

TECHNOLOGICAL CHANGE IN MILK PRODUCTION
AN ANALYSIS OF CROSS - BREEDING IN KERALA

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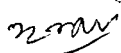
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I hereby affirm that the research for this dissertation titled, "Technological Change in Milk Production : An Analysis of Cross-breeding in Kerala" being submitted to the Jawaharlal Nehru University for the award of the Degree of Master of Philosophy in Applied Economics, was carried out entirely by me at the Centre for Development Studies, Thiruvananthapuram.

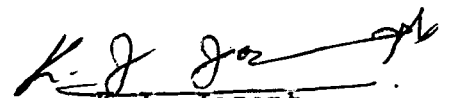


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ACHAN & AMMA

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Chapter 1

INTRODUCTION

1.1 The Problem

The contribution of livestock to the national economy has been well documented in a number of recent studies (A. Vaidhyathan, 1988; S.N. Mishra and R.K. Sharma, 1990; R.K. Patel, 1993). In 1990-91, the output from this sector contributed for about 8 per cent of GDP; its share in total agricultural output was about 24 per cent (Government of India, 1993). In the livestock sector, the dairy sub sector accounts for about 2/3 of the total output and it has been growing at a much faster rate than the agricultural sector. During the last two decades when the output of agricultural sector increased at a rate of about 2.5 per cent per annum that of dairy sector has increased at a rate of about 5 per cent. The production of milk which was about 20 million tonnes in 1970 increased to about 55 million tonnes by 1990. In value terms, at present, milk is the second largest agricultural commodity produced in India; the first being rice (R.K. Patel, 1993).

Recognising the importance of dairying in the Indian economy, a number of policies and programmes have been designed and implemented since the launching of economic planning. The content of development strategy pursued so far may be broadly divided into two distinguishable phases; first covering the period of the first three Five Year Plans (1951-66) and the second, the longer period of 1966 to the present (S.N. Mishra and R.K. Sharma, 1990). The approach to development during the first phase was marked by programmes and policies geared to indigenous breeding, feeding, disease control and veterinary cover. The second phase has been

marked by an approach in which cross-breeding of cattle with exotic European breeds and dairy commodity aid for financing investment constituted the crucial components. The second phase strategy, popularly known as the 'Operation Flood', is designed and implemented by the National Dairy Development Board (NDDB).¹ The components of the first phase strategy aimed at increasing milk production without adversely affecting the draught power need of agriculture. In the second phase, the draught power requirement to agriculture was relegated to the background. Intensive milk production through cross-breeding of cattle and investment in marketing and processing of milk received considerable attention. Further, dairy development has been viewed not only for achieving rapid break through in milk production and ensuring adequate supply of milk to the urban population but also as an instrument for the alleviation of rural poverty (G.Parthasarathy, 1991; Mascarenhas, 1988). Thus, over time, the rationale for dairy development has shifted from the objective of increasing milk production to that of dairy development as an instrument for rural poverty alleviation.

.The justification for adopting cross-breeding as a major component of the strategy for increasing milk production was the following: (1) The country faces an acute shortage of feed and fodder and (2) the indigenous breeds of cattle are inefficient converters of the scarce concentrate feed into milk. Since the crossbred cows are efficient converters of feed into milk, increase in the population of crossbred cows in the national milch herd has been considered as the most appropriate strategy for realising higher levels of milk production (Y.V.R.Reddy et.al 1981; Ram, Kubar and Singh, 1975; Patel et. al, 1976).

Critics of this strategy have questioned the rationale behind it on a number of grounds.² They argued that the primary role of cattle in the Indian economy is to meet the requirement of draught animals. Since crossbred bullocks are inefficient work animals, compared to the local breeds, the diffusion of crossbreeding may take place in regions where the requirement of draught animals in agriculture is very high. The creation of an elite herd of crossbreds would put further strain on the available feed resources (S. Singh, 1979; K.N. Nair, 1981). The increased claim of the elite herd on available feed and fodder would result in increase in feed prices unless there is significant reduction in the export of oil cake, expansion of area under cultivated green fodder and increase in the production of coarse grains. According to the critics these are unlikely to realise in the prevailing situation in the Indian economy. Therefore in a situation of increased feed prices, it would be difficult for the poor to participate in the utilization of this technology unless they received credit and subsidy for the purchase of feed and other expensive inputs.

Since the crossbred cows are more expensive and are prone to various diseases, the ownership of the crossbred cattle will be difficult and risky to the poor. Therefore, with the spread of cross-breeding technology the disparity in the ownership of milch animal holdings across size categories of land holdings may tend to widen. The new technology introduced at a time commercialisation of dairying through co-operative intervention may also result in higher outflow of milk from rural to urban areas and may adversely affect the consumption of milk in rural areas in general and producer households in particular.

Whatever may be the merits and demerits of the above arguments, analysis of the available data on the spread of cross-breeding reveals that it has taken place at a slow pace with considerable inter state variations. According to the estimates of the Planning Commission, the number of crossbred female cattle in 1989-90 was 9.7 million in the country. The concentration of crossbred female was more in the southern region (4.2 million) followed by the northern region (2.6 million), eastern region (2.1 million) and western region (0.8 million).³ The higher concentration of crossbreds in southern region appears to be due to the existence of cross-breeding programme for a long period in the states of Karnataka, Kerala and Tamil Nadu.

Since there has been uneven spread of the crossbred cattle across different regions in the country, an analysis of the trends and pattern in the diffusion of this technology in different states may provide a lot of insight into the constraints and scope for increase in milk production. The present study is a modest attempt in this direction and is carried out in the context of Kerala. A study of Kerala's experience with cross-breeding assumes importance since it is the only one state in the subcontinent which has made significant progress in the matter of upgradation of cattle using the technology (A. Vaidhyanathan, 1988)

A number of earlier studies has drawn attention to the significant achievement of Kerala in milk production through the application of cross-breeding technology (K.N. Nair, 1979, 1981; Gincey et. al, 1988; P.S. George et. al, 1989; P.S. George and K.N. Nair, 1990). Since considerable amount of fresh evidences are

available on the various facets of the cattle economy of Kerala during recent years, a reassessment of the Kerala experience using this data may be of considerable interest. The objectives and approach of the present study are briefly outlined below.

1.2 Objectives and Approach of the Study

The Objectives of the study are:

- (1) To examine the diffusion and adoption of cross-breeding technology in Kerala and its impacts on the productivity of milch cattle and production of milk in the state.
- (2) To bring out the benefits arising out of the technological change in milk production and its distribution.
- (3) To identify the factors governing the diffusion and adoption of cross-breeding technology.
- (4) To understand the changes taking place at the micro level on the diffusion, adoption and management of cross-breeding technology.

In order to achieve these objectives we have adopted an approach which incorporates some of the elements contained in the different approaches to the analysis of the diffusion and adoption of agricultural technology. In this context, it may be useful to clarify the meaning of the terms, diffusion, adoption and acquisition as used in the present study. Acquisition of technology, following Rogers (1962), can be defined as the primary introduction or the act of obtaining an alien technology. The process of modifying the technology and further developing it to

suit the local endowment and delivering it to the potential user is considered as diffusion. Here, adoption refers to the internalisation of the new technology in the production process.

The process of technology diffusion, following Brown (1981), could be examined in the following three perspectives : (a) adoption or epidemic perspective which emphasises the rate at which the technology diffuses over time; (b) market and infrastructure perspective which pre suppose a sound infrastructural network and (c) economic history perspective which treats innovation as a continuous process, tries to take into account the change in technology over time. Taken in isolation, none of these perspectives can provide a framework for analysing the diffusion and adoption of cross-breeding technology. However, it should be noted that certain elements of each of the above perspectives are relevant in the matter of dissemination of cross-breeding technology.

The applicability of these perspectives to any specific technology is conditioned by the nature of the technology and the context in which diffusion takes place. Most of the literature on technology diffusion in agriculture deals with the diffusion and adoption of HYV crops, which are different from the cross-breeding technology primarily in terms of the gestation lag involved. Diffusion and adoption of cross-breeding technology is more similar to that of tree crops than seasonal crops. Viewed in this sense, cross-breeding technology is more like a 'capital asset' and therefore appears to be similar to the industrial technologies. The similarity, however, ends here because in the case of

industrial technologies the adopter can make necessary adaptations to the technology so as to suit it to the local conditions. In the case of cross-breeding technology, such adaptations are not made by the farmer but by the diffusion agencies. Hence, the diffusion of cross-breeding technology also pre supposes the infrastructural facilities operating at the supply side. The diffusion of any technology cannot be delinked from the environment in which the adoption takes place. Here the demand side factors plays a crucial role and have to incorporated into the analysis. In this context, one need to take into account the broad changes in the agricultural sector in terms of: (1) shift in cropping pattern; (2) changes in the distribution of holdings; (3) farm mechanisation etc. These factors not only shape the rate and direction of diffusion process but also would play a crucial role in determining the distribution of the gains due to the diffusion of technology. Apart from this, it is also important to take into account, the role of the market in shaping the demand for milk, prices of inputs in milk production, extent of commercialisation and the price of milk as some of the important variables influencing technological change.

1.3 Data Sources

The major data sources of the study are the following :

- (1) Reports on various Quinquennial Livestock Censuses provided by Department of Animal Husbandry, Government of Kerala.
- (2) Reports on various Integrated Sample Surveys for estimation of production of Milk, Egg and Meat provided by the same department.

- (3) The Data on cattle holdings of Kerala available from the survey conducted by the Centre for Development Studies (CDS) in 1987.

In order to examine the extent of diffusion and pattern of adoption the data available from the Livestock Census Reports are utilised. The Integrated Sample Survey Reports are used mainly for the analysis of trends of productivity of milch cattle and the production of milk. The CDS data is used for understanding the distribution of gains from technological change in milk production and to analyse the temporal changes related to the diffusion, adoption and management of the technology at the farm level. For studying the temporal dimension of diffusion and adoption of cross-breeding technology, in order to supplement the CDS data, a Resurvey was conducted in one of the villages covered by the CDS study, in September and October, 1993. Apart from these, the data available from Kerala Livestock Development Board, Kerala Co-operative Milk Marketing Federation and from various Departments of the State Government are used to give a better understanding of the extent of institutional intervention in the livestock sector. A detailed note on the major data sources for the study is given in Appendix.

1.4 Outline of the Study

The rest of the study is organised as follows:

Chapter 2 will examine the diffusion and adoption of cross-breeding technology in the state. The impact of cross-breeding technology on the productivity of milch cattle and the production

milk in Kerala and the distribution of gains from the technological change in milk production are also discussed in this chapter. Chapter 3 discusses the factors governing the diffusion and adoption of the technology in the state. Chapter 4 gives the findings of the micro level study. The conclusion and policy implications of the study are discussed in chapter 5.

NOTES

1. 'Operation Flood' is a programme of integrated dairy development financed by the revenue from the sales of milk products received as food aid from European Economic Community (EEC) countries. For further details, see George, Shanti (1985 a, 1985 b), Martin Doornbos and K.N.Nair (1990) and R.C.Masceranhas (1988).

2. It is beyond the scope of this introductory section to provide a critical appraisal of the arguments for and against the cross-breeding technology and the associated components of the strategy for increase in milk production. A number of scholarly studies are already available on this subject (George, Shanthi, 1985 a ; Martin Doornbos and K.N. Nair, 1990; Martin Doornbos et.al, 1990 etc.).

3. The estimates of Planning Commission on the number of crossbred females, derived using the number of Artificial Inseminations (AI) done, are given below in the table:

Crossbred female population* (1989-90)

Region	Number of CB females	Number of AI with exotic bull semen
Northern	2.594	2.964
Southern	4.154	5.567
Eastern	2.147	1.664
Western	0.805	2.005
India	9.700	12.200

* Including female young stock.

Source : Planning Commission, Government of India,
New Delhi.

Chapter 2

DIFFUSION AND ADOPTION OF CROSS-BREEDING TECHNOLOGY: TRENDS, PATTERNS AND EFFECTS

Introduction

Kerala has witnessed a rapid increase in milk production over the last twenty five years. A number of factors were responsible for this significant achievement. Among them, the most important factor identified by earlier studies is the diffusion and adoption of cross-breeding technology (K.N. Nair, 1979, 1981; Gincey et.al, 1988; P.S. George and K.N. Nair, 1990). However, there has been no systematic attempt to examine (a) the trends in the diffusion of technology (b) its pattern of adoption across different size group of farmers (c) impact on the productivity of milk animals and production of milk and (d) the distribution of benefits among different sections of the population. In this chapter we have made an attempt to analyse these issues.

The organisation of rest of this chapter is as follows. Section 2.1 analyses the diffusion and adoption of cross-breeding technology. Section 2.2 examines the effect of technological change on productivity of milch cattle and production of milk. Section 2.3 will discuss the distribution of gains from technological change in milk production. Finally, Section 2.4 concludes the chapter.

2.1 Diffusion of Cross-breeding Technology

The acquisition and modification of cross-breeding technology in Kerala is primarily carried out by the Kerala Livestock Development Board (KLDB), earlier known as the Indo-Swiss project. The technology was acquired from the Government of Switzerland through a bilateral agreement between the Governments of India and of Switzerland.¹ The technology acquired has been modified by KLDB to suit the socio-economic and agro-ecological conditions prevailing in the State. Artificial Insemination (AI) using frozen semen was the technique adopted for implementing the breeding programme because superior genetic material could be disseminated faster and wider compared to natural service. The extent to which the diffusion of technology has taken place in the state could be understood by analysing the trends in artificial insemination and the extent of its utilisation at the farm level.

2.1.1 Trends Artificial Insemination

Data on the number of AI done in the state is available from the Department of Animal Husbandry. Until the mid seventies, since the AI was done free of cost there was a tendency among the AI centres to exaggerate the number of AIs done so as to show their fine performance. However, from the mid seventies, a fee was levied on the AI and therefore, the data kept is likely to be more accurate. The number of AI done in the early seventies was around 0.5 million and it increased to 1.5 million in the early nineties. Though this is a remarkable achievement, the rate of growth of AI has been at a slower pace in recent years (See Figure 2.1).

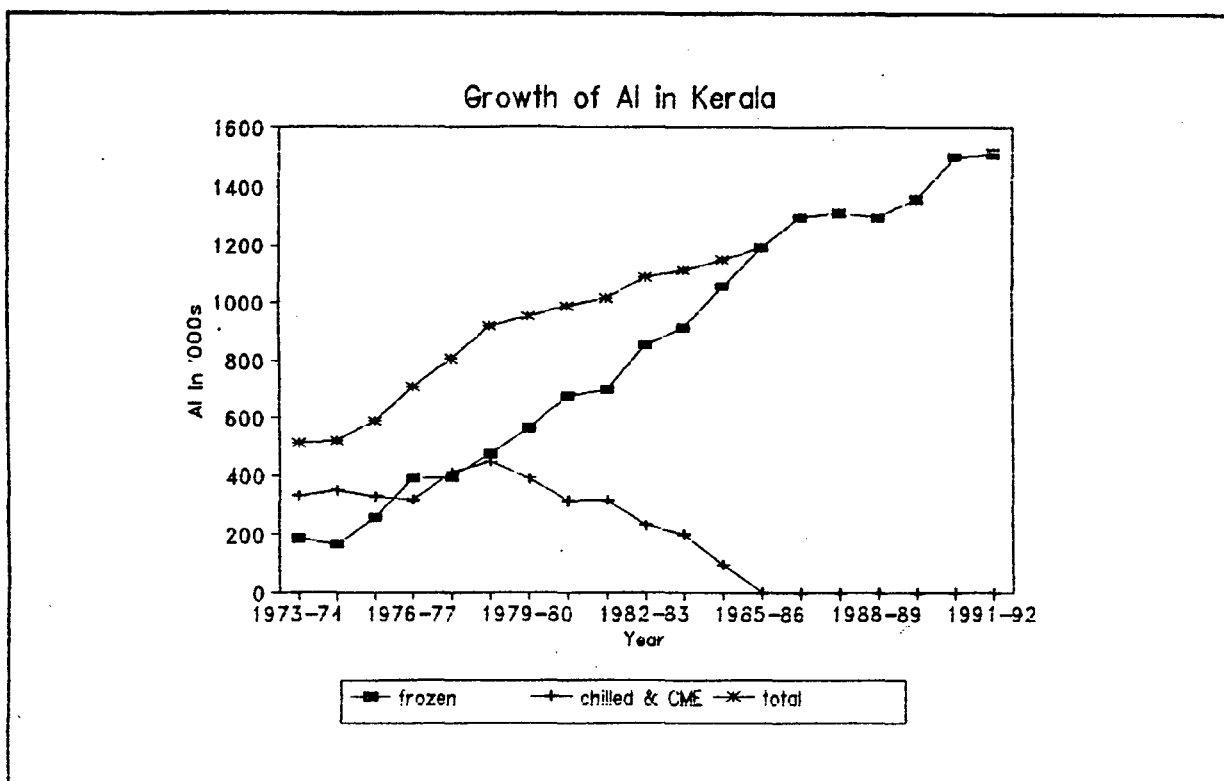


Figure 2.1

An early study has attributed this slow growth to the following facts : (a) in areas where the programme has been in operation for a long time, a stage of equilibrium was reached between the diffusion of technology and prevailing socio-economic conditions and (b) expansion to new areas was limited (George et.al, 1989).

The extent to which AI is utilised for cattle breeding at the farm level is evident from the data collected in the CDS study. Data on breeding practice by size of holdings and by breed of cattle showed that in the case of local breeds the percentage of cows under natural services was higher than under AI. (Table 2.1). However, among crossbreds AI was the dominant technique. There was no systematic variation in the case of AI across land holding categories. On the whole, the picture that emerges was the of AI dominance of AI over natural services in the state.

Table 2.1: Breeding Practice followed by the farmers

Size of holdings (Cents)	Percentage of local cows Using				Percentage of crossbred cows Using			
	AI	NS	Not known	Total	AI	NS	Not known	Total
Below 10	30.0	44.7	25.3	100.00	50.7	10.1	34.1	100.00
11 - 50	37.7	34.0	28.3	100.00	35.4	14.5	50.0	100.00
51 - 100	40.0	45.0	15.0	100.00	50.0	14.1	34.9	100.00
101 - 250	45.4	33.3	21.3	100.00	41.2	20.6	38.2	100.00
Above 250	32.0	44.0	24.0	100.00	45.4	15.1	39.5	100.00
Total	37.6	39.2	23.2	100.00	44.1	15.2	40.7	100.00

Note: AI: Artificial Insemination ; NS: Natural Service;

Not Known: In the case of purchased cattle the method of breeding was not known.

Source: P.S George and K.N Wair, 1990.

What is the extent to which diffusion of AI technique has resulted in the adoption of crossbred cattle in the state? In order to understand this question it is important to keep in mind the sequence in which diffusion of AI could result in the cumulative adoption of crossbred cattle. In the first stage, AI is performed on the local, non-descript cattle. The calves born from this will be the first generation of crossbreds. However, when they pass through the breeding and reproductive cycle, a second generation of crossbreds will be born. Thus, with the diffusion of AI, the population of crossbreds will increase from the crossbred calves of the local breed as well as that of the calves of the crossbred cows. The extent to which such genetic transformation has resulted in aggregate adoption of crossbred cattle in the state could be understood by analysing the breed composition of cattle population.

2.1.2 Breed Composition

Data relating to the breed composition of cattle population are available from the Quinquennial Livestock Census from 1977 to

Table 2.2 : Percentage of Crossbred Cattle in the Cattle Population of Kerala

Year	Female Crossbreds ('000)	Total crossbreds (,000)
1977	138 (50.51)	355 (45.08)
1982	1236 (50.7)	453 (46.93)
1987	1503 (51.5)	701 (49.6)

Note : The figures in brackets indicate percentages to the total number of female cattle and of the total number of cattle respectively.

Source: Government of Kerala, Department of Animal Husbandry, Report on Fourteenth Quinquennial Livestock Census, 1987.

1987.² This data is given in table 2.2. While interpreting this data it should be kept in mind that the percentage of crossbreds was very low in the state in the early seventies (K.N. Nair, 1979) and it quickly reached to a level of 45% by 1977. The subsequent rate of increase has been slower.

Coming to the region wise pattern of adoption, it was observed that while the southern districts of the state had a higher proportion of the crossbred cattle, northern districts showed the reverse pattern (Table 2.3). This regional variation may be due to the fact that the northern districts are backward in the matter of infrastructure development (such as number of AI centres) related to cross-breeding technology.

Table 2.3 : Classification of Districts according to percentage share of crossbreds in total Cattle Population - 1987

% share of CBs in Cattle population	Districts
Less than 20%	Kasaragod (13.2)
20% - 40%	Kozhikkode (28.92), Malappuram (31.38), Palakkad (34.16), Kannur (37.45).
40% - 60%	Wynad (41.44), Thrissur (49.72), Ernakulam (54.20), Pathanamthitta (57.22), Kollam (59.89).
Above 60%	Idukki (63.59), Alappuzha (66.50), Thiruvananthapuram (73.21), Kottayam (74.88) .

Note: Bracketed figures are percentages.

Source: same as table 2.2

2.1.3 Pattern of Farm Level Adoption

The pattern of adoption of crossbred cattle across size of land holdings is available from the CDS survey. As we have discussed elsewhere (Appendix), this survey covered 27 villages spread all over the state. Analysis of the data on the distribution of villages according to the percentage of crossbred

Table 2.4 : Distribution of Villages according to the percentage of Crossbred cows in the total population in each size groups

Size of holdings (Cents)	Number of Villages with percentage of Crossbred Cows					
	< 20%	20-29	30-39	40-49	50-59	60 and above
Upto 10	9	6	6	3	2	1
11 - 50	9	8	4	2	2	2
51 - 100	9	4	6	4	3	1
101 - 250	6	4	6	4	3	1
Above 250	5	7	3	4	3	5
Total	7	6	6	6	1	1

Source: Same as table 2.1

cows in the total cattle population in each size holdings indicated that the smaller holdings had a lower percentage of crossbreds (Table 2.4).

The modal class for the distribution of villages remained in the category of less than 20 per cent crossbred cows for the three land size groups upto 10 cents and then it shifted to the category of 20-29 per cent and 40-49 per cent for the next two groups. Thus, it appears that the higher land size groups had a higher tendency of adoption of crossbred cows. It was also noted that the percentage of cattle holdings with crossbred cattle tends to vary with increase in the size of land holdings. However, this inter group variation is seen to be very small in the holdings of less than 50 cents, but was very striking in the highest size group (Table 2.5). Thus size of holdings seems to be an important factor influencing the pattern of adoption of crossbred cattle.

Table 2.5 : Percentage of Cattle holdings with crossbreds in different size of holdings

Size of holdings (cents)	Percentage of Crossbred Cattle holdings in total cattle holdings
Upto 10	41.75
11 - 50	41.84
51 - 100	49.01
101 - 250	54.96
Above 250	81.34

Source: Same as table 2.1

Since the percentage of crossbred cattle in the total cattle population and the proportion of cattle holdings with crossbred cattle to total cattle holdings tend to increase with size of land holdings, we may conclude that the extent of adoption of crossbred cattle is relatively more in the larger size of holdings.

2.2 The Effect of Technological Change on Productivity of Milch Animals and Production of Milk

The data collected by the Department of Animal Husbandry, from their sample survey for the estimation of milk production is used for analysing the impact of technological change on productivity of milch cattle and production of milk in the state.

2.2.1 Impact on Productivity

A number of studies emphasised the superiority of crossbreds over their indigenous counterparts (Ram, Kubar and Singh, 1975; Patel et.al, 1976, K.N. Nair, 1985). Compared to local cows, crossbreds have lower age at first calving, longer lactation period lower dry period and shorter calving interval. Given such advantages, the large scale diffusion and adoption of cross-breeding technology would have resulted in substantial increase in the productivity of milch animals (K.N. Nair, 1981, Thara S. Nair, 1988; P.S. George et.al, 1989).

Table 2.6 depicts the trends in productivity of in-milk and milch cows. The estimated average milk yield per in-milk cow was about 2.5 kg. and that of milch cow was about 1.3 kg in 1977-78. But by early nineties, the average yield per in-milk cow increased to 3.8 kg and that of milch cows to 2.6. Thus, since mid seventies both productivity per in-milk cow and per milch cow rose by 51 per cent and 101 per cent respectively.

Table 2.6 : Trends in productivity of in-milk and milch cows

Year	Average Milk Yield					
	per in-milk cow (Kg)			per milch cow (Kg)		
	ND	CB	TOTAL	ND	CB	TOTAL
1977-78	1.642	3.230	2.475	0.851	1.756	1.317
1978-79	1.645	3.315	2.522	0.860	1.882	1.375
1979-80	1.625	3.414	2.567	0.848	1.998	1.419
1980-81	1.587	3.582	2.642	0.813	2.137	1.462
1981-82	1.627	3.821	2.787	0.836	2.346	1.567
1982-83	1.646	3.758	2.802	0.871	2.620	1.707
1983-84	1.695	3.800	2.861	0.901	2.779	1.710
1984-85	1.690	3.949	2.968	0.874	2.968	1.865
1985-86	1.718	3.998	3.089	0.884	2.901	1.927
1986-87	1.694	3.943	3.109	0.882	2.846	1.963
1987-88	1.577	4.523	3.323	1.037	3.162	2.151
1988-89	1.844	4.612	3.417	1.125	3.227	2.248
1989-90	1.622	4.991	3.513	1.063	3.543	2.408
1990-91	1.725	5.187	3.672	1.145	3.699	2.536
1991-92	1.749	5.259	3.781	1.155	3.755	2.611

Source: Government of Kerala, Department of Animal Husbandry, Report on sample survey for estimation of production of milk, egg and meat, various years.

The growth rates of productivity of in-milk and milch animals since mid seventies were computed using the following log quadratic functional form³ :

$$\ln(Y) = A + Bt + Ct^2 + e$$

The estimated values of the coefficients are given in

Table 2.7.

The growth rates showed that for both in-milk and milch cattle, the productivity of crossbreds were higher compared to non-descriptis. While the growth rates of in-milk and milch animals in crossbreds are 3.45 per cent and 5.35 per cent, the corresponding percentages for their local counterparts are 0.46 and 2.48 respectively. A closer examination of the table shows that : (1) while the productivity of crossbreds in-milk is increasing at an

Table 2.7: Trends in Productivity of Cattle - Regression Results

Equation number	Dependent variable	Constant (A)	Coefficient of time (B)	Coefficient time ² (C)	R ²	Growth Rate
1	Productivity of ND in-milk	0.51109	0.00463 (2.04489)	0.00013 (0.21676)	0.2606	0.46
2	Productivity of CB in-milk	1.37490	0.03450 (17.48140)	0.00119 (2.31546)**	0.9628	3.45
3	Productivity of total in-milk cattle	1.09037	0.03082 (48.67155)	0.00058 (3.53486)*	0.9950	3.08
4	Productivity of milch cattle-ND	-0.11413	0.02477 (9.44723)	0.00256 (3.75094)*	0.8959	2.48
5	Productivity of milch cattle-CB	1.02937	0.05354 (22.13324)	-0.00192 (-3.04867)*	0.9765	5.35
6	Productivity of total milch cattle	0.60254	0.05604 (45.41937)	0.00037 (1.28663)	0.9942	5.06

* - Significant at 1% level

** - significant at 5% level

Note: Figures in parenthesis are corresponding t values.

increasing rate, that of crossbred milch cattle is increasing at a declining rate. (2) Though the growth rate of productivity of in-milk animals in non-descript category was found neither accelerating nor decelerating, in the case of non-descript milch cattle, the rate of growth of productivity was found increasing at an increasing rate. The above facts can be explained as follows:

The increasing trend in growth rate of productivity of in-milk animals along with a declining trend in that of milch animal in crossbreds indicate that it is the dry animals in the crossbred milch cattle that bring down the rate of growth of productivity. However, the percentage of dry animals to the total milch cattle was found smaller among crossbreds compared to non-descripts. So the other possible explanations are : (a) a considerable portion of

dry animals in crossbreds must be those with higher order of productivity and (b) since rearing crossbreds is expensive, the dry animals in the crossbred category might be getting inadequate attention compared to wet ones and this might have resulted in a prolonged dry period of the animals and thus resulted in the declining trend in growth rate of the milch animal productivity. However, there is no data available to substantiate this.

The increasing trend in the growth rate of in-milk animals in the non-descript category may be attributed to the 'spill over' effects of the diffusion of cross-breeding technology. The local cows may be getting more attention than before due to the change in practices of feeding, animal care etc. since the advent of high yielding varieties of animals.

2.2.2 Impact on Milk Production

In the earlier section we found that the average yield per milch animal was increasing since mid seventies, especially due to the increase in crossbred cow's productivity. In the meanwhile, the milch animal population also increased considerably of which larger share owes to crossbreds.⁴ The increase in the productivity coupled with increase in population (especially those of crossbreds) resulted in a notable gain in production (K.N.Nair, 1981; Thara S. Nair, 1988). The growth of cow milk production in the state is depicted in Table 2.8.

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**Table 2.8 : Cow milk production
in Kerala ('000 tonnes)**

Year	ND	CB	Total
1977-78	196	428	624
1978-79	206	460	666
1979-80	211	491	702
1980-81	210	529	739
1981-82	222	583	805
1982-83	238	658	896
1983-84	255	711	966
1984-85	254	774	1028
1985-86	241	847	1088
1986-87	230	908	1138
1987-88	283	949	1232
1988-89	305	1003	1308
1989-90	284	1118	1402
1990-91	307	1185	1492
1991-92	307	1269	1576

Source : same as table 2.6

The growth rates were calculated to get the trend in milk production in the state using the data given in the Table 2.8. The functional form used for computation is :

$$\ln (Y) = A + Bt + Ct^2 + e$$

The estimated values of the coefficients are given in Table 2.9.

Table 2.9: Trends in Milk Production - Regression Results

Equation Number	Dependent Variable	Constant (A)	Coefficient of time (B)	Coefficient of time ² (C)	R ²	Growth Rate
1	Cow milk production	6.91887	0.06765 (66.506)	0.00054 (-2.03729)**	0.9973	6.76
2	CB cow milk production	6.6385	0.07943 (63.75744)	-0.00100 (-3.08018)*	0.9971	7.94
3	ND Cow milk production	5.50720	0.03256 (9.68475)	0.00015 (0.17078)	0.8867	3.26

* - Significant at 1% level.

** - Significant at 10% level

Note: The figures in parenthesis are corresponding t values.

It is clear from the table that growth rate for crossbred milk production (7.94 per cent) is significantly higher compared to that

of non-descript (3.26 per cent) and it is the higher growth rate of crossbred milk production that has contributed to higher growth rates for total cow milk production (6.77 per cent). The analysis of the trends in rate of growth of milk production showed that while the total cow milk production shows a slight tendency to increase at an increasing rate, the crossbred milk production is found increasing at a declining rate. This tendency can be explained by the declining trend in the rate of growth of productivity of the crossbred milch cattle.

2.3 Distribution of Gains from Milk Production

Though, the state has been witnessing rapid increase in milk production due to the diffusion and adoption of crossbred cattle the distributional aspects of this technological change did not receive the desired level of attention. In this context, an analysis of the available evidence on the gains to producers and consumers of milk may be of considerable interest.

2.3.1 Gains to Producers

Distribution of gains to producers can be explained by looking into (a) distribution of crossbred milch animal holdings and (b) distribution of benefits from ownership of crossbreds.

Data on the distribution of crossbred cows by size of holdings was collected and analysed in the CDS study. The major observations are the following: (a) the percentage of households with crossbreds cows tend to increase with size of land holding; a

pattern similar to ownership of total cattle and size of holding. (b) the average number of crossbred cows showed a positive association with size of land holdings. (c) crossbred cows as a percentage of total cows showed a positive association with size of land holding and (d) larger holdings tend to have a higher percentage of cows in milk than the smaller holdings. It is evident from these findings that the smaller holdings are in a disadvantageous position in relation to the ownership and distribution of crossbred cows. This fact is best brought out in the following extract from the study :

"The distribution of crossbred cows in the different size groups indicated that 21 per cent of the households with less than 10 cents owned 6 per cent of the total crossbred population and 35 per cent of the households belonging to the next category (11-50 cents) owned 21 per cent of the crossbred cows. It may be recalled that the distribution of total cattle indicated 6 per cent in the size group of less than 10 cents and 26 per cent in the next group. In other size groups also the distribution of crossbreds followed the distribution of total cattle. The concentration ratio for crossbred animals was 0.633 as against 0.639 for all cattle indicating the distribution of crossbred animals had only a slightly higher level of inequality than the distribution of all cattle."

P.S. George and K.N. Nair, 1990; pp 49-50

As discussed earlier, the adoption of crossbreds across size groups of farms may have taken place either through the crossbred calves born out of the AI done on local cows or by acquiring crossbreds through purchase. At the early stages of diffusion and adoption of the crossbreeding technology the former method would have played the major role. But over time, with the development of cross-breeding, the latter method also might have contributed to the adoption process. In this context an analysis of the mode of

acquisition of crossbred cattle by size of land holding has shown that in the lower size of land holdings, purchase constituted the dominant mode of acquisition. As the size of holdings increased the relative importance of purchase declined. Though, a similar pattern is also observed in the case of local cattle, this is more striking in the case of crossbreds (Table 2.10). Thus, acquisition of crossbreds through purchase is an important mechanism by means of which its ownership has become more widespread in the lower size group of holdings.

Table 2.10 : Mode of Acquisition of milch cows by size of holdings (in percentage)

Size of holdings (cents)	Mode of Acquisition by breed					
	Crossbred			Local		
	Homebred	Purchased	Lease	Homebred	Purchased	Lease
Below 10	8.0	71.0	1.0	37.5	56.2	6.3
11-50	24.7	75.3	..	31.3	59.7	9.0
51-100	36.7	63.3	..	29.0	69.0	2.0
101-250	50.7	49.3	..	48.9	50.0	1.3
Above 250	52.3	47.7	..	59.3	33.9	6.8
Total	39.7	60.3	..	41.7	53.4	4.9

Source : Same as Table 2.1

Because of the close association between purchase of crossbreds and its ownership, it is important to examine the mode of financing such purchases. In this context, the CDS study has shown that about 3/4 of the animals were purchased using resources with the farmers without any external sources. In the remaining cases, some amount of loan was utilised to meet either the full cost or part of the cost. About 76 per cent of the animals purchased using subsidy belonged to the households with less than half an acre of land. They also reported that the decision to own

cattle was influenced by the amount of subsidy. Only about 7 per cent of the households reported lack of/inadequate credit facility as a constraint for the adoption of cross-breeding.⁵

It is clear from the foregoing discussion that the benefits of cross-breeding in terms of milch animals as a capital asset has percolated into the lower size group of holdings through the market mechanism. However, this process has not reduced the inequality in the distribution of this asset. Therefore, one would expect the distribution of gains from the use of this asset also to follow more or less the same pattern. However, before drawing such conclusions, it may be also necessary to look at the differences in the allocation of resources in milk production and its productivity and returns across the different size group of holdings. Some data available on this from the CDS survey will be examined below.

Table 2.11 : Average daily feed intake of crossbreds according to size of holdings (Kgs/day/animal)

Size of holdings (cents)	Crossbreds in milk			Crossbreds dry		
	GF	DF	CON	GF	DF	CON
Below 10	12.95	3.81	3.61	23.30	1.00	2.99
11-50	14.26	4.62	2.90	20.03	4.33	2.80
51-100	8.82	5.00	2.71	17.34	3.09	2.50
101-250	10.01	6.34	3.16	8.30	3.60	2.53
Above 250	9.47	6.61	2.96	9.70	4.80	2.46
Total	11.13	5.37	3.04	13.28	3.70	2.59

GF : Green fodder ; DF : Dry fodder ; CON : Concentrates
Source : Same as table 2.1

The intake of different types of feed by crossbreds in milk and dry by size of land holding is given in Table 2.11. The data shows no systematic pattern in the quantum and quality of feed use

per animal across size groups of land holdings. However, the CDS study has shown that the smaller holdings depended more on the market for feed. Coming to the use of human labour in milk production, no separate estimates were available for crossbred cows as such from the CDS study. However, the general finding about the labour use in cattle keeping is that the smaller holdings tend to use more labour compared to the larger holdings and that about 2/3 of the labour employed is female labour. There is hardly any hired labour use in cattle-keeping. In the absence of data on labour use, it is not possible to estimate the actual cost of production. However, to get some insight into the size class variations in cost of production, we have examined the estimates of per litre cost of material inputs in milk production across size of holdings and lactation / dry periods for the crossbred cows. This data is given in Table 2.12.

Table 2.12 : Per Litre Cost of Milk Production of Crossbreds

Size of Holdings [acres]	Cost/Litre during lactating period	Cost/Litre [lactating + dry period]
Below 0.10	2.48	3.37
0.11 - 0.50	2.30	3.80
0.51 - 1.00	2.22	3.07
1.01 - 2.50	2.60	3.94
Above 2.50	3.87	4.02
Total	2.41	3.70

Source : Same as table 2.1

The estimates showed that cost of production is marginally lower in the bottom three size groups compared to the top two size groups. This marginal advantage of the bottom size groups is likely to disappear if we also impute the cost of labour. It

appears from the CDS study that there is unlikely to be any significant variation in the cost of milk production across different size group of producers. It is also pointed out in the CDS Study that for the lower size groups, raising crossbred cows in particular and milk animals in general is the way of gainful employment of family labour. For the higher size groups, it is both the means to use family labour and agricultural byproducts.

It appears from the foregoing discussion that it is unlikely to expect significant differences in the cost of milk production across different size group of holdings. Therefore the benefits from milk production using the cross-breeding technology among producers is likely to be distributed according to the distribution of crossbred cows across size groups of holdings.

2.3.2 Gains to Consumers

The increase in milk production in Kerala in the seventies has resulted not only in increase in levels of consumption of milk but it has also become more broad based (K.N. Nair, 1981). As we see later in chapter 3, the share of expenditure on milk in the total consumption expenditure has shown a marginal increase over time. This combined with the fact that the milk prices has been increasing at a slower rate than the general price increase in food indicates that there has been some amount of increase in the levels of per capita consumption of milk. However, what is important to note is that in the absence of the technological change in milk production, the milk prices would have increased at a much faster rate and therefore the consumers would have ended up paying a

higher price for milk. It follows from this that the consumers has potentially gained from the increased milk production due to technological change. Since there is skewness in the distribution of milk consumption across different expenditure groups (higher expenditure groups tend to have higher level consumption), as shown in Table 2.13, the potential gains from increased milk production is likely to be higher among consumers belonging to the higher expenditure groups.

Table 2.13 : Per capita milk consumption according to expenditure groups - Kerala

Household Monthly Per capita Expenditure group	Consumption of home produced milk (ltr.)		Purchase of milk (ltr.)	
	Rural	Urban	Rural	Urban
Upto Rs.9	0.52	1.00
Rs.10-19	0.09	0.05	0.06	0.06
Rs.20-29	0.14	0.09	0.13	0.13
Rs.30-39	0.26	0.17	0.23	0.27
Rs.40-49	0.45	0.28	0.32	0.51
Rs.50-59	0.79	0.42	0.52	0.76
Rs.60-69	1.04	0.72	0.67	1.07
Rs.70-79	1.78	1.17	0.89	1.53
Rs.80-89	1.55	1.18	0.95	2.09
Rs.90-99	2.08	1.43	1.01	2.12
Rs.100 & above	3.83	1.36	2.13	4.95
Not recorded	..	0.46	..	0.58
All classes	0.69	0.47	0.44	1.06

Source: Government of India, National Sample Survey Organisation, Sarvekshana, Vol. II, No. 2, Oct. 1978.

2.4 Conclusion

The foregoing examination of the trends and pattern in the diffusion of cross-breeding technology in Kerala, its impact on productivity of milch animals and production of milk and the analysis of distribution of gains from the technology came to the following conclusions:

1. Artificial Insemination was found as the dominant technique of cattle breeding in the state. However, recently, there has been a decline in the rate of growth of utilisation of AI. The analysis of the data on breeding practice by size of holdings and by breed of cattle showed that natural service was dominant in the case of local cows; where as, AI was prominent among crossbreds. No systematic variation in the utilisation of AI is noticed across land holding categories.
2. The aggregate level of adoption has reached some kind of equilibrium in recent years. This is evident from the very small increase in the proportion of crossbreds in the total milch animal holdings. Coming to the adoption across the size groups it is found to be relatively higher in large size holdings compared to smaller size groups.
3. The large scale diffusion and adoption of cross-breeding technology resulted in an increase in the matter of both productivity of milch animals and production milk in the state. The analysis of productivity figures exposed the fact that the rate of growth was higher among crossbreds compared to local cows. The analysis on milk production also reaffirmed the importance of crossbreds' contribution. However, the rate of growth of productivity of milch animals in crossbreds showed a statistically significant trend of deceleration. This is further reflected in a slight decelerating tendency in the rate of growth of crossbred milk production also.

4. Analysis of distribution of gains among milk producers shows that it is more or less in tune with the distribution of crossbreds across size groups of holdings. In the case of consumption, people belonging to the higher expenditure group has potentially gained more than those belonging to the lower expenditure groups.

The foregoing discussion showed a rapid diffusion and adoption of cross-breeding technology in Kerala. In the next Chapter, we shall examine the factors governing the diffusion and adoption.

NOTES

1. The Indo-Swiss project was established in 1963 in the high ranges of Kerala with the main objective evolving breeds of cattle which are suitable for Kerala's ecological and environmental conditions for achieving rapid break through in milk production during the shortest time period. For this, the project has adopted the technique of cross-breeding using high yielding exotic breeds for improving the genetic quality of the local and non-descript cattle.

2. We do not have data base to analyse the rate of growth of spread of crossbreds till 1977, since the data on crossbreds is available only from 1977. However, estimates of percentage of crossbreds prior to 1977 is available in K.N. Nair, 1979.

3. The functional form is selected by observing the trend from the scatter plot.

4. The table given below shows the increase in number of in-milk and milch animals in the state since mid seventies. The table also shows that increased share of crossbreds in the both in-milk and milch animal herd.

Percentage of Crossbred cows to total in-milk & milch cows

Year	in-milk cows (lakhs)			milch animals (lakhs)		
	Total	CB	%	Total	CB	%
1977-78	6.907	3.630	52.56	12.984	6.661	51.30
1978-79	7.236	3.806	52.60	13.270	6.705	50.53
1979-80	7.491	3.944	52.65	13.553	6.739	49.72
1980-81	7.663	4.042	52.75	13.845	6.773	48.92
1981-82	7.914	4.179	52.81	14.072	6.805	48.36
1982-83	8.760	4.794	54.73	14.377	6.874	47.81
1983-84	9.249	5.127	55.43	14.747	7.012	47.55
1984-85	9.489	5.371	56.60	15.106	7.146	47.31
1985-86	9.649	5.802	60.13	15.466	7.990	51.66
1986-87	10.025	6.306	62.90	15.886	8.736	54.99
1987-88	10.130	5.735	56.61	15.650	8.202	52.41
1988-89	10.485	5.957	56.81	15.934	8.516	53.45
1989-90	10.929	6.136	56.14	15.946	8.629	54.11
1990-91	11.320	6.259	55.29	16.120	8.777	54.45
1991-92	11.417	6.609	57.89	16.534	9.256	55.98

Source: Government of Kerala, Department of Animal Husbandry, Report on sample survey for estimation of production of milk, egg and meat, various years.

While the growth rates of total in-milk and milch animals were 3.7 per cent and 1.75 per cent respectively those of CBs were 4.5 per cent and 2.6 per cent respectively. Clearly indicating that the increase in total milch animal herd is mainly due to the increase in crossbred population.

5. For details see P.S. George and K.N. Nair, 1990 pp 127-128.

Chapter 3

FACTORS GOVERNING THE DIFFUSION AND ADOPTION OF CROSS-BREEDING TECHNOLOGY

Introduction

The fact that Kerala has succeeded in achieving increase in milk production through the utilisation of cross-breeding technology is evident from the preceding chapter. This was noted in some of the earlier studies (K.N. Nair, 1979, 1981) and explained in terms of the growth in demand for milk, increase in profitability of milk production and higher level of commercialisation on the one hand and the institutional intervention by the state in promoting cross-breeding through investment in infrastructure on the other. Though, these explanations are interesting, in the absence of adequate empirical support, have to be treated tentative and warrants further investigation. This chapter will attempt to do this by analysing the available evidence for recent years.

The organization of rest of the chapter is as follows. Section 3.1 will highlight the growth in infrastructure for the development of cross-breeding technology and the policies and programmes underlying it has contributed to the diffusion process. Section 3.2 will examine the changing role of cattle in the farm economy. Here, the analysis is confined to the factors operating in the farm economy that have facilitated a shift in the pattern of demand for bovine stock from draught power to milk. Section 3.3 will examine the extent to which institutional intervention in the area of

commercialisation of dairying helped diffusion and adoption of the cross-breeding technology. In section 3.4 we have made an attempt to bring out changes in economic viability of milk production. The main findings of the chapter are summarised in section 3.5.

3.1 Infrastructure and Technology Diffusion

Organised attempts to improve the genetic quality of cattle in Kerala began on a scientific basis during the post-independence period. The need for enhancing milk production is well recognised by all the successive state governments and have introduced various cattle development programmes from time to time.

(i) Breeding Policy and Strategy

During the First Five Year Plan, the Key Village Schemes (KVS) were introduced (Government of Kerala, 1989). Under this scheme 50 Artificial Insemination Centres, covering a breedable cattle population of 50,000 were started. The programme was designed to upgrade the indigenous cattle using the breed, 'Red Sindhi'.¹ The first pilot project for cross breeding with Exotic Jersey Cattle was introduced in Neyyattinkara and Chalakkudy blocks during 1955.² Initially, the principal focus of KVS was on increasing the supply of breeding bulls by setting up bull mother farms.³ However, gradually, the KVS was transformed into a more comprehensive programme for general cattle development intended to improve the productivity of cattle by giving simultaneous attention to better feeding, improved breeding, effective disease control measures, and organised marketing facilities.⁴ However the impact of KVS was not

impressive due to the limited coverage, inadequate infrastructure, insufficient funds, non-availability of pedigree bulls in sufficient numbers, gloomy adoption rate of cross breeding etc. In 1963 government introduced a 'Hill Cattle Development Project' on an experimental basis in Kanjirappally with a scheme for cross breeding local cattle with exotic Jersey. This also failed to bring desirable results.

The Key Village Schemes were later followed by the Intensive Cattle Development Project (ICDP) which was launched in 1969, as a part of All India Special Programme for Cattle Development and a large number of KVS were merged with these projects, which covered around one lakh breedable female cattle.⁵ It was an integrated scheme with the specific objective of stepping up the overall milk production in a particular area to a targeted level within a specific period by improving the quality of the animal through cross-breeding. It also gave greater emphasis to the provision of animal healthcare facilities and extension services.

In 1963, the Indo-Swiss Project Kerala (ISPK), for cattle breeding, fodder production and dairy development was started as a joint project by the Government of India and the Swiss Confederation. A cattle breeding policy for the state for the first time was formulated by the Indo-Swiss Project, Kerala, aiming the building up of a crossbred animal herd having definite percentage of exotic and indigenous inheritance. The basic philosophy behind this policy is that the new breed evolved should not be a pure exotic breed; but an animal suitable to local

conditions. Both the parent breeds have to make important contribution ; adaptability (such as heat tolerance, disease resistance, hardiness etc.) should come from local breed, whereas the exotic breed aids the milk production potential. The breeding policy targeted to develop a gene pool with a theoretical average of 62.5 per cent exotic and 37.5 per cent indigenous inheritance. This is brought about by two forward crossings and one backward crossing between the 3/4 (75 per cent) and 1/2 (50 per cent) generation, so that the blood level remain more or less static.⁶ In a later phase of the programme intensive selection within the crossbreds was envisaged to build up an economically viable stock in natural balance with local ecology.

The above breeding policy was followed in the state till 1980. In 1978, a Committee of Experts was appointed by the Government of Kerala to review cross-breeding activities in the state and to make recommendations on breeding policy. The committee submitted its report in 1980. They observed that there was no significant difference in production programme of animals with a 50 per cent level of exotic inheritance and those with 62 percent level. The committee therefore recommended limiting the level of exotic inheritance to 50 per cent, using mainly Jersey and Brown Swiss donor breeds.

The breeding programme is regulated by KLD Board, supplying frozen semen of exotic breed for cross-breeding indigenous stock and frozen semen of genetically superior cross-breed bulls for mating cross-bred female stock, followed with intense selection to

increase inter generational productivity. The inputs for the entire cattle breeding programme in the state are supplied by KLDB, to different institutions providing A I facilities to farmers.

(ii) Breeding Policy and Infrastructure Development

The breeding policy adopted by Government of Kerala since 1950s resulted in large scale development of the infrastructure which facilitated a speedy diffusion of the cross breeding. A large network consisting of Bull Stations, Bull Mother Farms, Regional Semen Banks (RSBs), Training Centres, Fodder seed production units, A I centres etc., were established to transfer the policies adopted by the government. The Bull Stations and Bull Mother Farms were established mainly for the purpose of production of frozen semen. The RSBs are established for the storage of frozen semen produced in these stations till its transfer to the field. The actual transfer of technology at the farm level is done through the A I centres.

The infrastructure development in the form of livestock farms in the state since the inception of the new breeding policy is summarised in Table 3.1.

KLDB has established 7 Regional Semen Banks (RSBs) in different parts of the state for arranging the distribution of equipments, semen and Liquid Nitrogen (LN) to AI centres. The RSBs collect and store semen from all the bull stations according to the breeding policy and allotment programme. The LN plants attached to these RSBs produces the LN required for the production of frozen

Table 3.1 : Livestock farms in Kerala

Unit	Activities	Capacity	Yearly Target
Mattupetti (1963)	Bull Station	75 bulls	
	Bull Mother Farm	100 cows	800000 doses of frozen semen
	Training Centre	250 growing stock	40 bull calves
Peermedu (1968)	Bull Mother Farm	80 cows	30 bull calves
		70 growing stock	
Kulathupuzha (1974)	Bull Station	70 bulls	900000 doses of frozen semen
	Regional Semen Bank	3 growing stock	
		10 cows	
Dhoni (1978)	Bull Station	100 bulls	800000 doses of frozen semen
	Bull Mother Herd	60 cows	20 bull calves
	Fodder Seed Centre	140 growing stock	
Overall		245 bulls 250 cows 470 growing stock	2500000 doses 90 male calves

Note : Figures in parenthesis indicate the year of establishment.

Source: Kerala State Livestock Development Board Ltd, Annual Report. (1991-92)

semen doses. The storage of semen is done both in the RSBs and in the AI Centres. Table 3.2 gives the details of Regional Semen Banks in the state as on 31.3.92.

The semen stored in the RSBs are distributed to the various Artificial Insemination Centres in the state. A I is being carried out in all the animal husbandry departmental institutions, the cattle improvement assistant centres of the dairy development department and few societies of Ernakulam and Malabar milk unions in addition to 27 centres of Tata tea company in their tea estates. With the expansion of infrastructure for semen production and

Table 3.2 : Details of Regional Semen Banks as on 31.1.92

Unit	Districts Covered	No. of AI Centres	Capacity of LN Plants
Kulathupuzha (1974)	Thiruvananthapuram, Kollam, part of Pathanamthitta	354	25 lt/hr
Mavelikkara (1970)	Alappuzha, parts of Pathanamthitta, Kollam	247	8 lt/hr & 6 lt/hr
Muvattupuzha (1981)	Idukky, parts of Ernakulam, Kottayam	259	6 lt/hr (2 nos)
Chalakkudy (1985)	Thrissur, parts of Ernakulam, Idukki	214	6 lt/hr
Dhoni (1992)	Palghat, parts of Thrissur, Malappuram	222	6 lt/hr
Puthuppady (1985)	Malappuram, Wynadu, parts of Kozhikkode	178	30 lt/hr
Kannur (1983)	Kannur, Kasaragod	229	6 lt/hr & 91 lt/hr

Note : Bracketed figures indicate year of starting
 Source : same as table 3.1

distribution, the number of AI centres increased from about 100 in the early seventies to 800 by the beginning of the eighties and to around 1700 by early nineties.

Thus, the breeding policy followed by the government and infrastructure development taken place due to the implementation of it created the background for the speedy dissemination of cross breeding in Kerala. As we noted in the earlier chapter, these policies and strategies have resulted in rapid diffusion of AI technique and shift in the breed composition of cattle in favour of crossbreds. However, even now about 50 per cent of the milch animals in the state are bred through natural service. The reason

for continued performance of natural service was highlighted by two earlier studies (Gincey et al, 1988; P.S. George and K.N. Nair, 1990). According to these studies the failure to conceive through AI remains as a major problem. Insufficient contact time between farmers and cattle, the fact that heat symptoms are not properly expressed in the absence of another cattle and free grazing, make accurate heat detection difficult. If a male member is not around, due to pre occupation with their work, the AI is often delayed or even postponed. Improper heat detection, doing AI very early or late in heat and such other factors contribute to failure of AI. The earlier studies (P.S. George and K.N. Nair, 1990; P.S. George et.al, 1989) showed that non descript animals were more often bred by natural service than crossbreds. The owners of non-descript cattle often keep them for home consumption of milk and are not enthusiastic of genetic improvement. If the AI centre is far off, driving the cow causes a drop in the milk yield and often an assistant has to be hired. To avoid all these inconvenience the cow will be taken to a bull if it is nearer. Farmers are also reluctant to take a cow to AI centres if it is located in a busy town. Thus it appears that the inappropriate strategy of locating the AI centres and the slow transformation of dairying from production for home consumption to market appears to be contributing to the slow growth of diffusion of artificial insemination noted in very recent years. The factors underlying the slow transformation of dairying is partly rooted in the changes taking place in the agricultural sector, which we shall take up for analysis in the following section.

3.2 Changes in the Agricultural Sector

It is argued in an earlier study (K.N. Nair, 1981) that the compositional changes in the cattle population in favour of milch animals has been facilitated by the reduction in the requirement of work animals due to changes in cropping pattern in favour of tree crops (which require very little draught power) and reduction in the average size of holdings. This section will examine this hypothesis further to bring out the inter linkages between changes in agricultural sector on the one hand and shift in the pattern of demand for cattle and how this change has facilitated the diffusion and adoption of technology on the other.

3.2.1 Changes in cropping pattern

It is found that some crops are conducive for rearing cattle (cattle friendly) while some other are either less cattle friendly/cattle hostile. The crops such as paddy, tapioca belong to the first category while the crops like Rubber, Coconut, Pineapple etc. represents the latter.

Paddy-based agriculture and cattle holdings form a closely interdependent farming system. While the cattle provide draught power for ploughing and dung for manuring the fields, paddy fields in turn provide cattle feed. Until a decade or two this interdependency was very prominent and rather stable in Kerala. Since then enormous changes have taken place in agriculture. Most importantly, there has been a drastic decline in cultivation of

subsistence food crops, especially paddy and tapioca, and rapid increase/intensification of cash crops such as coconut, arecanut and rubber.⁷

Table 3.3 presents the area under some important crops in the state. It is obvious from the Table that there occurred a significant decline in the area under paddy while the area under coconut and rubber showed an increase.

**Table 3.3 : Area under some important crops in Kerala
1975-76 to 1990-91 (area in '000 ha)**

Year	Paddy	Coconut	Rubber
1975-76	876.02	673.00	206.70
1980-81	801.70	651.37	237.80
1985-86	678.28	704.68	336.32
1986-87	663.80	706.10	347.81
1987-88	604.08	778.37	358.95
1988-89	577.56	816.88	366.50
1989-90	583.39	875.89	376.00
1990-91	559.45	864.06	384.00

Source: (1) Govt. of Kerala, Economic Review, various issues.
(2) Govt. of Kerala, Statistics for Planning, various issues.

It should be remembered in this context that, this drastic decline in area under paddy occurred despite the Kerala Land Utilization Order which was passed in 1967, under the Essential Commodity Act, 1955.⁸

The main cash crops which gained area under cultivation are Rubber and Coconut. Both these crops are perennial ones with long gestation period. So a farmer who is shifting from paddy to these crops has to face a reduction in his farm income during this period. At this juncture, in order to maintain his income statusquo, he might have started or intensified cattle keeping. The increase in the crossbred population since seventies which was

also the starting point of agricultural stagnation⁹ in the state is in line with this argument.

A number of studies (K.N. Nair,1981; Thara S.Nair,1988; P.S.George and K.N. Nair,1990; Sunny Jose,1991) observed that these changes in Kerala's cropping pattern has resulted in a decline in the supply of paddy straw, the main source of roughage for feeding the cattle population in the state. Thara S. Nair, 1988, has attempted to quantify the supply of paddy straw in the state,and found a declining trend since the early eighties. She observed that both the overall production of paddy straw and per capita availability declined simultaneously since early eighties.

K.N. Nair,1981; found a steep decline in feed supply as a result of changing crop pattern and identified it as the major constraint for the milk production enhancement strategies. He observes that in the face of dwindling area under paddy on account of shift in cropping pattern the supply of paddy straw falls short of demand.

Table 3.4 gives the estimates of supply of paddy straw in the state. A close look at the Table will help us to derive some insight into the declining trend in the supply of paddy straw since mid eighties.¹⁰

Table 3.4 : Estimated supply of Paddy straw (in '00000 tonnes)

Year	Supply
1966-67	16.03
1976-77	19.40
1980-81	19.10
1981-82	20.10
1982-83	19.59
1983-84	18.12
1984-85	18.85
1985-86	17.60
1986-87	17.00
1987-88	15.48
1988-89	15.03
1989-90	17.18
1990-91	16.30

Source: Government of Kerala, State Planning Board, Economic Review, various years

Studies (K.N. Nair,1981; C. Ramaswamy et al,1981) have shown that crossbreds are less dependant on natural fodder than their indigenous counterparts. A scenario of shrinking green and dry fodder compelled farmers to depend more on purchased feeds to maintain cattle. This is especially so in the small and marginal holdings (see Table 3.5). Since crossbreds are more efficient converters of feed into milk compared to the local breeds, in a situation of feed scarcity farmers have adopted the crossbreds. Thus, a reduction in the supply of paddy straw and other agricultural roughage at a time of increased involvement in cattle keeping facilitated the spread of crossbreds.

The shift in cropping pattern from paddy to plantation crops has resulted in a decline in the demand for work animals (K.N. Nair,1982; Thara S.Nair,1988; Sunny Jose,1992). In this situation, it is possible to implement a breeding strategy oriented mainly for enhancing milk production and not for producing dual purpose animals suitable for both milk and draught power. The

Table 3.5 : Percentage of farmers reporting purchase of feed stuffs by size class of holdings

Type of feed (cents)	Percentage of farmers among size of holdings					Total
	<10	11-50	50-100	101-250	>250	
Green fodder	3.90	3.90	4.30	4.60	6.00	4.30
Dry fodder	69.60	58.40	65.60	31.30	29.60	50.30
Groundnut cake	73.50	69.10	72.90	68.60	69.60	70.40
Coconut oilcake	10.70	8.80	8.00	7.10	10.10	8.80
Gingelly cake	7.80	8.80	5.10	4.50	9.30	7.00
Tamarind cake	18.60	16.90	21.90	18.90	20.30	19.10
Rice bran	15.60	15.00	14.60	13.80	11.80	14.30
Dry tapioca	4.90	0.01	2.19	0.50	0.08	1.64
Other						
concentrates	12.70	8.80	7.30	11.70	12.70	10.40
Compunded feed (Milma)	22.50	20.70	20.40	13.00	16.90	18.50
Compunded feed (Others)	34.30	26.40	21.90	36.60	30.50	29.70
Mineral mixture	6.90	5.60	10.20	13.00	8.40	8.90

Source: P.S. George and K.N. Nair (1990)

decline in demand for work animals was also because of the reduction in average size of holdings and increase in the intensity of agricultural mechanisation.

3.2.2 Decline in the average size of cultivated holdings

During the last few decades Kerala witnessed a noticeable decline in the average size of cultivated holdings. Agrarian reforms implemented in the state, the increased human population pressure on land etc. are identified as the factors responsible for this decline in holding size.

In Kerala Land Reforms (Amendment) Act which came into effect in 1970 abolished tenancy. The land ceiling, taking over and distribution of surplus land etc. as per the Land Reforms Act,

created a good number of new owners of land, most of them are small and marginal. (See Table 3.6)

Table 3.6 : Household Ownership holdings in Kerala, 1966/67 and 1971/72

Size class of ownership holdings (acres)	Number of Households (000)		Area (000 million)	
	1966/67	1971/72	1966/67	1971/72
0.00	2027 (%)	730 (%)	- (%)	- (%)
0.01 - 0.99	903 (60.0)	1805 (70.4)	348 (10.2)	514 (17.7)
1.00 - 4.99	472 (31.4)	646 (25.2)	991 (29.2)	1382 (47.6)
5.00 - 24.99	119 (7.8)	111 (4.3)	1036 (32.4)	931 (32.1)
25.00 & >	10 (0.7)	2 (0.1)	1021 (30.1)	79 (2.7)
0.01 & >	1504 (100)	2564 (100)	3396 (100)	905 (100)
Total (0.00&>)	3531	3294	3396	2904

Source: Land Reform Survey of Kerala: Report; NSS Survey 1971/72, in K.N. Raj and P.K.M. Tharakan (1983)

From the table, it can be seen that due to the implementation of the Act large holdings registered a sharp decrease in number. Subdivision and fragmentation of holdings continued to take place at a rapid rate during the post land reform period resulting in the creation of many uneconomic holdings.¹¹ During the decade starting from 1971, the decline in average size of holding was 14.29 per cent .i.e from 0.42 ha in 1971 to 0.36 ha in 1981 (Nair et.al, 1990).

This combined with the fact that plantations, private forests and land belonging to religious, educational and charitable institutions were exempted from the ceiling limit it was mainly the paddy and coconut lands which got subdivided. This sort of subdivision and loss of paddy lands (due to conversion activities followed by the fragmentation) has resulted in decreased

availability of paddy straw. The increase in the price of paddy straw, and increasing cost of feed inputs has contributed to optimum utilisation of available feed and fodder. In a situation where the attractiveness of milk production has improved due to the introduction of cross breeding technology, the farmers found it better to raise milch animals than maintain work animals. Since, the mechanisation of agriculture, especially tractorisation has been increasing, it offered further possibilities for reducing the draught animal stock.

Table 3.7 : Density of Tractors in Kerala 1961-1987

Year	No. of tractors	Paddy area ('000 hect.)	Density/ 10000 hect.
1961	276	778.91	3.54
1966	418	802.33	5.21
1972	1511	875.16	17.27
1977	1799	840.37	21.41
1982	1835	778.49	23.57
1987	1917	663.80	28.88

Source: 1. Upto 1971, Thara S. Nair (1988)
 2. After 1972, Livestock Census Reports, 1977 and 1987.

According to 1961 Livestock Census, there were about 276 tractors in the state. By 1972 their number increased to 1511. This increasing trend in the number of tractors continued and by 1987 the number of tractors in the state was 1917 (Table 3.7). As the area under paddy has been declining over this period, the density of tractors per 1000 hectares of net area under paddy increased. To that extent there must have been a substitution of work animals by tractors which have facilitated the diffusion of cross-breeding technology.

Table 3.8 : Trends in Work Animal Density in Kerala

Year	work animal/hect. of net sown area	work animal/hect. of area under paddy
1956	0.44	0.13
1961	0.43	0.91
1966	0.37	0.96
1972	0.28	0.70
1977	0.27	0.66
1982	0.20	0.55
1987	0.13	0.43

Source : Government of Kerala, Directorate of Economics and Statistics, Statistics for Planning (Various issues)

The extent to which various factors discussed above has effected reduction in the work animal population is evident from Table 3.8. The growth in commercialisation of dairying as a result of the institutional intervention by the state in the area of milk marketing and processing has further accentuated the reduction in work animals and increase in the size of crossbred stock.

3.3 Commercialisation of dairying

The fact that the dairy economy of Kerala is highly commercialised is evident from the data on the sale and purchase of milk by rural and urban households. According to the data collected in the 30th round of National Sample Survey, the number of households reported sale of milk in Kerala was much higher than the All India average (Table 3.9).

While 49 per cent of the producer households (which form 13.6 per cent of total households) reported sale of milk and milk products in rural Kerala, it was only 22 per cent at the all India

level. In the urban sector only 6 per cent of the household produced milk and of them 63 per cent reported sale of milk. The

Table 3.9 : Selected indicators of Commercialisation of dairy economy (1975-76)

Indicators	Kerala		India	
	Rural	Urban	Rural	Urban
Estimated No. of producing households ('000)	438	41	22225	1331
No. of households reporting sale of milk	215	26	4601	484
No. of households reporting sale of milk and milk products ('000)	216	26	4971	488
Sale of milk per day (lit.)	417	89	11346	2152
Production of milk per day (lit.)	823	145	5066	4987

Source: Government of India, National Sample Survey Organisation, Sarvekshana, Vol. II, No. 2, Oct. 1978.

corresponding figures for the whole of India are 6 per cent and 37 per cent respectively. In Kerala, percentage of milk sold per day out of the daily production is 54 per cent as against 26 per cent. in the country as a whole.

It can be seen that process of commercialisation has further intensified in the eighties. The information provided by the Integrated sample survey for the years 1984-85 to 1991-92 point towards this fact (see Table 3.10). According to their information on utilisation of milk produced in the households of the state a major share is always sold out to either private vendors or co-operative dairies and over the time period this market dependency is getting further strengthened.

According to the survey in 1984-85 61 per cent of the total milk produced at household level was sold out to different agencies like private vendors, co-operative and dairies. By 1991-92 this reached at 72 per cent clearly indicating the increased level of commercialisation of the dairy economy.

Table 3.10 : Percentage of milk sold out to different agencies

Year	Percentage of milk sold to		Total
	Private vendors	Co-operative primary society	
1984-85	42.66	18.46	61.12
1985-86	43.64	21.20	64.84
1986-87	35.90	25.64	61.54
1987-88	54.86	18.67	73.53
1988-89	51.50	17.77	69.27
1989-90	47.25	20.72	67.97
1990-91	50.02	17.32	67.34
1991-92	53.57	18.27	71.84

Source: Government of Kerala : Department of Animal Husbandry ; Report on sample survey for estimation of production of milk, egg and meat, various years.

The speed of commercialisation is really accelerated by the advent of Operation Flood II Programmes and the establishment of Kerala State Milk Marketing Federation (KCMMF) which resulted in a tremendous growth of dairy co-operative in the state. Table 3.11 gives a clear idea of the increase in the number of dairy cooperatives in the state.

Within the three decades, the number of dairy co-operatives increased from 195 in 1963-64 to 2109 in 1991-92 clearly capturing the rapid commercialisation of the dairy economy of the state. It is significant to note that the number of dairy co-operatives

witnessed a faster increase since early eighties due to the advent of Operation Flood Programmes.¹²

Table 3.11 : Growth of dairy co-operatives in Kerala

Year	Number of Primary co-operatives	Memberships of Primary co-operatives
1963-64	195	20860
1966-67	287	31280
1969-70	356	48507
1972-73	417	63170
1975-76	521	97764
1978-79	840	178814
1980-81	1043	231807
1981-82	1133	276271
1982-83	1207	318969
1983-84	1285	328879
1984-85	1308	343043
1985-86	1408	381000
1986-87	1582	386689
1987-88	1620	389754
1988-89	1737	403591
1989-90	1851	408263
1990-91	1963	411270
1991-92	2109	414245

Source: 1. Upto 1986-87, Dairying in India (1988), p.82.
 2. After 1986-87, Bulletin of Animal Husbandry Statistics, Various issues.

The inter relationship between commercialisation of milk production due to the growth of co-operative dairying and the diffusion of crossbred cattle becomes evident if we look at the data on the pattern of sale of milk by producer households. The data collected on this aspect by the CDS survey showed that about 32 per cent of the crossbred milk was purchased by the co-operatives ; the corresponding percentage for the local cows was only 18 as seen in Table 3.12.

Table 3.12 : Share of Agencies in handling milk

Outlet	Local cow milk	Cross bred cow milk	Total milk
Direct to Consumers	51.3	38.6	38.4
Middlemen	0	4.6	3.9
Teashops	31.5	24.8	27.4
Cooperatives	18.2	32.0	30.3

Source: Same as Table 3.5

Crossbred cows are raised mainly for milk for the markets. Therefore access to assured market is an important requirement for the diffusion of cross breeding technology. Since the co-operatives under the Operation Flood Programme provided this it might have definitely contributed to higher level of diffusion and adoption of cross-breeding technology. With the expansion of the market for milk, the prices of milk also should have shown an increasing trend which has significant implications for the viability of milk production. We shall take up this question in the next section.

3.4 Economic Viability of Cattle Keeping

The past few decades witnessed a considerable increase in the demand for milk and milk products in the state. The major determinants of this increased demand are growth in per capita real income, population and increase in prices of other animal proteins and increased awareness of people about the nutritive value of milk.

Among these factors growth in per capita income and population assume importance since a considerable portion of the growth in demand is determined by these two factors.

While analysing 'the changes in consumption behaviour in Kerala', K P Sunny (1988) concluded that growth in real income of the people resulted in an increased proportion of consumption expenditure on milk and milk products both in urban and rural Kerala. A recent study, (K P Sunny 1994) observed that the expenditure elasticity for milk and milk products have shown a declining trend both in urban and rural Kerala, clearly indicating that milk is gradually becoming a necessary item in the common man's consumption basket in the state.¹³

Although there was an increase in demand for milk, during the recent decades, it was observed that a considerable portion of this demand remained unsatisfied due to inadequate supply. i.e. there existed always a mismatch between demand for and supply of milk, in Kerala (K.N.Nair,1981). The estimates of demand computed by Thara S. Nair (1988) also confirmed this. She observed that during the period 1977-83, the supply of milk increased at an average annual growth rate of 10.71 per cent whereas the demand showed a rate of growth of 14.06 per cent per annum.¹⁴

This rapid growth in demand for milk have resulted in a 'demand pull' increase in the price of milk and this increase was large enough to offset the increase in input prices, which made rearing of milch animals profitable. While analysing the trends in relative prices of milk and feed since 1960s, K.N. Nair, (1981) found that the profitability of milk production increased in the sixties and early seventies as the price movements were in favour of milk.

Table 3.13 gives the trends in indices of input and output prices. From the table we can see that till eighties the milk procurement price was increasing at a faster rate compared to the input prices and after that input prices started increasing at a comparatively higher rate than milk price. These factors can very

Table 3.13 : Trends in indices of input and output prices related to milk (base year : 1976/77)

Year	MPPI	PIC	GFPI	DFPI	CFPI
1976-77	100	100	100	100	100
1977-78	113	83	108	110	96
1979-80	113	106	117	118	110
1981-82	113	120	136	123	128
1982-83	113	170	140	148	161
1984-85	184	244	160	167	206
1985-86	198	246	184	214	224
1986-87	198	252	212	227	231
1987-88	232	255	218	246	238
1989-90	255	258	242	287	267
1991-92	312	340	285	350	345
1992-93	390	398	312	418	404

MPPI = Milk procurement price index
 PIC = Price index of concentrates
 GFPI = Green fodder price index
 DFPI = Dry fodder price index
 CFPI = Cattle feed price index

Notes: 1. The milk procurement price used in computing MPPI is the price of the milk with 3 per cent Fat and 8.5 per cent SNF and is given by the KCMMF.
 2. The milk procurement price fixed by KCMMF is available only from 1976 onwards.
 3. The CFPI is computed as a weighted average of PIC, GFPI and DFPI. The weights are taken according to the norms provided by Animal Husbandry Department, Kerala.

Sources: 1. Government of Kerala, Department of Animal Husbandry, Animal Husbandry Statistics (various years).
 2. Government of Kerala, Department of Economics and Statistics, Statistics for Planning (various years).

well explain how the price factors governed the diffusion of cross-breeding technology. The conducive prices for milk in the late seventies (which was also the time of agricultural stagnation in the state) attracted a lot of farmers to rely on cattle keeping as

a supplementary source of income. Unlike earlier, since mid seventies they started keeping cattle for sale of milk in the markets. Obviously, they preferred crossbreds over non-descript since the feed conversion ability and the per litre cost is lower with the former. The fact that, by early seventies the percentage share of crossbreds in total cattle was very less and it quickly reached to 45 per cent, also substantiate this argument.

The faster rate of increase of input prices since early eighties compared to milk procurement price also reflects in the percentage of crossbreds in the total cattle. The unfavourable price movements resulted in a drastic decline in the rate of growth of diffusion of crossbreds. Here, it should be noted that during the decade starting from 1977, the increase in the percentage share of crossbreds in the total cattle population was only nominal. i.e, 4.52 per cent (see Table 2.2). In other words, the unfavourable price movements resulted in the increase in the percentage share of crossbreds in the total cattle at a very much declining rate. This has also contributed to the deceleration trends in the productivity growth of crossbred milch cattle.

3.5 Conclusion

The important conclusions that can be arrived at from the analysis are as follows:

1. The Breeding Policy followed by the government of Kerala since sixties resulted in a large scale development of infrastructure which set a conducive background for the diffusion of cross breeding technology.

2. The changes in agriculture in terms of shifting cropping pattern, declining average size of holdings and decline in demand for work animals, were also found conducive for its speedy spread. The shift in cropping pattern from food crops to cash crops resulted in a shrink in agriculture resource base for cattle keeping and increased the market dependency of the cattle keepers for feed. The implementation of Land Reforms which led to the subdivision and fragmentation of cultivated holdings further intensified the scarcity of natural fodder. The change in cropping pattern and the increased farm mechanisation led to a decline in the demand for work animals. All these factors were favourable for the spread of crossbreds.

3. The level of commercialisation of the diary economy further accelerated the above development. The increased demand for milk which led to an increase in milk price along with favourable movements of the relative prices of inputs and milk influenced the farmers decision making relating to the diffusion and adoption crossbreds.

In brief, the interaction of these factors has created an ideal situation for the adoption of cross-breeding technology. The extent to which such favourable environment for the diffusion and adoption of cross-breeding technology has been internalised by the farmers in Kerala will become more evident from the micro level case study discussed in the following chapter.

NOTES

1.The term 'upgrade' or 'grading up' is a variant of cross breeding. It is used when the local animal population is gradually raised to the level of donor population through successive matings of the progeny to the donor breed.

2.These pilot projects were aided by Indian Council of Agricultural Research and the objective was to investigate the potentialities of cross breeding in augmenting milk production and to arrive at the level of exotic inheritance in the cross breed cattle that would provide optimum yield under the agro-climatic environment of the state. These projects were later merged into Intensive Cattle Development Project in 1974. For a detailed account see Livestock Census-Kerala 1987.

3.Two of the major Bull Mother Farms is started during the effective implementation stage of KVS. For details see Thara S. Nair, 1988. Mattupetty Bull station and Bull Mother Farm started in 1963 with a capacity of 75 bulls, 100 cows and 225 growing stocks. After 5 years Peermedu Bull Mother Farm started with a capacity of 100 cows and 80 growing stocks.

4.For a detailed account of this see P.S.George and K.N. Nair (1990).

5.This achievement was due to the Special Employment Programme launched in 1972-73 by the Dairy Development Department, which proposed the cross breeding of one billion cattle of breedable age by using semen collected from exotic bulls of high production potential. About 1000 inseminators were trained under this scheme.

6.Forward crossing implies an increase in the exotic blood component by mating the local animal with an exotic dairy donor breed. The reverse process is called backward crossing. For a more detailed description see Thara S Nair (1988).

7.A number of studies [Geemol Unni (1983), C. Gopinath and C.S. Sudaresan (1990), Sivanandan (1985)] have come out with some sort of unanimous opinion about the changing crop pattern in the state in favour of cash crops. Geemol Unni (1983) who examined the shift in cropping pattern in Kerala from 1960-61 to 1978-78, found that there was a gradual expansion of area by the non-food grain sector and this expansion was mainly at the cost of food grain sector. Further she observed a trend in Kerala agricultural sector to switch over from paddy to coconut and from coconut to rubber while she was analyzing the changes in the area under cultivation of cash crops and the percentage contribution of various crops towards total agricultural production of the state. C. Gopinath and C.S.Sudaresan (1990) also highlighted the shift in Kerala's cropping pattern in favour of cash crops.They conducted a survey in Trivandrum and Malappuram districts and came out with the conclusion that the state's cropping pattern witnessed a shift from paddy and tapioca to coconut and rubber. See table given below.

Changes in the cropping pattern

Crop	Trivandrum district		Malappuram district	
	% of farmers discontinued	% of farmers added	% of farmers discontinued	% of farmers added
Paddy	50.00	0.00	81.50	0.00
Tapioca	46.40	1.20	8.50	0.00
Banana	0.00	6.00	6.60	5.10
Plantain	0.00	1.20	0.00	0.00
Coconut	0.00	52.00	0.00	83.00
Rubber	0.00	29.80	0.00	8.50
Pepper	0.00	4.80	0.00	0.00
Others	0.00	1.20	0.00	0.00
No shift	3.60	3.60	3.40	3.40
Total	100.00	100.00	100.00	100.00

Source: C. Gopinath and Sunderesan C.S. (1990)

A close study of the Table reveals that during the period 1979 to 1989 fifty per cent of the surveyed farmers in Trivandrum district discontinued cultivation of paddy, on their land. Amongst the new crops introduced were coconut (52 per cent), rubber (29.8 per cent), banana (6 per cent), rubber (29.8 per cent), and pepper (4.8 per cent). Similarly in Malappuram district 81.5 per cent of the farmers discontinued paddy cultivation. The new crops introduced by farmers were coconut (83 per cent), arecanut (8.5 per cent) and banana (5.1 per cent). Earlier their analysis on state level data also suggested the pattern and they concluded the study by anticipating a similar trend in the entire state in the matter of changes in cropping pattern. (It should be noted that in these two districts we see the shift mainly in favour of coconut. This may be because coconut is the major tree crop in this area. In the districts of Central Kerala where rubber is the major crop the shift could be mainly to rubber).

8. The order empowers the government to direct every holder of land not to leave any land fallow, not to cultivate any other food crops than the one grown during the three years immediately before the Commencement of the order or attempt to convert such land for any other purposes. Clause 3 of the order gives blanket powers to the government. It states that "notwithstanding anything contained in any law, order custom or practices for time being in force, if the state government are satisfied that it is necessary or expedient to increase the production of food crops in any area, they may by order published in the Gazette, direct that every holder of land in that area shall grow, over such portion of his land and any within such period as may be specified in addition to any crop he may have grown over such land". (GOK, Kerala Land Utilization Order, 1967, pp. 1-2).

9. for a detailed account of the agricultural stagnation see Kannan and Pushpangadhan 1988 a, 1988 b.

10. The estimates are obtained by multiplying the straw - grain ratio to the estimated production of paddy in the state. The straw-grain ratio used for the computation is 1.5 (See ICAR 1977)

11. Large scale subdivision and fragmentation of land taken place due to partitioning of land among members of a household, which created newly formed households cultivating smaller pieces of land. In Travancore, the decade preceding 1981, following the passing of regulation of the partition of tharavadu (i.e. joint family) properties of certain communities, over 400 thousand acres of land owned by these communities alone was partitioned. In respect of the Nair Community (which accounted for 83 per cent of the partition deeds) created shares of less than one acre each. A subdivision of this magnitude contributed significantly to the emergence of small peasants as the most prominent category in the country wide (Krishnaji, 1979, p. 10).

12. The responsibility of implementation of Programmes in the state is mainly entrusted with the Kerala Co-operative Milk Marketing Federation (KCMMF). A quick look at the following table will give a picture of the increased role of KCMMF in the commercialisation of dairying in the state.

Performance of KCMMF from 1982 to 1993

Year	No. of APCOs	No. of Members	Average daily procurement at the society level (ltr.)
1982	150	17510	22860
1983	286	21240	48085
1984	393	39399	63798
1985	471	48448	92602
1986	569	57816	11407
1987	692	73442	138559
1988	988	83710	190760
1989	1067	95918	228786
1990	1151	109964	235685
1991	1305	130800	232776
1992	1500	158035	314343
1993	1610	167008	345620

Source : KCMMF Annual Reports.

13. The expenditure elasticities provided by Sunny K.P. (1994) based on National Sample Survey rounds from 1965-66 to 1987-87 are given below:

Expenditure elasticity for milk and milk products
1965/66 to 1986/87

NSS Rounds	Urban	Rural
20 (1965-66)	2.07	1.72
21	1.60	2.08
22	1.94	2.17
23	2.10	1.45
24	2.01	2.24
25	1.53	2.22
27	1.96	1.78
28	2.42	1.63
32	1.61	1.36
38	1.67	1.54
42 (1986-87)	1.29	1.53

Source: Sunny K.P. (1994).

14. She considered demand for milk as a function of only per capita income and population and to estimate the growth in demand used the following identity.

$$Q_t = P_t q_t \dots\dots\dots (1)$$

where Q_t = aggregate demand for milk in the year t ;

P_t = population in the year t

and

q_t = per capita consumption in the year t , which is related to the per capita consumption in the base year through the relationship :

$$q_t = q_0 (1 + e.r)^t \dots\dots\dots (2)$$

where q_0 = per capita consumption of milk in the base year;

e = expenditure elasticity of milk

and

r = annual rate of growth of per capita income.

For estimating the aggregate demand, she assumed that supply and demand were equal in the base year 1956-66, the estimates arrived at are given below:

Growth in demand - Estimates

Year	Production ('000 MT)	Per capita income (Rs.)	Population ('000s)	Demand ('000 MT)
1964-65	204	568	18681	204
1977-78	702	590	24222	870
1983	1078	640	27097	1482

Source: Thara S. Nair (1988)

Chapter 4

CHANGES IN CATTLE HOLDINGS OF KERALA : A MICRO LEVEL STUDY

Introduction

In the previous chapters we have attempted to bring out the macro process at work that facilitated significant changes in the cattle economy of Kerala. The purpose of the present chapter is to analyse the extent to which the macro process at work has been operating at the micro level. More specifically, the issues investigated in the micro level study are the following : (a) how far the adoption of cross-breeding has affected the change in the ownership and composition of cattle, productivity of milch animals, production and utilisation of milk; (b) the impact of changes in the agricultural sector in the diffusion of cross-breeding; (c) the changes in the level of participation of the farmers in dairying and how far it is reflected in the various dimensions of the management of technology like breeding, feeding animal health care etc. It is hoped that the analysis presented in the micro level case study will help us to bring out better, how individual farmers moves from a point of disequilibrium to equilibrium in the management and internalisation of crossbreeding technology.

This micro level case study was conducted in one of the villages where the Centre for Development Studies and the Geographical Institute of the University of Zurich (GIUZ) had conducted farm level surveys of cattle holdings in 1987 (see Appendix.1 for the sampling and other details of the CDS survey). The major thrust of the surveys had been : (1) to determine the factors influencing the size and composition of the cattle ; (2) to understand the current practices of feeding and management of

cattle ; (3) to analyse the farmers interaction with input and output agencies and (4) to analyse the awareness, attitude and adoption of improved practices among farmers for maintaining cattle.

In order to bring out the temporal changes taking place in cattle holdings at the farm level, we conducted a Resurvey of the village in september and october 1993 with the same questionnaire used by CDS, in 1987. A total of 40 sample households were revisited and their responses were recorded. In the section that follows, we have analysed the major changes observed from the resurvey. However, while interpreting the findings, the following limitations of the data may be kept in mind : (a) since the study is based on the response of only 40 households this may not be a true representative of the situation in the state; (b) the entries in 1987 and 1993 are made by different investigators. Hence, there is a chance for errors, as the perception of two persons will always be different.

4.1 Profile of the study area

The area under study, Varicad Village of Vengola Panchayat in Vazhakkulam block, belongs to the Kunnathunad Taluk of Ernakulam district. Although situated away from urban centres, it has satisfactory facilities of milk marketing, A I, Veterinary care etc., and with reasonably good agricultural development.¹ Bamboo basket making was the traditional occupation of Harijan's in the area. But due to non-availability of bamboo most of them gave up the traditional occupation and started engaging themselves as

agricultural and non-agricultural labourers. Agriculture is the prime occupation in Varicad. The off farm employment includes casual employment in saw mills, non-agricultural labour, trade and employment services etc. Cattle keeping is treated as a supplementary source of income and subsidiary employment in many cases.²

Paddy is the most important crop in the study area in terms of area under cultivation, followed by rubber and coconut. Irrigation facilities available in this area (Periyar Valley Irrigation Canals) enabled the farmers to harvest three crops of paddy a year. The first cultivation is during January to April, second from May to August and the third from September to December. Rubber and coconut are the major perennial crops. Other crops include arecanut, banana, cocoa, pepper, pineapple, betelvine, tapioca and yam. These crops are cultivated both as intercrops in coconut gardens and as separate crops. In recent years, there has been an increased tendency among farmers to convert paddy lands for planting rubber and coconut as they fetch more income. This is reflected in data for the Panchayat as a whole of which the study village forms a part. (See table 4.1)

Table 4.1 : Change in the Cropping Pattern of Vengola Panchayat 1987-1993

Crops	Area under Cultivation (in Hectares)	
	1987	1993
Paddy	1324	1068
Coconut	811	924
Rubber	1477	1820
Other crops	358	279
Total	3970	4091

Source : Krishibhavan Records, Vengola.

In Varicad, 52 per cent of the households keep cattle among whom about 95 per cent are having cows , majority of them being crossbreeds. Very few households keep bullocks and buffaloes. Other species of livestock include goats, rabbits and poultry.

The nearest Veterinary hospital for the study area is in the neighbouring panchayat which is 0-3 kms away from the village. Veterinary Hospital and Artificial Insemination facilities were available to the farmers since the inception of the hospital in 1977. Before that the farmers had to go to the Veterinary Hospital in Perumbavoor (9 kms away) for artificial insemination and other veterinary services. There are 2 milk societies in Vengola Panchayat, one is in Varicad (Milk Society, Valayanchirangara) and the other in the nearby ward bordering Varicad (Milk Society, Vengola). The service of one dairy farm instructor is also available to the villagers.

4.2 Temporal Changes related to Cattle Keeping

The number of cattle holders declined steadily within the time span of two surveys. Of the 40 respondents in 1987, 36 (ie,90 per cent) were cattle holders. In 1993, the number of cattle holders declined to 28 (ie,78 per cent) (Table 4.2). Almost all the drop outs were within the size of land holdings of less than 50 cents. Between the two surveys, ie, within 6 years, nine persons stopped cattle rearing and one started it. The new entrant was in the category of cattle holders with land size 101-250 cents. All the nine dropouts were asked as to 'why they stopped cattle rearing?'

Six of them cited cost-price incompatibility as the major reason; while two pointed out labour shortage as the important factor . The other cited his changed cropping pattern as the hindrance to keep cattle. Among these nine dropouts three were from the lowest strata, ie with land size below 10 cents and five from the lowest but one strata, ie 11-50 cents.

In both the surveys it was seen that, people with more than 50 cents constituted the major portion of cattle holders. In 1987 they comprised 61.1 per cent of total cattle holders. While in 1993 it increased to 78.6 per cent of total cattle holders. It was also noted that the number of households owning cattle declined mainly

Table 4.2. The Pattern of Distribution of Households According to Land Size (1987 & 1993)

Size of Holdings (Cents)	1987			1993		
	No of Households			No of Households		
	With Cattle	Without Cattle	Total	With Cattle	Without Cattle	Total
Below 10	4 (10.0)	2 (5.0)	6 (15.0)	1 (2.5)	4 (10.0)	5 (12.5)
11 -50	10 (25.0)	1 (2.5)	11 (27.5)	5 (12.5)	6 (15.0)	11 (27.5)
51 -100	6 (15.0)	0 (0.0)	6 (15.0)	7 (17.5)	1 (2.5)	8 (20.0)
101 - 250	13 (32.5)	0 (0.0)	13 (32.5)	12 (30.0)	0 (0.0)	12 (30.0)
Above 250	3 (7.5)	1 (2.5)	4 (10.0)	3 (7.5)	1 (2.5)	4 (10.0)
Total	36 (90.0)	4 (10.0)	40 (100.0)	28 (70.0)	12 (30.0)	40 (100.0)

Note : Figures in parenthesis shows percentages to total number of respondents

Source : Survey data.

in the less than 50 cents category (see Table 4.2). This decline in number of cattle holders with less than 50 cents category of farmers might have occurred in the context of the higher cost of maintaining milch cattle coupled with an inadequate increase in price of milk to cover the increase in input prices. Another reason for this reduction was the lower availability of family labour in poor households. Cattle keeping at the household level requires a substantial amount of family labour. In poor families most of the members in the working age group were found to be engaged as agricultural or manual labourers, while in the better off families more family labour was available for maintaining cattle. If the marginal holders have given up cattle keeping because of the losses they might have incurred due to increased input prices, it becomes possible to think that this hike in input prices might have caused some changes in the structure of cattle holdings of the higher size groups also. In order to examine this issue, we have analysed the trends in the pattern of cattle holdings in relation to the size of holdings. The exercise confirmed our observation that the cattle rearing has become less profitable to all the farmers. This is reflected in the reduction in the number of cattle among all the size groups.

Table 4.3 shows the distribution of cattle among various size of holdings for both the survey periods. The Table brings out the fact that all sections of the cattle holders reduced the number of cattle with them. The average size of cattle in the cattle holdings has declined considerably from 2.5 in 1987 to 1.93 in 1993. The highest percentage decline in cattle number was seen among the households with less than 10 cents, obviously because the larger

Table. 4.3 : Distribution of Cattle Among Various Size of Holdings - 1987 & 1993

Size of holdings (in cents)	1987	1993	% change
Below 10 (7.5)	7 (1.9)	1	-85.71
11 -50	15 (16.1)	8 (14.8)	-46.66
51 -100	15 (16.1)	13 (24.1)	-13.33
101 -250	41 (47.3)	25 (46.3)	-39.02
Above 250	12 (12.9)	7 (13.0)	-41.66
Total	90 (100.0)	54 (100.0)	-41.94

Note : Figures in brackets are percentages to corresponding totals.

Source : Survey data.

number of dropouts are coming under this section. Another interesting result from the Table is that the lowest percentage decline in cattle number has happened with medium holders with 51-100 cents. An enquiry into the reasons of such an observation as to why a low level decline in cattle number happened in the case of medium householders compared to the other sections, revealed that the small holders dropped out of cattle keeping as they found it unprofitable while the large holders and medium holders reduced the number of cattle to meet the situation. But the rate of reduction of cattle stock of large holders were higher compared to that of medium holders. This higher rate may be because the large holders have showed a greater tendency to switch over to cattle hostile crops like rubber, coconut etc. instead of paddy, which is an important source of fodder supply. During this period, the

reduction in area under paddy was by 4.27 acres. Of this large holders (above 100) accounted for 95.03 per cent of the decline, while that of medium holders (51-100 cents) was only 0.9 per cent. 91.77 per cent of increase in area under rubber was among the large holders with more than one acre of land and that of medium holders were 8.22 per cent.

4.3 Changes related to the extent and diffusion of Cross Breeding Technology

The temporal changes related to the extent and diffusion of cross breeding technology at the household level can be analysed in two ways: (1) by looking into the changes in the proportion of crossbreds to total cattle stock and (2) by analysing the changes in percentage share of households with crossbreds to total households.

The discussion on the percentage share of crossbreds to total cattle, is limited to only cow population since the number of bulls were found to be negligible in the survey area. In 1987, two households had bulls while one kept a buffalo. But, in 1993, there were no cattle other than cows in the sample holdings. One person out of the two, who kept bull stopped rearing it due to lack of demand for natural breeding while the other stopped because there was no demand for draught power. The person who had a buffalo with him stopped rearing it because he lost interest in commercial dairying as it became unremunerative.

Table 4.4 explains the composition of cattle stock with the sample households. The percentage of CB stock in total cattle stock

has increased from 77.77 in 1987 to 81.48 in 1993. With regard to local cows it can be seen that this percentage has declined slightly from 22.22 to 18.52 which indicates an increased share of crossbreds in the total cattle stock.

Table. 4.4 : The Composition of Cattle Stock (1987 & 1993)

Breed category	1987		1993	
	Number of Cattle	%	Number of Cattle	%
(a) Crossbred Cows				
1. Adult	47	52.22	22	40.44
2. Young	23	25.55	22	40.74
Total (1+2)	70	77.78	44	81.48
(b) Non-descript Cows				
1. Adult	11	12.22	6	11.11
2 . Young	9	10.00	4	7.41
Total (1+2)	20	22.22	10	18.52
Grand Total (a+b)	90	100.00	54	100.00

Source : Survey data.

In 1987, of the total households 77.8 per cent kept crossbred cattle. Out of the 36 households who kept cattle, 28 had atleast one crossbred cattle with them. In 1993 this increased to 82.2 per cent with 19 out of 28 keeping crossbreds (Table 4.5). Although this is an indication of the increased proportion of crossbreds among the cattle keepers, the absolute number of crossbred cattle with the respondents has declined considerably from 70 to 44. The average number of crossbred cattle with farmers who maintained crossbred cattle to declined from 1.91 in 1987 to 2.5 1993. This clearly shows that although the breed preference of the farmers are towards crossbred they had to reduce the number of cattle.

Table 4.5 : The Distribution of Households According to Type of Cattle (1987 & 1993)

Households with	1987		1993	
	Number of Households	Number of Cattle	Number of Households	Number of Cattle
Crossbreds only	20 (55.6)	55	19 (67.9)	35
Non descript only	8 (22.2)	11	5 (17.9)	6
Both Crossbred and Non descript	8 (22.2)	27	4 (14.3)	13
Total	36 (100.0)	93	28 (100.0)	54

Note: Figures in parenthesis show the percentages to corresponding total

From Table 4.5 we can see that there occurred a considerable reduction in the number of households who kept either only non-descript cattle or both non-descript cattle and crossbred cows. However, the number of households with 'crossbreds only' remained almost the same. What becomes interesting to note is that there is definite shift of cattle owning households towards crossbreds during 1987-93 period.

While there was a general reduction in cattle in the survey area, the reduction in the number of local cows was more prominent than that of crossbreds. The respondents were asked as to 'why they prefer crossbreds over non-descript ones?' and majority of them opined that the cost of production of milk per litre is lower for crossbred cows compared to local cows. They also cited longer lactation periods, smaller dry period and small calving intervals etc, as the merits of crossbred cows. The persons who preferred

local cows over the crossbred cows opined that crossbreds have higher morbidity rate and found keeping them a costly affair in the matter of feed, animal care and labour. In short, the breed preference of the people has changed slightly favourable to crossbred cows.

4.4 The Impact of Cross-breeding Technology on Production and Utilisation of Milk at the Household Level

The number of in-milk cows with the sample households was thirty four among cross breds and six among non-descript in 1987. In 1993, these figures changed to seventeen and three respectively. The total daily milk production from these animals for 1987 and 1993 is given in the Table 4.6.

Table 4.6 shows that in 1987 about 91.16 per cent of the total milk production was from crossbred cows. However, this declined slightly in 1993 to 89.36 per cent. The productivity figure estimated from the Table showed that in 1987 the crossbreds were having an average daily yield of 4.04 litres and that of non-descript was 2.32 litres. This has changed to 3.87 litres and 2.61

Table 4.6: Details on milk production

Year	1987		1993	
	Production (ltrs.)	%	Production (ltrs.)	%
Crossbred cow milk	137.36 (34)	91.16	65.79 (17)	89.36
Non-descript cow milk	13.32 (6)	8.84	7.83 (3)	10.64
Total milk	150.68 (40)	100.00	73.62 (20)	100.00

Note: The figures in parenthesis corresponds to number of cows
Source: Survey data

litres respectively in 1993. While the yield of crossbreds registered a marginal decline that of local cows showed a slight increase. The following are the factors contributing to this: (1) In 1987, 50 per cent of the households with crossbred cows kept animals with high yield; 35.7 per cent, with medium yield and 14.3 per cent, with low yield. But in 1993 it is found that only 17.4 per cent crossbred cattle holders kept high yield animals and the percentage of those who kept medium and low yielders increased upto 52.2 per cent and 30.4 per cent respectively. The shift in favour of low and medium quality crossbred animals might have resulted in a decline in daily yield. (2) With the changes in cattle keeping practises with respect to fodder, feed, animal health care etc non-descript cows started getting more attention. This was very much true in the case of non-descript cows which were kept along with crossbred cows. The shrinkage in agricultural resource base which resulted in increased use of concentrates further facilitated this.

Table 4.7 : Utilisation pattern of milk

Year	Percentage of milk				Total
	Consumed as milk	Converted to milk products	Sold to		
			Co-operatives	Others	
1987					
CB	25.63	3.33	48.24	22.80	100.00
ND	34.19	27.26	22.48	16.07	100.00
Total	26.61	5.86	45.38	22.16	100.00
1993					
CB	27.02	1.02	55.94	16.02	100.00
ND	40.04	15.34	30.97	13.65	100.00
Total	28.06	2.30	54.18	15.46	100.00

Source: Survey data

Table 4.7, which explains the utilisation pattern of milk brings the following inferences :

- (1) For both the survey periods the percentage of crossbred milk consumed at the household level was lower than that of local cows. In other words, the sale of milk was higher in the matter of crossbreds for both the survey period. This indicates the increased market dependency of the crossbreds and it can be seen that this dependency was more or less same for both the periods. The share of sold out milk in the crossbred milk was 71.04% in 1987 and it increased slightly in 1993 to 71.96 per cent.
- (2) The share of the sold out milk in the matter of local cows registered an increase from 38.55 in 1987 to 44.62 in 1993. This points to the fact that the non-descript are also gradually becoming market dependent.
- (3) In the matter of agencies handling crossbred milk, we can see that, in both the time periods co-operatives handled a comparatively low share, and in fact its share has declined over the time period from 22.8 per cent in 1987 to 16.02 per cent in 1993. At the same time the share of other agencies registered an increase from 48.24 per cent to 55.94 per cent.

4.5 The Impact of Change in Cropping Pattern on the Spread of Cross-breeding Technology

Many factors were identified as the determining factors of temporal changes related to diffusion of cross breeding technology. However, shift in cropping pattern is identified as the prime

determinant in the study area. In 1987, paddy was the important crop with the respondents covering 31.75 per cent of total land. The second and third places were shared by coconut and rubber sharing 27.25 per cent and 23.28 per cent respectively. (Table 4.8)

But by 1993, the percentage area under rubber has increased to 38.13 per cent and both the shares of paddy and coconut declined to 21.97 per cent and 22.62 per cent respectively. This change in crop pattern clearly indicates a shift among farmers from less remunerative crops to more remunerative ones. It is observed in the study area that this increased importance of rubber resulted

Table 4.8 : Area under different crops 1987 & 1993 (Acres)

Year	Rubber	Paddy	Coconut	Others	Total Area
1987	9.97 (23.28)	13.60 (31.75)	11.67 (27.25)	4.76 (11.11)	42.83 (100.00)
1993	16.19 (38.13)	9.33 (21.97)	10.03 (23.62)	4.57 (10.76)	42.46 (100.00)

Source : Survey data.

in a drastic decline in the availability of natural fodder in the study area especially in the matter of paddy straw, the prime agricultural roughage for cattle feed, and this resulted in a decline in the number of cattle. Earlier, in 1987, 13 households had rubber in their holdings. By 1993, 4 more households were growing rubber, the number of cattle with these rubber growers were found to be 48 and 21 respectively for 1987 and 1993. The average

number of cattle with the rubber growers has declined from 4 in 1987 to 2 in 1993. A closer analysis reveals that the reduction in the number of cattle was mainly due to the reduction in the number of non-descript cows. From the earlier analysis we have seen that the reduction in non-descript cows during the period between the two surveys was 50 per cent (i.e, from twenty in 1987 to ten in 1993). But in the case of crossbreds this was only 37.14 per cent (Table 4.4). The distribution of households according to the type of cattle reaffirmed this fact. The households with " nondescript only" who gave up cattle keeping within six years was 60 per cent. While in the matter of households with "both crossbreds and non-descript" this was 50 per cent in the case of households with crossbreds only the percentage reduction was very low i.e, 5 per cent (Table 4.4).

Thus, the changes in cropping pattern brought about a shortage in the availability of natural fodder and this led the dairy farmers to a situation where they had to depend more on markets for inputs. In such a situation, it was reasonable from the part of the farmer to retain crossbred animals with high yield and other favourable economic traits such as longer lactation period, lower age at first calving, lower dry period, lower calving intervals and reduce the number of non-descript cows.

4.6 Changes in Participation of Farmers in Cross-breeding Related Activities

The changes related to the involvement of dairy farmers regarding cross-breeding related activities such as membership in dairy co-operatives, utilisation of AI, engagement in fodder cultivation etc. are enquired in this section.

4.6.1 Participation in Dairy Co-operatives

In 1987, 77.8 per cent of cattle holders were found to be members of Anand pattern Co-operative Society. The rest 22.2 per cent were not society members. But by the time of second visit the percentage were found to be 50 each (Table 4.9). This visible decline in the percentage of society members show that the cattle farmers are gradually getting disinterested with the working of APCOs.

Table 4.9 : Details on Society Membership of Cattle Farmers - 1987 & 1993

Year	Number of Cattle farmers		Total
	With Membership	Without Membership	
1987	28	8	36
	(77.8)	(22.2)	(100.0)
1993	14	14	28
	(50.0)	(50.0)	(100.0)

Source: Survey data.

While seeking the reasons for this sort of reduction in society membership, it was found that many of the cattle rearers changed their milch animal stock in order to meet the domestic requirements of milk instead of keeping them for commercial dairying. Out of 28 cattle holders in 1993, only 14 persons were members in Co-operative society. All the other 14 persons were asked as to 'why they are not taking the society membership?'. Eight opined that they don't need society membership as they don't

have enough milk to sell. Five told that they can sell milk to neighbours and can earn more money than what the society pays. One household did not take membership since there was no society available in his vicinity. Four out of these fourteen respondents told that earlier they were retaining the society membership as the bonus was attractive, the cattle feed supplied by the APCOs was cheap and good quality, the Veterinary health care provided by the society was convincing etc. But gradually they felt dissatisfied with all these and hence they did not show any interest in retaining the society membership. All the respondents who had society membership were asked questions about the facilities provided by the Co-operative Society, and most of them had complaints about the working of the society. 85.7 per cent of the present society members complained about the low level bonus paid by the APCOs, while 57.14 per cent were dissatisfied with the quality and price of cattle feed supplied by the APCOs and 42.86 per cent members complained on the improper working of the Veterinary routes with the society. None of the respondents were found to have used the emergency veterinary route of the 'Milma' since they were quite sure about the improper working of it. So we can clearly infer that most of the farmers are gradually getting discontent with the working of primary societies at the village level.

4.6.2 Changes in breeding practice

In 1987, 80 per cent of the respondents opted artificial breeding and 10 per cent, natural service for their cattle. By 1993, there was a slight change in these percentages. The percentage of

the respondents who went for artificial breeding became 85 per cent and those who availed natural service reduced to 7.5 per cent. Quality of progeny and less susceptibility of disease etc. were found as the major considerations influencing artificial insemination. However, the comparatively high failure rate of artificial insemination was pointed out as the main demerit with it.

4.6.3 Changes in Fodder Cultivation

At the time of the CDS Survey 10 per cent of the respondents were having at least 10 cents of land under fodder cultivation. The total land under fodder in 1987 was found to be 73 cents, but by the time of second survey, i.e. by 1993, the percentage of respondents with fodder cultivation reduced to 2.5 per cent and the area under fodder cultivation to 17 cents. By the time of 6 years 3 persons out of the 4 persons engaged in fodder cultivation stopped cultivating fodder. All these 3 dropouts were coming under the class of households with 101-250 cents of land and all of them stopped fodder cultivation because they had changed their cropping pattern in favour of rubber and thus reduced the number of cattle with them.

4.7 Temporal Changes in the Perception and Attitude of the Farmers on Cattle Keeping and crossbred cows

In this section it is attempted to bring about the temporal changes in the perception and attitude of farmers towards cattle keeping and crossbred cows. While doing this exercise, the reasons for maintaining the cattle, the characteristics and requirements of the crossbreds etc. are examined in a detailed manner.

4.7.1 Primary Reasons for Maintaining Cattle

The Pattern of Cattle Holdings in a rural society is highly related to the farmers' attitude towards improved farming techniques, the motivation behind them to maintain cattle etc. Therefore in the surveys attention has been given to enquire the primary motivation behind the farmers to maintain the cattle stock in the pattern that he had. Table 4.10, shows the changed attitude of the farmers towards maintaining the cattle.

It may be noted that in both the time periods a high proportion of farmers kept cattle for getting quality milk for their family members. However, in the later period, percentage of households who kept cattle for quality milk has increased

Table 4.10: The Distribution of the Households According to Primary Reason for Maintaining the Cattle

Primary Reason	1987		1993	
	No of Cattle holders	%	No of Cattle holders	%
1. Quality milk Requirements	14	38.9	16	57.1
2. Supplementary source of income	12	33.3	6	21.4
3. Farm yard manure	2	5.6	4	14.3
4. Employment for family	5	13.9	1	3.6
5. Traditional pattern	1	2.8	0	0
6. Utilisation of farm byproducts	2	5.6	1	3.6
Total	36	100.0	28	100.0

Source : Survey data.

drastically from 38.9 per cent to 57.1 per cent in 1993. This shows the changed attitude of the farmers in cattle rearing. Earlier majority of the farmers were keeping cattle in order to meet the needs, other than quality milk requirement. But now the situation has changed. This tendency is further confirmed, from the observation that 85 per cent of the cattle keepers were following 'one cow, one calf' pattern. And most of these households opined that they are not treating cattle keeping as a commercial activity. Only a small proportion of them were members in Co-operative society and the related activities of APCOs.

4.7.2 Requirements of Crossbreds

All the farmers were asked to indicate their perception regarding the characteristics of crossbred and local cows in relation to feed, animal care, labour, susceptibility to disease, milk yield and milk quality.

In 1987, all the 36 persons who had kept cattle were asked their perceptions about the comparative advantage/disadvantage of the Crossbred Cows. In 1993 Survey, although 28 households had cattle, all the 36 persons who maintained cattle in 1987 were again asked the same questions. Within the time period of the two surveys there came a new entrant to the category of cattle keepers. But he did not attend the question by saying that since he never maintained local Cow he cannot make a comparison between local and crossbred cow.

(i) Remarks on feed requirement

It is noticed that within the time span of 6 years the perception of Cattle farmers towards crossbred Cows has changed considerably (Table 4.11). From the Table we can see that in 1987 majority of the farmers (58.3 per cent) responded that crossbred cows need much more feed than local cows. But by 1993 the percentage of respondents with the same view declined to 22.2 and

Table 4.11 : Distribution of Respondents in Relation to Their Remarks on the Requirements of Crossbred Cows

Response	1987		1993	
	Number of Respondents	%	Number of Respondents	%
(a) On Feed				
Crossbreds require much more than local cows	21	58.3	8	22.2
Crossbreds require slightly more than local cows	13	36.1	28	77.8
Both are the same	2	5.6	0	0.0
Crossbreds require slightly less than local cows	0	0.0	0	0.0
Crossbreds require much less than local cows	0	0.0	0	0.0
	36	100.0	36	100.0
(b) On Animal Care				
Crossbreds require much more than local cows	22	61.1	20	55.6
Crossbreds require slightly more than local cows	10	27.8	15	41.7
Both are the same	4	11.1	1	2.8
Crossbreds require slightly less than local cows	0	0.0	0	0.0
Crossbreds require much less than local cows	0	0.0	0	0.0
	36	100.0	36	100.0
(c) On labour				
Crossbreds require much more than local cows	13	36.1	8	22.2
Crossbreds require slightly more than local cows	12	33.3	18	50.0
Both are the same	11	30.6	10	27.8
Crossbreds require slightly less than local cows	0	0.0	0	0.0
Crossbreds require much less than local cows	0	0.0	0	0.0
	36	100.0	36	100.0

Source : Survey data.

77.8 per cent of respondents (instead of a 36.1 per cent in 1987) opined that crossbred cow's feed requirement is only slightly more than that of local cows. Another noteworthy remark in regard to feed is that in 1987, 5.6 per cent of the respondents were with the remark that the feed requirement of the crossbreds are same as that of local cows. Now even a single respondent seems to believe so. All these indicate that the farmers attitude towards the feed requirement of the Cross bred has changed a lot and majority started considering that crossbred cows need only slightly more feed compared to local cows.

(ii) Remarks on Animal Health Care

The attitude of cattle farmers on animal care has also witnessed tremendous change. Earlier around 89 per cent indicated that crossbreds need more animal health care than local cow. Out of the 36 respondents 1 per cent remarked that they need much more care compared to their local counterpart and 28 per cent indicated that they need slightly more animal health care and 11 per cent remarked that both the categories need same amount of animal care. But, by 1993, these figures have changed to 56 per cent, 42 per cent and 3 per cent respectively. This also indicates a favourable change in the attitude of cattle farmers to adopt cross bred cattle.

(iii) Remarks on Labour

The response towards labour requirements also shows some sort of changed attitude. During both the time periods, a major chunk of the farmers believed that the crossbred cows need more labour compared to their local counterparts. At the time of first survey,

36.1 per cent respondents were of the opinion that cross bred require much more labour compared to local cows; 33.3 per cent opined that they need slightly more labour and 30.6 per cent were with the opinion that both the category need same amount of labour. But by the time of second survey these percentages have changed to 22.2 per cent, 50 per cent and 27.8 per cent respectively which clearly indicate that the farmers attitude towards the notion that "crossbreds need much more labour" is getting diluted gradually.

All the above analysis on the requirements of crossbred cows on feed, animal care and labour requirements showed that the farmers' disception towards the crossbred cows in the matter of comparatively high cost of maintenance has gradually disappeared and they have started believing that they need slightly higher requirements only compared to local cows. But this sort of a changed attitude on the requirements of crossbred cows might be because of the change in farmers' preference towards the quality of crossbreds. So an attempt was also made to enquire about the quality of crossbred animals they maintained. It is found that with the passing of 6 years the composition of crossbred cattle stock with regard to the genetical standard of the animal has changed considerably and it is this factor that is solely responsible for the change in farmer's attitude regarding the requirements of crossbred cows.

It is found that 5 households started rearing low quality animals mainly because high yielding variety of animals were found with the problems related to the extravaganza of feed, labour and animal care. Three out of these five respondents remarked that they

lost interest in commercial dairying because of unfavourable terms in cattle farming in the matter of price hike of inputs and milk along with the other for their switching over to low yielding variety of crossbred animal. All the farmers who reduced the quality of crossbred animal unanimously opined that still they prefer crossbred animal, compared to local, since they are all sure with the crossbred animal's increased capability of producing milk at a lower cost.

4.7.3 Characteristics of Crossbred Cows

All the respondents who kept cattle at the time of the first survey were asked about the characterisation of crossbred cows in relation to susceptibility of disease, milk yield and quality of milk and it is attempted to get an idea of their changes in perception regarding the characterisation of crossbred animals.

(i) On Susceptibility of Disease

At the time of CDS survey 88.9 per cent of people opined that the crossbred cows are more susceptible in the matter of diseases compared to their local counterparts and 10 per cent opined that both crossbred and non-descript cows are equally susceptible to diseases. In 1993 survey it was found that all the respondents unanimously indicated that crossbred cows were more susceptible to disease (Table 4.2).³ Even though all the 36 respondents concluded that crossbreds are disceptive on the grounds of incidence of diseases 28 respondents (23 out of them kept crossbreds) answered that still they wish to keep crossbred animals as they have faith in new variety animal in the matter of higher potentiality to

Table 4.12 : Distribution of Respondents in Relation to Their Remarks on the Characterisation of Crossbred Cows

Response	1987		1993	
	Number of Respondents	%	Number of Respondents	%
(a) On Suspectability of disease				
Crossbreds are more susceptible	32	88.9	36	100.0
Same for both	4	10.0	0	0.0
Crossbreds are less susceptible	0	0.0	0	0.0
	36	100.0	36	100.0
(b) On Milk yield				
Crossbreds give much higher yield than local	21	58.3	13	36.1
Crossbreds give slightly higher yield than local	14	38.9	23	63.9
Crossbreds give same yield as local cows	1	2.8	0	0.0
crossbreds give slightly less yield than local	0	0.0	0	0.0
crossbred gives very much less yield than local	0	0.0	0	0.0
	36	100.0	36	100.0
(c) On milk Quality				
Crossbreds give much better than local cows	0	0.0	0	0.0
Crossbreds give slightly better than local cows	0	0.0	0	0.0
Crossbreds give same as local cows	8	22.2	2	5.6
Crossbreds give slightly lower than local cows	12	33.5	18	50.0
Crossbreds give very much lower than local cows	16	44.4	16	44.4
	36	100.0	36	100.0

Source: Survey data.

convert inputs into milk in a comparatively economic way and only 8 persons rejected this superiority of the crossbred cows on the grounds of suspectability of diseases.

(ii) On Milk Yield

For both the time periods almost all the 36 respondents believed that crossbreds can give more amount of milk compared to their local counterparts. In 1987 only a few people (2.8 per cent) opined that both crossbreds and non-descript gave same amount of

yield. But by the time of second survey they also changed their attitude. A major shift happened with regards to the attitude towards milk yield was noticed. Unlike the first survey period more people started believing that crossbreds are giving slightly higher yields than local cows. It should be noted that earlier the respondents who opined that crossbreds are giving a much higher yield than local cows were 58.3 per cent, and those who opined crossbreds giving slightly better yield than local were 38.9 per cent. In 1993 these figures were 36.1 per cent and 63.9 per cent respectively (Table 4.12). This sort of a shift is not a surprise since we have already seen a shift among the crossbred cattle keepers towards crossbred cattle with low yield.

(iii) On Quality of Milk

There occurred certain notable shifts in the matter of farmers consensus about the quality of milk of crossbreds. In 1987, 22.2 per cent of the 36 respondents believed that crossbred cows give the same quality milk as that of local cows. But 33.5 per cent of respondents believed that they give slightly lower quality milk while 44.4 per cent people believed that the quality of milk of crossbreds is much inferior. In 1993, these percentages were 5.6, 50.0 and 44.4 respectively (Table 4.12). We can see that a certain number of people who believed earlier that both the crossbred and non-descript cows give same quality milk changed their attitude and started believing that they gives a lesser quality milk.

4.8 Conclusions

The following are the major conclusions of the resurvey:

1. In both the time periods, people with more than 50 cents constituted the major portion of cattle holdings. A considerable decline was seen in the number of cattle holdings over time and the drop outs were primarily from the land size less than 50 cents. Price-cost incompatibility was pointed as the major reason for most of the drop outs to stop cattle rearing.
2. A noticeable shift was seen in the cropping pattern, from paddy to rubber, in the survey area. This was prominent among the large size land holders (ie. Above 50 cents group).
3. Though, the absolute number of crossbreds and local cows declined in the survey area, over time, the percentage of crossbreds in total stock increased. This showed a shift in the cattle holding households towards crossbreds. The low cost of production per litre was found as the important factor in favour of crossbreds.
4. Though, the productivity of crossbreds were above the local cows, during both the periods, the productivity of the crossbred cows showed a decline, over time. The shift in favour of low and medium quality milch animals was the reason behind the decline in the productivity.
5. Regarding the utilisation pattern of milk it was found that:
(a) the major share of crossbred milk was found sold, during both the periods; (b) Market dependency of the non-descript

cows increased over time. However, in both the time periods the major share of non-descript milk was going towards home consumption.

6. The changes in cropping pattern in favour of crossbreds brought about a shortage in the availability of natural fodder and this led the dairy farmer to a situation where they had to depend more on the markets. In this situation farmers found crossbreds more suitable.
7. The major temporal changes observed regarding farmer participation in cross-breeding related activities are: (a) most of the farmers are gradually getting discontent with the working of primary milk co-operative societies at the village level, which was reflected in a noticeable decline in the percentage of milk society members among them. (b) slight change was observed in the matter of mode of breeding in favour of Artificial Insemination. (c) the percentage of farmers with fodder cultivation declined noticeably, overtime; the major reason being the giving up of cattle rearing due to changed crop pattern.
8. Regarding the changes in attitude of farmers on Cattle keeping and Improved farming practices, the following are the observations:
 - (a) The rearing of cattle for commercial purpose lost its importance over time, which is reflected in an increased number of farmers opining 'quality milk requirements' as the prime reason for cattle keeping.
 - (b) The farmers attitude towards the requirements of crossbreds (such as feed, animal health care, labour etc.) has changed noticeably; with majority started considering the requirements

of crossbreds are 'slightly more than the requirements of local cow'.

(c) The perception of farmers regarding the characteristics of crossbreds, the following changes were observed:

- (i) unlike, the earlier survey period, all the farmers considered crossbreds to be more susceptible to disease.
- (ii) Increased number of farmers started believing that the yield of crossbreds are slightly greater than that of local cows'.
- (iii) Increased number of respondents started believing that the quality of crossbreds is less than that of local cow.

On the whole, it can be concluded that the diffusion and adoption of crossbreeding technology, its management at the farm level, the attitude and percapita of the farmers towards crossbred cows etc. have changed considerably, over time.

NOTES

1. The infrastructural facilities of Vengola Panchayat is comparatively sound. There are 10 schools out of which 2 are high schools. In the neighbouring Panchayat which is within 0-4 km distance, there is one Technical Institute and a College. There are 3 Private Hospitals in the Panchayat. The village is electrified in 1964 and is well connected with the neighbouring town. For drinking water most of the villagers depend on private wells; and for irrigation, the Periyar Valley High Level Irrigation Canal.

2. The changes in occupational distribution of the people in Vengola Panchayat is given in the following table:

Changes in the Occupational Pattern of Vengola Panchayat

Categories	1987		1993	
	No.	%	No.	%
Cultivators	2097	7.02	2457	6.84
Agricultural workers	3109	10.41	4360	12.14
Industrial workers	137	0.45	219	0.61
Other workers	3917	13.11	5445	15.16
Marginal workers	1110	3.72	1824	5.08
Non-workers	19497	65.28	21609	60.17
Total	29867	100.00	35914	100.00

Source: Estimates from Panchayats Records

3. At the time of Resurvey many farmers remarked that one of the reasons for their switching over to genetically inferior crossbred cattle was to reduce the chance for diseases. But even those people who went for genetically inferior cattle with less suspectability of disease remarked that compared to local breed, crossbreds are more susceptible of diseases. The main reason cited by them are these crossbred varieties who carry the gene of some hybrid parents from alien climatic situations are not consistent to the climatic conditions of Kerala. the major diseases they found were related to heat tolerance and delivery.

Chapter 5

CONCLUSION

The objectives of this study as set out in the introduction were: (a) to examine the diffusion and adoption of cross-breeding technology and its impact on productivity of milch animals and production of milk (b) to bring out the factors governing this technological change (c) to analyse the distribution of gains from milk production and (d) to investigate the farm level responses to the changes in the economic, technological and institutional environment in which farmers are involved in the production of milk through the utilisation of improved cattle breeding technology.

The main findings of the study and its policy implications are briefly outlined below:

Analysis of the diffusion of cross breeding technology has shown that the process of diffusion has taken place at a faster rate in the seventies and has recorded a stagnant growth in very recent years. This is reflected in the trends in artificial insemination. Due to the faster diffusion of artificial insemination, the breed composition of cattle in Kerala has shifted significantly in favour of crossbreds. However, it may be noted that the percentage of crossbreds in the total cattle stock has shown only marginal changes from the early eighties. In other words, what it indicates is that the diffusion and aggregate adoption of technology has reached a stage of equilibrium by the 1980's.

Coming to the adoption of cross-breeding technology across different size groups of farms, we have noted that the level of adoption was higher in the higher size group of holdings, compared to the smaller size of holdings. Some degree of regional variations were also noted in the diffusion and adoption of cross breeding technology.

The spread of cross breeding technology has contributed to significant increase in the productivity of milch animals and rapid increase in milk production. However, it is disturbing to note that in recent years, the trend in the rate of growth in milk production has shown a deceleration. It appears that this deceleration has been contributed by the deceleration in the rate of growth of productivity of milch animals. This has taken place not due to deceleration in the increase in productivity of the in-milk cows, but because of the increase in the percentage of dry cows presumably because of the inadequate feeding and management during the dry period.

Analysis of the distribution of milch animals showed that it is highly skewed. In particular the relatively larger size of holdings tend to have a higher share of milch animals, especially cross breeds. Regarding the use of feed inputs, available data showed only marginal variation across size of holdings. The use of labour input was seen to be slightly more in the lower size group of holdings than the higher size groups. It appears that for the lower size of holdings, milk production is a gainful way of using their family labour; but for the higher size groups it provides opportunities for both utilisation of family labour and feed and

fodder available within their farm. On the whole the insight we get is that the gains from technological change in milk production is more in the large size group of holdings. Farmers belonging to the lower size groups got their access to the new breeds through purchase. In this context, credit and subsidy has helped them. However, it is not possible to expect market mechanism to bring about more equitable distribution of this productive asset.

Coming to the question of gain to consumers, since the overall availability of milk has increased considerably due to technological change, all sections of the consumers have benefited from it. However given the fact that the consumption of milk is more in the higher income groups, the potential gains in the upper income groups seem to be more than in the lower income groups.

Analysis of the factors governing the technological change in milk production in Kerala has revealed the following:

- (a) the institutional interventions and investment in infrastructure by the state through a well defined breeding policy and strategy has played a crucial role in the diffusion of cross breeding technology. But the strategies followed also have a number of limitations (such as inconvenient location of AI centres) which appear to have contributed to the slow diffusion observed in recent years

- (b) a shift in the cropping pattern from paddy to tree crops has resulted in a decline in the requirement of work animals in agriculture. This trend has been further reinforced by the

reduction in size of land holdings and increase in availability of mechanical power through tractorisation. The cropping pattern changes have resulted in a decline in the availability of paddy straw and increase in its cost. Since the technological change in milk production has taken place in a situation in which the scarcity of feed has increased and production of milk has become more attractive, there was a strong tendency to substitute draught animals by milch animals.

(c) the expansion of the market for milk due to rapid growth in demand has played an important role in facilitating rapid technological change in milk production. In the early years of technological change the milk price has been increasing at a faster rate than feed prices. This combined with the fact that the cross breeding technology itself is cost reducing and more profitable than the production of milk with local breeds of animals, has contributed to the faster diffusion and adoption of this technology. However in recent years, the profitability of milk production seems to have declined due to the faster increase in feed prices compared to milk prices. This may be one of the factors for the deceleration trend noted in the production of milk and productivity of milch animals.

(d) the increase in the commercialisation of milk production due to the increased involvement of the co-operative society in milk procurement and marketing has also played a vital role in the spread of cross-breeding technology. The development of

marketing infrastructure has provided outlets for the surplus milk produced in interior areas.

The micro level study provide some insight into the changing scenario of milk production in the state. It is seen from the study that the enthusiasm towards milk production among farmers has been slowly coming down in recent years. This is reflected in the reduction in the number of cattle holdings as well as in the number of crossbreds. It may also be noted that the holdings of less than 10 cents has been moving out of milk production and it is getting concentrated in the medium holdings (51-100 cents). Apart from the increase in feed cost and the relatively slow increase in milk prices, the changes in cropping pattern has also contributed to the change. Since commercial milk production is becoming less attractive, a tendency was also noted among the cattle holders to shift from high yielding animals to low yielding animals. Coming to the management of technology, the micro level study revealed that the farmers are very much aware of the advantages of crossbreds, better animal health care, feeding and so on. Inadequate knowledge of the technology is not a reason for the decline in the milk production scenario of the study village.

The foregoing findings help us in understanding better the emerging environment of milk production in Kerala. After the initial jump in milk production, its rate of growth has shown a deceleration and its source is traced to the deceleration in the rate of growth in productivity of crossbred milch animals. Therefore to step up the growth in milk production one area of effective intervention should be to reverse the deceleration trend

in the productivity of crossbred cows. Apart from this increase in the proportion of the crossbreds in the milch animal stock is also necessary to sustain milk production. As we have seen in this study the deceleration in productivity and near stagnation in the adoption of crossbreds are conditioned by factors which are closely inter related and therefore the level of policy intervention needs to be treated together. In this context few of our suggestions following from the present study are outlined below.

A near stagnation in technology adoption can be traced partly to the decline in the quality of AI technique and partly to the socio-economic environment in which the diffusion and adoption of AI technique has taken place in the state. The deterioration of the quality of the AI service has resulted in a shift from AI to natural service. This is noted even in the case of crossbreds. The reasons for this has been traced in certain studies to the failure rate of AIs and inadequate and inappropriate distribution of the AI infrastructure. In order to correct this deficiency of the AI facilities, it is not only important to provide adequate training to the personnel in charge of the AI stations and the farmers, but also to improve the quality of the infrastructural facilities with the AI stations. Apart from improving the coverage of AI centres it may also be necessary to extend the AI facilities to the farmer's door step wherever it is possible. Since AI infrastructure is unevenly distributed in the state, correction for the required imbalances may lead to gaining further momentum in the diffusion and adoption of cross-breeding technology.

However, the stagnation in the technology adoption is also related to changes in the economics of milk production; an aspect equally important in influencing the trends in milk animal productivity. We have seen in the course of our study that the cost of production of milk has been increasing at a faster rate than the price of milk in recent years. And the increase in cost of production has been due to the increase in feed cost. The changes in cropping pattern to cattle antagonistic crops have resulted in reduction in the availability of paddy straw and other crop residues for feeding cattle. The cultivation of green fodder is almost negligible in the state. Thus, even in the case of green fodder and roughage there is acute scarcity. Coming to concentrates the state has been resorting to imports for a long time. Here, the availability depends on the production of oil seeds, coarse grains and pulses which enters as important inputs in the feed milling industry. In this context, it is important to note that the supply of concentrate feeds from other regions will depend not only on the development of inter regional trade but also on the price the farmers in Kerala will be able to pay for it. In sum, shortages of feeds and fodder will be the major constraints for increasing milk production in the state. The long term solution to augment feed supply in the state will be changes in the cropping pattern to cattle friendly crops, expansion in the area under green fodder cultivation and utilisation of raw material available in the state for the manufacture of concentrate feeds. Unless concerted efforts are made in this direction, Kerala is likely to lose the past achievements in the area of dairying and milk production.

The present study also points out the need to have a proper pricing policy for milk. As we have seen the decline in profitability has been one of the major factors behind farmers gradually moving out of milk production. Therefore, if dairying has to be stabilised, there should be proper mechanism for enhancing procurement price of milk in relation to increase in feed prices. The present method of price fixation is not based on scientific norms. It is important to shift to a method of pricing that takes into account not only the cost of purchased inputs but also family labour.

Appendix

A NOTE ON DATA SOURCES

As mentioned in Chapter 1, the three major sources of data used for this study are : (1) Quinquennial Livestock Censuses Reports published by the Animal Husbandry Department of Government of Kerala. (2) Reports on Integrated Sample Surveys for estimation of production of Milk, Egg and Meat, provided by the same department. (3) The Data available from the survey conducted by the Centre for Development Studies (CDS) on cattle holdings of Kerala in 1987. This note is meant for giving some more details on the above data sources.

(1) Quinquennial Livestock Censuses Reports

Kerala State, in its present geographical-administrative shape, came into existence on 1st, November 1956. The state is composed of former princely States of Travancore and Cochin and the District of Malabar plus Kasargod Taluk, transferred from the former Madras State. It was in 1951 that a Livestock Census was conducted in Travancore, Cochin and Malabar areas. The Eighth Indian Quinquennial Livestock Census was conducted in 1956 in the Travancore-Cochin area by the Department of Statistics of the former Travancore-Cochin State while the next quinquennial census for livestock was conducted in 1961 which incidently was also the first livestock census for Kerala State as such, which was entrusted to the State Animal Husbandry Department. The Quinquennial Livestock Censuses are carried out regularly thereafter in the state by the Department. The latest Livestock Census Report available is the fourteenth one related to the year, 1987.

(2) Integrated Sample Survey Reports

The first sample survey on milk production, yield rates of milch animals, feeding and management practices of bovines etc. was the one carried out by Institute of Agricultural Research Statistics (IARS) in 1964-65. In the mid seventies (1975-76) the National Sample Survey Organization (NSSO) conducted a nation wide survey with the same objectives. Following this pattern, the state Animal Husbandry Department too has been conducting the integrated sample surveys for the estimation of production of milk, egg and meat since 1977-78. The reports on these surveys contain estimates on the production of milk, the productivity of milch cattle, the per capita per day availability of milk, the pattern of utilisation of milk, the breeding and feeding practices followed by the cattle farmer etc. The latest Integrated Sample Survey Report available at the time of this study was that related to the year 1991-92.

(3) The CDS Survey on Cattle Holdings - 1987

A study of cattle holdings of Kerala was taken up by the Centre for Development Studies (CDS) in 1987, which was sponsored by the Kerala Livestock Development Board (KLDB) and the Swiss Development Corporation (SDC). The study attempted to understand the then existing farm level practice of feeding, breeding and management of cattle; to analyse the farmers' interactions with input and output agencies; and to identify the nature of awareness, attitude and adoption of improved farming practices among the farmers.

The Primary data was collected from a household survey conducted in 27 villages spread over 9 taluks in the State. While evolving the sampling procedure attention was given to get representative sample households from different agro-climatic regions of the state and different levels of infrastructure availability.

The sample households were selected on the basis of a multistage stratified random sampling procedure. Since cattle development activities in the southern, central and northern regions of the states were initiated at different periods, the sampling was done in such a way to get equal representation to all the three regions. The taluks belonging to these three groups were further classified into three, viz., Coastal region, Midland region and Upland region. One taluk was selected from each of the 9 groups such that the scatter of selected taluks followed an even distribution. Table A.1.1 provides the list of selected taluks.

Table A.1 : List of Selected Taluks for CDS Study

Regions	Coastal	Midland	Upland
South	Mavelikkara	Adoor	Nedumangad
Central	Cranganore	Kunnathunad	Udumbanchola
North	Tellicherry	Perinthalmanna	Mananthodi

Source: P.S. George and K.N. Nair (1990)

At the second stage, three villages were selected from each of the 9 selected taluks. While doing this attention was given to regions with different levels of infrastructure availability. According to the availability of infrastructure facilities, three scenarios were identified (Table A.1.2) and representative villages from each of them were included in the sample.

Table A.2 : Typical Scenarios identified for Village Selection

Characteristics	Scenario I	Scenario II	Scenario III
1. Proximity to Urban Centre	Very close	Away	Far away
2. Milk marketing facility	Good	Satisfactory	Poor
3. Facility for AI	Good	Satisfactory	Poor
4. Veterinary facility	Good	Satisfactory	Poor
5. Agricultural development	Reasonably Good	Average	Poor

Source: Same as table A.1

The third stage of the sampling process involved the selection of 40 households from each of the 27 villages using a stratified random sampling procedure ; the criteria for stratification being the size of holdings and the type of cattle maintained. In order to get the population distribution in each stratum, a complete listing of all households in each of the selected villages was taken up. The information on size of land holdings and size of cattle holdings obtained from the listing schedule was used to obtain bi-variate frequency distribution of the total households in each village. The size of land holding categories included: (1) upto 10 cents; (2) 11-50 cents; (3) 51-100 cents; (4) 101-250 cents and (5) >250 cents. The cattle categories included : (1) crossbred cows (2) local cows and (3) no cattle. A sample of 40 households from each village was distributed among the 15 cells of the bi-variate table in such a manner that the distribution among the cattle holding categories was of 15 with crossbred, 10 with local and 15 without cattle. The required number of households from each cell was drawn at random with marginal adjustments in situations where sufficient number of households were not available in a given cell. Thus the sample size for the survey was 1680 households from 27 villages spread all over the state. The list of selected villages for CDS study is given below. (Table A.1.3)

Table A.1.3 : List of Selected Villages for CDS Study - 1987

Taluk	Scenario I	Scenario II	Scenario III
Nedumangad	Venkavila	Velijannoor	Parandod
Adoor	Pannivizha	Mallica	Thoviyur South
Mavelikkara*	Pallickal East	(T. Naduvath)	Komallur
Udumbanchola	Vellayamkudi	Nettithozhu	Rajakumari South
Kunnathunad	Pulluvazhy West	Varicaud	Pandikad
Cranganore**	Aarakulam West	Edavilangu	[Kudaliyur]
Perinthalmanna	Pathayakkara	TN Puram West	Pathiricode
Mannanthodi	Ozhakkodi	Trissileri	Varayal
Tellicherry	Kuttimakkul	Karayetta	Vilicode

Note : * Including Karthikappally ** Including Chawaghat
Source : Same as Table A.1.

The field work of the study was initiated in six villages in October 1987 and by April 1988, all the villages were covered. An elaborate report on this study has published later, in 1990, by the Centre for Development Studies (P.S. George and K.N. Nair, 1990). The two other books which based heavily on the findings of the study are Gincey et. al, 1988 and P.S.George et. al, 1989.

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