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Effect of participatory dissemination of fodder innovations in mango orchards of livestock farmers on fodder availability

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Abstract
Non-competitive land use was followed by introducing perennial fodder crops in inter-row spaces of mango orchards of 50 growers between 2013-14 to 2016-17. Dharwad and Belgaum districts of north Karnataka were selected based on maximum area under mango. As a part of the study, 179 mango growers were trained in cultivation aspect of fodder crops and were advised to select fodder crops based on their resource base. However, 50 mango growers who came forward to cultivate constituted sample for the study. These growers were assisted by giving seeds and planting materials for cultivation in their mango orchard. Data from these 50 mango growers were collected by using standardised interview schedule and analysed. Shortage of green fodder (33.18±3.18%) and dry fodder (37.02±2.92%) was experienced by mango growers before participating in the project. Bajra napier hybrid, guinea, perennial fodder sorghum were the grasses selected and grown either as sole crop or in combination. Legumes (*Stylosanthes hamata*, fodder cowpea, *Clitoria ternatea* and lucerne) in combination with grasses were cultivated by less number of farmers. Benefits of fodder crops interventions in mango orchards as observed by farmers decreasing feed cost (46.94%), increase in milk yield (0.93 litre/ animal) and improvement in livestock health. These crops helped them to save 0.91 mandays and distance of 1.42 km in lean period to collect fodder. Area under mango orchard, mass media participation and number of mango trees exhibited positive and significant relationship at 1% level and total land holding at 5% level of significance with mango area allotted by growers for fodder cultivation. The mean fodder deficiency experienced was 50.6 % before and it was decreased to 9% after the interventions of fodder crops in mango orchard indicating the improvement in fodder availability among participating farmers.

Keywords: Fodder crops, Fodder deficiency, Livestock health, Mango orchard

Introduction

Majority farmers in India rear large ruminants mainly for milk production and draft power. Fodder need for livestock has increased as many farmers shifted to rear from local to crossbred animals. Along with this, shrinking of community grazing lands and reduced availability of crop residue by cultivation of dwarf hybrids and varieties has increased the demand for fodder. Small land holdings of farmers are utilised mainly for cultivation of commercial and food crops. Fodder' is though required but farmers are unable to spare land for cultivation of fodder crops. So Livestock rearing remains by and large at subsistence level (Biradar *et al*., 2013).

Non-competitive land use for fodder production is inevitable to meet fodder deficiency situation in the country. Field bunds, pond embankments, back yards, either side of water ways, in between tree-rows in orchards and plantations etc are some of the niches where fodder crops can be introduced. Among these niches orchards and plantations provide good scope. Mango, coconut, sapota, guava, cashew etc are widely cultivated fruit crops in southern India.

The total area under mango crop in Karnataka is estimated to be 160,000 ha of which 90,000 ha is under prime fruit yielding area. Mango is one of the most popular fruit crops increasingly being grown by many farmers of Karnataka. In the year 2011-12 alone the area under mango crop has gone up by 10000 ha. The usual planting distance followed by majority farmers for mango is 10 m by 10 m. Though close spacing is now a day's being recommended, majority farmers are not taking it up readily as they find it difficult to take up intercultural operations. Intercropping is taken up till the mango trees attain suitable height and develop canopy (at 5-6 years of age). Farmers cultivate small millets, cotton and legumes till the crop becomes 5 to 6 years old. Later, the inter space is left fallow which provides niche to introduce fodder crops. Many fodder crops can provide best cover to the

ground, suppress weeds, grow in shades helping farmers not only to get fodder but also to add nutrients to the soil and retain moisture for long. Introduction of such fodder crops between tree rows for better utilization of interspaces thus helps farmers in multiple ways. So a study was conducted to assess the benefits accrued to farmers by introducing fodder innovations in mango orchards (2013-14 to 2015-16) and to know effect of growing fodder crops on fodder availability to livestock f farmers.

Materials and Methods

Study area and roadmap: The study was conducted in Dharwad and Belgaum districts of Karnataka, based on maximum area under mango in northern part of the state. First year of the study (2013-14) focused on finalising the research process, so only 5 mango growers were identified through participatory research. Discussions with five non-government organisations (NGOs) working on livestock development, and experiences gained by working with 5 farmers were used to develop a roadmap.

Training and participatory selection: Capacity building of mango growers on fodder crops emerged as the first step. So at the beginning of the second year (2014), 189 mango growers (identified by 5 NGOs) were trained in 7 batches at Dharwad regional research station of ICAR-Indian Grassland and Fodder Research Institute by exposing them to different fodder crops and their cultivation aspects. Individual preferences for different fodder crops by the participants were elicited at the end of each training program.

Sampling, data collection and analysis: The project targeted 25 acres of mango orchard in its second year (2014-15). The first 25 trained mango growers who approached at the beginning of the monsoon formed the sample study group. Third year project targeted 20 acres of mango orchards. Twenty mango growers again on first cum first basis formed the sample for the study in 3rd year. Planting materials of fodder crops selected by them during the training program were given mainly in monsoon, along with printed instructions of cropping practices. Regular visits were made to the fields of these mango growers to ensure that proper cultivation practices and harvest schedule were followed. Interested farmers were encouraged to take up seed production of grasses/legumes. Interview schedule was developed and standardised by consulting experts for collecting data on various parameters from all the 50 participating farmers at the end of third year. Data were collected through personal interview technique. Collected data were subjected to statistical analysis using mean, standard error and correlation coefficients.

Results and Discussion

Basic characteristics of participating mango growers: Average land holding size of participating mango growers was 11.97±2.52 acres. Average age was 43.40±2.05 years, average education was 9.10±0.80 years, average family education status was 6.00±0.44 years and mean herd size was 6.00±0.44 Adult Cattle Units (ACUs). Shortage of green fodder (33.18±3.18%) and dry fodder (37.02±2.92%) was experienced by mango growers before participating in the project. Only 8% of them had experience of cultivation of fodder crops before participating in the project (Table 1).

Table 1. Basic characteristics of participating mango growers (n=50)

Parameters	Mean	Range
Land holding (ac)	11.97±2.52	0.5-122.00
Age (yr)	43.40±2.05	20.00-80.00
Education (yr)	9.10±0.80	0.00-18.00
Family education status (yr)	6.00±0.44	2.00-19.00
Herd size (ACUs)	6.03±0.79	1.11-39.34
In milk animals (No.)	2.10±0.34	0.00-11.00
Green fodder shortage (%) n=33	33.18±3.18	0.00-80.00
Dry fodder shortage (%) n=42	37.02±2.92	0.00-80.00
Cultivation of fodder crops before	4 (8%)	

Basic parameters of mango orchard: Average area under mango orchard per farmer was 4.13±0.69 acres, average number of trees were 213.18±47.12 with the average tree age of 14.55±1.13 years. Nearly half of the respondents' had mango orchard in a land with gentle slope and 14 per cent had it in steep slope. Red soil was found in mango orchard of 86% respondents. Distance followed for planting mango trees varied among respondents, however, nearly half (44%) planted at 30'X30' distance. Similarly half of them had irrigated orchard (Table 2).

Fodder crops selected and cultivated by participating mango growers: Two perennial grasses (bajra napier hybrid-HN, guinea-G) were cultivated by 28% farmers, only one grass (HN) and three grasses (HN, G and Perennial fodder sorghum-PS) intercropped with fodder cowpea (CP) were cultivated by 14% each farmers. Six

Table 2. Basic parameters of mango orchard

Particulars	Mean	Range
Area under mango (ac)	4.13±0.69	0.50-25.00
Number of mango trees	213.18±47.12	22.00-2080.00
Age of mango trees (years)	14.55±1.13	1-40
	No	**%**
Slope		
Plain	19	38
Gentle	24	48
Steep	7	14
Soil type		
Red	43	86
Black	2	4
Loamy	5	10
Distance		
20' X 20'	3	6
25' X 25'	7	14
30' X 25'	2	4
30' X 30'	22	44
33' X 33'	2	4
35' X 35'	5	10
40' X 40'	8	16
50' X 50'	1	2
Recommended	33'X33'	
Type of land		
Irrigated	26	52
Rainfed	24	48

percent each farmers cultivated HN+PS, HN+CP, HN + G+PS. Four percent each cultivated HN + G + PS + Clitoria (Cl), PS alone and HN+G+Cl. Two percent each cultivated HN+G+PS+CP+Stylo (St), HN+PS+CP, PS+CP, HN+Cl, G only and HN+G+Lucerne (Fig 1). This indicated very good distribution of crop combinations in the fields of participating farmers. This distribution could be attributed to differential availability of various resources with the farmers, herd size possessed by them and fodder requirement of their livestock. Rajanikanth (2013) in his study conducted in north Karnataka on spread of perennial fodder crop technologies reported that one third respondents (33.33%) cultivated HN, 13.33%t cultivated only Rhodes, 18% cultivated HN+Rhodes, 24% HN+PS and 11.33% cultivated Rhodes+PS. However, use of legumes like cowpea enhances quality of fodder as they are rich in crude protein and antioxidants (Harveen *et al*., 2018).

Benefits of cultivating fodder crops in mango orchards as observed by participating mango growers: Cultivation of fodder crops in mango orchards resulted in many benefits to farmers. These benefits were categorised into three- benefits of fodder crops interventions on livestock rearing, on mango orchard per se and on farmers. Details regarding benefits accrued by participating mango growers were given in Table 3. On livestock rearing, cent percent of mango growers expressed that these crops helped them to decrease feed cost and improve livestock health. The decrease in feed cost was to the extent of 46.94%, increase in milk yield was 0.93 litre/ animal. An average increase in milk yield of 1.5 to 2 litres by feeding multicut fodder crops (HN and PS) was also observed by OFT (on farm trial) farmers of Ramanagar district of Karnataka (Kamala Bai *et al*., 2017). Decreased ratios of forage to concentrates resulted in increased milk yield and body weight gain of the cows and a tendency to higher milk protein content, but lowered milk fat content. Feed conversion was not different between ratios but feed cost per kg milk produced was lowest for cows given 70% forage (Sanh *et al*., 2002). In Netherlands research findings by Elgersma *et al.* (2006) showed that for every 10% increase in grazed grass in dairy cow ration, milk production costs reduced by 2.50 cents.

Table 3. Benefits due to fodder crops interventions in mango orchard (n=50)

Particulars	No/particulars	%
Livestock rearing		
Decrease in feed cost	50	100
Improvement in livestock health	50	100
Extent of feed cost decrease (%)	46.94	
Average increase in milk yield (Litres)	0.93	
Average distance saved in lean period (km)	1.42	
Average Labour saved (mandays)	0.91	
Mango orchard		
Orchard temp reduced	50	100
Weed intensity reduced	46	92
Soil erosion reduced	41	82
Water penetration improved	43	86
Reduced pest occurrence	39	78
Reduced disease occurrence	23	46
Farmers		
Improvement in knowledge level	25	100
Access to information	25	100
Access to seed/ propagation material	25	100
Improvement in family nourishment	42	84

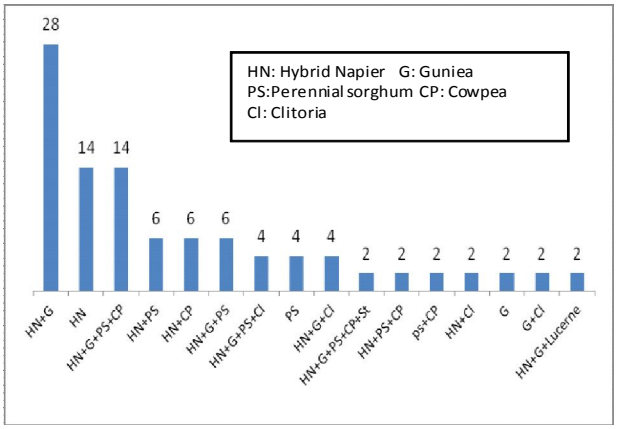

Fig 1. Fodder crops cultivated by mango growers

Cultivation of fodder crops in inter-row spaces of mango orchard helped them to save 0.91 mandays and distance of 1.42 km in lean period to collect fodder. On mango orchard, growers expressed 6 benefits. They were reduced orchard temperature (100%), reduced weed intensity (92%), reduced soil erosion (82%), improved water penetration (86%), reduced pest occurrence (78%) and reduced disease occurrence (46%). Sharma (2004) in his study found no significant adverse effect of tree and pasture on each other in the long run. Besides horti pasture system check land degradation. All the participating mango growers expressed that it helped them to improve their knowledge on fodder crops, helped to have better access for information sources and planting/propagation material and helped to improve family nourishment (84%). Islam *et al.* (2017) in their study reported that cent per cent farmers of the study areas opined that cattle rearing increased dramatically due to fodder production. As green grasses are more conducive to milk production, it has a great demand to the dairy cattle farmers. Almost all the farmers gave positive consent in case of more milk production, increasing family income, more milk consumption by the family members and development cost increased (such as education, health, sanitation, housing, clothing and nutrition etc.) due to increased family income in household (Islam *et al.,* 2017).

Correlation coefficient between mango area allotted for fodder production and selected independent variables: The relationship between mango area allotted for fodder cultivation by these farmers and with other variables was ascertained by subjecting data to the Pearson correlation coefficients. Results presented in Table 4 revealed that area under mango orchard, mass media participation and number of mango trees exhibited positive and significant relationship at 1% level and total land holding at 5% level of significance. Other variables did not show any relationship. Pushpa *et al.* (2017) found that the variables land holding, herd size, milk volume, income from agriculture and income from livestock showed positive and significant relationship with fodder management. Mulwale *et al.* (2014) reported significant

relationship between acreage allocated for fodder production and farm size in their study conducted at Homa Bay and Ndhiwa districts of Kenya. The significance in acreage allocated for fodder production could be explained by the fact that fodder availability, sufficiency and good management determined daily milk yield.

Table 4. Correlation coefficient between mango area allotted for fodder production and selected independent variables

Variables	Correlation coefficient
Type of farmer (X1)	0.26
Education (X2)	0.14
Area under mango orchard (X3)	0.31**
Total land holding (X4)	0.27*
Herd size (X5)	0.16
Shortage of dry fodder (X6)	-0.02
Shortage of green fodder (X7)	-0.06
Orchard topography (X8)	-0.06
Age of mango trees (X9)	0.16
Distance between mango trees (X10)	0.09
Mass media participation (X11)	0.38**
Extension participation (X12)	0.03
Economic motivation (X13)	-0.08
Scientific orientation (X14)	-0.17
Farming commitment (X15)	0.06
Soil type in mango orchard (X16)	-0.14
Family type (X17)	-0.18
Family size (X18)	-0.01
Family education (X19)	0.22
Livestock in milk (X20)	0.15
No. of mango trees (X21)	0.74**

*(P<0.05); **(P<0.01)

Effect on fodder shortage experienced by mango growers before and after intervention of fodder crops: Data on overall fodder deficiency experienced by participating farmers before and after the project interventions were collected (Table 5). Only 14% of respondents mentioned that they did not face fodder deficiency before taking up cultivation of fodder crops but more than half of them (52%) expressed that after they cultivated fodder crops, the fodder shortage was nil. The mean fodder deficiency experienced was 50.6% before and it was decreased to 9% after the interventions of fodder crops in mango orchard. So this indicated that the fodder availability among participating farmers improved considerably. Ahmad *et al.* (2018) concluded from their study that grass/legume intercropping not only augments forage availability but also it is an effective strategy for proper orchard floor management, thus enhancing system productivity as a whole. Yadav *et al.* (2015) in their study on forage production in peach based hortipastoral system in Indian Himalaya reported that winter grass, grassland manava (*Festuca jatia*) produced significantly higher mean green forage yield (284.1 q/ha) followed by perennial rye under peach tree.

Table 5. Fodder shortage experienced by the mango growers before and after intervention of fodder crops

Extent of fodder deficiency (%)	Respondents (%)	
	Before	After
0%	14	52
10%	0	18
20%	8	14
30%	10	12
40%	8	4
50%	12	0
60%	6	0
70% & above	42	0
Mean	50.6±4.39	9±1.64
Range	0-85	0-40

Conclusion

Cultivation of fodder crops in inter-row spaces of mango orchard in the present study proved that besides reducing weed intensity it also favoured other attributes like temperature reduction and conservation of soil and water. Utilisation of inter-row spaces otherwise left fallow considerably reduced animal husbandry cost besides bringing other spillover benefits on farm family. Addressing fodder shortage effectively due to non-availability of land for fodder cultivation is always enigmatic even at the level of policy makers. However, fodder shortage could be effectively addressed as demonstrated by this study by utilising non-competitive land for fodder production.

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