



**UNIVERSITI PUTRA MALAYSIA**

***REPRODUCTIVE AND CALF GROWTH PERFORMANCE OF KEDAH-  
KELANTAN (KK) AND BRAHMAN (BR) CATTLE IN A COMMERCIAL  
BEEF CATTLE FARM***

**NG KWOK CHYUAN**

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OF  
KEDAH-KELANTAN (KK) AND BRAHMAN (BR) CATTLE  
IN  
A COMMERCIAL BEEF CATTLE FARM**



**NG KWOK CHYUAN**

**An Animal Industry Project paper submitted in partial  
fulfilment of the requirements for the degree of  
Doctor of Veterinary Medicine at the  
Faculty of Veterinary Medicine and Animal Science  
Universiti Pertanian Malaysia.**

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# **DEDICATION**

**To**

**FOONG AND KEW**

**for their unfailing support and care**

**and**

**SARJIT, MAHEN, COLIN**

**for their love, patience and understanding**

**and**

**the SURVIVORS**

**for accepting me just the way I am**

**and being my true friends in the**

**course of my university education.**

**Monday, 19th of January, 1987**

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## TABLE OF CONTENTS

	<b>Page</b>
<b>ACKNOWLEDGEMENT.....</b>	<b>iii</b>
<b>TABLE OF CONTENTS.....</b>	<b>iv</b>
<b>LIST OF TABLES.....</b>	<b>v</b>
<b>LIST OF FIGURES.....</b>	<b>vi</b>
<b>ABSTRACT.....</b>	<b>vii</b>
<b>INTRODUCTION.....</b>	<b>1</b>
<b>LITERATURE REVIEW.....</b>	<b>2</b>
<b>MATERIALS AND METHODS.....</b>	<b>3</b>
<b>RESULTS AND DISCUSSION.....</b>	<b>6</b>
<b>CONCLUSION.....</b>	<b>21</b>
<b>REFERENCES.....</b>	<b>22</b>
<b>APPENDICES.....</b>	<b>25</b>

## LIST OF TABLES

Table	Title	Page
1	Age at puberty, age at first calving and calving intervals of Kedah-Kelantan (KK) and Brahman (BR) cattle.	.....
2	Calf performance of KK and BR (Jan., 1983 - Oct., 1986).	.....
3	Comparative reproductive and calf growth performance in Kedah-Kelantan (KK) and Brahman (BR) cattle.	..... 10



## **LIST OF FIGURES**

<b>Figures</b>	<b>Title</b>	<b>Page</b>
<b>1</b>	<b>Calving % of KK and BR in relation to Annual Rainfall (Jan., 1981 - Oct., 1986).</b>	<b>13</b>
<b>2</b>	<b>Yearly Preweaning Mortality % of KK and BR in relation to Annual Rainfall (Jan., 1981 - Oct., 1986).</b>	<b>14</b>
<b>3</b>	<b>Mean Calving % of KK and BR in relation to Mean Monthly Rainfall (Jan., 1981 - Oct., 1986).</b>	<b>15</b>
<b>4</b>	<b>Mean Preweaning Mortality % of KK and BR in relation to Mean Monthly Rainfall (Jan., 1981 - Oct., 1986).</b>	<b>18</b>
<b>5</b>	<b>Yearly Total Mortality % of KK and BR in relation to Annual Rainfall (Jan., 1981 - Oct., 1986).</b>	<b>19</b>
<b>6</b>	<b>Total Mortality % of KK and BR in relation to Mean Monthly Rainfall (Jan., 1981 - Oct., 1986).</b>	<b>20</b>
<b>7</b>	<b>Birth Weight of KK and BR (Male, Female and LS Means) over the years (Jan., 1981 - Oct., 1986).</b>	<b>25</b>
<b>8</b>	<b>Weaning Weight of KK and BR (Male, Female and LS Means) over the years (Jan., 1981 - Oct., 1986).</b>	<b>26</b>
<b>9</b>	<b>Average Daily Gains of KK and BR (Male, Female and LS Means) over the years (Jan., 1981 - Oct., 1986).</b>	<b>27</b>
<b>10</b>	<b>Days to Weaning of KK and BR (Male, Female and LS Means) over the years (Jan., 1981 - Oct., 1986).</b>	<b>28</b>

## ABSTRACT

### REPRODUCTIVE AND CALF GROWTH PERFORMANCE OF KEDAH-KELANTAN (KK) AND BRAHMAN (BR) CATTLE IN A COMMERCIAL BEEF CATTLE FARM

by

Ng Kwok Chyuan

January 1987

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**Faculty:** Veterinary Medicine and Animal Science

*A study was carried out on the reproductive and calf growth performance of Kedah-Kelantan (KK) and Australian Brahman (BR) in a commercial beef cattle farm (Darabif). Records from dam, calf, body weight, rainfall and livestock return were analysed. There was no significant difference in age at first calving between breeds ( $P < 0.01$ ). A breed difference was only found in the first 3 calving intervals ( $P < 0.01$ ) but not in the 4th calving interval ( $P < 0.05$ ). Birth weight, weaning weight and ADG showed a highly significant difference between breeds ( $P < 0.01$ ) (BR > KK). Within breeds, sex difference was not significant in all the parameters ( $P < 0.05$ ). Year effect between breeds was highly significant in all the calf growth parameters ( $P < 0.01$ ). There was a highly significant difference between the sexes in birth weight and ADG ( $P < 0.01$ ) from year to year while weaning weight and days to weaning indicated no significant*

difference ( $P < 0.05$ ). The means of age at first calving and calving intervals of KK vs BR were  $1,023 \pm 143$  days ( $n = 50$ ) vs  $1,077 \pm 189$  days ( $n = 38$ ), 338 days - 365 days vs 368 days - 426 days. The least square means of birth weight, weaning weight and ADG of KK vs BR were 18.1 kg vs 31.3 kg, 103.7 kg vs 153.1 kg and 0.42 vs 0.59 kg. The figures for both these sets were comparable and in most cases better than those of previous studies. There was no apparent seasonal trend between % calving ( $r < 0.22$ ) and mortality ( $r < 0.09$ ). (preweaning and total mortality) with rainfall. Mean % calving for the past 6 years was KK - 77%, BR - 68% (KK > BR). Mortality % of KK and BR were low (< 5%).

## ABSTRAK

### PEMBIAKAN DAN PRESTASI TUMBESARAN ANAK LEMBU KEDAH-KELANTAN (KK) DAN BRAHMAN AUSTRALIA (BR) DI SEBUAH LADANG TERNAKAN LEMBU DAGING KOMERSIAL

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*Satu kajian telah dijalankan mengenai pembiakan dan prestasi tumbesaran anak lembu Kedah-Kelantan dan Brahman Australia (KK dan BR) di sebuah ladang ternakan lembu daging komersial (Darabif). Analisa dijalankan ke atas rekod-rekod lembu betina, anak lembu, berat badan, taburan hujan dan pulangan ternakan. Perbezaan baka hanya diperolehi pada 3 jangkamasa antara kebuntingan yang pertama tetapi tidak pada selang masa yang keempat ( $P < 0.01$ ). Berat lahir dan purata pertambahan berat harian menunjukkan perbezaan yang sangat ketara di antara baka ( $P < 0.01$ ) (BR > KK) kecuali jangkamasa cerai susu ( $P < 0.05$ ). Jantina tidak menunjukkan sebarang perbezaan yang ketara di lembu KK dan BR ( $P < 0.05$ ). Dari tahun ke tahun didapati perbezaan yang sangat ketara di antara jantina dalam berat lahir dan purata pertambahan berat harian ( $P < 0.01$ ). Sementara itu berat masa cerai susu tidak menunjukkan perbezaan ketara ( $P < 0.05$ ). Min umur haiwan itu mula-mula beranak dan min jangkamasa antara kebuntingan untuk KK mln BR adalah  $1,023 + 143$  hari (n*

= 50) mln 1,077 + 189 hari (n = 38), 338 hari - 365 hari mln 368 hari - 426 hari. Min kuasa dua ganda kecil untuk berat lahir, berat semasa cerai susu dan purata pertambahan berat badan bagi KK mln BR adalah 18.1 kg mln 31.3 kg, 103.7 kg mln 153.1 kg dan 0.42 kg mln 0.59 kg. Nilai-nilai bagi kedua set tersebut boleh dibandingkan dan pada kebiasaannya lebih baik daripada nilai-nilai yang diperolehi dari kajian-kajian sebelum ini. Min % kelahiran dan kematian tidak menunjukkan sebarang corak perhubungan yang tertentu berbanding dengan taburan hujan ( $r < 0.22$  - kelahiran dan  $r < 0.09$  kematian). Min % kelahiran dari 6 tahun yang lepas adalah KK - 77%; BR - 68% (KK > BR). Pada amnya, peratus kematian KK dan BR adalah rendah (< 5%).

## INTRODUCTION

In view of the Government intention to be self-sufficient in beef and to make available suitable animals of quality for the Pawah Scheme, there is a need to improve the local indigenous cattle. This is either by selection and upgrading or crossbreeding with imported exotic semen. However, information regarding the Kedah-Kelantan (KK) cattle especially on aspects of reproduction and growth rates are limited (Camoens, 1980; Ahmad and Kamal, 1984). In fact, little documentation has been made on cattle performance from private farms (Dahlan *et al.*, 1982). Devendra and Lee (1978) have even suggested that further studies should be done on the optimal breeding period for local cattle. For the past decade, there was an influx of improved crossbreds and exotic cattle into the country. Therefore, there is a need to evaluate the reproductive and growth performance of these cattle before further importation of such animals are carried out. These were the considerations that led to the initiation of the present study.

The first objective of the study is to obtain values of reproductive and calf growth performance of both Kedah-Kelantan (KK) and Australian Brahman (BR) cattle. This is for the purpose of evaluating and comparing both cattle breeds in a similar environment under a commercially managed farm.

The second objective is to obtain the calving percentage (%) and mortality percentage (%) (preweaning and total mortality). This is to examine whether there is a seasonal trend in these parameters with monthly and yearly rainfall data and feed availability.

## **LITERATURE REVIEW**

### **Kedah-Kelantan (KK)**

KK is considered as an indigenous cattle, though not in origin and ancestry, but rather by virtue of its long domiciled history in the country. It was first mentioned by Anon (1938). The local Zebu had its origin in Thailand and was derived from the Indian Zebus (Marsh and Dawson, 1947). The importance of this animal as an economic resource for beef cattle production was highlighted by Devendra and Lee (1978). This is reflected by the fact that they constitute 82% of total cattle population and are almost exclusively owned by smallholders.

### **Australian Brahman (BR)**

Australian Brahman (BR) was developed from the American Brahman between 1933 and 1954 and have since evolved in the grazing areas of Australia. The Australian Brahman (BR) were first introduced to Malaysia by Darabif in 1974. No studies on the Australian Brahman (BR) in Malaysia are known. However the Malaysian Agriculture Research and Development Institute (MARDI) imported the American Brahman in 1972. Preliminary studies on the adaptation, reproductive and growth performance were reported by Pathmasingham and Devendra (1974), Pathmasingham (1975) and Mohd. Arieff Omar (1978).

## MATERIALS AND METHODS

### Darabif

The source of data was from Darabif. The farm was set up in 1974 between Lembaga Kemajuan Pahang Tenggara (DARA) and Commonwealth Development Corporation (CDC). It is situated approximately 3° north of the equator astride the Kuantan-Segamat highway in South-East Pahang. Presently the total land measures 6,875 acres of which 5,773 acres is planted with grasses and legumes. The grasses planted are Setaria kazungula/legumes (4,332 acres), Brachiaria decumbens (1,026 acres), Panicum maximum/legumes (46 acres), and Setaria splendida/legumes (23 acres). Legumes are mostly Desmodium ovaliflorum and Centrosema pubescens. The total animal population since October 1986 is 6,843 of which 5,796 heads are KK and 1,047 heads are BR.

The ratio of employees to heads of cattle range from 1:257 to 1:412. Cattle are continuously grazed or set stocked. Drinking water is obtained from constructed earth dams. Tagging and tattooing are practised in the farm for identification of the animals. Branding was introduced recently to replace tagging. The fertilization programme includes application of urea, Christmas Island Rock phosphate (CIRP) and muriate of potash (MOP). A non-seasonal breeding system of single and double sire heads is practised. The ratios of bulls to cows are 1:20, 1:30-35 and 1:40-45 for bulls less than 3 years, between 3-5 years and above 5 years of age, respectively. The herd-health programme involves deticking, deworming and vaccination with Foot and Mouth Disease (FMD) inactivated O and A bivalent vaccine.

## **Derivation of parameters**

The reproductive and calf growth performance parameters was derived from the calculations below:

### **Reproductive parameters**

1. Age at puberty =

Age at first calving - Average gestation period of that breed.\*

2. Age at first calving =

First calving date - Birth date of heifer.

3. Calving interval =

Time between two successive calvings.

4. Calving percentage =

$$\frac{\text{Number of calvings}}{\text{Number of females of breeding age}} \times 100$$

5. Calves born per month percentage =

$$\frac{\text{Number of calves born in the month}}{\text{Total number of calves born in the year}} \times 100$$

6. Mortality percentage =

$$\frac{\text{Number of deaths}}{\text{Total number of animals}} \times 100$$

### **Calf Growth Performance Parameters**

1. Birth weight (kg.)

2. Weaning weight (kg.)

\* KK : Gestation period =  $285 \pm 4.3$  days. (CAMOENS, 1980).

BR : Gestation period = 293 days. (PLASSE et al., 1968a).

3. Average daily gain from birth to weaning (kg./day) =

$$\frac{\text{Weaning weight} - \text{Birth weight (kg.)}}{\text{Weaning days}}$$

4. Weaning days =

$$\text{Weaning date} - \text{Birth date.}$$

### Statistical analysis

Data was analysed by a General Linear Model procedure (GLM) using the SAS system in the computer (SAS Users Guide, 1979). GLM was used for the analysis of variance (ANOVA) because of unbalanced data while the F-test was used to determine for statistical significance (Cochran and Cox, 1957).

The model for the reproductive parameters ( $Y_1$ ) was:

$$Y_1 = M + B + \text{Animal No. (Breed)} + E$$

where M = Means of calving interval; B = Breed; E = Error; Animal No. (Breed) = No. of animals within breed.

The model for the calf growth performance parameters ( $Y_2$ ) was:

$$Y_2 = M + B + S^{\#} + (S \times B) + Y + (B^+Y) + (S \times B^+Y) + E$$

where M = Means; B = Breed; S = Sex; Y = Year; E = Error; (S X B) = sex within breed; (B<sup>+</sup>Y) = breed between years; (S X B<sup>+</sup>Y) = sex within breed between years; S<sup>#</sup> = sex between breed.

Least Square Mean (LSM) was used to give a more accurate estimate of the subclass of the calf growth performance that would be expected had equal subclass numbers been obtainable. Regression analysis was used to determine any correlation of calving percentage (%) and mortality percentage (%) with the rainfall.

## RESULTS AND DISCUSSION

### Reproductive Performance

Age at puberty must be evaluated with caution as it was calculated from the age at first calving. In this case, age at puberty is not necessary age at first oestrus or conception as the animals might have several oestrus or conceived earlier. Although KK cattle is indigenous to Malaysia in comparison to BR cattle, there was no significant difference ( $P < 0.05$ ) between breeds on age at first calving (Table 1 and Appendix 5).

**Table 1: Age at puberty, age at first calving and calving intervals of Kedah-Kelantan (KK) and Brahman (BR) cattle.**

Parameter	No. of animals	KK		BR	
		Means + SD (days)	No. of animals	Means + SD (days)	
Age at puberty	50	738 + 143	38	784 + 189	
Age at 1st. calving	50	1023 + 143NS	38	1077 + 189NS	
1st. calving interval	183	353 + 60**	70	426 + 103**	
2nd. calving interval	183	357 + 58**	73	412 + 89**	
3rd. calving interval	121	364 + 69**	47	424 + 150**	
4th. calving interval	71	365 + 83NS	30	368 + 55NS	
5th. calving interval	22	363 + 83	6	371 + 29	
6th. calving interval	6	338 + 31	1	514	

\*\* highly significant ( $p < 0.01$ ).

\* significant ( $P < 0.05$ ).

NS not significant ( $P < 0.05$ ).

In contrast, the first to third calving intervals were significantly higher ( $P < 0.01$ ) in BR than KK cows. However, breed differences were not detected for the fourth calving interval. These results suggest that BR cows can reproduce as well as KK cows in later parities. Although parity effects were not clear, BR tend to have longer calving intervals in earlier parities. This accords with previously published work on tropical and temperate cattle (Anderson, 1966, Schalles and Marlowe, 1967; Sievers, 1967; Sanchez, 1969; Barrios, 1970; Estrada, 1970). As reported in previous studies on Zebu cattle (Cartwright and Carpenter, 1961; Melton, et al., 1967), KK cows in the present study appeared also to show a shorter first calving interval.

Long calving intervals in beef cattle are usually caused by long postpartum anoestrus and lactational anoestrus (Tan et al., 1986; Melton, et al., 1967). The short calving intervals in KK cows resulted from very early resumption of postpartum ovarian activity and conception, inspite of suckling, as reported by Tan et al., 1986.

As compared to previous studies, the mean age at first calving and calving intervals of KK in the present study were generally shorter in length, but comparable to those reported by Devendra and Lee (1978) and Wolf et al., 1982 (Table 3). Similarly, the BR also showed a slightly shorter age at first calving and calving intervals. The mean calving intervals of BR were comparable to the results of Lamond (1973) but were considerably shorter than those of American Brahman reported locally (Mohd. Arief Omar, 1978) (Table 3). This might be attributed to better nutrition and improved management which can enhance reproductive performance considerably, although genetic difference may also be responsible.

## Calf Growth Performance

The higher genetic potential in BR resulted in the cattle showing a significantly higher ( $P < 0.01$ ) birth weight, weaning weight and average daily gain (ADG) from birth to weaning than KK (Table 2 and Figs. 7 to 9). This might possibly also reflect better mothering ability in BR compared to KK cows. However, there was no significant difference ( $P < 0.05$ ) between both breeds in days to weaning (Table 2 and Fig. 10). Birth weight, weaning weight and ADG were highly significant ( $P < 0.01$ ) in terms of sex between breeds but again no significant difference ( $P < 0.05$ ) in days to weaning. However, within breeds, calf growth performance were equal as there was no significant difference ( $P < 0.05$ ) in all the parameters measured between sexes (Figs. 7 to 10).

Table 2: Calf Growth Performance of KK and BR

Parameter	KK			BR		
	M (n = 343) Mean + SD	F (n = 352) Mean + SD	LS Means	M (n = 94) Mean + SD	F (n = 117) Mean + SD	LS Means
Birth weight (kg.)	18+3 <sup>a</sup>	17+4 <sup>a</sup>	18	31+3 <sup>b</sup>	31+3 <sup>b</sup>	31
Weaning weight (kg.)	112+23 <sup>a</sup>	99+20 <sup>a</sup>	104	156+29 <sup>b</sup>	150+25 <sup>b</sup>	153
ADG: Birth to weaning (kg.)	0.460+0.115 <sup>a</sup>	0.394+0.101 <sup>a</sup>	0.417	0.611+0.147 <sup>b</sup>	0.567+0.121 <sup>b</sup>	0.586
Weaning days	202+36	208+16	206	206+17	211+17	209

<sup>†</sup>n = 342

Means of different superscripts within the row indicated significant difference ( $P < 0.01$ ).

M - male

F - female

The year effects from January, 1983 to October, 1986 revealed highly significant ( $P < 0.01$ ) difference in calf growth performance. This is most probably attributed to changes in environment and management from year to year. Breed differences were significant in all the parameters except for days to weaning ( $P < 0.05$ ). Within breeds, the males showed a significantly higher ( $P < 0.05$ ) birth weight and ADG from year to year than the females (Figs. 7 and 11). However, there were no significant difference ( $P < 0.05$ ) in weaning weight and days to weaning (Appendix 5).

In comparison to previous studies, KK showed a higher birth weight, weaning weight and average daily gain (ADG) from birth to weaning in the commercial farm. (Table 3). These higher values probably reflect better nutrition and improved management, especially in breeding selection and culling practised in the farm. Meanwhile, the BR showed a higher birth weight and ADG than previous studies. In contrast, weaning weight obtained was lower than those reported overseas (Crockett, 1973; Peacock et al., 1973) but higher than in American Brahman reported locally (Mohd. Arieff Omar, 1978. (Table 3).

**Table 3: Comparative reproductive and calf growth performance in Kedah-Kelantan (KK) and Brahman (BR) cattle.**

Item	KK		BR	
	Means $\pm$ SD	Reference	Means $\pm$ SD	Reference
1. Age at puberty (months)	24.6 $\pm$ 4.8	NG, K.C. (1987)	26.1 $\pm$ 6.3	NG, K.C. (1987)
	10 to 12*	DEVENDRA & LEE (1978)	27.2 <sup>2</sup>	REYNOLDS <i>et al.</i> (1963)
			14 to 24 <sup>+</sup>	PLASSE <i>et al.</i> (1968a)
2. Age at first calving	34.1 $\pm$ 4.8	NG, K.C. (1987)	35.9 $\pm$ 6.3	NG, K.C. (1987)
	44.4 $\pm$ 0.4	DEVENDRA & LEE (1975a)	39.3	WILLIS & WILSON (1974)
	26 to 54	DEVENDRA & LEE (1978)		
	39.1 $\pm$ 9.9	CAMOENS (1980)		
	36.8 $\pm$ 5.4	AHMAD & KAMAL (1984)		
3. Calving intervals (days)	338 to 365	NG, K.C. (1987)	368 to 426	NG, K.C. (1987)
	394 $\pm$ 73 <sup>x</sup>	TAN (1983)	460	LINARES & PLASSE (1966)
	451 $\pm$ 8 <sup>x</sup>	DEVENDRA & LEE (1975a)	409	PLASSE <i>et al.</i> (1968b)
	471 $\pm$ 13 <sup>x</sup>	SIVARAJASINGAM (1976)	431	SANCHEZ (1969)
	334 to 890	DEVENDRA & LEE (1978)	375	LAMOND (1973)
	390 to 535	CAMOENS (1980)	437	WILLIS & WILSON (1974)
	367 $\pm$ 39.8	WOLF <i>et al.</i> (1982)		
	431 to 473	AHMAD & KAMAL (1984)	478 $\pm$ 19.9	MOHD. ARIEFF OMAR (1978)

Table 3 (cont.)

Item	KK		BR	
	Means + SD	Reference	Means $\pm$ SD	Reference
4. Birth weight (kg) Both sexes	18.1	NG, K.C. (1987)	31.3	NG, K.C. (1987)
	15.3	DEVENDRA <u>et al.</u> (1973)	30	CARTWRIGHT (1973)
	15.3	KHAIRUDIN A. (1973)	26.36	PATHMASINGHAM (1975)
	15.2	DEVENDRA & LEE (1978)	25.52 $\pm$ 1.13 <sup>x</sup>	MOHD. ARIEFF OMAR (1978)
	14 to 16	LAPORAN MARDI KLUANG (1981)		
	16.6 $\pm$ 1.6	AHMAD & KAMAL (1984)		
5. Weaning weight (kg) Both sexes	103.7	NG, K.C. (1987)	153.10	NG, K.C. (1987)
	55.6 <sup>§</sup>	KHAIRUDIN A. (1973)	173.73	CROCKETT (1973)
	55.6 to 59.6	DEVENDRA <u>et al.</u> (1973)	194.59	PEACOCK <u>et al.</u> (1973)
	73.0	DEVENDRA & LEE (1978)	119.73 $\pm$ 10.04	MOHD. ARIEFF OMAR (1978)
	67.4 to 69.4	DAHLAN <u>et al.</u> (1981)		
	72.6 <sup>§</sup>	LAPORAN MARDI KLUANG (1981)		
6. ADG Birth to Weaning (kg) Both sexes	0.42	NG, K.C. (1987)	0.59	NG, K.C. (1987)
	0.31 to 0.33	DEVENDRA <u>et al.</u> (1973)	0.45	TURNER (1973)
	0.37 to 0.39	DAHLAN <u>et al.</u> (1981)	0.35 to 0.52	MOHD. ARIEFF OMAR (1978)
	0.31 <sup>§</sup>	LAPORAN MARDI KLUANG (1981)		

\* first puberty (first oestrus)

§ weight at 6 months

\$ ADG at 6 months

x standard error

+ first corpus luteum

z first oestrus

## **Month and year effect on percentage (%) calving and mortality**

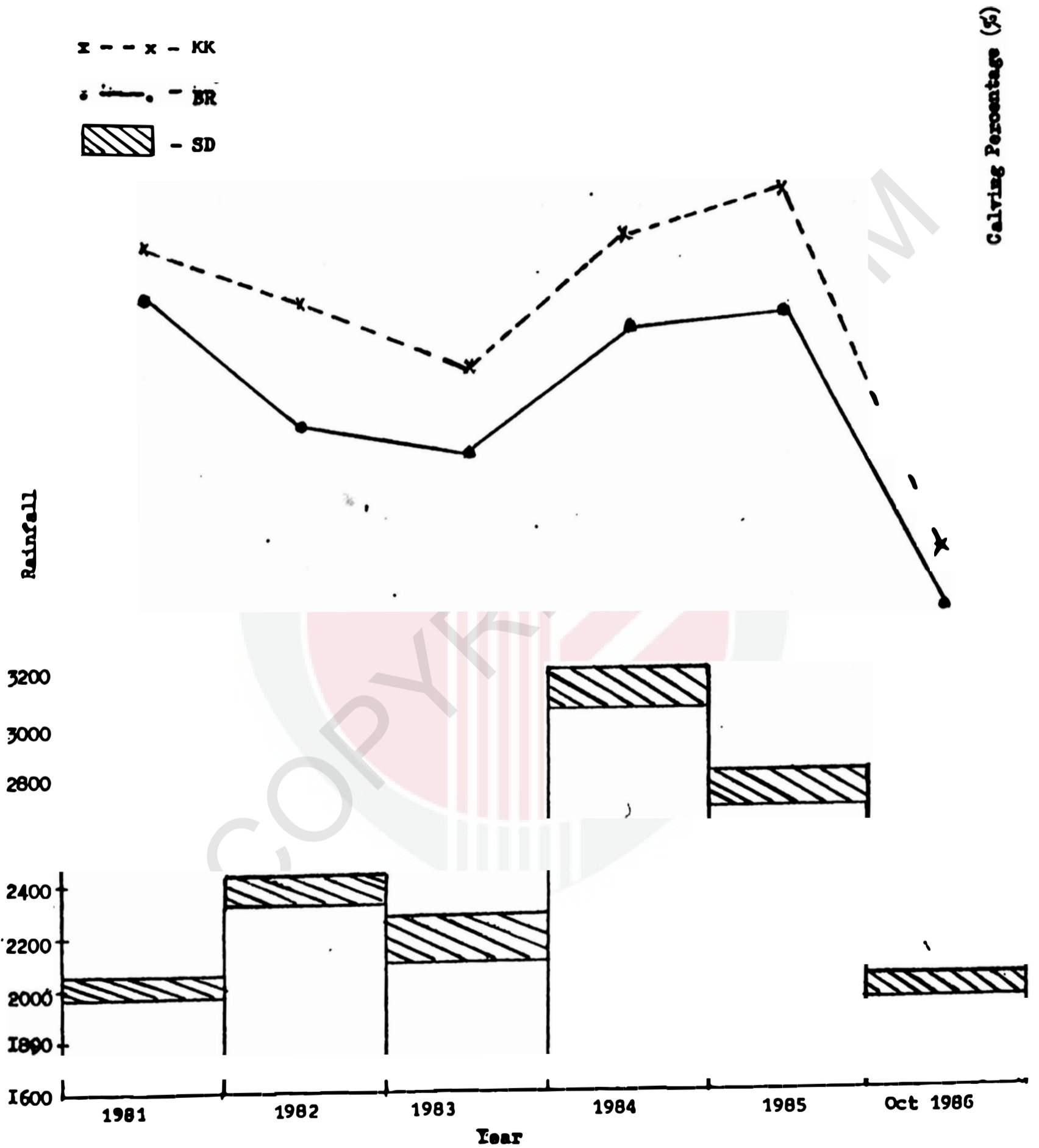
### **Year effect**

The ranch received an adequate amount of rainfall throughout the years (Jan., 1981 to Oct., 1986). It ranges from moderate (2,000–2,400 mm) (1981, 1982, 1983 and 1986) to intense (more than 2,400 mm) (1984 and 1985) (Figs. 1, 2 and 3).


The calving percentage (%) and the mortality percentage (%) have no significant correlation with the rainfall (Appendix 6). Variation in the calving percentage (%) from year to year may be due to management rather than seasonal climatic variation. Reduced fertility as the probable result of inbreeding in the BR herd may be the reason for the low calving percentage (%) of BR compared to KK (Fig. 1). The mean calving percentage (%) was good throughout the years (KK-77%, BR-68%).

The preweaning mortality contribute most to the total mortality (Figs. 2 and 3). The high mortality percentage (%) (preweaning and total mortality) especially for BR in 1981 and 1982 as compared to the other years was caused by tigers' attacks on the herd (Darabif annual report 1981 and 1982), while the reasonably high mortality percentage (%) in 1986 was the result of cobalt deficiency (Darabif annual report 1986). Generally the percentage (%) of preweaning and total mortality were very low, not exceeding even 5%.

Figure 1 : Calving % of KK and BR in relation to Annual Rainfall  
(Jan., 1981 - Oct., 1986)



**Figure 2 :**  
**Yearly Prewearing Mortality % of KK and BR in relation to Annual Rainfall (Jan., 1981 - Oct., 1986)**

x - - x - KK  
 . - - . - BR  
 - SD

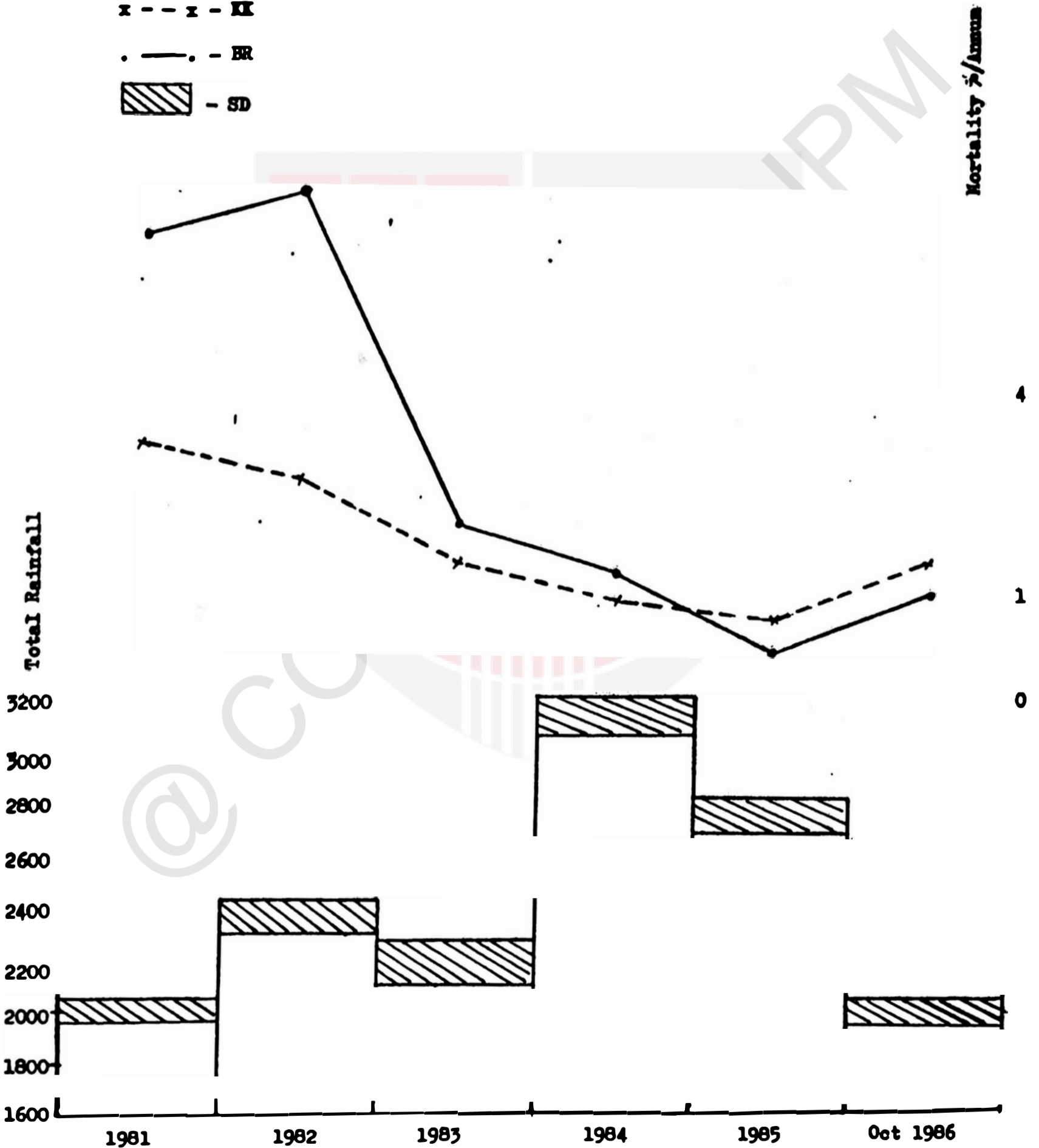
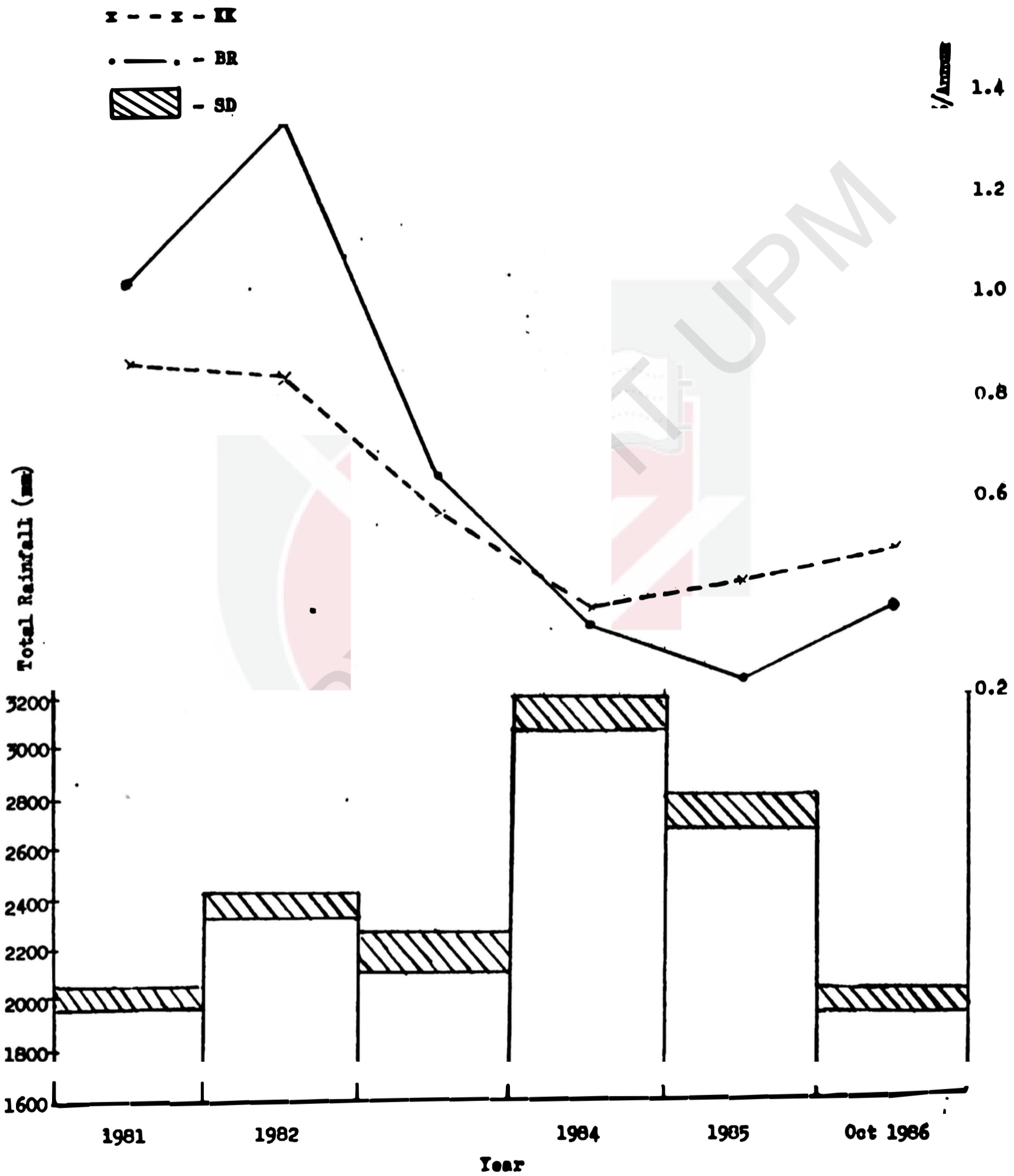


Figure 3 : Yearly Total Mortality % of KK and BR in relation to Annual Rainfall (Jan., 1981 - Oct., 1986)



### Month effect

The ranch received a well distributed rainfall throughout most of the year (Figs. 4, 5 and 6). Basically there are two monsoons, that is South-West monsoon from April to July and the North-East monsoon from September to January (peaking in November and December). The North-East monsoon is evident but not the South-West monsoon. The dry months were February and June (below 140 mm). The wet months were March and December (above 250 mm). Meanwhile the other months were considered moderately wet (Figs. 4, 5 and 6). As seen from the standard deviation, there was a lot of variation in the early part of the year. Therefore it is impossible to predict the timing or severity of the rainfall during the early part of the year. The rainfall pattern observed here suggests that rainfall was of little constraint on grass growth. However heavy storms, especially at the end of the year, prevent management from adhering to its pasture renovation programme and drainage work in swampy areas. This may result in feed reduction (forage) in terms of availability and quality as it also causes poor soil aeration, leaching and waterlogging.

The calving percentage (%) and mortality percentage (%) (preweaning and total mortality) showed no significant correlation with rainfall (Appendix VI). This differs from some studies which showed increased calvings in the dry season with American Brahman (Linares and Plasse, 1966; Sanchez, 1969) and Santa Gertrudis (Estrada, 1970; Barrios, 1970). In contrast, Willis and Wilson (1974) found a high proportion of calves born in the wet season. The non-seasonal trend observed in the ranch suggests that rainfall was adequate throughout the year for pasture growth in comparison to other countries with distinct dry season or drought. This suggests conception have no seasonal trend and consequently a more

uniform calving was observed throughout the year. Heavy rainfall affects the survival rate of calves (Plasse et al., 1968a), but it is not evident from the regression analysis of the mortality percentage (%) (preweaning and total mortality) with the rainfall (Appendix 6). This may be due to the fact that the variation of the early months affected the repeatability values. However, the wet month of December showed a higher mortality percentage (%) (preweaning and total mortality) than the other months (Figs. 5 and 6).



Figure 4: Mean Calving % of KK and BR in relation to Mean Monthly Rainfall (Jan., 1981 - Oct., 1986)

x - - x - KK  
 . - - . - BR  
 [Hatched Box] - SD

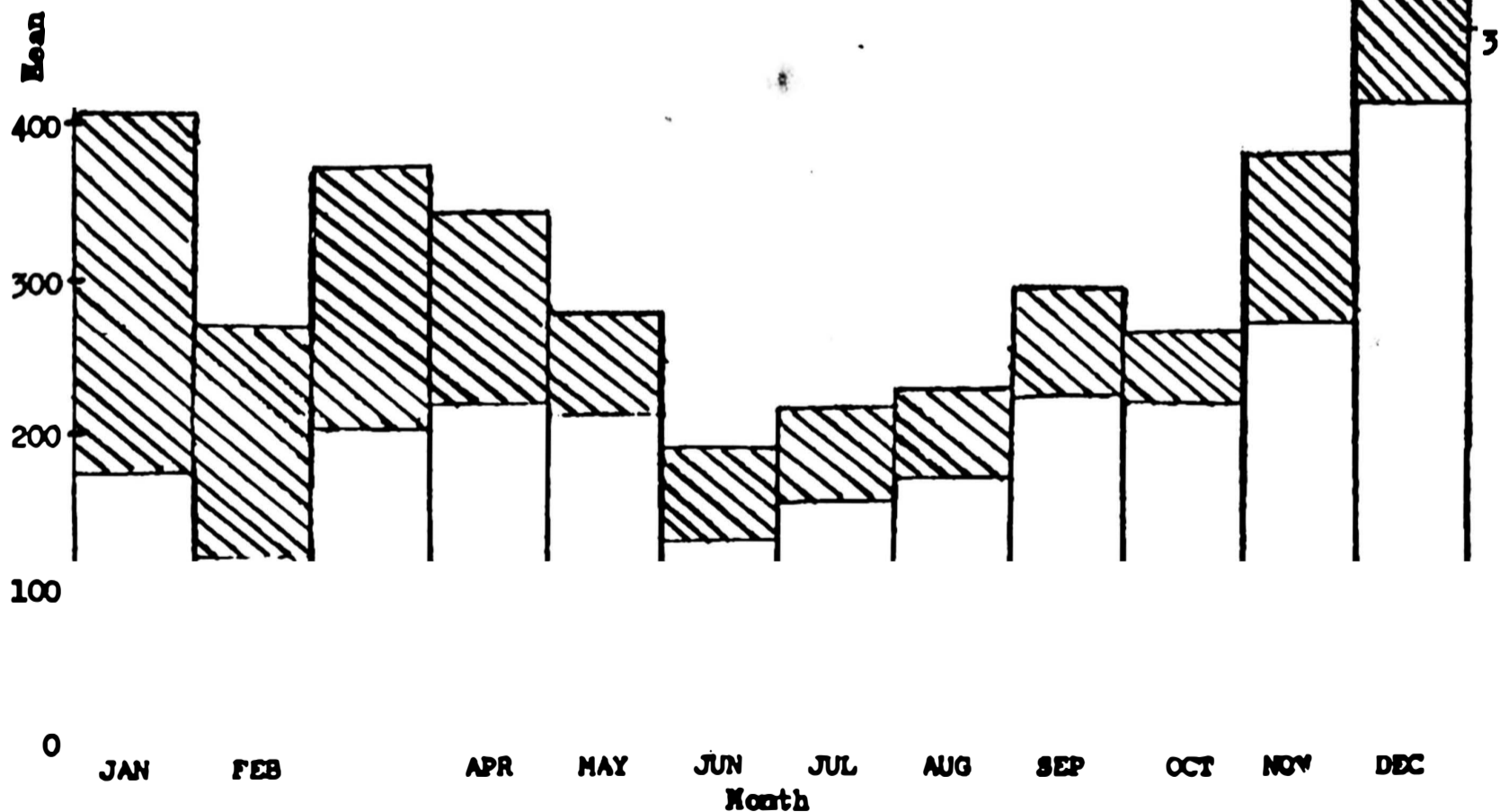


Figure 5 : Mean Preventing Mortality % of KK and BR in relation to Mean Monthly Rainfall (Jan., 1981 - Oct., 1986)

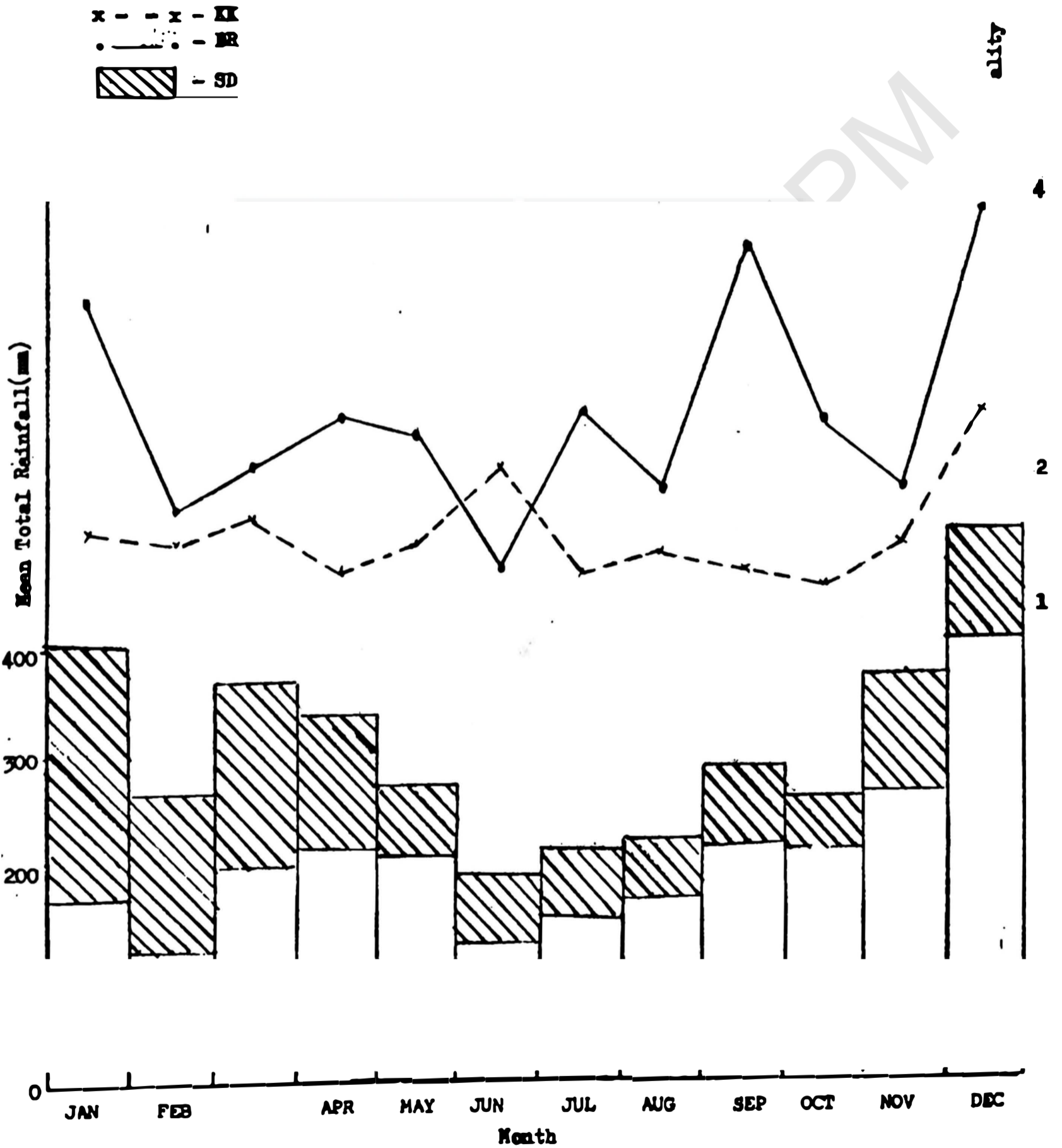
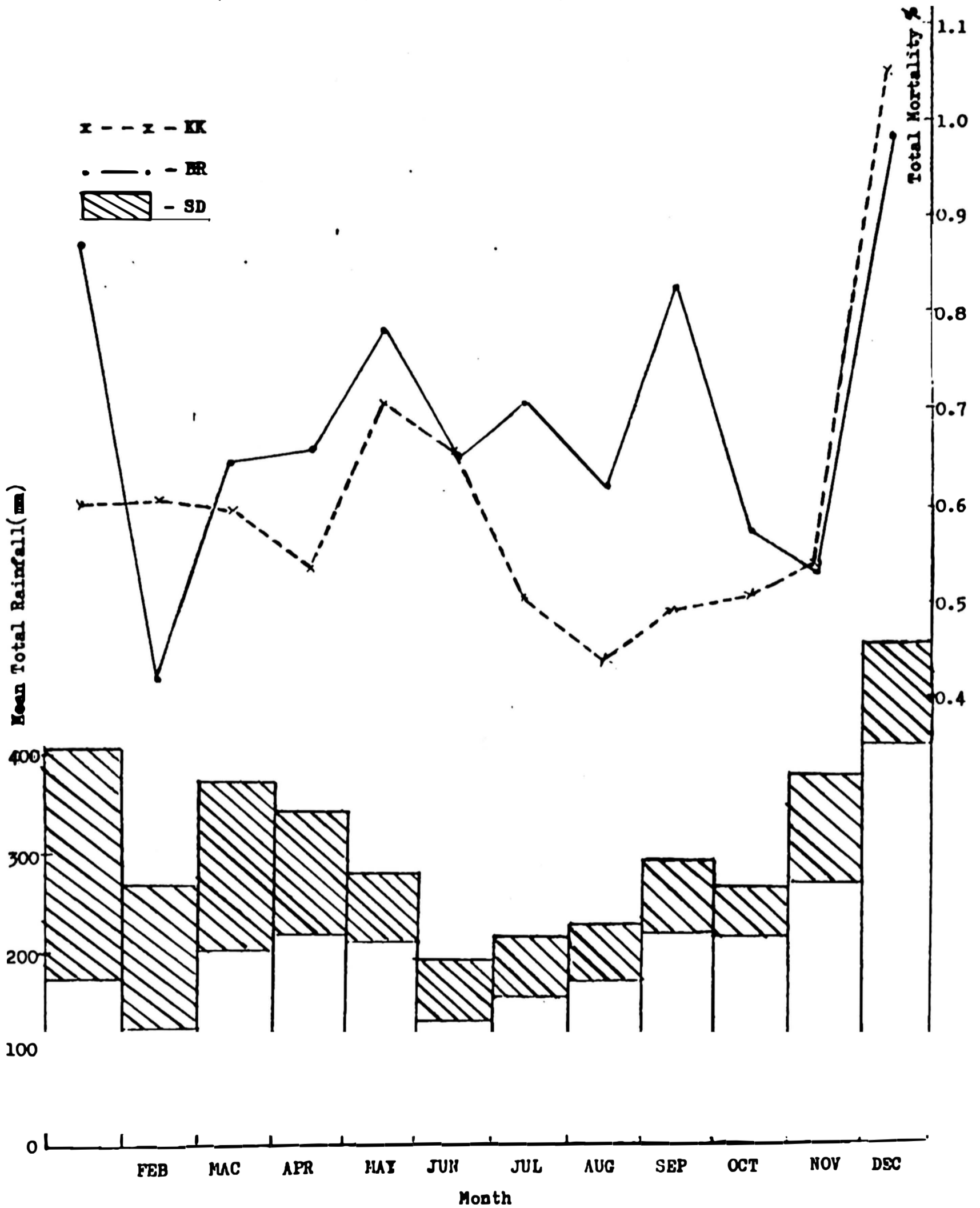


Figure 6 : Total Mortality % of KK and BR in relation to Mean Month Rainfall (Jan., 1981 - Oct., 1986)



## **CONCLUSION**

**This study suggests that in comparison with the BR, KK cows was more consistent in producing one calf a year. KK cows showed a short first calving interval with a relatively longer subsequent intervals. On the other hand, BR cows showed the opposite trend. In terms of age at first calving, KK and BR cows did not show any significant difference.**

**In view of the higher genetic potential of BR, the BR calf showed a significantly higher birth weight, weaning weight and ADG from birth to weaning than the KK calf. Males and females showed equal calf growth performance, as sex difference was not significant.**

**In general, the reproductive and calf growth performance of KK and BR obtained in this commercial farm were comparable, and in most cases were better than those of previous studies (Table 3). The reason for these was probably related to the good management and improved nutrition in the farm.**

**The rainfall pattern observed from 1981 to 1986 suggests that the amount of rainfall was adequate. Feed in terms of availability and quality are probably most affected during heavy rainfall as it causes poor soil fertility (leaching, waterlogging and poor soil aeration) and it prevents machines from working on the pasture.**

**The percentage (%) of calving and mortality for the past 6 years (1981-1986) showed no correlation or any apparent seasonal trend in relation to the monthly and yearly rainfall. On the whole, the percentage (%) calving and mortality were relatively good with an annual mean of 77% and 68% for KK and BR respectively for percentage (%) calving and not exceeding 5% for mortality (BR and KK).**

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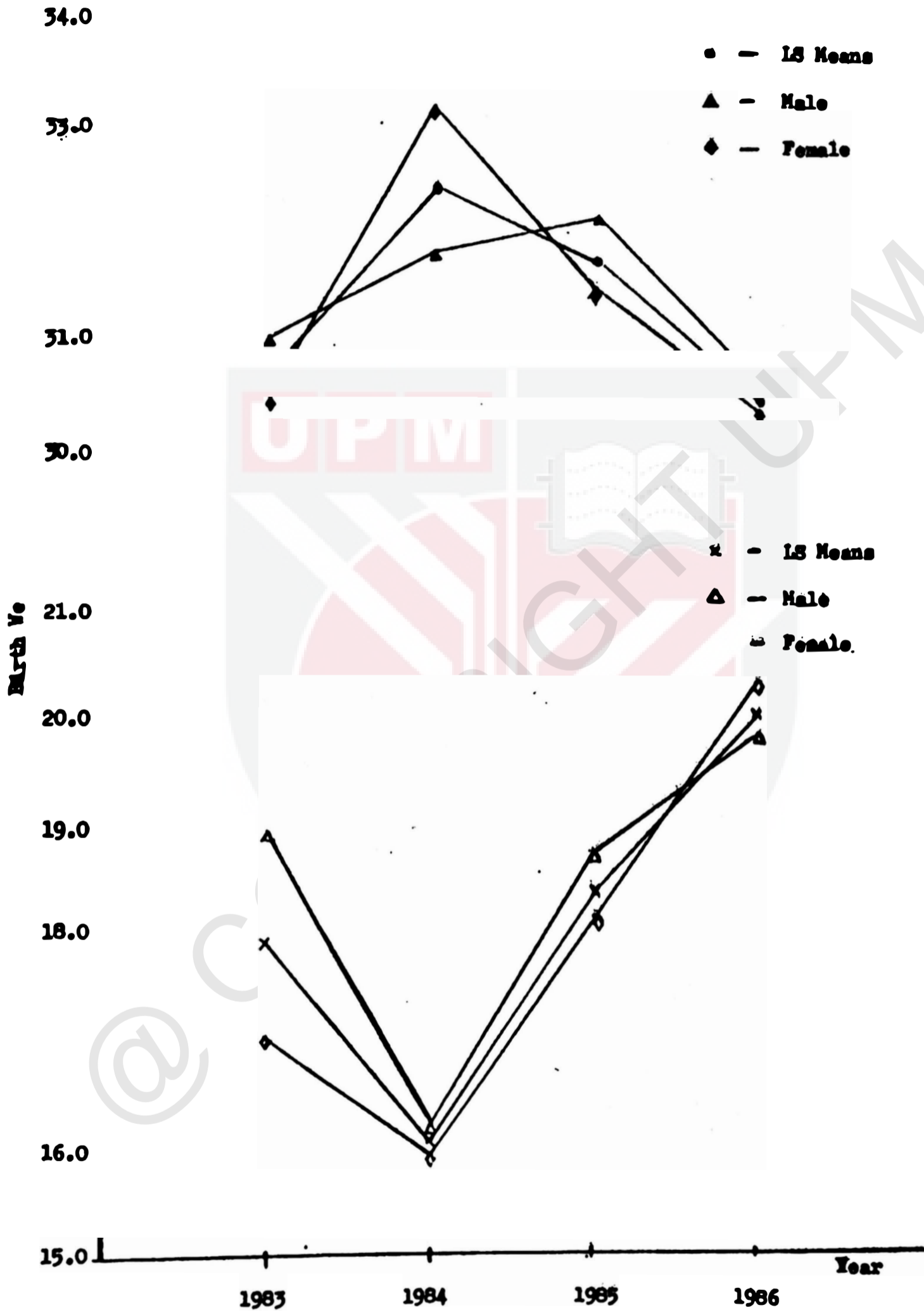
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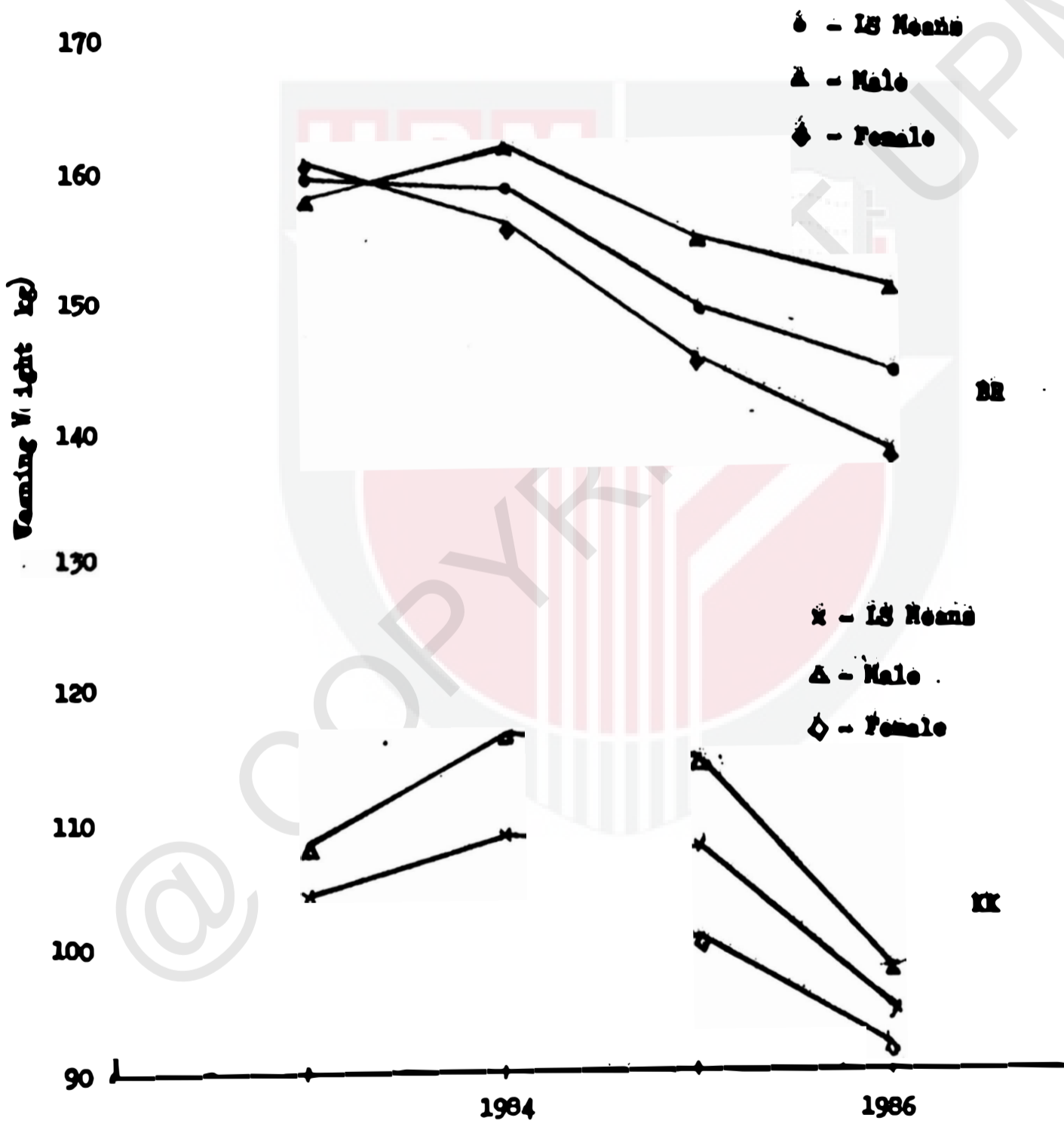
# APPENDIX 1

Figure 7 : Birth Weight of KK and BR (Male, Female and LS Means) over the years (Jan., 1981 - Oct., 1986)



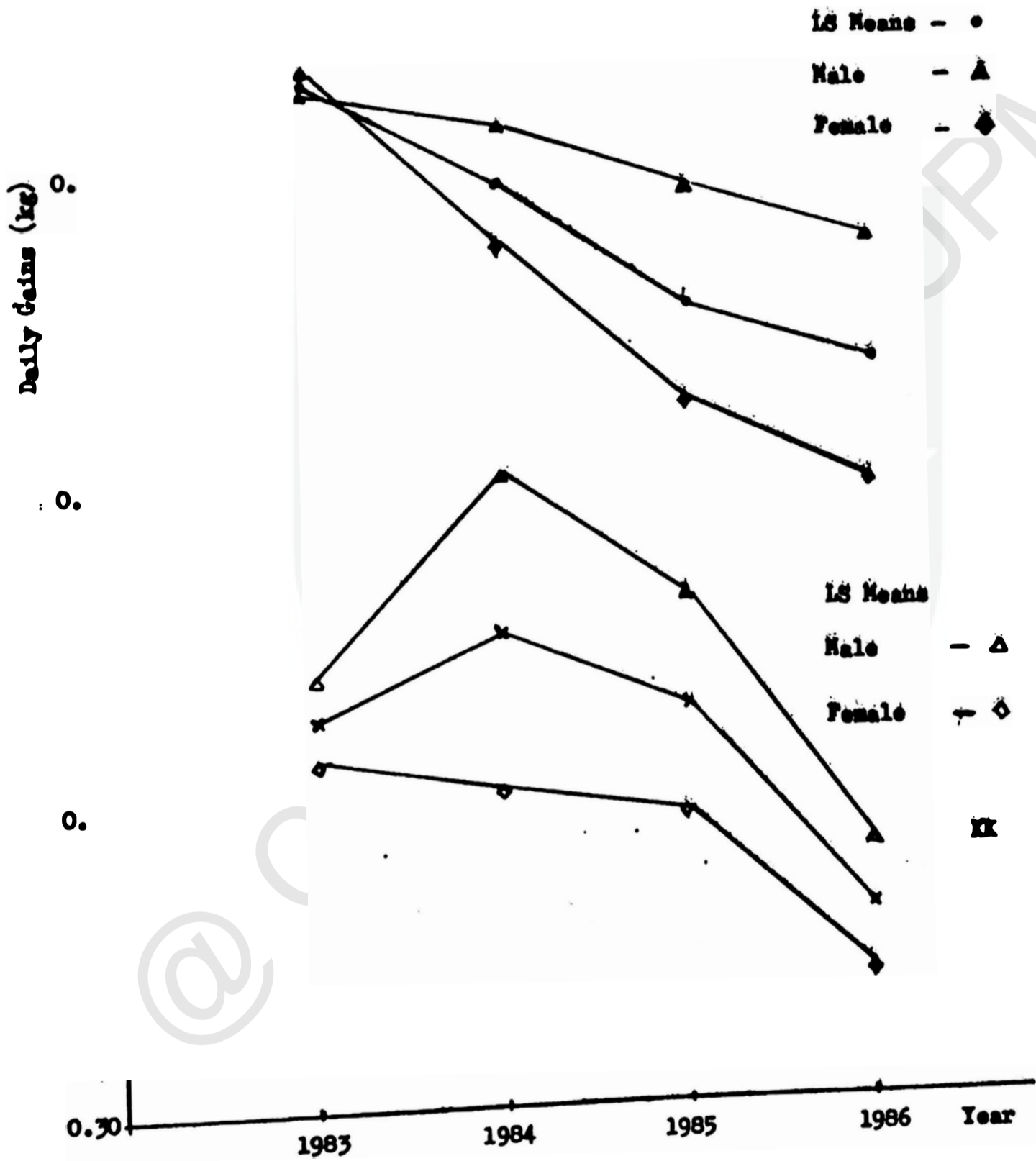
## APPENDIX II

**Figure 8 : Weaning Weight of KK and BR (Male, Female and LS Means) over the years (Jan., 1981 - Oct., 1986)**



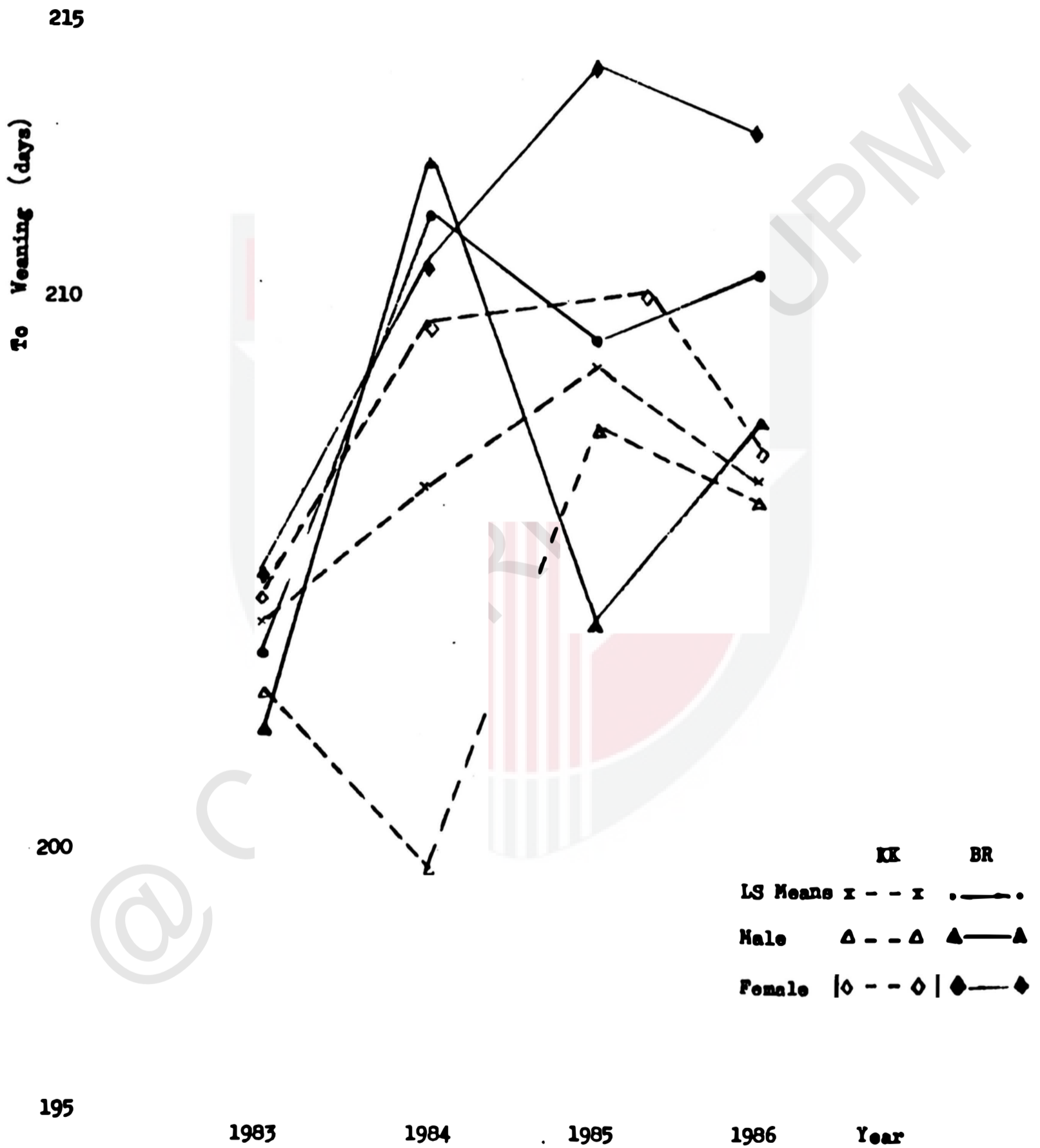
### APPENDIX III

**Figure 9 : Average Daily Gains of KK and BR (Male, Female and LS Means) over the years (Jan., 1981 - Oct., 1986)**



## APPENDIX IV

Figure 10 : Days to Weaning of KK and BR (Male, Female and LS Means)  
over the years (Jan., 1981 - Oct., 1986)



APPENDIX V

SAS: General Linear Model Procedure (GLM)

I. Birth weight (Jan., 1983 - Oct., 1986).

Source	DF	SS	MS	F <sub>tab.</sub>	F <sub>value</sub>
Breed	1	21984.36	29184.36	(1,890)1%:6.67	3095.08**
Sex	1	70.91	70.91	(1,890)1%:6.67	7.52**
Sex (Breed)	1	32.31	32.31	(1,890)5%:3.85	3.43NS
Year	3	545.61	181.87	(3,890)1%:3.81	19.29**
Breed <sup>+</sup> Year	3	565.15	188.38	(3,890)1%:3.81	19.98**
Sex (Breed) <sup>+</sup> Year	6	124.71	20.79	(6,890)5%:2.11	2.20*
Error	890	8392.04	9.43		
TSS	905	38915.10			

II. Weaning weight (Jan., 1983 - Oct., 1986).

Source	DF	SS	MS	F <sub>tab.</sub>	F <sub>value</sub>
Breed	1	363129.24	363129.24	(1,890)1%:6.67	719.24**
Sex	1	28203.94	28203.94	(1,890)1%:6.67	55.86**
Sex (Breed)	1	1789.57	1789.57	(1,890)5%:3.85	3.54NS
Year	3	10745.84	3581.95	(3,890)1%:3.81	7.09**
Breed <sup>+</sup> Year	3	5789.03	1929.68	(3,890)1%:3.81	3.82**
Sex (Breed) <sup>+</sup> Year	6	4331.09	721.85	(6,890)5%:2.11	1.43NS
Error	890	449343.90	504.88		
TSS	905	863332.61			

III. ADG Birth to Weaning (Jan., 1983 - Oct., 1986).

Source	DF	SS	SS	F <sub>tab.</sub>	F <sub>value</sub>
Breed	1	4.13	4.13	(1,890)1%:6.67	342.19**
Sex	1	0.18	0.81	(1,890)1%:6.67	67.04**
Sex (Breed)	1	0.02	0.02	(1,890)5%:3.85	1.74NS
Year	3	0.38	0.13	(3,890)1%:3.81	10.46**
Breed <sup>+</sup> Year	3	0.20	0.07	(3,890)1%:3.81	5.62**
Sex (Breed) <sup>+</sup> Year	6	0.18	0.03	(6,890)5%:2.11	2.51*
Error	890	10.74	0.01		
TSS	905	16.46			

APPENDIX V (cont.)

IV. Weaning days (Jan., 1983 - Oct., 1986).

Source	DF	SS	MS	F <sub>tab.</sub>	F <sub>value</sub>
Breed	1	622.87	622.87	(1,890)5%:3.85	2.16NS
Sex	1	2859.85	2859.85	(1,890)1%:6.67	9.91**
Sex (Breed)	1	76.04	76.04	(1,890)5%:3.85	0.26NS
Year	3	3498.66	1166.22	(3,890)1%:3.81	4.04**
Breed <sup>+</sup> Year	3	876.44	292.15	(3,890)5%:2.61	1.01NS
Sex (Breed) <sup>+</sup> Year	6	2499.29	416.55	(6,890)5%:2.12	1.44NS
Error	890	256911.47	288.66		
TSS	905	267344.63			

V. 1st Calving Interval.

Source	DF	SS	MS	F <sub>tab.</sub>	F <sub>value</sub>
Breed	1	264563.43	264563.43	(1,251)1%:6.75	48.24**
Animal No. (Breed)	251	1376664.87	5484.72		
Error					
TSS	252	1641228.30			

VI. 2nd Calving Interval.

Source	DF	SS	MS	F <sub>tab.</sub>	F <sub>value</sub>
Breed	1	157472.32	157472.32	(1,254)1%:6.74	33.48**
Animal No. (Breed)	254	1194648.70	4703.34		
Error					
TSS	255	1352121.03			

## APPENDIX V (cont.)

## VII. 3rd Calving Interval.

Source	DF	SS	MS	F <sub>tab.</sub>	F <sub>value</sub>
Breed	1	123383.56	123382.56	(1,166)1%:6.79	12.73**
Animal No. (Breed)	166	1608558.29	9690.11		
Error					
TSS	167	1731940.85			

## VIII. 4th Calving Interval.

Source	DF	SS	MS	F <sub>tab.</sub>	F <sub>value</sub>
Breed	1	149.65	149.65	(1,99)1%:6.89	0.03NS
Animal No. (Breed)	99	570604.71	5763.68		
Error					
TSS	100	570754.36			

## IX. Age at 1st Calving of KK and BR.

Source	DF	SS	MS	F <sub>tab.</sub>	F <sub>value</sub>
Breed	1	63838.41	63838.41	(1,86)5%:4.00	2.36NS
Animal No. (Breed)	86	2323239.03	27014.43		
Error					
TSS	87	2387077.44			

+ between.

\*\* highly significant.

\* significant.

NS not significant.

## APPENDIX VI

## Regression Analysis of Rainfall with Calving % and Mortality %.

## I. Year effect

No.	Item	Breed	r	r <sup>2</sup>
1	Calving %	KK	0.59	0.35
		BR	0.52	0.27
2	Preweaning mortality %	KK	-0.59	0.34
		BR	-0.39	0.15
3	Total mortality %	KK	-0.60	0.36
		BR	-0.45	0.20

## II. Month effect

No.	Item	Breed	r	r <sup>2</sup>
1	Calving %	KK	0.22	0.05
		BR	0.20	0.04
2	Preweaning mortality %	KK	0.06	4 x 10 <sup>-3</sup>
		BR	0.09	8 x 10 <sup>-3</sup>
3	Total mortality	KK	0.07	5 x 10 <sup>-3</sup>
		BR	0.09	8 x 10 <sup>-3</sup>

r - repeatability value.

r<sup>2</sup> = goodness of fit.