CROSSBREEDING TECHNOLOGY AND DAIRY DEVELOPMENT: The Kerala Experience

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I hereby affirm that the research for this dissertation titled "Crossbreeding Technology and Dairy Development: The Kerala Experience" being submitted to the Jawaharlal Nehru University for the award of Master of Philosophy in Applied Economics, was carried out entirely by me at the Centre for Development Studies, Trivandrum.

Trivandrum,
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Certified that this dissertation, the bonafide work of Thara.S.Nair, has not been considered for the award of any other degree by any other University.

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Chapter 1

Introduction

1.1 Nature of the Problem

Crossbreeding in cattle has been an important component of the strategy for enhancing milk production in India. It was argued that "unless crossbreeding of indigenous cattle with exotic dairy breeds is undertaken in a big way, it will be impossible to bridge or even narrow the gap between the availability of and demand for milk in the country" (Govt. of India, National Commission on Agriculture, 1976). Though sporadic attempts were made to introduce crossbreeding in India during the pre-independence period, systematic efforts in this direction were initiated only after the inception of the Five Year Plans, especially the Third Plan,[1] when investment priorities shifted towards agriculture.[2] The policy option in favour of crossbred cows reverberated in the Operation Flood (OF) programme launched in the early seventies. The document produced by the National Dairy Development Board in 1980 at the time of launching the second phase of OF, put forward the concept of a National Milch Herd comprising of ten million crossbred cows and graded she-buffaloes.[3]

The advantages or otherwise of crossbreeding indigenous cattle with the help of an exotic gene pool have been the subject of earnest debate in India. That the livestock and animal husbandry experts were not very enthusiastic about a large scale crossbreeding programme is apparent from various reports of the

earlier times (Morgan (1907), Col.Oliver (1938), Paperall (1948). However, in the latter half of the 20th century, a number of studies were conducted following the shift in the official policy in favour of crossbreeding. The major aspects which these studies try to throw light upon are (1) comparative performance of different breeds of animals, (2) responsiveness of productivity of animals to feed availability, and (3) adoption of crossbreeding technology and its implications for income distribution.

A number of studies have pointed out that, though the cost of maintenance of a crossbred cow is usually higher than that of a local cow (or a graded she-buffalo), the cost of production per unit of milk is considerably lower in the case of the former (T.R. Puri and Bhupal Singh, 1964; Sardiwal and Kalla, 1975; Madala and Charan, 1975; Y.V.R. Reddy et.al, 1980; C. Ramaswamy et.al, 1983). Studies undertaken at the National Dairy Research Institute, Karnal and the Indo-Swiss Project, Kerala, reveal that a crossbred cow (a) calves early, (b) has low dry period and calving interval, (c) has high average daily milk yield and (d) incurs low cost of calf rearing and milk production compared to its non-descript counterpart (Ram, Kubar and Singh, 1975; Patel et.al, 1975).

The advantages of the crossbred cattle as milch animals and the extensive efforts to promote diffusion of crossbreeding technology, have been questioned by many scholars. According to one line of criticism, the strategy of large scale crossbreeding would accentuate the already existing shortage of feed and fodder

in the country.[4] This would essentially limit the production potential of the crossbred animals (S. Singh, 1979). Nair and Jackson (1982) have pointed out that the actual requirement of feed and fodder in the coming years will be higher than what is expected. The strategy of increasing fodder supply through shifting more land to fodder crops, they argue, is unlikely to materialize as the cultivation of fodder crops does not have comparative advantage over other crops. Further, it has also been pointed out that, the crossbred animals may not be adaptable to all types of agro-climatic conditions in the country. A growing demand for milk (as a result of urbanization and higher income levels), low demand for draught power reqirement, and a preference for cattle meat consumption are some of the pre-conditions identified for large scale adoption of crossbreeding. In this context, it is also argued that, since in most parts of the country slaughter of cattle is legally banned, sustaining genetic quality of the stock through systematic culling of the unproductive stock may not be possible.[5]

Another argument against crossbreeding is that the crossbred bullocks are inferior work animals compared to their indigenous counterparts. According to one argument, though the physical efficiency of the crossbred bullock is higher, its economic efficiency is lower. However, Katpatal (1977) and R.M. Acharya (1987) argue that the prejudice against crossbred males is reasonably unfounded, since most of the crossbreds, espeically half-breds, have been observed to perform better than indigenous males because of their size.[6] In terms of efficiency, they are not inferior to indigeneous males, especially for slow and steady

work.

Studies relating to the question of distribution point out that since the crossbred animals are more expensive and risky to maintain compared to the indigenous breeds, the full potentialities of milk yield of the former will be tapped by the resourceful farmers with large landholdings. (Nyholm Klans et. al, 1974; Rajpurohit, 1979; Nair,K.N.,198Ø).

1.2 Need for the study

Notwithstanding the validity or the lack of it of the above arguments, a large scale programme of crossbreeding has been under implementation in the country for the last two and a half decades. The attempts in this direction have resulted in some degree of improvement in the genetic quality of the cattle population. According to the data on the distribution of cattle by breeds available from the 37th Round of the National Sample Survey, about 13 percent of the cattle population in India belong to the category of crossbreds.[7] (See table 1.1). A point to be noted here is that, there are significant inter-regional variations in the adoption of this technology. Out of the 19 states for which data were available, nine show percentage of cattle below the national average and ten, above it. Since crossbreeding has been introduced to improve the genetic quality of the milch cattle, a more appropriate indicator of the degree of technological change would be the proportion of crossbred cows in the total population of breedable cows. For the country as whole, about 24 percent of the she-cattle belong to the crossbred

category. In a large number of states, the estimated proportion of crossbred cows in the total cow population is much higher than that of crossbred cattle in the total cattle stock. In other words, the variations in the genetic quality of the milch herd are more striking than what is reflected in the overall change. The percentage of crossbred milch cattle is the highest in Gujarat, followed by Kerala and Punjab and is the lowest in Himachal Pradesh. Such differential adoption of crossbreeding technology could have arisen out of an interplay of a variety of factors.

Table 1.1 **Percentage of Cross-bred Cattle in the Cattle Population per 100 Households by States**

States	No. of cross bred cattle	Total no.of cattle	No.of CB adult female cattle	Total no.of adult females	% of CB cattle to all cattle	% of CB cows to adult females
Andhra Pradesh	11	132	9	43	8.33	20.93
Bihar	24	141	13	41	17.02	31.71
Gujarat	37	158	24	43	23.42	55.81
Haryana	27	139	13	40	19.42	32.50
HimachalPradesh	23	285	8	88	8.07	9.09
Jammu & Kashmir	34	271	20	100	12.55	20.00
Karnataka	17	200	12	72	8.50	16.67
Kerala	24	71	15	36	33.80	41.67
Madhya Pradesh	34	307	19	99	11.07	19.19
Maharashtra	18	179	10	54	10.05	18.52
Manipur	19	138	7	32	13.77	21.87
Meghalaya	36	302	19	81	11.92	23.45
Orissa	19	210	14	64	9.05	17.19
Punjab	33	131	15	41	25.19	36.59
Rajasthan	33	252	24	101	13.09	23.76
Tami Nadu	16	100	9	35	16.00	25.71
Tripura	47	180	24	71	26.11	33.80
Uttar Pradesh	22	156	13	39	14.10	33.33
West Bengal	14	167	11	53	8.38	20.75
All India	22	172	13	54	12.79	24.07

Source: Govt.of India, Ministry of Planning; National Sample Survey, 37th Round (January-December 1982); Survey on Land holdings and Livestock Holdings.

Being a biological population, the size, composition and growth or decline of livestock are determined by biological conditions of reproduction on the one hand, and environmental and socio-economic conditions, on the other. Biological conditions are expressed through such parameters as breeding efficiency, maturity period, life span, mortality rate etc. Environmental conditions include topography, agroclimatic conditions etc. (S.N Mishra, 1978). Any study concerning the differential adoption of the technology ought to take cognizance of these aspects. This is particularly so in the case of a country like India, where diversity in both environmental and socio-economic conditions is highly pronounced. In order to explain the variations across regions, investigations into the interplay of factors specific to each region are needed. It is in this background that the present study is taken up in the context of Kerala, which has a long history of organized attempts at crossbreeding local cattle for increasing milk production.

1.2 Objectives and Approach

Though an inquiry into the pattern and trends in the adoption of crossbreeding technology in the State forms the broad backdrop of the present study, the following specific objectives are considered.

a) To evaluate the earlier attempts made by the state for popularising the crossbreeding technology and to examine the extent of its adoption at the farm level.

(b) To examine the trends in the size and composition of the cattle population in the State and to analyse the

effect of crossbreeding technology in bringing about the observed trends.

(c) To determine the contribution of the breeding technology to the increase in prdouctivity of milch animals and production of milk.

(d) To identify the specific factors that facilitated a faster adoption of crossbreeding technology in the state.

To begin with, acquisition, diffusion and adoption of technology are clearly distinguished. Acquisiton refers to the primary introduction of an innovation or the act of obtaining an alien technology. The process of modifying the technology and further developing it to suit the local resource endowment and delivering it to the potential user is considered as diffusion. This is secondary introduction, which includes creation of an indigenous research and development (R&D) capacity and requires the mastery of certain techniques by local personnel. In otherwords, diffusion is the link between research and development and the user. Thus, effective diffusion becomes an essential, but not a sufficient condition for adotpion of new technology. Here, adoption refers to the internalization of the new technology in the production process.

Innovations can be of two kinds - induced and directed. According to the induced innovation hypothesis, advances in mechanical and biological technology respond to changes in relative prices of factors and to changes in prices of factors relative to products so as to ease the constraints on growth

imposed by inelastic factor supplies. (Hayami and Ruttan, 1971). As against this model, writers like Burmeister Lary (1987) cited the examples of developing countries and argued that agricultural change and research efforts can also be directed. In India, decisions to acquire the technology and its further development through internal research efforts are taken by the State and thus present an example of 'directed innovation'.

At the outset, it is assumed that the actual adopter is aware of the nature of the available technology and the decision to adopt or reject the given technology depends primarily on the expected benefits derived from continuing, modifying or discontinuing its use. More concretely, the factors that affect the farmer's decision-making are (1) the expected net returns; (2) suitability of the technology to the socio-cultural and institutional environment under which he operates; and (3) the effect of the technology on the benefits that he already derives from the existing production process. If a given technology is viable both economically and technically at the farm level, the question of adoption depends largely on the organizational support. Moreover, there are social and cultural factors also that are likely to influence technology adoption. For instance, if beef consumption is a social and cultural taboo, farmers would be reluctant to rear crossbred cows since it is difficult to sustain their genetic quality.

Chapter Scheme

In chapter two the following issues are analysed:

(i) the nature of the bovine economy of the state when

crossbreeding technology was acquired and the subsequent research and development efforts undertaken to modify and develop it to suit the environmental conditions; (2) the magnitude and quality of infrastructure (in terms of bull stations, semen banks, artificial insemination centres etc.) built up overtime and (3) the extent of utilization of the ifrastructure.

Chapter three examines the physical environment under which crossbreeding technology is getting internalised. In this context, an analysis of the size and composition of the cattle herd and the alterations resulting from the new technology is carried out. This will be followed by an analysis of the impact of technological change on the productivity of milch animals and production of milk in chapter four.

There are a number of factors, which in conjunction with the socio-economic and institutional forces, determine the adoption of crossbreeding technology. They include the demand for milk, movements of prices of milk and inputs, level of commercialization, size and distribution of land holdings, cropping pattern, the quantum and quality of feed available, the requirement of draught power in agriculture etc. The process of interaction of these factors, which influences the decision making of farmers, is analysed in chapter five.

Chapter six brings together the main findings of the study and highlights the implications for future development of dairy sector of Kerala.

Notes:

1. Crossbreeding Indian cattle with exotic breeds to improve milk production was begun in the late 18ØØs by European missionaries and tea planters in the hilly areas of Assam, West Bengal and Tamil Nadu and around Patna in Bihar state. At the turn of the century, the introduction of the exotic germplasm was adopted as an official policy by the military dairy farms of the country. Some of the civilian cattle breeding farms at the Imperial Dairy Research Institute, Bangalore,the agricultural insitutes in Pusa, Patna and Allahabad, and the livestock research stations in Hosur and Madras also introduced European breeds in the 192Ø's and 193Ø's. Most of these crossbreeding efforts were limited to the improved Indian dairy breeds such as the Red Sindhi, Sahiwal and Hariana. (B.G Katpatal, 1977)

2. For a detailed analysis of the evolution of cattle development policies and programmes see Dolberg (1976); George,S (1985); B.C Mascerenhas (1988).

3. The salient features of breeding strategy adopted by the Operation Flood Project are discussed in National Dairy Development Board (1979).

4. Based on the forage and concentrate levels recommended by the National Commission on Agriculture (1976) Surinder Singh has worked out the total requirements of dry fodder, green fodder and concentrates for bovines for the years 1978-79 to 1984-85. Comparing this with the availablity estimates, he has shown that there is considerable gap between the two. The magnitude of deficiency is high, especially in the case of green fodder and concentrates. According to his estimates, in the year 1984-85 the gap between the requirement and availability of green fodder and concentrates would be of the order of 2ØØ and 18 million tonnes approximately. The rate of increase of deficit in green fodder and concentrates would be at the rate of 2.3 per cent and 3.1 per cent respectively per annum during the period between 1978-79 and 1984-85. (See Surendar Singh, 1979)

5. According to the NCA (1976), while 37 per cent of the goats and 33 per cent of the sheep were slaughtered in 197Ø, the percentage of cattle brought to traditional butchers or slaughter houses was only Ø.9 per cent.

6. Half-breds refer to the crossbreds with 5Ø per cent exotic inheritance.

7. The difference between the 1982 Census figures and the NSS 37th round estimates is astounding . According

to the Census, except Kerala, in all the other states the percentage of crossbreds to the total cattle is below 2Ø per cent. While Kerala has had 46.91 per cent of the cattle stock crossbred, the all India percentage is only 4.57 per cent.

Chapter 2

Acquisition and Diffusion of Crossbreeding Technology in Kerala

2.1 Introduction

Until the last three decades, in Kerala, cattle were maintained with the primary objective of supplying draught power to the agricultural sector. Obviously, the types of cattle maintained were not suitable for milk production. These cattle were generally known as the 'non-descript' cattle and did not belong to any specified breed- either dairy, dual purpose or draught. Their milk yields were very low. According to a survey conducted in the State by the Institute of Agricultural Research Statistics (IARS) in 1964-65, the average milk yield per milch cow was around Ø.5Ø kg per day. Other reproductive characteristics like age at first calving, lactation length and dry period were also below desirable limits. Added to the genetic backwardness, the management offered to them was inefficient. However, these cattle were well-adapted to the management conditions and the tropical environment prevalent in the State and were resistent to external parasites, tropical diseases etc. (P.N.R. Nair, 1973).

Organised attempts to improve the genetic quality of cattle in Kerala began on a scientific basis during the post-independence period. The first step towards this direction was the implementation of the Key Village Scheme. Under this Scheme around 5Ø artificial insemination centres, covering a breedable cattle population of less than 5Ø,ØØØ were started in the State. The programme was one of grading up[1] the local cattle using the

Red Sindhi breed. Inspite of the problems of implementation like non-availability of pedigree bulls in sufficient numbers and low-profile technology, the scheme could produce a good number of crossbred calves. The breeding programme expanded in terms of both scope and coverage with the launching of the Intensive Cattle Development Project (ICDP) in 1966 which covered around one lakh breedable females.[2] Improvement of cattle management through extension work among farmers was also incorporated as an integral component of the programme.

In 1963 the Indo-Swiss Project (ISPK), the first bilateral project to be initiated in India for integrated dairy development, was set up in the high ranges of Kerala as a joint venture by the Government of India, Government of Kerala and the Confederation of Switzerland. Eversince its inception, it has functioned in the State as the major technology generating and input servicing agency. The project has developed the basic concepts of (1) evolving a suitable genetic combination to be in natural balance with the local ecology and (2) augmenting the availability of feed and fodder. (S. Chappatte and S. Krishnamoorthy, 1983). The development of frozen semen technology by the ISPK marked a breakthrough in the history of cattle breeding in the State. The crossbreeding programme of the Indo-Swiss Project, started in the high range district of Idukki, was extended to the southern districts of Trivandrum, Quilon and Alleppey during 1974 covering a breedable female cattle population of five lakhs, thanks to the implementation of the Special Employment Programme of the Dairy Development Department.[3] During the same period the northern districts of

the State viz. Kottayam, Ernakulam, Trichur, Palghat and Calicut were getting CME semen of Jersey breed supplied from the bull station at Dhoni under the Dairy Development Department and chilled semen of pure Jersey bulls from the Animal Husbandry Department.

Along with the expansion of the breeding programme the breeding policy of the State also underwent significant changes. The breeding policy adopted by the State aims at producing a crossbred population having a definite percentage of exotic and indigenous inheritance. The approved policy was to limit the exotic inheritance to 5\8 or 62.5 per cent level. This is brought about by two forward crossings and one backward crossing between the 3/4 (75%) and 1/2 (50%) generations, so that the blood level remains more or less static.[4] Once the required level is reached, further improvement in stock is brought about through a systematic selection programme. In other words, the underlying philosophy of breeding policy is that the new breed evolved should be an animal suitable to the local conditions, and not a pure exotic breed.

In 1978 a Committee of animal breeders was appointed by the State to study the existing breeding practice for cattle and to suggest a long term policy. The Committee concluded that there was no significant difference between the productive and reproductive performance of the two crossbred groups of Jersey and Brown Swiss. The salient points among their recommendations that form the present policy of the State are:

(1) There is no need to keep the breed barrier, viz., Brown Swiss

crossbred to the southern area and Jersey crossbred to the northern area;

(2) The level of exotic inheritance, whether it would be Jersey, Brown Swiss, Holstein Friesian (HF) or a combination of all, should be around 50 per cent;

(3) In addition to the existing breeds, HF should also be incorporated on a limited scale into the breeding programme;

(4) The ISPK (now the Kerala Livestock Development and Milk Marketing Board)[5] should be the sole agency for the production and distribution of semen;

(5) The entire quantity of semen should be processed in deep frozen conditions and supplied throughout the State making available the existing genetic material evenly to all parts of the state;

(6) After 1985 the use of pure breed for F1 production should be suspended and in their place highly selected crossbred bulls should be used;

(7) A sire evaluation system[6] should be built into the AI programme to make accurate selection of breeding bulls for continued genetic progress within the population.

2.2 Infrastructure

In order to translate the policies outlined above, the State has built up a large network of infrastructure consisting of bull stations and bull mother farms, Regional Semen Banks and AI centres. The main purpose of establishing bull stations and bull mother farms is to stock and maintain bulls required for the production of frozen semen. The Regional Semen Banks (RSB) are established for the storage of the frozen semen produced at the

bull stations to be transferred to the field. The actual transfer of technology at the farm level is done through the AI centres.

The infrastructure developed in the form of bull stations and bull mother farms in the State during the last two decades are summarized in Table 2.1. The four stations in the State accomodate around 900 heads of cattle, of which 180 are breeding bulls in collection, 400 are growing stock and 260 are bull mothers. The requirement of young bull calves is to the tune of 160, of which around 100 are produced in the Bull Mother Farms either through nominated mating of the crossbred cows with proven crossbred bulls or from the Zebu cows. Around 60 superior male calves, produced by nominated mating of the elite cows in the milk recording area with proven crossbred bulls, are purchased and reared in the rearing stations. In addition to this, bull stations also keep around 45 superior Murrah buffalo bulls to cater to the needs of the state.

Table 2.1 : Bull Stations and Bull Mother Farms in Kerala

Unit	Activities	Capacity
Mattuppetty (1963)	Bull Station Bull mother farm	75 bulls 100 cows 225 growing stock
Peermade (1968)	Bull mother farm	100 cows 80 growing stock
Kulatupuzha (1976)	Bull Station	75 bulls 25 growing stock
Duoni(1978)	Bull Station Bull mother farm	75 bulls 60 cows 70 growing stock

Note: Bracketed figures indicate the year of establishment.
Source: Kerala State Livestock Development and Milk marketing Board, Annual Report (1985-1986)

Data on the production of frozen semen in the bull stations from 1969-70 onwards is given in Table 2.2. In the early seventies bulk of the semen produced was from the exotic breed. However, overtime in conformity with the State's breeding policy, the requirement of semen from exotic breeds has declined, and as of now, production of semen is mostly from the crossbred bulls. In the early eighties, for the first time in India, the ISPK has successfully produced frozen buffalo semen. Eversince, the stations have been producing frozen buffalo semen to be supplied to the AI centres in the state for improving the genetic quality of the buffalo population.

Table 2.2: Details of Frozen Semen Production in Kerala
(in doses)

Year	Crossbred	Exotic	Total
1969-70	2132	59881	61593
1975-76	145576	92413	237989
1979-80	483400	437405	920805
1980-81	403405	201885	618875
1981-82	569987	250760	844292
1982-83	540305	297525	883070
1983-84	713615	154590	984880
1984-85	1101400	291285	1527645
1985-86	1575685	171680	1912400

Source: Same as for Table 2.1

The frozen semen produced in bull station is supplied to 1400 AI centres, controlled by the departments of Animal Husbandry, Dairy Development and Milk Marketing Federation, through six RSBs.

Table 2.3 gives the details of the RSBs in operation. An understanding of the spatial location of the RSBs and the bull stations in the State can be obtained from the given table. The RSBs have the following functions: (1) Distribution of frozen semen to all the AI centres under their control in accordance with the bull allotment programme, (2) supply of liquid nitrogen (LN2) to all the AI centres, (3) maintenance of the quality of frozen semen and (4) collection of random data on AI, its consolidation and evaluation.

Table 2.3 : Spatial Distribution of Regional Semen Banks

(as on March 1988)

Name	Districts covered	Number of Al Centres covered	Number of breedable females covered (in lakhs)
Kulathupuzha	Trivandrum, Quilon Part of Pathanamthitta	294	2.10
Mavelikkara	Alleppey, part of Pathanamthitta	218	2.77
Muvattupuzha	Idukki, part of Ernakulam, Kottayam	288	3.37
Chalakudy	Trichur, part of Ernakulam	176	1.24
Puthupady	Palghát, Malappuram Calicut, Kasargode, Wynad	262	2.65
Cannanore	Cannanore	143	1.20

Source: Same as for the earlier tables.

The semen stored in the RSBs are distributed to the various artificial insemination (AI) centres in the State. These centres are manned by qualified technicians and controlled by the Departments of Animal Husbandry, Dairy Development and Milk Marketing Federation. The number of AI centres under different agencies and number of inseminations performed by the different departments are given in Table 2.4. It can be noticed that 82 per cent of the total AIs are carried out by the Animal Husbandry Department and 15 per cent, by the Dairy Development Department. The AI programme has already covered 95 per cent of the villages in the State. It is also interesting to note that, though Kerala accommodates only 3 per cent of the total cattle stock in India,

about 20 per cent of the country's AI is being done in the State. (T.C Mathew et.al, 1983).

Table 2.4: AI Centres and AIs done Classified by Operating Agencies

Agency	AI Centre		AIs done	
	Number	% to total	Number	%
AHD				
Vet.Hos& Dis	405	30.31		
KDP	477	35.70		
Total	882	66.01	8,03,765	67.50
DDD	406	30.30	3,71,685	31.21
Others	48	3.60	15,372	1.29
Total	1336	100.00	11,90,822	100.00

AHD : Animal Husbandry Department, DDD: Dairy Development Department.

Source: Same as for the earlier tables.

With the expansion of infrastructure for semen production and distribution, the number of AI centres increased from about 100 in the early seventies to 800 by the beginning of the eighties and to 1400 by mid-eighties.

In the initial stages, use of frozen semen was confined to the southern districts of Trivandrum, Quilon, Alleppey and the hill region of Idukki district. The use of frozen semen in other districts of the State began only in the early eighties. Previously, for insemination CME semen was used in these districts. The distribution of AI centres also suggests that the northern districts are not given adequate attention. (See table 2.5). The number of AI centres per 1000 breedable cattle is

relatively less in the case of Malabar districts compared to the southern and central districts. However, efforts are being made to build up the necessary infrastructure in the northern parts of the State.

Table 2.5: Distrctwise Distribution of AI Centres 1985-86

District	Number of AI Centres[1]	Number of breedable cows in 1982 (in lakhs)[2]	Number of calves 1000 breedable cows
Trivandrum	118	1.06	1.11
{Quilon Alleppey Pathanamthitta}	401	3.89	1.05
Kottayam	143	1.54	0.92
Idukki	80	0.86	0.92
Ernakulam	110	1.43	0.77
Trichur	119	1.06	1.12
Palghat	83	1.15	0.72
Malappuram	47	0.80	0.59
Wynadu	35	0.46	0.76
Calicut	97	1.09	0.89
Cannanore	132	1.77	0.74
State	1336	15.13	0.93

Source: 1. Kerala Livestock Development and Milk Marketing Board, Annual Report (1985-86);
2. Govt. of Kerala, Department of Animal Husbandry, Report on the 13th Quinquinnial Livestock Census, 1982.

2.3 Utilization of the AI Facilities

In order to understand how far the infrastructure built up has been made use of at the farm level, we have used two indicators: (1) the number of inseminations done in the AI centres and (2) the number of calves born through AI service. Data on the number of AIs done in the AI centres are available only from 1973-74 onwards. Up to 1975-76 the available data are not dependable, since no fee was charged on the inseminations

done. However, from 1975-76 onwards the farmers have been charged a nominal fee of Rs.5 and the data on the number of inseminations done have been systematically recorded.[7] The relevant data for the period between 1973-74 and 1985-86 are given in table 2.6.

In 1973-74 the number of inseminations done was about five lakhs and it increased to 11.9 lakhs by 1985-86. But there has been a perceptible decline in the growth rate of AIs since 1978-79. The average annual growth rate of AI for the five years prior to 1978-79 was 15.4 percent, whereas it fell to a mere 3.5 percent for the succeeding period.

Table 2.6: Growth of AI in Kerala

Year	Total Number of AIs done (lakhs)	AIs with frozen semen (lakhs)	AIs with chilled\ CME semen (lakhs)
1973-74	5.11	1.78	3.33
1974-75	5.19	1.68	3.51
1975-76	5.86	2.58	3.28
1976-77	7.Ø4	3.89	3.15
1977-78	8.Ø4	3.94	4.1Ø
1978-79	9.2Ø	4.75	4.45
1979-8Ø	9.54	5.63	3.91
198Ø-81	9.87	6.75	3.13
1981-82	1Ø.42	6.99	3.17
1982-83	1Ø.86	8.54	2.32
1983-84	11.12	9.13	1.99
1984-85	11.46	1Ø.53	Ø.93
1985-86	11.9Ø	11.91	-

Source: KLD & MMB, (1985-86).

Another observation to be made is that in 1973-74 about 35 per cent of the total inseminations done in the State was with frozen semen and the rest with chilled and CME semen. By 1985-86 chilled and CME semen were entirely replaced by frozen semen,

which has resulted in significant improvement in the efficiency of crossbreeding programme in the State.

The extent to which the AI facilities are being utilized by the farmers can be understood from the type of service the farmers adopt for breeding their milch animals. The information collected on this aspect through the Integrated Sample Survey conducted by the Animal Husbandry Department in the mid-eighties shows that, about 21 per cent of the non-descript and 81 per cent of the crossbred cows received artificial insemination. On the other hand, 79 per cent of the non-descript cows and 19 per cent of the crossbred cows were serviced through the natural method. For the state as a whole, around 50 per cent of the cows were serviced through AI and the rest 50 per cent, through natural method.

Table 2.7: Distribution of Cows According to the type of Service in Selected Districts (1984-85)

Districts	Non-Descript Cow			Crossbred Cow		
	AI(%)	NS(%)	ALL	AI%	NS%	ALL
Trivandrum	33	67	100	89	11	100
Kottayam	52	48	100	91	9	100
Ernakulam	48	52	100	70	30	100
Cannanore	3	97	100	60	40	100
Other Districts	21	79	100	83	17	100
State	21	79	100	81	19	100

AI = Artificial Insemination, NS = Natural Service.
Source: Govt. of Kerala, Directorate of Animal Husbandry; Report on the Sample Survey for Estimation of Milk, Egg and Meat for the Period 1977-78 to 1984-85.

There are also considerable regional variations in the breeding practice followed. In the southern districts, breeding of

animals through AI is found to be much in vogue than in the Malabar districts (See Table 2.7).

It is, in fact, difficult to gauge the effectiveness of AIs in terms of addition of crossbreds to the State's cattle population. According to the available field studies, the success rate of AI in the State is some where around 20 per cent.[8] Therefore, one would expect at least about 1/5th of the AIs done in the State to result in the production of crossbreds. From 1977-78 onwards, fairly accurate data has been collected by the AI centres on the number of calves born from artificial insemination. The number of crossbred calves born through AI between 1977-78 and 1984-85 is given in table 2.8.

Table 2.8: AIs done and Calvings Recorded in Kerala
(in lakhs)

Year	AIs done[1]	Calvings[2] Recorded
1977-78	7.92	1.66
1978-79	8.82	1.75
1979-80	9.82	1.85
1980-81	9.33	1.89
1981-82	8.95	1.94
1982-83	9.95	1.91
1983-84	10.98	2.20
1984-85	11.10	2.13
1985-86	11.75	2.29

(The table shows the number of AIs done by the Animal Husbandry and Dairy Development Departments alone).

Source: 1. KLD & MMB; Annual Report,(1985-86);

2. Govt.of Kerala, Directorate of Animal Husbandry; Report on the Sample Survey for Estimation of Milk, Egg and Meat for the period 1977-78 to 1984-85.

It is evident from this table that during the period between 1977-78 and 1985-86 the average annual addition of

crossbreds to the State's cattle herd has been 1.9 lakhs. This, in turn, implies that the past attempts at popularising crossbreeding technology in the State would have resulted in significant changes in the breed composition of the cattle stock.

2.4 Conclusion

In the foregoing discussion, we have reviewed the salient features of the breeding policy of the State and the infrastructure built up to implement the policy. The breeding policy of the State largely envisages the production of a milch cow, the genetic combination of which is in natural balance with the local ecology and which has high milk production potential. With a view to achieve this objective, extensive infrastructure consisting of bull stations, bull mother farms, semen banks and AI centres have been built up. Over the last two decades, the rate of utilization of these facilities recorded impressive improvement as shown by the number of AIs done and calves born. A significant feature of the evolution of breeding technology in the State has been the gradual replacement of chilled and CME semen by deep frozen semen.

The rapid expansion of breeding facilities has resulted in the addition of a large number of crossbreds to the existing stock. The extent of influence that this process of genetic transformation has had on the characteristics of the cattle population, in terms of size and composition, is discussed in the following chapter.

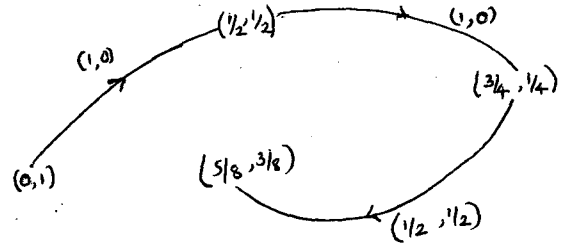
Notes:

1. When the local animal population is gradually raised to the level of the donor population through successive matings of the progeny to the donor breed, it is called grading up. It is, in other words, a variant of crossbreeding.

2. The ICDP is an integrated scheme with the specific objective of stepping up the overall milk production in a particular area to a targetted level within a specific period by improving the quality of the animal through crossbreeding. The first ICDP unit in Kerala was established in 1969 at Alwaye. This was followed by the setting up of five more Projects at Palghat (1972), Kozhicode (1979), Kottarakkara (1981), Cannanore (1983) and Trivandrum (1984).

3. The Special Employment Programme, which was launched in 1972-73 by the Dairy Development Department, proposed massive crossbreeding to cover one million cattle of breedable age by using semen collected from exotic bulls of high production potential. About 1000 inseminators were trained under this scheme.

4. 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. This can be explained with the help of the following diagram, which describes the genetic route of a model crossbreeding programme.



To begin with, the local cow population, denoted by blood composition (0,1) is to be crossed with the exotic, denoted by (1,0). The resulting first generation half-bred, denoted by (1\2,1\2), are to be further crossed with the exotic in order to obtain a breedable population (3\4,1\4) blood composition. By backward crossing the latter with (1\2,1\2) the programme finally arrives at a population of targetted (5\8,3\8) blood level.

5. The Kerala Livestock Development and Milk Marketing Board (KLD & MMB) was incorporated as a Government owned company in 1975 by bringing the Indo-Swiss Project, dairy plants milk chilling plants and the Dhoni Bull Station under the Dairy Development Department and the Cattle Feed factory at Malampuzha

under the Animal Husbandry Department within its fold. The Board was, thus, made responsible for the technical control over the breeding activities, production and distribution of frozen semen and the commercial operation of all Government owned dairy plants\milk chilling plants and the cattle feed factories.

6. Sire Evaluation System enables to select the best bulls on the basis of the performance of their daughters. The breeding value of the sire is evaluated based on the milk yield of their female progeny in the first lactation recorded at monthly intervals. The bulls are ranked according to the breeding value and the top bulls from each batch (around 10%) are employed for producing the next generation of young bulls and the cycle is repeated.

7. The fee has been revised in the subsequent years. Presently, it is Rs 10 per insemination.

8. The success rate of AIs is measured in terms of the calvings that result from the AIs done during a particular period of time, usually a year.

Chapter 3

Pattern of Bovine Holdings in Kerala

3.1 Introduction

Earlier studies on India's bovine economy have highlighted the peculiarities of age, sex and species composition of Kerala's bovine population, which make it distinctly different from the rest of India. These peculiarities, according to Vaidyanathan, Nair and Harris (1982), are:(1) while in India as a whole, among cattle, adult males outnumber adult females and, among buffaloes, adult females outnumber adult males, in Kerala, for both the species the pattern is just the reverse; (2) the downward shift in the Kerala cattle sex-ratio (i.e., the number of males per 100 females) in the age groups 0-1, 1-3 and 3+, precisely duplicates the downward shift in the buffalo sex-ratio.[1] They have explained these features of the State's bovine population in terms of the significant differences in the pattern of utilization of bovine population in Kerala in relation to the rest of India. In Kerala, she-cattle is raised primarily for milk production, whereas in other parts of the country its primary function is to produce male calves to be raised as bullocks, and milk is derived as a second order output. Buffaloes, on the other hand, are raised principally for milk production and their role as draught animals is limited, except in the states of Kerala, Assam, Orissa and West Bengal. These differences in the pattern of utilization of the two species explain the double reversal of the age specific cattle and buffalo sex-ratios observed in Kerala as against all India.

Nair (1982) has made an indepth analysis of the trends in the size and composition of Kerala's bovine population and the factors underlying the observed trends. His analysis indicates the following: in Kerala (1) the population of male cattle has been on the decline since the mid-sixties, (2) cattle sex-ratio has been shifting significantly in favour of females, and (3) among buffaloes, both the male and female population has been showing a continuous decline since the mid-sixties with he-buffaloes declining at a slower rate than the she-buffaloes. He explained these trends in terms of declining area under paddy, proliferation of small and marginal holdings, increasing opportunity costs of feed and fodder in the face of greater attraction towards dairying as a supplementary source of income and employment and the increasing demand for cattle and buffaloe meat, resulting in their large scale import from the neighbouring states.[2]

Though such studies provide useful insights into the factors shaping the size and composition of Kerala's bovine stock, they did not incorporate the impact of technological change on the size and composition of the cattle stock. Since the diffusion and adoption of crossbreeding has become so widespread in the State in recent years, it is important to understand the influence of technological change on the structure of the cattle population.

In the present chapter, we have attempted to bring out the role of technology in shaping the composition of the bovine stock. The rest of this chapter is organised as follows. First,

we will examine the salient features of the composition of the bovine population in Kerala in the early eighties. This will be followed by an analysis of the trends in the size and the composition of the bovine population during the last three decades. And finally, we have attempted to examine the changes in the ownership pattern of bovine stock across land holding categories.

3.2 Composition of the bovine population in Kerala- A cross-sectional view

According to the 1982 Livestock Census, the bovine population of Kerala was about 35 lakhs. Of this, 31 lakhs were cattle and 4.Ø9 lakhs were buffaloes. Among the cattle 14.5 lakhs were cross breds and 16.4 lakhs were non-descript animals.[3] This implies that the adoption of crossbreeding technology has transformed roughly about half of the cattle population into genetically superior animals.

The composition of the cattle and buffalo population by age and sex is given in Table 3.1. The main features of the composition of the two species are: (i) In the total stock, adult females occupy a dominant position accounting for about 5Ø per cent of the total, whereas adult males constitute only 9 per cent. In the case of young stock also, females far outnumber, males; (ii) Among both crossbred and indigenous varieties females far exceed males in all age groups. However, the differences is much sharper in the case of crossbreds with 85 per cent of the animals being females; (iii) Among the buffalo population, adult males account for about 45 per cent of the total and, thus, have an edge over adult females. On the contrary, among the young stock females are dominant.

Table 3.1 **Composition of bovine population -1982.**

Categories of bovinestock	Cattle			buffalo	Total bovine
	Total	CB	ND		
1. Adult Males (in '000s)	266.9 (8.6)	20.2 (1.4)	245.7 (14.9)	182.8 (44.7)	448.7
2. Adult females (in '000s)	1512.6 (48.8)	726.9 (50)	785.7 (48.7)	138.8 (34.0)	1651.4
3. Youngstock (0-1)(in '000s)					
a. Male	300.8 (9.7)	165.5 (11.4)	135.3 (8.3)	19.9 (4.9)	320.7
b. Female	543.7 (17.6)	323.1 (22.2)	220.1 (13.4)	29.4 (7.2)	573.1
4. Youngstock (1-2/3)(in '000s)					
a. Male	92.0 (3.0)	31.4 (2.2)	60.6 (3.7)	14.2 (3.5)	106.2
b. Female	381.5 (12.3)	186.2 (12.8)	195.3 (11.9)	23.5 (5.7)	405.0
5. Total (in '000s)	3096.8 (100)	1453.4 (100)	1643.3 (100)	408.6 (100)	3505.4
a. Male	658.9 (21.3)	217.3 (14.9)	441.6 (26.9)	216.9 (53.1)	875.8
b. Female	2437.9 (78.7)	1236.2 (85)	1201.7 (73.1)	191.6 (46.9)	2629.5

CB: Crossbred; ND: Non-descript.

Source: Govt. of Kerala, Department of Animal Husbandry; Report on the Thirteenth Quinquinnial Livestock Census, 1982.

The predominance of females over males among cattle becomes much more evident from the behaviour of age specific sex-ratios. The ratios are declining progressively as the population crosses the different age groups from birth onwards. (See Table 3.2). Interestingly, the sex-ratio of the crossbred cattle shows a sharper decline than that of the non-descript ones. Since cattle is raised in Kerala mainly for milk production, the progressive decline in the sex-ratio over the different age groups is consistent with this preference.

Table 3.2 **Bovine sex-ratio by age-groups 1982**

Category	Ø-1	1-2.5 or3	2.5+	Total
1. Cattle	55.32	24.11	17.65	27.Ø3
a. Cross bred	51.22	16.86	2.77	17.58
b. Indegenous	61.47	31.Ø3	31.27	36.75
2. Buffalo	67.69	6Ø.42	131.7	113.2

Source: Same as for table 3.1.

However, the differential behaviour of sex-ratios between crossbred and non-descript cattle could have risen out of the differential ability of the she-cattle in the respective breeds to let down milk after the death of the calves or after weaning. The amount of milk per lactation is drastically reduced in the case of indigenous cattle if the calf dies or is weaned during the lactation period, whereas the crossbred cows give milk even in the absence of the calf. This is the reason why the sex-ratio has a bias towards the males at an early age in crossbreds.

In the case of buffaloes, the sex-ratio remains highly in favour of females in the age group Ø-3, but shifts significantly in favour of males in the adult age groups. Obviously, the high adult sex-ratio is due to the preference for he-buffaloes as work animals. It is cheaper to import he-buffaloes for work rather than to raise them within the State. The sudden jump in the adult sex ratio is, thus, a reflection of the effect of inter-state trade and not due to the normal adjustment through age specific survival rates.

From the State level analysis let us now move on to an analysis by districts (Table 3.3 and 3.4). Quilon accomodates the biggest cattle herd (4.19 lakhs) followed by Cannanore (3.84 lakhs), Alleppey (3.19 lakhs) and Ernakulam (3.Ø4 lakhs). Wynad supports the least number of cattle (1.Ø9 lakhs). According to the Census figures, Trivandrum, Quilon, Alleppey and Kottayam have more than 55 per cent of their cattle crossbred, with Trivandrum ranking first in this category (58.3%). On the contrary, the northern districts of Palghat and Malappuram have the lowest percentge of crossbreds. In these districts local cattle account for nearly 65 per cent of the total cattle stock.

The district-wise analysis of the age composition of crossbred cattle reveals the following pattern. In all the districts crossbred adult males constitute only an insignificant proportion of the total crossbred stock. Both the adult females and the young animals are equally significant in the crossbred cattle stock. The districts of Trivandrum and Kottayam deserve special mention, since, of the total crossbred stock in these two regions, well above 5Ø per cent are adult females. Other districts also very closely follow them with crossbred adult females accounting for nearly half of the crossbred stock.

Table 3.3
Composition of Cattle Population in Kerala-1982

Dists.	Population ('ØØØs)			Crossbred (%)			Non-descript (%)		
	ND	CB	All	AM	AF	YS	AM	AF	YS
Trivandrum	82.5	115.Ø	197.5	Ø.9	53.7	45.3	9.8	53.5	36.5
Quilon	19Ø.1	229.2	419.3	Ø.7	49.8	49.6	1Ø.8	52.3	36.9
Alleppey	141.7	177.5	319.2	Ø.3	5Ø.8	48.8	3.7	6Ø.4	35.9
Idukki	77.3	88.7	166.Ø	1.3	5Ø.9	47.7	9.4	53.2	37.4
Kottayam	122.3	161.Ø	283.3	Ø.6	52.Ø	47.4	3.8	57.5	38.5
Ernakulam	165.1	139.3	3Ø4.4	Ø.9	5Ø.2	48.8	18.5	44.1	37.3
Trichur	121.2	112.4	233.6	1.3	48.4	5Ø.3	17.9	42.3	39.1
Palghat	177.4	96.4	273.8	2.7	49.5	47.7	26.7	38.2	34.9
Malappuram	123.2	7Ø.1	193.3	4.Ø	48.6	47.4	29.8	37.1	33.Ø
Wynad	76.6	32.3	1Ø8.9	4.Ø	47.4	48.6	24.Ø	39.8	36.2
Kozhikode	14Ø.9	71.6	212.5	1.7	5Ø.7	47.6	8.2	51.4	4Ø.3
Cannanore	224.9	159.7	384.6	2.6	46.4	51.Ø	14.8	46.Ø	39.1

AF:Adult female; AM: Adult male.
Source: Same as for table 3.1

In the case of indigenous cattle, animals are slightly more dispersed across the various types. In six out of the 12 districts (Alleppey (6Ø.4), Kottayam (57.5), Trivandrum (53.5), Idukki (53.2), Quilon (52.3) and Kozhikode (51.4) more than 5Ø per cent of the indigenous cattle are adult females, whereas in the rest the proportion is below 4Ø per cent. An important observation to be made here concerns the relatively greater proportion of adult males among the indigenous cattle as distinct from the corssbred category. This is especially so for the

northern districts of Palghat, Malappuram and Wynad. Young animals are obviously significant in number in the population of indigenous cattle in all the districts, but not as significant as they are in the category of crossbreds.

The largest number of buffaloes are found in Palghat (1.Ø2 lakhs). Of this, 65 per cent are adult males and 21 per cent, adult females. Malappuram comes next with 6.4 lakhs buffaloes, of which 48 per cent are adult males. The two other districts which have most of their buffalo stock in the adult male category are Wynad (54.5%) and Ernakulam (54.2%). Kozhikode, which accommodates the least number of buffaloes (Ø.72 lakhs), has about 6Ø per cent of them in the category of adult females. The districts of Trivandrum, Idukki and Kottayam seem to have a marked preference for adult she-buffaloes than otherwise. It is surprising to note that young stock form only 14 per cent of the buffalo stock of Palghat.

The ratio of young stock to total population is very low in the case of buffaloes compared to cattle. This is true in all the districts, though with considerable variations. It is also very interesting to note that in districts where the percentage of adult male buffalo is higher, that of young buffalo is lower. This pattern further reinforces our earlier argument that the inter-state trade in adult males is a major factor affecting the composition of the buffalo population.

Table 3.4 **Composition of Buffaloes in Kerala -1982**

Dists.	Popula-tion ('ØØØs)	Distribution by Type (%)		
		AM	AF	YS
Trivandrum	31.4	21.7	51.6	26.7
Quilon	24.1	32.3	41.1	26.6
Alleppey	9.7	39.2	4Ø.2	2Ø.6
Idukki	7.9	24.Ø	53.1	22.9
Kottayam	14.2	18.3	52.1	29.6
Ernakulam	7.3	54.2	3Ø.4	15.4
Trichur	54.3	34.8	35.2	3Ø.Ø
Palghat	1Ø2.3	64.8	21.4	13.8
Malappuram	64.4	48.3	3Ø.3	21.4
Wynad	28.6	54.5	28.Ø	17.5
Kozhikode	7.2	12.5	61.1	26.4
Cannanore	37.Ø	32.4	42.8	24.8

YS:Young stock
Source: Same as for table 3.3

There is considerable variation in the ratio of cattle to buffaloes across districts. (See Table 3.5). The number of cattle per 1ØØ buffaloes is about 27Ø in Palghat, whereas it is as high as 3586 in Kottayam. A comparison of the ratio of cattle to buffaloes in the adult male and adult female categories across districts clearly shows that inter-district variations in the cattle to buffalo ratio arise out of the relative importance of he-buffaloes as source of draught power. According to an earlier study (Vaidyanathan, et.al. 1982) significant variations in the cattle to buffalo ratio across districts is due to the variations in the importance of paddy in the cropping pattern.[4]

Table 3.5 **District-wise distribution of adult cattle per 100 buffaloes- 1982**

Category of animal / District	Number of cattle per 100 Buffaloes		
	Adult male	Adult Female	Total
Trivandrum	133	654	629
Quilon	283	2156	1739
Alleppey	150	4507	3291
Idukki	327	1166	1169
Kottayam	295	3669	3586
Ernakulam	214	1722	1115
Trichur	124	556	430
Palghat	75	528	267
Malappuram	127	410	300
Wynad	126	579	381
Kozhikode	1422	2470	2952
Cannanore	312	1130	1039
Kerala	145	1090	758

Source: Same as for the earlier tables.

To sum up, in the preceding analysis we have seen that in Kerala (a) roughly about half of the cattle population belongs to the category of crossbreds; (b) though both among the crossbreds and the indigenous cattle females outnumber males in all age-groups, this is more marked in the case of crossbreds; (c) the sex-ratio of cattle over age-groups shows a progressive decline from birth to adult age and in the case of crossbreds, the decline is more pronounced than indigeneous breeds; (d) the breed composition of cattle shows significant inter-district variations, with the southern districts having higher percentage of cross breds in the total cattle stock; (e) the importance of buffaloes in the bovine population varies significantly across districts. These variations, to a large extent, are due to the importance of he-buffaloes as a source of draught power in agriculture. In order to fully understand the significance of these patterns, it is

essential to view them in relation to the changes in the composition of the bovine stock overtime.

3.3 Trends in the size and composition of bovine stock

The bovine population of Kerala in the mid-fifties was about 35 lakhs. This increased slightly by early sixties and thereafter remained almost stable up to the early seventies and showed a marginal increase up to the early eighties. (See Table 3.6). Interestingly, during this period while the cattle population showed an increasing trend, the buffalo population declined slightly. As a result, the species composition of the bovine population has remained in favour of females.

Table 3.6 **Changes in the composition of bovines in Kerala 1956-82**

Year	Cattle (in '000s)					Buffalo (in '000s)					Total bovines
	Adult		Young stock		Total	Adult		Young stock		Total	
	M	F	M	F		M	F	M	F		
1956	602	998	352	558	2510	257	138	45	47	487	2997
1961	566	1162	407	618	2753	285	135	35	30	485	3237
1966	519	1219	394	724	2857	254	135	41	42	471	3327
1972	391	1300	389	775	2857	225	156	43	47	472	3327
1977	371	1371	381	882	3006	219	157	35	43	454	3460
1982	266	1513	393	925	3097	183	139	34	53	409	3504

M: male; F:female

Source: Govt. of Kerala, Department of Animal Husbandry; Reports on the Quinquinnial Livestock Census, various years.

Among cattle, adult males registered a sharp decline and

adult females showed an increasing trend during the period 1956-82. In the case of young stock, female population has been increasing over time whereas the male population has remained almost unchanged. Among buffaloes, adult males declined sharply, but adult female population remained around 15,ØØØ between 1956 and 1982. The size of the young buffalo stock, both male and female, has not shown any appreciable change over time.

The changes in the sex composition of cattle and buffalo stock are visible through the trends in their sex-ratios. (See Table 3.7). The sex-ratio of adult cattle fell from 6Ø in the mid-sixties to 15 by the early eighties. The sex-ratio of young cattle showed a sharp decline during the period between mid-fifties and mid-seventies. Thereafter, it remained unchanged. The sex-ratios of both young and adult buffalo population have been showing a consistent decline since the early sixties.

Table 3.7 **Sex-ratios of cattle and buffaloes in Kerala 1956-1982**

Category of animals / Year	Cattle		Buffalo	
	Adult	Youngstock	Adult	Youngstock
1956	6Ø	63	186	96
1961	48	66	211	117
1966	43	54	188	98
1972	3Ø	5Ø	144	91
1977	27	43	139	81
1982	18	42	132	64

Source: Same as for 3.5

Thus, the trends in the size and composition of cattle and buffaloes in the State over the period 1956-1982 unfold many interesting features. Particularly striking is the sharp decline

in the total adult male cattle by 50 per cent and the almost equal percentage increase in adult female cattle. In order to obtain a clear insight into the trends in compositional changes, it is necessary to do a disaggregated analysis of the changes in cattle population at the district level.

Table:3.8

District-wise Distribution of Cattle
A Comparison of 1972 and 1982 Census Figures.

Year	Adult Female		Adult Male		Young Stock		Total Cattle	
Dists.	1972	1982	1972	1982	1972	1982	1972	1982
Trivandrum	82	106	14	9	71	82	166	197
Quilon	178	213	35	22	168	183	381	419
Alleppey	177	176	12	6	147	138	336	319
Kottayam	133	154	13	6	123	123	269	283
Idukki	65	86	12	8	59	71	156	166
Ernakulam	103	143	55	32	105	130	265	305
Trichur	85	106	47	23	90	104	222	234
Palghat	119	116	59	50	102	109	280	274
Malappuram	73	80	48	39	55	73	179	193
Kozhikode	121	139	32	26	94	120	249	283
Cannanore	163	193	63	44	156	185	372	422

Source: Govt of Kerala; Quinquinnial Livestock Census, 1972 and 1982.

Table 3.8 gives district-wise data on the population of cattle by types for the two census periods, 1972 and 1982. Barring the two districts of Alleppey and Palghat, population of adult female cattle in all the other districts increased between 1972 and 1982 and that of adult males declined. The conclusions emerging from the analysis are summarised in table 3.9.

It is interesting to note that the four northern districts of Palghat, Malappuram, Kozhikode and Cannanore showed less than 20 per cent increase in the population of adult females. At the same time, in Palghat, Malappuram and Kozhikode, decline in the population of adult male cattle was less than 20 per cent. Cannanore registered a decline of 30 per cent in the adult male population. Ernakulam, which showed the highest percentage growth in adult females (39%), also witnessed the highest percentage decline in adult males (42%). The highest percentage decline in adult males was registered by the district of Kottayam (54%). This is very much expected of a region, of which the agricultural sector is dominated by plantation crops. Alleppey, with virtually no increase in adult females, showed a very high percentage fall in adult males. Trivandrum, Quilon and Idukki are in the middle with an increase between 20 per cent and 40 per cent in the case of breedable cattle and a decline between 30 per cent and 40 per cent in the case of adult males. There was a fall of 51 per cent in the number of adult males in Trichur district over the decade between 1972 and 1982.

The observations made here are clearly indicative of a dichotomy between the northern and southern regions. Northern districts as a whole have not witnessed any significant increase in adult female cattle population. Coming to adult males, not only that they have accomodated greater number of adult males in absolute terms, the decline overtime has also not been significant enough compared to other districts.

Table 3.9

Classification of districts according to percentage change in adult male and female cattle population 1972-82

per centage change in the number of adult females and males	Districts showing increase in adult females	Districts showing decline in adult males
Below 2Ø	Alleppey (Ø), Paghat (-2), Malappuram (9), Kozhikode (15), Kottayam (16), Cannanore (19).	Palghat (18), Malappuram (18), Kozhikode (19)
2Ø-3Ø	Quilon (2Ø), Trichur (25), Trvandrum (29)	Cannanore (3Ø)
3Ø-4Ø	Idukki (32), Ernakulam (39)	Idukki (33), Trivandrum (36), Quilon (37)
4Ø & above	---	Ernakulam (42), Alleppey (5Ø), Trchur (51), Kottayam (54)

Bracketed figures are percentages.

Another notable feature that emerges out of the population dynamics of cattle in Kerala is the marginal increase in the population of crossbred animals in the total cattle stock from 45.Ø7 per cent in 1977 to 46.93 per cent in 1982.[5] (The Census reports give breed-wise data only for two years, 1977 and 1982). A detailed break-up in fact, reveals that breedable crossbred female cattle have declined, though marginally, both in the total female cattle stock (from 3Ø.45% in 1977 to 29.82% in 1982) and in the stock of adult female cattle (from 5Ø.Ø4% to 48.Ø5%).

The predominance of crossbreds in the cattle stock of the State has been caused by a number of factors. A drop in the male cattle population signifying a reduction in the draught animal requirement in the State has been the major factor responsible for the popularisation of the cross breeding technology, apart from the so-called 'service push' in the form of increased facilities for AI, veterinary care, etc. This factor becomes further clear from a disaggregated analysis of the changes in the breed composition of the cattle population.

Table 3.1Ø gives breed-wise percentage distribution of cattle population across districts in the census years 1977 and 1982. In the southern districts of Trivandrum, Quilon, Alleppey and Kottayam, the proportion of crossbreds in the adult female cattle population showed an upward movement; in Idukki it remained almost constant and in all the other districts except Malappuram, it declined marginally. The decline was much sharper in Malappuram. However, the changes in the percentage of crossbreds in the population of total cattle showed a slightly different pattern. It rose considerably in the districts of Trivandrum, Quilon, Alleppey, Kottayam, Idukki and Trichur. In Ernakulam and Palghat the increase was not much. The proportion remained unchanged in the case of Malappuram and in the remaining districts it declined.

Table 3.10

Percentage changes in the composition of indigenous and crossbred cattle A district-wise analysis (1977 and 1982)

Category	Adult female*				Adult male *			
Year	1977		1982		1977		1982	
Distrct	Ind	CB	Ind	CB	Ind	CB	Ind	CB
Trivandrum	42	58	42	58	95	5	88	12
Quilon	45	55	46	54	98	2	93	7
Alleppey	47	53	49	51	94	6	90	10
Kottayam	47	53	46	54	94	6	83	17
Idukki	48	52	48	52	73	27	86	14
Ernakulam	49	51	51	49	88	12	96	4
Trichur	47	53	49	51	98	2	93	7
Palghat	57	43	59	41	99	1	95	5
Malappuram	51	49	57	43	89	11	93	7
Kozhikode	65	35	66	34	99	1	92	8
Cannanore	54	46	59	41	98	2	89	11

* Figures are percentages to the respective totals.

Source: Govt. of Kerala, Department of Animal Husbandry; Reports on the 12th and 13th Quinquinnial Census, 1977 and 1982.

However, what is more striking are the differences in the adoption of crossbreeding technology as between northern and southern districts. The following two factors must have contributed to this difference: (1) the slow pace of development of infrastructure for popularising crossbreeding in the northern districts, and (2) the requirement of draught animals for purposes of traction.

We have seen in section one that the sex-ratio of crossbred cattle shifts more in favour of females with increase in age than in the case of indigenous breeds. In this context the vigorous efforts made to diffuse crossbreeding technology in the State (especially since the early seventies) has resulted in

significant increase in the proportion of crossbreds in the cattle population. This, in turn, is an important factor that has contributed to the decline in cattle sex-ratio during the seventies.

The fact that the size and composition of the cattle population in Kerala has been changing rapidly in favour of females, is evident from the preceding analysis. These compositional changes are noted in all the districts, but are more visible in the southern than in the northern districts. Though by 1977 the State had transformed about 45 per cent of the cattle stock into crossbreds, in the subsequent five years the adoption of the technology seemed to have taken place at a slow pace. Moreover, the adoption of crossbreeding has been at a faster rate in the southern districts than in the northern districts. The large scale adoption of crossbreeding has also contributed to the decline in cattle sex-ratios in the State. Since these changes have taken place at differential rates in different size groups of farms, an analysis of the size and composition across land-holding classes is attempted in the following section.

3.4 Variation in bovine stock- Analysis by land-holding classes

The source of data used to analyse the size and composition of bovines across land-holding classes is the various rounds of the land-holding surveys conducted by the National Sample Survey Organisation. While the 26th round of the NSS (1971-72) gives classification of cattle and buffalo population

by age and sex, the 37th round (1981-82) provides additional information on the breed-wise composition of cattle too.

The distribution of cattle and buffaloes per 100 household operational holdings across various size groups is given in Table 3.11. Boradly, the composition of cattle and buffaloes for all size classes together, replicates the pattern observed for the State as a whole. However, there are significant variations in the compositional pattern of bovines across size classes.

Irrespective of the size of land-holding, all classes reveal a preference for adult female cattle. This preference is much stronger among large holdings where more than 60 per cent of the cattle are in the category of adult females. Adult she-cattle account for 50 to 60 per cent of the total cattle stock of the small, semi-medium and medium categories. In the size class less than 0.49 acres, under the category of marginal holdings the young stock constitutes the major component with a share of 54 per cent in the total cattle stock. Young stock forms a significant proportion (nearly one-third) of the cattle stock of all the land-holding classes. Adult males, as is expected, are practically absent in the size class of less than 0.49 acres and are very insignificant in the other two classes under the category of marginal holdings. Compared to the other classes, those under the medium category have more number of adult males.

In the case of buffaloes, adult males form the largest share of all the categories. The share of adult females is not at all significant in the small, semi-medium and medium

categories. For all the classes taken together, adult males and young stock account for 37.5 per cent each in the total stock, and in adult females, 25 per cent.

Table 3.11

Number of heads of cattle and buffaloes owned by broad categories of operational holdings- 1982

Size Holdings (acres)	Cattle				Buffaloes			
	AM	AF	YS	All	AM	AF	YS	All
Marginal (upto 2.49)	3.1 4*	42.8 51*	37.4 45*	83.3 100*	2.5 26*	3.8 39*	3.4 4*	9.7 100*
Small (2.5 - 4.99)	17.0 10*	90.0 53*	63.0 37*	170.0 100*	12.0 70*	3.0 18*	2.0 12*	17.0 100*
Semi-medium (5.0 - 9.99)	21.0 8*	136.0 51*	109.0 41*	266.0 100*	35.5 94*	1.0 3*	1.0 3*	37.5 100*
Medium (10.0-24.99)	21.0 6*	196.0 58*	120.8 36*	337.8 100*	55.0 99*	0.5 1*	nil	55.5 100*
Large (25.0 and above)	9.7 4*	157.0 64*	79.0 32*	245.7 100*	126.7 68*	41.7 23*	16.0 9*	184.4 100*
All	9.0 12*	36.0 47*	32.0 41*	77.0 100*	3.0 37*	2.0 26*	3.0 37*	8.0 100*

Source: Govt. of India, Ministry of Planning; Survey on Land-Holdings and Livestock Holdings, 37th Round (Jan-Dec 1982).

Since breed-wise data on cattle population by size groups of operational holdings is available from the 37th NSS Round, an analysis of this information will help us not only to obtain insights into the difference in the composition of crossbred and indigenous cattle, but also to comprehend the pattern of adoption of crossbreeding technology across land-holding classes. The relevant data is given in Table 3.12.

Table 3.12

Breed-wise distribution of cattle owned per 100 households 1982

Size Class of Operational Holding(acre)	Crossbreds				Others			
	AM	AF	YS	All	AM	AF	YS	All
Upto 0.49	0	4.1 50*	4.1 50*	8.2 100*	4.9 19*	8.8 35*	11.6 46*	25.3 100*
0.50-0.99	-	24.0 80*	6.0 20*	30.0 100*	6.0 9*	28.0 42*	32.0 49*	66.0 100*
1.00-2.49	0.68	28.2 59*	18.6 41*	46.8 100*	14.9 17*	34.7 39*	39.8 45*	89.4 100*
2.50-4.99	0	41.0 65*	22.0 35*	63.0 100*	24.0 21*	49.0 43*	41.0 36*	114.0 100*
5.00-7.49	-	53.0 59*	37.0 41*	90.0 100*	38.0 21*	77.0 43*	65.0 36*	180.0 100*
7.50-9.99	-	46.0 53*	41.0 47*	87.0 100*	34.0 17*	96.0 47*	75.0 36*	205.0 100*
10.00-12.49	-	120.0 80*	30.0 20*	150.0 100*	82.0 38*	60.0 28*	74.0 34*	216.0 100*
12.50-14.99	-	82.0 69*	36.0 31*	118.0 100*	43.0 28*	73.0 48*	37.0 24*	153.0 100*
15.00-19.99	-	100.0 50*	100.0 50*	200.0 100*	-	200.0 67*	100.0 33*	300.0 100*
20.00-24.99	-	100.0 50*	100.0 50*	200.0 100*	-	200.0 67*	100.0 33*	300.0 100*
25.00-29.99	-	100.0 52*	93.0 48*	193.0 100*	-	108.0 100*	- -	108.0 100*
30.00-49.99	-	215.0 88*	29.0 12*	244.0 100*	99.0 38*	48.0 18*	115.0 44*	262.0 100*
50 and above		0	0	0	-	0	-	0
All	0	15.0 62*	9.0 38*	24.0 100*	9.0 19*	21.0 45*	17.0 36*	47.0 100*

* Percentages to the respective totals.

Source: Govt. of India, Ministy of Planning; Survey on Land Holdings and Livestock Holdings . NSS 37th Round.

It is clear from the table that crossbred cattle are mainly reared as milch animals. Hardly any crossbred adult male cattle can be found across the various size classes. In all the land-holding classes, of the total crossbreds, more than 50 per cent are adult females. The proportion is as high as 80 per cent in the size class 30.00-49.99 acres under the category of large holdings. At the same time, the share of adult females other

than crossbreds in this class is only 18 per cent. In the case of cattle other than crossbreds, both adult females and young stock seem to be equally important in the total stock for all the categories.

Another important feature emerging from the above table is the relatively higher rate of adoption of crossbreeding technology in the medium and large holdings than in the marginal, small and semi-medium size groups. This is reflected in the relatively higher proportion fo crossbred cows in the total adult female cattle and also in the share of crossbred cattle in the total cattle in both the medium and large holdings. It is difficult to judge from the NSS data whether this differential adoption is due to the differential distribution of productive assets or because of the differential accessibility to the infrastructural facilities.

A comparative picture of the changes in the size and composition of the cattle population during the period 1971-1972 to 1982 can be obtained from Tables 3.13 and 3.14. In the lower size holdings the number of cattle held showed a slight increase, but in the higher size holdings it showed a slight decline.

Table 3.13

Distribution of cattle per 100 households by size class of operational holdings in Kerala 1971-72 to 1982

Size class (acres)	1971-72 (26th Round)				1982 (37th Round)			
	AF	AF	YS	ALL	AF	AM	YS	ALL
Upto 0.49	11.56 44*	1.96 8*	12.52 48*	26.04 100*	13.38 46*	0.01 0.00*	15.73 54*	29.12 100*
0.50-0.99	41.11 47*	16.75 19*	29.00 34*	86.86 100*	52.00 56*	3.00 3*	38.00 41*	93.00 100*
1.00-2.49	63.60 56*	14.62 12*	45.15 36*	123.37 100*	62.91 49*	6.17 5*	58.36 46*	127.44 100*
2.50-4.99	76.18 44*	39.30 23*	57.59 33*	173.07 100*	90.00 53*	17.00 10*	63.00 37*	170.00 100*
5.00-7.49	117.23 40*	81.65 28*	90.26 32*	289.14 100*	130.00 51*	23.00 9*	102.00 40*	255.00 100*
7.50-9.99	130.03 42*	96.11 31*	82.69 27*	308.83 100*	142.00 51*	19.00 7*	116.00 42*	277.00 100*
10.00-12.49	149.55 37*	130.28 32*	122.94 31*	402.77 100*	180.00 38*	58.00 22*	104.00 40*	262.00 100*
12.50-14.99	213.10 43*	114.29 23*	169.05 34*	496.44 100*	149.00 58*	-- --	106.00 42*	255.00 100*
15.00-19.99	200.00 38*	170.50 33*	150.00 29*	520.50 100*	155.00 61*	26.00 10*	73.00 29*	254.00 100*
20.00-24.99	400.00 63*	137.50 21*	100.00 16*	637.50 100*	300.00 60*	-- --	200.00 40*	500.00 100*
25.00-29.99	127.27 37*	90.91 26*	127.27 37*	345.45 100*	208.00 69*	--	93.00 31*	301.00 100*
30.00-49.99	280.00 40*	200.00 30*	200.00 30*	680.00 100*	263.00 60*	29.00 7*	144.00 33*	436.00
50.00&above	83.33 22*	166.67 43*	133.33 35*	383.33 100*	--	--	--	--
All sizes	35.06 46*	13.30 17*	27.83 37*	76.19 100*	36.00 47*	9.00 12*	32.0 41*	77.00 100

Note: Figures with astericks are percentages to the respective totals.

Source: Govt. of India, Ministry of Planning; Survey on Land Holdings and Livestock Holdings, National Sample Survey 26th Round (July 1971-Sept.1972) and 37th Round (Jan.-Dec. 1982).

Looking at the various categories of cattle, it can be inferred that (1) the number of adult females showed an increase in the lower size holdings and a decline in the higher size holdings; (2) the adult male declined in all size classes and the number of young cattle held increased in the lower size

holdings and declined in the higher size holdings. Thus, in all size groups of holdings a general shift has been observed in favour of females and the young stock. This shift, however, has been much sharper in the large size holdings.

The number of buffaloes has declined in all size holdings. (See Table 3.14). But the fall is quite striking in the case of adult males and young stock in the same size groups than in the case of adult females. On the whole, adult males continue to dominate the composition of the buffalo stock.

Let us sum up the main findings of this section. All size holdings showed a marginal preference for adult female cattle with the larger holdings possessing relatively higher proportion of this category. All size holdings have accepted the technology of crossbreeding, but the level of adoption is relatively higher among larger holdings. Trends over time reveal a sharp decline in adult male cattle and buffaloes in all size groups. The lower size holdings show a marginal increase in the number of adult female cattle, while the large holdings show a slight decline. The composition of cattle has shifted in favour of adult females in all size holdings. This shift has been more marked among the larger size holdings. The buffalo population shows a sharp decline among all size groups, but continue to be dominated by adult females.

Table 3.14

Distribution of buffaloes per 100 households by size class of operational holdings in Kerala 1971-72 to 1982

Size Class of Operational Holding(acre)	1971-72				1982			
	AM	AF	YS	All	AM	AF	YS	All
Upto Ø.49	Ø.93	Ø.84	Ø.49	2.26	-	Ø.78	3.12	3.9Ø
	41*	37*	22*	1ØØ*		28*	8Ø*	1ØØ*
Ø.5Ø-Ø.99	4.78	1.Ø7	-	5.85	-	6.ØØ	6.ØØ	12.ØØ
	82*	18*		1ØØ*		5Ø*	5Ø*	1ØØ*
1.ØØ-2.49	2.81	6.32	2.79	11.92	7.54	4.72	1.ØØ	13.52
	24*	53*	23*	1ØØ*	6Ø*	36*	72*	1ØØ*
2.5Ø-4.99	33.82	6.Ø3	2.91	42.76	12.ØØ	3.ØØ	2.ØØ	17.ØØ
	79*	14*	6.8*	1ØØ*	71*	18*	12*	1ØØ*
5.ØØ-7.49	53.93	12.55	6.74	73.22	28.ØØ	2.ØØ	2.ØØ	32.ØØ
	74*	17*	9*	1ØØ*	88*	6*	6*	1ØØ*
7.5Ø-9.99	56.54	7.77	3.53	67.84	43.ØØ	-	-	43.ØØ
	83*	11*	5*	1ØØ*	1ØØ*			1ØØ*
1Ø.ØØ-12.49	88.Ø7	27.52	6.42	122.Ø1	44.ØØ	2.ØØ	-	46.ØØ
	72*	23*	5.3*	1ØØ*	96*	4*		1ØØ*
12.5Ø-14.99	151.19	25.ØØ	3.57	179.76	67.ØØ	-	-	67.ØØ
	84*	14*	2*	1ØØ*	1ØØ*			1ØØ*
15.ØØ-19.99	122.22	18.52	3.7Ø	144.44	1Ø8.ØØ	-	-	1Ø8.ØØ
	85*	13*	3*	1ØØ*	1ØØ*			1ØØ*
2Ø.ØØ-24.99	237.5Ø	75.ØØ	-	312.5Ø	-	-	-	-
	76*	24*		1ØØ*				
25.ØØ-29.99	54.55	-	-	54.55	-	-	-	-
	1ØØ*			1ØØ*				
3Ø.ØØ-49.99	12Ø.ØØ	34Ø.ØØ	8Ø.ØØ	54Ø.ØØ	38Ø.ØØ	125.ØØ	48.ØØ	553.ØØ
	22*	63*	15*	1ØØ*	69*	23*	9*	1ØØ*
5Ø & above	183.33	-	-	183.33	-	-	-	-
	1ØØ*			1ØØ*				
All	7.45	2.81	1.25	11.51	3.ØØ	2.ØØ	3.ØØ	8.ØØ
	65*	24*	11*	1ØØ*	38*	25*	38*	1ØØ*

Source: Same as for table 3.12

3.6 Conclusion

The fact that the size and composition of bovine population have been fast undergoing changes in recent years is evident from the preceding analysis. More specifically, we have seen among cattle a sharp reduction in adult males, increase in adult females and young stock. The sex-ratios in this species

have been shifting significantly in favour of females. These changes are reflected in all size groups of holdings with some degree of variation. It is also evident that there has been large scale adoption of crossbreeding technology in the State. The impact of this technology on the productivity of milch animals and production of milk and the factors that facilitated its faster adoption during the last two decades will be analysed in depth in the subsequent chapters.

Notes:

1. The differences in the sex-ratios of cattle and buffaloes as between Kerala and All-India is well explained by the following table.

Sex-Ratios of Cattle and Buffaloes by Age Group

	Males per 100 females by age group					
	Kerala(1971)			All India (1966)		
	0-1	1-3	3+	0-1	1-3	3+
Cattle	67	35	31	101	90	136
Buffalo	79	108	145	67	39	32

Source: Vaidyanathan et.al. 1982

2. Between 1965-66 and 1985-86 the number of incoming animals increased by 250%. Official statistics reveal that almost 90% of the animals imported are slaughtered (See Unnithan, 1987)
3. They have observed that there is a significant positive correlation between the percentage of cultivated area devoted to rice production and the density of he-buffalo across states. Quoting Nair K.N.(1979), they have also shown that, within Kerala, across various districts, a similar relationship exists.

Percentage of Gross Cropped Area in Rice and Buffalo Sex-ratio and Density by district, Kerala

District	Percentage of gross cropped area in rice	Adult buffalo Sex-Ratio	Adult Male Buffalo per hectare of Gross Cropped area
Palghat	76	291	.315
Trichur	53	357	.219
Malappuram	46	110	.162
Alleppey	39	34	.036
Calicut	33	158	.073
Ernakulam	35	156	.048
Cannanore	29	163	.055
Quilon	18	65	.040
Trivandrum	18	67	.090
Kottayam	16	39	.011

Source : Nair, K.N. (1979)

4. The proportions of crossbreds in the total cattle stock of other states, as per the Quinquinnial Livestock Census, 1982 are given below: Andhra Pradesh (1.3%), Assam (2.1%), Bihar (.009%),Gujarat (.007%), Haryana (11.6%), Himachal Oradesh (6%), Jammu & Kashmir (7%), Karnataka (5%), Madhya Pradesh (.002%), Maharashtra (.3%), Manipur (8.3%), Meghalaya

(3.3%), Nagaland (20%), Orissa (1.7%), Rajasthan (.003%), Sikkim(19%), Tamil Nadu (8.5%), Tripura (5.2%), Uttar Pradesh (12.4%) and West Bengal (3.5%).

Chapter 4

Impact of Crossbreeding on the Milk Economy of Kerala

4.1 Introduction

The fact that the crossbred cows are far superior to indigenous ones is evident from a number of studies. The crossbred animals, compared to their indigenous counterparts, have lower age of first calving, longer lactation period, higher milk yield and lower cost per unit of milk produced. Given such advantages, the large-scale adoption of crossbreeding in Kerala would have resulted in substantial increase in the productivity of milch animals and production of milk.

In this chapter we will examine the extent to which adoption of crossbreeding technology has contributed to changes in the productivity of the milch animal herd and production of milk in the State. Apart from this, we will also examine how the increase in milk production is getting reflected in the per capita consumption of milk. The analysis is divided into three sections. Section one analyses the changes in productivity of milch animals. Section two attempts to account for the contribution of technological change to the growth in milk production. The effect of growth in milk production on consumption of milk in the State is brought about in section three.

4.2 Trends in milch animal productivity

In order to understand the productivity changes of the milch animal population, it is important to look not only at the yield per animal in milk, but also a number of related parameters

like lactation length, dry period, age at first calving etc. Data on milk yield per animal in milk and per milch animal for the State are available from a number of sample surveys. The Institute of Agricultural Research Statistics (IARS) conducted a sample survey to estimate the yield rates of milch animals, feeding and management practices of bovines etc. Based on this, the IARS estimated the production of milk in the State for the reference year 1964-65. In the mid seventies (1975-76) the National Sample Survey Organization (NSSO) conducted a nation-wide survey to estimate milk production, yield rates of milch animals etc. From 1977-78 onwards, the State Animal Husbandary Department has been conducting the Integrated Sample Survey for the estimation of milk production, yield rates of milch animals etc. The sampling frame adopted in the NSS survey and the Integrated Sample Surveys are a modified version of the sampling procedure developed by the IARS in the mid-sixties and the estimates of the various parameters obtained from these surveys are broadly comparable[1]. It may be noted that the Integrated Sample Survey reports estimates of milk yields and production of milk by crossbred and indigenous breeds, whereas the other survey reports only the overall milk yield. The Integrated Sample Survey also reports district-wise estimates of milk production. Unfortunately these surveys provide very little information on lactation length, dry period, age of calving etc. of milch animals. However, the estimates of the percentage of animals in milk, available from these surveys would provide an indirect evidence of the changes in efficiency of the milch animal herd. Data on the percentage of animals in milk can also be computed from the quinquinnial livestock census reports.

The estimated average daily milk yield per cow in milk according to the IARS Survey (1964-65) was about one kg and the yield per milch cow was Ø.51 kg. The yield levels increased to 2.48 kg per cow in milk and 1.32 kg per milch cow by the mid-seventies. By mid-eighties, yield per cow in milk increased to 2.97 kg and that of the milch animal, to 1.98 kg. Thus, between the mid-sixties and the mid-eighties the yield per cow in milk increased by about 167 per cent whereas that per milch cow rose by about 288 percent (See Table 4.1).

Table 4.1 **Trends in productivity of in-milk and milch cows**

Year	Average Milk Yield	
	per cow in milk (kg)	per milch cow (kg)
1964-65	1.11Ø	Ø.51Ø
1977-78	2.475	1.317
1978-79	2.522	1.375
1979-8Ø	2.567	1.419
198Ø-81	2.642	1.462
1981-82	2.787	1.567
1982-83	2.8Ø2	1.7Ø7
1983-84	2.861	1.795
1984-85	2.968	1.865
1985-86 #	2.971	1.92Ø
1986-87 #	2.97Ø	1.976

Figures are provisional.

Source: Institute of Agricultural Research Statistics (IARS), 1964-65. Estimates of Milk Production and Bovine and Goat Practices in Kerala, for the estimates for the year 1964-65; For later years, Govt. of Kerala, Department of Animal Husbandry; Report on the Sample Survey for Estimation of Production of Milk, Egg and Meat for the period 1977-78 to 1984-85.

However, it should be noted that growth in productivity has taken place at a much faster rate during the period between the mid-sixties and the mid-seventies, compared to the later period between the mid-seventies and mid-eighties. During the first

period, the growth rate in prodcutivity per animal in milk was about 8.8 percent per annum and that per milch animal, 11.3 per cent per annum. The annual average growth rate of productivity during the second period, for animals in milk was 2.2 per cent and that for milch cow, about 5 percent.

It is significant to note that the productivity changes per milch animal has inceased at a faster rate than that per animal in milk. This, in turn, indicates that the breeding efficiency of the milch animal herd has increased along with the rise in the yield per animal in milk. In fact, the data on the percentage of animals in milk available from the livestock census reports and from the Integrated Sample Surveys corroborate this. According to the Livestock Census Report, in the mid-sixties, about 40 percent of the she-cattle in the State was in milk and the proportion increased to 47 percent by 1972, 51 percent by 1977 and 57 percent by 1982. Interestingly, during the years 1956, 1961 and 1966 the percentage of she-cattle was around 40 per cent. (See table 4.2).

Table 4.2 **Percentage of Cattle in Milk in Kerala**

Year	Total no. cattle ('000s)			% of cattle in milk
	in-milk	dry	all fem.	
1956	396	454	998	39.68
1961	428	503	1162	36.83
1966	483	593	1219	39.86
1972	606	579	1300	46.61
1977	705	585	1371	51.42
1982	864	561	1513	57.10

Source: Govt. of Kerala, Department of Animal Husbandry; Reports on the Quinquinnial LIvestock Census, various Years.

The pencentage of cows in milk as derived from the Livestock Census Report 1982 is roughly comparable with the estimate of the Integrated Sample Survey for the year 1981-82. It has been observed that the percentage of cows in milk shows an upward trend between 1981-82 and 1986-87. (See table 4.3).

Table 4.3 **Estimated Number of Cows in milk and Milch cows in Kerala 1964-65 to 1986-87**

Year	Estimated no. of cows in milk (lakh)	Estimated no. of milch cows (lakh)
1964-65	3.84	8.50
1977-78	6.91	12.98
1978-79	7.23	13.27
1979-80	7.49	13.55
1980-81	7.66	13.84
1981-82	7.91	14.07
1982-83	8.76	14.38
1983-84	9.25	14.75
1984-85	9.49	15.11
1985-86 #	9.96	15.41
1986-87 #	10.46	15.72

Figures are provisional.

Source: Same as for table 4.1.

The improvement in the breeding efficiency of the milch animal herd has been due to the increase in the proportion of crossbreds in the cattle population since the mid-sixties. Insights into the extent to which genetic improvement has contributed to the increase in the productivity of the milch animal herd can be obtained by comparing the trends in yield rates and breeding efficiency of crossbred and indigeneous breeds of cattle. It is significant to note that yield rates of non-descript milch animals remained almost stagnant since the mid-seventies;

but shows an increase for the years 1985-86 and 1986-87. On the other hand, the yield rates of crossbred animals continued to increase at a rapid rate until 1984-85 and shows a marginal decline since then. (See Table 4.4).

Table 4.4 **Trends in Daily Milk Yield per Cow in milk and Milch Cow in Kerala 1964-65 to 1986-87.**

	Average yield\cow in milk		Average yield\ Milch cow	
Year	Crossbred	Non-descript	Crossbred	Non-descript
1964-65	--	1.080	--	0.510
1977-78	3.230	1.642	1.756	0.851
1978-79	3.315	1.645	1.882	0.860
1979-80	3.414	1.625	1.998	0.848
1980-81	3.582	1.587	2.137	0.813
1981-82	3.822	1.627	2.346	0.836
1982-83	3.760	1.647	2.620	0.871
1983-84	3.802	1.691	2.779	0.901
1984-85	3.951	1.690	2.968	0.874
1985-86#	3.746	1.946	2.965	1.007
1986-87#	3.707	1.978	2.896	1.027

Figures are provisional.
Source: Same as for table 4.1.

The faster increase in the productivity of crossbreds compared to the non-decript cows must have taken place either due to the increase in the levels of feeding or the continued improvement in the quality of the crossbreds overtime or the combined effect of both these factors. Available data on consumption of feed do not show any significant improvement for the crossbreds over time as compared to the non-descript animals. (See Table 4.5).

Table 4.5 **Average consumption of feed per animal per day in Kerala 1977-78 to 1984-85**

Year	Feed category	Crossbred		Non-descript	
		In-milk	adult	in-milk	adult
		(kg)	(kg)	(kg)	(kg)
1977-78	GF	6.77	4.73	5.59	3.83
	DF	4.ØØ	3.ØØ	2.13	1.75
	CON	2.3Ø	Ø.8Ø	1.Ø5	Ø.25
1978-79	GF	7.77	6.93	7.99	5.83
	DF	4.44	3.Ø8	3.13	1.92
	CON	2.43	Ø.81	1.Ø5	Ø.27
1979-8Ø	GF	6.86	4.37	5.83	3.34
	DF	5.41	2.85	3.53	2.86
	CON	1.86	1.Ø2	1.Ø4	Ø.4Ø
198Ø-81	GF	7.62	5.Ø2	6.85	3.37
	DF	4.Ø1	5.51	2.74	2.36
	CON	2.97	1.1Ø	Ø.94	Ø.55
1981-82	GF	7.15	5.71	6.23	3.65
	DF	3.3Ø	2.57	2.68	2.1Ø
	CON	2.41	Ø.86	1.Ø6	Ø.76
1982-83	GF	7.47	5.93	4.9Ø	3.33
	DF	3.77	3.ØØ	3.53	1.82
	CON	2.62	1.25	1.25	Ø.87
1983-84	GF	6.54	5.21	4.76	2.84
	DF	4.17	2.85	3.62	2.56
	CON	2.83	1.Ø2	1.15	Ø.8Ø
1984-85	GF	7.82	5.81	5.82	3.37
	DF	4.3Ø	3.71	2.	2.51
	CON	3.ØØ	1.4Ø	1.64	Ø.86

GF:Green Fodder; DF: Dry Fodder; Con: Concentrates.

Source: Same as for table 4.3.

Thus, the factor that has contributed to the increase in the productivity of crossbreds is the improvement in their genetic quality, which has resulted in higher breeding efficiency. It was observed that in 1977, about 45 percent of the milch cows in the State belonged to the category of crossbreds and that this proportion remained unchanged for the subsequent five years. (See

table 3.1Ø in the previous chapter). The changing breed composition of the milch animal stock for more recent years is available in the Integrated Sample Survey reports (See Table 4.6). The data showed a marginal fall in the ratio of crossbred to non-descript milch animals during the period 1977-78 to 1985-86. On the other hand, the ratio of crossbred cows in milk to non-descript cows in milk has been showing an upward trend since 1981-82. Thus, the in-milk population of the crossbred category has been growing at a more rapid rate than that of the non-descript variety. While the percentage of cows in milk in the non-descript population remained around 52 percent during the 1977-87 period, in the case of crossbreds, it increased from 55 percent to 78 percent.

Table 4.6 **Trends in the breed compositon of in-milk and milch cattle in Kerala** (in lakhs)

	Milch cow population			Population of in-milk cows		
Year	Non-descript	Cross breds	Cross-bred\non-descript	Non-descript	Crossbred	Cross-bred\non-descript
1977-78	6.23	6.66	1.Ø5	3.28	3.63	1.11
1978-79	6.56	6.7Ø	1.Ø2	3.43	3.81	1.11
1979-8Ø	6.81	6.74	Ø.99	3.54	3.94	1.11
198Ø-81	7.Ø7	6.77	Ø.96	3.62	4.Ø4	1.12
1981-82	7.27	6.8Ø	Ø.94	3.73	4.18	1.12
1982-83	7.5Ø	6.87	Ø.92	3.97	4.79	1.21
1983-84	7.73	7.Ø1	Ø.91	4.12	5.13	1.24
1984-85	7.96	7.15	Ø.9Ø	4.12	5.37	1.3Ø
1985-86 #	8.21	7.21	Ø.88	4.25	5.69	1.34
1986-87 #	8.45	7.72	Ø.91	4.39	6.Ø3	1.37

Figures are provisional.
Source: Same as for table 4.3

However, it is important to examine whether the potential yield rates of the crossbreds are being realised under field

conditions. Data on the production and reproduction traits of crossbred and indigenous cows, available from a recent survey conducted by the Centre for Development Studies in collaboration with the KLD & MM Board, provides some information on this aspect. The survey covers 27 villages spread over nine ecological zones in the State and a total sample of 675 cattle-keeping households. According to the survey estimates, the average daily milk yield per crossbred cow in milk is about 4.3Ø kg and that of local cow, 2.32 kg. The average daily yield per milch cow, for the crossbreds, is 2.86 kg and for the local cow, 1.32 kg. Similarly, the lactation length of the crossbred animal is 338 days as against a lactation period of 3Ø7 days for the local cow. The dry period of the local cow seems to be much higher than that of the crossbred cow. However, the calving intervals of crossbred and local cows show only marginal differance. (See table 4.7)

Table 4.7 **Production Traits of Crossbred and Local Cows Under Field Conditions, Kerala 1987-88**

Production Tracts	Crossbred	Local
1. Yield per animal in milk (kg)	4.3Ø	2.32
2. Yield per milch animal(kg)	2.86	1.32
3. Lactation length (days)	338	3Ø7
4. Dry Period (days)	169	227
5. Calving interval (days)	5Ø4	534
6. Yield per lactation (kg)	1453	712

Source: George and Nair (1989, forthcoming)

The performance of milch cows under field conditions is not at all impressive compared to their potential under ideal conditions in the research stations. For instance, the average

lactation yield recorded by the crossbreds at the Dhoni farm is 1952 kg whereas under the field conditions it is only 1453 kg, i.e., nearly 500 kg less than the former. Similarly, the intercalving period of cows under field conditions is much higher than the desired level. (See table 4.8). It has been pointed out that by bringing down the inter-calving period to a lower level the calving rate of milch animals could be raised considerably. This implies a larger annual addition to the total milk output. (Unnithan, 1987; Chacko C.T, 1988).

Table 4.8 **Reproductive performance of Zebu and crossbred cows at the Dhoni Farm**

Category of cow	Calving Interval (days)	Average lactation yield (kg)
Zebu	501	1254
Crossbred	451	1952

Source: Estimates from the Dhoni Farm

We have seen in the preceding analysis that the milk yield and other reproductive parameters of the milch animals in the State have improved in the recent past. More importantly, it has been noted that the milk yield and breeding efficiency of the crossbred cow has increased at a faster rate than that of the non-descript cow. The impact of these productivity changes in the milch animal herd on the production of milk is analysed in the following section.

4.2 Impact on Milk Production

In order to understand the trends in milk production in the State, data from three sources were used: (i) the IARS estimate

for 1964-65 (2) the NSS estimate for 1975-76 and (3) the estimates of production from 1977-78 to 1986-87 from the Integrated Sample Surveys. Though these estimates are not strictly comparable, they will give some idea as to the trends in milk production.

According to the IARS survey, the estimated milk production in the State in 1964-65 was about 2.Ø4 lakh tonnes. Out of this, 88 percent was contributed by cattle and the rest, by buffaloes (See Table 4.9). By 1975-76 the estimated milk production increased to 3.8 lakh tonnes; an increase of about 1Ø percent within a period of 11 years. However, there has been rapid increase in milk production since the mid-seventies. Since the annual estimates of milk production, available from 1975-76 onwards are comparable, it is useful to have a close look at them.

According to the Integrated Sample Survey, the estimated milk production in 1977-78 was about 7.8 lakh tonnes. Of this, about 8Ø percent was obtained from cows and the rest from buffaloes. The estimated production in 1986-87 was about 13.5Ø lakh tonnes and the contribution of cows increased to 85 percent. Looking at the annual rates of change in milk production, it is seen that the output has been increasing at a rapid rate till 1983-84: in the subsequent years it increased at a slower rate. Thus, the trend in milk output during the last two decades clearly shows that the State has witnessed a white revolution.[2] Estimates of milk production by breeds show that by 1977-78 about 7Ø percent of the cow milk in the State was produced by the crossbreds. In the subsequent years, the relative contribution of crossbreds to total milk production has shown further improvement.

Table 4.9 **Estimates of Milk Production in Kerala**
(in lakhs)

Year	Cow milk production	Total milk production	Annual rate of change	
			Cow milk	Total milk
1964-65	1.73	2.Ø4	--	--
1977-78	6.24 (69)	7.78	--	--
1978-79	6.67 (69)	8.24	Ø.Ø69	Ø.Ø59
1979-8Ø	6.99 (7Ø)	8.66	Ø.Ø48	Ø.Ø51
198Ø-81	7.38 (71)	9.Ø8	Ø.Ø56	Ø.Ø48
1981-82	8.Ø5 (72)	9.81	Ø.Ø91	Ø.Ø8Ø
1982-83	8.96 (73)	1Ø.78	Ø.113	Ø.Ø99
1983-84	9.73 (74)	11.54	Ø.Ø86	Ø.Ø71
1984-85	1Ø.28 (75)	12.2Ø	Ø.Ø57	Ø.Ø57
1985-86 #	1Ø.8Ø	12.82	Ø.Ø51	Ø.Ø51
1986-87 #	11.34	13.5Ø	Ø.Ø5Ø	Ø.Ø53

Figures in brackets denote the proportion of milk output by crossbreds in the total cow milk output.
Provisional.

Source: Same as for table 4.3.

Decomposition of the growth in milk output

In order to bring out the contribution of crossbreeding technology to the growth in milk production two approaches were followed.[3]

Approach 1

Since data on the production milk by crossbred and indigenous cattle are available separately, decomposition of population and yield effect were carried out separately for the two breeds.

The basic model used for decomposition can be specified as follows.

$$M_1 - M_0 = P_0 (Y_1 - Y_0) + Y_0 (P_1 - P_0) + (P_1 - P_0)(Y_1 - Y_0)$$

M_1: level of milk production by cows in the terminal year
M_0: level of milk production by cows in the base year
P_1: population of milch cows in the terminal year

P_0: population of milch cows in the base year

Y_1 : yield or productivity of milch cows in the terminal year.

Y_0: yield or productivity of milch cows in the base year

From equation (1)

$\frac{Y_0 (P_1 - P_0)}{M_1 - M_0}$ gives the population effect and

$\frac{P_0 (Y_1 - Y_0)}{M_1 - M_0}$ denotes the yield effect.

The term $\frac{((P_1 - P_0)(Y_1 - Y_0))}{M_1 - M_0}$ shows the contribution of the interaction between increase in milch animal population and increase in yield to milk production which is obtained as a reisdual term.

The decomposition exercise reveals that in the case of cross breds the growth in productivity far outweighs the herd effect. In sharp contrast to this, the dominant effect in the case of indigenous cows is herd effect. The contribution of productivity increase of indigenous cows is not a significant factor as far as the growth in milk production is conerned.

Table 4.10 Relative Contribution of Various Components to Growth in Milk Production for the period 1977-78 to 1986-87

Sl .no	Sources of Growth	Share in milk prodn. growth by (%)	
		crossbred	indigen.
(1)	Contribution of yield increase	84.70	9.80
(2)	Contribution of population increase	9.20	87.49
(3)	Interaction between (1)&(2)	6.57	2.54

Approach 2

Another way of decomposing the total milk output in the State is to look into the contribution of both crossbreds and indigenous cattle in the following manner:[4]

$$M_1 - M_0 = (M_{c1} + M_{i1}) - (M_{c0} + M_{i0})$$
$$= (M_{c1} - M_{i1}) + (M_{c0} - M_{i0})$$

where

$M_{c1} = P_{c1} Y_{c1}$; $M_{c0} = P_{c0} Y_{c0}$; $M_{i1} = P_{i1} Y_{i1}$; $M_{i0} = P_{i0} Y_{i0}$

M_{c1} : Total milk output from the crossbreds in the terminal year [Population of crossbred milch cows in the terminal year (P_{c1}) x Yield (Y_{c1})]

M_{c0} : Total milk output from the crossbred milch cows in the base year [Population of crossbred milch cows in the base year (P_{c0}) x Yield (Y_{c0})]

M_{i1} : Total milk output from the indigenous milch cows in the terminal year [Population of indigenous milch cows in the terminal year (P_{i1}) x Yield (Y_{i1})]

M_{i0} : Total milk output from the indigenous milch cows in the base year [Population of indigenous milch cows in the base year (P_{i0}) x Yield (Y_{i0})]

$$M_1 - M_0 = (P_{c1} Y_{c1} - P_{c0} Y_{c0}) + (P_{i1} Y_{i1} - P_{i0} Y_{i0})$$
$$= (P_{c1} - P_{c0}) Y_{c0} + (Y_{c1} - Y_{c0}) P_{c0} + (P_{c1} - P_{c0})(Y_{c1} - Y_{c0})$$
$$+ (P_{i1} - P_{i0}) Y_{i0} + (Y_{i1} - Y_{i0}) P_{i0} + (P_{i1} - P_{i0})(Y_{i1} - Y_{i0})$$

$\frac{(P_{c1} - P_{c0}) Y_{c0}}{M_1 - M_0}$ shows the crossbred population effect;

$\frac{(Y_{c1} - Y_{c0}) P_{c0}}{M_1 - M_0}$ gives the yield effect of crossbred animals;

$\frac{(P_{i1} - P_{i0}) Y_{i0}}{M_1 - M_0}$ shows the population effect of indigenous cows;

$\frac{(Y_{i1} - Y_{i0}) P_{i0}}{M_1 - M_0}$ denotes the yield effect of indigenous cows.

Here again, the terms other than those mentioned above, represent the interaction between yield and population effects, and are obtained as residual terms.

The results of the analysis reveal that the breed effect accounts for more than 70 percent of the growth in milk production. Thus, large scale of crossbreeding has been a major factor that resulted in rapid increase of milk output in Kerala. The extent to which consumption of milk has changed consequent upon the increase in milk production is analysed in the following section.

Table 4.11 : Relative contribution of different components in the growth of milk production for the period 1977-78 to 1986-87

Sl. No.	Sources of Growth	Share of total change (%)
1	Contribution of increase in the population of crossbred milch cows	7.72
2	Contribution of increase in the yield per cross-bred milch cow	72.54
3	Contribution of interaction between (1) & (2)	5.30
4	Contribution of increase in the population of indigenous milch cows	12.60
5	Contribution of increase in the yield per indigenous milch cow	1.40
6	Interaction between (4) and (5)	0.004

4.3 Changes in milk consumption

Various NSS Reports on consumer expenditure furnish details regarding percapita consumption on milk and milk products across different expenditure groups both for rural and urban sectors.

Data available from these rounds indicate that the per capita expenditure on milk and milk products as percentage of total per capita expenditure in both rural and urban sectors has been remaining almost constant in the State, especially in the seventies and the early eighties. (See table 4.12)

Table 4.12 **Changes in per capita Consumption expenditure on milk and milk products - A comparison of various NSS rounds**

	Rural			Urban		
Year	Exp. on milk (Rs)	Total exp. (Rs)	Milk exp as % total	Exp on milk (Rs)	Total Exp (Rs)	Milk exp as % total
1966-67	Ø.84	24.56	3.42	1.72	35.45	4.85
1967-68	Ø.93	28.54	3.26	1.82	34.81	5.23
1968-69	1.29	36.12	3.57	2.1Ø	38.39	5.47
1969-7Ø	1.17	31.Ø7	3.77	2.57	44.11	5.83
197Ø-71	1.59	36.12	4.4Ø	2.59	47.63	5.44
1972-73	1.52	42.19	3.6Ø	3.Ø6	58.27	5.25
1973-74	1.82	55.35	3.29	3.93	68.93	5.7Ø
1977-78	3.Ø7	74.22	4.14	4.35	82.73	5.26
1983	5.97	145.2Ø	4.11	9.Ø2	176.36	5.11

Source: Govt. of India, National Sample Survey; Tables with note on Consumer expenditure. Reprts on the 2Øth, 21st, 22nd, 23rd, 24th, 25th, 26th, 28th, 32ndand 38th Rounds..

Assuming that the proportion of milk converted into byproducts is small [5] and that consumption is mainly in the form of fluid milk, it is possible to estimate the quantum of milk consumed, by dividing the per capita consumption expenditure on

milk and milk products by the unit price of fluid milk. The estimated quantities for the urban and rural areas are available in table 4.13.

Table 4.13 **Trends in estimated per capita monthly consumption of milk in Kerala (1965-66 to 1983)**

Year	Price of milk (kg)	Per capita monthly consn. of milk (kg)	
		Rural	Urban
1965-66	1.2Ø	Ø.66	Ø.85
1966-67	1.37	Ø.61	1.25
1967-68	1.41	Ø.65	1.27
1968-69	1.44	Ø.89	1.46
1969-7Ø	1.48	Ø.79	1.74
197Ø-71	1.53	1.Ø4	1.69
1971-72	1.8Ø	Ø.84	1.7Ø
1973-74	2.1Ø	Ø.87	1.87
1977-78	2.36	1.3Ø	1.84
1983	3.51	1.7Ø	2.57

Source:# State Planning Board,Kerala; Economic Review, various years.

It may be noted that the per capita monthly consumption of milk in the rural sector was less than around one kg till the mid-seventies, and was less than urban consumption. The quantity of milk consumed per capita in both the urban and rural sectors has been steadily increasing overtime, with the former registering a growth rate of 11 per cent per annum and the latter, 9 per cent between 1977-78 and 1983.

Conclusion

The main findings from the analysis in the present chapter are the following: (1) The adoption of crossbreeding technology has resulted in improving the productivity of the milch animal

herd. (2) Over time, the productivity of the crossbreds has increased, indicating sustained improvement in the genetic quality of the crossbred animals maintained in the State. (3) Because of the technological change, the State has been witnessing rapid increases in milk production. The decomposition exercise reveals that the predominant component contributing to the increase in milk production is the growth in productivity of the crossbred animals. (4) There has been increase in per capita milk consumption in the State along with the increase in output.

Notes:

1. A stratitified multistage sample design was used for the IARS Survey (1964-65), with the basic stratum being roughly equivalent to a district in size. A cluster of two adjoining villages formed the first stage of the sample. Stage two was a cluster of two households and the third stage, an animal in milk. Data relating to 4191 cows and 566 she-buffaloes were collected for each season using the actual weighing method. The NSS Survey (1975-76) had taken 1971 Census villages and urban blocks as the first stage and households as the second. The NSS, unlike the IARS relied on the respondent's recall of the quantity of output, feed etc. Thus, in terms of data collection and sampling frame the two surveys are not strictly comparable. District forms the basic stratum of the Integrated Sample Surveys (from 1977-78 onwards). From each district one corporation or municipality (urban sample) and four panchayats (rural sample) are selected during each season. One ward is chosen at random from each municipality or panchayat and from each ward, 100 households. These houses are enumerated during the first month of every season.Milk production is estimated separately for non-descript and improved cows.

2. During the period under study milk production in India registered an overall increase of 55 %. The average annual increase in production was 6.89 %. (Dairy India, 1987).

3. Several methods of decomposing output growth have been suggested, especially during the last three decades, in the context of agricultural production. (See Minhas and Vaidyanathan, 1965; Hossain, 1977; Narain, 1977; Pray, 1979; Sagar, 1977,1980; Venkataremanan and Prahladachar, 1980). The Minhas- Vaidyanathan (V-M) method, which divides output growth into components, viz, yield and area, is the most widely used one. Variants of this method have been made use of by researchers to decompose growth in milk production. (See Nair, K.N. 1981, 1985; George, T. 1985; Dhas, A.C. 1986)

4. See A.C.Dhas, 1986. The model was used to decompose the growth in milk production in Tamilnadu between 1966 and 1982 into the relative contribution of population and yield effects of cows and buffaloes.

5. According to the data furnished by the Directorate of Animal Husbandry, in Kerala, of the total milk production only 6 percent is being converted into milk products.

Chapter 5

Factors Facilitating the Adoption of Crossbreeding Technology in Kerala

5.1 Introduction

During the last two decades, Kerala witnessed rapid growth in the production of milk; the major contributing factor being largescale adoption of crossbreeding technology at the farm level. As outlined in the approach to the study (in chapter one), adoption of crossbreeding technology (like any other agricultural technology) presupposes that it is economically viable and is conducive to the existing agro-climatic environment under which the farmer operates. It also presupposes that the technology will not adversely affect other goods and services (like draught power) derived from cattle keeping. In the present chapter, we propose to explore in greater detail the conditions that have stimulated adoption of crossbreeding technology in Kerala.

The chapter is organised in the following manner. Section one analyses the economic viability of crossbreeding technology as expressed in the profitability of milk production. Questions relating to the compatibilty of the technology with changes in the agriculutral sector are dealt with in section two. In this section we restrict our analysis to the agricultural sector because such changes have immediate implications for the farmer's decision regarding the type of cattle holding.

5.1 Economic Viability of Crossbreeding Technology

Given that the crossbreeding technology is cost-effective, every rational farmer would see to it that its adoption results in higher returns or a direct improvement in his income. We have approached profitability from two angles; from the demand side and the cost side, assuming that the increase in the price of milk results from both a'demand-pull' and a 'cost-push'. In the absence of cost of production data, we have used the relative prices of milk and feed to get an idea about cost movements.

5.1.1 Demand for Milk

The major determinants of the demand for milk are growth rate in percapita real income, population and prices of close substitutes. Though edible oils, meat, fish and egg are normally considered as close substitutes of milk, based on the criteria like amino acid composition and purpose for which they are used, we have not included these items in our analysis. Thus, here, the demand for milk is considered a function of only percapita income and population.

ie, $M_d = f(Y_i, P)$

where, Y_i = percapita income and

P = population.

To estimate the growth in demand for milk we have used the following identity:

$$Q_t = P_t \, q_t \qquad \text{----------} \qquad (1)$$

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

P_t : population in the year t;

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

$$q_t = q_0 (1+ e.r)^t \quad \text{----------} \quad (2)$$

where

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

e = expenditure elasticity of milk;

r = annual rate of growth of per capita income.

The income estimates used in this exercise are the official estimates prepared by the Central Statistical Organisation (CSO). These estimates suffer from certain shortcomings like non-accounting of the remittances of money from outside the State and inadequate accounting of export incomes. Due to these reasons, the percapita income estimates are likely to be on the lower side. To this extent the estimates of demand will also be underestimates. We have also not taken into consideration the effect of changes in price on the demand for milk.

The population figures for 1971 and 1981 are taken from the decennial Census Reports and those for the later years are obtained by projection. Expenditure elasticity is estimated from the tables on consumer expenditure prepared by the NSSO for various rounds. Since separate estimates of income for urban and rural areas are not available, demand is not estimated separately for the urban and rural sectors.

Expenditure elasticity is estimated (separately for rural and urban areas) using a log-linear functional form:

$$\log Y = \log a + b \log X$$

Where Y = percapita consumption expenditure on milk amd milk products;

X = Percapita total consumer expenditure.

Since the function is of a log-linear form, the parameter value 'b' gives the expenditure elasticity of milk.

The expenditure elasticity for the relevant year was arrived at by taking the weighted average of the rural and urban expenditure elasticities for that year. The weights are the total consumer expenditure by the rural and urban population.(Product of total percapita consumption expenditure and the rural/urban population).[1]

Table 5.1 **Estimated demand for milk**

Year	Production ('ØØØ MT)	Per capita income(Rs)	Population ('ØØØs)	Demand ('ØØØ MT)
1964-65	2Ø4	568	18681	2Ø4
1977-78	7Ø2	59Ø	24222	87Ø
1983	1Ø78	64Ø	27Ø97	1482

For estimating the aggregate demand, we have assumed that supply and demand were equal in the base year 1965-66 (See table 5.1). However, it is clear from the estimates that there is a wide gap between the demand for and supply of milk in the State. During the period 1977-83, the supply of milk increased at an average annual growth rate of 1Ø.71 per cent whereas the demand

showed a rate of growth of 14.Ø6 per annum.

The rapid growth in demand must have resulted in the increased price of milk. If this increase was large enough to offset the increase in input prices, farmers would consider it profitable to rear milch animals and thus intensify milk production. The basic input required for maintaining an animal is feed. A number of studies have shown that feed cost forms the major component in the cost calculations of a dairy farmer. (Singh (1965), Reddy and Mathur (198Ø), Ramaswamy et al (1981). According to an estimate made by the National Dairy Research Institute, Karnal, feed cost accounts for about 76 per cent of the total cost. (Ram, Kuber and Singh, (1975). It has also been argued that shortage of feed and the resultant increase in their cost is mainly responsible for the rise in milk price.

5.1.2 Movements of the relative prices of milk and feed

Given the above facts, we have tried to examine the movements of milk prices relative to feed prices for the last one and a half decades (See table 5.2). Nair's study (1981) shows that the profitability of milk production was increasing in the sixties and early seventies as the price movements were in favour of milk. The relative prices of dry fodder (paddy straw) for the years after the mid-seventies show that the growth in milk price has been at a relatively slower pace compared to the period prior to that. At the same time, a notable change is visible in the case of parity of price between milk and concentrate feed. Since concentrates are mostly purchased by the farmers, slow rise in

their prices relative to the price of milk is likely to act as an incentive for the dairy farmer.

Table 5.2 **Movement of relative prices of milk and feed**

Year	Price of cow milk by	
	Paddy straw	concentrate
1970-71	0.009	2.198
1971-72	0.009	2.232
1972-73	0.009	2.257
1973-74	0.009	2.273
1974-75	0.008	2.270
1975-76	0.009	2.305
1976-77	0.007	2.324
1977-78	0.008	2.313
1978-79	0.007	2.331
1979-80	0.008	2.323
1980=81	0.006	2.352
1981-82	0.009	2.334
1982-83	0.007	2.302
1983-84	0.008	2.321

Source: Figures upto 1973-74 are taken from Nair K.N (1981) and for the later years, computed from Govt. of Kerala; Animal Husbandry Statistics.

It was under such circumstances that the crossbreeding technology was introduced in the State. The technology, as discussed earlier, ensures higher productivity of milch cattle. It is true that the crossbred animals need more feed than the local animals. But their feed conversion efficiency is much higher than that of their indigenous counterparts. In other words, the high cost of maintenance of a genetically improved animal is more than compensated for by the increase in the milk yield, resulting in lower cost of milk production. Thus, the marginal revenue from feed is greater than the marginal cost, which acts as an incentive for the farmer to maintain a crossbred milch cow in the place of local milch cow. However, this assumes the existence of a well-developed market for absorbing the surplus

milk output produced by the farmers. In other words, commercialization of the dairy economy is an important pre-condition for the crossbreeding technology to get internalised quickly at the farm level.

5.1.3 Commercialization of the dairy economy in Kerala

Certain indicators are presented in table 5.3, with the help of which we will try to understand the degree of commercialization of the dairy sector. To contrast the Kerala situation with that of all India, the corresponding national figures are also given. According to the data given, 49 per cent of the producer households (which form 13.6 per cent of all the households) report sale of milk and milk products in rural Kerala, while it is only 22 per cent in the rural sector of the whole of India. In the urban sector only 6 per cent of the households produce milk and of them 63 per cent report sale of milk. The corresponding figures for the whole of India are 6 per cent and 37 per cent respectively. In Kerala, the percentage of milk sold per day out of the daily is production is 54 per cent as against 26 per cent in the country as a whole.[2] Since the mid-seventies the process of commercialization has further intensified. This is evident from the information provided by the Integrated Sample Survey for the year 1984-85. According to the Survey, of the total milk produced by the producer households, nearly 60 per cent is sold out to different agencies like private vendors, co-operatives and dairies and only 40 per cent is consumed.

Table 5.3 **Selected indicators of commercialisation of Kerala's dairy economy (1975-76)**

Indicators	Kerala		India	
	Rural	Urban	Rural	Urban
Estimated number of Households (10^3)	3215	656	84573	22895
Estimated number of milch animals (10^3)	907	80	65008	2940
Estimated number of animals in milk (10^3)	491	53	29474	1826
Estimated number of producer households(10^3)	438	41	22225	1331
Number of households reporting sale of milk(10^3)	215	26	4601	484
Number of households reporting sale of milk and milk products (10^3)	216	26	4971	488
Sale of milk per day (lit)	417	89	11346	2152
Production of milk per day (lit)	823	145	50566	4987
Households reporting consumption of milk (%)	50.0	54.2	52.9	74.2
Per capita consumption of home-produced milk (lit)	0.69	0.47	2.33	0.63
Per capita consumption of purchased milk (lit)	0.44	1.06	0.47	2.52

Source: Sarvekshana, Volume II, No.2, Oct.1978.

The intensification of commercialization depends, to a large extent, on the increase in the procurement of milk from rural ares through organized dairy co-operatives. Organized dairying, however, is of recent origin in Kerala. Though the first co-operative organization, the Calicut Milk Supply Union, was registered way back in 1939, the impact of co-operative

dairying remained inconsequential till the modern dairies started processing and marketing of milk. In 1963-64 there were only 195 primary co-opertive) societies functioning in the state. Within a decade their number increased to 521. Now there are 1742 primary dairy co-operatives in the State. (See Table 5.4).

Table 5.4 **Growth of dairy co-operatives in Kerala**

Year	Number of pri.co-ops	mem.ships of pri.co-ops
1963-64	195	2Ø86Ø
1966-67	287	3128Ø
1969-7Ø	356	485Ø7
1972-73	417	6317Ø
1975-76	521	97764
1978-79	84Ø	178814
198Ø-81	1Ø43	2318Ø7
1981-82	1133	276271
1982-83	12Ø7	318969
1983-84	1285	328879
1984-85	13Ø8	343Ø43
1985-86	14Ø8	381ØØØ
1986-87	1582	386689

Source: Dairying in India, (1988) p.82.

In 198Ø, under the OF II Programme the Kerala Co-operative Milk Marketing Federation (KCMMF) was launched. It forms a three tier co-operative system with the milk producers' societies at the village level, Regional Producers Union in the middle and in the apex, the State Federation. Due to urbanisation, urban migration and urban income growth, there has been a rapid increase in the effective demand for milk in the urban areas which in turn has created overall scarcity of milk. The Anand pattern dairy co-oeprative movement tries to turn this scarcity into profitable market opportunities for rural milk producers. Procuring milk from rural areas in order to market it in various forms, either as liquid milk or as products, is the basic formula of these co-

operatives. This does not necessarily mean an increase in the overall milk production. Till 1986 the procurement and input service activities of the Federation were confined to the eight southern districts of Kerala. As of now, the Federation has six dairies and eight chilling plants. Eversince the inception of KCMMF the number of Anand Pattern Co-operative Societies (APCOS) increased from 257 in 1983 to 643 in 1987 (as on 30-9-1987).

Between 1983 and 1986 the proportion of milk procured by the APCOS increased by more than 200 per cent. (KCMMFF Status reports, various quarters). This is a substantial growth, considering the fact that it happened within a very short span of time. The main factors that have contributed to the increase in procurement can be (1) increase in the procurement due to expansion in the number of APCOs and due to expansion of membership of the existing APCOs and (2) increase in the procurement due to expansion of procurement per APCO per day.

Another point to be noted in connection with expanding milk procurement is that it can also be the result of expanding geographical coverage. To have a realistic picture of procurement by APCOs let us look at the procurement of milk per APCO per day. Between the first quarter of 1983 and the last quarter of 1987, the procurement intensity shows an increase from 141 litres to 241 litres.

Table 5.5: **Procurement of milk per APCO per day** (quarterly) (lit)

Year	Quarter I ending 30th March	Quarter II ending 30th June	Quarter III ending 30th Sept.	Quarter IV 30th December
1983	141	170	170	170
1984	177	200	180	198
1985	205	221	230	230
1986	214	253	224	210
1987	198	220	241	241

Source: KCMMF Status Reports, various quarters.

The interacton of the factors analysed above has created an ideal situation where the adoption of crossbreeding technology could take place at a faster rate in the state.

5.2 Agricultural sector and cattle holdings- an analysis of the interlinkages

The bovine sector serves as the major supplier of the vital input, viz, draught power to the agricultural sector, while it receives from the latter a constant supply of feed and fodder. The introduction of crossbreeding would deter the growth of the agricultural sector if it results in a reduction of the supply of draught power. It has been argued that, it is the consideration to preserve the quality of draught animals that acts as the major constraint on the adoption of crossbreeding technology. In this context Kerala has been cited as an example where the technology adoption has taken place at relatively faster pace mainly due to a decline in the requirement of draught animals. Starting from this premise we will try to capture the predominant changes in the agricultural sector of the economy, which caused a decline in the

draught power requirement in the State. In this section we have examined (a) the changes in cropping pattern and its impact on the availability and cost of feeds and fodder and (2) changes in the size and distribution of land holdings.

(a) Changes in cropping pattern

During the fifties and the sixties Kerala experienced rapid agricultural expansion. This is evident from the increase in the percentage of area cultivated to the total geographical area from about 48 per cent in the mid-fifties to about 56 per cent by the early seventies. In the subsequent years we could see a virtual stagnation in the percentage of cultivated area around 56 per cent. Though the fifties and the sixties witnessed marginal increase in the cropping intensity, it has remained more or less stable for the last fifteen years.

Looking at the allocation of cultivated area under various crops, we can observe the following trends (See Table 5.6). Firstly, the area under foodgrains, which showed an increase in the 50's and 60's has been declining rapidly since the 70's. A similar trend is noticeable in the case of tuber crops like tapioca. Secondly, the area under other annual/seasonal crops like banana, turmeric etc. has remained constant. The third notable feature is the significant increase in the area under plantation crops during the last three decades. The area under tree crops increased rapidly in the 50's and the 60's, but showed a slight decline in the 70's, and then again a marginal increase in the first half of the eighties.

Table 5.6 **Land utilization in Kerala**

Classification	1957-58	1960-61	1970-71	1980-81	1984-85
Land put to crop production (%)	45.56	49.8	56.2	56.8	56.2
Cropping Intensity (%)	120	122	132	132	132
Area covered by different crops (%)					
(a)Food grains	41.3	39.5	34.7	32.9	27.8
(b)Tuber crops	11.2	11.9	11.3	9.8	8.1
(c)Other annua or seasonal crops	5.4	5.5	4.0	4.1	3.9
(d)Tree crops	32.7	33.7	38.7	37.9	42.4
(e)Plantaion crops	9.3	9.8	11.2	15.3	17.8

Note: Food grains include rice, jowar, ragi and pulses;
Tuber crops include tapioca and sweet potatoes;
Ginger, banana, turmeric, groundnut, seasamom, cotton and sugarcane are the annual and seasonal crops included;
The tree crops included are pepper, coconut, arecanut, cashew and cocoa;
Plantation crops taken are cardamom, rubber,tea and coffee.

Source: (1) Government of Kerala; Bureau of Economics and Statistics; Statistics for Planning, 1983 and 1986.
(2) Bureau of Economics and Statistics; Agricultural Statistics in Kerala, 1975.

The overall piture that emerges out of the trends in cropping pattern is one of significant shift away from food crops towards plantation crops, especially, since the early 70s. In the early 70's, area under food grains (mostly paddy) occupied 35 per cent of the gross cropped area and it declined to about 28 per cent by the mid-eighties.

The trends in cropping pattern across districts broadly

conform to those observed at the State level. But the magnitude of relative shift from food grains to tree crops shows some degree of difference among districts (See Table 5.7). The decline in the importance of paddy in the cropping pattern has been much sharper in Trivandrum, Trichur, Palghat and the other districts of Malabar. In the other regions the decline has been much less.

Table 5.7 **Changing Trends in Cropping Pattern - Districtwise Analysis**

Districts	Year	percentage of area under		
		Paddy	Other food crops	Tree crops
Trivandrum	1961-62	18.9	28.4	30.6
	1971-72	15.9	31.0	34.5
	1980-81	14.1	32.7	36.8
	1984-85	12.1	29.5	41.7
Quilon and Alleppey	1961-62	26.1	30.5	34.8
	1971-72	23.7	32.4	37.6
	1980-81	25.9	30.0	36.9
	1984-85	25.1	31.2	39.0
Kottayam, Idukki and Ernakulam	1961-62	22.1	19.8	37.0
	1971-72	22.2	22.1	39.1
	1980-81	21.9	20.1	39.9
	1984-85	19.6	19.7	42.0
Trichur	1961-62	56.6	18.8	21.8
	1971-72	46.4	23.1	26.9
	1980-81	48.0	24.3	27.7
	1984-85	44.9	23.0	31.3
Palghat	1961-62	59.9	11.3	8.5
	1971-72	54.3	11.7	9.9
	1980-81	54.2	10.4	10.8
	1984-85	51.8	10.1	12.7
Malappuram, Wynadu, Kozhicode, Cannanore	1961-62	31.9	25.7	32.1
	1971-72	28.8	28.4	37.2
	1980-81	21.9	25.3	37.2
	1984-85	19.1	25.5	40.9

Source: Same as for table 5.6

The change in cropping pattern in the recent years has significant implications for the type of cattle kept in the State. Paddy is the main crop which requires the use of draught animals for

purposes of traction. The rapid shift in cropping pattern in favour of tree and plantation crops (the cultivation of which hardly requires any draught animal) implies a reduction in the need for draught power in Kerala's agriculture. In fact, one can observe a rapid decline in the number of work animals per hectare of net sown area under paddy over the last 30 years (See table 5.8 and 5.9). The decline in the density of work animals has been at a rapid rate in all the districts, except the region comprising Kozhikode, Malappuram, Wynad and Cannanore.

Table 5.8 **Trends in work animal density (1956-82)**

	1956	1961	1966	1977	1977	1982
Work animals ('000s)	817	830	758	626	582	440
Cattle	560	547	507	390	363	259
Buffalo	257	283	251	226	219	181
Net area under paddy('000 hec)	759	779	802	875	854	807
Work animals\ net area under paddy	108	106	94	71	68	54

It may be noted that since paddy straw is the main source of roughage for feeding the bovine population in the state, decline in the area under this crop is likely to have a negative effect on the supply of feed stuff to the livestock sector.

Table 5.9 **Trends in the density of work animals= Analysis by districts**

Districts	Density of Work animals				
	1961	1966	1972	1977	1982
Trivandrum	107	85	68	53	48
Quilon	141	123	84	73	57
Alleppey	31	31	20	12	10
[Kottayam, Idukki, Ernakulam]	116	104	62	58	43
Trichur	93	83	66	49	35
Palghat	113	102	80	81	49
[Kozhikode, Malappuram, Wynad, Cannanore]	118	108	79	100	83

Source: (1) Govt.of Kerala, Department of Animal Husbandry; Report on the Quinquinnial Livestock Census, various years.
(2) Govt of Kerala, Directorate of Economics and Statistics; Agricultural Statistics in Kerala,1975.

We have attempted to quantify the supply of paddy straw in the state. This estimate is done by multiplying the straw-grain ratio to the estimated production of paddy in the State[4]. The estimates, given in table 5.10, show a declining trend since the early eighties. The per capita availability of paddy straw also declined simultaneously.

Table 5.10 **Estimated supply of paddy straw (in '000 tonnes)**

Year	Supply
1966-67	1602.73
1976-77	1939.91
1980-81	1907.94
1981-82	2009.09
1982-83	1959.30
1983-84	1811.87
1984-85	1883.85

(b) Changes in land holding pattern

Another important factor, which, along with the shift in cropping pattern, has accentuated the decline in draught animal population in the State could be the changes that have taken place in the size and distribution of land holdings in recent years. As an explanation for the relationship between the size of holdings and draught animal holding, Vaidyanathan, Nair and Harris (1982) put forward a 'density dependent' model. In simple terms, the model states that there is a tendency for draught animal population to rise with human density; but at a declining rate. Beyond a point, when the cost of maintaining draught animals relative to the human needs increase and the average size of the farm declines below a critical minimum, the farmers will be forced to give up ownership of draught animals. Nair (1981) examined this hypothesis making use of historical data and showed that while the country is in the ascending phase of the relation between bovine density and human density, Kerala has been on the declining side. He attributed the declining trend observed in the population of work animals partly to the decline in the average size of holdings, on account of the agrarian reforms starting from the late fifties.

Using data from the 26th and 37th rounds of the NSS on land holdings, we have examined the recent changes in the size and distribution of operational land holdings and their effect on the population of draught animals. The analysis shows that, between 1971-72 and 1982 there was a slight increase in the percentage of marginal holdings (holdings upto one hectare) and a marginal decline in other size categories (See Table 5.11). Secondly, the percentage of operated area of the marginal holdings shows a

slight increase and that of the other categories, a slight decline. Finally, the average size of operated area under the category of marginal holdings remained more or less the same, whereas that under the other categories declined slightly. A point worth noticing is that during this period the concentration of operational holdings remained almost unchanged.[3] Thus, changes in the size and distribution of land holdings do not seem to have caused any reduction in the population of draught animals across land holding classes.

Table 5.11 **Percentage distribution of households, area operated and averge size of holdings classified by size class of operational holdings**

Size class (hec)	% of household operational holding		Percentage of area		Average size of holding (hec)	
	1971-72	1982	1971-72	1982	1971-72	1982
Ø.ØØ-Ø.Ø2	57.29	59.61	8.Ø3	8.45	Ø.Ø8	Ø.Ø7
Ø.21-Ø.4Ø	14.32	15.95	9.31	11.84	Ø.29	Ø.28
Ø.41-Ø.5Ø	5.26	4.7Ø	5.2Ø	5.66	Ø.45	Ø.45
Ø.51-1.ØØ	11.ØØ	1Ø.74	17.51	19.77	Ø.72	Ø.72
1.Ø1-2.Ø2	7.83	6.19	24.76	23.78	1.42	1.42
2.Ø3-3.Ø3	2.1Ø	1.7Ø	11.44	1Ø.99	2.45	2.41
3.Ø4-4.Ø4	1.11	Ø.85	8.64	7.9Ø	3.5Ø	3.48
4.Ø5-5.Ø5	Ø.43	Ø.39	4.27	4.68	4.49	4.46
5.Ø6-6.Ø7	Ø.33	Ø.14	3.99	1.96	5.43	5.26
6.Ø8-8.Ø9	Ø.21	Ø.18	3.35	3.33	7.Ø9	6.96
8.1Ø-1Ø.12	Ø.Ø3	Ø.Ø1	Ø.65	Ø.14	9.25	9.Ø6
1Ø.13-12.14	Ø.Ø4	Ø.Ø3	1.ØØ	Ø.94	1Ø.36	1Ø.71
12.15-2Ø.24	Ø.Ø2	Ø.Ø3	Ø.69	Ø.88	15.8Ø	13.ØØ
2Ø.25&above	Ø.Ø3	--	1.16	--	22.17	--
All sizes	1ØØ.ØØ	1ØØ.ØØ	1ØØ.ØØ	1ØØ.ØØ	Ø.45	Ø.37

Source: 1. National Sample Survey, 26th Round (July 1971-September 1972); Report No.215, Tables on Land Holdings, Kerala.
2. National Sample Survey, 37th Round, (January-December, 1982).

However, the density of work animals per hectare of operated area across various size groups of farms declined sharply between 1971-72 and 1982. (See Table 5.12). This, infact, indicates that in order to understand the cattle economy, one has to take note of a large number of other factors which have been at work in Kerala's agricultural economy. These factors include the rising cost of draught animal power, the increasing use of tractors for farm operations, and the growing attraction towards maintaining milch animals.

Table 5.12 **Number of animals owned per 100 hectares of household operational holdings by size class.**

Rural Sector

Size class (in hectares)	Draught animals			Milch animals		
	1971-72	1982	% fall	1971-72	1982	% rise
0.002-0.02	32	15	-56	175	257	+49
0.21-0.40	64	11	-83	140	186	+33
0.41-0.50	13	--	--	141	120	-15
0.51-1.00	28	26	-7	89	93	+4
1.01-2.02	50	18	-64	54	63	+17
2.03-3.03	53	19	-64	48	54	+12
3.04-4.04	42	18	-57	37	41	+11
4.05-5.05	47	23	-51	33	40	+21
5.06-6.07	49	13	-73	39	28	-28
6.08-8.09	41	18	-56	28	22	-21
8.10-10.12	36	--	--	43	33	-23
10.13-12.14	14	--	--	12	19	+58
12.15-20.24	20	31	+55	20	20	0
20.25 & above	17	--	--	4	--	--

Source: Same as for table 5.11.

The fact that the cost of draught animal power in Kerala has been increasing at a faster rate is evident from the trends in the indices of prices of draught cattle, wages of paddy field labour and prices of feed items. (See Table 5.13).

Price of draught cattle over the last two and a half decades has increased at a rapid rate. The period also witnessed an increase in the wage rate of paddy field labour. The rise in the capital cost and maintenance cost of bullocks (as reflected in the rise in the feed cost), coupled with the increasing wages of the field labour (whose labour is a complementary input to the labour of the work animal) suggest that the cost of draught animal power has increased over the years.

Table 5.13 **Trends in the indices of price of draught cattle, feed and wage of paddy field labour.**

(base year:1970-71)

Year	PDCI	WPFLI	FPI
1970-71	100	100	100
1972-73	98	166	160
1976-77	189	170	163
1978-79	216	177	156
1979-80	263	188	208
1980-81	266	218	217
1981-82	288	250	208
1982-83	331	262	262
1983-84	386	278	321

PDCI: Price of draught cattle index; WPFLI: Wage of paddy field labour index; FPI: Feed price index, (concentrates).

Source: (1) Feed price and price of draught cattle computed from Govt of Kerala, Department of Animal Husbandry; Animal Husbandry Statistics, (various years).
(2) WPFLI are estimated from Govt of Kerala, Directorate of Economics and Statistics; Statistics for Planning (various years).

Since the relative importance of paddy in the cropping pattern of the State has been on the decline in recent years, the increasing cost of draught animal power implies that the ownership

of work animals has become more and more uneconomical to the farmer. This must have strengthened the tendency to reduce the stock of draught animals.

In this context, it is necessary that, one should examine the increase in the availability of alternative sources of draught power, especially tractors. There has been a notable increase in the number of tractors in the State since the early 70's. According to the 1972 Livestock Census Report there were about 1500 tractors in the state. By 1982 their number increased to 5289. As the area under paddy has been declining over this period, the density of tractors per 10000 acres of net area under paddy increased (See Table 5.14). To that extent there must have been a substitution of tractors for work animals.

Table 5.14 **Density of tractors in Kerala (1961-82)**

Year	No.of tractors	Paddy area ('000 hec)	Density\ 10000 hec
1961	276	778.91	3.54
1966	418	802.33	5.21
1972	1511	875.16	17.26
1977	3010	854.37	35.23
1982	5259	806.85	65.18

Source: Same as for table 5.8.

Since the size of holding in Kerala is very small and cost of rearing animals, very high a rental market for bullock has developed in the State (Nair, 1981). In very tiny holdings, for tillage operations human labour is substituted for bullock labour. Besides these, the increased availability of tractors must also

have resulted in the development of a rental market for tractors, so that holdings without draught animals could depend on hired tractors to till their paddy lands.

While the ownership of draught animals has become more uneconomical, density of milch animals per 100 hectares of operated area has increased (See Table 5.11). Interestingly, the substitution of draught animals by milch animals has taken place mostly in the case of marginal, small and semi-medium categories of holdings.

Conclusions

Our analysis in this chapter has identified the following factors as being responsible for the rapid adoption of crossbreeding technology in Kerala. Over the last 25 years the demand for milk has been increasing steadily resulting in the price of milk moving at a slightly faster rate than feed prices, especially the price of concentrates. This, combined with the fact that crossbreeding technology inherently is cost reducing has increased the profitability of milk production. Recent years also witnessed an expansion of the co-operative infrastructure for the procurement and marketing of milk from rural areas, which has resulted in high degree of commercialization of the dairy economy of the State. While the profitability of milk production has been favourable along with an expanding market, the requirement of draught animals in agriculture has been on the decline. This in turn, is attributable to the fact that the ownership of draught animals has become uneconomical due to the shift in cropping pattern from paddy to perennial crops, reduction in the average size of

cultivated holdings and increasing cost of draught animal power. As production of milk has become more attractive and there is acute shortage of feed and fodder, farmers could take up dairying only by reducing their draught animal stock and thereby releasing more feed for the maintenance of milch animals. This process is more visible in small and marginal holdings where the substitution between milch animal holdings and draught animal holdings has been much sharper than in other size groups. The reduction in draught animals has been facilitated also by the increase in the availability of mechanical power in agriculture. It is, thus, evident from the foregoing analysis that the rapid adoption of crossbreeding in Kerala has to be explained not only by the increased profitability of milk production and market expansion but also by a sharp reduction in the requirement of draught power in agriculture.

Notes:

(1). The expenditure elasticities estimated are:

Year	Rural	Urban	Weighted
1964-65	1.79	2.14	1.85
1977-78	1.52	1.28	1.46
1983	Ø.99	2.16	1.Ø3

Thus, milk and milk products are found to be sensitive to changes in expenditure. The price responsiveness of these items is also more than unity for both rural and urban sectors. (See Sunny, K.P. 1988)

(2). The figure is a weighted average of the percentage of the households reporting sale milk, in the rural and urban sectors, the weights being the proportion of producer household in the respective sectors.

(3). The lorenz ratios were found to be Ø.69 for the year 1971-72 and Ø.68 for 1982.

(4). The straw-grain ratio used for the computation is 1.50 (See ICAR, 1977)

Chapter 6

Conclusions and Policy Implications

Improving the genetic quality of indigenous cattle breeds through crossbreeding has been the key element of the strategy for enhancing milk production in India during the last two decades. This strategy has been under implementation in various cattle development programmes like the ICDP and also the Operation Flood Projects. However, the efforts at popularizing crossbreeding technology have made significant progress only in a few states, particularly in Kerala, where nearly one half of the cattle population belong to the category of crossbreds.

In this study, we have made an attempt to analyse the process of diffusion and adoption of the crossbreeding technology and to identify the factors that facilitated its rapid adoption at the farm level. We have clearly distinguished between diffusion and adoption of technology and viewed the process of adoption of crossbreeding, not only in terms of its effect on the cattle sector, but also its economic viability and compatibility with the existing environment in the agricultural sector. The main findings of the study and their implications for policy making are discussed below.

The indigenous cattle, existed in Kerala were poor in milk production due to both genetic limitation and inefficient management, especially, poor feeding. As the strategy for increasing the production of milk, the State opted for the technology of crossbreeeding. The basic philosophy of the State's

breeding policy was to limit the exotic inheritance to an optimum level of 50 per cent. With this in view, an extensive net work of infrastructure has been built up in the form of bull stations, bull mother farms, semen banks and AI Centres. Over the past two decades, the content of the technology has undergone several changes, thanks to the activities of the Indo-Swiss Project. In the place of chilled and CME semen deep frozen semen has come to be used extensively. This has improved the efficiency of the artificial insemination programme. At present, success rate of AI in Kerala is higher than that in other states.

Past attempts at diffusing crossbreeding have been successful to a large extent. This is evident from the fact that about two lakhs crossbred cows are born annually in the State. The technology has significantly influenced the structure and composition of the cattle population in the State, especially, over the last one and a half decades. The predominance of females is more marked among the crossbreds than among the local cattle. The progressive decline in sex-ratio from birth to adult age is also more pronounced in the case of crossbred animals. All these observations are indicative of the importance being attached to crossbred female cattle as source of milk. The preference for crossbred cows is visible in all size groups of land holdings, though it is stronger among the larger classes.

Another significant effect of large scale adoption of crossbreeding technology has been the increase in the productivity of milch cows, which has resulted in the increased production of milk. Between 1977-78 and 1985-86 the production of milk in the State increased at an annual average growth rate of 5.5 per cent.

It is estimated that the yield effect of crossbred cows accounts for about 70 per cent of the increase in milk production. It is also significant to note that the increase in milk output resulted in a rise in the per capita consumption of milk in the State.

The rapid adoption of crossbreeding in Kerala has been due to the interaction among a large number of factors. In the first place, over the past 20 years milk production has become an economically viable proposition for the farmers. In the face of increasing demand for milk, high level of commercialization and increased organizational intervention in the areas of procurement and processing, milk price has increased rapidly. The parity of price between milk and concentrate feed has been favourable to the producers. This, coupled with the fact that the technology itself is cost-reducing, has made production of milk profitable. Secondly, the requirement of draught power in agriculture has been declining, consequent upon the changes in the cropping pattern in favour of plantation and perennial crops. Also, the ownership of draught animals has become increasingly uneconomical to the farmers due to the increase in their price and maintenance cost. In this situation, a tendency has been noted among farmers to reduce the work animal stock and thereby to release more feed to the milch animals. This process has further been hastened by the increased availability of tractors in the State. In short, it is the interaction of the factors discussed above and the direct intervention by the State that has facilitated rapid adoption of crossbreeding technology in Kerala.

The foregoing findings provide significant insights into

the future prospects of increasing milk production through crossbreeding. The sustainability of the technology will be determined by the expansion of the size of the market for milk on the one hand, and the availability and the cost of the complementary inputs, especially, feeds and fodder, on the other. Assuming that the expenditure elasticity of milk will be around 1.Ø3 (as estimated from the NSS consumer expenditure data for 1983), that the per capita real income will grow at the same rate at which it has been growing in the last two decades and making use of the official population projections, we have estimated the growth in aggregate demand for milk for the year 2ØØØ A.D. The estimates show that the demand for milk will more than double the present level by the turn of the century - about 3.5 million tonnes.

Since the possibility of increasing the supply of animal protein from marine resources are likely to decline in the years to come, milk and other animal food will continue to remain important in our diet. In other words, there will be no demand constraint operating against the future expansion of the production of milk. The increasing requirement of milk can be met by resorting to the following strategies: (1) augmenting the productive capacity of the existing crossbred stock and (2) raising the proportion of crossbreds in the milch cattle stock. Strategy (1) essentially implies further enhancement of the level of exotic inheritance. However, both these strategies are faced with a serious constraint, viz., inadequate feed supply.

The cattle sector of Kerala is dependent exclusively on paddy straw, which is the principal source of roughage. Coarse

grains like millets and sorghum, oilseeds and nitrogen-rich pulses are practically unimportant in Kerala's agriculture. In the face of dwindling area under paddy, on account of the shift in cropping pattern in favour of perennial and plantation crops, the supply of paddy straw falls far short of demand. Green fodder, on the other hand, is yet to be incorporated as part of the State's cropping system, because its cultivation is not as profitable a proposition as that of other crops. Added to this is the heavy demographic pressure on land which makes it difficult to divert land under food and cash crops to fodder crops. It has been pointed out that, 60 to 70 per cent of the feed cost is accounted for by concentrates, the supply of which is extremely deficient in the State. More than 80 per cent of the concentrate feed requirement within the State is being met by imports from the neighbouring states (P.K. Sivanandan, 1983). This implies that the benefits derived from the crossbreeding technology have been flowing out of the State. The hike in feed prices due to scarcity, dissuade the small peasant farmers from undertaking the risks involved in maintaining a genetically superior milch animal. The cattle sector also reflects the severity of this constraint; the productivity of milch animals has been increasing at a slow rate and the adoption of crossbreeding has been stagnant around 50 per cent in recent years.

The future strategy for increasing milk production should be designed for a situation characterized by thousands of small and marginal farmers undertaking dairying under the condition of acute feed and fodder scarcity. The strategy, most appropriate for this situation, will be a medium term one which envisages the

realization of the unutilized production potential of milch animals in the State supported by a long-term strategy for increasing the proportion of crossbreds in the milch animal population. To achieve the former, it is necessary to improve the efficiency of the AI programme by expanding the geographical coverage and increasing the conception rate. The regional disparity in the distribution of AI centres as between the northern and southern districts should be removed. It is also necessary to reduce substantially, the geographical area covered per AI centre from the present level so as to make the AI facilities more accessible. This should also be supplemented by improvement in the skills of the personnel involved in the AI programme. By significantly improving the success rate of the AI, the dry period and inter-calving interval of the milch animals can be reduced and their productivity, increased.

The production of feeds and fodder can be enhanced by (1) cultivating more coarse grains which can be used as sources of roughage and (2) incorporating fodder crops on intercrops in garden lands. These two alternatives require considerable organizational support. There is also scope for increasing the supply of concentrate feed supply through manufacturing compounded feed, using domestically available resources like coconut oil cake and tapioca. Even then, there will be a large deficit of concentrates of all categories and the State will have to depend on imported feed to meet the increasing demand for milk. This indicates that feed prices are unlikely to come down in the near future. A suitable policy for monitoring feed prices, and controlling them in relation to milk prices, is extremely

important for sustaining milk production.

Kerala's dwelling pattern is distinctly different from the national pattern. The typical village pattern of a cluster of households nestled together is alien to Kerala's rural landscape. With high density of population and fragmented small holdings with individual and independent households distinctly separated from each other, the whole of Kerala looks like a rural-urban continuum. Thus, in Kerala's situation it is very difficult to demarcate between rural and urban markets. In fact the biggest markets for milk could be found in rural areas which accomodate more than 80 per cent (as per the 1981 census 81.25%) of the total population of the State. The co-operative network should be further extended to the rural areas not only for the procurement of milk, but also for its better distribution.

Dairy extension services need to concentrate more on the dissemination of improved milk production practices among dairy farmers in the rural areas. The small and marginal farmers and agricultural labourers, for whom dairying provides a supplementarty source of income, need to be educated in scientific calf rearing, feeding and management of milch animals. The contribution of women in the development of the livestock sector has hitherto been underestimated by the policy makers. For any development programme in this area to be meaningful, it is neceesary that the role of women is duly recognized.

It has been shown that for the last 25 years Kerala's agricultural economy has remained stagnant with the productivity

of almost all major crops revealing a declining trend. In the farm sector, milk production is an exception to this general decline, thanks to the success of crossbreeding technology. It is hightime that our policy makers realize the potential of this sector to generate income, employment and to promote domestic consumption of milk and other livestock products. As it appears now, we can hope to revive our rural economy by relying more on milk production.

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