea hay	No reported usage	3(A)
Green fodder		
Sorghum/grasses (cultivated)	9(M)	12 (M)
Grass/weeds (commons/bunds/grazing)	9(A)	8(A) <sub>3</sub>
Sorghum panicles	No reported usage	5(A) <sup>3</sup>
Concentrates		
Groundnut cake	7(M)	12 (M)
Rice bran	7(M)	12 (M) <sup>3</sup>
Wheat bran	7(M)	12 (M)
Concentrate mixtures	No reported usage	12 (M)
Safflower cake	7(M)	No reported usage
Pulse husk	7(M)	No reported usage

**1. A: fed to all large ruminants; M: fed to milk animals only; and B: fed to bulls only.**

**2. Includes white sorghum stover.**

**3. Fed to all large ruminants for one month only.**



- Sorghum stover is an important fodder for those who do not have access to irrigation, as they have fewer alternative sources.
- Sorghum stover is an important source of fodder for both types of dairy villages, but it is used for a longer period (one month extra) in the "low-dairy village."
- The "low-dairy village" depends on a more varied selection of dry crop residues and for longer periods.
- Dairy animals are given special care in the "intensive-dairy village," and fed with a good mixture of feeds that include green fodders and concentrates.
- Green fodder from forage sorghum varieties and cultivated grasses are used for a much longer period in the "intensive-dairy village."

### **Preferential feeding**

- Buffalo are given special care at feeding time in the "intensive-dairy village," as it is believed that milk yields are higher from this species.
- Only large ruminants are fed in confinement. Small ruminants are not stall-fed but grazed.
- Women believe that milk animals give higher yields when fed with sorghum stover as compared to paddy rice straw.
- Men believe that sorghum stover gives more strength to the animals as they drink more water after eating this fodder.

### **Relative importance of sorghum fodder**

- Farmers in the "low-dairy village" consider paddy rice straw as a staple fodder that can be used throughout the year.
- Farmers consider March-April as the months of greatest fodder shortages. Green fodder is unavailable during these times.
- When there is a fodder crisis, farmers procure paddy rice straw as it is cheaper than sorghum stover in the market, and is available from nearby villages/towns.
- The rich have better access to paddy rice straw as they have irrigation.
- Forage sorghum varieties were introduced into the "intensive-dairy village" after the start of milk production as a commercial activity.

- A majority of rich farmers, followed by the middle-wealth categories, grow fodder crops in the "intensive-dairy village".
- A majority of rich farmers own crossbred buffalo in the "intensive-dairy village".
- A majority of farmers in the "intensive-dairy village" grow dual-purpose sorghum and retain the crop residues as fodder.
- Most of the sorghum fodder produced in the "intensive-dairy village" is consumed within the village.
- A majority of farmers in the "low-dairy village" do not grow fodder crops as they use the scarce water resources for producing "cash" crops. Forage crops play an important role in the diet of milk animals in the "intensive-dairy village", as the sale of milk is an important income-generating activity.

The data presented in Table 3 give an overview of the relative importance of sorghum fodder to the different wealth categories.

**Table 3. Details of animal ownership of large ruminants, use of sorghum stover and fodder, and milk sales using social mapping in "low-dairy village" and "intensive-dairy village\*\*.**

Item	"Low-dairy village"	"Intensive-dairy village"
Number of households (total) in the village	73	113
Number of households with large ruminants (milk and draught)	43	72
Number of households with dairy cattle <sup>1</sup>	31	65
Number of households with draught animals	31	47
Number of households growing sorghum	50	95
Number of households using dry sorghum stover	38	72

Contd

**Table 3. continued**

Item	"Low-dairy village"	"Intensive-dairy village"
Number of households (total)		
buying dry sorghum fodder	16	29
• Rich category	3	21
• Medium-wealth category	5	6
• Poor category	8	2
Number of households (total) selling dry sorghum fodder	12	24
• Rich category	1	1
• Medium-wealth category	3	5
• Poor category	8	18
Number of households selling milk	27 <sup>2</sup>	58
• Rich category	4 (6) <sup>3</sup>	30 (32)
• Medium-wealth category	9(16)	21 (35)
• Poor category	12 (41)	7(42)

1. The number of households under each item is counted separately. Thus, a household owning dairy and draught animals may be counted twice under "dairy animals" as well as under "draught animals". Similarly, households that are growing and using sorghum fodder may or may not buy fodder. Therefore, they may be included twice if they both grow and buy fodder.

2. Other category households: 2

3. Figures in brackets indicate total number of households in each wealth category. The figures do not add up to the total number of households in each village because households belonging to "others" category and "very poor" category are not listed. The reason for not listing these households is that "very poor" category households do not own either land or dairy animals, and the households of "others" category do not belong to any specific wealth category. Therefore, 10 households from "low-dairy village" and four households from "intensive-dairy village" were excluded from the number of households selling milk.

- A majority of farmers, irrespective of wealth status, grow sorghum in the "intensive-dairy village"
- The rich and middle-wealth categories constitute the majority of buyers of sorghum fodder, whilst the poor form the majority of sellers in the "intensive-dairy village".

- A minority of the poor in the "intensive-dairy village" own ruminants, but a majority of these owners do not have dairy animals.
- Milk sales are highest in the rich category, followed by middle and poor-wealth categories in the "intensive-dairy village".
- The poor depend mostly on the sale of sorghum fodder as a source of cash income. Fodder quality is of concern to both the rich and poor for different reasons.
- Though sorghum is a major crop, fewer people grow sorghum in the "low-dairy village".
- The buyers of sorghum fodder outnumber the vendors in the "low-dairy village".
- The buyers of sorghum fodder are the milk producers and the vendors are those with few or no ruminants, particularly dairy cattle.
- The proximity of the "low-dairy village" to a nearby town (Mehboobnagar) increases the demand for sorghum fodder, as it links the village to urban consumers.
- A majority of households in the "low-dairy village" fall under the middle- and poor-wealth categories.
- More poor households sell sorghum fodder in the "low-dairy village," although some of them also buy in sorghum fodder.
- A significant proportion of milk vendors are from poor households in the "low-dairy village".
- Sorghum fodder in the "intensive-dairy village" is usually sold within the village.

## Perceptions of farmers on the quality of sorghum fodder

Farmers have definite perceptions about the indicators of good quality sorghum fodder. These are listed in Table 4. Both men and women view the concept of good fodder in a similar manner in both dairy systems. Color, plant height, starch content of the stalks, taste and animal preference were some of the qualities that farmers would like to see in sorghum fodder, besides the absence of diseases. All of these traits convey the message that, ideally, farmers would like to have disease-free fodder.

**Table 4. Farmers' perceptions of good quality sorghum fodder.**

Perceived traits in good sorghum fodder	"Low-dairy village"	"Intensive-dairy village"
Color: light green/golden yellow	3 <sup>1</sup>	2 Desirable
Full/firm stem (no hollowness); high starch content	2	5
More leaves	3	4
Animal preference (wastage of fodder is reduced if animals prefer to eat)	6	Desirable
Good/sweet taste	5	2
No observable pest/disease problems; less damage to leaves	4	Desirable
No blackening	Not reported	Desirable
Less spoilage (tolerant to rains)	7	Not reported
Pleasant smell	8	Not reported
Long-storage capability	Not reported	3
Tall plants	1	1

**1. Figures indicate rank (1 = most preferred) for each criterion.**

**2. Farmers considered these traits as desirable but preferred not to rank these.**



## Perceptions on incidence of pests and diseases

The importance of pests and diseases, according to the perceptions of farmers, is presented in Table 5.

**Table 5. The perceived importance of pests and diseases of sorghum identified by farmers.**

Name of pests/diseases	Perceived effects	
	"Low-dairy village"	"Intensive-dairy village"
Stem borer/rcdmite/ anthracnose ( <i>Erragummadi tegulul Gandamala</i> ) (confusion in identification)	Parts of stem turn reddish as in a wound and affect plant growth; when stalks become red, insect problems start. Version of women: retards plant growth and prevents panicle formation. Wastage of fodder as animals do not eat the affected parts. Plant dries off, 50% of grain and fodder loss.	Occurs on patches of land. Leaves and some parts of the stem become reddish. More problematic in clay soils than sandy soils. Fodder loss in extreme cases up to 30%; stalks become hollow.
Leaf blight ( <i>Aggittegulu</i> )	Leaves become reddish and desiccate; fodder yield loss but no effect on quality.	Leaves (midrib) become reddish and desiccate.
Grain smut ( <i>Katuka</i> )	Grain (panicle) becomes black and powdery (like eye-liner); grain yield nil but fodder yield and quality not affected.	Grain (panicle) becomes black and powdery; grain yield nil. It also retards plant growth and so affects fodder yield.
Shoot fly	Retards grain formation and plant growth; no major loss of fodder as side tillers appear and no change in fodder quality.	Insects suck the sap from the grain and the cob becomes hairy. More problematic with white sorghum varieties; total grain loss but no change in fodder quality.
Midge	Insects eat away the connecting part of the panicle to the stalk and retards growth; grain loss.	Problem starts at seedling stage. Grain formation does not take place; panicle becomes loose and comes out of the stalk; grain loss.

Contd.

**Table 5. continued**

Name of pests/diseases	"Low-dairy village"	"Intensive-dairy village"
Ergot	Panicle becomes small and thin, and grain formation does not take place; less grain yield and fodder yield slightly reduced.	Starts at flowering stage and stops growth. Phnicle becomes small and thin. Women say that an insect causes it. A gummy substance appears on the panicle. If the grain is consumed it causes vomiting. Grain loss, slight fodder loss.
Head bug	Problematic in the last two years.	No reported perception.
<i>Striga</i>	Flowery, white structures appear on the plant; retards growth; poorer the soil, the greater the occurrence.	Problem started in 1985.
White grub	No reported perception.	White insect eats away plant; 25% of crop is affected.

The sorghum varieties grown in the two types of dairy villages are shown in Table 6.

**Table 6. Sorghum varieties grown in the two types of dairy villages.**

"Low-dairy village"	"Intensive-dairy village"
Yellow sorghum (local)	Yellow sorghum (local)
White sorghum (local)	White sorghum (local)
Hybrid sorghum (name not given; discontinued)	CSH 5 (hybrid) <sup>1</sup> CSH 1 (hybrid) <sup>1</sup> ICSV 112 (ICRISAT-bred variety) <sup>1</sup> SSGH 777 (green fodder) SSGH 898 (green fodder)

**1.2-3 fanners tried these varieties once/twice. These varieties are not grown regularly.**

- Farmers can clearly correlate the occurrence of each pest/disease with that part of the plant where it causes damage and observe the symptoms well (except for midge in "intensive-dairy village").
- Foliar diseases occur once every 2-3 years, and the perceived losses in fodder yield are less in the "low-dairy village" (10%) compared with the "intensive-dairy village" (30%).
- Farmers from both dairy systems perceive anthracnose and leaf blight as the most damaging foliar diseases. But, they have no visible impact on fodder quality after the plant dries off.
- Stem borer causes visible damage, as the stalks become hollow. Losses in fodder yield are perceived, as the animals do not eat hollow stalks.
- Causes and effects of foliar pests/diseases are similar to stem borer according to the perceptions of farmers from both dairy systems.
- Farmers expressed confusion in distinguishing between pests and diseases, as they are not aware of the causes of foliar diseases. The occurrence of anthracnose is related to the presence of red mites.
- Farmers prefer to look at the combined effects of pests and diseases rather than diseases in isolation. This could be due to a problem of awareness.
- The awareness of farmers regarding the incidence of pests and diseases is more or less at a similar level in both dairy systems.
- In general, local yellow sorghum was rated as the variety most resistant to pests and diseases, particularly stem borer and anthracnose. However, the local white sorghum scored highest for resisting leaf blight. The bitter content of yellow sorghum is the reason given for its capacity to resist pests.
- Farmers in both dairy systems prefer the local yellow sorghum variety because it is pest resistant.
- Farmers in the "low-dairy village" have less choice for dual-purpose varieties, as they grow only local yellow and white varieties. They have yet to find a good variety to replace the local lines.
- Sorghum varieties in the "intensive-dairy village" generally escape pest attacks, as plants are defoliated more than once during a growing season.

## **Farmers' perceptions on relevance and importance of foliar diseases and pests**

- Animals do not like to eat sorghum fodder heavily affected by diseases, or if the stalks are hollow.
- If animals consume diseased fodder, they develop 'tight tummy' suffering from indigestion and diarrhea.
- Diseased fodder reduces milk yield as animals do not eat properly and become weak.
- Farmers from both dairy systems are concerned about the effects of stem borer on fodder quality, as the stalks become hollow leading to wastage of fodder.
- Rain during the drying of crop residues is a major concern for farmers. Crop residues turn black and give off a noxious odor, rendering the crop residues inedible.
- Farmers do not consider that damage caused by foliar diseases represents a substantial loss, as the investment in sorghum production is very low.
- The major fodder losses seem to occur when heavy rains damage the crop residues at the time of drying.
- Farmers from both dairy villages have similar views on the effects of pests and diseases on fodder quality.
- Although farmers are concerned about the effects of pests and diseases on grain and fodder, the emphasis is more on grain-related aspects as this affects their food requirements.
- Farmers in the "intensive-dairy village" do not pay too much attention to foliar pests and diseases, as they also grow other fodder crops to take care of the requirements of their dairy cattle.
- Farmers in the "low-dairy village" are also not overly concerned about foliar pests and diseases, because the frequency of occurrence is once in 2-3 years and the local yellow sorghum variety has some tolerance.
- Farmers in the "low-dairy village" expressed interest in control of pests and diseases that affect fodder quality and yield, as they have fewer options for dry fodder production other than paddy rice straw.

- Farmers do not control pests and diseases, even if they affect grain yield, as sorghum is a low-input crop and they cannot afford any extra investment.
- Economic considerations are not the only reasons for failure to apply any control measures. A lack of knowledge about pest and disease prevention and the availability of cheap methods of control are also factors.

## **Effects of foliar diseases on fodder price**

- In the "low-dairy village", there is a greater impact of price discrimination if the residues are affected by foliar pests and diseases, as sorghum fodder is sold outside the village (mostly to traders associated with the Hyderabad fodder markets). In the "intensive-dairy village" the impact is less as the fodder is sold usually within the village.
- Farmers in the "low-dairy village" will not accept too great a price discrimination, as there is a high demand for sorghum fodder in the urban markets. Hence, vendors have some influence in price determination.

## **Gender perceptions**

The exclusive interactions with women revealed that their perceptions of fodder quality, pests and diseases and the relative importance of sorghum fodder broadly matched those of the men. Women admitted that men observed the crops for pests and diseases much more closely. Women usually do not pay too much attention to this aspect, as the differences in color are not obvious in the dry crop. However, animals eat the leaves but not the stalk of diseased residues because of the peculiar smell from the affected fodder. The women think that this will lead to wastage of fodder. Women have clear perceptions about the relationship between different animal feeds and milk yields.

## **Groundnut**

### **Social stratification**

Social mapping, followed by a wealth-ranking exercise, led to the categorization of households into three distinct socio-economic groups (rich, medium-wealth and poor) in the "low-dairy village" and four groups (rich, medium-wealth, poor and very poor) in the "intensive-dairy village," based on the criteria used by the villagers. The criteria included size of landholding, extent of wetland and the



mulberry crop, ownership of well/bore well, access to tank irrigation, ownership of cows and bulls, area under vegetable cultivation and employment status.

## Feeding systems and fodder-use patterns

- Groundnut fodder is the most important fodder for farmers in both dairy systems.
- Farmers believe that groundnut fodder is nutritious for animals as it keeps them strong.

## Seasonal calendar of ruminant feeding practices and role of groundnut fodder

The types of fodder and feeds used in ruminant diets and the length of the feeding period are presented in Table 7.

**Table 7. Types of feeds used for ruminants and length of feeding period (months year<sup>1</sup>) in groundnut-based crop-livestock systems.**

Feeds	"Low-dairy village" (monthsyear <sup>-1</sup> )	"Intensive-dairy village" (monthsyear <sup>-1</sup> )
Dry fodder		
Groundnut hay	8(A) <sup>1</sup>	12(A)
Paddy rice straw	9(A)	12(A)
Finger millet stover	No reported usage	6(A)
Sorghum stover	3(A)	4(A)
Green fodder		
Sorghum	4(A)	4(A)
Grasses	No reported usage	12 (M)
Mulberry leaves	6(A)	No reported usage
Grass/weeds from fields/field bunds	10(A)	9(A)
Forest grasses/hillock grazing	7(A)	12(A)

Contd.

**Table 7. continued**

Feeds	"Low-dairy village" (months year <sup>-1</sup> )	"Intensive-dairy village" (months year")
Concentrates		
Groundnut cake	2(A)	12 (M) <sup>2</sup>
Rice bran	12 (M)	12 (M) <sup>2</sup>
Wheat bran	No reported usage	12 (M)
Mixtures	No reported usage	12 (M)
Pulse husk	2(A)	No reported usage

1. A: fed to all ruminants, M: fed to milk animals only.

2. Fed to all ruminants for two months.

- The most crucial period for feeding groundnut hay is during the summer months.
- The feeding pattern for dry fodder is similar in both dairy villages.
- The main difference in the feeding systems between dairy villages is in relation to the use of green fodder and concentrates.
- Farmers in the "intensive-dairy village" pay extra attention to the feeding of dairy animals, growing cultivated grasses and using commercial feed mixtures.
- The length of the feeding period for each feed is different in the two dairy villages.
- The two dairy villages differ in the weightage given to different feeds at different times of the year. These are governed by the availability of feeds, preferential feeding patterns, affordability, and local customs/beliefs about suitability of feeds for animals.
- Groundnut hay is fed to all large ruminants throughout the year in the "intensive-dairy village", compared to eight months in "low-dairy village". This explains why more fodder transactions take place in the former.
- Small ruminants are not fed groundnut hay, and are usually taken out for grazing on the common property resources.

## Importance of groundnut fodder to the different wealth categories

Details of the ownership of large ruminants, the use of groundnut hay, and fodder and milk sales derived from social mapping are given in Table 8.

**Table 8. Details of the ownership of large ruminants, the use of groundnut hay, and fodder and milk sales.**

Item	"Low-dairy village"	"Intensive-dairy village"
Total households in the village	46	193
Households with large ruminants (milk and dairy)	40	133
Households with milk cattle <sup>1</sup>	40	131
Households with draught animals	29	8
Households growing groundnut	41	158
Households using groundnut fodder	39	128
Total households buying groundnut fodder	0	9
• Rich category		0 (21) <sup>2</sup>
• Medium-wealth category		4(103)
• Poor category		2 (35)
• Very poor category		3 (34)
Total households selling groundnut fodder	0	29
• Rich category		4
• Medium-wealth category		15
• Poor category		9
• Very poor category		1
Households selling milk	12	119
• Rich category	7(32)	11 (21)
• Medium-wealth category	3 (5)	75(103)
• Poor category	2 (9)	21 (35)
• Very poor category	0	12 (34)

**1. Number of households under each item was counted separately. Thus, a household owning dairy and draught animals may be counted twice under "dairy animals" as well as under "draught animals." Similarly, households that grow and use groundnut fodder may or may not buy fodder. Hence, they may be included twice if they grow as well as buy fodder.**

**2. Figures in brackets indicate total number of households in each wealth category.**

- A majority of the farmers in the "low-dairy village" grow groundnuts and use the residues as an important source of fodder.
- Sale and purchase of fodder does not take place in the "low-dairy village" as all the producers use the fodder for their own livestock.
- The majority of milk vendors are from rich households in the "low-dairy village," but the proportion of rich households in the village as a whole is higher due to sericulture.
- Groundnut crop residues are an important source of fodder to farmers in the "intensive-dairy village", as all the households (with a few exceptions) that own milk animals feed them with groundnut fodder.
- Groundnut fodder is bought and sold within the "intensive-dairy village" itself, but the volume of transactions is low.
- Sellers of fodder outnumber buyers in the "intensive-dairy village". Fodder buyers are milk vendors, whilst fodder sellers are those who do not own ruminants but cultivate groundnuts.
- A high proportion of poor households are fodder vendors in the "intensive-dairy village", whilst the buyers are in the medium- and poor-wealth categories.
- A majority of the milk vendors in the "intensive-dairy village" are from the medium-wealth category, followed by those from the poor and very poor categories.
- The rich are a minority amongst milk vendors as they have labor constraints in the management of their dairy enterprises.
- The poor in the "intensive-dairy village" prefer to own cows, as they can also be used for other purposes.

# Incidence and perceptions of farmers on pests and diseases and fodder quality

The perceptions of farmers on the incidence of important pests and diseases in groundnuts and their effects are summarized in Table 9.

**Table 9. Perceptions of farmers on important groundnut pests and diseases and their effects.**

Pest or disease	Perceived effects	
	"Low-dairy village"	"Intensive-dairy village"
Leaf spots	Reduced pod formation; loss of affected leaves; pod and fodder.	Less pod formation, pod filling, less oil content; leaves wilt and are lost; pod and fodder losses.
Stem rot	Pods remain in the soil; 3% pod loss every year.	Fungus destroys plant to ground level; pod and fodder losses every year.
Rust ( <i>aggi rogamu</i> )	Leaves turn red or red patches develop on the lower portion of the foliage, leaf loss; reduced fodder yield.	Leaves turn red or red patches develop on the lower portion of the foliage; leaf loss, main stem remains; serious fodder losses.
Leaf miner	Wilting and leaves turn black; occurs every year, but disappears if it rains; otherwise the entire field is affected; serious fodder loss.	Wilting takes place as insect sucks leaf sap; leaves turn black; occurs every year, but disappears if it rains; otherwise the entire field is affected; serious fodder losses.
Red hairy caterpillar	Insect eats the leaves; occurs occasionally; limited fodder loss.	Insect eats the leaves; occurs occasionally; 1-2% fodder loss.
White grub	Not reported.	Insect eats the whole plant; 25% crop loss (pods and fodder).

- Farmers' perceptions of good-quality groundnut fodder indicate their desire to produce fodder free of pest and disease damage.
- Farmers are aware of the fodder losses due to foliar pests and diseases, and fodder losses up to 50% were estimated.
- In both dairy villages, the damage caused by foliar pests and diseases is so extensive that the foliage is totally lost and only the main stem remains.
- Farmers in both dairy villages expressed similar concerns about the effects of pests and diseases on fodder yield and quality.
- Farmers fear heavy fodder losses if it rains around harvest time, as the crop residues drying in the field become black and are completely spoilt.
- Farmers perceive that JL 24 is the most vulnerable variety to pests and diseases. The variety Samrat is perceived as having good tolerance to rust, leaf spot, stem rot and leaf miner.

## Relevance and importance of foliar diseases in the different dairy villages

The criteria used by farmers for evaluating different groundnut varieties are presented in Table 10.

**Table 10. Criteria used by farmers for evaluating groundnut varieties.**

Criteria for varietal evaluation	"Low-dairy village"	"Intensive-dairy village"
Pod yield	1 <sup>1</sup>	
Less pests and diseases	4	2
Adapted to drought	2	5
Fodder yield	6	7
Fodder taste (good)	5	9
More leaves and strength to animals	8	3
More oil content	11	Not reported
Short duration	7	4
Superior-fodder quality	9	Not reported
Longer storage of fodder	10	6
Adapted to less fertile soils	Not reported	8
Needs less plowing	Not reported	9
More demand for seed	3	Not reported

1. Figures indicate the rank (1 = most preferred) for each criterion.

- The problem of pests and diseases gets second priority in the ranking of farmers after pod yield.
- Farmer concerns in the "low-dairy village" are focused on fodder yield, whereas, in the "intensive-dairy village", the emphasis is on fodder-quality related traits such as "more leaves" and "less pests and diseases". This is because "low-dairy village" has a higher cattle population and fewer alternatives for fodder compared to the "intensive-dairy village".
- JL 24 emerged as the preferred variety in spite of pest and disease susceptibility, as farmers think it has many desirable traits for pod and fodder production.

## **Perceptions of farmers on the effects of pests and diseases**

- Farmers do not use any control measures for pest and diseases, as groundnut is a low-input rainfed crop.
- Animals do not select fodder affected by foliar pests or diseases due to poor taste.
- Animals become sick and weak if fed with diseased fodder. Also, milk yields are less.
- Rain causes diseased crop residues to deteriorate faster.
- Local veterinarians have observed that the spraying of insecticides such as gamma-xene, while stacking fodder to increase storage capacity, harms animals if the fodder is fed directly.
- Groundnut residues are not available commercially, as there is no fodder market. Farmers substitute groundnut residues with paddy rice straw when there are fodder shortages due to crop damage.

## **Gender perceptions**

The perceptions of both men and women were obtained during the PRA exercise in the two dairy villages. The perceptions of women with regard to feeding practices, the importance of groundnut fodder, and the incidence and effects of pests and diseases on fodder quality broadly matched those of the men. There were no marked differences in their perceptions. However, the roles and responsibilities of men and women in fodder management, fodder sale, decision-making with regard to feeding strategies, and dairy activities need to be studied separately in order to target research more clearly and efficiently.

# **Research Implications and Conclusions**

## **Relative importance of sorghum/groundnut crop residues in feeding systems**

The overall picture from the results of the PRAs suggests that both sorghum and groundnut residues are considered to be a major animal-feed resource, and are fed over 7-12 months of the year. Moreover, both sorghum and groundnut residues provide 'feed security' for animals during the summer period, when few alternatives are available in rainfed areas.

## **Perceptions on the incidence of foliar pests and diseases**

Farmers view pest and disease problems together. They have difficulty in isolating the diseases, as the causative factors are not clear to them although they know the symptoms. This is more pronounced with sorghum, where farmers seemed to confuse the symptoms of pests and diseases.

Anthracnose and leaf blight are considered to be particularly important amongst the foliar diseases of sorghum, as they change the color of the foliage. Hence, the damage is more visible. In the view of farmers, this problem becomes serious only if the disease incidence is high. Then, the color of the crop residues becomes black or dark red, which might attract the attention of the traders. Generally, it is difficult for traders to distinguish diseased plants, or they might just overlook the effects. Differences are only noticed if the fodder is black or if there are too many hollow stalks. Traders treat such fodder as being of inferior quality and offer low price. A more focused study is required to understand the market implications of color and appearance of crop residues affected by foliar diseases, and the tolerable limits necessary for them to escape price differentiation.

Farmers are more concerned about stem borer attack, as it turns the stalks hollow. Animals do not like hollow stalks and, hence, this leads to wastage of fodder. Traders also treat hollow stalks as one of the negative quality traits for fixing prices.

The occurrence of leaf spot, rust, leaf miner and stem rot in groundnut affects the fodder yield as well as nutritive value. Hence, this is a major concern to farmers.



## **Impact of foliar diseases on the livelihoods of farmers**

Farmers expressed concern that diseased fodder affects the health of the animals and their nutritional status causing weakness, diarrhea, and reduced milk yields. Similarly, diseases are perceived to affect fodder quality causing a bitter taste, changes in color, and a bad odor. Thus, animals do not select diseased residues.

Farmers have a good understanding of the negative effects of pests and diseases both on the vegetative parts of the crop as well as on the pods and grain. The effects on the quality of crop residues are more seriously perceived in the groundnut crop, where farmers report losses in foliage and fodder yield of as much as 50%. In sorghum the perceived losses are 10-30%, but traders might offer a lower price for diseased fodder compared to healthy fodder. The price may vary from Rs. 20-100 bundle<sup>-1</sup> of fodder depending on the severity of disease occurrence.

Control measures are not applied by farmers even if they notice the presence of pests and diseases on both groundnut and sorghum since:

- Both crops are raised under rainfed conditions with minimal inputs. Any extra investment would be uneconomical in their view, as it is risky and impractical as the areas are large and the fields are scattered.
- Farmers are not aware of any inexpensive and effective control measures. For sorghum, they are unaware of techniques to spray chemicals on tall plants, and foliar diseases occur usually once every 2-3 years.

Although farmers admit that both losses of grain and fodder are equally important, their evaluation of varieties is dominated by their primary concerns about grain or pod yield. This is for the simple reason that sorghum provides them with food security and groundnut with livelihood security. At the same time, there is no conclusive evidence to suggest that farmers are concerned only if diseases that affect the vegetative parts also reduce grain/pod yield. For both groundnut and sorghum, farmers highlight the effects of diseases on vegetative parts even though they are not connected to grain losses.

Farmers use a limited number of varieties of both crops. For sorghum particularly, farmers do not have the opportunity to try out alternative disease-resistant varieties. Farmers are concerned about a host of factors including pod/grain yield, grain quality, fodder yield, plant height, long-storage capacity of fodder, leafiness,

good taste, pest and disease tolerance and animal preference, which need to be satisfied before a new variety is introduced. Hence, there is a heavy reliance on, and trust in local yellow varieties of sorghum and JL 24 for groundnut.

## **Rich versus poor**

An analysis of wealth categories shows that, for sorghum, more of the rich and medium-wealth groups are involved with the sale of milk in the "intensive-dairy village", whereas the opposite situation exists with regard to fodder sales. It is usually the poor that have less livestock and are more dependent on returns from fodder sales. On the other hand, for groundnut, in the "intensive-dairy village", it is the middle and poor categories that are involved with milk sales as well as the sale of groundnut fodder. However, the numbers of farmers involved with groundnut fodder sales are very small. Those involved with milk sales, in general, have more alternative sources of fodder.

The poor grow sorghum, to meet their food requirements, either on their own land or on land that is leased. The social mapping showed that the poor either have no ruminants or own fewer animals than the rich or medium-wealth categories. As a result, milk sales are the highest amongst the rich followed by the medium-wealth and poor categories. Ironically, it is the poor, therefore, who have to be more concerned about the quality of sorghum fodder, as they depend most on its sale as a source of income. Therefore, it is probably the poor that have the greatest stake in improving the quality of fodder, as it gives them a better market price and additional cash income. On the other hand, the rich and the medium-wealth categories would like to increase milk yields and maintain animal health with good-quality fodder.

In the case of groundnut, there are no market forces to judge the quality of fodder, as there is no commercial market. The sales and purchases usually occur within the village or in the surrounding villages, where local demand and supply factors might determine the price. Since the volume of transaction is small, it is not clear whether quality aspects determine the price paid for the fodder. On the other hand, fodder quality is important for the poor, as it constitutes the main source of feed for their cattle. As the poor and medium-wealth categories are involved with milk sales, a 50% loss in fodder yield combined with inferior quality cost them dearly. The poor are deprived of their livelihood when the health of the dairy cattle is affected, and milk yield is reduced.

An analysis of gender perceptions shows that, generally, those of men and women match. This is so regarding the importance of sorghum/groundnut fodder, preferential feeding, effects of pests and diseases on the quality of crop residues, and the criteria for varietal selections. There were slight differences with regard to feeding of dairy cattle and concern for grain-damaging pests and diseases. Women are more concerned about quality of grain in the case of sorghum, and admitted that men observe the occurrence of foliar pests and diseases more closely than themselves. Further research on the roles and responsibilities of men and women in crop-livestock systems may be necessary to understand the perceptions of women more clearly.

## **"Low-dairy village" versus "intensive-dairy village"**

In both systems, groundnut/sorghum residues constitute an important source of fodder, particularly in the summer season when few alternatives are available. In the "intensive-dairy village", there is comparatively less concern about quality of fodder in dual-purpose sorghum as farmers also grow varieties for green forage.

For groundnut, farmers in the "intensive-dairy village" are concerned about fodder as well as quality losses, because they depend on the crop residues for 12 months of the year. Although they cultivate improved grasses for green fodder, they believe that groundnut residues provide animals with a better feed that helps in producing higher milk yields.

The perceptions of farmers on the incidence of pests and diseases, the criteria for good-quality fodder and the tolerance of varieties to pests and diseases are similar in both dairy villages.

## **Linkages with the fodder markets**

The results clearly show that farmers do not grow sorghum exclusively to cater to the needs of the fodder markets. The supplies to the fodder markets are made up from the small proportions of fodder that are sold from individual villages. Furthermore, fodder sales take place usually after the requirements of the farmers for home consumption are fulfilled. The sales are usually made 3-4 months after harvest. Residual stocks are usually sold in July and August of the following year. Those who do not own ruminants usually sell fresh fodder stocks, and a majority of them belong to the poor-wealth category.

The PRAs in the groundnut-growing villages indicate that no formal fodder markets exist for crop residues. Most of the groundnut residues are usually consumed on site and there are practical difficulties in transporting the dry fodder. There is an urgent need, in this situation, to focus research on improving the fodder quality, as farmers report 50% fodder losses every year and the fodder plays an important role in the diet of dairy cattle.

The dairy activities are carried out on a small scale at an individual household level. The household activities are networked through a dairy cooperative at village level, that takes responsibility of milk collection and transportation to urban centers for chilling and further processing. The State Department of Animal Husbandry has assisted in the introduction of crossbred animals and on issues of animal health. Additionally, public enterprises such as the Andhra Pradesh Dairy Development Cooperative (APDDC) and private enterprises such as Heritage provide information and subsidies on inputs such as seeds of fodder crops and concentrates. Their extension activities should include fodder quality perceptions and its relationship with animal health.

## **Recommendations**

- Foliar diseases affect animal health and milk yield when affected crop residues are fed to ruminants. Research on cheaper management options is essential for pest and disease control, to improve the quality of crop residues in both sorghum and groundnut. Currently, farmers are reluctant to make any extra investment for the rainfed crop.
- The problem of foliar diseases cannot be viewed in isolation, as the concerns of farmers are more on the cumulative effects of foliar insect pests and diseases.
- Farmers consider stem borer damage important in sorghum, as hollow stalks are treated as an indicator of inferior quality that command a low price in the market. This problem has to be considered together with that of foliar diseases.
- Damage levels for anthracnose and leaf blight in sorghum residues, acceptable to fodder traders in the market, need to be identified. The effects of the color changes and the factors contributing to the change need further studies.

## **Wealth ranking (categorization)**

Categorization of wealth ranking was done immediately after social mapping. For a good understanding of the crop-livestock relationship, it was important to have information about different socio-economic categories of farmers that are involved with sorghum/groundnut fodder use, sale/purchase of fodder, milk sale, etc. This information provided insights about the relative importance of sorghum/groundnut fodder to different categories of farmers and helped select informants from different wealth groups for focus-group discussions and case studies.

Wealth ranking was done with the participation of a group of key informants consisting of men and women. Wealth ranking cards were prepared for all the households recorded in the social map. The name of the household with its serial number was written on each of these cards. The group was asked to identify criteria for classification of households into different wealth categories, and the cut off points between different wealth groups. Next, the group piled up the cards according to wealth categories. In three out of four cases, the groups classified the households into three categories — rich, medium and poor. In one village, a fourth category — very poor — was also added as the fourth pile. Ranking was not attempted within the household categories, as the team did not feel the need for it.

The wealth category of each of the household was subsequently recorded in the data sheet used for social map. The wealth ranking sheets, thus, were useful to collect information on the number of households under different wealth categories, and the cut off points between wealth groups.

## **Annual calendar of ruminant feeding practices**

Discussion with a focus group of men and women that owned livestock led to listing of all the sources of fodder available in the village. The group then drew an annual calendar that displayed the feeding pattern of ruminants during the year, and the fodders used. This helped to assess the relative importance of different fodders/feeds at different periods of the year, the feeding strategy and periods of scarcity. A total of 100 beans were used for scoring across the months (rows). Number of beans earmarked for each feed resource within a month showed the weightage in terms of amount of a particular fodder fed during each month. The group was also asked to explain animal preference and feeding strategies. Codes were used to differentiate the type of animals (all, milch animals only, draught animals only) if animal preference was shown for a particular feed.

## Focus-group discussion

Two types of group discussions were held in each village, one with a mixed group of men and women, and the other exclusively with either men or women. The farmers in the mixed group represented sorghum/groundnut cultivators and users of crop residues of these crops. Farmers with similar background participated in the second type of group discussion except that it was formed on the basis of gender.

The first mixed group discussion focused on:

- village profiles,
- sources of irrigation,
- soil types,
- crops grown,
- importance of sorghum/groundnut crop in the cropping system of the village,
- type and number of livestock reared,
- importance of groundnut/sorghum crop residues in crop-livestock system,
- share of groundnut/sorghum crop residues in the feed of large and small ruminants,
- total milk sale in the village,
- infrastructure and subsidies for milk collection and sale,
- storage practices of fodder,
- fodder sales,
- linkages with fodder markets, and
- fodder scarcity periods and crisis management in case of severe scarcity of fodder.

The second set of group discussions, separately with men and women, focused on identification and incidence of important pests and diseases of groundnut/sorghum crop with their symptoms. Farmers' perceptions were obtained regarding the effects of these pests and diseases on grain yield, fodder yield and the quality of crop residues. Farmers' views about qualities of good fodder were obtained. Farmers' perceptions on the effects of diseases on the nutritive value of fodder were discussed and recorded. The measures taken, if any, to control the pests and diseases, and the reasons for not undertaking any control measures were

discussed. Later, frequency of occurrence and the historical background of occurrence of these pests and diseases were tracked from the village time line drawn by the farmers.

Farmers preferred to discuss about the pests and diseases together and highlighted all those pests and diseases that would cause visible damage to either the grain or other plant parts. An analysis of their perceptions helped to gauge their implicit priorities and concerns about grain and crop residues. A matrix drawn after group discussion led to an evaluation of sorghum/groundnut varieties against a set of traits chosen by farmers. A ranking of these traits indicated the priorities of farmers for grain and fodder.

### **Matrix scoring of groundnut/sorghum varieties**

A mixed group of farmers discussed the desirable traits (used as criteria) of groundnut/sorghum varieties that they would prefer to grow. These traits were listed and then ranked in the order of their preference. Subsequently, the farmers named the varieties used by them. In case of groundnut, the proportion of area allotted for each of these varieties was also listed. A variety matrix was drawn and the named varieties were scored by farmers against each of their criteria (traits). Scoring was done using 100 beans and helped to compare the performance of each variety against the criteria listed.

This matrix was drawn in three out of four villages where PRAs were undertaken. In one village (Siddayapalli), farmers were reluctant to draw a matrix, as they believed that only the local yellow sorghum variety they grow satisfied their requirements. Only male farmers drew the matrix in two out of three villages while both men and women together drew it in the third village (Machinenipalli).

### **Matrix scoring of varieties for pest and diseases occurrence**

Farmers expressed keen interest to discuss the performance of groundnut/sorghum varieties against occurrence and tolerance of pests and diseases. They drew a matrix with a list of pests and diseases they consider as important on one axis and varieties on the second axis. The performance of each variety was compared by scoring the severity of each pest and disease that occurs in their field.

While male farmers drew the matrix in three villages, women did it in one village (Tettu). Women preferred to discuss this topic in focus-group discussions in the

three villages where men drew the matrix, and vice versa in the village where women showed enthusiasm to draw the matrix.

## **Village time line**

A time line describing the significant changes of pest and disease occurrence in groundnut/sorghum crop was drawn by a group of older community members. It helped to gain insights into village history; history of groundnut/sorghum cultivation; occurrence of pests and diseases in groundnut and sorghum in the last 20-30 years; and frequency of occurrence, role of climatic factors and impact of pests and diseases on fodder scarcity.

## **Case studies**

Individual households were identified from different wealth groups and interviews conducted with men and women in a prescribed manner. Households involved in milk sale, fodder sale and those growing fodder crops were selected for this purpose. The information collected included: land and livestock operations, number of livestock owned, grain and fodder yield from sorghum/groundnut crops, estimate of quantity of sorghum/groundnut fodder required for each ruminant, feeding strategy, quantity of milk sale, price of milk, method of milk sale, method of fodder sale, effect of pests and diseases on fodder sale, and type and varieties of fodder crops grown. The information obtained from case studies was compared with the information collected from focus-group discussions.

## **The PRA team**

An experienced PRA practitioner and a trained associate constituted the core of the team. One sorghum pathologist from a national program (National Research Center for Sorghum) assisted the team in one village while a groundnut pathologist from ICRISAT joined the team for one PRA exercise in groundnut field work. Two local veterinary officers of Department of Animal Husbandry of Andhra Pradesh (one each for sorghum and groundnut) and two trained persons from APDDC (for sorghum study in one village) supported them in the field work. The officers were trained in PRA techniques. In addition, one trained person from a local NGO (RRS) in Madanapalli division also participated in the field work for groundnut.





# About ICRISAT

The semi-arid tropics (SAT) encompasses parts of 48 developing countries including most of India, parts of southeast Asia, a swathe across sub-Saharan Africa, much of southern and eastern Africa, and parts of Latin America. Many of these countries are among the poorest in the world. Approximately one-sixth of the world's population lives in the SAT, which is typified by unpredictable weather, limited and erratic rainfall, and nutrient-poor soils.

ICRISAT's mandate crops are sorghum, pearl millet, finger millet, chickpea, pigeonpea, and groundnut; these six crops are vital to life for the ever-increasing populations of the SAT. ICRISAT's mission is to conduct research which can lead to enhanced sustainable production of these crops and to improved management of the limited natural resources of the SAT. ICRISAT communicates information on technologies as they are developed through workshops, networks, training, library services, and publishing.

ICRISAT was established in 1972. It is one of 16 nonprofit, research and training centers funded through the Consultative Group on International Agricultural Research (CGIAR). The CGIAR is an informal association of approximately 50 public and private sector donors; it is co-sponsored by the Food and Agriculture Organization of the United Nations (FAO), the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP), and the World Bank.

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**ICRISAT**

**International Crops Research Institute for the Semi-Arid Tropics  
Patancheru 502 324, Andhra Pradesh, India**