

# **Crop-Livestock Production Systems in Some Rain Fed Areas of Western India**

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## **Abstract**

In India, like many other south and south-east Asian countries, crop-livestock mixed farming is traditional. BAIF is an NGO which has been implementing a large livestock development programme for about three decades and spread over six states in India. Its experience indicates that most of the traditional systems are highly efficient and self-sufficient, and thus are sustainable. The combination of livestock with crop production is an effective risk aversion mechanism, developed out of generations of experience of farmers in rainfed areas. The system is a very good example of recycling of all the products of the farming operations, local material, household waste, etc., with little dependence on outside resources. This is an appropriate and sustainable approach for remote rural areas, where accessibility to outside resources or services is difficult. The system illustrates very well how rural families can match production with resources and available (or unavailable) services and linkages.

The paper discusses a few examples of crop-livestock integrated systems from semi-arid and tribal pockets of western India. The studies were carried out in order to understand production systems and to assess the need, priorities and scope for development interventions. In semi-arid regions, the combination of trees, cereal crops, leguminous pulses and oilseeds along with a mix of livestock (cows, buffalo and goats) is common. Each of these is adopted with a multi-purpose objective. Trees

provide fruit, fodder and fuel, and some trees improve the soil or serve as a wind break. Crops provide food, fodder and fuel, and leguminous crops improve the soil. Most preferred fodder crops are leguminous species grown in the winter and rotated with cereal crops; thus they provide a much needed protein source for the animals. Livestock are a source of food, fuel, manure, draught power, ready cash in emergency, a movable asset and an investment but with social value. Thus each has multipurpose value but they are usually assessed with a singular approach. In tribal areas, the combinations generally seen are trees, cereal-legume mixed cropping, cows and/or goats and poultry.

The paper briefly discusses the outcome of a few studies on farming systems and perceptions of men and women farmers, tribals and agro-pastoralists, carried out in western India. The results indicate that the majority of landowners, irrespective of the community to which they belong, and about half of the landless, own some animals or poultry. During the years when rains fail or in semi-arid/arid areas, income from livestock accounts for about 60% of the farm income. In semi-arid and tribal areas, there is a shift towards small ruminants. In better rainfall areas, there is shift towards buffalo. The majority of tribal families and the underprivileged community in general own poultry which are managed in the traditional backyard system. These families (women) prefer coloured country fowl for specific and logical reasons. Unfortunately there are hardly any development schemes to improve the productivity of small ruminants or country fowl. Support services do not reach many rural areas.

The paper cites some examples of indigenous knowledge of farming men and women, gained through generations of experience, in the utilisation of local resources. The farmers prefer varieties of crops which are appropriate for local conditions and provide better quality crop residues. They choose trees which provide leaves as well as flowers and pods for feeding animals. They have identified bushes which have protein-rich leaves. They are aware of aquatic plants, mangroves, salt bushes and weeds which can be fed to different type of animals with beneficial results.

In the end, a challenge to scientists is indicated: to develop technologies and recommendations which will improve productivity (not just production of one sub-system) in a sustainable, environment-enriching and energy efficient manner but without competing for human food and, at the same time, benefiting small, underprivileged farmers. Some caution is required: the benefit is not always a straightforward equation of rupees in and rupees out.

**KEY WORDS:** India, integrated systems, livestock, indigenous knowledge, small farmers, arid, semi-arid

### **Introduction**

Keeping livestock is traditional and closely linked to rural culture, indicative of the fact that rural families have always realised the importance of livestock and clear evidence is available in literature, art and ancient epics dating back to 4000 B.C. or maybe even earlier (Rangnekar 1995, Dolberg 1982).

The BAIF, a non-governmental, voluntary organisation, established in 1967, has been involved in livestock-based integrated rural development activities since 1969. The small cattle development project in western Maharashtra and south Gujarat regions of western India has grown into a large integrated livestock development programme covering more than 1.25 million livestock and involves 500,000 families in six states of the country.

Livestock development was taken up as the first major activity, considering the role of livestock in rural systems which extends from economic activity, supporting agricultural production, as an energy source and food for the family, to socio-cultural aspects, as a risk aversion mechanism and meeting needs during emergencies. Thus not much has changed in respect of the role of livestock since 4000 B.C., but we still do not have a clear understanding of the various crop-livestock systems that have emerged through generations of experience. The farmers have made appropriate changes in the mixes (crop-livestock) according to changing agro-ecological conditions and markets. The

systems are more complex in rain-fed areas where the farmer has to cope with the vagaries of the monsoon and unfavourable soil conditions.

Almost three-quarters of the area of western India is rain-fed and a large part of it is semi-arid. Studies indicate that much of the area has not shown persistent improvement in crop production (Abrol 1992). According to Kanwar (1991), dryland and rain-fed agriculture are practised on 73% of the cultivated area and contribute to more than 40% of total food grain, 75% of oil seeds, 90% of pulses, 70% cotton and almost the entire quantity of coarse grain. Some of the best indigenous breeds of livestock originate from the rainfed semi-arid areas. Walker and Rajan (1990) and Kanwar (1991) have emphasised the appropriateness of livestock-crop integrated systems for rainfed areas. They recommended the re-orientation of research and extension workers towards such systems, since it is felt that the risks and economic factors of rainfed areas are probably not well appreciated.

### **Methodology**

In the BAIIF project areas, studies were undertaken within the prevailing production systems; the livestock sub-system was studied in more detail. The methodology and approach adopted for such studies and some of the initial results were reported earlier by Rangnekar *et al.* (1991) and Rangnekar (1993). The studies were conducted by combining area and family surveys, field recording and a variety of participatory exercises, including group discussions. A clear understanding of farmer perceptions, priorities and suggestions is as important as the study of different crop-livestock combinations and their productivity and interactions. Equally important was an understanding of social and gender issues which influence the systems profoundly (Crotty 1980, Dolberg 1982, Rangnekar (1992 A & B). A few examples of different crop-livestock integrations, as seen in different agro-ecological and social situations in Gujarat and Rajasthan states, are discussed in this paper. The studies relate to smallholder farmers from rainfed, semi-arid tribal and non-tribal areas of Rajasthan, and north Gujarat, and irrigated areas of south Gujarat. The contribution of livestock to whole farm productivity and family income is discussed. In the case of Rajasthan, the usefulness of

livestock in sustaining livelihood during periods of drought is described.

## **Results and Discussions**

For ease of description, findings are grouped according to social and agro-ecological considerations.

### **1. Smallholder non-tribal farmers of rain fed Central Rajasthan (district Bhilwara)**

Rajasthan is located in the north-western part of the country and about 60% of the area is desert or semi-desert. Much of the state falls in agro-ecological zone 14 of the country which is typically arid. The south eastern part of the state is in zone 8 and is hilly and rainfed. Livestock play an important role in the rural economy of Rajasthan and contribute about a quarter of the net domestic income. The contribution is more in arid areas compared to other areas. Small ruminants dominate the livestock population and their numbers are increasing fast, while the large ruminant population is static. The state has peculiar variations in agro-ecological conditions and social groups. The north-western arid region is dominated by pastoralists, central Rajasthan has a mixed population, while south Rajasthan is dominated by tribals. The social-cultural background has a bearing on agriculture production systems apart from the agro-ecological conditions. Distinct differences are observed between the production systems of the pastoralists, agro-pastoralists, non-tribal farmers and tribal farmers. Differences are observed in respect of major crops and livestock maintained by these social groups.

In central Rajasthan, the main crops are maize, wheat or pearl millet, along with pulses. The dominant livestock species are cattle and goats. The average land holding is about 1.5 hectares, and the facility for irrigation is very limited. However, even with limited availability of water for irrigation, farmers reserve a small plot for the cultivation of lucerne (alfalfa), along with wheat in winter. Lucerne is the crop of choice for fodder production and farmers are not interested in producing green fodder in the rainy season. The farmers give preference to food crops in the rainy season and, due to the small land holdings, they cannot spare

land for fodder. Moreover, they feel that cattle can get some green material while grazing. In winter, they do spare some land for lucerne and the choice appears logical (Rangnekar 1996). The area has experienced repeated spells of drought during the last 15 years and thus crop production has not been very reliable.

The BAIF became involved in livestock development in the district of Bhilwara in central Rajasthan 15 years ago. The programme involves breed improvement, health control, feed and fodder resource development, and farmer training. A system of continuous feedback has been developed through field recording, farmer participatory exercises, etc. The BAIF has a network of 20 centres for implementing the programme through which the majority of the villages are covered; the programme involves cows, buffalo and goats.

The experience of the last decade indicates growing interest in livestock production, since crop production is unreliable due to the uncertainty of timely and adequate rains, and lack of irrigation potential. Cows, buffalo and goats are the most popular and preferred animals. Dairy production has developed very fast in the last decade in this district and adoption of cross-bred cows is very good. There are several villages in the district where 80-90% of farmers keep cross-breds. There is growing interest in selling surplus cross-bred animals, besides milk. The animal market has developed in the district along with the milk collection network of the farmers' cooperatives.

The crops of choice are maize, sorghum, pearl millet, wheat, pulses and groundnut which are good sources of fodder and well-suited to rainfed farming. The farmers, especially the women, collect the crop residues and store them meticulously. Special care is taken in the collection and storage of crop residues from pulses and groundnut crops. During winter, it is a common practice to mix small quantities of green lucerne with cereal straws. While in summer, the cereal straws are supplemented with the leaves and pods of pulses, groundnut leaves and Acacia pods. These practices are good examples of strategic supplementation. It was found that the farmers (particularly women) were aware of the value of these crops and by-products.

**Table 1: Contributions to income of rural families (%) in parts of central Rajasthan**

Sources of Income	Percentage contribution before 1983 (under normal conditions)	Percentage contribution after 1985	
		Normal conditions	Drought Conditions
Crops	65	45	6
Sale of milk	15	41	38
Sale of livestock	-	8	36
Off-farm labour	20	6	20

Observations gathered for more than a decade on sources of income of the farming families from a few clusters of villages provided interesting information. The results, summarised in Table 1, indicate that the contribution from livestock towards total income has increased appreciably. The increase was mainly due to the increased sale of milk, as well as of cross-bred cattle. The contribution from livestock has increased, from a meagre 10%, to 45% and an important aspect is the decrease in human labour. The latter is indicative of the employment generated by the improved dairy animals. Even more interesting was the situation during the drought years when the crops failed and their income contribution decreased to 5%. It is noteworthy that the total contribution from livestock increased. Milk production was not as adversely affected by drought as crop production, an observation also reported by Gupta (1993). Many farmers sold off unproductive animals and growing heifers during drought conditions and the sale of the animals added to the income from livestock. It was also observed that, during subsequent good years after the drought, the milk production per family and the breeding performance improved substantially, probably due to the retention of better animals by the farmers. A study on the nutritional status of the dairy animals owned by the farmers was carried out to study nutritional status. Initial results indicate that the most limiting factor is protein for the majority of the cross-bred cows (averaging between 2000 to 3000

litres/lactation), taking the whole year into consideration. Both energy and protein become limiting factors for higher yielding crossbreds (3000 litres/lactation) and during the summer months for medium producers (2000 to 3000 litres/lactation). Farmers have not shown much interest in improving milk yield or reducing age at first calving which is about 30 months. This aspect will be discussed later as it is common perception in many areas.

## **2. Tree-crop-livestock based system of tribal areas of Gujarat and Rajasthan states.**

The tribals are generally referred to in India as "Sons of the Forest" which aptly describes their way of life and habitat. In western India, they inhabit the Aravally hill ranges along with the border between north Rajasthan, Madhya Pradesh and Gujarat states, extending up to Maharashtra state. A tract of over 1500 km. The tribals were essentially gatherers and the dense forest in this hill range provided them adequate shelter, food and fuel. With the changing conditions, dwindling of forests due to population pressure, encroachment, poaching, etc., they found it difficult to make a living out of the forest. In many districts of these states, the tribals have adopted farming. The keeping of livestock and poultry has been traditional in the tribal families and they have an intimate relationship with the trees. The common crops in the tribal area are the minor millets, their traditional staple food. Cattle, goats and backyard poultry are maintained by the majority of the tribal families. Very few tribal families keep buffalo. The average land holding in the tribal area is about 1.5 hectares, the land is undulating with low productivity and there is very little irrigation.

Amongst the tribal families the production of milk has never been a traditional vocation and is a relatively new introduction to India, as a result of development interventions by the government and non-governmental agencies. Milk is not a major part of their diet and the main objective of keeping cattle was for draught purposes or as source of fuel and manure. Livestock density in the tribal districts of Gujarat is highest in the western Region (1737 per 1000 hectares) with the majority of livestock being nondescript.



The common livestock feeding practices in the tribal region include grazing in the forest and the use of crop residues supplemented with the leaves, flowers and pods of forest trees. Better producing animals are given concentrates which are generally home-made using farm produce like grains, by-products of pulses, tree pods, flowers, etc.. Studies carried out by Rangnekar (1992 & 1993) indicate that the tribal women assume the major burden of livestock production and have very good knowledge of local feed resources. The farmer men and women have identified a variety of plants (trees, bushes and creepers) as beneficial to livestock and these are used to supplement livestock feed. The tree fodder is mainly used during dry months. Various plant species, identified as good feed resources, are shown in Table 2 and the different months in which they are used for feeding livestock are indicated along with the benefits reported.

**Table 2**

Name of feed material	Season of availability	Nutritional characteristics
Mahuva flower	April/May	Rich in energy
Pods of <i>Acacia</i> & <i>Prosopis</i>	March/April	Rich in energy & protein
Leaves of <i>Ziziphus</i>	April/May	Rich in protein
Leaves of <i>Prosopis cineraria</i>	March-May	Rich in protein & minerals
Leaves and pod	October/	Rich in protein & minerals
Covers of pulses and oilseed crops	March/April	

Studies conducted in some tribal pockets on nutritional status of dairy animals indicated that protein availability is a major limiting factor. It is likely that the high protein content of leaves of some of the tree species is responsible for the beneficial effect observed by the tribal farmers (Rangnekar 1991). Based on these observations, a programme of promoting cultivation of these plants has been instigated in the livestock projects and is well accepted by the tribal families.

A study comparing the contributions to income from crops and livestock among tribal and non-tribal farmers in some districts of Gujarat was carried out (Patil *et al.* 1997). It is reported that livestock contribute about 33% to the income of the tribal families, as compared to a 20% contribution in non-tribal families. The contribution to income includes directly measurable products like milk and the indirect contribution in the form of energy (for crop production or transport). The study indicates that, in view of the small land holdings and limited irrigation, the only way tribal farmers can improve whole farm production is through the integration of food crops, horticulture and livestock production. Dairy production has better scope in states like Maharashtra and Gujarat because of the developing network of farmer cooperatives in tribal areas.

The systems in these rainfed, under-developed tribal areas are complex, with tribal farmers preferring "assured subsistence" to risky high production. The systems are fully self-sufficient with each commodity having multi-purpose objectives. Thus the need is to suitably modify the development approach and to consider improving whole farm production with mixed livestock (large ruminant, small ruminant and poultry) and mixed crops (cereal, pulses, vegetable and multipurpose tree species for fodder, fuel and fruits). Considerable thrust is given to the improved utilisation of local resources, re-cycling of residues, wastes and by-products. An equally important aspect is the establishment of linkages (forward and backward), or strengthening them according to need. The development of farmer groups and para-extension workers, through appropriate training, is another important activity.

Detailed studies are in progress to evaluate local feed sources like tree fodders, pods and various feed mixtures used by the tribals for feeding ruminants. The technology of urea-treatment of cereal straws has been

tried in locations where it is most likely to be useful and the response from farmers has been very positive (as they notice an improvement in productivity). Improvement in feed mixtures for dairy animals is attempted through the use of urea and local feed resources like *Acacia* pods and the flowers of trees like *Madhuca indica* which are traditionally used by tribal farmers. The use of mineral supplements is also felt necessary. More data and analysis is needed to refine the recommendations for improving the feeding practices. Small projects to study feeding practices, evaluate local feed resources, test technologies and modify home-made feed mixtures are in progress. The studies adopt a participatory approach involving farmers (men as well as women) at all stages, so as to get their perceptions duly incorporated, and subjectivity or bias is minimised.

### **Some Issues and Challenges Facing Livestock Development**

The lack of participatory and systems approaches to livestock development and research.

In most cases livestock development is considered in isolation, without giving due cognizance to the total rural system. Such an approach has resulted in adverse effects in some cases and, in other cases, very limited benefit to the rural community. Recent studies and reviews arranged by the Government of India for framing livestock policy for the future clearly indicated that there is a need for serious thought to change the approach to livestock research. The research has to be directly related to the situations faced by the farming community and conducted with a systems and participatory approach, previously lacking in animal science. In crop science, some change has already occurred and on-farm research with participation of the farmer has been introduced in several projects by many agriculture universities. In a country like India where a variety of production systems and considerable variation in social and ecological conditions exist, it is necessary to evolve appropriate approaches, with a clear understanding of the different niches.

Livestock extension is another area which is neglected and considerable effort is needed to strengthen extension which is the backbone of the development. However, here again there is a need to

develop the participatory approach and ensure that appropriate recommendations are made by the extension system. The involvement of women in a major way in livestock management makes livestock extension difficult. Gender sensitisation is grossly lacking amongst those concerned with planning and coordinating development and research. There are hardly any women extension officers in livestock departments. Most of the female veterinary/animal science graduates are confined to laboratories or offices.

A development strategy for rainfed, semi-arid and arid areas is a challenge facing all those involved in planning and implementation. For such areas, the scope for increasing production from crops is limited and the contribution of livestock to total production and as source of employment is high. However, livestock are regarded as a threat to the environment and a cause of desertification. There is lack of a clear strategy for a balanced approach to sustainable development. A major constraint in the rainfed, semi-arid and arid areas is the lack of strong linkages (forward and backward). The centralised system of extension services has very limited penetration in these areas, where the population is well spread out and communication is difficult. A different approach involving the rural families is called for. The inadequacy of feed resources is also a major constraint to high productivity, more so when the major thrust in livestock development is for milk production.

Related to the above aspect is lack of research on production systems under unfavourable ecological conditions and in areas which are less well endowed with natural resources. One of the dilemmas is whether keeping fewer high producing animals is desirable or keeping more low producing animals is appropriate (to cover the risks). There is always criticism against keeping a larger number of animals, but higher producing animals need better quality feed and a more favourable environment, which a small farmer in an arid area may not be able to offer. There is precious little research on ways of augmenting feed and fodder resources in arid and semi-arid areas or areas with problematic soils (saline and alkaline soils with brackish water). There is not much research on traditional systems and indigenous knowledge of the farmers, which enabled them to survive under unfavourable conditions. The interesting part of the

story is that some of best Indian breeds of livestock were developed in semi-arid and arid areas. In some cases, we are ignoring their potential and the crucial characteristics of these breeds. However, there is some resurgence, awakening and development of interest in these indigenous breeds and hopefully efforts will be made to make best use of their potential.

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