FACTORS INFLUENCING CALF GROWTH AND MORTALITY IN FIELD AND ORGANISED FARMS

By

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THESIS

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DECLARATION

I hereby declare that the thesis entitled **"Factors Influencing Calf Growth and Mortality in Field and Organised Farms"** is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title of any other University or Society.

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Certified that the thesis entitled "**Factors Influencing Calf Growth and Mortality in Field and Organised Farms**" is a record of research work done independently by **Shri. Shaji Antony**, under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to him.

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Introduction

INTRODUCTION

Crossbreeding indigenous zebu cattle with exotic dairy breeds having superior genetic potential for milk production has been adopted as a national policy in India. Introduction of European dairy breed inheritance to raise the initial level of production followed by inter-se mating among crossbreds and selection has been accepted as a faster means of increasing milk production (Acharya, 1979).

Kerala was among the first few states to plunge into cross-breeding of cattle at full steam. Because of this, the state had a head-start over other states in producing cross-bred cattle. Presently more than 50 per cent of cattle in the state are crossbreds compared to six per cent for the whole country. Because of this, the state has succeeded to more than quadruple its milk production in the past two decades. In spite of an increase in human population, the per capita availability of milk increased from 114 g in 1975 to 178 g in 1992.

Notwithstanding all these glaring achievements, the average milk production of the Kerala cross-bred cow remains lower than the average yield of crossbred cows in major milk production centres of Punjab, Haryana, Gujarat, U.P. and Karnataka. It will be difficult to find an answer to why this

is so without properly studying and analysing the production systems in the field.

Success of dairy farming depends to a very large extend upon rearing calves to breedable age at a fast rate and with minimum mortality rate. The initial growth of an animal is the most important phase of its life because it has immense bearing on the early maturity and production.

General observations have shown that the age at first calving in cross-bred cattle is delayed and one of the reasons often quoted is poor growth rate. Whatever information is available on these aspects is mainly based on observations from organised farms. Only limited information is available on performance of crossbred calves under agroclimatic conditions prevailing in Kerala especially under field conditions. Hence, growth and other performance characteristics of these cross-bred calves in the field were studied and compared to those in organised farms. Information pertaining to the management system and farmer qualities were also collected. By such a comparison, it has been expected to gain insight into various components of the farming system adopted in the field by farmers of the locality, find lacunae if any and come out with recommendations for improvement on the basis of results in organised farms. Scientific management and adequate feeding of young stock is very important in dairy farming since they form the basic units for

future stock within the limits set up by the genetic factors. Well-nourished calves have a better opportunity to develop into more productive adult animals and are much more resistant to diseases. If the young calves are not fed adequately and managed properly it may result in retarded growth and delayed maturity and thus the farmer will have to maintain the animal for a longer period to attain maturity and start production.

Information from the field on calf management systems are scanty. Mostly, projections based on observations on young stock in government and other organised farms are available. The rate of calf mortality is taken as an index of the general health and management of the animals. Roy (1990) considers five per cent to be the desirable level and this appears to be a reasonable target even under Indian conditions. In general, cross-breds are having less disease resistance character in comparison to Zebu breeds especially with respect to Foot and Mouth disease and mastitis. Calf mortality in cross-breds is high due to parasitic infections in comparison to Zebu breeds. A high rate of mortality and morbidity among livestock in India is caused by the diseases due to bacteria, virus and protozoa. The economic loss through reduced productivity of the infected animals are recurrent and heavy. Previous studies conducted in this country indicate that calf mortality is more a management problem than a disease problem. Many field workers presume

that the management of calves in the field is inferior to that in organised farms. But there are others who hold just the opposite view. With the help of deligently gathered comparable data, it would be easier to subscribe to any one of the opinion.

The progeny testing area of Kerala Livestock Development Board in Mavelikara was selected as the field area. Mavelikara has a good history of dairy development and progeny testing scheme has flourished there due to excellent cooperation from the farmers.

Fortunately two earlier studies were carried out in the present project area covering some aspects of calf management (Chacko, 1994). This will give valuable comparison for the present with calf raising in the past one or two decades.

The present study proposes to make observations on growth and mortality among cross-bred calves in Mavelikara and compare it with conditions in organised farms mainly University Livestock Farm, Mannuthy and the Dhoni Farm, K.L.D. Board. It is expected that information arising out of this study will provide practical solutions for field problems that hamper optimum growth in cross-bred animals and result in high mortality rate.

Review of Literature

REVIEW OF LITERATURE

Growth is a very important economic trait which ultimately lays the foundation for adult performance and overall economy in dairy cattle. An individual's survival and physiological and functional development depends to a very large extent on the body weight gain. Scholl (1911) defined growth as the correlated increase in the mass of the body in definite intervals of time, in a way characteristics of the species.

Brody and Ragsdale (1921) reported that in dairy calves there are two post-uterine cycles with maximum growth at about five and 20 months.

For the purposes of quantitative analysis Brody (1945), defined growth as relatively irreversable time change in magnitude of the measured dimension or function.

Study of growth of Hariana calves by Kohli et al. (1962) revealed an increase of 100 per cent, 150 per cent and 200 per cent over the birth weight at the age of three, six and nine months respectively irrespective of sex.

Goswami and De (1963) studied the body weights in Zebu and Frierian crossbred calves at birth, one, three, six, nine

and 12 months of age. They found that calves having 50 per cent exotic blood showed better growth rate than those with either 37.5 per cent or 70.52 to 87.5 per cent. The latter animals were the least efficient in growth and weight gain.

Growth rate studies were carried out in Indian breeds of cattle by Mudgal and Ray (1966). The average birth weight for male calves was 21.14 $\pm$ 2.16 and female calves 20.07 $\pm$ 2.19 kg. The coefficient of regression of weight gain from birth to six months per fortnight was 6.43 $\pm$ 1.48 kg in male and 5.17 $\pm$ 1.20 kg in female calves. Male calves gained at a higher rate than female calves.

Taneja and Bhat (1970) observed that the growth rate was maximum between 19 to 26 weeks of age than between birth and 19 weeks and other ages in Sahiwal x Freisian Cross breds. Slow growth rate from birth to 19 weeks was attributed to weaning at birth and maladjustment to artificial feeding.

Taneja and Bhat (1971) studied the growth rate of Sahiwal females maintained at military dairy farms. The growth rate was slower from birth to 19th week (0.458 kg/day) compared with that from 19th to 26th week (0.526/day).

Agrawal and Tomar (1972) analysed the growth rate of Hariana female calves in relation to the weight and season of birth. The growth rate upto 24 months of age was not

significantly different among the groups of calves born within a range of 15 to 20 kg and 20 to 24 kg birth weight. The growth rate was maximum upto 6 months of age, thereafter the general trend in growth declined. The growth rate observed at six, 12, 18 and 24 months of age varied significantly.

Growth pattern of 96 F_2 and 46 F_3 Holstein x Hariana crossbred calves of the State Livestock Farm, Kalyani was ascertained in terms of live weights gained at the ages of one, two, three, four and six months, by Ghosh et al. (1979). Phenotypic correlations and regressions between live weights at different ages of growth were positive and highly significant.

Role of exotic genes on growth rate of zebu crosses were investigated by Chawla and Mishra (1981). The investigation was carried out on 689 Sahiwal, 639 Brown Swiss x Sahiwal and 3802 Holstein x Sahiwal crossbreds. Body weights at various intervals of age had curvilinear relationship with the increase of Holstein inheritance from 1/8 to 7/8 except at birth and at 2 months of age where it was linear. Crossbreds with various levels of Brown Swiss and Holstein inheritance showed maximum growth rate during 4 to 6 month of age, Heifers with higher growth rate had lower age at first calving.

Al-Hakim et al. (1981) studied the growth rate and weaning weight in Karadi and exotic breeds and inferred that the weaning weight at six months of age averaged 82.15, 115.08, 106.90 and 134.10 kg for Karadi, Friesian, Limousin and Brahman respectively. Sex had significant effect on weaning weight but season of calving and age of dam did not.

Kulkarni et al. (1982) studied the growth rate of different cross bred calves and found out that the mean growth rate at three, six, nine and 12 months of age to be 0.50, 0.47, 0.44 and 0.40 kg for male calves and 0.46, 0.44, 0.42 and 0.40 kg for female calves.

The birth weight and growth rate from birth to 12 months of age were studied by [illegible] Rao (1983) in 64 Jersey calves. The gain in body weight was maximum during birth to six months of age in both the sexes. The relative growth rate of male and female calves at different ages were estimated and it was found that the relative growth rate of female calves was rapid during the first three months and appreciable upto six months of age in both the sexes.

Narayanaswamy and associates (1984) conducted a study on the growth efficiency in Freisian x Sahiwal crosses and found that the average body weight at birth and six months

ranged from 23.74-25.69 kg and 126.09-127.68 kg. The growth rate was maximum between birth and six months of age.

Kassa-Mersha and Arnason (1986) from Ethopia have reported that birth and weaning weights and growth to weaning were significantly affected by sex and year of birth while weaning weight and growth rate were also affected by season of birth and parity.

In general, it could be seen that growth was not uniform in different segments of the growth period. Therefore it was suggested that the growth period should be split up into different segments of shorter intervals and then studied (Shrivastava et al., 1986).

Dhumal and associates (1988) studied the factors affecting the growth rate of local and Jersey x local calves. Their studies revealed that non-genetic factors had no significant influence on the different growth stages of both the genetic groups. Growth during different stages was found to have highly significant and positive correlation.

Growth performance of Jersey x Kankrej half bred calves was studied by Dhangar and Patel (1990). The overall body weight gain during birth to four months and four to six months was 376.99 $\pm$ 9.28 and 517.06 $\pm$ 16.79 g per day respectively. The association between birth to four and birth

to six months of age was significant. The birth weight of calf did not contribute towards daily gain from birth to six months period. They also found that the relative gain was maximum during 5-12 week period.

There are only very few reports on growth performance of cattle from the field. Reddy and associates (1991) investigated the growth of crossbred calves under field conditions by recording the chest girth, height at withers and body length at monthly intervals upto one year of age and there after at quarterly intervals upto 18 months of age. The average chest girth increased from 79.5 cm during the first month to 126.7 cm at 12 months and 139.8 cm at 18 months. The averages of body length and height at withers were 68.8 and 71.4 cm during the first months, 108.7 and 101.8 cm at 12 months and 118.9 and 108.4 cm at 18 months respectively. The estimated average body weights were 40.2, 161.4, 214.8 kg during the first, 12th and 18 months respectively.

Pre-weaning growth performance of the progenies of three West African breeds crossed with either Jersey or Friesian cattle were studied (Danbaro et al., 1991). For the three dam groups, birth weight averaged 22.2, 24.0 and 22.0 kg respectively. Weaning weight averaged 120.1, 138.4 and 126.7 kg and daily gain 450, 512 and 472 g.

Measurements

Effect of genetic and non-genetic factors on linear body measurements in crosses of Holstein, Brown Swiss and Jersey with Hariana was studied by Bhat and Singh (1978). Height at withers and pinbone and body length of Hariana x Friesian and Hariana x Brown Swiss did not differ from each other. Body measurement of crossbreds were not affected by sequence of calving except height at pinbones at birth and 12 months, chest girth at birth and six months.

Rao and Nagarceakar (1979) studied the body weights in exotic cattle and the crosses with indigenous breeds upto two years of age. The study revealed that among the various levels of exotic inheritance, half breds in general had the highest body weights at different ages from sixth to two year.

Factors affecting body weight and measurements at birth in three breed crossed were analysed (Srivastava et al., 1986). The birth weight averaged 28.23, 24.54, 29.75 and 24.82 kg for H.F x B.S x Hariana, HF x J x Hariana, BS x HF x Hariana and J x HF x Hariana respectively. Height at the withers were 68.61, 68.35, 69.06 and 66.14 cms, body length 69.73, 68.42, 70.80 and 65.83 cm in the same order. Birth weight was significantly correlated with these three body measurements.

Morrison et al. (1986) studied the weight gain and associated factors of cattle of north-east of Columbia and found the average weight gain per month to be 11 ± 5.2 kg it was significantly correlated with weaning weight and stocking density.

Birth weight and linear body measurements of 267 Jersey x Gir F_2 Calves maintained at Jabalpur, were analysed (Singh and Parekh, 1986). The mean birth weight (kg) and body measurements of length, height and heart girth (cm) at birth were 24.19 ± 0.25, 59.27 ± 0.66, 67.24 ± 0.25 and 67.55 ± 0.24 respectively. The season, year, parity, sire and sex had highly significant effect on the birth weight, length, length and girth, while season year, sire and sex did not affect the body length.

Patel and Dave (1987) studied changes in body weight and growth pattern from birth to 24 months of age in Jersey-Kankrej and Holslein-Kankrej crossbreds. Holstein crossbreds showed significantly higher body weight and daily gain at all the phases from birth to 24 months. Effect of season of birth and year on body weight was non-significant. Calves born in winter showed higher body weights than others.

Data on body weights of calves of Hereford cattle were analysed by Satava and Mouhamed (1988). Weight gain from

birth to weaning was 156-171.9 and 146.5-156.9 kg for steers and heifers respectively. Daily gain from birth to weaning was 0.733-0.758 and 0.709-0.755 kg. The weaning age was 209.0-231.0 and 213.8-233.4 days.

Saha and Parekh (1988) studied the body weight of females at birth, three, six, nine, 12, 18 and 24 months of age on half and 3/4 breed cattle. They noticed differences due to year for all the traits in different genetic groups. Significant season effect was observed for both the half bred groups from 12 months onwards.

Data on 293 half bred and 419 three breed crosses from Jabalpur, spanning over 10 years (1973-82) was analysed by Saha and Parekh (1989) to study the factors affecting body length. The year of birth had significant effect on body length at different age intervals, however, season of birth had significant effect only in few cases. The heritability estimate were low both in half bred and three bred crosses.

In body weight and body measurement studies conducted by El-Feel *et al*. (1990), season did not affect most body measurements upto 76 weeks of age, but 104 week calves born in winter had higher body measurements than those born in summer. Many significant differences in body measurements were observed between sexes, with males having higher values than

females. Significant correlations of body weight with heart girth, width at hooks and cannon girth in cattle were found. Most body measurements were affected by the weaning system.

Dhangar and Patel (1990a) made an attempt to generate prediction equations for estimation of body weight from different body measurements. For birth weight prediction equation with only body length gave the highest accuracy. The prediction equation, equations with heart girth along with body length/height at withers covered variation to the extent of 75.12 to 80 per cent for body weight at four and six months of age.

Body weight and 11 body measurements taken at birth and at six, seven, 18 and 24 months of age on 1479 Korean native cattle, were analysed by Yang et al. (1990). The least square model used included effects of location, year of birth, season, age group, parity, generation and sire. The least square means of body weight at the six ages were 22.49, 147.2, 170.1, 223.5, 267.8 and 291.8 kg respectively. The rate of increases in body measurements was highest from birth to six months of age.

Factors influencing growth

1. Birth weight

Post-natal growth begins with birth and birth weight reflects the sum total of pre-natal growth. A calf with higher birth weight had greater pre-natal growth velocity, the momentum of which is likely to continue after birth to produce greater post-natal growth rate. With the above premise in mind many workers have investigated birth weight and its relationship with cumulative growth at different time intervals.

Birth weight has been found associated with growth rate and other economic characters in dairy animals (Singh and Desai, 1959). A study on growth rate of 145 Hariana calves by Kohli et al. (1962) revealed that male calves were heavier than the females at birth. Variation in the weaning weight of the calves were due to birth weight (26 per cent) age of dam (20 per cent) and weight of cow (21 per cent).

A significant correlation of birth weights and weights at one and six months of age has been observed in crossbred calves by Sharma (1969). The mean weight of male calves at birth appeared to be more than that of female calves. They also observed a highly significant positive correlation between the birth weights of male and female calves with their

respective weights at one month of age. The degree of correlation decreases with advancement of age perhaps due to increased environmental effects. There was no significant difference between the correlation coefficients of male and female calves between their respective birth weights and weights at one month and six months of age.

The growth rate of Sahiwal females maintained at military Dairy farms was studied by Taneja and Bhat (1971). Average body weight at birth, 19 weeks, 52 week and 36 month were 20.91 $\pm$ 0.16, 81.88 $\pm$ 0.78, 182.54 $\pm$ 1.60 and 361.48 $\pm$ 2.46 kg respectively. The growth rate was slow from birth to 19 weeks (0.458 kg/day) when compared with that from 19 to 26 weeks (0.526 kg/day). The average daily gain from 27 to 52 weeks was 0.411 kg. The genetic correlation of birth weights with body weight at various ages were small and negative except with weight at 36th month (0.61).

Aggarwal and Balaine (1973) studied the effect of non-genetic factors on the growth of Hariana calves. The regression of growth rate on the birth weight was 0.12 $\pm$ 0.03. Heavier calves at birth would also have the tendency to grow at a faster rate than lighter calves.

Selection of calves on the basis of higher birth weight and higher live-weights at initial ages was emphasised

in the studies of Ghosh and Co-workers (1979). In their studies, they found the phenotypic correlations and regressions among birth weight and live weight to be positive and highly significant.

A comparative study of the body weights in 84 Sahiwal, 54 Tharparkar and 27 Red Sindhi cows were undertaken by Taneja and Co-workers (1979). Tharparkar calves had the highest birth weight and was significantly heavier than Sahiwals while no significant difference in birth weights between Tharparkar and Red Sindhi or Sahiwal and Red Sindhi calves could be observed.

The body weights and growth rates of different genetic groups of dairy cattle have been reported by Bhat and Chandramohan (1982) as follows:

Breed	Weight at			Daily gain during the period of maximum gain (12-26 weeks) (kg)
	Birth	6 months	12 month	
Friesian	38.0	176.0	297.0	0.958
Sahiwal	19.6	104.6	176.6	0.568
Sahiwal x Friesian	23.9	135.4	213.9	0.684
Hariana	18.7	113.9	178.7	0.566

Hariana x Friesian	23.9	139.9	222.6	0.689
Tharparkar	19.5	96.7	168.8	1.488
Tharparkar x Friesian	22.1	126.3	209.5	0.621
Red Sindhi	17.3	97.8	174.2	0.464
Red Sindhi x Friesian	19.8	131.6	209.1	0.668
Gir	20.3	113.3	166.1	0.540
Gir x Friesian	22.1	131.6	223.2	0.653

Kassa-Mersha and Arnason (1986) analysed the body weight on 4021 Boran cattle at state farms in Ethiopia (1961-84). Birth weight averaged 23.5 $\pm$ 2.5 kg and daily gain to weaning 0.57 $\pm$ 0.12 kg. The birth weight was significantly affected by sex and year of birth.

Body weight studies were conducted by Saikia *et al.* (1987) in Kankrej x Jersey and Kankrej x Holstein Friesian. The mean birth weight were significantly different.

Ribeiro *et al.* (1988) found the birth weight of calves born to American Angus - Devon, Charolais - Devon and Tabapua x Devon dams to be averaging at 27.5, 29.7 and 28.4 kg respectively. Daily gain from birth to 205 days of age

averaged 539, 539 and 671 g. There were no significant differences between male and female calves in birth weight but males had significantly higher daily gains than females.

2. Colostrum

Intestinal absorption of antibodies in calves declined very fast with time and almost cease at 36 hours (Kaeckenbeeck et al., 1961; Jonic and Damnianovic, 1991).

Schoenaers and Kaeckenbeeck (1963) observed that antibodies against Escherchia coli appeared in calves' blood one to two hour after ingestion of colostrum and reached a maximum at 6 hours. There was no correlation between the maximum level of antibodies and age at time of ingestion or the time of appearance of antibodies.

Husband et al. (1972) analysed blood samples of seven calves from birth to 18 weeks of age. Immunoglobulin G_1 and G_2 were present in low concentration in the serum of all calves before the first suckling. Peak serum concentration of IgM and IgA were observed 12 hours after first feeding of colostrum whereas IgG_1 and IgG_2 did not reach peak concentration until 24 hours. The initial increase in concentration of all four immunoglobulins was followed by a linear decline during the subsequent 8-16 days.

Investigations conducted by Frerking and Aeiken (1978) showed a lower gamma globulin concentration in calves born from heifers rather than cows; from younger dams; compared to older and by caesarean section compared to normal delivery. They established a correlation between low gamma-globulin concentration and incidence of enteritis, omphalitis and hypothermia in calves.

Foley and Otterby (1978) observed that colostrum could replace more than an equal weight of whole milk in calf feeding due to its higher solid content. When colostrum was fed on a equal solid basis with whole milk, differences in calf performances were minimal. Colostrum generally does not cause scour in calves.

According to Stott et al. (1979) neither the body weight of calves nor pooled colostral concentration of immunoglobulins influenced maximum concentration of serum immunoglobulins. Compared with bottle feeding of pooled colostrum, rate of absorption and maximum absorption were superior in suckled calves regardless of age or amount of colostrum ingested.

Bush and Staley (1980) found that the absorption of immunoglobulins from colostrum occurs for 20-30 hours after birth by means of apical tubular system in the intestinal

cells. Efficiency of absorption is decreased if the ingestion of first colostrum is delayed and presence of this in the intestine prevents transmigration of pathogenic bacteria.

Besser et al. (1991) studied the absorption of colostral immunoglobulins by Holstein calves in which three methods of colostrum feeding were used. Failure of passive transfer, as determined by calf serum immunoglobulin GI concentration <10 mg/ml at 46 h of age, was diagnosed to be 61.4 per cent of calves from a dairy in which calves were suckled by their dams, 19.3 per cent of calves from a dairy using nipple-bottle feeding, and 10.8 per cent of calves from a dairy using tube feeding.

Jonasen and Krohn (1991) while studying cow-calf relationships concluded that, in addition to providing Ig in colostrum, it was beneficial for calves to remain with their dam for atleast first 5 days as they were stimulated to move and drink earlier.

3. Feeding of calves

The effects of restricted grain mixture feeding and ad libitum roughage feeding on the growth rate of the female calves of Red Sindhi, Sahiwal and Tharparkar calves from birth to 24 months of age were studied (Bhosrekar et al., 1967). The calves grew normally without any untoward effect and

during 7 to 24 months put on a higher body weight than the control animals of the same age.

Studies carried out at NDRI, Karnal (Razdan et al., 1965) revealed that calves reared on milk substitutes grew normally upto six months of age.

Dave and associates (1971) observed that Tharparkar and Murrah buffalo calves receiving restricted milk feeding for one and a half months attained similar growth rate as those on full milk feeding.

Das et al. (1987) studied the performance of young crossbred calves fed different levels of milk and different types of calf starter. The average daily gain of calves from birth to three months of age did not show significant differences between levels of milk or between types of calf starters. Feed efficiency was also not significantly different between level of milk or type of calf starter.

Saikia et al. (1987) reported the effect of limiting the whole milk feeding upto 90 (T_1), 60 (T_2) and 30 (T_3) days of age in crossbred calves. In T_3 skim-milk replaced the whole milk from 31-60 days. The mean daily weight gain was significantly affected by treatment T_1, T_2 and T_3 (467.4, 252.7 and 172.2 g). The mean body length, height and girth at 90 days of age were significantly different (79.9, 76.1 and

73.4 cm; 83.3, 80.9 and 78.9 cm; 90.5, 86.7 and 82.3 cm respectively).

Effect of different planes of nutrition on nutrient utilization and growth performance were studied by Singh et al. (1991). There was no significant difference in the growth rate upto 75 days.

Sharma and Thomas (1981) observed that the most economical growth was obtained in Murrah buffalo heifers above one year when they were fed concentrates at the rate of two per cent of their body weight. Similarly Thomas and Nair (1982) observed that crossbred calves can be raised on ad libitum forages and a small quantity of concentrates.

Suzuki et al. (1979) studied the natural sucking behaviour in dairy calves during the first 24 hours after birth and found out that the mean time of first sucking was 264-279 minutes. Eighty one per cent of calves sucked within eight hours. Edwards and Broom (1979) observed the period between birth and first sucking in dairy calves and found out that 11 per cent of calves born to heifers and 46 per cent born to cows had not sucked by six hours after birth.

Balaine et al. (1982) studied the behavioural responses of weaned calves and found learning time and

drinking rate of milk under complete weaning has a bearing on the growth and health of calves.

Studies of Ventrop and Michanek (1991) showed calves to suck for the first time at a median of four hours nine minutes after birth. Calves that were active early usually sucked early. However, irrespective of the start of a calf's activities, long pauses were observed while teat seeking played a decisive role in the time of first sucking.

Gassille et al. (1992) examined the motivation of non-nutritive sucking by calves. A series of tests were conducted on calves that were fed milk replacer by bucket and allowed to suck on a dry artificial teat. It was concluded that the ingestion of milk plays an important role in stimulating sucking in calf.

4. Housing and management practices

The importance of good hygiene for the healthy development of calves was demonstrated by Hoy et al. (1983) in their studies on dependence of the weight gain of calves on the hygienic status of calf rearing premises.

Shivprasad et al. (1986) worked on the effect of different type of housing management; namely (i) loose house with wheat bhusa bedding, (ii) individual cages with slatted

floor and (iii) loose house without bedding on the growth rate of calves. The effects of treatment, sex and sex x treatment interaction on growth rate and feed efficiency were found to be non significant.

A comparison of individual crates and group pens was made by Wilt (1987). He found that the individually housed calves showed slightly better performance. Bose and Thomas (1979) observed that individual housing significantly increased growth rate and reduced the incidence of disease and mortality in Murrha buffalo calves. According to Seng et al. (1987), calves upto two to three weeks old kept tethered, without partitions, on a straw litter over a slatted floor had better health performance than without litter. Daily weight gain was two per cent higher.

Dybkjaer (1988) studied various rearing methods and concluded that the dam has a positive influence on the welfare of the calves, that it is preferable to have milk constantly available and that calves restricted to bucket feeding takes solid food earlier. He also found that calves housed in groups stimulate each other specially in obtaining milk and food.

Saharia and Sarker (1989) found the daily average gain over a 90 day period to be 366, 352, 329 and 306 g in calves

housed (1) in-doors on a pucca floor (50 per cent concentrate + 50 per cent roughage) (2) in-doors on a pucca floor (25:75) (3) out-doors on a brick floor (50:50) and (4) out-doors on brick at a 25:75 ratio respectively.

Studies of Jonasen and Krohn (1991) on cow-calf relationship showed that later weaned calves (42-56 days) had difficulty in changing from mainly milk to diet of hay and concentrates, and weight gain was impaired for three weeks.

Thiagarajan and Thomas (1991) studied the effect of shelter and level of roughages in the ration on growth response of crossbred calves. Rearing under open conditions increased the physiological reaction significantly ($P < 0.01$), however, these increases were not physiologically meaningful to cause retardation of growth. Calves housed in open and maintained on roughage oriented feeding recorded the maximum gains in live weight between 6-12 months of age.

5. Climatic factors

Mudgal and Ray (1966) found that season of birth had a significant effect on growth of Red Sindhi calves. The calves born during winter gained at significantly higher rates followed by summer and rainy season.

Aggarwal and Balaine (1973) studied effects of factors

like year and season of birth on growth rate. Season alone was responsible for 44.7 per cent of the total variability of this trait.

Thomas and Razdan (1973) observed that Sahiwal-Brown Swiss crossbreds, eventhough they showed evidences of greater susceptibility to high ambient temperature during summer, exhibited their capacity to adapt themselves to such conditions by eating more during the night and maintaining an equal growth rate as that of pure Sahiwals.

The thermal comfort zone for most of the crossbred cattle has been stated to be around 65-75°F (Banerjee, 1982).

Malhotra et al. (1986) collected data from four farms on weekly body weights from birth to one year of age. One hundred and twenty four Holstein-friesian x Sahiwal calves were fitted with nine growth functions, the largest percentage of variation was explained by an orthogonal polynomial of 2nd degree. Analysis of variance showed that average growth rate and rate of change of growth were both influenced by environmental factors.

Calving season had no effect on birth weight or body weight according to Saindane et al. (1990). Dhangar and Patel (1990) concluded that season significantly influenced body weight gain of calves.

Mortality

Mortality rate among calves serve as an important parameter to detect the reasonable adaptability of the crossbred to the new environment. Young calves are the future herd, hence mortality has to be checked by every possible means in the calf-hood stage. Mishra et al. (1990) conducted a study to compare performance between F_1 Jersey calves under organised sector and unorganised sector. The parasitic load and mortality of calves in the organised sector was less than those of the calves of the unorganised sector irrespective of the age group from birth to 24 months.

The factors influencing mortality included birth weight, age, sex, management and housing, diseases, feeding, climate, season and dairy awareness of owners.

1. Birth weight

Brody (1945) has reported that animals born younger than normal are often lacking in normal development of heat regulation system and so have less power of survival after birth in a new environment.

Many studies indicated that mortality was higher among calves born with lower birth weights (Singh and Singh, 1973; Singh and Mishra, 1990 and Katoch et al. 1991). However,

Singh and associtates (1989) and Pachalag and Santra (1991) observed just the opposite in crossbred calves, ie., the mortality rate was higher amoung heavier calves.

Gowrishankar et al. (1987) studied the influence of age, birth weight, gestation length and parity of dams on mortality among ongole crossbred calves. It was observed that while age and parity of dam had influenced the mortality rate of calves of either sex, birth weight and gestation length had affected the survival of only male calves. A gestation length of 265-285 days and birth weight of 26-35 kg ensured maximum survival of male calves.

Zrelli and Ben Younes (1989) conducted a study in three herds with a mean 50 per cent calf mortality rate and observed that the most important factors were low birth weight, lack of hygiene and poorly insulated, draughty buildings.

2. Age

A survey of 77 Michigan dairy herds by Oxender et al. (1973), revealed calf mortality of 17.7 per cent between birth and 60 days of age. Still birth accounted for 6.4 per cent, death between birth and 14 days of age 8.5 per cent and death between two weeks and two months of age, 2.8 per cent.

According to Singh and Singh (1973), over 70 per cent of the deaths occurred during the first three months of life.

Srivastava and Agarwala (1973) studied the births and deaths of female calves upto the age of 6 months for 20 years in herds kept at the Institute of Agriculture, Allahabad and observed that highest mortality occurred in the age group of 0-2 months followed by 3-4 months and 5-6 months age group.

Sharma and Jain (1976) observed that crossbred calves had slightly higher mortality rate from birth to one month of age compared to pure bred Zebu. Nearly 50 per cent of the calves which died during the first month died during the first week of birth itself.

Umoh (1982) found that the proportion of calves in the herd surviving for the first 12 weeks was 91.3 $\pm$ 0.8 per cent. The probability of dying was greatest during third week of life and reduced with age after the fourth week. Batabyal *et al*. (1984) also observed that mortality rate decreased with increasing age.

Kulkarni and associates (1985) observed a mortality rate of 12.79 among young calves compared to 3.65 per cent in adult cattle.

Gowrishankar *et al*. (1987) observed that most death

occurred between zero to one month of age. Similar observation was made by Maarof and Co-workers (1987).

Calf mortality in Irish Dairy herds were analysed by Mee (1987, 1988). Of the 775 calves that died within two days of birth, 73 per cent died at birth.

Zrelli and Malek (1988) observed that over half the calf deaths in dairy farms in Tunesia occurred after three weeks of age.

The pattern of calf survivability in half bred cattle were studied in 578 Holstein x Hariana, Brown Swiss x Hariana and Jersey x Hariana by Singh et al. (1989). The overall survival rates were 87.9, 93.1, 96.8 and 96.7 per cent from birth to one month, one to three, three to six and six to twelve month respectively.

Erf et al. (1990) concluded from his study that male calves were more likely to die at birth, to die through second day and to die from first to seventh day of life than female calves.

In a study conducted by Singh and Mishra (1990) in 252 Freisian x Hariana, 176 Brown Swiss x Hariana and 150 Jersey x Hariana calves, the mortality during the first week of life

averaged 37.9, 28.6 and 31.6 per cent respectively. Differences among breed types were not significant.

The overall mortality rate in the first year of life among buffalo calves was much higher (32.7 per cent) compared to Jersey crossbred calves (15.13 per cent) (Patil et al., 1991).

3. Sex

Singh and Singh (1973) reported that male calves had a higher mortality rate than females. Similar finding were reported by Sharma and Jain (1976), though the differences were not significant, statistically.

Studies on calf mortality in Kankrej cows by Chaudhary and co-workers (1986) revealed an overall mortality of 28.7 per cent with a break-up of 27.85 per cent among males and 29.87 per cent in females.

Thurmond (1986) used epidemiologic approaches to investigate neonatal calf mortality in a 1400 cow dairy. During the outbreak of calf diarrhoea, female calves experienced a higher rate of mortality (10.7 per cent) than males (5.3 per cent).

But according to Maarof et al., 1987, who studied factors affecting mortality rate among Friesian calves in

Iraq, sex of calf did not significantly influence mortality rate. Patterson et al. (1987) investigated the occurrence of neonatal and post natal mortality in range beef cattle. They studied 13296 calving and saw that more bull calves (57.6 per cent) died than heifer calves (44.4 per cent).

An investigation of the causes of parturient calf mortality in Short horn heifers done by Gee et al. (1989) revealed that significantly more male than female calves died from maternal dystocia.

Erf et al. (1990) also laid emphasis on the fact that male calves were more likely to be dead at birth, to die through second and to die from first to seventh day of life than female calves.

Katoch and Associtates (1991), in a study of incidence of calf mortality upto one year of age in an organised herd observed that season of birth and sex of calf did not have any significant effect on mortality.

Pachalag and Santra (1991) conducted studied on 2172 calves, born in five year period from Karan Swiss and Karan Friesian, from birth to 90 days. Between 2.18 and 8.42 per cent of male calves were born weak (<20 kg) in different seasons, while in female calves these figures were between 3.68 and 17.50 per cent.

4. Management and housing

Speicher and Hepp (1973) studied the results from 379 Michigan dairy farms and noted that mortality rate was significantly less in stanchion barns than in loose and free-stall housing (15.1 per cent and 14.2 per cent respectively). Other characteristics shown to significantly affect calf mortality were temperature of calving facilities, type of housing for calves, supplemental heat in calf barns, person caring for calves, and attendance at calving.

Control of diarrhoea and death in homebred dairy calves was investigated by Barber (1979). The feeding of colostrum to new born calves from a bucket was more effective in ensuring immunoglobulin uptake than leaving cow and calf together for two days after parturition. But according to Umoh (1982) suckled calves survived better than bucket fed calves.

Fink (1980) studied the influence of type of housing, micro climate and management on health of 1616 calves, on 52 medium sized farms. Navel disinfection and removal of mucus from the mouth and nose reduced the mortality and morbidity rate. Death rate decreased when the calves were fed three times instead of twice a day but increased with delayed and rapid weaning. Significantly fewer illness occurred in calves

reared in cowsheds than in calf pens and fewer in new than in old buildings.

While studying the factors affecting susceptability of calves to diseases, Roy (1980) emphasized that well ventillated, draught proof building should be used for housing.

Jenny et al. (1981) did a survey of mortality among calves aged upto six months in 140 dairy herds. The mortality rate was lower when the calves were taken from the dam within the first 12 hours rather than later, when weaning was delayed and when calves were fed increased amounts of colostrum.

Egginton et al. (1986) associated low growth rate and high calf mortality with weaning in their studies on cattle weaning, growth and survival in Darwin district of Northern Territory.

Health and performance of calves kept on slatted floor with straw litter was analysed by Seng and Co-workers (1987). Calves upto two weeks old or two three weeks old kept tethered, without partitions, on straw litter over a slatted floor had better health and performance than under the system in which calves were kept on slatted floor without litter.

Ruzier (1989) studied the natural resistance of calves

kept under different intensive conditions. The healthiest calves in terms of bacteriocidal and lysosomal activity of serum, phagocytic activity of neutrophil, haemoglobin contents, blood cell counts and blood proteins, were produced by loose housing of calves between one to four months of age in pens measuring 1.2 x 0.55 m, instead of in crates.

Studies in three herds with mean 50 per cent calf mortality rate was done by Zrelli and Ben Younes (1989). The most important factors were low birth weight, lack of hygiene, and poorly insulated, draughty buildings.

5. Disease factor

The causes of mortality in calves were investigated by many workers. Obviously these will vary according to the environment and management. The results of investigations showing the percentages of different causes of death among calves have been tabulated below.

Percentage of calves died due to different causes

Sl. No.	Digestive disease	Respiratory disease	Septicaemia	Other causes	Authors (year)
1.	49.00	20.46	28.00		Ottasen (1959)
2.	35.90	--	--	--	Fink (1980)

3.	31.07	--	20.71	--	Greene and Bakheit (1980)
4.	49.66	20.46	5.75	--	Khera (1981)
5.	32.00	51.00	--	--	Kubin et al. (1984)
6.	14.10	48.30	--	--	Peters (1986)
7.	34.08	53.87	--	--	Maarof et al. (1987)
8.	47.00	27.40	--	--	Sunder and Chouduri (1988)
9.	24.50	34.20	--	--	Zrelli and Malek (1988)
10.	24.04	29.36	--	11-49 (Navel ill)	Reddy and Nagarcenkar (1989)
11.	54.67	8.00	--	8 (Navel ill)	Dhangar and Patel (1990b)

Highest mortality occurred due to weakness and debilitation of calves in all breeds followed by tympanites, Foot and mouth disease, gastroenteritis and Haemorhagic septicaemia (Srivastava and Agarwal, 1973).

Bose and Thomas (1979) observed that the incidence of pneumonea, calf-scours, navel ill, mange, ticks and mortality were high in group housed compared to individually housed buffalo calves.

6. Feeding

Some statistics on calf mortality were studied by Ottasen (1959) in Denmark. Mortality appeared to be lower in herds fed on silage than in fed root crops or concentrates.

Fink (1980) studied morbidity and mortality rates among 1616 calves aged upto nine weeks. Death rate decreased when the calves were fed three times instead of twice a day. A 6.1 per cent morbidity rate following change to skim milk compared favourably with 7.6 per cent after change to soured milk and 12.2 per cent with milk substitutes.

Studies of Roy (1980) showed that mortality and morbidity can be reduced to negligible proportions by providing adequate colostrum in the first two days of life, followed by milk substitutes made from mildly heat treated milk powder.

Incidence of ailments and mortality in early weaned Kankrej-Bos taurus crossbreds were analysed by Patgiri et al. (1987). The calves under study were fed whole milk for 30 days and skim milk from 31st to 60th day of age.

Makarechian et al. (1988) compared the incidence of morbidity and mortality in a feed lot of 381 bull calves weaned one month apart. The calves were 156 and 192 days old

at weaning. Following an adjustment period, the calves were fed mixed finishing diet containing 90 per cent concentrate ad lib. for 140 days in a feed lot. The rate of morbidity did not differ significantly between the two weaning groups.

Survey on calf mortality in Dairy farms in Tunisia was conducted by Zrelli and Ben Younes (1988). The calves, reared indoors were fed colostrum followed by milk replacers. Overall calf losses were 18.8 per cent in the first year and 23.6 per cent in the second year. Zrelli and Malek (1988) also studied ante natal factors of calf mortality. It revealed that frequent changes of green feed, rich in soluble nitrogen during February-May, were associated with high still birth rate while feeding rations supplying excessive energy and nitrogen during December-January was associated with both high still birth and high calf mortality rates.

Patil et al. (1991) did a comparative study on calf mortality in Jersey crossbred and Surti buffaloe calves. All calves were fed colostrum from their dams for five days after weaning at birth, whole milk upto three months and calf starter after one month age. Mixed milk of cows and bufaloes was fed to both cow calves and buffalo calves. The overall mortality of cow calves and buffalo calves from birth to 12 months of ages was 15.13 per cent and 32.70 per cent.

7. Climate and season

Record and results of a questionnaire from 379 Michigan dairy farms, analysed by Speicher and Hepp (1973), showed that the annual calf mortality for all herds averaged 13.5 per cent. Winter and summer losses were 17.1 and 10.3 per cent respectively. Singh and Singh (1973) also found the mortality rate of calves born during winter to be higher than those born in summer or rainy season. Sharma and Jain (1976) also reported the same.

Effects of ambient temperature on calf mortality was investigated by Mishra et al. (1977). Calf mortality was lowest in April and May, when the climate was warm and dry, increased from June onwards and was highest in rainy, winter months of October to December. The lowest temperature and the high humidity recorded at that season were thought to cause chilling and stress in the new born animals.

Fink (1980) also reported that the highest monthly mortality rate was in December (28.2 per cent). Thermal comfort zone for most of the cross bred cattle has been stated to be around 65.75°F by Banerjee (1982).

Maarof et al. (1987) observed 3713 Friesian calves born alive during 1982-84 at the Dujailah Grand Dairy Farm, Iraq. Year and month of birth, and month of death had highly significant effects on mortality rate.

Brenner and co-workers (1989) studied the influence of climate on the mortality of young calves in Israel. During critical period of young calf mortality, throughout the winter, there was significantly negative influence of low minimum and low maximum temperature and high humidity as well as a higher number of rainfall days above 10 mm. Similarly IVRI workers (Singh et al., 1989) observed that the survivability of half-bred calves remained poor during rainy and winter months.

Research on natural resistance of calves by Ruzier (1989) revealed that the summer climate of Uzbekistan (26-28°C, 30-35 per cent Relative humidity) could be accompanied by a check in the growth rate of calves and in an increase in the morbidity rate to 35-40 per cent.

Dhangar and Patel (1990b) observed that season had a significant influence on calf mortality. High mortality (54.54 per cent) during March-June was attributed to high incidence of different ailments, stressful environment and unhygienic conditions.

Pachalag and Santra (1991) analysed the factors associated with calf losses in cross-bred cattle in organised farms. Mortality ratio in winter, summer and rainy seasons were 9.81, 14.54 and 11.81 per cent respectively.

8. Herd size

According to Oxender et al. (1973) mortality ranged from 16.1 per cent for herds less that 50 cows to 34.9 per cent for herds of more than 200 cows.

Mortality increased with size of the farm (Remmen and Blom, 1973). Speicher and Hepp (1973) supported this. Their studies revealed that mortality increased from 9.7 per cent for herds of less than 25 cows to 16.6 per cent for herds of more than 85 cows. Mortality after birth was a function of herd size.

Fink (1980) observed high morbidity and low mortality rates in herds of less than 50 herds. Disease rate increased with herd size.

On the contrary, Jenny et al. (1981) found that the mortality rate was lowest (16.3 per cent) in herds of more than 200 cattle and highest (21.0 per cent) in herds of less than 100.

9. Dairy awareness

Jenny et al. (1981) observed that the mortality rate was lower when the owner or his family were responsible for rearing the calves than hired labour.

Materials and Methods

MATERIALS AND METHODS

The main objective of the experiment was to evaluate the system of calf raising in the field vis-a-vis that in organised farms. In order to achieve this objective, a study was undertaken which included contemporary calves born in field and organised farms. The system of management followed as well as performance of calves in either case were objectively compared.

3.1 Study area

3.1.1 Field

Mavelikara was chosen as the study area from where the experimental field calves were selected. Mavelikara was deliberately chosen because of its history of continuous dairy development and dairy extension work for a long time. It was one of the first key village scheme areas and cross-breeding was successfully implemented continuously from late 1950's. Later Intensive Cattle Development Project (ICDP) took over and was efficiently run. It is considered to be one of the best ICDP regions in India along with Mehsana. The Indo-Swiss collaboration was an added advantage for its outstanding achievement in the field of cattle breeding. Georgraphically, it is dense in human and cattle population. Because of all

these, Mavelikara was assumed to be an area where there is considerable dairy awareness. Most of the farmers here are adopting improved technology and follow scientific methods of calf raising. Thus what exists in the field in Mavelikara can be taken as a reasonable benchmark achievable in the field in Kerala through good extension work. In addition to this, earlier studies conducted in the area give material for comparison to ascertain if progress has been achieved.

Two sub-centres, namely, Peringala and Punnamoodu of the Mavelikara ICDP which are also covered by the Progeny Testing Scheme of the Kerala Livestock Development (K.L.D.) Board were chosen for the study.

3.1.2 Farms

Two farms, namely, University Livestock Farm, Kerala Agricultural University, Mannuthy and Dhoni farm, KLD Board, Dhoni, Palghat were chosen to represent organised farms in the experiment and data obtained are likely to be reliable.

3.2 Experimental animals

All the calves born in the experimental area or farms during a period of two months (23.9.92 to 24.11.92) were included in the experiment excepting a few calves in the field from inaccessible households or belonging to less cooperative owners.

The calves were selected and included in the experiment at birth or shortly thereafter in the field but never later than 14 days after birth. They were subjected to various observations upto the age of six months.

3.3 Observations

3.3.1 Climatic information

Climatic information was collected from the nearby meteorological stations. Monthly averages of maximum and minimum temperature, relative humidity, rainfall and hours of bright sunshine were obtained.

3.3.2 Birth weight and fortnightly live weight of calves

Birth weight of the animals were obtained from the registers maintained on the farms while in field birth weights were unavailable except for those born on the day of weight recording. In farms the animals were weighed fortnightly using a platform balance, while in the field weight was recorded using a spring balance at the short arm of a lever (Plate 1). After applying the sling underneath the calf and hooking on to the balance, the calf and balance were lifted by applying force on the long arm of the lever (Plate 2). Although the balance had the capacity of 200 kg, it was found difficult to use the device to weigh calves beyond three and a half months of age, as the calves struggled and tipped the

device. The weights of calves beyond three and a half months were therefore estimated using a prediction equation.

3.3.3 Heart girth, length and height of calves

Fortnightly measurements of heart girth, length and height were made. A measuring tape, measuring scale and a height measuring equipment were used for the purpose of measuring heart girth, length and height of calves respectively. The height measuring equipment comprised of a graduated vertical rod with a movable horizontal bar which had a spirit level incorporated into it (Plate 3). This ensured that the arm is horizontal and the rod vertical at the time of taking the height. Animals were measured in a quiet atmosphere and restrained effectively by skilled labourers.

3.3.4 Feeding of calves

3.3.4.1 Colostrum feeding

The time, method and quantity of colostrum fed to the calves were obtained from direct observation or from records maintained on the farms. In the field, the time and method of colostrum feeding were known by interviewing the farmers. The quantity of colostrum fed was not obtained in the field.

3.3.4.2 Milk consumed by calves

The quantity of milk fed to the calves was obtained

from the registers maintained on the farms while in the field the following method was adopted. The time given for the calves to suckle was found out by direct observation and by enquiring with those who look after the animals. On the day of recording, the calf was not allowed to suckle for an equivalent period after milking. Normal milk produced was recorded using a spring balance and the animal was milked again after the specific time interval for which the calf is normally allowed tc remain with the mother to drink milk. The milk obtained in the second milking after the specific period was taken as the quantity of milk consumed by the calves.

3.3.4.3 Concentrate feeding

The quantity of concentrates fed to calves was ascertained by actual observation, referring to the records or by putting relevant questions to the farmers or farm managers.

3.3.5 Housing

The type of calf housing followed was observed, categorised and recorded.

3.3.6 Management practices

The practice followed in the farms were obtained by direct observation, discussion with farm staff or by consulting farm records. In the field these were obtained by

means of a questionnaire (Annexure) in addition to direct observation. Information with respect to (i) deworming (ii) vaccination (iii) hygiene and (iv) grooming were collected.

3.3.7 Dairy awareness

The farms were maintained by experts while the farmers had varying range of dairy awareness. A questionnaire (Annexure) was used to determine the dairy awareness of the farmers. Also information on economic status, occupation, land holding and person looking after the animals was collected.

3.3.8 Incidence of disease, morbidity and mortality

During the fortnightly visits observations on disease incidence, morbidity and mortality if any, were noted both in the field and the farms.

3.3.9 Statistical analysis

The observations from the field and from the organised farms were compared and statistical analysis was carried out wherever feasible. This was done as per the various statistical techniques described by Snedecor and Cochran (1967).

Plate 1. Device for weighing calves in the field

Plate 2. Device for weighing calves in the field (lever pressed)

Plate 3. Measuring rod with spirit level for height measurement

Results

RESULTS

4.1 Meteorological information

Meteorological information was collected from Meteorological Station at Vellanikkara (2 km from ULF Mannuthy), Fodder section, Dhoni Farm and Coconut Research Institute, Kayamkulam (6 km from Mavelikara). The average monthly meteorological data of the study areas have been presented graphically. Figures 1, 2 and 3 give the data pertaining to maximum and minimum temperature and rainfall in the organised farms and field (Mavelikara). Rainfall ranged between 280 to 346 mm/month during September, October and November in Mavelikara and was practically nil for the remaining months of study. Similar conditions were observed in the farm locations with respect to rainfall. Maximum temperature ranged from 30 to 34°C and minimum from 14.1 to 19.6°C in Mavelikara. At Mannuthy maximum temperature ranged from 30.1 to 35.4°C while minimum from 20.7 to 23.7°C. Dhoni farm had maximum temperature ranging from 28.4 to 36.0°C and minimum temperature 19.5 to 25.9°C. Hours of bright sunshine and relative humidity are presented in Fig.4 and Fig.5. It can be seen from the figures that hours of bright sunshine and relative humidity were generally less at ULF Mannuthy compared

to Mavelikara. Relative humidity was similar at Dhoni Farm and Mavelikara.

4.2 Birth weight and fortnightly live weights of calves

The birth weight and fortnightly weights of calves in the two farms and field (Mavelikara) are presented in Table 1 and Fig.6. The birth weight of calves as well as the weights beyond the 7th fortnight of the calves in the field have been estimated on the basis of observed weights from 1st to 7th fortnights. T test was done between the farm born calves and the field born calves with respect to the birth weight of calves. It was found that there were no significant differences between the birth weights of farm born and field born calves. From an average birth weight of 27.46 $\pm$ 2.04 kg, the males in the farms grew to weigh 132.25 $\pm$ 5.23 kg in the 12th fortnight. Estimated birth weight of male calves in the field was 25.39 $\pm$ 1.14 kg which increased to an estimated value of 72.93 $\pm$ 4.50 kg in the 12th fortnight. The females in the farms grew from a birth weight of 23.94 $\pm$ 4.60 kg to 90.35 $\pm$ 11.47 kg in the 12th fortnight. On the other hand, the females in the field grew from an estimated birth weight of 24.61 $\pm$ 0.73 kg to a predicted weight of 74.69 $\pm$ 3.20 kg in 12th fortnight. The corresponding live weights of calves in the farms and field were tested in the 1st fortnight, 6th fortnight and 12th fortnight and the results have been

presented in Table 2. It was observed that the body weight of male calves in the farms were significantly higher at the three growth stages at which they were tested. The females also showed a similar trend but differences were significant only in 12th fortnight. When the males and females were put together and the weight of calves in the farms and field were tested at 1st, 6th and 12th fortnights. The differences were found to be significant at 1 per cent level for 6th and 12th fortnights. While only a 5 per cent significance in 1st fornight. Fortnightly gain in weight and girth and daily gain during each fortnight were recorded and presented in Table 1a and 1b. Fortnightly weight gains in farm ranged from 5.51 kg to 9.6 kg; in the field it was between 1.43 kg to 3.42 kg. In farms, higher gains were during 6th to 11th fortnights, while in field during 1st to 6th fortnight. Similar picture has been obtained for daily gain also. Daily gain of male calves in farms was 0.623 and females 0.467 kg upto 6 months of age. In the field daily gain of male and female upto 3½ month of age was 0.166 and 0.171 kg respectively. Overall daily gain of calves was 0.590 and 0.170 kg in farms and field respectively. T-test revealed that the differences were significant at 1 per cent level. The trends of weights in farms and field are presented in Fig.7. Figure 8 gives weight gain of calves in farm and field.

4.3 Body measurements

4.3.1 Height at withers

Figure 9 and Table 3 depict the fortnightly measurements of height of calves in the farms and field. The male calves in the farms averaged 69.18 ± 0.88 cm in height in the first fortnight and grew to 98.31 ± 1.90 cm in 12th fortnight. The corresponding figures for calves in field were 67.45 ± 1.14 cm and 84.12 ± 1.73 cm respectively. The females in the farms averaged 67.61 ± 0.63 cm in first fortnight and grew to a height of 88.07 ± 2.32 cm in the 12th fortnight. The female calves in the field also had almost identical height of 67.62 ± 2.80 cm in the 1st fortnight and grew to 84.30 ± 1.04 cm in the 12th fortnight. The overall height in the first fortnight was 67.55 ± 0.69 and in the 12th 84.26 ± 0.95 cm. Table 4 gives the results of t-tests carried out between farm raised and field raised calves with respect to height at 1, 6 and 12 fortnights. Among the male calves, the differences in height between the farms and field were not significant in the first fortnight; however, it was significantly ($P < 0.01$) higher in the farms in 6th and 12th fortnights. In case of female calves, statistical analysis showed that there was no significant difference in height of calves in the farms compared to those in field in all the three fortnights tested. The overall picture was similar to

that in the case of male calves. Eventhough there was no significant difference between calves raised in farm and field in 1st fortnight, the height was significantly ($P<0.01$) higher in farm raised calves during 6th and 12th fortnights.

4.3.2 Heart girth

The average fortnightly girth of calves in the farms and field have been presented in Table 5 and Fig.10. The information with respect to girth also showed a similar trend as in the case of weight and height. The average girth of calves and the results of the t-test have been presented in Table 6. In the male calves, the heart girth averaged 72.38 $\pm$ 1.16 cm in farms compared to 66.95 $\pm$ 1.39 cm for calves in the field in the first fortnight. Similarly, in the 6th fortnight, males in farms had a girth of 94.18 $\pm$ 1.61 cm compared to 79.05 $\pm$ 2.09 in the field. The corresponding figures in 12th fortnight were 116.0 $\pm$ 2.43 and 92.62 $\pm$ 2.90 cm. In all three cases the difference were significant ($P<0.01$). On the contrary, in case of females, the farm bred and field bred calves had more or less similar girths during the three fortnights tested. Overall, the farm bred calves had a girth of 69.67 $\pm$ 1.04 cm in 1st fortnight, 88.5 $\pm$ 1.76 in 6th fortnight and 108.5 $\pm$ 2.59 cm in 12th fortnight. The field raised calves had corresponding figures of 66.70 $\pm$ 0.62, 80.86 $\pm$ 1.04 and 94.73 $\pm$ 1.42 cm in the 1st, 6th and 12th

fortnights. In all three cases the differences were significant (6th and 12th fortnights were significant at 1 per cent level).

4.3.3 Length

Table 7 and Fig.11 depict the fortnightly averages of length of calves in the farms and field from 1st to 12th fortnights. The length of male calves in farm grew from 61.62 $\pm$ 1.03 cm in the 1st fortnight to 103.43 $\pm$ 1.68 cm in the 12th fortnight. In the field, eventhough the males had a slightly higher average of 65.72 $\pm$ 1.51 cm in 1st fortnight, their average length in 12th fortnight was lower than those in the farms (82.75 $\pm$ 2.38 cm). Females in the farm had an average length of 61.50 $\pm$ 0.70 cm in the first fortnight which increased to 91.00 $\pm$ 1.19 cm in the 12th. On the other hand the females in the field had a length of 65.25 $\pm$ 1.26 cm in the 1st fortnight and 85.23 $\pm$ 3.14 cm in 12th fortnight.

The fortnightly length of calves in the farm and field were compared in the 1st, 6th and 12th fortnights and results have been presented in Table 8. In the first fortnight, the male calves in the farms measured significantly ($P<0.05$) lower than male calves in the field. However, by the 6th fortnight they had grown fast enough to overtake the male calves in the field and measure significantly longer than them. In the 12th

fortnight, they further widened the gap with those in the field. On the other hand, there was no significant difference in length in female calves of farms and field during 6th and 12th fortnight tested. The overall values showed a similar result as in males. While calves in the farms started with a lower length, they overtook the calves in the field by the 6th fortnight to measure significantly longer and further widened the difference by the 12th fortnight by increased growth in length.

4.4 Prediction equations

Equations to predict body weight from body measurements were evolved using the multiple regression method. The equation for the calves in the farms was as follows:

$$W = -145.408 + 2.238646 \times G - 0.54034 \times L + 0.653957 H$$

where

W = Weight in kg

G = Girth in cm

L = Length in cm

H = Height in cm

Similar equation developed for farm-bred calves has been:

$$W = -62.488 + 0.7084\ G - 0.1399\ L + 0.7518\ H$$

The equations developed from the body measurements of field-raised and farm-raised calves were found to have high degree of accuracy, the R^2 values being 0.999 and 0.998 respectively. Prediction equations were also developed on the basis of girth alone. In the farm bred calves the body weight could be predicted using the following equation.

$$W = 0.0000535 \times G^{3.10998}$$

The equation had a high degree of accuracy, the R^2 value being 0.998.

Similar equation developed from the data of field calves was:

$$W = 0.002196 \times G^{2.23908}$$

This also had a high degree of accuracy, the R^2 value being 0.996. Figure 12 and 13 shows the relationship between live body weight and heart girth in farm and field respectively.

Table 1. Average fortnightly live weight of calves in the farms and field

Fort-night	Farm (weight, kg)			Field (weight, kg)		
	Male	Female	Overall	Male	Female	Overall
Birth weight	27.46 ± 2.04	23.94 ± 4.60	25.42 ± 2.47	25.39 ± 1.14	24.61 ± 0.73	24.97 ± 0.91
1.	32.62 ± 2.15	26.47 ± 1.53	29.37 ± 1.43	26.22 ± 1.12	26.39 ± 0.63	26.32 ± 0.60
2.	39.52 ± 1.68	30.75 ± 1.08	35.02 ± 1.08	28.93 ± 1.13	30.40 ± 0.62	29.74 ± 0.61
3.	46.10 ± 1.89	34.30 ± 1.41	40.53 ± 1.31	31.60 ± 1.30	33.77 ± 0.81	32.82 ± 0.75
4.	54.15 ± 1.92	39.15 ± 1.99	47.30 ± 1.91	34.36 ± 1.57	36.59 ± 0.92	35.55 ± 0.86
5.	60.73 ± 2.33	43.45 ± 2.25	53.11 ± 2.24	36.80 ± 1.82	39.29 ± 0.95	38.31 ± 0.93
6.	68.06 ± 2.47	49.24 ± 3.10	58.95 ± 3.20	39.85 ± 2.10	42.14 ± 1.09	41.26 ± 1.05
7.	76.93 ± 3.34	54.68 ± 4.22	66.17 ± 4.13	41.40 ± 2.31	45.09 ± 1.20	42.69 ± 1.12
8.	88.25 ± 3.94	62.14 ± 5.10	75.62 ± 5.01	48.90*± 2.50	51.14*± 2.11	50.52*± 2.40
9.	100.87 ± 4.62	68.53 ± 6.44	85.22 ± 5.95	57.5 *± 3.51	59.93*± 2.42	59.15*± 2.92
10.	111.81 ± 4.65	75.24 ± 7.58	94.12 ± 6.49	64.56*± 3.75	66.48*± 2.60	65.97*± 3.26
11.	121.93 ± 4.74	81.33 ± 9.80	102.29 ± 7.11	68.99*± 4.21	71.8 *± 3.01	71.08*± 3.46
12.	132.25 ± 4.69	90.35 ± 9.40	112.36 ± 6.98	72.93*± 4.50	74.69*± 3.20	74.28*± 4.11

* There are estimated weights

Table 1a. Fortnightly gain in weight and girth

Fortnights	Body weight gain (kg)		Girth gain (cm)	
	Farm	Field	Farm	Field
2-1	5.67	3.42	5.21	3.17
3-2	5.51	3.08	3.73	2.92
4-3	6.77	2.73	3.67	2.69
5-4	5.81	2.76	3.36	2.67
6-5	5.84	2.95	2.80	2.71
7-6	7.22	1.43	3.42	1.99
8-7	9.45	3.07	3.26	2.32
9-8	9.60	2.39	3.13	2.33
10-9	8.90	2.94	3.42	2.75
11-10	8.17	2.38	2.97	2.15
12-11	6.77	2.65	3.76	2.33

Table 1b. Average fortnightly daily weight gain (kg)

Fortnight	Farm	Field
1-2	0.378	0.228
2-3	0.367	0.205
3-4	0.451	0.182
4-5	0.387	0.184
5-6	0.389	0.196
6-7	0.481	0.095
7-8	0.630	0.204
8-9	0.640	0.159
9-10	0.593	0.196
10-11	0.544	0.158
11-12	0.451	0.176

Table 2. Comparison of live weight of calves in the farms and field at 1st, 6th and 12th fortnights

Fort-night	Male			Female			Overall		
	Farm	Field	T value	Farm	Field	T value	Farm	Field	T value
1	32.62±	26.22±	** 3.2763	26.47±	26.17±	NS 0.2541	29.37±	26.20±	* 2.5203
	1.74	1.15		1.11	0.64		1.12	0.61	
6	68.06±	39.85±	** 7.2277	45.11±	42.18±	NS 0.7874	58.95±	41.34±	** 5.2883
	3.45	2.17		3.69	1.10		3.20	1.06	
12	131.62±	72.93±	** 9.8152	90.35±	74.69±	* 3.032	112.36±	74.28±	** 7.9897
	5.23	4.50		11.47	3.20		6.98	4.11	

NS - Non significant

* Significant at 5 per cent level

** Significant at 1 per cent level

Table 3. Average fortnightly height of calves in farms and field

Fort-night	Farm height (cm)			Field height (cm)		
	Male	Female	Total	Male	Female	Total
1.	69.18 ± 0.88	67.45 ± 1.14	68.35 ± 0.52	67.45 ± 1.14	67.62 ± 2.80	67.55 ± 0.69
2.	74.41 ± 2.16	70.27 ± 2.66	72.28 ± 2.20	69.00 ± 0.95	69.70 ± 0.69	69.38 ± 0.56
3.	75.89 ± 1.93	71.94 ± 1.67	74.02 ± 1.94	70.42 ± 0.98	71.55 ± 0.71	71.06 ± 0.58
4.	79.42 ± 1.78	73.75 ± 1.81	76.82 ± 1.80	72.45 ± 0.98	73.29 ± 0.78	72.93 ± 0.57
5.	81.89 ± 1.67	76.00 ± 2.25	79.29 ± 1.71	74.11 ± 1.14	74.51 ± 0.86	74.35 ± 1.74
6.	84.37 ± 1.22	77.40 ± 1.13	81.00 ± 1.04	75.64 ± 1.34	75.77 ± 0.30	75.72 ± 0.68
7.	85.87 ± 1.63	79.13 ± 1.73	82.61 ± 1.04	75.73 ± 1.41	76.40 ± 0.77	76.16 ± 0.70
8.	87.75 ± 1.53	80.83 ± 1.70	84.41 ± 1.63	77.76 ± 1.69	78.56 ± 0.84	78.27 ± 0.78
9.	90.31 ± 1.42	82.80 ± 1.97	86.67 ± 1.46	79.23 ± 1.72	79.70 ± 0.90	79.55 ± 0.81
10.	93.43 ± 1.32	84.53 ± 1.73	89.12 ± 1.24	81.10 ± 2.04	81.26 ± 0.98	81.22 ± 0.89
11.	96.06 ± 1.26	85.86 ± 1.33	91.12 ± 1.41	82.00 ± 2.36	82.80 ± 1.01	82.60 ± 0.95
12.	98.31 ± 1.90	88.07 ± 2.32	93.53 ± 1.57	84.10 ± 1.73	84.30 ± 1.04	84.26 ± 0.95

Table 4. Comparison of height of calves in the farms and field at 1st, 6th and 12th fortnights

Fort-night	Male			Female			Total		
	Farm	Field	T value	Farm	Field	T value	Farm	Field	T value
1	69.18 ± 0.88	67.45 ± 1.14	NS 1.2338	67.61 ± 0.63	67.62 ± 2.80	NS 0.9989	68.35 ± 0.52	67.55 ± 0.69	NS 0.9286
6	84.37 ± 1.22	75.52 ± 1.34	** 5.0307	77.40 ± 1.13	75.77 ± 0.30	NS 1.2144	82.61 ± 1.04	75.68 ± 0.68	** 4.4985
12	98.31 ± 1.90	84.12 ± 1.73	** 5.8239	88.07 ± 2.32	84.30 ± 1.04	NS 1.5293	93.53 ± 1.57	84.26 ± 0.95	** 5.1212

NS - Non significant

* Significant at 5 per cent level

** Significant at 1 per cent level

Table 5. Average fortnightly girth of calves in farm and field

Fort-night	Farm girth (cm)			Field girth (cm)		
	Male	Female	Total	Male	Female	Total
1.	72.93 ± 1.16	66.72 ± 1.20	69.64 ± 1.04	66.95 ± 1.39	66.50 ± 0.65	66.70 ± 0.62
2.	78.94 ± 1.36	71.05 ± 1.27	74.88 ± 1.14	69.31 ± 2.12	70.33 ± 0.71	69.87 ± 0.65
3.	82.29 ± 1.28	73.82 ± 1.53	78.61 ± 1.26	71.61 ± 2.41	73.70 ± 0.83	72.79 ± 0.75
4.	86.47 ± 1.34	77.31 ± 1.80	82.28 ± 1.47	73.75 ± 2.61	76.77 ± 0.89	75.48 ± 0.86
5.	90.47 ± 1.31	79.53 ± 2.07	85.64 ± 1.49	76.33 ± 2.95	79.37 ± 0.93	78.15 ± 0.93
6.	94.18 ± 1.61	82.53 ± 2.37	88.54 ± 1.76	79.05 ± 2.09	82.00 ± 1.05	80.86 ± 1.01
7.	98.06 ± 1.48	85.46 ± 2.55	91.96 ± 1.86	80.53 ± 2.12	84.14 ± 1.01	82.85 ± 1.08
8.	101.75 ± 1.72	88.26 ± 2.84	95.22 ± 2.03	83.15 ± 2.41	86.14 ± 1.08	85.17 ± 1.15
9.	105.37 ± 1.61	90.86 ± 3.18	98.35 ± 2.18	85.15 ± 2.61	88.62 ± 1.28	87.50 ± 1.21
10.	108.62 ± 1.65	94.46 ± 3.49	101.77 ± 2.28	88.10 ± 2.95	91.07 ± 1.33	90.25 ± 1.26
11.	112.12 ± 1.58	96.86 ± 3.76	104.74 ± 2.48	89.66 ± 3.46	93.34 ± 1.37	92.40 ± 1.35
12.	116.00 ± 2.43	99.92 ± 4.28	108.50 ± 2.59	92.62 ± 2.90	95.38 ± 1.43	94.73 ± 1.42

Table 6. Comparison of girth of calves in the farms and field at 1st, 6th and 12th fortnights

Fort-night	Male			Female			Total		
	Farm	Field	T value	Farm	Field	T value	Farm	Field	T value
1	72.93 ± 1.16	66.95 ± 1.39	3.375 **	66.72 ± 1.20	66.50 ± 0.65	0.180 NS	69.64 ± 1.04	66.70± 0.62	2.4642 *
6	94.18 ± 1.61	79.05 ± 2.09	5.898 **	82.53 ± 2.37	82.00 ± 1.05	0.211 NS	88.54 ± 1.76	80.86 ± 1.01	3.8407 **
12	116.00± 2.43	92.62 ± 2.90	6.525 **	99.92 ± 4.28	95.38 ± 1.43	1.041 NS	108.50 ± 2.59	94.73 ± 1.42	4.7265 **

NS - Non significant

* Significant at 5 per cent level

** Significant at 1 per cent level

Table 7. Average fortnightly length of calves in farm and field

Fort-night	Farm length (cm)			Field length (cm)		
	Male	Female	Total	Male	Female	Total
1.	61.62 ± 1.03	61.50 ± 0.70	61.55 ± 0.59	65.72 ± 1.51	64.89 ± 1.26	65.26 ± 0.94
2.	66.23 ± 1.44	63.44 ± 0.80	64.80 ± 0.84	67.59 ± 1.15	67.87 ± 1.10	67.74 ± 0.79
3.	69.57 ± 1.08	66.82 ± 0.77	68.27 ± 0.73	61.33 ± 1.23	71.48 ± 1.08	70.35 ± 0.81
4.	73.89 ± 1.09	71.00 ± 1.17	72.57 ± 0.85	71.60 ± 1.29	73.74 ± 1.01	72.82 ± 0.80
5.	77.84 ± 1.26	73.40 ± 1.36	75.88 ± 1.00	73.16 ± 1.39	74.77 ± 0.92	74.13 ± 0.78
6.	82.62 ± 1.62	75.93 ± 1.78	79.38 ± 1.31	74.47 ± 1.40	76.11 ± 0.96	75.55 ± 0.80
7.	86.12 ± 1.28	78.86 ± 1.99	82.61 ± 1.34	74.60 ± 1.26	77.66 ± 0.95	76.57 ± 0.78
8.	89.68 ± 1.33	81.13 ± 2.39	85.54 ± 1.53	76.07 ± 1.42	79.88 ± 1.18	78.12 ± 0.97
9.	92.00 ± 1.28	83.06 ± 2.50	87.67 ± 1.59	77.84 ± 1.62	80.59 ± 1.00	79.70 ± 0.95
10.	95.75 ± 1.29	85.46 ± 2.60	90.77 ± 1.70	80.10 ± 1.84	82.23 ± 1.11	81.63 ± 0.95
11.	99.68 ± 1.14	88.06 ± 2.71	94.06 ± 1.87	80.77 ± 1.02	83.65 ± 1.10	82.93 ± 0.98
12.	103.43 ± 1.68	91.00 ± 1.19	97.63 ± 2.03	82.75 ± 2.38	85.23 ± 3.14	84.64 ± 1.05

Table 8. Comparison of length of calves in the farms and field at 1st, 6th and 12th fortnights

Fort-night	Male			Female			Total		
	Farm	Field	T value	Farm	Field	T value	Farm	Field	T value
1	61.62 ± 1.03	65.72 ± 1.51	2.329 *	61.50 ± 0.70	65.25 ± 1.26	2.649 *	61.55 ± 0.59	65.46 ± 0.94	3.5511 **
6	82.62 ± 1.62	74.47 ± 1.40	3.930 **	75.93 ± 1.78	76.11 ± 0.96	0.099 NS	79.38 ± 1.31	75.55 ± 0.80	2.6469 **
12	103.43 ± 1.68	82.75 ± 2.38	7.3902 **	91.00 ± 1.19	85.23 ± 3.14	1.7761 NS	97.63 ± 2.03	84.64 ± 1.05	5.7740 **

NS - Non significant

* Significant at 5 per cent level

** Significant at 1 per cent level

4.5 Feeding of calves

4.5.1 Colostrum feeding

In the field, calves were invariably allowed suckling. The exact quantity of colostrum consumed by the calves could not be ascertained. However, since the cows were not milked or were only partially milked, the calves would have received adequate quantity of colostrum. The interval between birth and first feeding of colostrum varied from 15 minutes to 2.0 hours in the field.

Out of the two organised farms studied, at Dhoni farm, Palghat, a quantity of 2.0 to 2.5 kg of colostrum was fed per day depending on the weight of the calf for a period of one week. In the University Farm, Mannuthy a similar quantity of colostrum was fed for a period of 3 days only. In both the farms, colostrum was milked out and the specified quantity fed from the pail. The time of feeding in farms depended on the time of birth. In the case of birth taking place during the day-time when worker was available, colostrum was fed within half an hour. However, when births took place during the night, colostrum feeding was delayed until next day morning.

The time of colostrum feeding was correlated with daily weight gain upto three months (Fig.14a). Highest daily weight gain was seen when colostrum was consumed within 15 minutes.

4.5.2 Milk feeding

The schedules of milk feeding at Dhoni farm and ULF, Mannuthy are presented in Tables 9 and 10.

Table 9. Milk feeding schedule at Dhoni Farm

Period	Quantity of milk fed (kg/day)
7 - 45th day	4
45 - 90th day	3
90 - 105th day	2
105 - 120th day	1

Table 10. Milk feeding schedule at ULF, Mannuthy

Period	Quantity of milk fed (kg/day)
0 - 30th day	2.5
31 - 45th day	2.0
46 - 60th day	1.5
61 - 75th day	1.0
75 - 90th day	0.5

The sex-wise average daily milk consumption of crossbred calves in the field during the first, second and third month of life as well as the overall averages have been presented in Table 11.

Table 11. Milk consumed by crossbred calves in the field (kg/calf/day)

Period (month)	Male calves	Female calves	Overall average
1	1.81 ± 0.14	2.47 ± 0.14	2.13 ± 0.44
2.	0.91 ± 0.08	1.42 ± 0.08	1.20 ± 0.09
3.	0.31 ± 0.08	0.75 ± 0.05	0.59 ± 0.05

Correlation was worked out between milk produced by cow and milk consumed by the calf in the 1st, 2nd and 3rd months. In the case of females the correlation coefficients were 0.683**, 0.677** and 0.472* for the 1st, 2nd and 3rd month respectively while in case of males it was 0.614**, 0.428NS and 0.157NS.

Correlation analysis was also carried out between milk consumed in first month and weight at 2nd, 6th and 12th fortnights. In females, a highly significant correlation was observed between the milk consumed in the first month and weights at all three stages (0.669**, 0.587**, 0.700**). In

males the weights at 2nd and 6th fortnight did not show any significant correlation with milk consumed in the first month (0.292NS, 0.451NS) whereas the weight at 12th fortnight was highly correlated with it (0.857**).

4.5.3 Concentrate feeding

The concentrate feeding schedule of ULF, Mannuthy has been presented in Table 12.

In Dhoni farm concentrate and grass were fed ad libitum from 1st month onwards. Daily grazing for 3 hours in the morning was practised.

In the field, the feed consumed by male and female calves have been obtained by questioning the farmers and through direct observation. The information has been presented in Table 13.

Table 12. Quantity of concentrates fed to calves in the ULF, Mannuthy

Age	kg
Birth - 3.5 months	small quantity
3.5 - 4.5 months	0.75
4.5 - 6.0 months	1.00
Above 6 months	1.50

Table 13. Quantity of concentrates fed to calves in the field (kg)

Month	Male	Female	Average
1	0	0	0
2	0.127 ± 0.03	0.101 ± 0.02	0.110 ± 0.02
3	0.200 ± 0.05	0.300 ± 0.04	0.210 ± 0.04
4	0.280 ± 0.06	0.523 ± 0.04	0.310 ± 0.039
5	0.385 ± 0.09	0.800 ± 0.06	0.495 ± 0.05
6	0.500 ± 0.10	1.000 ± 0.08	0.740 ± 0.06

4.6 Housing

In the farms, individual boxes with concrete flooring and tiled/asbestos-cement roof and an attached common paddock were provided. The types of cattle sheds in the field have been classified and presented in Table 14. It was found that concrete floor with tiled roof was the most common type. Daily weight gain of calves kept in different types of houses have also been presented in Table 14 and Fig.15. Concrete floor with tiled roof resulted in the highest daily gain of calves.

Table 14. Frequency distribution of different types of cattle houses and the daily weight gain of calves under each

Type of housing	No. of units	Daily gain (kg)
A. Lean-to type		
1. Concrete floor & thatched	1	0.130
2. Kacha floor & thatched	3	0.170
3. Concrete floor & tiled	8	0.195
4. Kacha floor & tiled	1	0.250
B. Separate shed		
1. Concrete floor & thatched	11	0.175
2. Kacha floor & thatched	8	0.175
3. Concrete floor & tiled	18	0.216
4. Kacha floor & tiled	--	--

4.7 Management practices

Certain management practices followed in the field and farms were observed. In the two farms under study, monthlY deworming upto the age of 12 months was done as a routine.

In the Mavelikara area where the study was conducted in the field, all the farmers included in this investigation dewormed their calves in the first month. In the second month 89 per cent of female and 68 per cent of male calves were dewormed. In the third month 81 per cent of female and 68 per cent of male calves received deworming treatment. In the fourth month while 12 per cent females were dewormed no male calves were administered with deworming drugs (Table 15).

Vaccination for Foot and Mouth disease was carried out in the farms when the calves were about six months old. No vaccinations were given to the calves in the field. There were no out-breaks during the period of study.

Hygiene was fair in both the farms, where daily grooming was also practised. In the field, in majority (54 per cent) of farmer households, the hygiene in cow/calf sheds was fair while it was poor in 8 per cent and good in 38 per cent farms. Daily grooming was followed in the case of 84 per cent calves in the field. The correlation between hygiene and

grooming with daily weight gain of calves in the field were studied and the results are presented in Table 16 and Fig.16.

Daily gain of calves increased with the increase in hygienic conditions. The daily gain in calves was significantly higher in farms with 'good' hygiene compared to poor hygiene; the farms with fair hygiene falling in between. Similarly, calves which were groomed daily had significantly higher daily gain (0.198 kg) compared to those which were groomed weekly (0.146 kg).

In the farms, experienced labourers looked after the animals while in the field family labour was involved. Sixty seven per cent of persons looking after the animals in the field were women. Daily gain of calves was not significantly affected by the sex of the calf-tender. However, there was a trend indicating that the calves had higher weight gains when men looked after them (Fig.17a and Table 17).

Dairy awareness of owners of calves was assessed on the basis of a questionnaire (provided in the annexure). Only 2 per cent had a dairy awareness of 80 per cent and above. Four per cent had 70 per cent awareness 10 per cent had 60 per cent, 48 per cent had 50 per cent 24 per cent had 40 per cent and 4 per cent had 30 per cent awareness on dairy farming.

Majority had a dairy awareness of 40 to 60 per cent.

Association between daily weight gain of calves upto 3 months and dairy awareness was studied. The results are presented in Table 18. The daily gain in calves tended to increase with increase in dairy awareness of owners. A highly significant difference was obtained between 40 per cent and 60 per cent dairy awareness (T = 2.118*) and 50 per cent and 60 per cent dairy awareness with respect to weight gain of calves.

Educational status of farmers also was recorded (Table 19) and correlated with daily gain of calves.

The calves of high school educated farmers had an average daily weight gain of 201 g compared to 108 g for lower primary, 177 g for upper primary and 173 g for college educated farmers' calves. Eventhough the differences were not significant, the trend appeared to show that the calves of farmers educated upto high school level fared better.

The influence of occupation of farmers on growth rate of calves was studied and the results have been presented in Table 20.

The calves were classified on the basis of size of the land-holding on which they were raised and the daily gain studied (Table 21). Calves in larger units appeared to have better daily gain. Order of calving did not seem to have much effect on the growth rate of the calves (Table 22).

Table 15. Deworming of calves in field area

Months	1	2	3	4	5	6
Male (%)	100	68	68	0	0	0
Female (%)	100	89	81	12	0	0

Table 16. Hygiene and grooming in field units

Grade	Number	%	Daily weight gain (kg)
Hygiene in sheds			
Poor	4	8	0.139
Fair	27	54	0.176
Good	19	38	0.208
Grooming			
Daily	42	84	0.198
Weekly	8	16	0.146
Occasionally	--	--	--

Table 17. Gender of the person looking after the animals and daily gain of calves

Gender of the person	Male	Female
Number	12	38
Percentage	24	76
Daily gain (kg)	0.228	0.191

Table 18. Dairy awareness among calf tenders

	Percentage of awareness								
	10	20	30	40	50	60	70	80	90
Frequency			2	12	24	9	2	1	
Percentage			4	24	48	18	4	2	
Daily weight gain (kg)			0.130	0.150	0.187	0.221	0.261	0.207	

Table 19. Educational status of farmer and daily weight gain of calves

	Lower Primary School	U.P School	High School	College
Number	4	16	24	6
%	8	32	48	12
Daily weight gain (kg/day)	0.108	0.177	0.201	0.173

Table 20. Occupational status of farmer and daily weight gain of calves

Sl. No.	Occupation	No.	%	Daily weight gain (kg)
1.	Govt. employment	10	20	0.213
2.	Private employment	5	10	0.186
3.	Self employment	11	22	0.185
4.	Agricultural and allied activities	11	22	0.187
5.	Agricultural and other labourer	13	26	0.153

Table 21. Land holdings of farmers and daily weight gain of calves

Land holding	No.	%	Daily weight gain (kg)
<10 cents	4	8	0.180
10 cent-1 Acre	33	66	0.178
1-2 Acre	8	16	0.211
>2 Acre	5	10	0.223
	56		

Table 22. Parity of dam and weight gain of calves

Calving No.	No. of dams	%	Daily weight gain (kg)
1.	17	34	0.189
2.	10	20	0.186
3.	9	18	0.169
4.	5	8	0.200
5.	5	8	0.200
6.	4	2	0.152
7.	-	-	-

Table 24. Mortality in calves as imfluenced by colostrum feeding time in relation to birth

	No colostrum	Within 15 mts	Between 16-30 mts	Between 31 min to 1 hour	Between 1-2 hour
Born	3	12	16	11	8
Died	2	0	1	2	2
%	66.66	0	6.25	18.18	25

Table 25. Sex-wise mortality rate among calves in field

Particulars	Sex of the calves		
	Males	Females	Overall
Number born	22	28	50
Number died	6	1	7
Mortality % (birth to 6 months age)	27.27	3.57	14.00

Parity: When the mortality of calves was classified according to parity of their dams, higher rate was observed in calves born to first calvers (29.41%). The results are given in Table 26.

Mortality of different age groups of calves has been presented in Table 27. In the field mortality was higher in the 1st and 5th months.

Housing influenced mortality rate in calves (Table 28). Houses, where floor was of concrete and roof was either concrete or tiled had maximum mortality (16.66% in separate housing and 25% in lean-to type housing). Minimum rate of mortality was observed in concrete floored thatch-roofed sheds.

Mortality among calves born in the field was classified according to the sex of the caretaker and presented in Table 29. Eventhough a higher percentage of caretakers were women (76%) the calf mortality seemed to be higher in the group of animals looked after by them (15.78%) than by men (8.33%).

Influence of educational status and occupation of the farmer on mortality rate among calves was observed and presented in Tables 30 and 31 respectively.

Table 26. Mortality of calves influenced by calving number

Particulars	Order of calving						
	1	2	3	4	5	6	7
Born	17	10	9	5	5	4	-
Died	5	-	1	1	-	-	-
%	29.41	0	11.11	25	0	0	-

Table 27. Mortality of calves during different months of age

Area		Total calves born	Died during different ages (months)					
			1	2	3	4	5	6
Farm	No.	37	-	1	1	-	-	1
	Percentage		0	33.33	33.33	-	-	33.33
Field	No.	50	2	1	1	1	2	-
	Percentage		28.50	14.30	14.30	14.30	28.50	

Table 28. Effect of type of housing on mortality in field

Type of house	No. of calves born during the study period	No. of calves died during the study period	Mortality rate (%)
1. Separate	37	5	13.51
a. Concrete floor & thatched	11	1	9.09
b. Kacha floor & thatched	8	1	12.50
c. Concrete floor & tiled/ concrete roofed	18	3	16.66
d. Kacha floor & tiled/ concrete roofed	-	-	-
2. Lean to house	13	2	15.38
a. Concrete floor & thatched	3	0	0
b. Kacha floor & thatched	1	0	0
c. Concrete floor & tiled/ concrete roofed	8	2	25
d. Kacha floor & tiled/ concrete roofed	1	0	0

Table 29. Influence of the gender of the caretaker on calf mortality

Gender of the caretaker	Calves		
	Born	Died	Mortality %
Men (24%)	12	1	8.33
Women (76%)	38	6	15.78

Table 30. Mortality rate in calves according to educational level of owners

	LP school	UP school	High school	College
Born	4	16	24	6
Died	-	4	3	-
%	-	25	12.5	-

Based on the questionnaire dairy awareness was estimated and equated to the mortality rate. The results of the same have been presented in Table 32.

Table 33 gives the relation of hygiene and mortality rate. Poor hygiene resulted in the highest rate of mortality (50%) and it decreased when hygiene improved.

The observations with respect to the influence of frequency of grooming on mortality rate have been presented in Table 34. There was only 11.9 per cent mortality in calves groomed daily compared to 25 per cent in calves groomed once a week.

The field studies revealed that several animals were being disposed off by the farmer. The disposal pattern for male and females in the field area by the farmers are depicted in Table 35.

The population trend in the field was examined and the results have been presented in Table 36. Under field conditions, the number of male calves went down to 36.36 per cent and that of female calves to 92.85 per cent at the end of the study period of 6 months. The overall decrease in the number of experimental calves was 32 per cent during the period.

Table 31. Mortality in calves as related to the occupation of the owners

	Govt. employed	Private employed	Self employed	Agri. & allied activities	Labourers
Born	10	5	11	11	13
Died	1	0	3	2	1
%	10	0	27.27	18.18	7.69

Table 32. Mortality rate in calves related to dairy awareness in owners

	Awareness (%)						
	20	30	40	50	60	70	80
Born	-	2	12	24	9	2	1
Died	-	0	3	4	-	-	-
Mortality	-	0	25	16.66	0	0	0

Table 33. Effect of hygiene on mortality of calves

	Poor	Medium	Good
Born	4	27	19
Died	2	3	2
%	50	11.11	10.5

Table 34. Effect of grooming on mortality of calves

	Daily	Weekly	Occasionally
Born	42	8	-
Died	5	2	-
%	11.90	25	-

Table 35. Disposal of calves in field

	1 month	2 month	3 month	4 month	5 month	6 month
Male	1	1	2	2	2	-
Female	-	-	-	-	1	-

Table 36. Population trends in the farms and field during the experimental period

	Fortnights											
	1	2	3	4	5	6	7	8	9	10	11	12
Number of males	22	22	21	20	18	17	15	13	13	9	9	8
Percentage	100	100	95.34	90.8	81.72	77.18	68.1	59.02	59.02	40.56	40.86	36.36
Number of females	28	27	27	27	27	27	27	27	27	26	26	26
Percentage	100	96.42	96.42	96.42	96.42	96.42	96.42	96.42	96.42	92.85	92.85	92.85
Total number	50	49	48	47	45	44	42	40	40	35	35	34
Percentage	100	98	96	94	90	88	84	80	80	70	70	68

Discussion

DISCUSSION

5.1 Meteorological data

The climatic conditions at the two organised farms were quite similar. Rainfall, maximum and minimum temperature, relative humidity and hours of bright sunshine were the parameters studied. The hours of bright sunshine and relative humidity were generally more at Mavelikara (field) compared to the ULF at Mannuthy while Dhoni had similar conditions. The thermal comfort zone for most of the cross bred cattle has been stated to be around 65.75°F (19°C) (Banerjee, 1982). Growing cattle generally can tolerate higher effective temperature compared to lactating cows (Bianca, 1965). However, it is reasonable to presume that the calves were under some degree of thermal stress in all the locations where the present study was conducted.

5.2 Birth weight and body weight at different intervals

The birth weight of the male calves in the farms was 27.46 $\pm$ 2.04 kg. The estimated birth weight of male calves in the field was 25.39 $\pm$ 1.14 kg. The females in the farm had a birth weight of 23.94 $\pm$ 4.60 kg. The estimated birth weight of female calves in field was 24.61 $\pm$ 0.73 kg. Chacko (1994) observed slightly higher birth weight in male (30.4 kg) and

female (28.3 kg) calves of the Sunandini breed. According to Mudgal et al. (1966) the average birth weight of male calves in Indian breeds of cattle was 21.14 ± 2.16 and that of female calves was 20.07 ± 2.19 kg. Narayanaswamy et al. (1984) reported that the average birth weight ranged from 23.74 - 25.69 kg in Friesian x Sahiwal crosses. Danbaro et al. (1991) reported that the average birth weight of the progenies of three West African breeds crossed with either Jersey or Friesian to be 22.2, 24.0 and 22.0 kg respectively. Singh et al. (1986) reported the mean birth weight to be 24.19 ± 0.25 kg in 267 Jersey x Gir F_2 calves. According to Srivastava et al. (1980) the average birth weight was 28.23, 24.54, 29.74 and 24.82 kg for HF x BS x Hariana, HF x J x Hariana, BS x HF x Hariana and J x HF x Hariana crossbred calves respectively. Taneja and Bhat (1971) recorded an average body weight of 20.91 ± 0.16 at birth. Kassa-mersha et al. (1986) analysed the body weight of 4021 Boran cattle and found that the birth weight averaged 23.5 ± 2.5 kg.

Ribeiro et al. (1988) found the birth weight of calves to American Angus-Devon, Charolais-Devon and Tabapua-Devon dams to be averaging at 27.5, 29.7 and 28.4 kg respectively.

It can be seen from the foregoing that calves in the present study in the farms as well as in the field generally

had birth weights similar to those reported for crossbred calves from various stations.

It was observed that the body weights of male calves in the farms were significantly higher at the first, sixth and twelfth fortnights. The females also showed similar trend but the differences were significant only in the 12th fortnight. There was significant difference in the pooled weights of male and female calves both in farms and field.

Kohli et al. (1962) in 145 Hariana calves, Mudgal et al. (1968) in Indian breeds of cattle and Sharma (1969) in crossbred calves found that male calves had a higher mean birth weight than female calves which is in agreement with the finding of the present study under farm conditions. Under field conditions it was estimated that the females had a higher birth weight than the male calves though the differences were not significant. This is in agreement with the finding of Ribeiro et al. (1988) in crossbred calves.

The male calves in the farm averaged 27.46 $\pm$ 2.0 kg at birth and grew to 131.62 $\pm$ 5.23 kg at 12th fortnight, while in the field, male calves grew from 25.39 $\pm$ 1.14 kg at birth to 72.93 $\pm$ 4.50 kg at 12th fortnight. The daily gains of male calves in the farms and field were 0.623 kg and 0.166 kg respectively

The female calves in the farm averaged 23.94 ± 4.6 at birth and grew to 90.35 ± 11.47 kg at 12th fortnight, while in the field grew from 24.61 ± 0.73 at birth to 74.69 ± 3.20 kg at 12th fortnight. The daily gain of female calves in the farms was 0.467 kg compared to 0.171 kg in the field.

The corresponding live weights of calves in the farms and field were tested in the 1st, 6th and 12th fortnights. The body weight of male calves in the farms were significantly higher at the three ages. The females also showed a similar trend but differences were significant only in the 12th fortnight. When males and females were put together and tested the differences were found to be significant at 5 per cent level in 1st fortnight and at 1 per cent level in 6th and 12th fortngihts.

The results clearly indicate that the calves in the farms had a significantly higher gain in weight to record higher cumulative weights at different stages tested. The difference was more evident in the cases of male calves. This may be due to the fact that male calves are neglected in the field due to lower economic value while male calves in the Dhoni Farm were given special attention and higher plane of feeding being a bull-mother farm.

Chacko (1994) in an overall assessment of the

Sunandini breed observed that the male calves attained a cumulative live weight of 104.5 kg compared to 98.5 kg in females at the age of 6 months. In the present study the weight attained by male calves in the farms was considerably higher while that of female calves slightly lower. The performance of field calves was definitely inferior in comparison.

Fortnightly weight gain ranged from 5.51 kg to 9.6 kg in farms, compared to 1.43 to 3.42 kg in the field. In the farms the highest fortnightly gains were obtained during the period from 6th to 11th fortnights. On the contrary, in the field, the highest fortnightly gains were seen in the first 6 fortnights. This shows that the higher rate of growth achievable during the interval from 6th to 11th fortnights (as demonstrated by the performance of calves in the farms) have not been realised in the field probably due to poor feeding and management. This points to the necessity for better feeding and managemental measures from 6th to 11th fortnight in the field.

Daily gain for each fortnight showed similar trend. The maximum daily gain in the farm was 640 g in the 9th fortnight while in the field maximum gain of 228 g was in the 2nd fortnight when sufficient milk was being fed.

Kohli et al. (1962) reported an increase in 100 per cent over birth weight in three months and 150 per cent in six months irrespective of sex of calves. In farms studied, results obtained were in accordance to the above criteria, but in the field it was below the expected levels.

Many workers have reported that maximum weight gain in crossbred calves is seen during the first six months of life (Taneja and Bhat, 1970; Agrawal and Tomar, 1972; Chawla and Mishra, 1981; Narasimha, 1983 and Narayana Swamy et al., 1984).

Narayanaswamy et al. (1984) also reported the increase in live weight of cross-bred calves from birth to six months to be from 23.74-25.69 kg to 126.09-127.68 kg. In the present study, male calves in the farms alone had similar gains. Chawla and Mishra (1981) have observed that heifers with higher growth rate had lower age at first calving.

Ghosh et al. (1979) reported that phenotypic correlations and regressions between live weights at different ages were positive and highly significant. This holds good in the current study also.

Mudgal and Ray (1966) observed that the coefficient of regression of weight gain from birth to six months per fortnight was 6.43 $\pm$ 1.48 kg in male and 5.17 $\pm$ 1.20 in

females. Male calves gained at higher rate than female calves.

The daily gains of calves reported by various worker have been tabulated below:

Daily gain (kg/day)	Age	Author (year)
0.458	0-19th week	Taneja and Bhat (1971)
0.526	19-20th week	Taneja and Bhat (1971)
0.621-0.689	12-26th week	Bhat et al. (1980)
0.460-0.500	12th week	Kulkarni et al. (1982)
0.440-0.470	24th week	Kulkarni et al. (1982)
0.539-0.671	0-30 week	Ribeiro et al. (1988)
0.376 ± 0.009	0-16 week	Dhanger and Patel (1990)
0.517 ± 0.016	16-24 week	Dhanger and Patel (1990)
0.450-0.512	0-weaning	Danbaro et al. (1991)

The male and female calves in the two farms studied had comparable daily gains. Plate 4 shows a good female calf (6 months) of age in Dhoni farm. But the calves in the field had daily gains far below the reported values. In the field, female calves performed slightly better (171 g) compared to male calves (166 g). The results indicate that there is a great scope for improvement in the growth of cross-bred calves in the field through better feeding and management.

FIG.1 WEATHER CHART FOR THE EXPERIMENTAL PERIOD U.L.F MANNUTHY

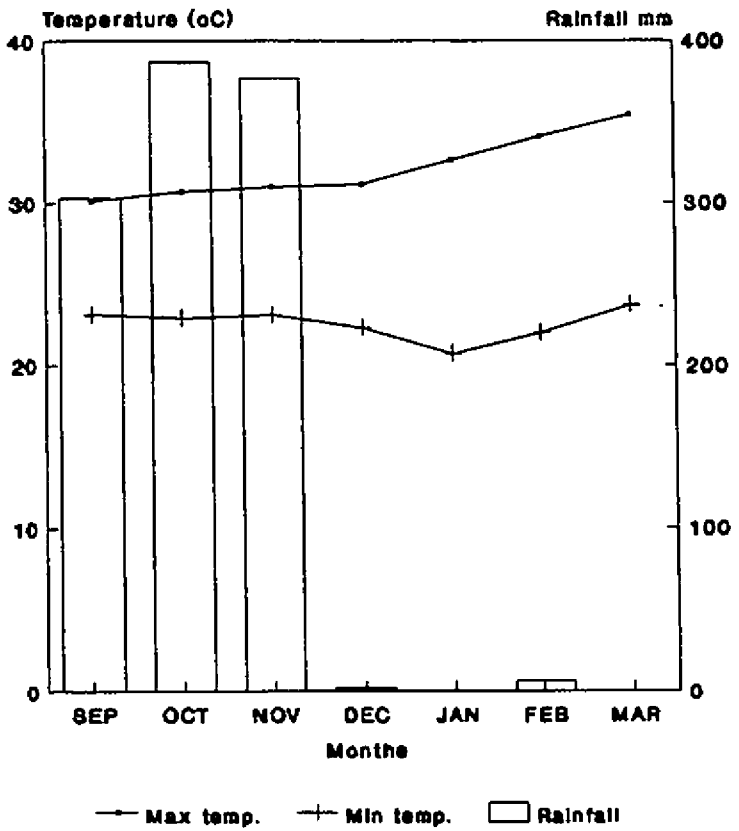


FIG.2 WEATHER DATA FOR THE EXPERIMENTAL PERIOD - DHONI FARM PALAKKAD

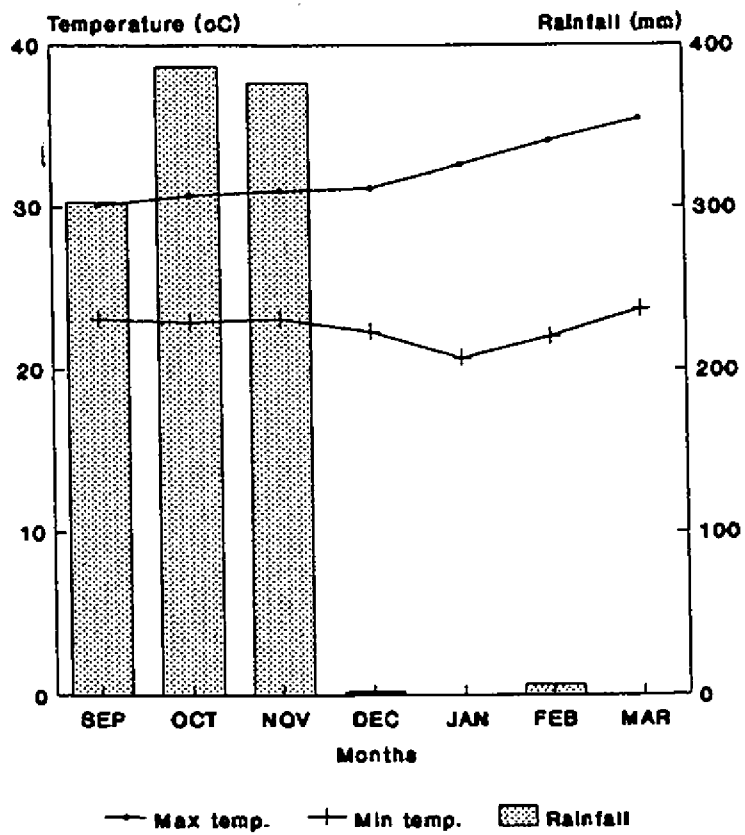


FIG.3 WEATHER CHART FOR THE EXPERIMENTAL PERIOD IN THE FIELD

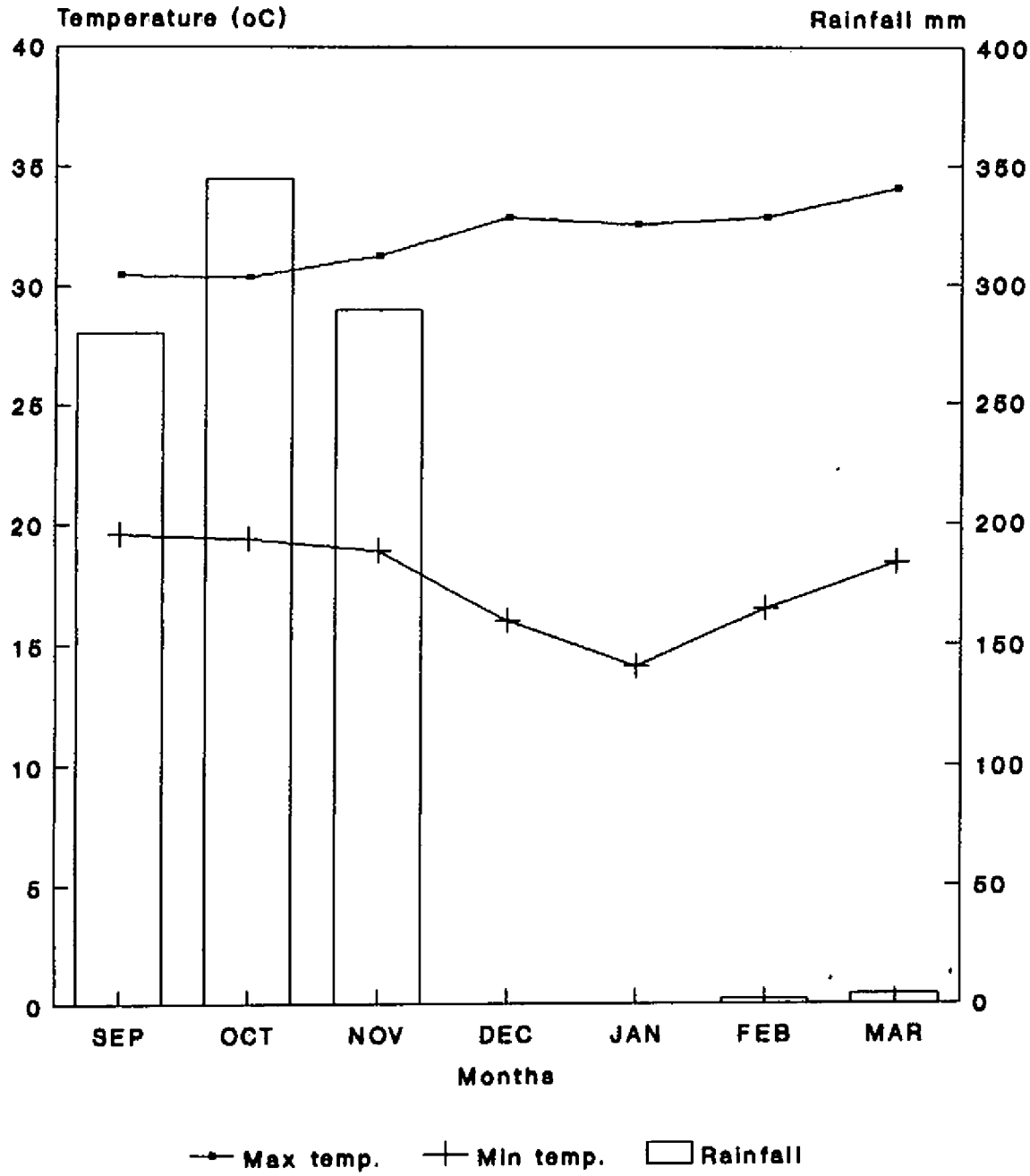


FIG.4 HOURS OF BRIGHT SUNSHINE FOR THE EXPERIMENTAL PERIOD

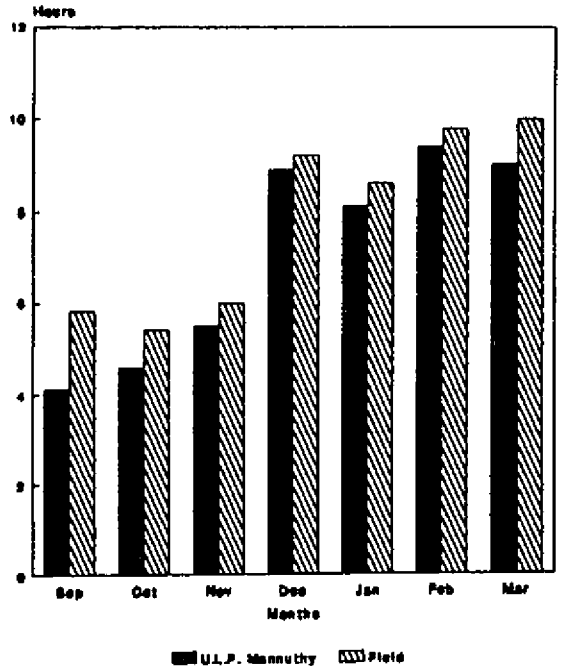


FIG.5 COMPARISON OF RELATIVE HUMIDITY AT THE THREE SITES

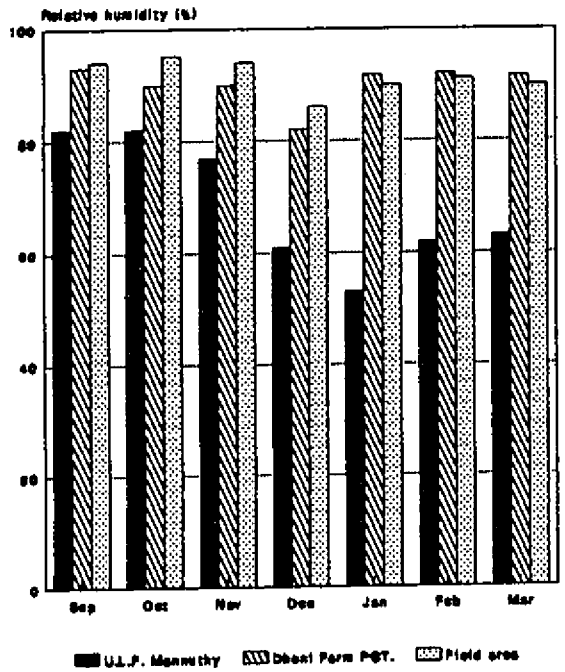


FIG.6 COMPARISON OF BODY WEIGHTS(Kg) IN FARMS AND FIELD

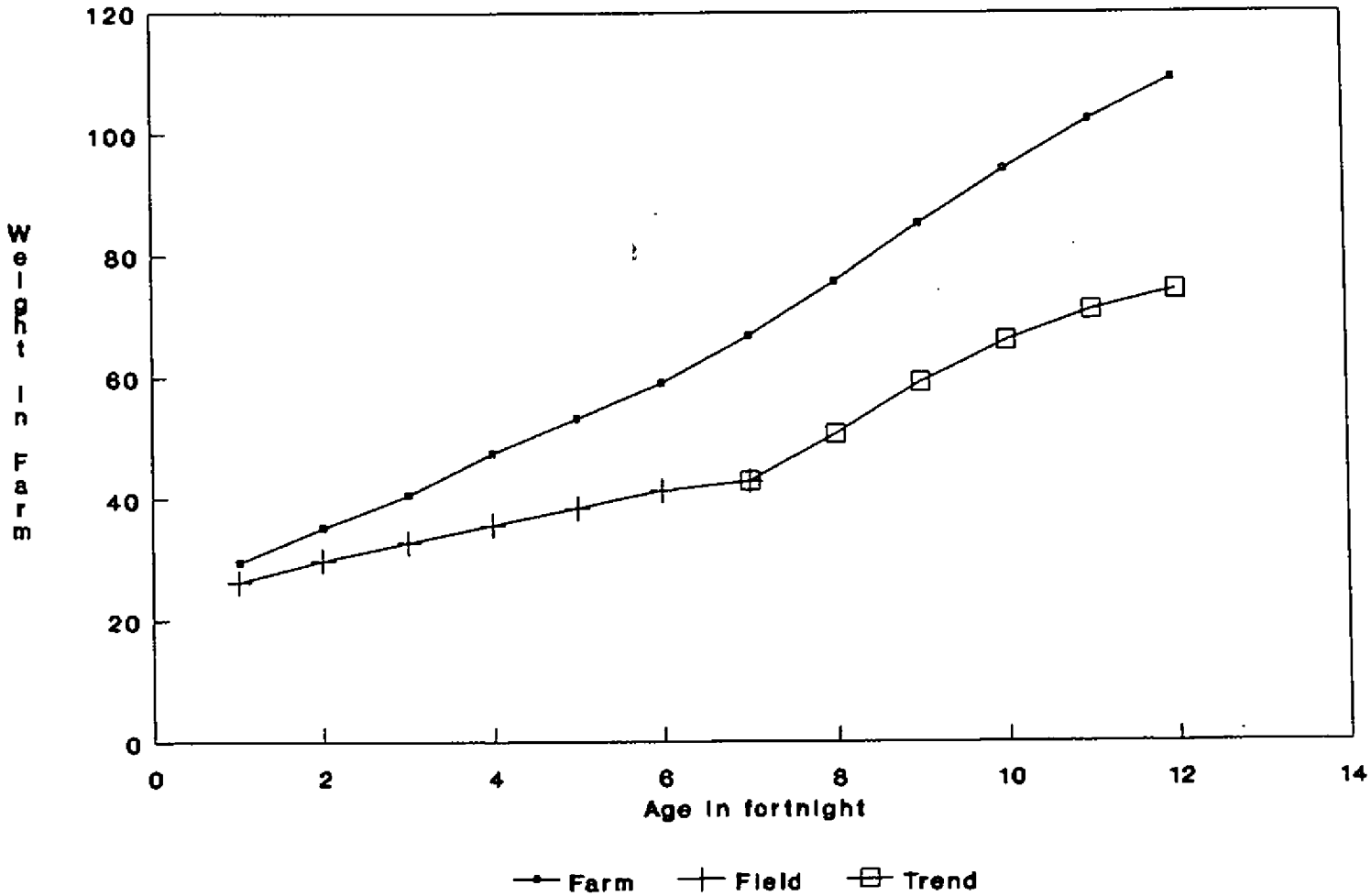


FIG.7 TRENDS OF BODY WEIGHTS(Kg) IN FARMS AND FIELD

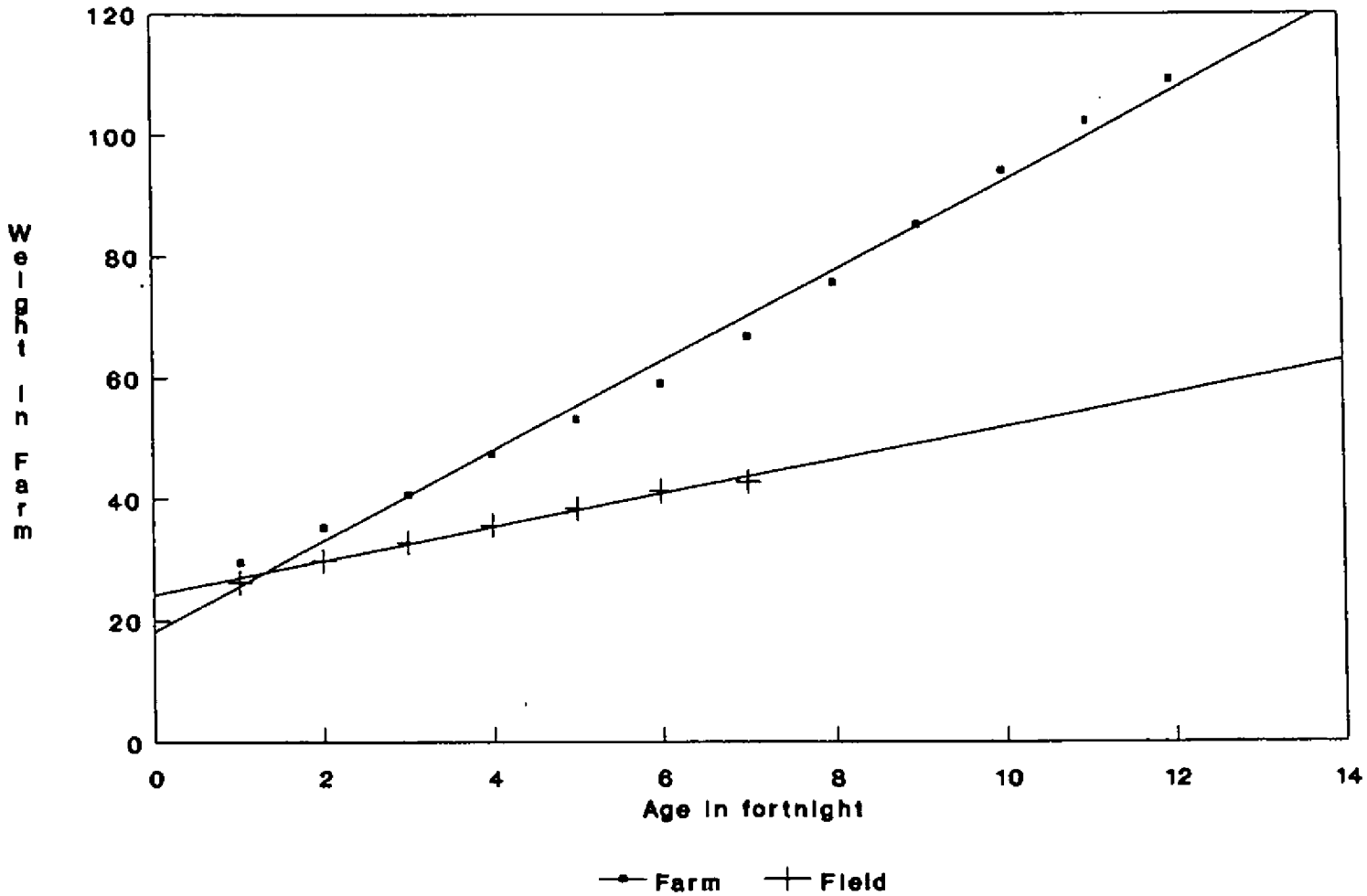
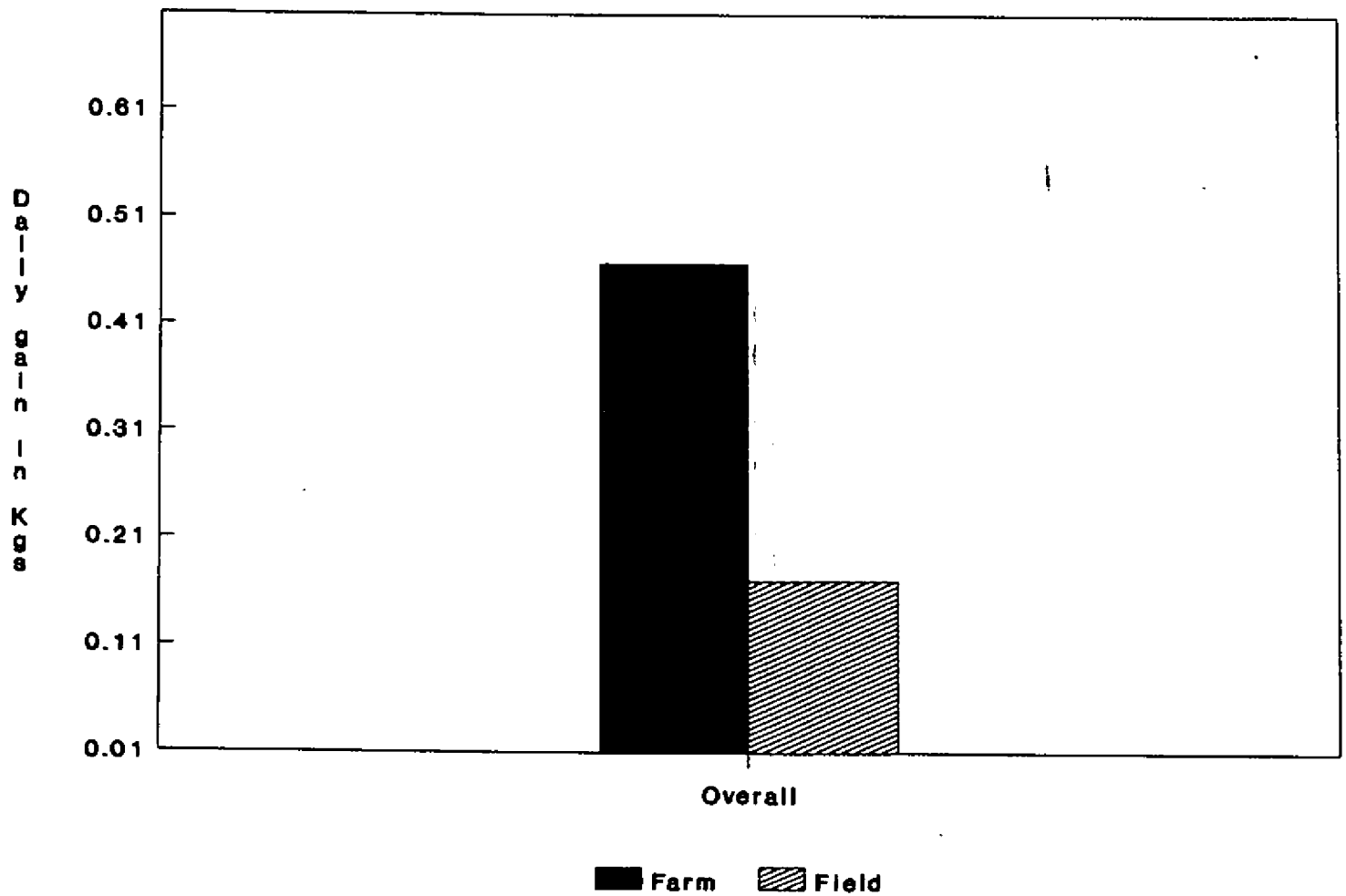


FIG.8 COMPARISON OF AVERAGE DAILY GAIN(Kg) IN FARMS AND FIELDS



5.3 Body measurements

5.3.1 Height at withers

The male calves in the farms averaged 69.18 cm in height in the first fortnight and 98.31 cm in the 12th fortnight. The corresponding figures for male calves in the field were 67.45 $\pm$ 1.14 cm and 84.12 $\pm$ 1.73 cm. In the farms, the female calves had a height of 67.61 $\pm$ 0.63 cm in the first fortnight which increased to 88.07 $\pm$ 2.32 cm in the 12th fortnight. Female calves in the field starting from a height of 67.62 $\pm$ 2.80 cm grew to 84.30 $\pm$ 1.04 cm in the 12th fortnight. The overall height in the first and 12th fortnights were 68.35 $\pm$ 0.52 and 93.53 $\pm$ 1.57 cm in the farms compared to 67.55 $\pm$ 0.69 and 84.26 $\pm$ 0.95 cm respectively in the field. In the male calves, the differences in height between the farms and field were not significant in the first fortnight but was significantly higher in the farms in the sixth and 12th fortnights ($P < 0.01$). There were no significant differences in height of female calves in the farms and field in all the three fortnights tested. Overall, there was no significant difference in the height between calves raised in the farms and field in the first fortnight, however it was significantly higher in farm raised calves during the sixth and 12th fortnights ($P < 0.01$).

The mean height at birth of 267 Jersey x Gir F_2 calves

was reported to be 67.24 ± 0.25 cm by Singh et al. (1986). According to Srivastava et al. (1986) the average height at withers were 68.61, 68.35, 69.06 and 66.14 cm in HF x BS x Hariana, HF x J x Hariana, BS x HF x Hariana and J x HF x Hariana respectively. According to Reddy et al. (1991) the height at withers of cross bred calves under field conditions was 71.4 cm during the first month of age. It can be concluded that the height at withers of the calves in the first fortnight in the farms and field were similar and comparable to reports from other stations.

The comparisons done at 6th and 12th fortnights indicated that the male calves in the farms grew in height at a significantly ($P < 0.01$) faster rate than their counterparts in the field. At these ages, there were no significant differences between the heights of farm-raised and field-raised female calves eventhough the numerical values were higher for female calves in the farms.

The growth performance with respect to height by female calves in the field was comparable to that in the two organised farms. On the contrary, the male calves in the field were significantly inferior to farm raised calves with respect to gain in height. Two main reasons can be attributed for this. Farmers in the field have greater economic value for the female calf, the heifer being the future cow, and

might be giving preferential treatment in terms of feeding and management to the female calves. Similarly, all the farm raised male calves were from Dhoni Farm where male calves are fed at a very high plane to achieve fast growth rate. The female farm-raised calves were from KAU farm where calves were maintained and fed at average plane.

5.3.2 Heart girth

In the male calves, the girth averaged 72.93 ± 1.16 cm in farms compared to 66.95 ± 1.39 cm in the field in the first fortnight. In the sixth fortnight males on farms had a girth of 94.18 ± 1.61 cm compared to 79.05 ± 2.09 cm in the field. The corresponding figures in the 12th fortnight were 116.0 ± 2.43 cm and 92.62 ± 2.90 cm. T- test revealed significant differences in all the three cases. In the case of females, the farm and field bred calves had similar girth in the three fortnights tested. The overall girths in the farm bred calves were 69.67 ± 1.04, 88.54 ± 1.76 and 108.50 ± 2.59 cm in the first, sixth and 12th fortnights. The field raised calves had corresponding figures of 66.70 ± 0.62, 80.86 ± 1.01 and 94.73 ± 1.42 cm in the first, sixth and 12th fortnights. In all the three cases the differences were significant ($P < 0.01$). According to Singh *et al*. (1986), the mean heart girth at birth was 67.55 ± 0.24 in 267 Jersey x Gir F_2 calves. The average chest girth was reported to be 79.5 cm during the

first month of age in crossbred calves under field conditions (Reddy et al., 1991). The heart girths of experimental calves in the study in the neonatal stage are similar to those reported from elsewhere in the country. The growth in heart girth behaved similar to that of height. While the male calves in the farms grew at a significantly faster rate than their counter-parts in the field, the female calves in the farm and field had similar heart girths at the three ages tested. The reasons for the differences between the two sexes appear to be similar to those in the case of body weight and height.

5.3.3 Length

The male calves in the farm had a length of 61.62 ± 1.03 cm and 103.43 ± 1.68 cm in the first and 12th fortnights respectively. In the field, eventhough, the males had a slightly higher average of 65.72 ± 1.51 cm in the first fortnight, their average length in the 12th fortnight was lower than those in the farms (82.75 ± 2.38 cm). Females in the farm had an average length of 61.50 ± 0.70 and 91.00 ± 1.19 cm in the first and 12th fortnight respectively. On the other hand the females in the field had a length of 65.25 ± 1.26 and 85.23 ± 3.14 cm in the first and 12th fortnights. In the first fortnight, the male calves in the farms measured

significantly lower than male calves in the field. However, there was a faster increase in the length of the male calves in the farms to measure significantly more in length at sixth and 12th fortnights. On the other hand there were no significant differences in the length of female calves from the farm and field during the three time intervals tested. The overall values showed a result similar to that in males. The calves in the farms started with a lower length, they overtook the calves in the field by the sixth fortnight to measure significantly longer and the difference increased by the 12th fortnight.

Singh et al. (1986) reported that the mean body length at birth was 59.27 $\pm$ 0.66 cm in 267 Jersey x Gir F_2 calves. According to Srivastava et al. (1986) the average body length at birth were 69.73, 68.42, 70.80 and 65.83 cm in HF x BS x Hariana, HF x J x Hariana, BS x HF x Hariana and J x HF x Hariana respectively. Reddy et al. (1991) recorded a body length of 68.8 cm during the first month of age in crossbred calves under field conditions. The length in the 1st fortnight of experimental calves is comparable to the values reported from other stations. The trends observed are similar to those for live weight and body measurements.

5.3.4 Growth

Live weight and the body measurements of height, girth and length behaved similarly in the case of experimental calves indicating that the differences observed were real differences in the growth rate.

On overall basis, the calves in the farms had similar or only slightly different body weight and dimensions in the first fortnight as compared to calves in the field. However, they grew faster to weigh and measure significantly more than the field calves at 6th and 12th fortnights. This clearly demonstrate that there is a great scope for enhancing growth rate of calves in the field. Presently they are growing at a rate far below their genetic potential and by better feeding and management higher growth rate can be achieved especially for females to get more returns.

The differences between field and farm was evident to a greater degree in the case of male calves. This was mainly because the farmers were obviously neglecting the male calves and the male calves in the Dhoni Farm were receiving a high plane of nutrition to elicit faster growth, they being future breeding bulls.

FIG.9 COMPARISON OF WITHER HEIGHTS(Cms) IN FARMS AND FIELD

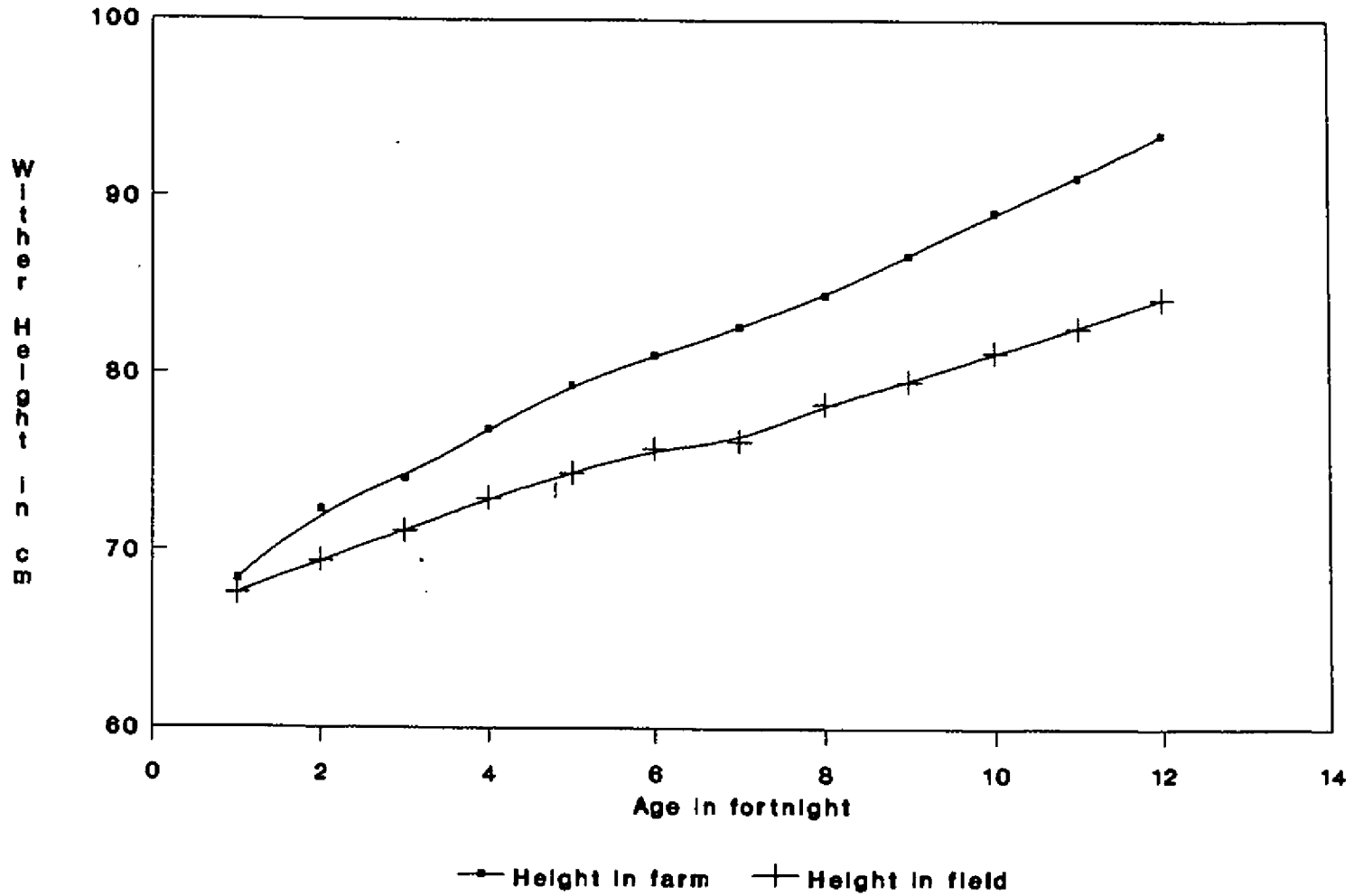


FIG.10 COMPARISON OF HEART GIRTH(Cms) IN FARMS AND FIELD

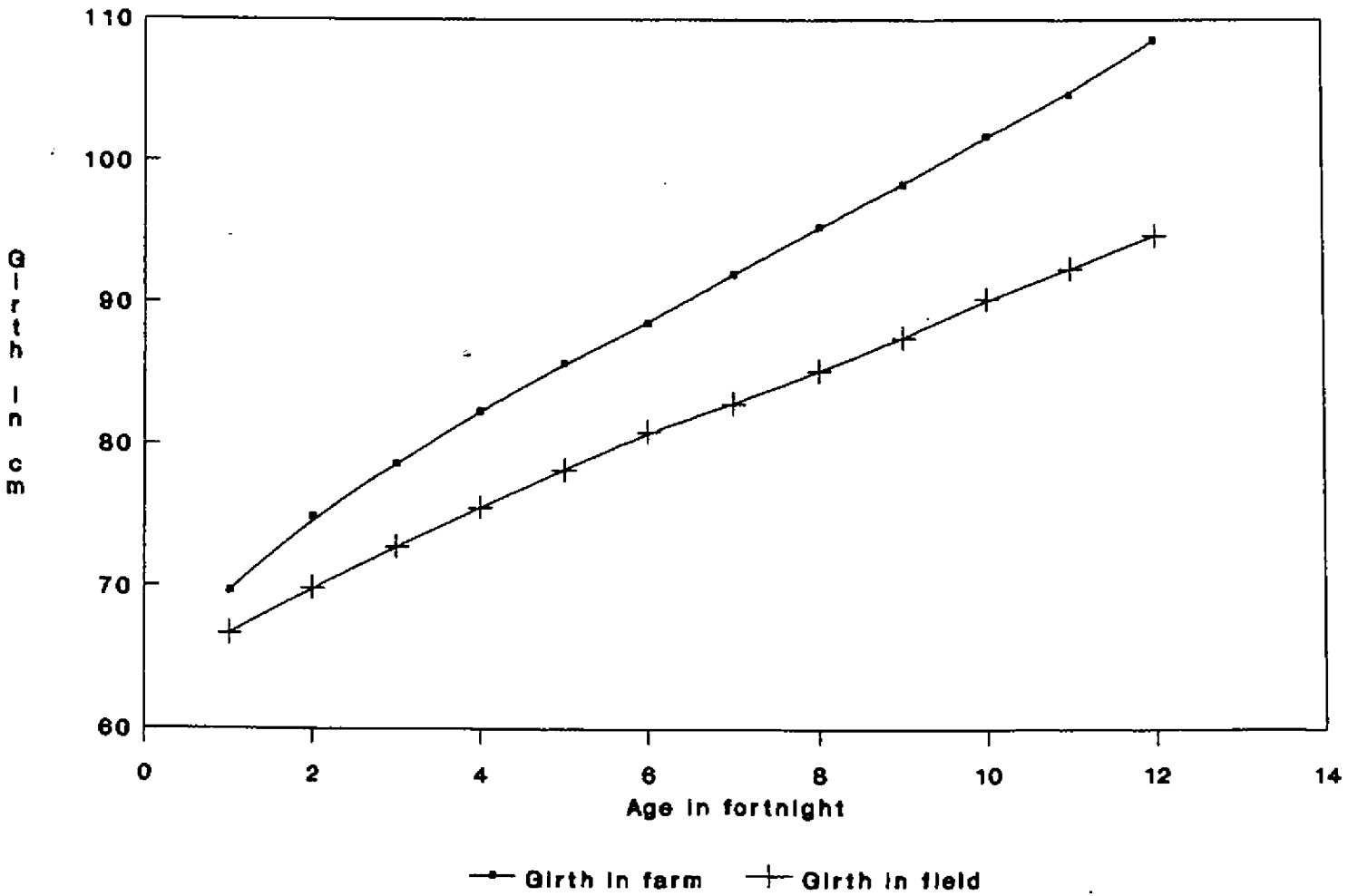


FIG.11 COMPARISON OF LENGTH(Cms) IN FARMS AND FIELD

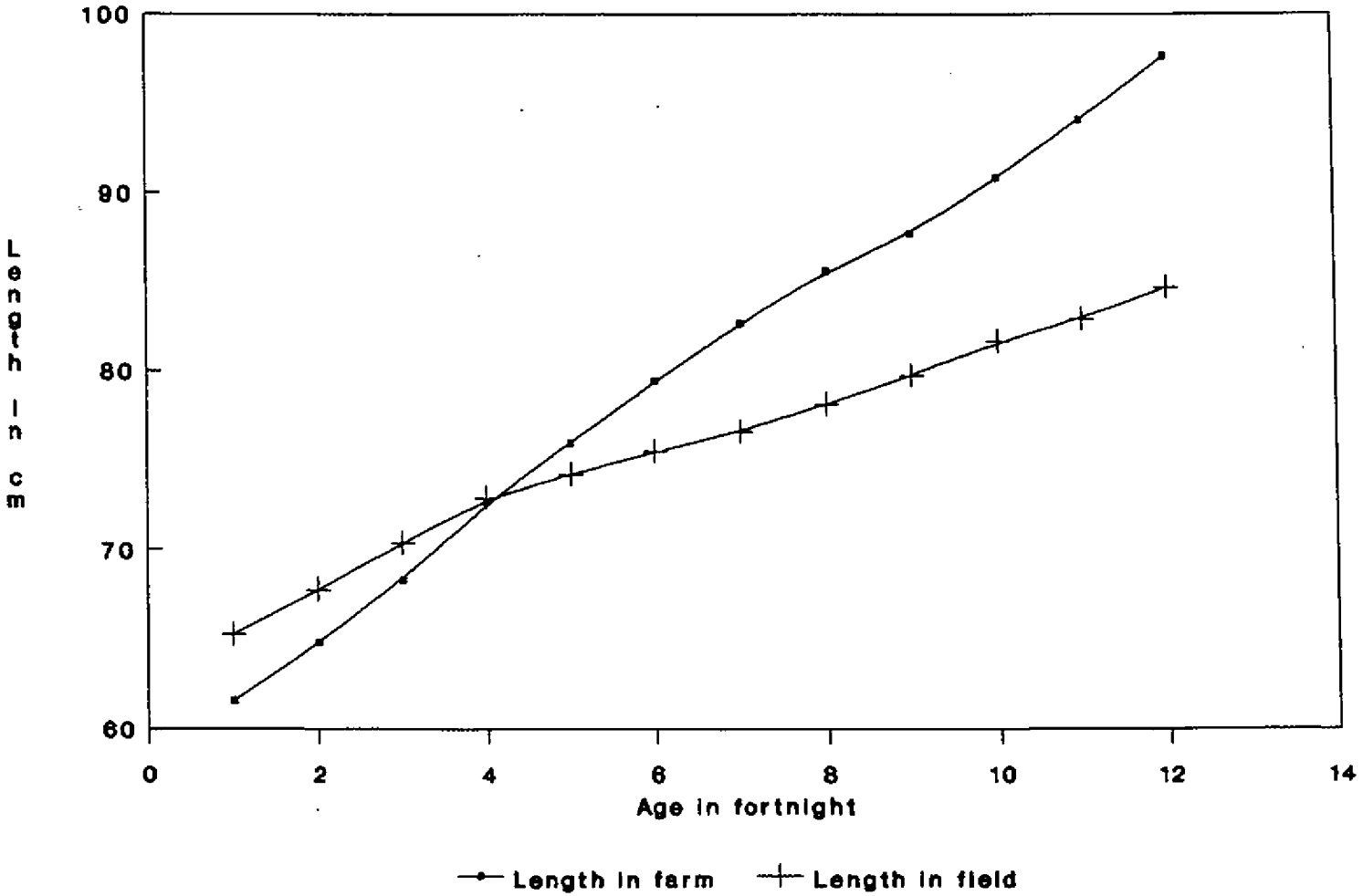


FIG.12 RELATIONSHIP BETWEEN LIVE BODY WEIGHT (Kg) AND HEART GIRTH(Cm) IN FARMS

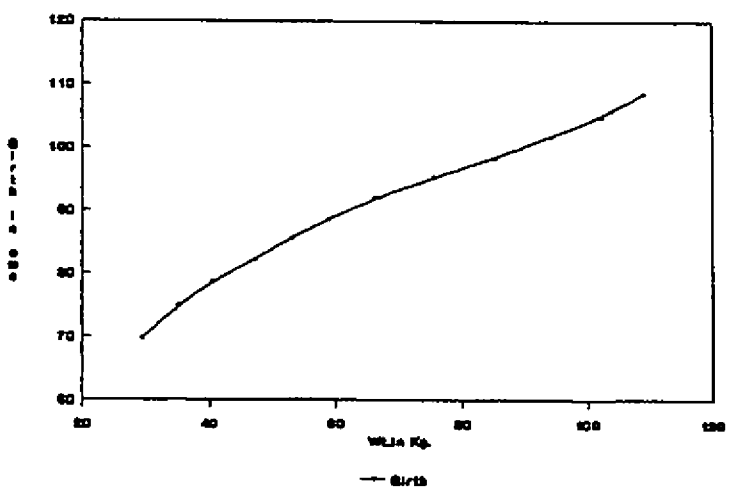
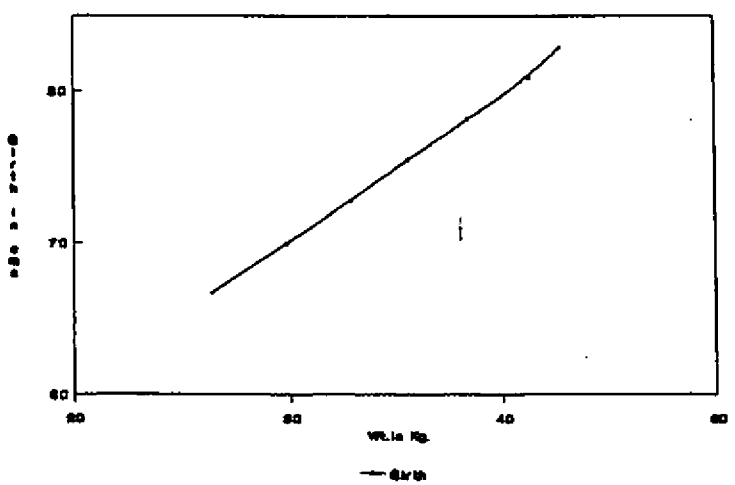


FIG.13 RELATIONSHIP BETWEEN LIVE BODY WEIGHT(Kg) AND HEART GIRTH(Cm) IN FIELD



5.4 Prediction equations

Weighing of calves under field conditions often pose problems as the small farmers cannot afford the cost of weighing machines. Knowing the weight of animals has many advantages as the feeding can be more precise and many management decisions can be made more accurately. Because of this an attempt has been made to predict the body weight of calves from body measurements like length, girth and height for the farm-bred and field calves separately. These equations have been presented in section 4.4. The accuracy of the predicted equations were tested and was found to be of very high order. The R^2 value for the field data prediction equation was 0.999 against 0.998 for the farm data. Predicting body weight on the basis of heart girth alone has certain advantageous field applicability. Using a measuring tape with equivalent body weights marked on it the body weight can be directly read from it. Oommen (1994) observed that the body weights predicted from heart girth alone had a high degree of accuracy. The heart girth data from the present study was utilised to develop prediction equations for farm bred and field raised calves separately. The equations in this respect have been presented in section 4.4. It was found that the R^2 values with respect to both were of high order. Eventhough based on limited data, the equations are likely to

time of feeding in farms depended on the time of birth. The time of colostrum feeding was correlated with daily weight gain upto 3 months (Fig.14a). Highest daily weight gain was seen when colostrum was consumed within 15 minutes. The time-wise break up of calves getting colostrum is given in Fig.14b).

According to Kaeckenbeeck et al. (1961) the intestinal absorption of antibodies was greatest during the first 12 hours of life and almost ceased at 46 hours. Antibodies against E. coli appeared in calves' blood 1 to 2 hours after ingestion of colostrum and reached maximum at 6 hours (Schoenaers and Kaeckenbeeck, 1963). Peak serum concentration of IgM and IgG were observed 12 hours after 1st feeding colostrum whereas IgG_1 and IgG_2 did not reach peak concentration until 24 hours (Husband et al., 1972). According to Stott et al. (1979) neither the body weight of the calves nor pooled colostral concentration of immunoglobulins influenced maximum concentrations of serum immunoglobulins. They found that compared to the bottle feeding of pooled colostrum, rate of absorption and maximum absorption was superior in suckled calves regardless of age or amount of colostrum ingested. Bush and Staley (1980) found that absorption of immunoglobulins from colostrum occurs for 20-30 hours after birth by means of apical tubular system in

be of greater promise as indicated by the high degree of accuracy. In earlier attempts in this direction (Dhanger and Patel, 1990 and Pani et al., 1981) the degree of accuracy was lower.

In spite of the high degree of accuracy observed, it is necessary to test the equations on larger number of calves before advocating them for general use.

5.5 Feeding of calves

One of the objectives of the experiment was to study the calf feeding methods employed in the field and compare them with that in the farms.

5.5.1 Colostrum feeding

In the field, calves were invariably allowed suckling. The exact quantity of colostrum consumed by the calves could not be ascertained. The time between birth and first feeding of colostrum varied from 15 minutes to 2.0 hours in the field. Out of the two organised farms studied, at Dhoni farm, Palghat, a quantity of 2.0 to 2.5 kg of colostrum was fed for a week depending on the size of the calf. In the University Livestock Farm, Mannuthy, a similar quantity of colostrum was fed for a period of 3 days only. In both the farms the measured quantity of colostrum was fed from the pail. The

the intestinal, cells. Efficiency of absorption is decreased if the ingestion of first colostrum is delayed. Jonic and Damnjanonic (1990) found that efficiency of absorption of colostral immunoglobulins declined from a mean of 44.6 at one hour to 27 per cent at six hours after birth.

The feeding of colostrum to new-born calves from a bucket was more effective in ensuring immonoglobulin uptake than leaving cow and calf for two days after parturition (Barber, 1979). The mean time of first suckling was 264-279 minutes. It was observed that 81 per cent suckled within eight hours (Suzuki et al., 1979).

Ventorp and Michanek (1991) found that calves sucked for the first time at a median of 4 h 9 min after birth.

The finding in the present study that calves receiving colostrum within 15 minutes after birth had better growth rate than those receiving it later reiterated the generally held view that early colostrum feeding is highly beneficial for the growth and survival of calves.

FIG.14A TIME OF COLOSTRUM CONSUMPTION AND DAILY GAIN(Kg.) IN FIELD

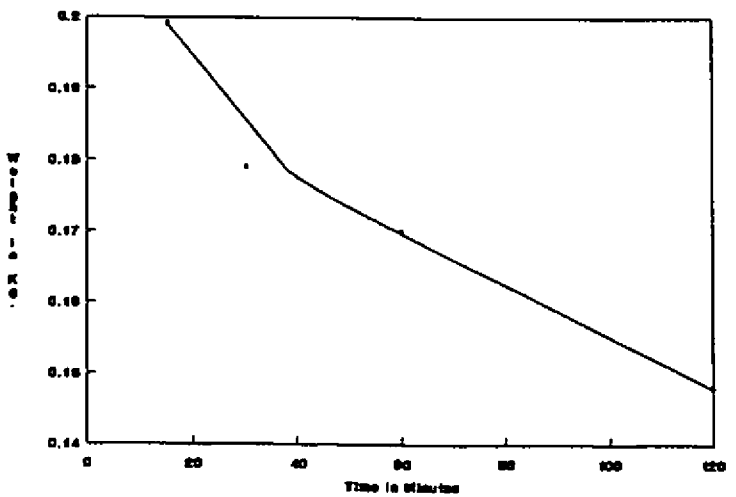
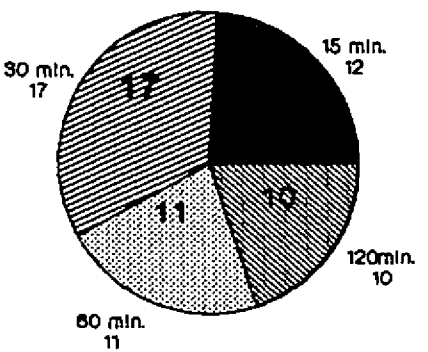


FIG.14B TIME-WISE DISTRIBUTION OF CALVES CONSUMING COLOSTRUM



5.5.2 Milk feeding

One of the most difficult aspect of similar field studies is to quantify the milk consumed by the calves. Because of this, field data on the quantity of milk consumed by suckled calves as scanty. In variably suckling is followed and calves are used for the let-down of milk (Plate 5). An attempt was made to find out the possible quantity of milk consumed by the calves.

Preliminary observations revealed that the farmers use the calves for let-down and then almost completely milk-out the cows. After the milking, the calves were allowed to remain with the cows for varying periods and the milk secreted during that period was consumed by the calves. In the present study, the time allowed by each farmer was first ascertained. On the test days, after the milking, calves were kept tied for the period for which they are normally allowed to remain with their mother, at the end of which the cows were milked a second time. The milk received in the second milking was assumed to be the quantity normally consumed by the calves. The results in this regard have been presented in Table 11.

In general, it was seen that the milk feeding of calves in the field was arbitrary and varied considerably from

0.3 to 2.5 kg per day in the 1st month for male calves and 0.6 to 3.5 kg per day for female calves.

In the field the average milk consumed by the crossbred calves was 2.13 kg/calf/day during the first month, 1.20 kg/calf/day in the 2nd month and 0.59 kg/calf/day in the 3rd month.

The quantity of milk fed at Dhoni farm and ULF were higher than that consumed by the calves in the field. This could be due to the fact that milk in the field was being targeted to the cooperative societies and lack of awareness of the importance of milk feeding for making good replacement stock.

The milk consumption of female calves in the field was comparable with that of the farms. On the other hand the male calves were seen to receive significantly lower quantity of milk. This is reflected in the growth performance of these calves. The relative milk feeding pattern in male and female calves seems to be a reflection of their future economic worth to the farmer.

In the case of female calves there was a significant positive correlation between milk produced by the cows and the milk consumed by the calves. The correlation coefficients for the 1st, 2nd and 3rd months were 0.683**, 0.677** and 0.472*.

In the case of male calves there was a significant correlation only in the first month. These results in general indicate that the female calves received milk in proportion to the yield of their mothers. The male calves, on the other hand were not fed according to the mothers' yield except in the 1st month.

Weights of female calves at 2nd 6th and 12th fortnights were having a highly significant positive correlation with milk consumed by them in the first month. In the case of male calves only weight at 12th fortnight was significantly correlated with milk consumed in the first month. The findings emphasise the importance of milk feeding in the first month in maintaining good rate of growth in calves.

Umoh (1982) reported that suckled calves survived better than bucket fed calves.

Jonasen and Krohn (1991) found that if calves were allowed to remain with the dam for at least the first 5 days it was beneficial for the calves as they were stimulated to move and drink earlier.

While the female calves were fed relatively better even among them there was a high degree of variability (0.6 kg/day to 3.5 kg per day). It points to the need for

evolving better milk feeding procedures for cross-bred calves. As far as male cross-bred calves are concerned, the farmers will be prompted to feed them better only if they are convinced of their future economic worth. Research directed towards their utility for meat, drought and breeding are necessary to see whether this resource being neglected at present can be economically utilized.

5.5.3 Concentrate feeding

In case of ULF, Mannuthy, the calves were fed a measured quantity of concentrates while at Dhoni farm they were allowed ad libitum feeding. In the field, only small quantities of concentrates are being fed to the calves. Although very good growth of calves could be achieved by roughage-oriented feeding (Thiagarajan and Thomas, 1991) this requires incorporation of leguminous crops like subabul. In the field (Mavelikara) very few farmers are feeding legumes. The poor growth rate seen in field calves could be partially remedied by incorporating protein rich concentrates or leguminous forages in their ration.

5.6 Housing

The type of housing used for calves and their dams in the field and the daily weight gain of calves under each were studied and presented in Table 14 and Fig.15.

The cattle sheds in the region of study could be broadly classified into two, i.e., (A) lean-to type and (B) separate sheds. The lean to type sheds were extensions of the roofs of a main building, often the residence of the owner, to provide a simple shelter for the cows and calves (Plate 6). Others were separate sheds for the cattle (Plate 7). In the study, there were 13 lean-to type sheds and 37 separate sheds. The calves in the lean-to type sheds had an average daily weight gain of 0.188 kg compared to 0.196 kg for those raised in separate sheds. These houses were further sub-classified on the basis of the types of floor and roofs. The floors were either 'Kacha' (mud) or were covered with cement concrete. The roofs were thatched or of earthern tiles. The distribution of different types of houses with different type of floors and roofs have been presented in Table 14.

Out of 50 cattle houses studied 38 (76%) had concrete floor and the remaining Kacha floor. Similarly there were 27 with tiled and 23 with thatched roofs. Calves on concrete floor were found to have an average daily gain of 0.199 kg compared to 0.180 kg for those on Kacha floor. Similarly calves raised in sheds with tiled roof had an average daily weight gain of 0.211 kg compared to 0.174 under thatched roof.

Because of the very small number under certain categories, no statistical analysis could be done. However,

on the basis of trends shown by averages, it appears that separate sheds with concrete floor and tiled roof favoured better weight gain in crossbred calves. The largest number of units were of this type and barring one calf under lean-to type kacha floored and tiled shed, the group of calves under the above type had the highest average daily weight gain (Fig.14).

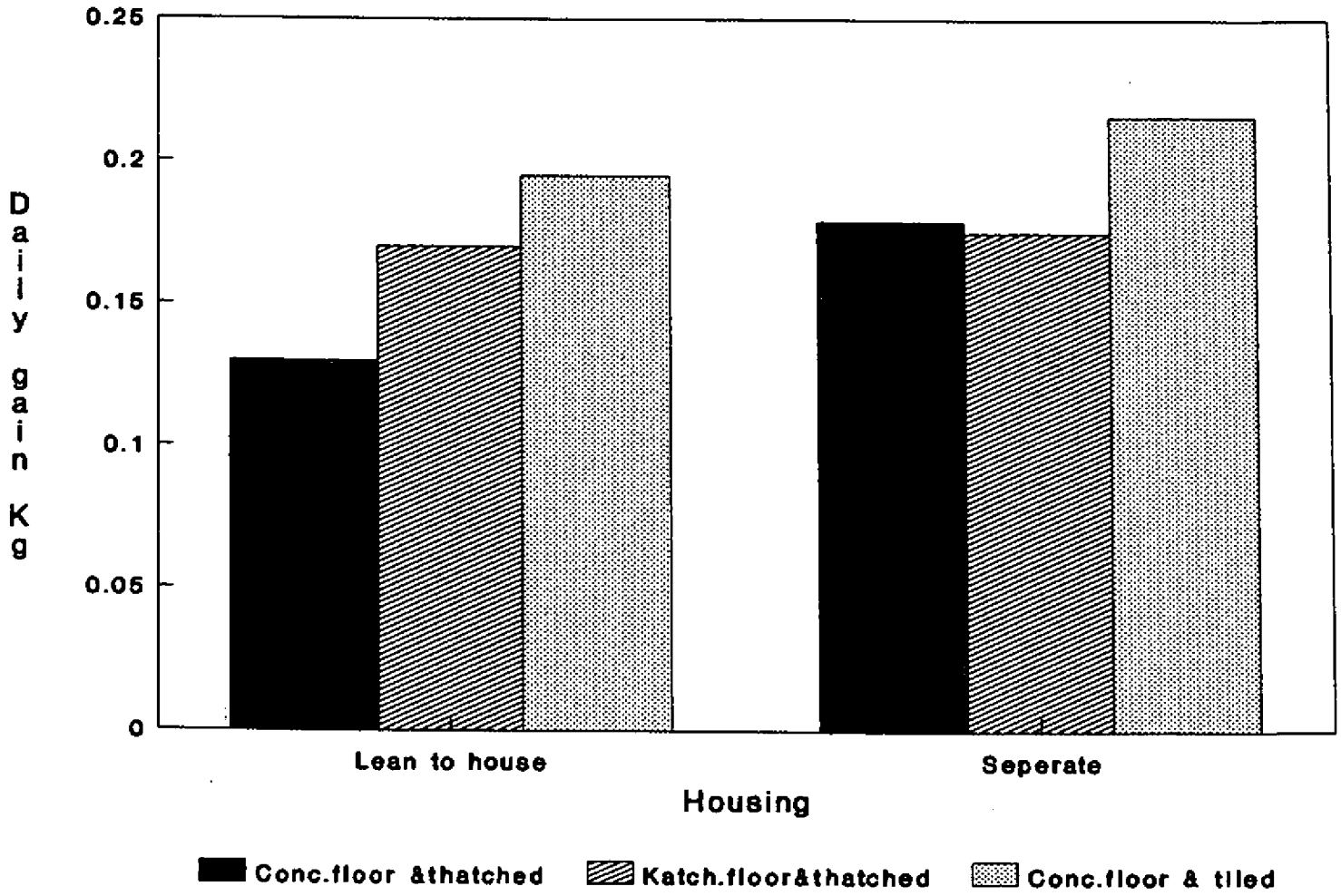
In comparison to the above, the two farms had individual calf boxes with concrete floor and ACC/tiled roof (Plate 8). This might have been one of the reasons for higher growth rate observed in farm-bred calves.

Saharia and Sarker (1989) found that the growth performance of Jersey calves reared indoor on a pucca floor was superior to those reared out door on a brick floor.

Saseendranath et al. (1983) observed that the daily gain was higher in crossbred calves reared in conventional sheds with tin roof and concrete floor compared to those raised in a shed with thatched roof and split bamboo-slatted floor.

Thiagarajan and Thomas (1991) observed that cross-bred calves housed in the open and maintained on roughage oriented feeding recorded the maximum gains in body weight.

FIG.15 EFFECT OF HOUSING ON DAILY GAIN (KG) OF CALVES IN FIELD



5.7 Management practices

In the two organised farms under study, monthly deworming upto the age of 12 months was done as a routine. In the disorganised units in the field all calves were dewormed in the first month only (Table 15). In the second month 89 per cent females and 68 per cent of male calves were dewormed while in the 3rd month 81 per cent female and 68 per cent male calves were dewormed. In fourth month while 12 per cent females were dewormed no males were dewormed. In a field study it was observed that calves were dewormed at first and third month and given timely treatment against ailments (Dhangar and Patel, 1990).

Vaccination for foot and mouth disease was done in farms while no vaccination was done in field as a routine practice.

5.7.1 Hygiene

Hygiene was fair in both the farms. Compared to this, hygienic conditions in the units in the field were good in 19 (38%) fair in 27 (54%) and poor in 4 (8%) cases. The average daily gain seems to improve with the hygiene quality of the environment (Table 16 and Fig.16). The above results goes on to show that in the Mavelikara region of Kerala where the study was conducted a majority of farmers are aware of and

adopting good to fair hygienic measures and are grooming the calves daily. Sustained extension work is necessary to disseminate the information to the remaining farmers.

5.7.2 Daily grooming

Similarly daily grooming of calves was done in both the farms. In the field daily grooming was done in 42 (84%) units while weekly grooming in 8 (16%). Higher average daily gain was observed in calves groomed daily (Table 16 and Fig.16).

5.7.3 Persons looking after calves

In the farms, experienced labourers looked after the animals while family labour was involved in the field. Jenny et al. (1981) found that mortality rate was lower when farmer or his family were responsible for rearing rather than hired labourers. In 76 per cent of the units in the field, women looked after the calves (Table 17 and Fig.17a). This shows the importance of dairying in providing gainful occupation to women and absorbing family labour. However, the daily gain of calves tended to be lower in the case of calves looked after by women (Table 17 and Fig.17b). This may point to the requirement for targetting dairy extension work towards rural women to train them on dairy production skills in general and calf care in particular.

5.7.4 Dairy awareness

Majority of the dairy-men were found to have medium knowledge regarding animal husbandry practices (Table 18). The degree of dairy awareness varied between 30 and 80 per cent with 90 per cent of the farmers having an awareness from 40 to 60 per cent. The dairy awareness of farmers in Mavelikkara region appears to be better than those reported by Nataraju and Channagowda in 1988. They observed that a large percentage of agricultural labourers were in the low to medium knowledge group. The findings once again point to the relevance of sustained extension work. The observation of Nataraju and Channegowda (1988) that farm and home visits, film-shows and cattle rallies were popular sources of information contacted by dairy men appears relevant under Kerala conditions also. In a questionnaire survey on farmers opinion on the knowledge of the veterinarians revealed that it was highest for diagnosis and treatment of sickness or injury and reproduction and breeding. But their knowledge was equal to or even lower than the producers for feed/nutrition and animal management and was considerably lower for economics and agricultural business (Wise, 1988). Figure 18 illustrate the relationship of daily growth rate of calves to the dairy awareness of the farmers. The daily weight gain increased with increased awareness. This points to the need for

transferring more technical information and thereby creating better awareness among the farmers.

Other factors like educational status and occupation of farmers and size of land holdings were considered. People with high school education seemed to have maintained their calves better than very high or very low educated people (Fig.19). Among the farmers 48 per cent were educated upto high school level and 32 per cent, upto upper primary level thus forming 80 per cent together. The highest daily weight gain of calves (0.201 kg) was in the group looked after by those who had educational level upto high school closely followed by U.P. School (0.177 kg). Educational levels lower than this or higher than this were associated with lower daily weight gain of calves. Presumably education upto the high school level and to a certain degree U.P. level was enough for the farmers to absorb technical information on calf care. Those who were educated at a higher (college) level might not be dependent on dairy farming as a livelihood and therefore might have neglected the care of calves as reflected in their daily weight gain.

Occupation of the farmers hardly had any significant bearing on gain of weights of calves, though calves grown by agricultural labourers and other workers/labourers seems to have lower weight gain (Fig.20). In these families, both men

and women go for work and they also do not have much land. Coupled with these, their generally lower economic status might have contributed towards lower levels of inputs in feeding and care resulting in lower weight gain. The relationship between size of land holding and daily weight gain of calves in the field was examined (Fig.21). It was found that 74 per cent of the holdings were 1 acre and below and 16 per cent between one and two acres. Thus the holdings in the locality were predominantly small. Among them, the calves in the larger units seems to have greater daily weight gain. The larger area of land available for grazing and fodder production and the higher financial capacity of owners of larger holdings may favour better feeding and care of calves in these units.

The effect of calving number on daily weight gain of calves was examined (Fig.22). Parity did not appear to influence daily weight gain of calves in any consistent manner.

FIG. 16 EFFECT OF HYGIENE & GROOMING ON DAILY GAIN OF CALVES IN FIELD

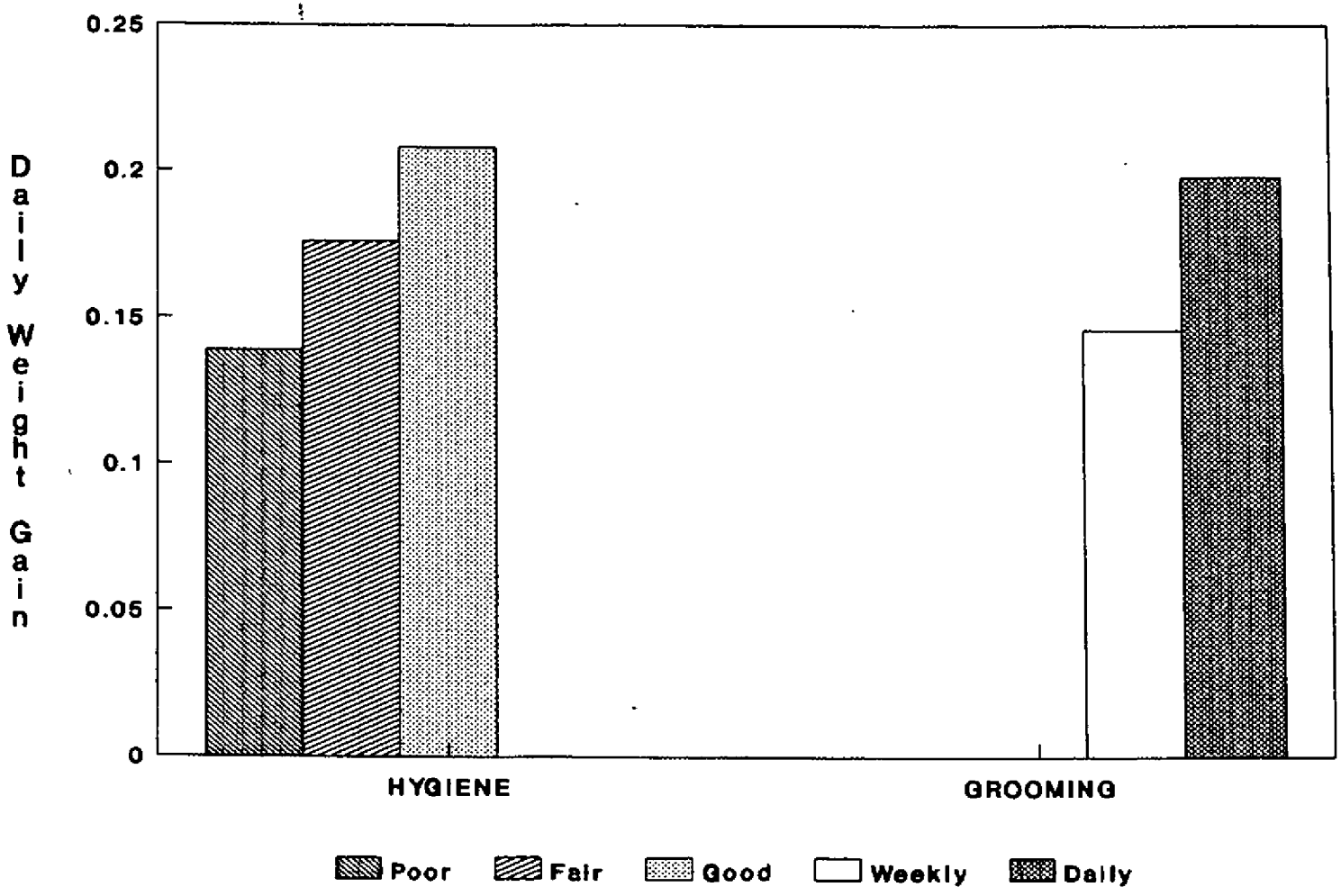


FIG.17A DAILY WEIGHT GAIN(Kg) IN FIELD RELATED TO GENDER OF CALF TENDERS

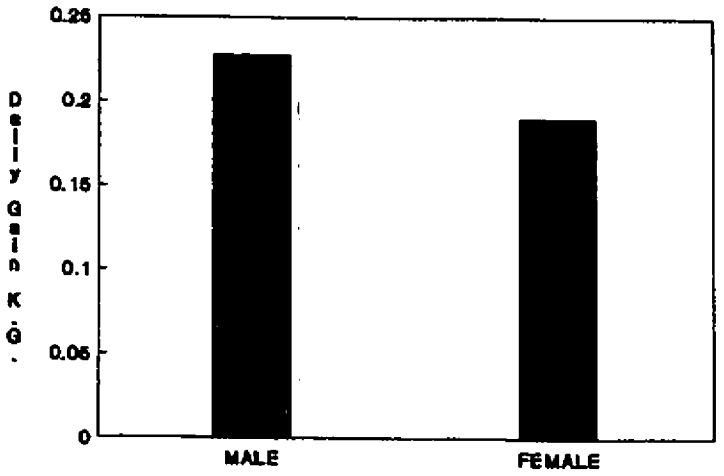


FIG.17B SEX-WISE DISTRIBUTION OF CALF TENDERS IN FIELD

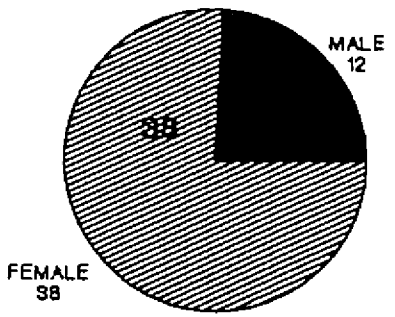


FIG. 22 EFFECT OF PARITY OF DAM ON DAILY WEIGHT GAIN OF CALVES IN FIELD

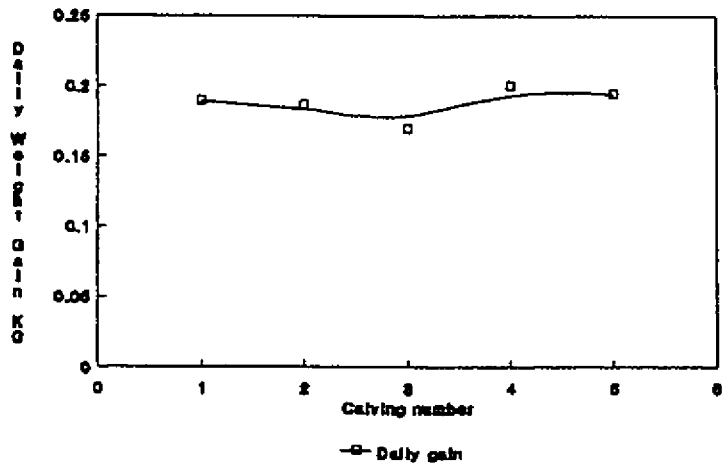


FIG. 18 DAILY GAIN OF CALVES RELATED TO DAIRY AWARENESS OF FARMERS

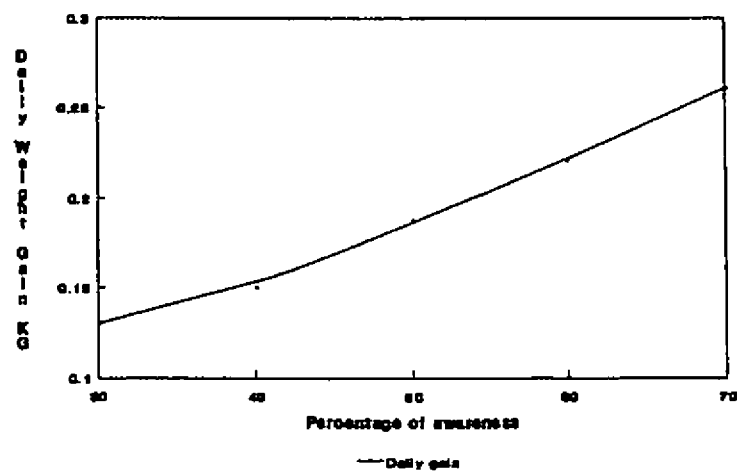


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FIG. 19 EFFECT OF EDUCATIONAL STATUS OF FARMERS ON DAILY GAIN OF CALVES

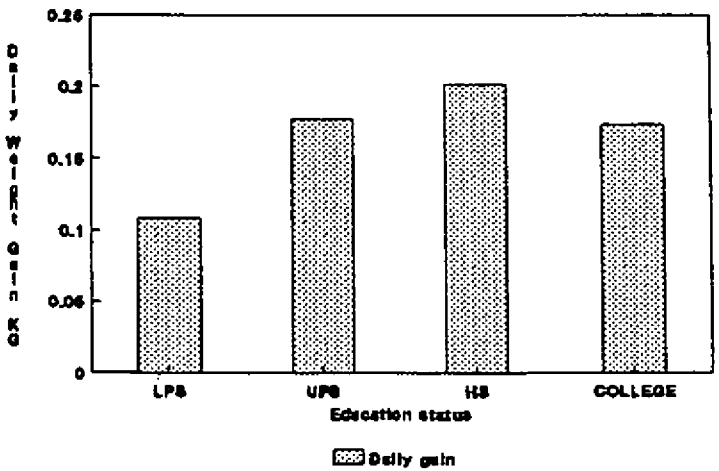

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FIG. 21 EFFECT OF SIZE OF LAND HOLDING OF FARMERS ON DAILY WEIGHT GAIN OF CALVES

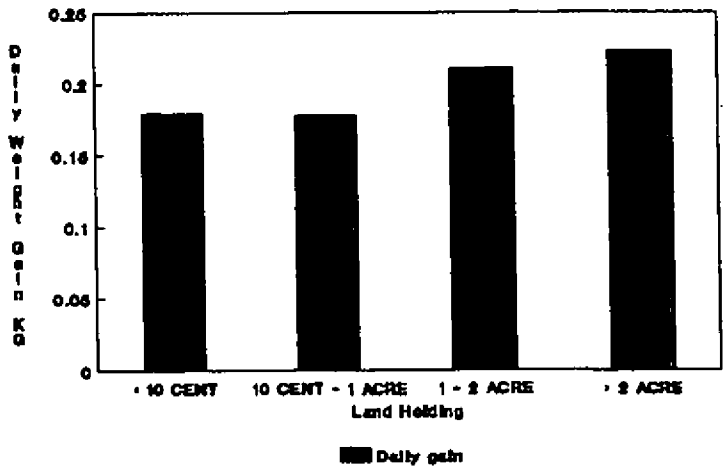
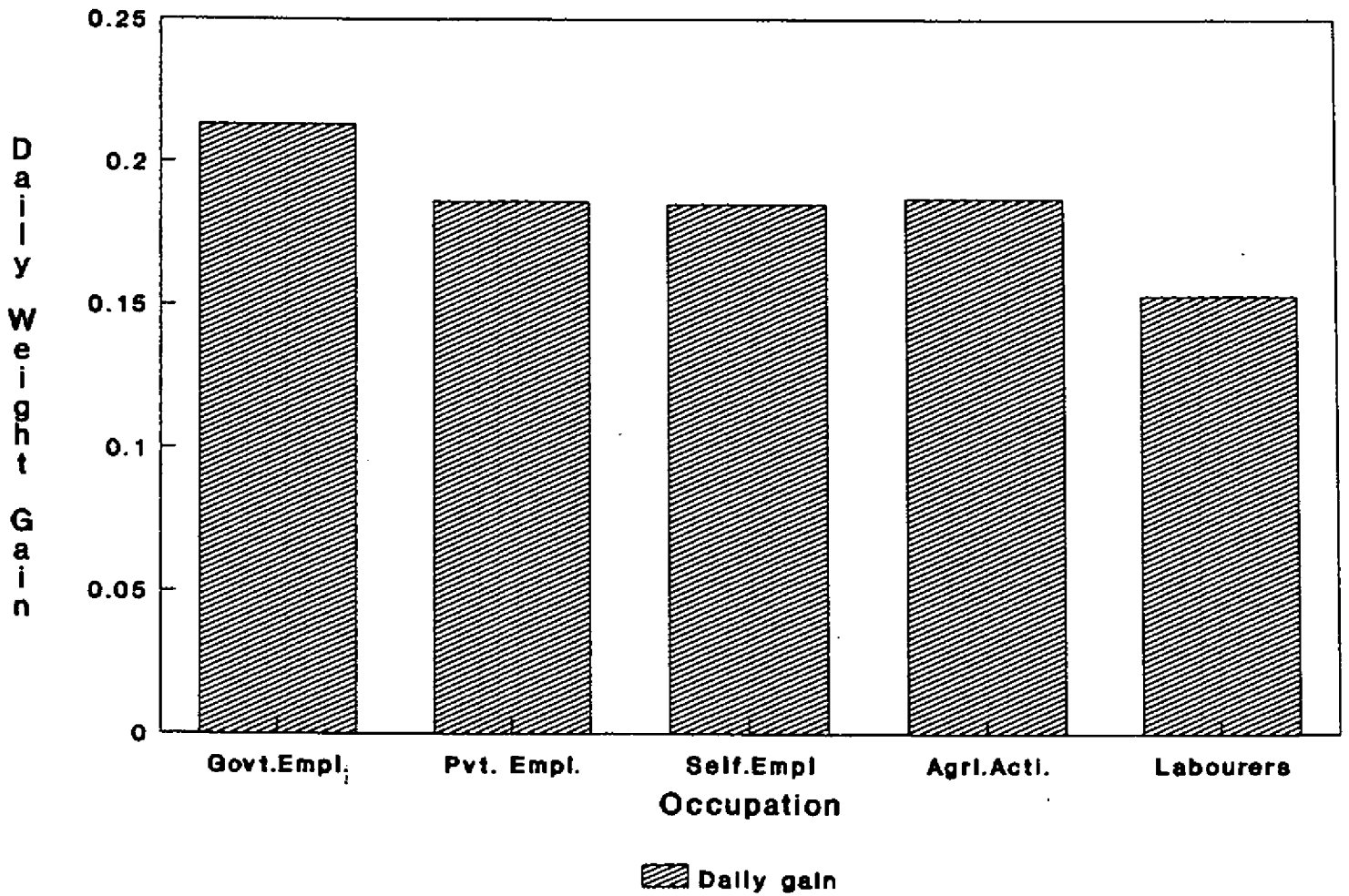


FIG. 20 EFFECT OF OCCUPATION OF FARMERS ON DAILY WEIGHT GAIN OF CALVES IN FIELD



5.8 Calf mortality

Mortality rate in calves in any population serves as an important pointer towards their adaptability to the environment and the level of management. In general, in developed countries where milk substitutes are used widely, the main cause of death is enteric infection, whereas in some developing countries, the main cause of death is often respiratory infection (Reddy and Nagarcenkar, 1989).

In the two organised farms under study, Dhoni farm had no mortality among 28 calves during the period of study while in ULF, Mannuthy three died from a total of nine female calves. The male calves were being disposed off from the farm for various research work. The causes of death were pneumonia and gastro-enteritis. In field, the main cause of death was gastro-enteritis. This is supported by Rao and Nagarcenkar (1980) who observed that mortality during 3 to 6 month was mainly due to digestive causes while in 1st month due to respiratory diseases. Ottasen (1959), Fink (1980), Green and Bakheit (1980), Khera (1981), Sunder et al. (1988) and Dhangar and Patel (1990) agree to the fact that main cause of mortality was due to alimentary diseases. But a few workers observed that respiratory diseases were the main causes of death (Kuben et al. (1984), Peters (1986),

Maarof et al. (1987), Zrelli et al. (1988) and Reddy and Nagarcenkar (1989).

Not feeding colostrum due to ignorance resulted in death of two out of three calves. No mortality was observed when colostrum was fed within 15 minutes. These findings highlight and restate the importance of feeding colostrum in the right quantity within 15 minutes. Similar views were expressed by Roy (1980) and Bakkeit and Greene (1981). Withero (1952, 53) stated that the animals in field were fed directly from the mother and hence utilized colostrum better.

In the field, the males had higher mortality rate (27.27%) as compared to female calves (3.57%). Singh and Singh (1973), Patterson et al. (1987), Chaudhary et al. (1986) and Gee (1989) also reported higher mortality rate in male calves. The major reason for significantly higher mortality rate of male calves in the field might be due to neglect and inadequate feeding and management given to them in comparison to female calves. This is evident from the fact that the male calves in the field had significantly lower growth rate compared to those in the farms whereas in the case of females both groups had similar growth rates. The farmer obviously has less economic value for the male calf and therefore neglect it.

Calves born to first calvers had the maximum mortality rate (29.41%). This fact is acknowledged by Simensen (1982). Lack of experience on the part of heifers and consequent lower level of maternal care given by them to their calves may be a possible reason. More difficulties and time needed in parturition due to under-developed genetalia in heifers may also contribute to birth of weak calves resulting in higher mortality rate. Sensible breeding of heifers and attention to heifers at calving and before calving may be helpful.

Mortality rate of the animals were more in 1st month of age (28.5%) and 5 months of age (28.5%) in the field. Higher mortality rate in the first month has been reported by many workers (Oxender et al., 1973); Singh and Singh, 1973; Umoh, 1982; Srivastava and Agarwal, 1973 and Singh et al., 1989). Higher mortality rate in the fifth month may be probably due to the fact that the calves are nutritionally at a transitional stage in which milk feeding is almost completely curtailed and the calves have to depend on a predominantly roughage diet for their nutrition. The rumen is also not fully developed to meet the requirements of a high-roughage diet. This might have resulted in nutritional inadequacies leading to higher mortality.

better training and information on dairy farming in general and calf care in particular to rural women.

Educational status of farmers seems to have a bearing on mortality rate of calves kept by them. Farmers with just upper primary education were having high calf mortality (25%). As educational level increased the rate decreased.

Occupation of the farmers did not have much influence on the mortality rate of calves.

Dairy awareness of the owners also seems to affect survival of calves. As the awareness score increased from 40 per cent the mortality rate decreased. This indicates to the need for greater extension effort to educate the farmers on calf rearing.

Good hygiene and daily grooming seem to reduce mortality rate among calves. These are universally accepted facts, but often forgotten in practice. The results emphasise the need to educate the farmers the benefits of hygienic measures and daily grooming.

According to Singh et al. (1989), overall survival rates were 87.9, 93.1, 96.8 and 96.7 per cent from birth to one month of age, from 1 to 3, 3 to 6 and 6 to 12 months respectively in half bred cattle.

The population trends of male and female calves in the field were studied (Fig.23). Out of 22 male calves born only eight were still retained at the end of 6 months. This amounted to 36.36 per cent. On the other hand out of 28 female calves at the beginning 26 (92.85%) were still being retained by the farmers at the end of the six month period. The calves either died or were disposed off by sale. This once again reflect the relative utility and economic worth of male and female calves for the farmers.

FIG. 23 POPULATION TREND OF CALVES IN THE FIELD

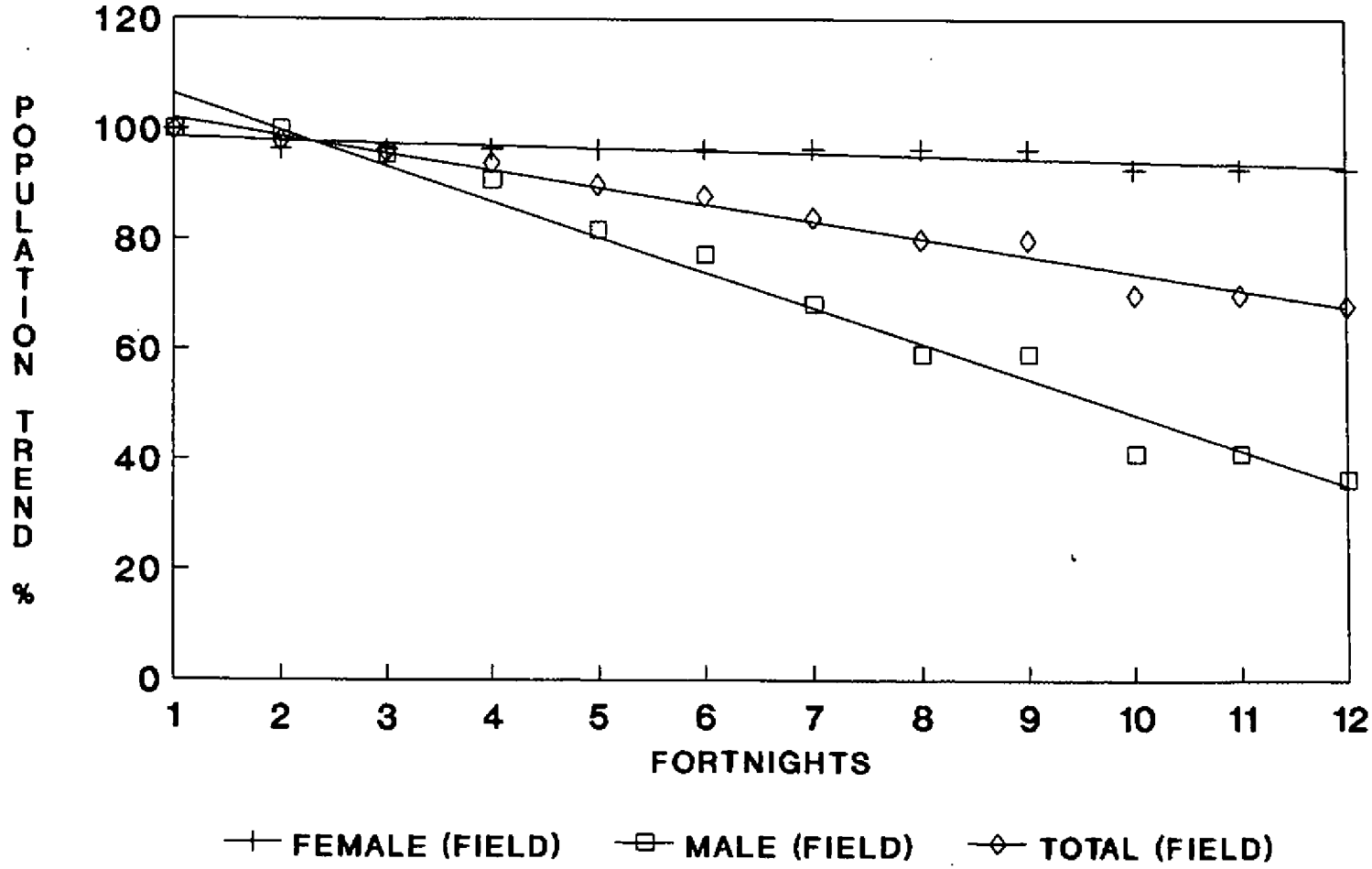


Plate 4. Crossbred calf with optimum growth - Dhoni farm

Plate 5. A good specimen of crossbred cow and her calf in the field. Suckling is the common method of milk feeding

Plate 6. Cattle shed in the field (separate type, concrete floor, tiled roof) with a calf in front

Plate 7. Cattle shed (lean-to type, concrete floor, tiled roof) in the field with the calf raised in it

Plate 8. Individual calf pens - Dhoni farm

Summary

SUMMARY

The study was undertaken to evaluate the system of calf raising in the field vis-a-vis that in organised farms, which included contemporary calves born in field and organised farms. Mavelikara was chosen as the study area from where the experimental field calves were selected. University Livestock Farm, Kerala Agricultural University and Dhoni Farm, KLD Board, Palghat were chosen to represent organised farms in the experiment.

All the calves born in the experimental area or farms during a period of two months were included in the experiment. Calves were studied upto a period of six months of age.

It was observed that climatic conditions in general were similar at the three locations except that at ULF, Mannuthy relative humidity and hours of bright sunshine tended to be less than the other two locations.

The male calves in the farms weighed heavier at birth and gained significantly faster to weigh 132.25 kg at the end of 12th fortnight compared to 72.93 kg in the field. There was no significant difference in the birth weight of farm-born and field-born female calves. However the female calves in

the farms grew at a faster rate to weigh significantly heavier at 12th fortnight (90.35 kg) compared to field calves (74.69 kg). When the males and females were put together and the weights of calves in the farms and field were tested at 1st, 6th and 12th fortnights, the calves in the farms weighed significantly heavier than the field calves in all the three time intervals.

The daily weight gain during different fortnights was always higher in the farm grown calves compared to field-raised. The results indicated that there is a lot of scope for improvement in the growth rate of cross-bred calves in the field through better feeding and management as they were not attaining the potential obtainable in comparison to calves of similar genetic constitution in the farms.

In the male calves the differences in height between farms and field was not significant in the first fortnight but was significantly higher in the farms in the 6th and 12th fortnights. There was no significant difference in height of female calves in the farms compared to those in field in all the three fortnights tested.

The information with respect to girth showed a similar trend as in the case of weight and height.

In the first fortnight the male calves in the farms measured significantly shorter in length than male calves in the field but by 6th and 12th fortnights they measured significantly longer than their counterparts in the field. There was no significant difference in the length of female calves in field and farms during the three time intervals tested.

The prediction equations developed from the body measurements of field and farm raised calves were found to have a high degree of accuracy.

In the field, calves received colostrum through suckling and because of that the exact quantity consumed was not known. But through observation and through discussion with farmers it has been concluded that the calves were receiving adequate quantity of colostrum. The calves in the farms were fed 2.0-2.5 kg colostrum daily from the pail.

In the field, the interval between birth and first nursing of colostrum varied from 15 minutes to 2 hours. In the farms calves born during the day-time received colostrum within half an hour. However, those born during the night received colostrum only in the next day morning. The time of colostrum feeding affected daily gain and mortality rate.

Highest daily gain and lowest mortality ratio were seen among calves fed colostrum within 15 minutes of birth.

The correlation coefficient between milk consumed by the calf and milk produced by the cow during the 1st, 2nd and 3rd month were highly significant in the case of female calves while in case of males it was significant only during the first month.

It was estimated that the female calves in the field consumed 2.47, 1.42 and 0.75 kg of milk per day during the first 2nd and 3rd months. The corresponding figures for male calves are 1.81, 0.91 and 0.31 kg. It was seen that the quantity of milk available for the female calves in the field was comparable to that in the farms. On the contrary, the male calves in the field were receiving much lower quantity.

In the female calves, a highly significant correlation was obtained between milk consumed in first month and weight during the 2nd, 6th and 12th fortnights. In males there was no significant correlation during the 2nd and 8th fortnight but was significant at 12th fortnight.

In Dhoni farm concentrate and grass were fed ad libitum from first month onwards. At ULF a daily schedule was followed. In the field, the feed consumed by the calves was assessed by measuring and by enquiring with the farmers.

In the field, female calves received on an average 101 g concentrates per day in the second month compared to 127 g in the case of male calves. This increased to 523 g and 283 g in female and male calves respectively in the fourth month and by sixth month, the female calves were receiving 1 kg concentrates compared to 0.5 kg for male calves.

Concrete floor with tiled roof was the most common type of housing in the field. Among the different types of houses observed in the field, maximum daily gain of calves was seen in this type of housing.

In the two farms studied monthly deworming upto the age of 12 months was carried out. In the field, all calves were dewormed during the first month only. In the second month 89 per cent of females and 68 per cent of male calves were dewormed. In the third month this decreased to 81 per cent in females while the percentage remained unchanged in the case of male calves. In the fourth month only 12 per cent of the female calves received anthelminthic treatment. Males were not dewormed after the 3rd month.

Vaccination against Foot and Mouth disease was carried out in farms at 6 months of age. No vaccination was done in the field.

The correlation between hygiene and grooming with daily gain of calves in the field was studied. Good hygiene and daily grooming appeared to increase daily gain of calves.

Better growth also was observed when men looked after the animals through 67 per cent of persons looking after the animals were women.

Dairy awareness of 40 to 60 per cent was seen in 90 per cent of the farmers included in the study. The daily gain of calves seemed to increase with increased dairy awareness of the owners. This points to the need of transferring more technical information and thereby creating better awareness among farmers.

People with high school level education seemed to have maintained their calves better than those with higher or lower levels of education as judged on the basis of daily weight gain in calves.

Occupation of farmer had hardly any significant bearing on weight of calves, through calves grown by agricultural labourers and other workers/labourers seemed to have lower weight gain.

Considering land holding, calves in the larger units seem to have greater daily weight gain.

upper primary (25%) and lowest in those who studied upto high school level (12.5%).

Mortality rate among calves seemed to decrease with increasing dairy-awareness of owners. While there was 25 per cent mortality when owners had an awareness score of 40 per cent it decreased to 16.66 per cent when awareness score increased to 60 per cent. No calves died in those house-holds where the owner had an awareness higher than 60 per cent. Mortality rates of calves was highest in those with poor hygiene (50%) followed by medium hygiene (11.11%) and good hygiene (10.5%). Similarly daily grooming seemed to reduce mortality rate (11.9%) compared to weekly grooming (25%).

The population of male calves dwindled very fast in the field. Out of 22 male calves born only eight (36.36%) were retained by the farmers at the end of six months age. On the contrary out of 28 female calves born 26 (92.85%) were retained in the herds at the end of six months.

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ANNEXURE
Questionnaire

BASIC DATA SHEET NO.

1. Owner's name & address :
2. Educational status : LPS/UPS/HS/College
3. Occupation
    1. Government Employment
    2. Private Employment
    3. Self Employment
    4. Agriculture and allied activities
    5. Agricultural and other labourers
4. Dairy awareness
    1. Are you a member/office bearer in organisation like milk society, farmer's, club etc. : Yes/No
    2. Do you increase concentrates with increase in milk production : Yes/No
    3. Importance of colostrum feeding in new born calf : Yes/No
    4. Which is the best method of milking : Full hand/thumbing

9. Feeding of calf and cow

a. Colostrum - Time

Method

b. Milk - 1st month

2nd month

3rd month

		Calf	Cow
Feed	1st month		
	2nd month		
	3rd month		
	4th month		
	5th month		
	6th month		
Concentrate	:		
Roughage	:		
Quality	:		
Milk yield of cow	- 1st month		
	2nd month		
	3rd month		

10. Livestock position

(i) No. of cows

(ii) No. of heifers

(iii) Calves

5. After onset of heat when the animal should be bred : 8-12 hours

6. Importance of Dry period for your cow : Yes/No

7. Can you name some disease in cattle that can be prevented by vaccination Yes/No (FMD,RP,HS, Authrax, BQ, Johnes, Brucellosis)

8. Importance of deworming : Yes/No

9. Can you name some diseases transmitted from animal to man : Yes/No (TB, Rabies, Cow pox, Brucellosis, Anthrax).

10. Name your nearest Veterinary Surgeon

5. Land holding

1. Below 10 cents
2. 10 cents-1 Acre
3. 1-2 Acre
4. 2 Acre and Above

	Calf	Cow
Ear tag		
Date of birth		
Sex		
Genetic group		
Deworming		
Vaccination		

6. Housing

   1. Lean to house with concrete floor and thatched
   2. Lean to house with kacha floor and thatched
   3. Lean to house with concrete floor and tiled/concrete
   4. Lean to house with kacha floor and tiled/concrete
   5. Separate house with concrete floor and thatched
   6. Separate house with kacha floor and thatched
   7. Separate house with concrete floor and tiled/concrete
   8. Separate house with kacha floor and tiled/concrete

7. Hygiene - Poor/Medium/Good

8. Grooming/washing - Daily/weekly/occasionally/Not at all

FACTORS INFLUENCING CALF GROWTH AND MORTALITY IN FIELD AND ORGANISED FARMS

By

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ABSTRACT OF A THESIS

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ABSTRACT

A study was undertaken to evaluate the system of calf raising in the field vis-a-vis that in organised farms, which included contemporary calves born in field and organised farms. Mavelikara was chosen as the study area from where the experimental field calves were selected. University Livestock Farm, Kerala Agricultural University and Dhoni Farm, KLD Board, Palghat were chosen to represent organised farms in the experiment.

All the calves born in the experimental area or farms during a period of two months were included in the experiment. Calves were studied upto a period of six months of age.

It was observed that climatic conditions in general were similar at the three locations except that at ULF, Mannuthy relative humidity and hours of bright sunshine tended to be less than the other two locations.

The male calves in the farms weighed heavier at birth and gained faster to weigh significantly more at the 12th fortnight compared to those in the field. There was no significant difference in birth weight of farm and field born female calves. However, those in the farms grew faster to

weigh significantly heavier at 12th fortnight. When male and female calves in the farms and field were put together and tested at 1st, 6th and 12th fortnights, the calves in the farms weighed significantly heavier than those in the field at all stages.

The daily weight gain during different fortnights was higher in the farm grown calves compared to their counterparts in the field.

There was no significant difference in height of male calves in the farms and field in the 1st fortnight but was significantly higher in the farm grown calves in the 6th and 12th fortnights. There was no significant difference in the height of the female calves in the farms and field in all the three fortnights tested.

Information with respect to girth showed similar trend as in the case of weight and height.

In the first fortnight, the male calves in the farms measured significantly shorter in length than those in the field but by 6th and 12th fortnights, they measured significantly longer than male calves in the field. There was no significant difference in length of female calves in the field and farms during the time intervals tested.

In the field, calves received generally an adequate amount of colostrum through suckling. Those in the farm were fed 2-2.5 kg colostrum daily from the pail. The interval between birth and first nursing varied from 15 min to 2 h in the field. In the farms, calves born during day time received colostrum within half an hour, while those born in night received colostrum the next morning. Highest daily gain and lowest mortality was seen in calves fed colostrum within 15 minutes.

It was observed that the quantity of milk available to female calves in the field was comparable to that in the farms. Male calves in the field received much lesser quantity.

Female calves received more quantity of concentrates compared to males except in the early fortnights.

Maximum daily gain of calves was observed in sheds with concrete flooring and tiled roofs.

Monthly deworming was practised upto 12 months of age in the two farms studied. In the field all calves were dewormed during the 1st month only. Thereafter, female calves were given more frequent deworming treatment. Vaccination against Foot and Mouth disease was carried out in the farms but not in the field.

Good hygiene and daily grooming increased the daily gain of calves. Better growth was seen when the animals were looked after by men than women. Average dairy awareness was observed in 90 per cent of the farmers. Daily gain of calves increased with increased dairy awareness. People with high school level education maintained their calves better than those with higher or lower levels of education. Calves grown by agricultural labourers seemed to have lower weight gain. Calves reared in larger units of land had a greater daily weight gain.

The mortality rate among calves was 14 per cent in the field compared to 8.5 per cent in the farms. Mortality rate of 66.6 per cent was seen when no colostrum was fed. There was no mortality among calves fed colostrum within 15 minutes. Male calves had higher mortality rate than female calves. Higher mortality rate was observed in calves born to first calvers. In field mortality was higher in 1st and 5th month of age. Mortality rate was lower when calves were looked after by men compared to women. The lowest calf mortality rate was observed among calves owned by those who had high school level education.

Mortality rate among calves seemed to decrease with increasing dairy awareness of owners. Mortality rate of

calves was highest in shed and premises with poor hygiene (50%) followed by medium hygiene (11.11%) and good hygiene (10.5%). Similarly daily grooming seemed to reduces mortality rate (11.9%) compared to weekly grooming (25%).

At the end of 6 months, 92.85 per cent of the female calves were retained by the farmers compared to only 36.36 per cent male calves, clearly pointing towards the greater future economic utility of the former.