STUDIES ON ECONOMIC TRAITS OF DEONI CATTLE

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CERTIFIED that Shri KRISHNA SRINIWASRAO DESHPANDE, U.P. College of Veterinary Science and Animal Husbandry, Mathura, a candidate for M.V.Sc. Final Examination of 1970 in Animal Genetics and Breeding has been working under my supervision during the session and that the accompanying thesis entitled "STUDIES ON ECONOMIC TRAITS OF DEONI CATTLE", which he is submitting is his genuine work.

Dated, April_____, 1970.

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CHAPTER - I

INTRODUCTION

CHAPTER - I

INTRODUCTION

That there exists a useful person like 'animal breeder' has been realized by our country because of the spectacular 'green revolution' brought about by our counterpart - 'the plant breeder.' We are all proud of it. The green revolution has brought a new wave of progressive awareness in our farmers. Slowly but surely they are shedding their illusions.

This situation is of advantage to animal breeders also. After all, Agriculture and Animal Husbandry have close associations.

Our specialities are our drawbacks. Every seventh person and every fourth cattle in the world is Indian. Inspite of this we are unable to meet the requirements of milk. Why such a condition? Nature does not want a cow to calve at a record age of three years or give an average of ten litres of milk per day or to calve at regular intervals of thirteen months or so. A breeder has to operate against the will of nature. When no breeding and feeding programme is carried out the cow

will naturally regress to its original level of producing an amount of milk just sufficient for the calf and will attain the age at maturity at a later stage and will calve irregularly and so on. Our cows have been neglected from the beginning. Only recently we have started a scientific approach and have made a little progress. If we adjourn all the feeding and breeding programmes sine die, cattle will attain the status quo.

The cow can eat the things, which we cannot (i.e. fodders, grasses, various bye-products) and convert into milk, meat, butter fat, which we can eat. We must see that these qualities are exploited to the maximum. Breeding them judiciously is the answer. The role of cattle breeder has always been to produce the genetic populations that are superior to the existing ones. The materials at his command for creation of such populations are the genes. The task is to produce individuals, whose genotypes represent optimum contributions of the available genes and devise breeding systems with which these superior genotypes are reproduced. For doing this, information on all the economic parameters is needed.

There is no possibility for any improvement in the economic production unless and until the breeder resorts to and depends upon the Population Genetics as a tool for manipulating the genes, necessary for further

improvement. Population Genetics as a science, art and tool for improving animals is indispensable for a breeder.

Along with the knowledge of Population Genetics the breeder must have the down to earth practicality of an economist. The economics of any enterprise is primarily based on the capital investment and the returns from it, after meeting the recurring expenditure incurred. In the same way the economics of a cow, rest on the cost of raising her during heifer stage to her age at first calving, when she will be called 'cow'. It is this capital she has to return through her production during lifetime after having met the overall expenditure on feeding, management and other miscellaneous items, To increase the load of capital investment on a heifer during the growth period amounts to increasing the liability on that animal to repay it back irrespective of her inherent capacity (Desai and Kumar, 1963).

In the advanced countries, where the mechanization is well established, the cow is maintained for production. In India, it is not so. The cow has to maintain the supply line of bullocks for agricultural purposes. The Deoni breed of cattle are dual purpose animals. The cows of this breed are good milkers and the bullocks are very famous for their enduring capacity and vigour. More than once, they have secured the supreme championship at the 'All India Cattle Shows.'

The present piece of work is undertaken with the following objectives in mind.

1. Hardly any published literature is available on this breed.

2. Recently the Government of Maharashtra is planning a cross-breeding project at Hingoli (Distt. Parbhani) with exotic breeds. The present work may help in knowing the breed qualities and structures before the project begins.

Therefore, in the present work, an attempt has been made to find out averages, repeatabilities, correlations, and regressions of economic characters in Deoni cattle.

CHAPTER - II

REVIEW OF LITERATURE

CHAPTER - II

REVIEW OF LITERATURE

GENERAL CONSIDERATION :

The essence of Mendelism is that inheritance is by particles or units (genes) and that these genes are present in pairs, one member of each pair having come from each parent. When the individual reproduces, it transmits to each offspring one or the other, but not both, of the genes in each pair it possesses. Thus the parent gives to each offspring a sample half of its own inheritance. The laws of chance govern this sampling, subject to the restriction that each sample must contain one gene of every pair.

Variation - differences between individuals - is the raw material on which the breeder works. It is not necessary that the animals vary widely enough, that the breeder can at the very start find some perfect ones to select, but merely that some of them will be closer to his ideal than others.

It was thought that Holstein could not cross 9000 Kg. limit. It has already crossed now. In the

Dairy Herd Improvement Registry (DHIR), Holsteins are improving 50 Kg. of milk/year from 1956 to 1961 (Legates, 1967). This shows that for all practical purposes breeder can remain optimistic in improving upon his herd as a plateau is not reached in the true sense of the word and some amount of variation can always be available.

A commonly accepted criterion for genetic improvement is to maximise the milk yield during a 305-day lactation with 12 or 13 month calving interval. It is recognized that there are some traits, which this definition fails to include, such as productive efficiency, longevity, ease of milking, and mastitis resistance. Nevertheless, our evidence indicates that high 305-day milk yield is the major component of the aggregate genetic goal. Except for certain milk constituents, no antagonisms between increased milk yield and other desirable traits have been demonstrated (Legates, 1967).

In order to make any breeding plan effective the knowledge of averages, heritabilities, repeatabilities, correlations and regressions for all the traits of economic importance is necessary.

The intraclass correlation between repeated measurements is known as repeatability. It measures the degree to which phenotypic expression of a character is free from temporary influence of divorce origin.

The accuracy of selection is augmented by making the repeated measurements on the same individual, thereby also increasing the expected gain from selection. If there is high repeatability, it clearly indicates that the first observation contributes nearly all the information. If it is low, repeated observations are desirable. The genetic value can be found out by the application of repeatability estimates, when the observations of the same individual are available in a random breeding population.

The correlation between two characters in the same individual may be caused by similar environment or by the action of the same genes. The correlation manifested by the genes and the environment is the phenotypic correlation, while that caused by gene only is called genetic correlation. The genetic correlated responses are mainly due to pleiotropy, linkage or polygenic blocks. Different genes and blocks may affect the two traits differently.

The following review is limited to the consideration of the characters studied.

1. AGE AT FIRST CALVING :

The age at first calving is a character of much economic importance. It affects the life production

of the animals and the genetic improvement in the breeding plans. By reducing the age at first calving, following benefits could be achieved:

i) Generation interval will be reduced.

ii) Progeny testing of bull will be more feasible.

iii) The period between testing and final proving will be reduced so that the bull may be used for service effectively for a longer time.

iv) A greater number of bulls can be tested, if the age at first calving is low.

That the age at first calving is influenced by both genetic and environmental factors, has been shown by many investigators.

a) Average :-

The average age at first calving for different breeds of cattle is given in Table 1.

TABLE 1. AVERAGE AGE AT FIRST CALVING

Authors	Year	Average Age at First Calving (Days)		Breed
1	2	3		4
Gehlon & Sekhon	1966	1722±10	(57.41 mth.)	Hariana
Guha *et al*	1968	1591±10	(53.03 ")	Hariana
Damasoury & Bayoumi	1962	1287	(42.9 ")	Egyptian

Contd....

TABLE 1. (Contd....)

1	2	3	4
Singh & Desai	1961	1421.06±13.4 (46.7 mth.)	Hariana
Kohli *et al*	1961	1779±15 (59.3 ")	Hariana
Raj Kumar	1969	1529 (51 ")	Red Sindhi & Jersey Grades
Singh	1957	1461.0±14.5 (48.7 ")	Tharparker
Bhasin & Desai	1967	1380±42 (46.06 ")	Hariana
Dutt & Desai	1965	1365±42 (45.5 ")	Hariana

b) Correlation :-

The phenotypic correlations of age at first calving with several other economically important traits as reported by various workers are given in Table 2.

TABLE 2. CORRELATIONS OF AGE AT FIRST CALVING WITH OTHER TRAITS

Author	Year	Trait with which age at first calving is correlated	"r"	Breed
1	2	3	4	5
Gehlon & Sekhon	1966	Milk yield (1st. lact.)	-0.07	Hariana
"	1966	Lactation period	0.6504	"
"	1966	Calving interval (1st.)	0.291	"
Ragab *et al*	1954	Milk yield (1st.lact.)	0.034	Egyptian
Singh & Desai	1961	Peak yield	-0.033	Hariana
"	1961	Milk yield	0.078	"
"	1961	Lactation period	0.071	"

contd.....

TABLE 2. (Contd...)

1	2	3	4	5
Singh & Chowdhury	1961	Milk Yield (1st.lact.)	0.09	Sahiwal
"	1961	First lactation period	0.19	"
"	1961	Milk yield (1st.lact.)	0.047	Tharparker
"	1961	First lactation period	0.08	"
Gehlon & Sekhon	1966	First dry period	-0.13	Hariana
Hargrove et al	1969	Lactation period	-0.07	Holstein
"	1969	Milk yield (1st.lact.)	-0.05	"
Singh	1957	First calving interval	0.025	
Syszkowski	1968	Milk yield (1st.lact.)	0.54	

2. PEAK YIELD :

The initial maximum production of milk in a day is the peak yield of the lactating animals.

Peak yield of cows is often reached during the first eight weeks of lactation under normal conditions of feeding and management (Krishna & Desai, 1969).

Villagers in our country who usually do not maintain milk yield records, most often remember the peak yield records of their cows and also rely upon it, as a reliable indicator of their milking capacity. As per scientific literature too, it is evident that

there is very high relationship of peak yield with milk yield of cows. The character peak yield is expressed early in the lactation period and can be used as a very reliable tool for the early selection of dairy cows, particularly in India. This can reduce the time taken in progeny testing of bulls by about 8-9 months. Such an early selection would facilitate the disposal of the culled animals while they are still in milk.

Krishna and Desai (1969) have estimated the average peak yield of first lactation in Sindhi cows to be 8.17±0.16 Kg. with coefficient of variation 16.29%.

Correlation :-

The phenotypic correlation of peak yield with other traits, as reported by various workers is reported in Table 3.

TABLE 3. CORRELATIONS OF PEAK YIELD WITH OTHER TRAITS

Author	Year	The Trait With Which Peak Yield is Correlated	"r"	Breed
Singh & Desai	1961	Milk yield	0.734**	Hariana
"	1961	Lactation period	0.277**	"
Krishna & Desai	1969	Milk yield	0.778**	Sindhi
"	1969	Lactation period	0.221	"
Singh & Desai	1961	Age at first calving	-0.033	Hariana

3. SERVICE PERIOD :

The calving interval has two components. Gestation period and service period. Since the variation for the gestation length is very small, the intracalving period is mostly dependent upon the length of service period. If we want the cow to calve regularly, service period must be checked.

a) The average service period for various breeds is given in Table 4.

TABLE 4. AVERAGE SERVICE PERIOD (IN DAYS)

Authors	Year	Average ± S.E. Service Period in days	Breed
Venkayya and Anantakrishnan	1958	156±63.4	Red Sindhi
Malik & Sindhu	1968	195.54±67.2	Sahiwal
Singh and Dutt	1963	126±6.0	Sahiwal
Aboo Soof	1968	159±13.25	Hariana
Dutt and Desai	1965	118	Gangatiri

b) Repeatability :-

Dhillon et al (1969) have reported the repeatability of service period to be 0.25±0.04 in Hariana cows maintained at Hissar.

Dutt and Desai (1965) have estimated the

repeatability of service period to be 0.1339 in Gangatiri cows, maintained at State Livestock-cum-Agricultural Farm, Arazilines, Varanasi.

c) Correlation :-

The correlation between service period and other economic traits as reported in the literature are given in Table 5.

Very few attempts appear to have been made for finding the correlation of service period with other traits. It is reported to be positively correlated with milk yield and dry period.

TABLE 5. CORRELATION OF SERVICE PERIOD AND OTHER TRAITS OF CATTLE (IN DAYS)

Author	Year	Trait with which Service Period is Correlated	"r"	Breed
1	2	3	4	5
Venkayya & Anantakrishnan	1958	Milk yield	0.179*	Red Sindhi
Malik & Sindhu	1968	Milk yield	0.161	Sahiwal
"	1968	Lactation period	0.434**	Sahiwal
Kavitkar et al	1968	Dry period	0.4774**	Sahiwal
Dutt & Desai	1965	Preceding dry period (following service period)	0.5366**	Gangatiri
Pajalic	1952	Lactation period	0.895**	Montafom
"	1952	Milk yield	0.532**	"
"	1952	Dry period	0.427**	"

4. MILK YIELD :

The amount of milk produced from a herd is of greatest economic importance for any dairy enterprise. A high milk producing cow is more economical to the owner as compared to the low producing one. The amount of milk produced by an animal is influenced by genetic and environmental factors.

Bayley and Heizer (1952) in their extensive study on the factors influencing milk production, have found nine variables which were important. They are:

i) Number of days carrying calf while milking.
ii) Length of preceding dry period.
iii) Length of lactation.
iv) Feed rating of previous dry period.
v) Kilograms total digestible nutrients (TDN) fed per 455 Kg. body weight.
vi) Herd size.
vii) Age at calving.
viii) Month of freshening.
ix) Selection rating.

a) Average :-

A solitary report on average lactation milk yield of Deoni cattle could be traced out. Rahman (1958) has reported an average of 2400 lb. of milk in 300 days for Deoni cows.

The average lactation milk yield of some dairy breeds of Indian cattle is reported to be higher than the Deoni breed (Table 6). The average milk yield per lactation of the crossbred cows involving Indian and exotic breeds have been reported to be greater than those of the dairy breeds of Indian cattle.

TABLE 6. AVERAGE LACTATION MILK YIELD

Author	Year	Average Milk Yield ± S.E.		Breed
1	2	3		4
Gehlon & Sekhon	1966	2317.34±203.69	lb.	Hariana
Dadlani & Prabhu	1968	2578.78±130.30	"	"
Kohli *et al*	1961	1491.1±37.1	"	"
Singh	1969	1589±29	"	"
Bhasin	1969	953.20±19.65	Kg.	Mewati
Rajkumar	1969	1159.3	"	Red Sindhi & Jersey Grades
Singh & Dutt	1963	3804±27	lb.	Sahiwal
Bhasin & Desai	1967	4018±227	"	"
"	1967	2897±207	"	Red Sindhi
"	1967	4258±96	"	Hariana X Sahiwal
"	1967	3014±337	"	Hariana X Red Sindhi
"	1967	7322±194	"	Friesian X Sahiwal
"	1967	6157±276	"	Friesian X Red Sindhi
"	1967	7170±278	"	Friesian X Hariana

Contd....

TABLE 6. (Contd..)

1	2	3	4
Mishra & Biswas	1963	4027±32.6 lb.	Tharparker
Dutt & Desai	1965	1255.9 Kg.	Gangatiri
Benintendi *et al*	1966	1155.1 "	Kankrej

b) Repeatability :-

That the milk yield has a genetic basis is now pretty well established. Repeatability forms the upper limit of heritability. In general the milk yield is reported to be moderately repeatable.

From a data of 270 dam and daughter pairs under 34 sire groups of Holstein Friesian breed, Laben and Herman (1950), estimated the repeatability of milk yield to be 0.41.

Mahadevan (1954) calculated the repeatability of the milk yield on the data of 1/4, 1/2, 5/8 and 3/4 crossbred groups. He found the repeatability estimates of 0.58, 0.55, 0.65 and 0.4 respectively in these animals. The overall average was 0.53.

Singh and Desai (1961) reported the repeatability of milk yield to be 0.3878 in Hariana cattle.

Bhasin (1969) calculated the repeatability of milk yield in Mewati cattle to be 0.1869.

Dutt and Desai (1965) estimated the repeatability of milk yield in Gangatiri cattle to be 0.5241.

c) Correlation :-

The estimates for phenotypic correlations between milk yield and other traits in dairy cattle have been given in Table 7. Milk yield is highly correlated with lactation period and peak yield.

TABLE 7. CORRELATIONS OF LACTATION MILK YIELD IN FIRST LACTATION WITH OTHER TRAITS

Author	Year	The trait with which milk yield is correlated	Correlation	Breed
1	2	3	4	5
Gehlon & Sekhon	1966	Age at first calving	-0.07	Hariana
Dadlani & Prabhu	1968	Preceding dry period (Milk yield in 2nd. lactation)	-0.2286	"
Gehlon & Malik	1967	-- do --	-0.0195	Sahiwal
Ragab et al	1954	Age at first calving	0.034	Egyptian cattle
Singh & Desai	1961	-- do --	0.078	Hariana
"	1961	Peak yield	0.734**	"
Singh & Chowdhury	1961	Age at first calving	0.09	Sahiwal
"	1961	-- do --	0.047	Tharparker
Singh & Desai	1961	Lactation period	0.7455**	Hariana
Venkayya & Anantakrishnan	1958	Service period	0.179*	Red Sindhi

Table contd....

TABLE 7. (Contd...)

9	2	3	4	5
Hargrove et al	1969	Age at first calving	-0.05	Holstein
Krishna & Desai	1969	Peak yield	0.778**	Sindhi
Bhasin	1969	Age at first calving	0.0995	Mewati
"	1969	Lactation period	0.6576**	"
Malik & Sindhu	1968	Service period	0.161	Sahiwal
Singh & Prasad	1968	Calving interval	0.307**	Hariana
"	1968	Lactation period	0.3969**	"
"	1966	Lactation period	0.3517**	"

The reports of Singh and Desai (1961) and Krishna and Desai (1969) indicate that milk yield is very highly correlated with peak yield. The reports of Singh and Desai (1961) and Singh and Prasad (1968) show that the milk yield in first lactation is highly correlated with lactation period. Singh and Prasad (1968) found significant correlation between milk yield and calving interval. Gehlon and Sekhon (1966) found a negative and non-significant correlation between age at first calving and milk yield in first lactation, but Singh and Desai (1961), Singh and Chowdhury (1961) have reported positive and nonsignificant correlation. Malik and Sindhu (1968) have reported positive and

non-significant correlation between milk yield and service period. Dadlani and Prabhu (1968) and Gehlon and Malik (1967) have reported negative and non-significant correlation between preceding dry period and subsequent milk yield. Not many reports are available for the correlations of milk yield with body measurements. All the reported correlations are very small and non-significant.

5. LACTATION PERIOD :

The amount of milk produced by a particular cow in a lactation depends on the initial maximum milk secretion, persistency of milk production and the lactation period. Lactation length of 305 days is desirable, since it closely associates with the reproductive cycle of the cow calving once a year.

a) Average :-

The average lactation periods of Indian breeds of cattle are given in Table 8. The lactation length for the crossbred cattle had been reported to be longer than the purebreds (Bhasin and Desai, 1967).

TABLE 8. AVERAGE LACTATION PERIODS IN DAYS OF SOME INDIAN BREEDS

Authors	Year	Average ± S.E. Lactation Period (Days)	Breed
Gehlon & Sekhon	1966	255.71±5.75	Hariana
Danasoury & Bayoumi	1962	319±69	Egyptian cattle
Singh & Desai	1961	290.85±28.12	Hariana
Singh & Chowdhury	1961	264.7	Sahiwal
"	1961	271	Tharparker
Rajkumar	1969	268.8	Red Sindhi & Jersey Grades
Singh & Prasad	1966	294.2±4.2	Hariana
Singh and Dutt	1963	299±4.8	Sahiwal
Bhasin & Desai	1967	301.75±8.30	Sahiwal
"	1967	254.82±10.25	Red Sindhi
"	1967	284.34±11.06	Hariana X Sahiwal
"	1967	231.20±21.04	Hariana X Red Sindhi
"	1967	326.66±12.89	Friesian X Sahiwal
"	1967	327.86±15.63	Friesian X Red Sindhi
"	1967	327.79±10.57	Friesian X Hariana
"	1967	274.45±7.67	Hariana
Benintendi *et al*	1966	262.8	Kankrej

b) Repeatability :-

El-Itriby and Asker (1956) estimated the repeatability of the lactation period in the native cattle of Egypt as 0.258, in European cattle as 0.186, in crossbred cattle as 0.19 and in buffaloes as 0.187.

Singh and Desai (1961) reported the repeatability of lactation period to be 0.2766 in Hariana cattle.

Bhasin (1969) reported the repeatability of lactation period to be 0.1190 in Mewati cattle.

Dutt and Desai (1965) estimated the repeatability of lactation period in Gangatiri cattle to be 0.1831.

c) Correlation :-

Highly significant correlation between lactation period and milk yield have been reported by Singh and Desai (1961), Bhasin (1969) and Singh and Prasad (1968).

TABLE 9. CORRELATIONS OF LACTATION PERIOD IN DAYS WITH OTHER TRAITS

Authors	Year	The trait with which lactation period is correlated	Correlation	Breed
1	2	3	4	5
Singh & Desai	1961	Milk yield	0.7455**	Hariana
Bhasin	1969	Milk yield	0.6576**	Mewati

Table contd....

TABLE 9. (Contd...)

1	2	3	4	5
Singh and Prasad	1968	Milk yield	0.3969**	Hariana
Gehlon & Sekhon	1966	Age at first calving	0.6504**	Hariana
Danasoury & Bayoumi	1962	Age at first calving	0.080	Egyptian
Singh & Desai	1961	-- do --	0.078	Hariana
"	1961	Peak yield	0.277**	Hariana
Singh & Chowdhury	1961	Age at first calving	0.19*	Sahiwal
Krishna & Desai	1969	Peak yield	0.221	Sindhi
Malik & Sindhu	1968	Service period	0.434**	Sahiwal
Pajalic	1952	Service period	0.895**	Montafom

6. DRY PERIOD :

An optimum dry period or period of rest is essential for the maximum production of milk in the subsequent lactation. None of our animals suffer from want of rest.

a) Average :-

The average dry periods for various Indian breeds of cattle are given in Table 10.

Mahadevan (1958) computed the dry periods in some of the important herds of the recognized breeds of cattle

in India. He observed the dry periods of 130 and 153 days in Sahiwal, 114 to 160 days in Red Sindhi, 138 to 169 in Tharparker, 194 days in Hariana, 133 days in Gir and 153 days in Kankrej herds. He concluded that there was no evidence to indicate whether these long dry periods in zebu cattle represented a genetic trait peculiar to zebu cattle. The very considerable reduction in length of dry period that had been achieved by improved management in some tropical herds suggested that the long dry period in tropical cattle was influenced to a great measure by the environment.

TABLE 10. AVERAGE DRY PERIOD IN DAYS

Authors	Year	Average ± S.E. Dry Period (in days)	Breed
Mahadevan	1958	130 - 153	Sahiwal
"	1958	114 - 160	Red Sindhi
"	1958	138 - 169	Tharparker
"	1958	133	Gir
"	1958	153	Kankrej
"	1958	194	Hariana
Dadlani & Prabhu	1968	133.03 - 157.66	Hariana
Singh	1969	342±8	Hariana
Dutt & Desai	1965	143.8	Gangatiri

b) Repeatability :-

El-Itriby and Asker (1956) estimated the repeatability of the dry period in the native cattle of Egypt as 0.052, in European cattle as 0.131, in crossbred cattle as 0.17, and in buffaloes as 0.123.

Singh and Desai (1962) have reported the repeatability of dry period to be -0.138 in Hariana cows.

Bhasin (1969) estimated the repeatability of dry period to be 0.1058 in Mewati cattle.

c) Correlation :-

The correlation of dry period with other traits, reported by various workers is shown in Table 11.

TABLE 11. CORRELATIONS OF DRY PERIOD IN DAYS WITH OTHER TRAITS

Author	Year	Trait with which dry period is correlated	"r"	Breed
Gehlon & Sekhon	1966	Age at first calving	-0.13	Hariana
Dadlani & Prabhu	1968	Milk yield (with preceding dry period)	-0.2286	Hariana
Kavitker *et al*	1968	Service period	0.4774**	Sahiwal
Gehlon & Malik	1967	Milk yield (with preceding dry period)	0.0195	"
Singh & Desai	1961	-- do --	-0.355**	Hariana
Singh	1959	Calving interval	0.734**	Hariana
Pajalic	1952	Milk yield	0.157	Montafom
"	1952	Service period	0.427	"

7. CALVING INTERVAL :

The period between two consecutive calvings is called calving interval. For profitable milk production and the best reproductive efficiency, the dairy cow must reproduce regularly. An interval of 12 or 13 months is considered satisfactory.

Service Period + Gestation Period = Calving interval
= Lactation period + Dry period

In most of the Indian cattle whether on farm or in the village area the intercalving period is long. In some of the poorly developed rural tracts there is a practice of getting only one calf in two years. This reduces the number of lactations which a cow would complete in her lifetime and would, therefore, decrease the overall lifetime production. By reducing the number of calvings, the contribution in terms of improved progeny from a superior cow would also be less. It is, therefore, essential that a cow should not only be a high yielder but should also calve once a year regularly.

a) Average :-

The average calving interval for some breeds of cattle is given in Table 12.

TABLE 12. AVERAGE CALVING INTERVAL OF SOME BREEDS OF CATTLE.

Author	Year	Average ± S.E. Calving Interval	Breed
Bhasin & Desai	1967	478.82±15.87	Sahiwal
"	1967	429.85±15.65	Red Sindhi
"	1967	431.38±12.87	Hariana X Sahiwal
"	1967	440.25±43.95	Hariana X Sindhi
"	1967	403.66±15.12	Friesian X Sahiwal
"	1967	411.63±14.63	Friesian X Red Sindhi
"	1967	396.82±22.19	Friesian X Hariana
"	1967	418.58±21.74	Hariana
Singh & Desai	1962	457.9±4.1	Hariana
Danasoury & Bayoumi	1962	414±73	Egyptian
Singh & Chowdhury	1961	484.4	Sahiwal
"	1961	480.6	Tharparker
Kohli *et al*	1961	630.8±9.0	Hariana
Bhasin	1969	503.99±8.53	Mewati
Rajkumar	1969	432.7	Red Sindhi & Jersey Grades
Singh and Prasad	1968	523.7±7.2	Hariana (Pusa)
"	1968	478.9±4.9	Hariana (Dumraon)
Dutt & Desai	1965	411.5	Gangatiri

b) Repeatability :-

Singh and Desai (1962) have reported the

repeatability of calving interval to be 0.101 in Hariana cattle.

Bhasin (1969) has estimated the repeatability of calving interval in Mewati cattle to be 0.497.

Singh and Prasad (1968) have reported the repeatability of calving interval to be 0.2458±.053 in Hariana cattle of Bihar.

El-Itriby and Asker (1956) have reported the repeatability of calving interval in Egyptian cattle to be 0.137.

Amble, Krishnan and Srivastava (1958) have estimated repeatabilities of calving interval in six different herds. They came to the conclusion that there was little genetic variation present for exploitation through selection and that the early calving interval record of a cow is not correlated appreciably with the later calving intervals. The repeatability estimates of calving interval found out by them are as follows:

Red Sindhi herd, Hosur	0.21
Red Sindhi herd, Bangalore ..	0.08
Kangayam herd, Hosur	0.08
Gir herd, Bangalore	0.17
Kankrej herd, Anand	0.17
Tharparker herd, Patna	0.19

Dutt and Desai (1965) have reported the repeatability of calving interval to be 0.1334.

8. BODY MEASUREMENTS :

With the object of finding relationship of physical feature with production, measurements of girth, belly, length, height etc. are investigated. Girth and belly seem to be the two important measurements indicative of blood supply and digestive capacity respectively.

Capacity for milk production, being distinctly at different levels, is an inherent feature. The body capacity merely indicates the ability of the animal to hold and utilize higher amount of nutrients necessary for higher milk production. The lower ratio of girth and belly indicates the lower productive ability and such a type is suitable for draft purpose (Desai and Dutt, 1963).

The association of body measurements with production, if any, may facilitate selection of animals for higher yield.

Desai and Dutt (1963) have presented body measurements on 83 Hariana cows of District Dairy Demonstration Farm, Mathura and State Livestock cum-Agricultural Farm, Madhurikund. Their studies reveal that the body measurements show a very little change

with the increase in lactation numbers as compared to first lactation. The measurements of belly and girth for first lactation are given below (in cms.)

i) Girth :

	Av.	S.E.	C.V.
Hariana herd of Mathura Farm	170.4	0.95	9.4%
Hariana herd of Madhurikund Farm	157.6	1.14	10.7%

ii) Belly :

Hariana herd of Mathura Farm	198.5	1.42	12.2%
Hariana herd of Madhurikund Farm	166.4	1.29	10.9%

Correlations among body measurements reported by Desai and Dutt (1963) were highly significant except between body length and height at withers.

Most of the workers have reported the correlations between different body measurements and milk yield to be small indicating little usefulness of these correlations in predicting milk yield. But Busjko (1966) reported the correlation of height at withers and milk yield to be 0.796, which was highly significant; and that of chest girth and milk yield to be 0.307, which was also highly significant.

CHAPTER - III

MATERIAL & METHODS

CHAPTER - III

MATERIAL & METHODS

MATERIAL :

The Deoni Breed of Cattle :-

'Deoni' is a breed of recent origin of about 150 to 200 years or perhaps a little more (Rahman, 1958). Deoni breed of cattle has more than once won the supreme championship of the All India Cattle Show and was declared to be the best animal of the country. This breed of cattle has its home located in the Marathwada area of the erstwhile Hyderabad State, now integrated with Maharashtra State.

The Marathwada area consists of five districts i) Aurangabad, ii) Bhir, iii) Parbhani, iv) Nanded and v) Osmanabad. The whole area is more or less arid with 25" to 30" of rainfall on an average and covered mostly by the chain of Balaghat mountains. The cultivation mostly is limited to the production of Jowar, Bajra, Cotton-seed, Ground-nut and Wheat. Thus the crop residuals of each of these various crops and the various grasses from non-cultivable and the fallow lands,

constitute the feeds and fodder for the animals of this breed.

The most concentrated area of Deoni type of cattle is Nanded and Osmanabad. The breed has been known for its hardiness, general utility purposes and also for milk and stability at work.

General conformation of the cow, docile temperament and good development of mammary system point to good potentialities for milk.

The critical study of these animals show that some very important and the oldest breeds of the country like Gir and Kankrej together with the non-descript cow of the locality, have taken part in the evolution of this breed. Animals of this breed are heavy in size, majestic and cheerful to look at, slow but active in action, docile and placid in disposition. They are rather slow but full of vitality, endurance and stability at work (Rahman, 1958).

Source and Collection of Data :-

The data of Deoni breed of cattle were collected from Government Cattle Breeding Farm, Hingoli (Distt. Parbhani) and Government Cattle Breeding Farm, Udgir (Distt. Osmanabad). Both the farms are under the control of the Department of Animal Husbandry,

Maharashtra State.

The Udgir farm was started by purchasing the animals of Deoni breed from the markets in 1952. The Hingoli farm was started in 1940.

The data on the Deoni cattle from 1952 to 1969 at the Udgir farm and from 1941 to 1969 at the Hingoli farm were collected for the present study. The records of each farm were examined and scrutinized. Any records, which contained any clerical mistakes, were corrected, when reasonable proof for reliability was obtained, otherwise they were dropped off the analysis. The lactation records, which were considered abnormal on account of abortions, systemic disorders, death of the calf during lactation, or incomplete lactation records due to the culling of the cow, were not considered.

The chances of inbreeding among the animals have been very much reduced by using a good number of bulls for Artificial Insemination.

The management of both the farms is done by the Farm Superintendents. In broad sense the management and feeding practices at these farms did not differ much as they were according to the scientific standards prescribed.

Weaning was not practised in both the farms and the calf share was not measured. However, there

had been a uniform general practice to suckle approximately the same amount of milk to all the calves. It can reasonably be assumed that each calf is fed the same amount of milk on these farms and so the deviations from the mean in all lactation records will not be affected. With this idea in view the records for calf share were not corrected.

Only Deoni bulls were used for breeding purposes. Selected farm-bred bulls were used for breeding the cows artificially. The selection of female stock was time to time carried on the basis of individual performance and pedigree information.

The data on the following quantitative characters were analyzed:

1. Age at first calving.
2. Peak Yield.
3. Service period.
4. Lactation milk yield.
5. Lactation period.
6. Dry period.
7. Calving interval and
8. Body measurements.

Looking at the magnitude of data it was not considered appropriate to estimate heritabilities and genetic correlations of the traits considered.

METHODS :

a) Repeatabilities :-

Repeatability is the ratio of the genetic variance ($\sigma^2 G$) and the variance due to permanent environmental effects to the total variance.

$$r = \frac{\sigma^2 G + \sigma^2 Ep}{\sigma^2 G + \sigma^2 Ep + \sigma^2 Et} = \frac{\sigma^2 G + \sigma^2 Ep}{\sigma^2 p}$$

Where $\sigma^2 G$ = Genetic variance.

$\sigma^2 Ep$ = Variance due to permanent environment.

$\sigma^2 Et$ = Variance due to temporary environment.

$\sigma^2 P$ = Total phenotypic variance.

Repeatability can be estimated as intraclass correlation or as a correlation among different records of the same cow.

The following model was considered as explaining a record of a cow:

$$Y_{ij} = U + ci + eij$$

Where Y_{ij} is the jth record of ith cow.
U is the overall mean.
ci is the effect common to all records of ith cow.
eij is the random error.

It was assumed that $E(c_i) = E(e_{ij}) = 0$

$$E(c_i)^2 = \sigma^2_c \; ; \quad E(e_{ij})^2 = \sigma^2_e$$

The analysis of variance was carried out as below:

TABLE 13. ANALYSIS OF VARIANCE (MODEL)

Source of Variation	Degrees of freedom	Sum of Squares	M.S.	E.M.S.
Total	N-1	$i \; j \; Y^2_{ij} - \frac{Y^2_{..}}{N}$		
Between cows	n-1	$i \; \frac{Y_{i.}^2}{n_i} \; \frac{Y^2_{..}}{N}$	A	$\sigma^2_e + K\sigma^2_c$
Within cows	N-n	By subtraction	E	σ^2_e

$$K = \frac{1}{n-1} \cdot \left[N - \frac{\sum_i n_i^2}{N} \right]$$

$$\sigma^2_c = \frac{A - E}{K}$$

Then :

$$\text{Repeatability (t)} = \frac{\sigma^2_c}{\sigma^2_c + \sigma^2_e}$$

σ^2_c is the variance of cows.

σ^2_e is the variance of error.

K is the number of records per cow.

Standard error (S.E.) of repeatability is calculated by the method described by Cockerham (1948).

S.E. of repeatability =

$$\sqrt{\frac{2(1-R)^2}{K^2(n-1)(K-1)n}\left[n(K-1)\left\{1+R(K-1)\right\}^2+n-1\left\{1-R(K-1)\right\}\right]}$$

Where - R = repeatability

K = No. of records per cow.

n = No. of cows.

Pooling of the repeatability estimates of the two farms was done as given below:

$$\text{Pooled Repeatability} = \frac{\dfrac{R_1}{(S.E._1)^2} + \dfrac{R_2}{(S.E._2)^2}}{\dfrac{1}{(S.E._1)^2} + \dfrac{1}{(S.E._2)^2}}$$

Where R_1 = Repeatability of one farm.

R_2 = Repeatability of other farm.

$S.E._1$ = S.E. of R_1

$S.E._2$ = S.E. of R_2

Pooling of the standard errors of the repeatability estimates of the two farms was done as given below:

$$\text{Pooled Standard Error} = \sqrt{\frac{1}{S.E._1} \quad \frac{1}{S.E._2}}$$

b) Phenotypic Correlation :-

The phenotypic correlation between two characters was estimated as a ratio of the appropriate covariance or cross products to the product of the phenotypic standard deviations for the two characters (Snedecor, 1956). Symbolically:

$$r = \frac{\Sigma XY}{\sqrt{\Sigma X^2 . \Sigma Y^2}}$$

Where r = Phenotypic correlation coefficient.

ΣX^2 = Corrected sum of squares of character X

ΣY^2 = Corrected sum of squares of character Y

ΣXY = Corrected sum of cross products of the character X with the character Y in the same animal.

The phenotypic correlation coefficient was tested for its significance by the correlation table at N-2 degree of freedom (Snedecor, 1956).

The two correlation coefficients were pooled after 'Z' transformation by the following formula.

$$Z_m = \frac{Z_1(n_1-3) + Z_2(n_2-3)}{n_1 + n_2 - 3p}$$

Z_m is the best value of Z. When the Z_m value is seen in the table, the corresponding value is the best value (pooled) of the correlation coefficient.

p = Number of correlation coefficients being pooled together (i.e. two).

c) Regression :-

The regression of first lactation milk yield on lactation period, service period and age at first calving was calculated by the method described by Snedecor (1968). Symbolically :

$$b_{xy} = \frac{\Sigma XY}{\Sigma Y^2}$$

Test of significance of regression coefficient b_{xy} was estimated by applying "t" test.

$$\text{S.E. of } b_{xy} = \sqrt{\frac{\Sigma Y^2 - \frac{(\Sigma XY)^2}{\Sigma X^2}}{(n-2)\ \Sigma Y^2}}$$

$$\text{"t"} = \frac{b_{xy}}{\text{S.E.}}$$

Table value of "t" at (n-2) degrees of freedom was seen.

d) Mathematical Model for Analysis of Variance for Factors Affecting Milk Yield :-

The following mathematical model was assumed to explain the contributions of the different factors to the milk yield in first lactation :

$$Y_{ijklmn} = \mu + F_i + A_j + L_k + S_l + S'_m + e_{ijklmn}$$

Where - $i = 1 \ldots\ldots p$ (p = no. of farms, i.e. 2)

$j = 1 \ldots\ldots q$ (q = age groups at calving, i.e. 4)

$k = 1 \ldots\ldots r$ (r = groups of lactation period, i.e.4)

$l = 1 \ldots\ldots s$ (s = groups of service period, i.e. 4)

$m = 1 \ldots\ldots t$ (t = no. of seasons of calving, i.e.4)

Y_{ijklmn} = Milk yield in first lactation at i^{th} farm, j^{th} age group at calving, k^{th} group of lactation, l^{th} group of service period and m^{th} season of calving of nth individual.

μ = Population mean.

F_i = Effect of ith farm.

A_j = Effect of jth age at first calving

L_k = Effect of Kth lactation period.

S_l = Effect of lth service period.

S'_m = Effect of mth season of calving.

e_{ijklmn} = Random error peculiar to the $Y_{ijklmn}{}^{th}$ observation. It will also contain interactions of factors and contributions of factors not included in the model.

The assumptions underlying the model are:

$$\sum_i F_i = \sum_j A_j = \sum_k L_k = \sum_l S_l = \sum_m S'_m = 0$$

$$E(e_{ijklmn}) = 0 \quad \text{and} \quad E(eijklmn)^2 = \sigma^2_e$$

TABLE 14. ANALYSIS OF VARIANCE TABLE

Source	d. f.	S.S.	M.S.
Total	N-1	T	
Farms	p-1	T_1	$T_1/p-1$
Age at first calving	q-1	T_2	$T_2/q-1$
Lactation period	r-1	T_3	$T_3/r-1$
Service period	s-1	T_4	$T_4/s-1$
Season	t-1	T_5	$T_5/t-1$
Error	N-p-q-r-s-t	T_6	$T_6/N-p-q-r-s-t$

CHAPTER - IV

RESULTS & DISCUSSION

CHAPTER - IV

RESULTS & DISCUSSION

1. AGE AT FIRST CALVING :

The age at first calving data were available for 100 cows of Hingoli farm and 42 cows of Udgir farm.

a) Average :-

The average age at first calving for cows at Hingoli and Udgir was found to be 1474 days (about 49 months) and 1659 days (about 55 months) respectively (Table 15). The pooled average comes to about 51 months or 4.25 years. This figure is quite high and it must be reduced.

The average age at first calving for Hariana cows as estimated by Gehlon and Sekhon (1966), Guha et al (1968), Kohli et al (1961) is higher than our present estimate of Deoni cows.

The average age at first calving in Hariana cows reported by Singh and Desai (1961), Bhasin and Desai (1967), Dutt and Desai (1965) is lesser than our estimate. Lower average has also been reported in Tharparker cattle

by Singh (1957) and in Red Sindhi and Jersey grades by Rajkumar (1969).

TABLE 15. AVERAGE AGE AT FIRST CALVING (DAYS) IN DEONI CATTLE

	No. of Animals	Average age at 1st. calving (days)	S. E.	C.V. (%)
Hingoli	138	1474 (49)	21.4	16.9
Udgir	65	1659 (55)	34.3	16.6
Pooled	203	1533 (51)	19.2	11.2

Figures in parentheses indicate average age at first calving in months.

b) Correlation :-

The correlation of age at first calving was found out with milk yield, lactation period, service period, dry period and days to peak yield (Table 16). Age at first calving had significant correlation with service period, dry period and lactation period. It had negative non-significant correlation with milk yield in first lactation and with days to peak yield.

Gehlon and Sekhon (1966) also found a negative non-significant correlation of age at first calving with milk yield for Hariana cows. Similar results were obtained

by Hargrove et al (1969) for Holstein cows. However, Ragab et al (1954), Singh and Desai (1961), Singh and Chowdhury (1961) found positive non-significant correlation.

Gehlon and Sekhon (1966) have found a positive and highly significant correlation between age at first calving and lactation period in Hariana cows. Singh and Chowdhury (1961) have found significant correlation in Sahiwal cows and non-significant correlation in Tharparker cows. Singh and Desai (1961) have found positive non-significant correlation but Hargrove et al (1969) have found negative non-significant correlation between age at first calving and lactation period.

Gehlon and Sekhon (1966) have found negative and non-significant correlation between age at first calving and dry period. But the present work showed a positive non-significant correlation in these two traits in Deoni cattle.

The correlations for cows at Hingoli and Udgir were calculated separately and then the pooled correlation coefficient was calculated.

TABLE 16. CORRELATIONS OF AGE AT FIRST CALVING (DAYS) WITH OTHER TRAITS

The trait with which age at first calving was correlated	"r" Hingoli	"r" Udgir	"r" Pooled
Milk yield	-0.22* (83)	0.08 (47)	-0.12 (130)
Lactation period	0.32* (100)		
Dry period	0.21* (100)		
Service period	0.25* (100)		
Days to peak yield	-0.02 (60)	-0.24 (19)	-0.07 (79)

Figures in parentheses indicate the number of cows on which the correlation coefficients were based.

* = Significant at 5% level of probability.

2. PEAK YIELD :

The data of peak yield in first lactation were available for 67 cows at Hingoli farm and 79 cows at udgir farm.

a) Average :-

The average peak yield in first lactation for cows at Hingoli and Udgir was found to be 4.373 and 4.582 Kg.

respectively and the average of days to peak yield was 31.432 and 34.936 days respectively.

The average peak yield in Sindhi cows as reported by Krishna and Desai (1969) was found to be much higher.

TABLE 17. AVERAGE PEAK YIELD (Kg.) IN DEONI CATTLE

	No. of Animals	Average (Kg.)	S. E.	C.V. (%)
Hingoli	67	4.37	0.10	10.52
Udgir	79	4.58	0.21	41.24
Pooled	146	4.48	0.12	33.43

TABLE 18. AVERAGE OF DAYS TO PEAK YIELD IN DEONI COWS

	No. of Animals	Average (Days)	S.E.	C.V. (%)
Hingoli	67	31.4	0.85	22.27
Udgir	79	34.9	0.55	14.11
Pooled	146	33.3	0.51	18.60

b) Correlation :-

The phenotypic correlation of peak yield with milk yield in first lactation, first lactation period

was found out. Similarly, the correlation of days to peak yield in first lactation with lactation milk yield in first lactation, first lactation period, first dry period, first service period and age at first calving was found out. The correlations were estimated separately for the cows at Hingoli and Udgir and were then pooled.

The correlation between peak yield and milk yield in first lactation was found to be highly significant. Similar results have been reported by Singh and Desai (1961) and Krishna & Desai (1969).

The correlation between peak yield and first lactation period was found to be positive and non-significant. Similar result has been reported by Krishna and Desai (1969) in Sindhi cows. But Singh and Desai (1961) have reported a positive and significant correlation between these two traits in Hariana cows.

TABLE 19. CORRELATION OF PEAK YIELD (Kg.) WITH OTHER TRAITS

Trait with which peak yield was correlated	Hingoli	Udgir	Pooled
Milk yield in first lactation	0.58** (67)	0.46** (79)	0.55** (146)
Lactation period	0.05 (67)	0.26* (74)	0.16 (141)

Figures in parentheses are the no. of cows on which the correlation coefficients were based.

* = Significant at 5% level of probability

** = Significant at 1% level of probability.

TABLE 20. CORRELATION OF DAYS TO PEAK YIELD WITH OTHER TRAITS

Trait with which days to peak yield was correlated	Hingoli	Udgir	Pooled
Milk yield in first lactation	0.12 (67)	0.05 (79)	0.08 (146)
Lactation period	0.08 (60)	0.18 (63)	0.13 (123)
Dry period	-0.05 (60)	0.13 (63)	0.04 (123)
Service period	-0.003 (60)	0.05 (63)	0.02 (123)
Age at first calving	-0.02 (60)	0.24 (19)	-0.07 (79)

Figures in parentheses are the no. of cows on which the correlation coefficients were based.

3. SERVICE PERIOD :

Service period is the interval between calving and the effective service when conception takes place.

a) Average :-

The averages of all the service periods of all the animals at both the farms have been shown in Table 21.

The average service period for the cows at Hingoli and Udgir was 172 and 141 days respectively. The pooled average was 184 days. This service period is

higher than those reported by Venkayya and Anantakrishnan (1958) in Red Sindhi, Singh and Dutt (1963) in Sahiwal and Aboo Soof (1968) in Hariana and is lesser than that reported by Malik and Sindhu (1968) in Sahiwal.

The length of service period is mainly controlled by environment i.e. better feeding, breeding operations and management - especially looking after the cows at post-parturition to see that the normal cows get sexual rest of two months after which they become pregnant. Any negligence may result in long service period and consequently a long calving interval which is undesirable from economic point of view. Bhasin (1967), while working at Livestock Research Station, Bassi, Rajasthan, reported that one day increase in service period would increase dry period and intercalving period by 0.8 and 1.0 day respectively. He has given following six reasons for the service period being high:

i) There may be negligence on the part of management so that the cows coming into heat are not spotted and served or they are served at leisure when the heat period has passed long back.

ii) The bull in the herd may be infertile or may have some physical abnormality preventing him from doing successful service.

iii) The cows may be silent heaters. In cases where artificial breeding is practised, this would create difficulties if a teaser is not kept in the herd.

iv) The cows may have infertility or lower fertility due to various reasons. There may be a deficiency of one or more of the essential food substances. There can be some pathological conditions involving the ovary, fallopian tubes, uterus or vagina.

v) The cow may be coming into heat but because of certain pathological conditions, she may not be getting settled.

vi) The early embryonic mortality may take place, but the aborted embryo may be too small to be noticed, with the result the cow will repeat the heat but at an irregular interval. This is common in rural areas because of nutrition and management.

Following the cows closely and removing the obstacles in the way along with proper examination of semen can make a lot of improvement in settling the cows earlier.

TABLE 21.. AVERAGE SERVICE PERIOD (DAYS) IN DEONI CATTLE

	No.of Observations	Average	S. E.	C.V. (%)
Hingoli	306	172.6	7.2	73.3
Udgir	473	191.6	7.4	84.9
Pooled	779	184.2	4.6	70.3

b) Repeatability :-

Repeatabilities of service period were based on 306 observations of 80 cows at Hingoli farm and 473 observations of 96 cows at Udgir farm. The estimates were calculated separately for both the farms and were then pooled.

The repeatability estimate for service period of cows at Hingoli and Udgir farms were 0.20 and 0.39 respectively and the pooled estimate was 0.30. The present findings are somewhat higher than those reported by Dhillon *et al* (1969) in Hariana cattle.

TABLE 22. ANALYSIS OF VARIANCE OF SERVICE PERIOD (DAYS)

Source of Variation	Hingoli Farm		Udgir Farm	
	d.f.	M.S.S.	d.f.	M.S.S.
Total	305		472	
Between cows	79	25,411	95	43,784
Within cows	226	12,760	377	10,416

Repeatability estimates of service period:

For cows at Hingoli Farm .. 0.20±0.03

For cows at Udgir Farm .. 0.39±0.02

Pooled estimate .. .. .. 0.30±0.02

4. LACTATION MILK YIELD :

a) Average :-

The total lactation milk yields for all the normal lactations of all the cows at both the farms have been analyzed. The overall average lactation milk yield for the cows at Hingoli farm, Udgir farm as well as the pooled averages for both the farms are given in Table 23.

The averages of both farms show that the cows of Udgir farm give about 27% more milk than the Hingoli cows. More culling carried out at Udgir farm as compared to Hingoli farm could be a contributory factor. Sire indices of breeding bulls employed at Udgir farm could have been better with respect to milk yield than the breeding bulls employed at Hingoli farm. Even though the feeding and management is similar at both the farms, some amount of farm differences could have been there.

The average milk yield of Udgir farm is closer to the report of Rahman (1958) but the pooled average is lesser. The average is very close to that of Mewati cattle as reported by Bhasin (1969).

The average milk yield in Hariana cattle as reported by Kohli et al (1961), Singh (1969), is lesser but it is more as reported by Gehlon and Sekhon (1966) and Dadlani and Prabhu (1968). The averages for Sahiwal cows as reported by Singh and Dutt (1963), Bhasin and Desai (1967), Bhasin and Desai (1967) are higher.

TABLE 23. THE OVERALL AVERAGES OF TOTAL LACTATION MILK YIELDS (Kg.) FOR ALL THE LACTATIONS TOGETHER

	No.of Lactations	Average	S. E.	C.V. (%)
Hingoli Farm	340	818.1	16.5	37.2
Udgir Farm	427	1041.9	26.1	51.7
Pooled	767	942.7	16.6	49.0

b) Repeatability :-

The repeatability of total lactation milk yield of cows at Hingoli farm and that of Udgir farm were calculated separately. The repeatability was based on 340 lactations of 87 cows at Hingoli and 427 lactations of 88 cows at Udgir.

The repeatability of total lactation milk yield of cows at Hingoli and Udgir and the pooled repeatability estimate were 0.32, 0.20 and 0.25 respectively. This estimate is more than that reported by Bhasin (1969) in

Mewati cattle but is less than those reported by Laben (1950) in Holstein cattle. The reports of Mahadevan (1954), Singh and Desai and Dutt and Desai (1965) are also higher.

TABLE 24. ANALYSIS OF VARIANCE OF TOTAL LACTATION MILK YIELD (Kg.)

Source of Variation	Hingoli Farm		Udgir Farm	
	d.f.	M.S.S.	d.f.	M.S.S.
Total	339		426	
Between cows	86	181,456	87	515,360
Within cows	253	62,951	339	234,122

Repeatability estimate of total lactation milk yield :

For cows at Hingoli Farm .. .. 0.32±0.02

For cows at Udgir Farm .. .. 0.20±0.02

Pooled estimate .. .. .. 0.25±0.01

c) Correlation :-

The correlation of milk yield in first lactation with the following traits was found out.

i) Age at first calving.

ii) Peak yield.

iii) Days to peak yield.

iv) Lactation period.

v) Dry period.

vi) Service period.

vii) Body measurements (i.e. height, length, heart girth and belly girth).

The pooled coefficient of correlation of milk yield was highly significant with peak yield, lactation period and belly girth. No other correlation was significant. The milk yield had positive non-significant correlations with days to peak yield, service period, height and heart girth and negative non-significant correlations with age at first calving, dry period and body length.

The results in the present work are similar to those reported by Singh and Desai (1961), Krishna and Desai (1969). They have also reported highly significant correlations between peak yield and milk yield.

Highly significant correlations between milk yield and lactation period have been reported by Singh and Desai (1961), Singh and Prasad (1966, 1968) and Bhasin (1969).

TABLE 25. CORRELATION OF MILK YIELD IN FIRST LACTATION WITH OTHER TRAITS (IN Kg.)

Trait with which milk yield was correlated	Hingoli	Udgir	Pooled
Age at first calving	-0.22 (83)	0.08 (47)	-0.12 (130)
Peak yield	0.58** (67)	0.45** (79)	0.55** (146)
Days to peak yield	0.12 (67)	0.05 (79)	0.08 (146)
Lactation period	0.59** (100)	0.64** (100)	0.62** (200)
Dry period (preceding)	0.18 (86)	-0.17 (90)	0 (176)
Service period	0.12 (100)	0.13 (100)	0.13 (200)
Length	-0.09 (36)	-0.15 (37)	-0.12 (73)
Height	0.16 (36)	-0.003 (37)	0.07 (73)
Heart girth	0.20 (36)	0.11 (37)	0.16 (73)
Belly girth	0.15 (36)	0.68 (22)	0.38 (58)

The figures in parentheses denote the number of cows on which the correlation coefficients were based.

** = Indicate significance at 1% level of probability.

d) Regression :-

Regression coefficients of first lactation milk yield on four traits (i.e. age at first calving,

lactation period, service period and peak yield) were calculated separately for both the farms and were tested for significance.

Regression of first lactation milk yield on age at first calving was -0.02 and 0.16 Kg. per day respectively for cows of Hingoli and Udgir farms. The regressions were not significant. These estimates are similar to those of Gehlon and Sekhon (1966) in Hariana cows; but differ with those of Ragab et al (1954) who found significant regression of milk in first lactation on age at first calving in Egyptian cows.

Regression of first lactation milk yield on first lactation period was 2.57 and 4.26 Kg. per day respectively for cows at Hingoli and Udgir farms. The regressions were highly significant. These estimates are similar to those of Singh and Desai (1961), who estimated highly significant regression of milk yield on lactation period.

Regression of first lactation milk yield on service period was 0.23 Kg. and 0.53 Kg. per day respectively for cows of Hingoli and Udgir. The former was not significant but the latter was significant at 5% level of probability.

Regression of first lactation milk yield on the peak yield of the same lactation was 164.91 and

157.72 Kg. respectively for cows at Hingoli and Udgir. Both the estimates were highly significant. These estimates are higher than those obtained by Krishna and Desai (1969) for Sindhi cows and Singh and Desai (1961) for Hariana cows.

TABLE 26. REGRESSION OF MILK YIELD (IN Kg.) ON OTHER TRAITS.

Trait on which regression of milk yield is correlated	Hingoli	Udgir
Age at first calving	-0.02 (83)	0.16 (47)
Lactation period	2.57** (100)	4.26** (100)
Service period	0.23 (100)	0.53* (100)
Peak yield	164.91** (67)	157.72** (79)

The figures in parentheses are the number of cows on which the linear regressions were based.

* = indicates significance at 5% level of probability

** = indicates significance at 1% " "

e) Analysis of variance for factors affecting milk yield :-

The farms were two. According to the minimum and maximum age at first calving four groups of equal class intervals were made. Similarly four groups were also made according to the length of lactation period,

and according to the length of service period. The seasons of calving were four :

Spring (February, March, April).
Summer (May, June, July).
Rainy (August, September, October).
Winter (November, December, January).

The data of lactation milk yield were plotted for the above mentioned groups and analysis of variance was run to find out the contributions of different factors affecting milk yield.

The percentage contributions of various factors are given below:

i)	Farms	18.43
ii)	Age at first calving ..	7.62
iii)	Lactation period	42.25
iv)	Service period	5.22
v)	Season of calving	4.51
vi)	Error	21.97

The error term contained various interactions and those sources of variation which have not been included in the model.

It is interesting to see that chiefly the length of lactation period affected milk yield, whereas

season of calving had very less effect on milk yield. The table for analysis of variance shows that the farms and the length of lactation period had highly significant effect and age at first calving, season of calving and service period had only significant effects on lactation milk yield.

TABLE 27. ANALYSIS OF VARIANCE FOR FACTORS AFFECTING MILK YIELD

Source of Variation	d.f.	M.S.S.	"F"
Total	141		
Between farms	1	4,720,301.0	107.35**
Between age at first calving	3	650,798.0	14.80*
Between lactation periods	3	3,606,979.3	82.03**
Between service periods	3	445,808.0	10.14*
Between seasons of calving	3	384,920.6	8.75"
Error	128	43,967.9	

5. LACTATION PERIOD :

a) Average :-

The average lactation period based on all the normal lactations of all the cows at both the farms separately and pooled over farms is presented in Table 28.

The cows at Udgir farm had an average lactation period of 301 days and the cows at Hingoli farm had an average lactation period of 282 days. The ideal lactation period is 305 days. The cows at Udgir farm are nearer to this ideal than that of the cows at Hingoli farm.

The cows at Hingoli farm had on an average a lactation period lesser than the cows at Udgir farm by 19 days. This could have been a contributory cause for the difference in lactation milk yield of the two farms.

No published report on average lactation period of Deoni breed is available, When we compare our pooled average lactation period of 293 days to the published reports of other breeds (Table 8), we find that the average lactation period of Deoni cattle is similar to Hariana cattle as reported by Singh and Desai (1961), Singh and Prasad (1966), and Singh and Dutt (1963).

The average lactation period of Sahiwal cattle as reported by Bhasin and Desai (1967) is higher than that of the average lactation period of Deoni cattle.

TABLE 28. AVERAGE LACTATION PERIOD IN DEONI CATTLE (IN DAYS)

	Number of Lactations	Average	S.E.	C. V. (%)
Hingoli	331	282.1	3.7	24.4
Udgir	439	301.8	4.1	29.0
Pooled	770	293.3	2.9	27.4

b) Repeatability :-

The repeatability estimate of lactation period was based on 331 observations of 82 cows at Hingoli farm and 439 observations of 87 cows at Udgir farm. The repeatability estimates for the cows at both the farms were calculated separately and then the pooled estimate was obtained.

The repeatability estimates of lactation period for cows at Hingoli and Udgir and the pooled estimate were 0.18, 0.23 and 0.21 respectively. These estimates are similar to those of El-Itriby and Asker (1956) in Egyptian cows. The estimate reported by Singh and Desai (1961) in Hariana cows is higher and that of Bhasin (1969) in Mewati cows is lower.

TABLE 30. CORRELATIONS OF LACTATION PERIOD (DAYS) WITH OTHER TRAITS.

The trait with which lactation period was correlated	Hingoli	Udgir	Pooled
Milk yield	0.59** (100)	0.64** (100)	0.62** (200)
Service period	0.29* (100)	0.54 (100)	0.43 (200)
Age at first calving	0.32 (100)		
Dry period	-0.19 (100)	-0.13 (100)	-0.165 (200)

Figures in parentheses indicate the number of animals on which the correlation coefficients were based.

* = Significant at 5% level of probability.

** = Significant at 1% level of probability.

6. DRY PERIOD :

a) Average :-

The averages for all the dry periods of all the cows at both the farms along with their measures of dispersion are presented in Table 31. The averages have been calculated separately for both the farms and were then pooled.

The average dry period for cows at Hingoli

farm was 183 days and at Udgir farm 172 days. The average dry period as obtained in this study indicates that the cows remained unproductive for pretty long period which is undesirable from economic point of view.

Higher averages have been found in Hariana cows by Mahadevan (1958) and Singh (1969). Lower averages have been found out in Sahiwal, Red Sindhi, Tharparker, Gir, and Kankrej cows by Mahadevan (1958) and in Hariana cows by Dadlani and Prabhu (1968).

Singh (1959) indicated that there would be no advantage if a dry period of more than 90 days is given. He further cited that a dry period of more than 150 days will be disadvantageous for milk production and suggested that the optimum dry period should be between 60 and 90 days.

TABLE 31. AVERAGE DRY PERIOD (DAYS) IN DEONI CATTLE

	No. of Observations	Average	S.E.	C.V. (%)
Hingoli	325	183.3	6.9	69.4
Udgir	448	172.4	5.3	66.1
Pooled	773	177.0	4.2	66.7

b) Repeatability :-

Repeatability estimates of dry period were based on 325 observations of 83 cows at Hingoli farm and 448 observations of 88 cows at Udgir farm. The estimates were calculated separately and were then pooled.

The repeatability of dry period for cows at Hingoli, for cows at Udgir and the pooled estimate were 0.10, 0.18 and 0.16 respectively. The reports of El-Itriby and Asker (1956) and Bhasin (1969) are lower than the present estimate.

TABLE 32. ANALYSIS OF VARIANCE OF DRY PERIOD (DAYS)

	Hingoli Farm		Udgir Farm	
	d.f.	M.S.S.	d.f.	M.S.S.
Total	324		447	
Between cows	82	20,813	87	22,253
Within cows	242	14,125	360	10,298

Repeatability estimate of dry period :

For cows at Hingoli farm ... 0.10±0.02

For cows at Udgir farm ... 0.18±0.01

Pooled estimate ... 0.16±0.01

c) Correlation :-

Correlation of dry period was found out with milk yield, lactation period, service period, and age at first calving. The correlations for cows at both the farms were calculated separately and were then pooled.

The correlation of preceding dry period with subsequent milk yield was not significantly different than zero at both the farms. The correlation of dry period with lactation period was negative and non-significant. The correlation of dry period with service period was positive and highly significant. Whereas, the correlation of dry period with age at first calving was positive and significant.

Kavitkar et al (1968) have also estimated a positive and highly significant correlation between dry period and service period in Sahiwal cows.

Gehlon and Malik (1967) have found non-significant correlation between preceding dry period and subsequent milk yield, but Singh and Desai (1962) have reported negative and highly significant correlation of these two traits.

TABLE 33. CORRELATION OF DRY PERIOD (DAYS) WITH OTHER TRAITS

The trait with which dry period was correlated	Hingoli	Udgir	Pooled
Milk yield (subsequent lactation	0.18 (86)	-0.17	0.0 (176)
Lactation period	-0.19 (100)	-0.13	-0.16 (200)
Age at first calving	0.21* (100)		
Service period	0.55 (100)	0.69**	0.63** (200)

The figures in parentheses indicate the number of animals on which the correlation coefficients were based.

* = Significant at 5% level of probability.

** = Significant at 1% level of probability.

7. CALVING INTERVAL :

a) Average :-

The average calving interval based on all the calvings of the cows at both the farms are given in Table 34. The average calving interval was 456 days for cows at Hingoli, 472 days for cows at Udgir.

This average is closer to the average calving interval in Hariana cows reported by Singh and Desai (1962) and Singh and Prasad (1968).

The average for Red Sindhi and Hariana cattle reported by Bhasin and Desai(1967) and for Red Sindhi and Jersey grades reported by Rajkumar is less. The average for Sahiwal reported by Bhasin and Desai (1967), for Sahiwal and Tharparker reported by Singh and Chowdhury (1961), for Mewati cows reported by Bhasin (1969) is higher.

The intercalving period consists of service period and gestation period. It is mainly affected by service period because the gestation period is generally constant. If we try to reduce gestation period, some breeding and calving troubles may arise.

Acharya (1966) has studied some nongenetic factors affecting calving interval in Hariana herd stationed at Hissar. Year of calving and month within year of calving had significant effect on calving interval.

Bhasin (1967) has given a systematic programme of ensuring regular calving interval. A cow comes in heat after 45 to 60 days after calving. She should be inseminated or bred right in the first heat, if heat has occurred at 60 days or after. If the first heat has occurred before 60 days this may be missed but the date and period recorded so that the date of next heat can be predicted, when she should be definitely served.

After service the cow should again be examined after nearly 20 days till it becomes definite through pregnancy diagnosis that she has settled. Some of the cows may be silent heaters and do not show any visible sign of heat. If the lips of vulva of such animals are opened, a copious fluid will flow out. Therefore, the silent heaters require a close attention. The semen of the bull should also be periodically examined in herd where natural service is being given. Where artificial insemination is being practised, the examination of the semen before insemination is a must.

The cow should invariably be put for examination of any abnormality or disease of the reproductive organs.

All this procedure coupled with proper feeding can ensure a calving interval of 12 to 13 months.

TABLE 34. AVERAGE CALVING INTERVAL IN DEONI CATTLE.

	No. of Observations	Average (days)	S.E.	C.V. (%)
Hingoli	307	456	7.2	27.6
Udgir	468	472	6.0	27.7
Pooled	775	466	4.6	27.7

b) Repeatability :-

The repeatabilities were based on 307 observations of 80 cows at Hingoli farm and 467 observations of 96 cows at Udgir farm. The repeatabilities for both the farms have been calculated separately and were then pooled.

The repeatabilities were 0.172 and 0.296 respectively for Hingoli and Udgir farms and the pooled estimate was 0.25. These estimates are somewhat similar to those reported by Singh and Prasad (1968) in Hariana cattle. The repeatability estimate reported by Bhasin (1969) in Mewati cattle is higher. Other reports of Singh and Desai (1962), El-Itriby and Asker (1956), Amble et al (1958) are lower.

TABLE 35. ANALYSIS OF VARIANCE OF CALVING INTERVAL (DAYS)

Source of Variation	Hingoli Farm		Udgir Farm	
	d.f.	M.S.S.	d.f.	M.S.S.
Total	306		467	
Between cows	79	23,672	95	36,936.7
Within cows	227	13,262	372	12,217.7

The repeatability estimate of calving interval :

For cows at Hingoli farm ... 0.17±0.03

For cows at Udgir farm ... 0.29±0.02

Pooled estimate ... ... 0.25±0.01

8. BODY MEASUREMENTS :

Four body measurements (i.e. height, length, heart girth, and belly girth) were taken on 48 adults cows at Hingoli farm and 40 adult cows at Udgir farm.

a) Average :-

The averages of all the body measurements (in cms.) with the measures of dispersion are given in Tables 36 to 39.

The average heart girth of the cows at Hingoli and Udgir was 169.6 and 166.8 cms. respectively. This figure was nearly the same as that of the heart girth of Hariana cows at Mathura and Madhurikund farms as reported by Desai and Dutt (1963).

The average belly girth of the cows at Hingoli and Udgir was 189.7 and 202.7 cms. respectively. The average belly girth of Hariana cows maintained at Mathura farm as reported by Desai and Dutt (1963) is similar to our present estimate.

TABLE 36. AVERAGE LENGTH IN DEONI CATTLE

	No. of Animals	Average (cm.)	S.E.	C.V. (%)
Hingoli	48	130.2	0.98	5.22
Udgir	40	134.7	1.24	5.84
Pooled	88	132.2	0.81	5.77

TABLE 37. AVERAGE HEIGHT IN DEONI CATTLE

	No. of Animals	Average (cm.)	S. E.	C.V. (%)
Hingoli	48	121.6	0.60	3.42
Udgir	40	131.8	1.14	5.49
Pooled	88	126.2	0.81	6.07

TABLE 38. AVERAGE HEART GIRTH IN DEONI CATTLE

	No. of Animals	Average (cm.)	S.E.	C.V. (%)
Hingoli	48	169.6	1.03	4.20
Udgir	40	166.8	1.48	5.61
Pooled	88	168.3	0.88	4.93

TABLE 39. AVERAGE BELLY GIRTH IN DEONI CATTLE

	No. of Animals	Average (cm.)	S.E.	C.V. (%)
Hingoli	48	202.7	1.93	4.48
Udgir	22	189.7	1.43	5.21
Pooled	70	193.8	1.37	5.87

b) Correlation :-

The correlations of all the four body measurements with the milk yield have been described under lactation milk yield (Table 25). The correlations among body measurements are described here.

The correlations among most of the body measurements were highly significant. The correlation between heart girth and belly girth, height and length, length and belly girth, height and belly girth were highly significant. Correlation of heart girth and body length were significant.

TABLE 40. CORRELATIONS AMONG BODY MEASUREMENTS (Cms.)

Correlated Traits	Hingoli	Udgir	Pooled
Hearth girth and belly girth	0.72** (48)	0.33 (22)	0.63** (71)
Heart girth & body length	0.18 (48)	0.37* (40)	0.27* (88)
Height and length	0.39** (48)	0.42** (40)	0.41** (88)
Body length and belly girth	0.28 (48)	0.65** (22)	0.41** (70)
Height and belly girth	0.49** (48)	0.23 (22)	0.43** (70)
Height and heart girth	0.52** (48)	0.37* (40)	0.46** (88)

Figures in parentheses indicate the number of cows on which the correlation coefficients were based.
* = Significant at 5% level of probability.
** = Significant at 1% level of probability.

CHAPTER - V

SUMMARY

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SUMMARY

The data for Deoni cattle, maintained at the Government Cattle Breeding Farms, Hingoli and Udgir, were utilized for this study. The records of age at first calving, peak yield, service period, lactation milk yield, lactation period, dry period, calving interval, and body measurements for the Deoni cows at both the farms were analyzed. The averages for above mentioned traits were 1533±19.2 days (51 months), 4.48±0.12 Kg., 184.1±4.6 days, 942.7±16.6 Kg., 293.3±2.9 days, 177.0±4.2 days and 466.0±4.6 days respectively. The averages for four body measurements were - length 132.2±0.8 cm., height 126.2±0.8 cm., heart girth 168.3±0.8 cm., and belly girth 193.8±1.3 cm. The coefficient of variation for all the traits, except body measurements was high indicating the possibility of selection for each trait.

The repeatability estimates based on intra-cow correlation method were 0.254±0.015, 0.215±0.017, 0.168±0.014, 0.309±0.020, 0.252±0.014, respectively for lactation milk yield, lactation period, dry period,

service period, and intercalving period. All the repeatability estimates were moderate to low. Heritabilities would be still lower. This suggests the use of progeny tested bulls and selection of young stock based on collateral relatives in bringing about improvement in the above mentioned traits.

The phenotypic correlations of peak yield, lactation period and belly girth with lactation milk yield were positive and highly significant. These findings indicate that the milk yield is highly affected by the length of lactation period and amount of peak yield. The correlation of lactation period with service period and dry period was also positive and highly significant. So also the correlations among different body measurements.

The regression of first lactation milk yield on the lactation period and peak yield of the same lactation was positive and highly significant. Every increase of one day in lactation period also increased the milk yield by 3.4 Kg. and for every increase of one Kg. in peak yield the milk yield increased by 160 Kg. Highly significant correlations and regressions of milk yield on lactation period and peak yield suggests that the selection for milk yield can be based on the latter two traits.

Sources of variation in milk yield were found out by analysis of variance. The maximum variation was due to lactation period (42.25%) followed by farms (18.43%). Age at first calving (7.62%), service period (5.22%) and season of calving (4.51%) caused lesser variation.

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APPENDIX

APPENDIX

TABLE i). AVERAGES

	Average	S.E.	C.V. (%)	Trait
1	2	3	4	5
Hingoli Farm	1674.0	21.4	16.9	AGE AT FIRST CALVING (DAYS)
Udgir Farm	1659.0	34.3	16.6	
Combined	1533.0	19.2	11.2	
Hingoli Farm	4.37	0.10	10.52	PEAK YIELD (Kg.)
Udgir Farm	4.58	0.21	41.24	
Combined	4.48	0.12	33.43	
Hingoli Farm	172.6	7.2	73.3	SERVICE PERIOD (DAYS)
Udgir Farm	191.6	7.4	84.9	
Combined	184.2	4.6	70.3	
Hingoli Farm	818.1	16.5	37.2	MILK YIELD (Kg.)
Udgir Farm	1041.9	26.1	51.7	
Combined	942.7	16.6	49.0	
Hingoli Farm	282.1	3.7	24.4	LACTATION PERIOD (DAYS)
Udgir Farm	301.8	4.1	29.0	
Combined	293.3	2.9	27.4	
Hingoli Farm	183.3	6.9	69.4	DRY PERIOD (DAYS)
Udgir Farm	172.4	5.3	66.1	
Combined	177.0	4.2	66.7	

Contd.....

TABLE i) (Contd.....)

1	2	3	4	5
Hingoli Farm	456.5	7.2	27.6	CALVING INTERVAL (DAYS)
Udgir Farm	472.3	6.0	27.7	
Combined	466.0	4.6	27.7	
BODY MEASUREMENTS OF ADULT COWS				
Hingoli Farm	130.25	0.98	5.22	BODY LENGTH (Cm.)
Udgir Farm	134.75	1.24	5.84	
Combined	132.29	0.81	5.77	
Hingoli Farm	121.60	0.60	3.42	HEIGHT (Cm.)
Udgir Farm	131.82	1.14	5.49	
Combined	126.25	0.81	6.07	
Hingoli Farm	169.64	1.03	4.20	HEART GIRTH (Cm.)
Udgir Farm	166.80	1.48	5.61	
Combined	168.35	0.88	4.93	
Hingoli Farm	189.72	1.43	5.21	BELLY GIRTH (Cm.)
Udgir Farm	202.77	1.93	4.48	
Combined	193.82	1.37	5.87	

TABLE ii). REPEATABILITIES

	Repeatability	Trait
Hingoli Farm	0.32±.02	
Udgir Farm	0.20±.02	MILK YIELD (Kg.)
Pooled	0.25±.01	
Hingoli Farm	0.18±.02	
Udgir Farm	0.23±.02	LACTATION PERIOD
Pooled	0.21±.01	
Hingoli Farm	0.10±.02	
Udgir Farm	0.18±.01	DRY PERIOD
Pooled	0.16±.01	
Hingoli Farm	0.20±.03	
Udgir Farm	0.39±.02	SERVICE PERIOD
Pooled	0.30±.02	
Hingoli Farm	0.17±.03	
Udgir Farm	0.29±.02	CALVING INTERVAL
Pooled	0.25±.01	

TABLE iii) POOLED CORRELATIONS OF PRODUCTIVE AND REPRODUCTIVE TRAITS.

Trait	Milk Yield	Lactation Period	Dry Period	Service Period	Age at 1st. calving
PEAK YIELD	0.55** (146)	0.16 (141)			
DAYS TO PEAK YIELD	0.08 (146)	0.135 (123)	0.0427 (123)	0.0238 (123)	-0.075 (79)
LACTATION PERIOD	0.621** (200)			0.431** (200)	
DRY PERIOD	-0.198 (200)	-0.163 (200)		0.63** (200)	
SERVICE PERIOD	0.13 (200)				
AGE AT FIRST CALVING	-0.12 (130)				

Figures in parentheses indicate number of animals on which the correlation coefficients were based.

** = Significant at 1% level of probability.

TABLE iv). POOLED CORRELATIONS OF BODY MEASUREMENTS (Cms.)

Trait	Length	Height	Heart Girth	Belly Girth
MILK YIELD	-0.12 (73)	0.079 (73)	0.16 (73)	0.38** (58)
LENGTH				0.41** (70)
HEIGHT	0.41** (88)		0.46** (88)	0.43** (70)
HEART GIRTH	0.27* (88)			0.63** (70)

Figures in parentheses indicate the number of animals on which the correlation coefficients were based.

* = Significant at 5% level of probability

** = Significant at 1% level of probability.