Strategies for livestock development in rainfed agro-ecosystem of India

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Abstract

Livestock plays an important role in the sustainable livelihood of poor people of rain-fed agro-ecosystem, because of inherent risk involved in the crop farming due to uncertainty of rainfall and occurrence of recurrent droughts. They provide income and increased economic stability, and often the most important "cash crops" in small-scale mixed farming systems. Small stock acts as cash buffer and large ruminants as a capital reserve. The objectives of the present investigation were to characterize the traditional livestock production systems, identify major constraints and suggest livestock production strategies based on participatory action research. *Salaha Samithi* (farmer advisory committee) facilitated implementation and monitoring of various interventions, mostly in the form of observation trials-cum-demonstrations.

Inadequate availability and poor quality of feed and fodder; high incidence of diseases; and inadequate knowledge on appropriate management of livestock were identified as the major problems facing smallholder farmers. To enable the rain-fed farmers for livestock development, a favorable policy environment in terms of access to micro-credit, assured market and veterinary services will have to be provided and socio-economic and technical constraints needs to be addressed. The study suggested that the participation of farmers is essential for developing and promoting the livestock interventions. Animal health camps created awareness among farmers regarding the adoption of better livestock practices like supplementation of mineral mixture in the concentrate ration and hopping of crop-residues.

Through exposure visits and farmer-to-farmer interaction, many farmers realized that integration of livestock and fodder production within their limited land and water resources provides a better livelihood option in dry lands.

Key words: Livestock development, livelihood, rain-fed agro-ecosystem, India

Introduction

Rain-fed agro-ecosystem has a distinct place in Indian Agriculture, occupying 67 % of the cultivated area, contributing 44% of the food grains and supporting 40% of the human and 65% of the livestock population (Singh et al 2004). Livestock plays an important role in the economy of India in general and sustainable livelihood of poor people of rain-fed agro-ecosystem in particular, because of inherent risk involved in the crop farming due to uncertainty of rainfall and occurrence of recurrent droughts (Misra 2005). They are raised mainly for meat, milk and skin, and providing a flexible financial reserve (social security) in bad crop years for the rural population (Puskur et al 2004; Rangnekar 2006). In India, income from livestock production accounts for 15-40 % of total farm household earnings (World Bank 1999). Milk production contributes on an average 27 percent of the household income; its contribution varies from about 19 percent in the case of large farmers to about 53 percent in the landless category in India (Shukla and Brahmankar 1999). Apart from the monetary benefits provided by milch animals, the role of small ruminants like goats and sheep is very important, as they serve as a lifeline during drought years by providing income and sustenance. The small ruminants contribute 15 to 27 % of family income of smallholders and provide gainful employment of 180 to 330 man-days per annum depending on the size of the flock (Misra et al 2000). It has also been shown that irrespective of flock size, women and children contribute to labour force to the extent of about 90 % (Deoghare 1997). Thus, llivestock provide income and increased economic stability, and often the most important "cash crops" in small-scale mixed farming systems. Small stock acts as cash buffer and large ruminants as a capital reserve. These assets can be realized at any time, adding security to the production systems.

In India, about 75 % of rural households are small and marginal farmers, who own 56 % of the large ruminants and 62 % of the small ruminants (World Bank 1999). In most of the drylands and hill regions, livestock farming is a major player, as more than 70 % of family income is derived from livestock (GOI 2002). The Government of India has recognized the livestock development as an important tool for poverty alleviation. However, most of the technical service oriented livestock projects have had little impact on livelihood of the poor (Ashley et al 1999) and adoption of technology by the resource poor has been low (Francis and Sibanda 2001; Parthasarthy Rao et al 2005). The two major reasons indicated for this failure are lack of poverty focus and institutional framework being incompatible with the systems and conditions in which poor farmers stay. The institutions implementing the projects are probably unable to select appropriate interventions and approaches to reach poor farmers in an effective manner (Ashley et al 1999; Rangnekar 2006). In order to solve

these problem, approaches that guarantee effective linkages among researchers, NGOs, extension workers, decision-makers and farmers, are required (Misra et al 1997; Conner et al 1998) and some researchers now believe that "participatory approaches are mandatory" for the development of livestock technologies particularly forage production (Peters et al 2001). Therefore, the challenge is to develop novel mechanism involving all stakeholders (researchers, extension workers, NGOs and farmers) to provide a better environment to enable that developed technologies are appropriate to livestock producer's need and circumstances, and hence increase the likelihood of adoption (Conroy et al 2002; Reddy et al 2005).

The present study was undertaken under DFID-NRSP project entitled "Enabling rural poor for better livelihoods through improved natural resource management in SAT India". The objectives of the study were to: 1) characterize the traditional livestock production systems, 2) identify major constraints for improved livestock production, and 3) suggest livestock production strategies based on participatory action research for sustainable development of rain-fed agro-ecosystems.

Materials and methods

The study area

The present study was conducted in a cluster of villages each in Mahabubnagar and Anantapur districts of Andhra Pradesh and in Tumkur district of Karnataka. The locations were chosen to represent the natural resource base available to rural communities in semi-arid regions in southern India. The three districts have contrasting characteristics in terms of climate and rainfall viz. semi arid in Mahaboobnagar and Tumkur and arid in Anantapur; soils range from very shallow-to-shallow mostly alfisols in all the three clusters. Anantpur, the largest district of Andhra Pradesh, is a hot arid zone and falls under rain shadow region with a mean annual rainfall of 520 mm. The soils are red sandy loams with patches of black cotton soils in certain areas. Mhabubnagar is another chronically drought prone district of Andhra Pradesh with light textured soils and a mean annual rainfall of 600 mm. Crop failures are common in both the districts due to scanty rainfall and peoples' dependence on livestock is high. Tumkur district is a part of the central dry zone of Karanataka and has bimodal rainfall distribution (650 mm). Soils are mostly loam with high slopes and high erosion rates. The demographic characteristics of the household, land use pattern, major crops grown and livestock species reared in the selected cluster are given in Table 1.

Table 1. Demographic characteristics of the household, land use pattern, major crops grown and livestock species

reared in the selected cluster

Particulars/cluster	Anantapur	Mahabubnagar	Tumkur
Demographic characteristics			
Total households, Nos.	530	1517	235
SC/ST household, %	50	35	26
Landless households, %	15	12	9
Rich households, %	9	15	11
Middle households, %	39	29	55
Poor households, %	52	56	34
Average land, ha	3.47	3.42	3.55
Irrigate land, %	23	27	29
Dryland, %	77	73	71
Land use pattern			
Total Geographical area of the cluster, ha	2111	15617	711
Forest area, ha	427	4833	67
Fallows/wasteland, ha	227	3143	123
Net cultivated area, ha	1431	3970	521
Major crops grown	Groundnut, paddy pigeon pea, sorghum, castor, cow pea, other pulses- horse gram, red gram and sunflower	Castor, sorghum, maize, paddy, groundnut, pigeon pea, and finger millet, chick pea	Finger millet, sorghum, pulses, groundnut, castor, sesame, niger, paddy, and red gram, horse gram
Major livestock species	Buffaloes, small ruminants, backyard poultry	Local buffaloes and cows, sheep and goats, backyard poultry	Crossbred cattle and local buffaloes, goats, sheep

Research approach adopted

The study was conducted in collaboration with BAIF Institute of Rural Development-K, Tipture, a reputed NGO, Acharya N.G. Ranga Agriculture University, Hyderabad,

University of Agricultural Sciences, Bangalore, and International Crop Research Institute for Semi Arid Tropics, Hyderabad. The project introduced a participatory approach to promoting livestock technologies with small-holder farmers in selected clusters. The approach takes advantage of indigenous knowledge and the capacity of farmers to experiment and solve their own livestock production problems. It uses many of the principles of Participatory Rural Appraisal, but extends the active participation of farmers well beyond the initial stage of appraisal to technology development and evaluation on farms. The approach begins with in-depth participatory diagnosis by a broad cross section of the farming community, including both men and women and farmers from the different wealth groups. This helps the community to define, group and prioritize their main problems. After identifying the major problems, various interventions, mostly in the form of observation trials-cum-demonstrations, were planned and discussed in *Salaha Samithi* (farmer advisory committee) meetings.

The *SalahaSamithi,* an advisory group of villagers promoted by the NRSP-DFID project, in which existing community based organizations (Panchayat Raj Institution and Self help groups) along with the women, and weaker section (Schedule caste and schedule tribes) of the society are represented, who are voluntary willing to work for the common good of the villagers and are acceptable to the community as a whole. Several interventions were brought to the doorsteps of farmers in the form of a 'basket' of technologies' in order for the farmers to select those interventions they felt could assist them in improving the productivity with available resources. Then, a comprehensive schedule for implementing the technical interventions was discussed and finalised in the *Salaha Samithi* meetings. An 'open door policy' was adopted for the implementation of interventions, implying that all interested farmers in the community were free to participate in them. *SalahaSamithi* facilitated implementation and monitoring of interventions. Volunteer farmers served as advisory persons. The evaluation process is monitored and assessed by the *Salaha Samithi* members and necessary changes made to any technology that is being developed or adapted. The core principle of the process is active, decision-making involvement of farmers at all stages of technology development with technical input and facilitation by project staff.

Results and discussion

Livestock resources

The livestock population in term of adult cattle unit was highest in Ananatpur and lowest in Tumkur cluster. There were striking differences in terms of composition of animal population across the clusters (Table 2).

Table 2. Livestock resources (number) in the selected clusters

Particulars/cluster	Anantapur	Mahabubnagar	Tumkur
Cows	730	310	550
Buffaloes	402	500	25
Bullocks	450	270	210
Sheep	2590	1850	80
Goat	620	1850	85
Poultry	1650	5700	65
Large ruminant/household	2.98	0.71	3.34
Small ruminant/household	6.06	2.44	0.70
Poultry/ household	3.11	3.76	0.28
Adult cattle unit*	2224	1820	818
Adult cattle unit /ha	1.05	0.12	1.15
Large ruminant /ha	0.75	0.07	1.10
Small ruminant /ha	1.52	0.24	0.23

**1 adult cattle unit: one cow/buffalo/bullock or 0.2 sheep/goat and 0.6 heifers/young ones*

The population of small ruminants (sheep and goats)/household was highest in Anantapur followed by Mahabubnagar cluster whereas large ruminant dominated Tumkur cluster. Buffalo was a main source of milk production in the Ananthpur and Mahbubnagar cluster, while crossbred cattle in Tumkur cluster. Majority of the households reared non-descript local breed of buffaloes, where as in Tumkur cluster farmer had more number of crossbred cows. Backyard poultry were made up entirely of *desi* fowl. Average holding size of poultry varies from 0.28 to 3.76 birds/household.

Farmers keep mixed species of animals depending on availability of crop residues and family labour. Small and marginal farmers generally keep sheep and goats; whereas medium and big farmers keep large ruminants. The main purpose for rearing livestock was to "earn income and provide economic stability to the farming systems". Keeping livestock was treated as a means of security and some times of status, whereas few

farmers having good access to market maintain graded buffaloes and crossbred animals primarily for production of milk. Small ruminants have been primarily kept as mobile asset, which can be realized in need in any place and at any time of the year. Several studies have indicated that livestock not only generate income and employment but also stabilize family income and meet equity considerations (Pasha 2000; Sharma 2004; Misra et al 2006 and Rangnekar 2006).

Characterization of traditional livestock production systems

The traditional livestock production systems were complex and based on tradition and socio-economic considerations and mainly guided by available feed resources (Misra 2006). In the study area, livestock and food production systems are closely integrated and can be described as low input system. Low technology uptake, insufficient market facilities and infrastructure and small-scale economies were common features of traditional livestock production practiced by the small, marginal and landless livestock keepers in all the clusters. However, these traditional production systems were designed to be self-sufficient at the household level and were dependant on the low-cost agro-by-products as nutritional input to animals for producing quality food of high biological value. Crops provide feed and fodder to the animals, while in return dairy animals provide milk as a source of nutrition and cash income, supply draught power and manure for crop production.

A close link exists between livestock and common property resources (CPRs), with the relative importance varying depending on the cropping intensity, proximity to common lands for fodder and access to market. Poor livestock keepers depend heavily on common property resources-village pasture, forests, tanks, etc. for feeding and watering. Grazing in common forests and pastures was estimated to account for 31% of livestock feed consumption in India (World Bank 1999). Farmers' fallow fields become another major grazing resource after harvesting of crops (Misra 2006). Animals of the poor depend completely on CPR during the monsoon season (6 months). The grazing hours in the study area varies from 4.7 hour in Tumkur to 6.1 hour in Ananatpur. Majority of farmers in the study area sent their animals for open grazing in CPRs. A study conducted in Andhra Pradesh (ISPA 1997) found that about 90 percent of householdsdepends on open grazing on common lands for an average supply of 35 percent of the total forage. This complex inter-relationship between CPRs, livestock and crops in rain-fed farming systems has contributed to the sustainability of rain-fed agriculture for generations. However, this relationship is now under increasing pressure from different sources (Misra 2006). Traditional grazing lands are being encroached upon or under faulty land distribution system. In AP grazing lands are getting distributed to the landless. The inedible weeds

like *Parthenium* and *Lantena* have replaced the traditional nutritional species in the grazing lands.

Farmers tend to ration their home grown crop residues for optimum use: large ruminants receive priority for crop residues and milking animals in addition receive some amount of supplementary feeding - home-made concentrate prepared mostly on local grain residues such as rice bran, broken grains and oil cakes.. Salt and mineral mixtures were occasionally provided to animals. Compound cattle feed was only available in Tumkur cluster through cooperative milk societies and restricted to its members only. The average amount of concentrate fed to the lactating animals varies from 0.5 to 2.9 kg/animal/day. There was very little cultivation of fodder crops in the selected cluster on account of water scarcity even though farmers were aware of the importance of feeding green fodder and also the existing high yielding fodder varieties. The important major fodder crops grown in the study area were maize, sorghum, hybrid napier and guinea grass. The characteristics of various kinds of production systems are given below:

Large ruminants

Predominantly local buffalo and cattle were largely kept for production of milk for direct consumption and occasional sales in rural areas. The animals were maintained mostly on open grazing and locally available feed resource. Only few farmers maintained graded or purebred Murrah buffalo and occasionally crossed of Jersey/Holstein Friesian. Milk production in the selected clusters was a low-input, low-output farm activity with a smallholder production system. The average milk productivity per year per cow was about 1,120 kg. In general, buffaloes have higher yields than indigenous cows, but crossbred cows are more productive than either indigenous cows or buffaloes. The average productivity of local cows was 3.08 kg/day. For crossbred cows it was 5.73 kg/day. The average productivity of buffaloes was 4.15 kg/day.

Small ruminants

In Anantapur, Nellore sheep were kept in mostly stationary flocks whereas, in Mahabubnagar, mainly Deccani, partly stationary partly migratory flocks were maintained. In Anantapur, farmers purchase lambs for the purpose of fattening for a period of 4 to 5 months and sale for ready cash. Flock size fluctuates from a few to 30 head. In Mahabubnagar, most villagers have few goats that utilize the available fodder trees. The concentration of goats was higher in Mahabubnagar than in Anantapur. Farmers of Andhra Pradesh consider sheep and goats as a working capital and opt for a zero input system of production.

Backyard poultry

Keeping a few chickens for eggs and meat for direct consumption was widely spread practice in Anantapur and Mahabubnagar. By contrast, in Tumkur cluster poultry was less preferred species of animal because of the dominance of *Lingayat* community who are mostly vegetarians.

Problems related to livestock production

The agro-eco system and problem analysis of the villages revealed that the productivity of livestock was affected adversely by number of causes. Most of the problems were common, which are crosscutting and feature prominently in all the clusters. The main constraint faced by the farmers of all the clusters was scarcity of fodder and water in summer particularly during April to May, resulting in reduced productivity of animals and high incidence of diseases. The various reasons mentioned by the farmers for this were 1) collapse of traditional water harvesting systems created the shortage of water, 2) change in cropping pattern from traditional food crops to cash crops resulted in lack of crop residues-a major problem in all the selected clusters, and 3) shrinking of common grazing resources was another factor for scarcity of fodder to livestock. Low production potential of the native breeds, non-availability of services (veterinary, credit, seed, feed, market) in time, high incidence of diseases and high cost of maintenance have been mentioned as other reasons low productivity of livestock.

In Anantapur, livestock are experiencing serious fodder and water scarcity in summer, accentuated by the drought in the last four years, which forces many farmers to sell their valuable and productive animals at distress rates during summer and again repurchase them at higher prices at the onset of monsoon. Foot and mouth disease and premature abortions have been mentioned as major diseases among cattle and buffaloes.

In the Mahabubnagar cluster a similar situation prevails. Fodder availability was maximum for four months between August and November with acute shortages between March and June. Foot and Mouth Disease (FMD), Black Quarter and Hemorrhagic Septicemia were the major diseases among cows and buffaloes. Among sheep and goats, FMD and Blue Tongue were common. Livestock diseases occur mostly between November and February. Similarly in Tumkur cluster, heavy morbidity due to FMD and premature abortions were reported with shortage of fodder in summer as the main problem.

Strategies adopted for improving livestock productivity

The major constraints facing smallholder farmers in the selected cluster were inadequate availability and poor quality of feed and fodder; poor genetic potential of animals, high incidence of diseases; and inadequate knowledge on appropriate management of livestock. There is significant potential to improve the average productivity of livestock simply by improving breeding, feeding and herd management. Several technological interventions such as provision of timely availability of veterinary services, exposure visits, training and demonstration on balanced feeding and scientific management were implemented with active consultation and participation of stakeholders in their farming situations in order to improve the productivity of animals. The following interventions implemented by the project seem to be most promising and could be adopted for livestock development.

Breed improvement

The project staff encouraged farmers to breed indigenous cows and buffaloes with improved breeds, particularly Jersey and Murrah, through artificial insemination (AI) to improve the productivity of the existing livestock resources. This was done in order to combine the hardy characteristics of indigenous cattle (namely tolerance to poor nutrition, heat stress and tropical disease challenge) with higher milk-producing qualities and hence the higher income potential of the improved breeds. To support this, an artificial insemination (AI) centre was established in Mahabubnagar cluster to provide door-to-door artificial insemination service and to serve as a training centre to promote entrepreneurship among the unemployed youths in the project villages.

The performance of the AI centre shows that the conception rate achieved by the centre is considerably higher (70 % in cattle and 50 % in buffaloes) than the usual Veterinary Department AI conception rates (20-45%) (GOI 2005). More than 300 farmers from all sections of the community (Rich/Poor; Forward /Backward caste; SC/ST)/ used the AI service for breeding their cows and buffaloes. Farmers from the surrounding villages (apart from project villages) also used the services of AI centre for up grading of local cows and buffaloes.

An unemployed youth of Mahabubnagar cluster was trained in Artificial Insemination at Tumkur for three months to enable him to take up the cattle breeding AI for breed improvement in the project area and to train the other interested persons. The AI trained youth at the AI centre has now trained another three persons and is running the AI centre successfully. He is earning on an average Rs. 3000/ per month from the AI centre by charging the farmers Rs. 20/ per AI done. In addition, he receives incentives of Rs. 50/ per calf born from "Farmer's Corpus Fund" of BIRD-K.

Improved forage production

The most important constraint prioritized by the farmers in all the cluster villages was the problem of fodder availability. Various fodder interventions (maize, sorghum PC 23, hybrid napier-Co1/2, guinea grass and lucerne, were promoted under irrigated conditions in a smaller area alongside the farmer's priority of their stable crop of paddy. Most farmers initially refused to spare their land, as irrigated land possessed by them is very small. However, four farmers including a women farmer from Anantapur cluster came forward to take up Napier planting in their field. All farmers were supplied with cuttings for an area of 1/10 of an acre after imparting training at Regional Research station, Anantapur. Only the women farmer retained the cuttings and other farmers removed them. After she successfully grew the fodder she started feeding it to her milch animals, which has resulted in increased milk production and also quality of the milk. To overcome the inhibition of Mahabubnagar cluster farmers', an exposure visit was arranged to Ananatpur cluster to have one-to-one interaction with fodder growers. Farmer-to-farmer interaction did result in changing the mindset of Mahabubnagar farmers and after their return; they also took up fodder cultivation. Through exposure visits and farmer-to-farmer interaction, many farmers realized the economic benefits of feeding green forage to animals and came forward to take the cultivation of improved forage cultivars. Presently around 163 farmers representing all socio-economic classes are sparing about 0.04 to 0.10 ha of paddy area for growing fodder crops.

Chopping of crop residues

In all the clusters normally the farmers offer fodder without chopping where as in case of sorghum and maize, sometimes they cut it by sickles into large pieces (50 cm length). In this kind of prevalent practice, wastage of the fodder was very high. In order to reduce the wastage of feed resources, the chaffing of fodder was promoted. Two kinds of chaff cutter: manual and power operated were promoted in all the clusters. By using the chaff cutter wastage of the fodder could be reduced substantially (up to 30%). For personal use, villagers preferred the manual chaff cutter rather than the powered chaff cutter, because of its low cost as well as easy operation. Only two persons are required to cut the fodder by manual chaff cutter, whereas for the power operated chaff cutter, a minimum of three persons are needed to perform the task satisfactorily. The power chaff cutter is generally fixed in one place to which people have to bring their fodder for cutting, which is not preferred by some social groups. However, one advantage is that it can provide a livelihood option: because of its output capacity, the owner or operator charges a cutting fee (Rs. 0.70/crop residue bundle of about 10 kg) to villagers those wishing to cut their fodder.

Improved feeding practices

The farmers were mixing different feed (concentrate) ingredients such as wheat bran, rice bran, cakes, broken grains, *chunies* (broken grains of pigeon pea/ black gram) before offering them to their animals as supplements or in a few cases, as complete diets. However, the quantities of individual feed ingredients included in the concentrate mixtures seemed to depend on their relative availability rather than on the farmers' conscious desire to supply better quality feed to their animals. Only lactating cows and bullocks during work were allocated the supplementary feed. Livestock rearers use their limited available resource (concentrate feed) based on the priority of the animals. The farmers reported that repeat breeding was a serious problem in their herds particularly in buffaloes and crossbred cows. Probably, this was the major cause of the long calving intervals. Mineral deficiencies were suspected to cause this problem. Use of mineral mixture in concentrate feed was demonstrated to the farmers of Tumkur cluster to overcome this problem. Farmers' response was very encouraging: they observed an improvement of 0.5 to 1.0 litre/animal in milk yield due to supplementation with mineral mixture. They also reported that mineral supplementation was helpful in increasing the appetite of animals. Now farmers from all wealth groups have started purchasing the mineral mixture from the local market and mixing in the concentrate.

In order to improve the productivity of milch animals during summer, supplementary feeding of urea molasses mineral blocks (UMMB) was demonstrated to the farmers in Mahabubnagar cluster. The main objective of UMMB supplementation was to provide a constant source of degradable nitrogen throughout the day and promote growth of rumen microbes in ruminants fed poor quality forage. The UMMB was kept in front of animals in the wooden dispenser to allow optimum licking. The intake of UMMB ranged from 200 to 275 g/animal/day. An average increase of 1.25 litre/day in milk yield was observed due to supplementation of UMMB during summer. Besides the increase in milk production, all the animals of supplemented group showed symptoms of heat at the proper time and conceived at first service. By comparison, in the un-supplemented group, one cow did not conceive even after third service/insemination and on average 1.7 services were needed for conception. No symptoms of mineral deficiency and disease were observed in the supplemented group whereas animals of un-supplemented group showed symptoms of mineral deficiency. All the farmers readily accepted the practice of using UMMB supplementation and are willing to purchase UMMB.

Integrated animal health camp

Almost 90 % of the farmers in the cluster villages did not follow the deworming and vaccination calendar recommended by the scientists and extension workers. Most of

the farmers lacked confidence in applying the extension advice and cited cash constraints as a compounding problem. This problem was discussed in *Salaha Samithi* meetings along with the local veterinary/extension staff of the respective clusters. As a result and in conjunction with the local Animal Husbandry Department, animal health camps were conducted in Mahabubnagar and Tumkur cluster. Promotional campaigns were launched in these clusters that encouraged farmers to keep more productive animals and adopt a regular vaccination and deworming schedule as a preventive measure, and provide mineral supplements to animals to overcome the problem of infertility in case of buffaloes and crossbred cattle. Initially, the cost of medicines was met from the project funds. Afterwards, the *Salaha Samithi* mobilised the funds from the farmers.

Implementation of scheduled prophylactic health measures has reduced mortality from 17 to 8 percent in small ruminants and from 12 to 7 percent in large ruminants. Most of the farmers reported an increase in growth rate of 25 - 30 percent in the animals between 6 and 12 months of age in their flocks. The treated cows recovered from mastitis. About 30 percent of the animals, which were suffering from fertility problems became pregnant after treatment. Further, farmers reported immediate recovery of animals from recurrent attacks of gastro-intestinal parasite infestation. A large gathering of farmers from all livestock owning wealth groups was evidenced during the animal health camps. Camps created awareness among farmers regarding the adoption of better livestock practices. Farmers are demanding more number of such camps in the clusters. The more progressive farmers are following the recommended livestock management practices at their own cost.

Ethno-veterinary training

From each cluster, 3-4 persons who are already involved in the livestock treatment of diseases were identified and trained in order to upgrade their skill and capacity. All the trained persons are doing good service as para-vets in their respective clusters. They are helping the farmers in identifying the health problems, providing information on husbandry practices and treating the sick animals. They have become a good link between the Animal Husbandry department and farmers. Even the Animal Husbandry department recognized their talent and seeks help from them during vaccination and deworming camps.

Policy and support services

For smallholder livestock producers, credit is most critical input, as they require cash for day-to-day management of their household enterprise. Garcia et al (2006) recommended that access to credit can enable the subsistence farmers' access to technologies and would enable them to cross the poverty line and become viable

farmers. No intuitional mechanism exists in the study area for giving them cash/micro credit. The *Salaha Samithi* emerged as effective institutions for providing micro credit to participating farmers based on their need and maintained timely recovery. Therefore, village based institutions should be enabled to handle the term loans for livestock production, as this is the simplest solution for accessing loans and repaying them. In addition, women self help groups as institutions for cash/micro credit for livestock production should be promoted as a part of livestock schemes under rural development programmes

Extension approach should be need-based with problem-solving dimensions and participatory in nature. The exposure visits and training were essentially aimed at strengthening the human capital of the individuals. For example, ethno-veterinary training was provided to traditional healers in order to upgrade their skill and capacity. Similarly, groups with specific needs for training on fodder production were taken to the research stations specializing on fodder technology. These visits and training programs facilitated understanding of the advantages and disadvantages of the technologies by the farmers and hastened the process of technology adoption. Again, there was a logical process adopted to undertake exposure visits and training. Once the needs and groups were identified (where the *SalahaSamithi* played an active role), the possible place of training/exposure visit was identified. A massive campaign required to launch capacity building and empowerment of village communities that will act as the harbinger of change and technology adoption and to establish the foundation for a farmer-to-farmer livestock extension mechanism. Sharma (2004) suggested the need for the Government to continue to protect the interests of livestock producers, as livestock sector has shown higher growth compared to other sub-sector of agriculture and makes major contribution to family income of the poor. The need for appropriate policy about livestock breeding and delivery services (credit, health, market and extension) and steps to improve feed and fodder situation are strongly recommended for sustainable development of livestock sector by several researchers (Pasha 2000, ILRI 2003, Sharma 2004, Turner 2004, Parthasarthy Rao et al 2005, Garcia et al 2006, Misra et al 2006 and Rangnekar 2006).

Conclusions

- Sustainable development in dry lands can only be achieved through optimum utilization of the natural resources. There is tremendous scope of increasing productivity of existing livestock resources by improving the feed and fodder resources. Participation of farmers and village based institution (*Salaha samithi*) proved to be an effective and efficient mechanism for faster technology diffusion. A favorable policy environment in terms of access to

micro-credit, key inputs, assured market and veterinary services will have to be provided and socio-economic and technical constraints needs to be addressed in order to enable the rain-fed farmers for livestock development.

- The project interventions had an ample effect not only on the farming community but also on the landless livestock keepers. The project experiences suggest that a continuous dialogue is essential for promoting the interventions. Animal health camps created awareness among farmers regarding the adoption of better livestock practices like supplementation of mineral mixture in the concentrate ration, chopping of crop-residues, cultivation of improved forage cultivars, etc. Through exposure visits and farmer-to-farmer interaction, many farmers realized that integration of livestock and fodder production within their limited land and water resources provides a better livelihood option in dry lands.

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