Field Performance Recording (FPR): Potential and Weakness in Management and Breeding Programme in Transition and Developing Countries – Indian Experience

C T Chacko
Livestock Consultant, Chathanatt, Kalampoor, Ernakulam, 686664, Kerala, India
drctchacko@gmail.com; +9447663513

Summary

The contribution of livestock sector to the gross domestic product of India is steadily increasing during the last two decades. Milk contributes to some 67 % of the total value of livestock sector out put. The national policy for cattle and buffalo breeding emphasises for crossbreeding of the local cattle with exotic dairy breeds, genetic improvement of designated dairy zebu breeds and grading up of the buffaloes with Murrah.

FPR integrated into the breeding programmes would be a better alternative to institutional farms for production of breeding bulls. A method for field based milk recording suitable for low input and small herd animal production system was developed and practiced with out break by the KLDB since 1978. Its impact in terms of annual increase in first standard lactation milk yield of the crossbred cows (from 1,480 kg to 3,071 kg during 1983-2011), is worth eight times the investment by the government. KLDB tested some 967 bulls in 28 batches from 1978 to 2005 and the proven bulls are routinely employed for the production of next generation bulls. NDDB, BAIF, ICAR assisted university implemented programmes employs FPR for selection of elite bull mothers and for evaluating the production of indigenous and crossbred cattle.

FPR has the important roles of sire evaluation and bull mother selection in addition to monitoring of livestock performance at the smallholder level. Non-governmental organisations were successful and sustainable in establishing and running FPR programme with the participation of farmers. A quick and simple method of FPR for estimating the milk yield would be necessary for states where introduction of a full-fledged FPR is difficult. A long-term strategy for integrating FPR into the breeding programme of the state and steps for cost recovery may be instituted.

Introduction

Livestock scenario

The livestock sector in India is linked with the livelihoods of millions of rural households and livestock production has always been an integral part of the farming systems. Almost 75% of the rural households own livestock of one type or the other and is more equitably distributed than land resources. The fact that 60% of the livestock owners are marginal and landless farmers support the claim that livestock related interventions are useful strategies for poverty alleviation.

India had some 199 million cattle and 105 million buffalo in 2005 (GOI Annual Report 2012). The average annual growth rate of cattle and buffalo population was -0.86 %, and 0.99% respectively, during 2000-2005. The trend in changes of cattle and buffalo population in

India as compared to that of world developing countries (DGC) and developed countries (DDC) can be seen in figures 1 & 2 respectively.

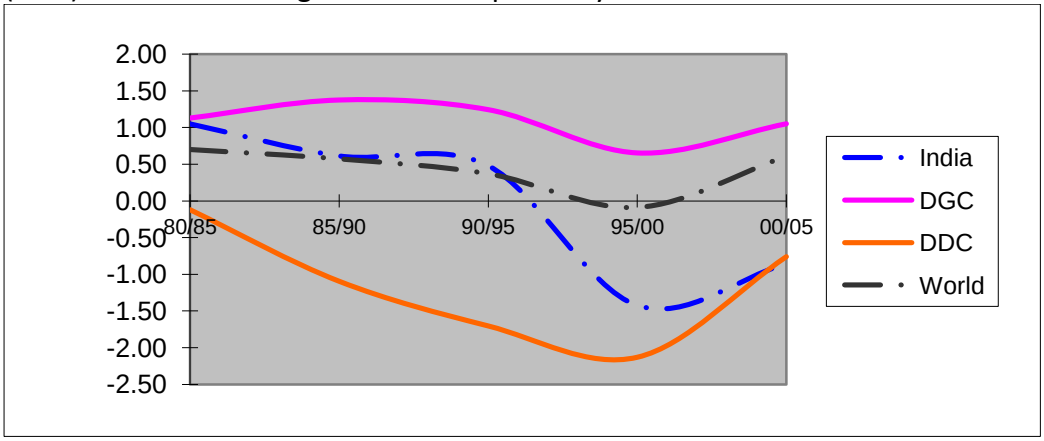


Figure 1 Average annual growth rate of cattle population in India, World, developing countries (DGC) and developed countries (DDC)

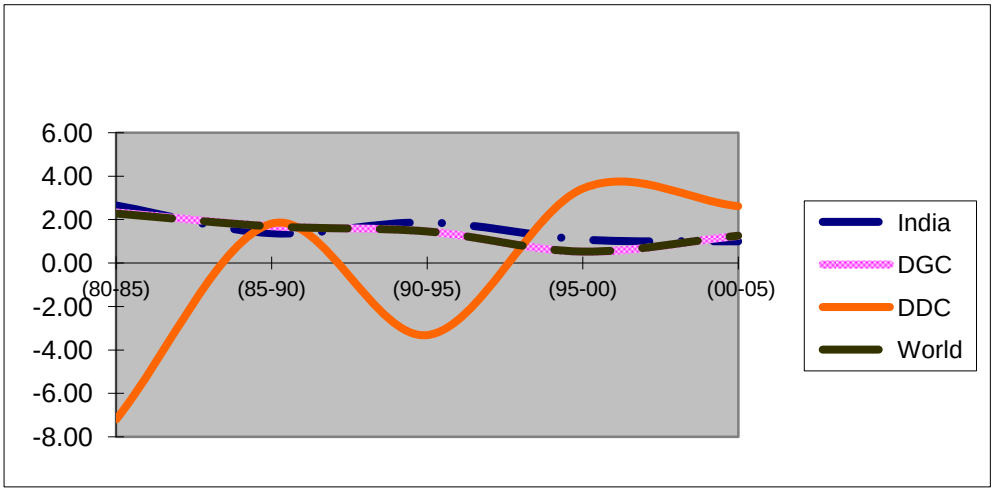


Figure 2 Average annual growth rate of buffalo population in India, World, developing countries DGC) and developed countries (DDC)

Cattle population shows a declining trend in all the four groups while buffaloes rather steady or show a slight increase.

Livestock production systems

The predominant farming system in India is mixed crop-livestock farming, in terms of total production, numbers and number of people served. In this system livestock utilise the crop residues and crop by-products and in turn generate cash income, draught power & manure. Mixed crop livestock farming systems differ with the farming culture practiced by the holders; high-input-high-output systems as practiced in Punjab, low-input-low output systems (Haryana & Western Uttar Pradesh) and zero input-low-output subsistence systems (Orissa & Bihar).

There are some 11.85 million hectors of permanent pastures and grazing lands in India (Sastri, 1993). In addition around 121.1 million hectors are also used for grazing temporarily after the harvest of cereals and other seasonal crops. The pasturelands are not adequately managed for optimum yield and as such cannot sustain a good yielding dairy animal. Large livestock farms are rare and are mostly institutional farms. The few commercial farms that

exist near the metro cities keep large herds of milking buffaloes. Transhumant livestock farming systems though still prevalent in India, the numbers involved, animals and human living a nomadic life are very few and are on the decline. Against all these odds the milk production in the country is steadily increasing over the years as can be seen in figure 3.

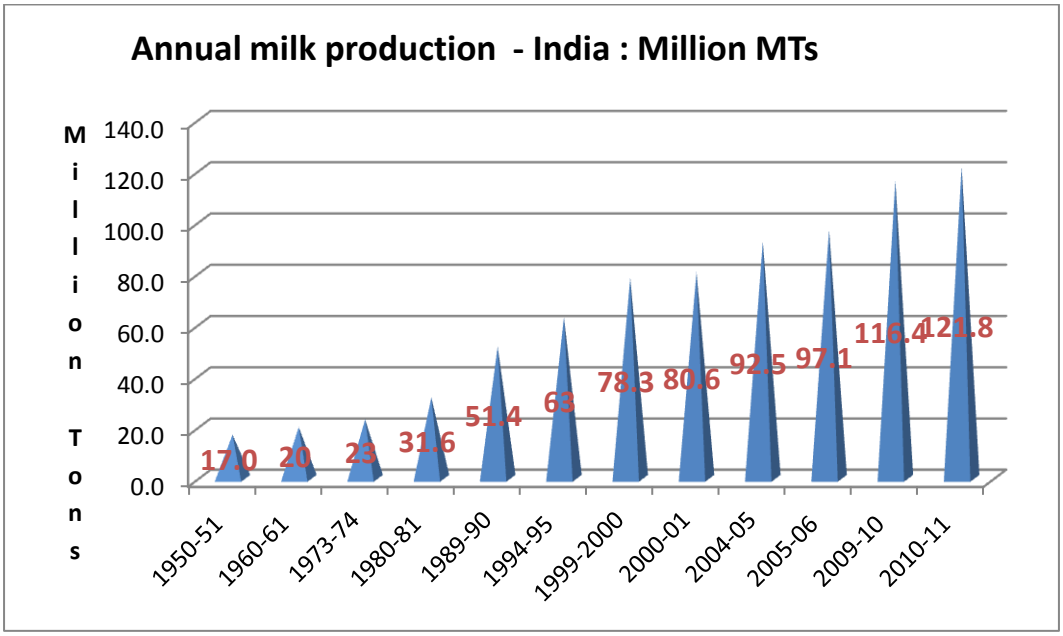


Figure 3 Annual milk production of India over the years (FAO 2012)

Breeding policy

The national policy for cattle and buffalo breeding postulated in 1962 emphasised the need for milk production increase through the use of selected dairy breeds of cattle and buffaloes in India. The use of exotic dairy breeds for crossbreeding of cattle gained momentum as the dairy co-operative network under NDDB provided the much needed market stimulus and price incentive. The policy was to limit the level of exotic inheritance to around 50%. Jersey, Brown Swiss, Red Dane and Holstein Friesian were used initially but the choice has soon narrowed down to Jersey and Holstein.

Breeding

AI for cattle and buffaloes is one of the most important services provided by the state governments. With some 48 frozen semen stations stationing 3321 breeding bulls producing 62.00 million doses of frozen semen annually and 84, 000 AI out lets, India has the world's largest AI infrastructure; some (GOI. 2012).

Table 1. Performance of AI Centres

Agency	No. of AI	AI mio.	Av.No. of AI/

	centres		centre/per year
Government	48000	35.00	555
Private AI worker	15000		
Co operative	15000	14.50	966
NGO	6000	2.50	619
Total	84000	52.00	619

Source GOI Annual report 2012

Breeding programme implementation did not reach the desired level of success in many states: there were lapses in maintaining the blood level at the prescribed levels due to non-availability of crossbred bulls, using genetically selected breeding bulls, ensuring quality of the frozen semen and AI delivery. The national project for cattle and buffalo breeding provides support for farm gate AI service, create a national milch herds of cattle and buffaloes, support conservation of genetic diversity, improve the efficiency of the AI services, effect full cost recovery of the AI services by privatising the services and increase the coverage of AI to 40 % in the coming 10 years (GOI, 1997)

Limitations of breed improvement

All too often in the past, genetic improvement has aimed simply at producing high-yielding animals. A yield, better than the previous one, but not as high as what is possible, is likely to be a better option. The overall objective of increasing the efficiency of the animal production system will often have to be attained by bestowing attention to some particular components. However, the first step is to decide what is meant by 'improvement' in any particular situation. There are many ways of changing the productivity of livestock, whether judged on the basis of efficiency or yield. These include: feeding; management (including the physical environment); health care; physiological or pharmacological intervention and animal breeding (genetic improvement).

As a first step it will nearly always be better to consider the resources available for animal production and the limits to these resources and to match them against the animal breeding objectives. Later on, improvements in any or all the resources (for example feed or management capability) can be matched by further improvements in the genetic capabilities of the animals.

To start the process the other way round - to try to match the resources to the assumed genetic potential of the animals (for example an imported exotic breed or its crosses) is risky and more prone to failure.

Selection

Good cow-selection decisions require ongoing month-by-month evaluation and cow comparisons. The timing of removal of culled female stock should be planned to minimize extended low-profit periods. Cows can be culled for sub standard milk production after the completion of the first lactation based on the estimated breeding value. It can be shown that under optimum reproductive management 33% of the cows can be culled for sub standard milk production after the completion of the first lactation with out affecting the herd size. Selection intensity that can be obtained in a herd of bull mothers can be calculated using the following formula. In this formula a constant mortality rate of 5 % is assumed.

$$GS = \frac{A - (0.5A*RES*SUR)}{0.5A\,[(SUR*RES)^2 * CIN + (SUR*RES)^3 CIN^2 + ... + (SUR*RES)^n * CIN^{(n-1)}]}$$

Where:

GS: The genetic selection after first lactation in proportion

A: Number of heifers in the farm

SUR: Survival rate - the proportion of animals that are alive out of the total number of female calves born

RES: Reproductive success - the proportion of animals that become conceived during each reproductive cycle. The remaining proportion of animals are culled and removed from the herd

CIN: Calving ratio - the ratio between 12 and the average inter calving period (months) of the farm.

n: Average number of lactations for which the cows are kept in the farm.

Examples of selection intensities that can be achieved with varying levels of reproductive management calculated using the above formula is given in table 2.

Table 2. Selection intensity obtained at varying levels of reproductive management.

Average calving interval (m)	Reproductive success (RES)	Number of lactation kept (n)			
		4	5	6	7
13	0.85	0.86	0.73	0.66	0.61
	0.90	0.70	0.58	0.52	0.47
14	0.85	0.98	0.85	0.78	0.74
	0.90	0.81	0.69	0.62	0.58
15	0.85	--	0.98	0.91	0.87
	0.90	0.91	0.79	0.73	0.69

With longer calving interval and with lesser number lactations kept, the selection intensity decreases. With an average calving interval of 15 months, cows kept for 4 lactations and RES of 0.85 no selection are possible and the herd size would decrease year after year.

Reproductive management:

Efficient reproductive management is one of the most important elements of farm management. It has a major effect on the profitability of the farm and will help in increasing the selection intensity there by improving productivity over generations. Unlike genetic progress, improvements made in reproduction during one year are not carried forth to the next year unless the improved practices are maintained. When all economic factors are considered, improved heat detection has a large beneficial economic impact. Improving heat detection to 80% is worth a significant investment in detection procedures. Missing an opportunity to inseminate means an increase in the calving interval by 21 days.

Percentage of cows in milk. In a herd of cows with an average calving interval of 12 months, 100 per cent of the cows should be calving every year. With an average lactation length of 305 days there shall be:

100% *305 (average number of days milked)/365=83.56 per cent of animals in milk round the year. The percentage of animals in milk out of the total number of cows will be varying according to the average inter calving interval and the days milked, and can be calculated. An example is shown in table 3.

Cows in milk at any given time (%) = Average days milked / Average calving interval in days *100.

Table 3. Percentage cows in milk round the year according to changing calving interval and average days milked

Days milked	Average calving interval in days				
	400	410	420	430	440
285	71.25	69.51	67.86	66.28	64.77
295	73.75	71.95	70.24	68.60	67.05
305	76.25	74.39	72.62	70.93	69.32

Sustainability of FPR programme is an excellent means for getting breeding bulls from smallholder dairy farmers in India. In the era of privatisation FPR with Field Progeny Testing (FPT) programme integrated into the breeding programmes is a better alternative to institutional farms for production of breeding bulls. Wherever it was a part of the breeding programme, FPT programmes have been instrumental for genetic improvement of herds belonging to farmers. There are, however, very few FPT programmes in India that have created significant impact for genetic improvement of livestock in the country (Goe et al, 1999). The organisation implementing FPR programme should have a reasonable autonomy to operate, a better understanding of its need and qualified persons for its management (Trivedi, 1998).

FPR programmes

Relevance of FPR

Government institutions and farms continue to be responsible for genetic improvement of cattle and buffaloes in India. It could be argued that the smallholder herds are too heterogeneous for a reasonably accurate estimation of genetic potential and government farms with reasonably large herds would provide better estimates. However it was not possible to benefit from the advantages due to the inherent weaknesses in the government system like, lack of clear objectives, non accountability, non availability of finances timely, decision making not at the place of activity, political interferences, etc.

FPR to select the best animals as bull mothers among the small herds with the smallholder will have the positive advantage of getting higher selection intensity and would cut the cost of bull mother production. A field based progeny-testing programme cannot function with out FPR. It is a major task of the FPR organisations to properly involve the farmers. The recent attempt in Uttar Pradesh to institute Breeder's Association for the monitoring of the FPR programmes is found to be promising. Though the FPR programmes in India are not

self-supporting, it can be shown that the economic benefit, as a result of genetic improvement, will more than compensate the money spent by the government.

Development of FPR programmes in India

A method for field based milk recording suitable for low input and small herd animal production system was developed and practiced by the KLDB since 1977. BAIF started FPR to monitor the performance of crossbred animals in 1980 (Goe M R et al, 1998). FPR started as part of the Indian Council of Agricultural Research (ICAR) schemes during late eighties were discontinued, modified or shifted to new areas before demonstrating any measurable impact. NDDB started FPR for evaluation of breeding bulls both buffalo and crossbred cattle since 1987. The FPR for goats initiated in 1988 by the Indo Swiss Goat Project (ISGP) Rajasthan, employed it to select superior indigenous Sirohi bucks for natural service. The development of FPR programmes for cattle, buffaloes and goats are summarised in Table 4. (Chacko, CT, 1998)

Table 4. Field performance-recording programmes in India

Organisation	Began	Breed or type	Objective
KLDB	1978	Sunandini	
BAIF Development Research Foundation	1980	HF, Jy, & their crosses Surti, Murrah, Jaffrabadi	Progeny testing & as part of the breeding
NDDB	1987	Mehsana & CB cattle	programme
Andhra Pradesh AHD	1988	Murrah & HF& Jy crosses	
Indo Swiss Project Sikkim	1995	Jersey crosses	Natural service bull selection
ISGP Rajasthan	1988	Sirohi goats	Bucks selection
Kerala Agric. Univ., Trichur	1986	Crossbred cattle	Research
Punjab Agricultural University	1988	Murrah buffalo	

Wherever it was a part of the breeding programme FPRs have been instrumental for genetic improvement of herds belonging to farmers. The average lactation yield of buffaloes in the DIPA villages increased from 1600 litres during the pre - programme period to 1933 litres now (Trivedi KR, 2002). The first lactation milk yield of recorded animals in Kerala increased from 1,480 kg to 3071 kg from 1983 to 2011 (Jose James 2013) ISGP Rajasthan reported that milk yields and body weights of the local Sirohi goats were 50-75% greater than previous findings, which had been based on institutional herds (Groot, B.de.,1996).

Use of information

FPR could well be an entry point for farmer participation in breeding. FPR can bring about real farmer participation and could be a feasible and better alternative to having nucleus herds on institutional farms. The KLDB results show that, the genetic potential of farmers' herds exceeds that of institutional herds. Furthermore, the selection intensity, which can be applied in the field, is much higher than in institutional herds.

FPR would be a means for local breed conservation and development. Only recently the potential of FPR for local breed improvement and conservation of biodiversity has been applied in the field. A general observation from all the areas where FPR is going on is value addition for animals under the FPR. Other potential benefits, which are yet to be tapped, are:

- Healthy competitions among farmers in the management of their herd. The milk societies can print out the ranks of cows under milk recording in the area.
- Suggest 'easy to practice' feeding regimes to the farmers based on the daily milk yield and considering the locally available feed materials.
- Advise farmers on efficient economic practices based on the reproductive data available from the FPR.
- Use for the planning exercises for breeding programmes.
- Research organisations can make good use of the information from FPR.

Results

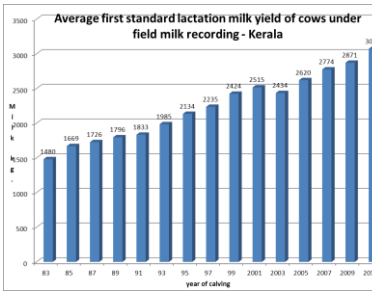
A summary of the activities taken up by the KLD Board is summarised in Table 5.

Table 5. Summary Statement of FPR programmes by KLDB

	KLDB
Period	1978-2005
Bulls tested	977
Bulls evaluated	691
Type of bull	CB
Av. AI per bull	1500
Semen stored	3000
Selection method	YB
Cows	2372
Comp. lactation %	79
Farmers awareness	Doubtful

(Source: personnel communication Jose James)

Figure 3. First lactation yield of crossbred co



The average first standard lactation milk yield of the recorded animals of the daughters of the bulls tested through years given as figure 3 (KLD Annual report2004-05) confirms that the KLDB programme has significantly contributed to the genetic improvement of the cattle in the state. The first standard lactation milk is increasing at an average rate 3.8 % annually

Strengths and weaknesses of FPR

Guaranteed availability of funds and resources are pre requisites for the sustainability of the project. The organisation implementing the FPR programme should have a reasonable autonomy to operate, a better understanding of its need and qualified persons for its management. Specific technical training in breeding strategies and FPR has received low priority in the last decade. Most technical problems within FPR are of a nature that they can be solved with a reasonable effort in research and development. It is felt that the early pioneering spirit in FPR cannot be found any more in many of the FPR programmes in the country. FPR is not a research project; it is an essential part of the breeding programme and as such is a continuous entity.

Strengths

- FPR as part of a well defined breeding programme: In Kerala and Gujarat FPR is employed for progeny testing and for selection of elite cows; and the context and role of FPR are well defined and accepted by all concerned including the main actors, the farmers.
- FPR as entry point for farmer participation in breeding: FPR can bring about real farmer participation. FPR can only be successful with true farmer involvement. In the KLDB and ISGP Rajasthan programmes this aspect has received adequate importance and attention. FPR is the most efficient tool for monitoring livestock performance at the smallholder level.
- FPR an alternative to large institutional farms: KLDB, NDDB and ISGP Rajasthan experiences show, that with FPR, the elite herd belonging to smallholder farmers can replace the bull mother herds maintained by the government at least partially. The selection intensity, which can be applied in the field, would be much higher than in institutional herds.
- FPR as the base for local breed development: The potential of FPR for local breed development has been recognised recently by the milk federation of Uttar Pradesh under the World Bank programme for development of Sahiwal cattle and Bhadawari buffaloes.

Weaknesses

- FPR has not been widely adopted: In spite of its acknowledged relevance and reasonably well-documented results, FPR has not been taken up in a wider scale. It has remained within a few organisations and is not yet a mainstream methodology.
- Government structures are not conducive for FPR programmes: The problems faced in many states funded by government of India are instances that give the message that government set-up cannot successfully operate a FPR programme.
- Emphasis in creation of awareness for FPR is not enough: In spite of the well-documented evidence of the merits of FPR, efforts on a national level to create awareness on the benefits of FPR are not satisfactory.
- The smallholder production system is not conducive: For the smallholder, dairying is only one of the many sources of income. Some FPR organisations still do have a top-down approach and fail to get real participation of the smallholders.
- Human and institutional developments not received sufficient attention: The major bottlenecks of FPR are in the area of human and institutional development. Attempts to bring the scientists around a table for concerted action in the field of FPR were not common. NDDB would the apt body to initiate action on this regard.
- The data analysis systems of the various FPR organisations have been developed in an iterative fashion. All the models used are adapted versions of models used in FPR systems with larger herds. More specific research and development in this important area of FPR is needed.

Future directions

Should genetic progress to happen selection is inevitable and FPR is a prerequisite. Though there are not many alternatives for FPR, planners and administrators do not understand its necessity. All states should have a small but well run unit for progeny testing of their future bulls especially the buffalo, the crossbred and the widely used zebu bulls. This herd of animals should also provide a good number of elite cows to produce the replacement bulls through nominated mating.

Since government departments cannot handle the FPR, it shall be contracted to co operatives/NGOs/Autonomous bodies on a clearly spelt out memorandum of understanding and for a sufficiently long period.

In India it is now time ripe to introduce acts and rules to prevent falsification of FPR records. The penalties for offences done in FPR should be in par with that prevalent in other developed countries.

A quick and simple method of FPR for estimating the milk yield is to be developed for states where starting of a full fledged FPR is difficult with a view to select elite cows for production of young bulls. This would enable government to get rid off the large contingent of useless stock maintained in government farms, which are redundant for the purpose for which it is maintained.

Breeder's Associations may be formed in areas where FPR is taken up and they may involve in the running of the programme. A massive campaign for awareness creation about the essentiality of FPR is to be carried out at all levels (from planners to farmers).

A long-term strategy for integrating FPR into the breeding programme of the states and steps for cost recovery may be made. Value addition for proven bulls' semen, charging for managemental advice and assisting farmers in animal transactions, etc. should support the FPR programme on a long run.

References

Chacko, C.T., 1998; Field performance recording. Input paper for 2nd CAPEX workshop, September 3-4, Bangalore- Attibele.

FAOSTAT. 2012. Agriculture data, Rome, Italy.

Goe, M. R., Chacko, C.T. & Tuller, M.,. 1999; Field performance recording. Approaches used in selected animal breeding programmes; Capex ;IC Bern.

Government of India, 1997; Basic animal husbandry statistics, Government of India; 1997.

Government of India, 2012, Annual Report 2011-2012, Department of animal husbandry & dairying; Government of India; 2012.

Groot B de, 1996; Experiences on animal recording in bilateral collaborative projects for livestock development in India. Pages 33-39 in J. Renaud and J. van Gelder (editors), Performance recording of animals, State of the Art. Proceedings of the 30th biennial session of ICAR, June 23-28, Veldhoven. European Association for Animal Production Publication No. 87. Wageningen Press, Wageningen ISPA, 1996.

Jose James,2013: Personnel communication

Kerala Livestock Development Board, 2007; Kerala Livestock Development Board Annual report 1999-2000; Trivandrum, Kerala.

Sastri, N.S.R., 1993; Animal husbandry in different agro-climatic regions of India; internal report; SDC, New Delhi;1993.

Trivedi, K.R., 1998; International workshop on animal recording for smallholders in developing countries; ICAR Technical Series 1; FAO, Rome. 1998.

Trivedi, K.R. 2002; Personal communication; 2002.