"Genetic Studies on Economic Efficiency of Cattle and Buffaloes in and Around Hajipur (Vaishali), Bihar"

THESIS

By

Dr. Prabhat Ranjan Kumar
Registration No. M/ABG/67/2003-2004

In partial fulfillment of the requirement
FOR THE DEGREE OF

MASTER OF VETERINARY SCIENCE
(ANIMAL BREEDING & GENETICS)

DEPARTMENT OF ANIMAL BREEDING & GENETICS
BIHAR VETERINARY COLLEGE
P A T N A (BIHAR)

2006

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(Faculty of Veterinary and Animal Sciences)

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OF CATTLE AND BUFFALOES IN AND AROUND
HAJIPUR (VAISHALI), BIHAR"

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2006

DEPARTMENT OF ANIMAL BREEDING & GENETICS
BIHAR VETERINARY COLLEGE, PATNA – 14
RAJENDRA AGRICULTURAL UNIVERSITY
PUSA (SAMASTIPUR), BIHAR

Dr. Siya Ram Singh
M.V.Sc., Ph.D
University Professor and Chairman

C E R T I F I C A T E – I

This is to certify that the thesis entitled *"Genetic studies on economic efficiency of cattle and buffaloes in and around Hajipur (Vaishali), Bihar"* submitted in partial fulfillment of the requirements for the Degree of Master of Veterinary Science **(Animal Breeding & Genetics)** of the faculty of post-graduate studies, Rajendra Agricultural University, PUSA, Samastipur, Bihar is the record of bonafide research work carried out by **Dr. Prabhat Ranjan Kumar, Registration No. M/ABG/67/2003-04,** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

It is further certified that the assistance and help received during the course of this investigation and preparation of the thesis have been fully acknowledged.

Endorsed

(S. R. Singh)
Chairman of the Department

(Siya Ram Singh)
Major Advisor

DEPARTMENT OF ANIMAL BREEDING & GENETICS
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RAJENDRA AGRICULTURAL UNIVERSITY
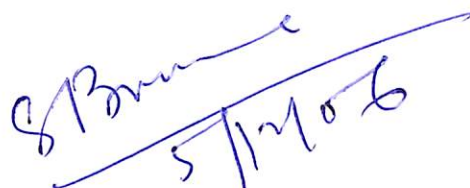## PUSA (SAMASTIPUR), BIHAR

CERTIFICATE – II

We, the undersigned members of the Advisory Committee of **Dr. Prabhat Ranjan Kumar**, Registration No. **M/ABG/67/2003-2004**, a candidate for the Degree of Master of Veterinary Science with major in **Animal Breeding & Genetics** have gone through the manuscript of the thesis and agree that the thesis entitled *"Genetic studies on economic efficiency of cattle and buffaloes in and around Hajipur (Vaishali), Bihar"* may be submitted by **Dr. Prabhat Ranjan Kumar** in partial fulfilment of the requirements for the degree.

(S. R. Singh)
Univ. Prof. & Head
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PUSA (SAMASTIPUR), BIHAR

CERTIFICATE – III

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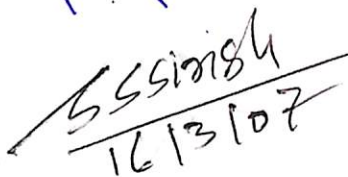
(S. R. Singh) 16/3/07
University Professor & Head
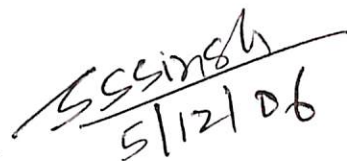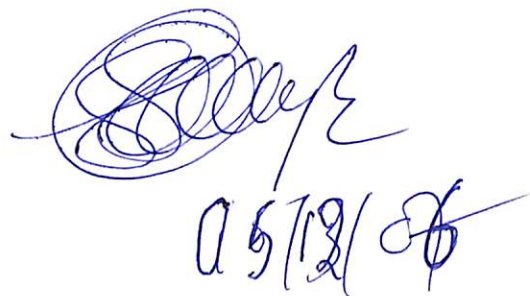Chairman, Advisory Committee

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ACKNOWLEDGEMENT

With all sincerity I wish to express my sum sincere thanks and deep sense of gratitude to my major advisor, Dr. S. R. Singh, M.V.Sc. (IVRI), Ph.D. (B.A.U.) University Professor and Chairman, Department of Animal Breeding & Genetics, Bihar Veterinary College, Patna for his erudite guidance pervaded with the spirit of keen interest and insight as well as magnanimous help during the period of study culminating in the final presentation of this dissertation.

I must express my inexplicable gratitude and indebtedness to the learned members of my advisory committee Dr. S. B. Verma, University Professor-cum-Chief Scientist, Department of Animal Breeding and Genetics, Dr. S. S. Singh, University Professor and Head, Department of Livestock Production and Management, Dr. C. Singh, University Professor and Head, Department of Veterinary Physiology (Nominee Dean Post Graduate Studies), B.V.C., Patna for their constant encouragement, valuable suggestions and kind helps during entire period of the study. I also want to thank Dr. K. G. Mandal, Associate Professor-cum-Senior Scientist, Department of Animal Breeding and Genetics, B.V.C., Patna.

I am highly thankful to Dr. S. P. Verma, Principal, B.V.C., Patna for providing co-operative behaviour and constant encouragement during the research period.

It is great pleasure to record my thanks to my seniors Dr. Dhirendra Kumar, Dr. Niraj Kumar, Dr. Rajiv Kumar, Dr. Rajiv Thakur, Dr. Brajesh Kumar, Dr. Shanker Dayal (Scientist, CDRI), Dr. Ravikant Nirala, Dr. Rajesh Mahtha,

Dr. J. D., Dr. Manoj Kumar and my juniors Dr. Ved Prakash, Dr. Subhash Kr. Pd. Singh, Dr. Dilip Kumar, Dr. Deepak Kumar Chaurasia, Dr. Dhiraj Chaurasia, Dr. Diwakar, Mr. Shashi Bhushan Prasad, Mr. Shiv Shankar Das, Mr. Kush Kumar, Mr. Mahesh Kumar, Mr. Shashi Bhushan Kr., Mr. Umesh Kumar alongwith all near and dear ones who have contributed in their own way to get my work accomplished.

I would like to convey my sincere thanks to my colleague viz. Dr. Mithilesh Kumar, Dr. Shashi Shankar, Dr. Ranjeet Kumar Sinha, Dr. Rupesh Kumar, Dr. Pankaj Kumar Chaudhary, Dr. Govind Choudhary, Dr. Samir Mandal and all other friends for their friendly co-operation throughout the study.

I wish to record my personal reckoning of gratitude to my school friends Mr. Manoj Kumar, Mr. Satendra Mishra, Mr. Sanjeev Kumar Singh, Mr. Nageshwar Thakur, Mr. Rajesh Kumar. Here I want to mention the name Miss Rita Singh whom I will never forget for my entire life.

I am equally grateful to campus librarian Dr. B. N. Mishra and other library staff for extending library facilities.

Gratitude alone fails to convey my feeling which can not be expressed in words for the affectionate care, moral support and encouragement constantly received from all members of my family especially my elder brother Mr. Arun Kumar Prasad, Mr. Sanjeev Ranjan Kumar and my loveable younger brother Nayan Ranjan for their support, blessing, love, gravious sacrifice and inspiration to pursue higher education and to achieve the goal in my life.

Last but not the least I express my heart touching and warm feeling to my parents Sri Ram Sharan Sahu and Smt Tara Devi for their blessing, enthusiastic moral

support, inspiration and deep affection during the entire period of study. I owe them what I am today.

I admire the patience, devotion and unfailing courtesy of ABG IT Unit, Department of Animal Breeding & Genetics, Patna especially Mr. Santosh, Mr. Ajay and Mrs. Mahalaqua who have taken great interest to publish this manuscript.

Finally, I again express my heartiest gratitude to my Maa for giving me patience and strength to overcome the difficulties which crossed by way in accomplishment of this endeavour.
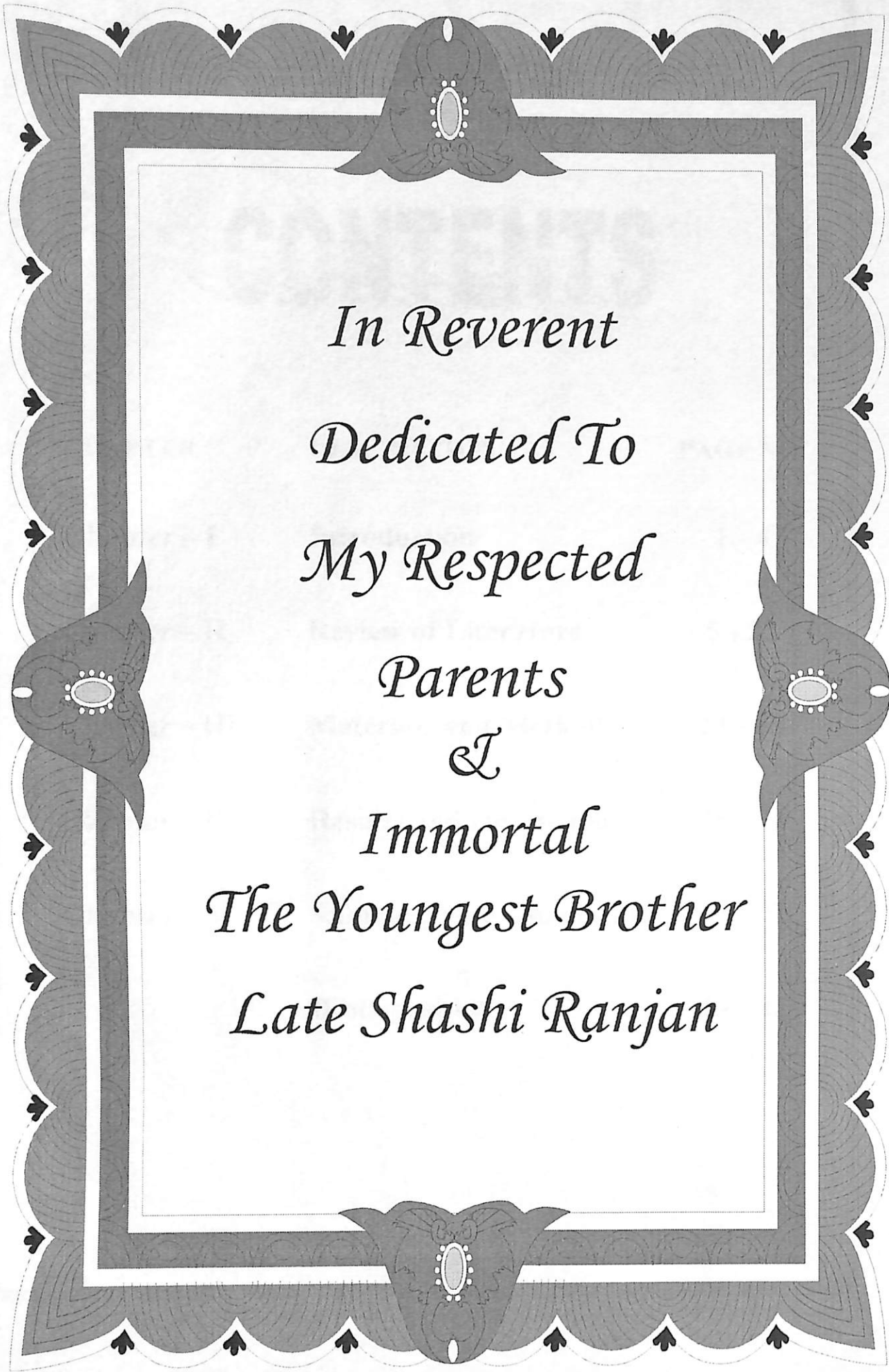
All may not have been mentioned but none has been forgotten.

Date : 5/12/2006

Place : B.V.C., Patna

(Prabhat Ranjan Kumar)

In Reverent

Dedicated To

My Respected

Parents

&

Immortal

The Youngest Brother

Late Shashi Ranjan

CONTENTS

LIST OF TABLES

Animal Husbandry, particularly dairy farming, is an integral part of diversified Indian Agriculture, contributing about 30% to the national agricultural output in the fiscal year 2002-2003 at current prices. Animal Husbandry contributed 5.42% to the total GDP of the country. Dairy husbandry, with the ecology & equity helps in elimination of poverty, hunger, pollution & malnutrition through enhanced quality food production. Besides that, livestock sector plays an important role in upliftment of the socio-economic status of rural mass in general and economically weaker section in particular through providing regular income and employment.

India is endowed with the largest livestock population in the world. It

INTRODUCTION

2003 (covering 91.7 million tons of milk) and this is expected to rise to 125 million tons by 2010.

Livestock sector contributes about

which constitute 6% percent of the labour force. Livestock sector provides about 65% of rural farmers (Hari Bau 2004). India has attained top position in milk production in the world after a record level production through Operation Flood and cross-breeding programmes.

The white revolution in dairying has contributed substantially in attainment of the highest position in milk production through increased greater access to the milk products and remuneration of many dairy farmers.

1. INTRODUCTION

Animal Husbandry, particularly dairy farming, is an integral part of diversified Indian Agriculture, contributing about 30% to the national agricultural output. In the fiscal year 2002-2003 at current prices, Animal Husbandry contributed 5.42% to the total GDP of the country. Dairy husbandry, with the ecology & equity, helps in elimination of poverty, hunger, pollution & malnutrition through enhanced quality food production. Besides that, livestock sector plays an important role in upliftment of the socio-economic status of rural mass in general and economically weaker section in particular through providing regular income and employment.

India is endowed with the largest livestock population in the world. It accounts for 57 percent of world's buffalo and 15% of cattle population. According to Livestock Census (2003), the country has 185 million cattle, 98 million buffalo, 61.47 million sheep, 124.36 million goat and 12.8 million pigs, producing 90.7 million tonnes of milk, 45.2 billion eggs, 44.5 million kg wool, 2.12 million tonnes of meat and 6.3 million tonnes of fish during the year 2004-05. Livestock sector provides regular employment to more than 11 million people as a primary and to 9 millions as subsidiary venture. Women constitute 69 percent of the labour force in Livestock sector as against 35% in crop farming (Dairy India 2006). India has attained first position in milk production in the world after successful implementation of Operational floods and cross-breeding programmes.

Co-operative movement in dairying has contributed significantly in attainment of the glorious position in milk production through expertise and input support to the milk producers and intensification of marketing network

from grass root level. However, the average milk yield per milch animal (cow/buffalo) in India is comparatively lower than that in the developed countries.

The Truncated Bihar is a milk deficient state (Bihar Govt. Report 2001) and there is a great need to augment milk production to cope with its increasing demand due to rapid growth in human population. Milk production in Bihar is predominantly a domain of small and marginal households contributing more than 65% to the state milk pool and thus, it is vivid that formulation of suitable package of dairy practices to maximize milk production in the small dairy units distributed throughout the state under farmers managemental system is essentially required. Systematic studies on the present status of production and reproduction efficiencies of cattle & buffaloes, the major milk producing stock, in the different agro-echo-socio-climatic regions of the state have not been made. The nature as well as the magnitude of variations in the economic indicators due to genetic and different non-genetic factors are the pre-requisite for formulating & recommending an area-specific package of practices for betterment of dairy farming in Bihar.

Milk yield is the principal economic trait of dairy animals affected by various genetic & non-genetic factors. Profitable production is the prime objective of dairy enterprises and the optimum level of production is the key to maximize it. Producer must be aware of the nature as well as the magnitude of different determinants of profit in the dairy farming. Apart from this, economic analysis of milk production is also needed for providing effective linkage among producers, consumers and policy makers for fixing prices of inputs & outputs in rational way. The concept of profit also

provides an alternative approach to the analysis of production system. Thus it is necessary to study the economic aspect of dairy farming.

Although, Cross-breeding in cattle and upgrading of buffaloes in Bihar has increased the total production of milk in recent past, but still we are lagging behind in meeting the recommended optimum requirement of 220 gm of milk/capita/days to the human population. The per capita availability of 186 gm of milk in Bihar is significantly lower than the present national average of 231 gms. A considerable number of crossbred cows, with variable level of Jersey and Holstein-Friesian inheritance as well as the local buffaloes available in the state are required to be evaluated for their adaptability in terms of their production, reproduction and economic efficiencies in the different agro-climatic regions of the state. These basic information are required to formulate a suitable breeding strategy for their further improvement.

Reports are available to indicate that high yielding dairy animals require some hi-tech management and as such farmers are facing several constraints in adoption and rearing of high yielding stock.

Hajipur (Vaishali) is the Northern Gateway of Patna, the capital city of Bihar. Milk produced in and around Hajipur is marketed in Patna and farmers are getting remunerative price for milk & milk products. As such, a large number of milk production units have grown up in and around Hajipur and running under both the co-operative and non-cooperative sectors. Most of the dairy units are covered by state Dairy co-operative networking of COMPFED and farmers are getting input support in terms of potent animals, balanced concentrate mixture, high quality semen, vaccines etc. besides

technical know-how. There is need to assess the impact of dairy co-operative in the aforesaid area in terms of production & reproduction performance of milk producing stock. No systemic study has been undertaken either to estimate the phenotypic parameters of milk production efficiency measures or the economics of milk production of the cows and buffaloes maintained by the farmers in and around Hajipur. Besides, the magnitude and direction of the effects of genetic as well as non-genetic factors on milk production efficiency traits of these animals are also yet to be determined. The constraints perceived by the farmers in maintaining high yielding dairy animals are also to be listed out & prioritized. The above considerations have been pivotal in planning this study with following objectives:

1. To estimate the phenotypic parameters of different economic indicators in cows & buffaloes under farmers managemental system in the study area.

2. To delineate nature as well as s magnitude of variation in economic indicators due to influence of genetic and some non-genetic factors in cows & buffaloes in the area under investigation.

3. To study the impact of dairy co-operative in terms of variation in economic performance of cattle and buffaloes in the study area.

4. To suggest a suitable package of dairy practices for profitable milk production in the study area.

Studies on economic efficiency of milk producing animals have been a subject of investigation by several workers since long, but most of the studies were confined to organised herds. The studies on performance traits of livestock species reared under farmers management system and contributing considerably to the national milk pool has attracted attention of Animal scientists. At recent, past and sporadic reports are available from different agro-climatic zones of the country. Reports on comparative analysis of economic efficiencies including cost of milk production of cattle or buffaloes of different genetic groups managed under the co-operative and non-cooperative system. The available reports on such investigations, were pertinent to this study, have been reviewed here.

REVIEW

LITERATURE

2.1

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2. REVIEW OF LITERATURE

Studies on economic efficiency of milk producing animals have been a subject of investigation by several workers since long, but most of the studies were confined to organized herds. The studies on performance traits of livestock species reared under farmers managemental system and contributing considerably to the national milk pool has attracted attention of Animal scientists in recent past and sporadic reports are available from different agro-climatic zones of the country. Reports on comparative analysis of economic efficiencies including cost of milk production of cattle & buffaloes of different genetic groups managed under the co-operative and non-cooperative sectors are a few. The findings of such investigations, very pertinent to this study, have been reviewed here.

2.1 PRODUCTION AND REPRODUCTION TRAITS :

Prasad et al. (1991) studied the performance of indigenous and crossbred cows under village conditions in Andhrapradesh and reported that the average lactation length in local, Jersey crossbred and HF crossbred cows were 300.97, 333.99 and 343.41days respectively.

Dev Raj & Gupta (1994) found that in Churu district of Rajasthan, the buffalo rearing was more economical as compared to local cows. The average lactation length and daily milk yield in buffaloes and local cows were recorded to be 310 and 270 days as well as 4.47 and 2.13 litres respectively.

Shah and Sharma (1994)[a] conducted a comparative study on economic performance of milch animals of different genetic groups in typical rural condition of Bulandshahar district of Uttarpradesh. The district was divided

into two areas, the one covered by Dugdh Utpadak Sahkari Sangh (DUSS) and other not covered by DUSS (NDUSS). The study revealed that the lactation length in Murrah buffaloes, local buffaloes, local cows and crossbred cows were 362 ± 7.32, 343 ± 7.68, 317 ± 19.95, and 359 ± 18.73 days in DUSS and 354 ± 5.58, 334 ± 6.30, 336 ± 5.23 and 334 ± 7.59 days in NDUSS. The average lactation yields were 1795.25, 1456.33, 926.61 and 1972.99 litres in DUSS and 1572.74, 1301.91, 918.61 and 1995.07 litres in NDUSS respectively. In general, the animals managed under DUSS performed better than those under NDUSS group.

Deshmukh and Singh (1995) reported the average value for lactation length & lactation milk yield in Jersey cross-bred cows to be 309.87 ± 3.56 days & 1954.53 ± 68.99 kg respectively. The season of calving did not have significant influence on the traits, while parity effect was significant on lactation milk yield. The same group of workers also reported the average value for dry period in Jersey crossbred cows to be 141.18 ± 6.02 days. The season of calving did not have significant influence on dry period.

Rao and Singh (1995) reported the average estimates for lactation yield, lactation length and dry period in graded Murrah buffaloes as 1528 kg, 341 days and 194 days respectively. Season of calving did not have any significant influence on dry period.

Singh (1995) reported that in Friesian x Zebu cows in private dairy herds in and around Ranchi (Jharkhand), the average values for lactation length, lactation yield and peak milk yield were 324.7 ± 6.4 days, 2370.8 ± 66 kg and 13.3 ± 0.3 kg respectively. The effect of the level of Friesian inheritance influenced all the traits significantly except the lactation length. Half-bred were recommended to be the grade of choice for economic milk production in the study area.

Verma and Kherde (1995) studied the productive and reproductive performances of buffaloes in upper Gangetic plain and reported the average values for lactation length, dry period and C.I. to be 329 days, 185 days and 513 days respectively.

Choudhary et al. (1995) estimated average calving interval in Jersey crossbred cows to be 451.70 ± 7.76 days. The influence of season of calving and parity on calving interval were statistically not significant.

Venkatasubramanian and Fulzele (1996) conducted a study involving 288 small dairy units under private sector distributed in villages of Tamil Nadu and recorded average lactation yield of crossbred and indigenous cows to be 2075.00 ± 20.26 and 950 ± 7.86 litres respectively. The average lactation length in the crossbred and indigenous cows were 9.11 ± 0.05 and 8.18 ± 0.02 months respectively. The production performance was found to be greatly influenced by the feeding, housing and breeding management in the herds.

Shrivastava et al. (1996) conducted a study to find out the effect of various genetic & non-genetic factors on dry period and calving interval in Friesian x Zebu crossbred cows maintained under farmers' managemental condition in Chotanagpur. The overall mean dry period and calving interval were found to be 85.98 ± 1.36 and 384.48 ± 1.40 days respectively. The effects of location of the herd and season of calving were non-significant on both the traits. However, the size of herd had significant influence on dry period & calving interval. Cows in smaller herds i.e. groups of 1-2, 3-5 and 6-8 cows, had significantly shorter dry and inter calving periods as compared to those in herds of 9-11 and more.

Shrivastava et al. (1998) Studied the effect of genetic and different non-genetic factors on some dairy traits in Friesian crossbred cows of un-organised herds. The estimates of overall mean lactation yield, lactation length and peak yield were reported to be 2716.03 $\pm$ 7.89 kg, 298.73 $\pm$ 0.48 days and 13.52 $\pm$ 0.04 kg respectively. The herd size and parity had significant effect on all the traits under study. The cows in smaller herds (1-2 and 3-5 cows) had higher lactation yield and peak milk yield than those in larger herds (6-8, 9-11 and above 12 cows). The lactation length, lactation yield & peak yield increased linearly with increase in sequence of lactation up-to fifth lactation.

Tomar et al. (1998) estimated the 1st lactation length, peak yield, average milk yield per day of lactation length and calving interval in HF half breds to be 234.49 days, 8.51 kg, 6.75 kg and 4.18 kg respectively. They also reported the average dry period and calving interval in HF half-breds to be 167.07 & 403.72 days respectively.

Pathodiya et al. (1998) reported that the period of calving had significant influence on lactation milk yield, lactation length, dry period and calving interval in buffaloes, the average values for dry period and calving interval being 203.8$\pm$ 0.00 and 469.4$\pm$6.4 days respectively.

Deepak Shah (2000) conducted a study to assess the perception of the farmers towards milk co-operative in Maharastra and concluded that dairy co-operatives have played a pivotal role in raising socio-economic status of farmers in the state. The facilities like loans and subsidies for milch animals, extension facilities, Veterinary health care services and other technical inputs provided to the farmers through milk co-operatives were the reasons of attraction of dairy farmers to join co-operative sector.

Sasidhar et al. (2000) recorded average lactation length and daily yield in Murrah buffaloes to be 1820.3 kg, 289.6 days and 3.18 kg respectively.

Shrivastava and Singh (2000) studied the factors influencing efficiency of milk production in Friesian x Zebu crossbred cows in unorganized herds located in and around Ranchi. The overall mean MY/CI and MY/LL were 7.11± 0.03 & 9.09 ± 0.03 kg respectively. The effects of herd size and parity were observed to be statistically significant on both the traits. However, the season of calving did not have any significant influence on the traits under investigation.

Singh et al. (2000) studied the factors affecting lactation performance in Jersey and Friesian crossbred cows. The overall mean, irrespective of the genetic groups of the cows, for lactation yield, lactation length and peak yield were estimated to be 2748.20 ± 18.93 kg, 338.78 ± 1.76 days 13.92 ± 0.07 kg respectively. When taken genetic group-wise, the corresponding values for Jersey and Friesian crossbreds were 2355.42 ± 56.29 kg, 322.50 ± 5.23 days and 13.27 ± 0.30 kg as well as 3021.73 ± 40.53 kg, 337.73 ± 3.37 days and 15.23 ± 0.21 kg respectively. The effect of genetic group was significant on lactation yield, lactation length and peak yield, while it was not significant on calving interval. The effect of parity was statistically significant on all the traits, but the season of calving did not have any significant influence on any of the traits under study. Further, the overall mean, irrespective of the genetic group for calving intervals was 434.77 ± 2.74 days. When taken genetics group-wise, the corresponding value for Jersey and HF crossbred cows were 405.94 and 429.47±40.53 days. The effect of parity was statistically significant on both the reproduction traits under study, but the season of calving did not have any significant influence

on the traits. The Least Squares Means for calving interval & dry period in Jersey cross bred were 453.73 ± 4.4 and 8.39 ± 3.10 days respectively. The corresponding value in HF were 472.82 ± 10.78, 90.53 ± 7.54 days and in buffalo 643.51 ± 5.08 days & 242.84 ± 4.34 days respectively.

Rao et al. (2000) conducted study in 15 villages covered under Milk Producers Co-operative Societies (MPCS) and another 10 villages not covered under the Milk Producers Co-operative Societies (Non-MPCS) for evaluation of performance of crossbred cows and buffaloes in Vishakhapatnam district of Andhrapradesh. They estimated average lactation milk yield and lactation length in crossbred cows under MPCS to be 2543.11±63.76 kg and 363.36±4.14 days, the corresponding values for Non-MPCS being 2147.51±96.97 kg and 368.47±6.30 days respectively. Average lactation milk yield and lactation length in graded buffaloes under MPCS were reported to be 1734.20±35.98 kg and 371.45±3.34 days while the corresponding estimates for buffaloes under Non-MPCS were 1703.84±56.57 kg and 378.21±5.25 days respectively. They further reported the average calving interval and dry period in crossbred cows under the MPCS were 440.70±5.93 and 76.30±4.15 days while the same under Non-MPCS were 467.84±9.02 and 98.16±6.31 days respectively. For buffaloes the estimates of average calving interval and dry period under MPCS were 538.70±6.81 and 167.29±5.52 days while the same under Non-MPCS were 551.27±10.70 and 172.72±8.67 days respectively.

Thakur et al. (2000) reported the average 300 days total milk yield, milk yield per day of lactation length and calving interval in Jersey crossbred cows ranging between 1652.2 ± 129.4 & 2044.55 ± 55.5 kg, 5.81 ± 0.60 & 7.25 ± 0.26 kg and 4.28 ± 0.40 & 5.43 ± 0.17 kg respectively. The corresponding overall least squares means for the aforesaid traits were 1850.1 ± 31.8 kg, 6.61 ± 0.15 kg and 4.76 ± 0.50 kg respectively.

Dutt and Bhushan (2001) estimated the mean peak yield in Friesian and Jersey half breds to be 11.09 ± 0.22 and 8.89 ± 0.35 kg respectively. The effect of season of calving on peak yield was statistically not significant.

Srivastava et al. (2001) reported that the average daily milk yield in crossbred cows maintained at Faizabad (UP) varied from 7.47 ± 0.17 to 9.62 ± 0.38 kg. The duration of shower provided to the cows in summer gave better results.

Singh (2002) analyzed the first performance record of buffaloes in UP and reported the estimate of the overall means for lactation milk yield, MY/LL and lactation length to be 1400.05 ± 19.25 kg, 3.776 ± 0.042 kg and 378.59 ± 4.8 days respectively.

Priya Raj (2002) reported that in HF and Jersey crossbred cow genetic group significantly ($P<0.01$) influenced the lactation milk yield and calving interval but its effect on dry period was not significant. MY/CI in HF crossbred cows was significantly higher than in Jersey crossbreds. The average peak milk yield of HF crossbred cow was also significantly ($P \leq 0.01$) higher than those in Jersey crossbreds. Size of herd had no significant effect on average peak yield, but its effect was significant ($P<0.01$) on MY/LL in HF and Jersey crossbreds under field conditions in and around Patna (Bihar). She also recorded the effect of herd-size to be not significant on calving interval and dry period in Desi, HF and Jersey crossbreds.

Ramchandra et al. (2003) conducted a study on the functioning of State Dairy Co-operatives in India and concluded that with the changing global scenario and the strength of Indian dairy sectors, there is an urgent need to improve the quality of milk being produced in million houses through out the country and also at the collection centers. The co-operative

sector can succeed in attaining the aforesaid objectives more easily as compare to private milk producers.

Verma and Sharma (2003) studied the impact of dairy union in the adoption of improved Animal Husbandry practices in Rajasthan and found that the members of dairy co-operative societies had higher adoption level of all major improved Animal Husbandry practices resulting into relatively better production and profit as compared to non-members. The improved practices pertained to breeding, feeding, management, health care and clean milk production.

Hemalatha et al. (2003) made an attempt to work out economics of milk production of different breeds of bovines in Ahmadnagar district of Maharastra and reported that the average lactation length was the longest (320 days) in HF crossbreds followed by Jersey crossbreds (298 days), graded buffaloes (278 days) and non descript cows (240 days). The average daily milk in Friesian and Jersey crossbred cows, non descript cows as well as Buffaloes were recorded to be 13.0, 11.0, 3.0 and 6.5 litres respectively. The average calving interval was maximum in non-descript cows (420 days) followed by buffaloes (413 days), HF cross-bred (410 day) & Jersey cross bred (381 days) respectively, the effect of genetic group being significant.

Akhtar et al. (2003) estimated the average calving interval & dry period in HF cross-breds to be 382.37 ± 0.93 & 72.82 ± 0.65 days respectively. Findings revealed that the effect of genetic constitution of HF, J & RD crossbreds on dry period was significant ($P<0.05$).

Niraj (2004) estimated the average lactation milk yield, lactation length, peak milk yield, days to attain peak milk yield, MY/LL and MY/CI in HF cross-breds, Jersey crossbreds, graded buffaloes and desi cows to be 2160.16 ± 20.69 kg, 2037.54 ± 21.03 kg, 1369.88 ± 18.91 kg and $734.45 \pm$

17.85 kg; 334.64 ± 1.89 days, 333.43 ± 2.02 days, 321.14 ± 1.82 days and 293.29 ± 1.71 days; 12.30 ± 0.16 kg, 11.89 ± 0.16 kg, 7.72 ± 0.14 kg and 4.99 ± 0.14 kg; 43.02 ± 0.52 days, 42.51 ± 0.53 days, 39.00 ± 0.48 days and 35.90 ± 0.45 days; 6.47 ± 0.07 kg, 6.16 ± 0.07 kg, 4.32 ± 0.06 kg and 2.54 ± 0.06 kg; 4.79 ± 0.05 kg, 4.58 ± 0.05 kg, 3.10 ± 0.05 kg and 1.71 ± 0.05 kg respectively. He conducted study in and around Darbhanga (Bihar). He further reported that the effects of Genetic group and lactation order on LMY, LL, PMY, DAPMY and MY/LL were highly significant (P≤0.01), while the effect of herd-constitution on the aforesaid traits were statistically non-significant. Further, the effect of herd-size, genetic group and lactation order on MY/CI was statistically significant, while herd-constitution did not have statistically significant influence on MY/CI. The effect of herd-size was significant on LMY and MY/LL, while the herd-size-effect on LL, PMY and DAPMY were statistically not significant. He also reported that the averages for dry period and calving interval in Desi cows, HF cross bred, Jersey cross bred and Graded buffalo were 134.82 ± 3.06 & 427.08; 117.52 ± 3.54 & 453.45 ± 4.089; 227.82 ± 3.62 & 451.85 ± 4.15 and 128.96 ± 3.24 and 449.87±3.73 days respectively. He observed that the influence of genetic grade on dry period and calving interval were highly significant but the herd-size, herd-constitution and parity did not have any significant effects on the reproductive traits under the reference.

Kumar (2005) reported that average total lactation yield and yield (kg) per day of lactation length in Desi, HF crossbred and Jersey crossbred cows were 1005.19 ± 43.83 kg & 2.98±0.19 kg, 2800.2±34.32 & 28.05±0.15 and 2169.30±40.25 kg & 6.06±0.17 kg respectively. He also observed the effect of genotype on peak yield to be significant, the highest average peak yield (12.19 kg) being observed in HF crossbred followed by Jersey crossbred and Desi cows. Among the reproductive traits the average dry period and average

calving interval of Desi, HF and Jersey crossbreds were 115.3±5.49 & 470.56 ± 5.05; 77.25±4.30 & 427.09 ± 3.96 as well as 70.44 ± 5.05 & 430.07 ± 4.04 days respectively.

Ayub (2005) studied the economic efficiency in Desi, HF crossbred and Jersey crossbred cows in and around Muzaffarpur (Bihar) and recorded the average LMY, LL, PMY, DAPMY, MY/LL and MY/CI to be 792.82±57.23, 2111.80±58.80, 2179.48±18.30 kg; 291.76±1.07, 332.75±1.74, 334.87±1.15days; 5.60±0.06, 12.96±0.10, 12.78±0.10 kg; 36.41±0.42, 43.05±0.30, 43.00±0.32 days; 2.72±0.023, 6.43±0.05, 6.51±0.05 kg and 1.89±0.20, 4.73±0.05, 4.90±0.04 kg respectively. The genetic group and parity of calving had significant influence on all the above traits. Although the herd-size did not have any significant effect on LMY, PMY, DAPMY but its influence on daily milk yields i.e. MY / LL and MY/CI were statistically significant. The least squares means for dry period and calving interval in Desi, HF crossbred and Jersey crossbred cows were reported to be 129.48±1.51, 114.05±2.40 & 111.23±2.10 days as well as 420.48±2.14, 446.22±3.06 and 446.10±2.21 days respectively.

2.2 ECONOMICS OF MILK PRODUCTION :

Ahir & Singh (1994) studied the cost of maintenance and return from milch animals in South Gujarat. They reported that among the various variable cost items contributing to the gross cost of milk production the contribution of cost of feeds and fodder was the highest (54.75, 59.19 and 63.90 percent) followed by that of hired and inputed value of family labour (8.10, 13.94 and 12.93 percent) and Veterinary and miscellaneous charges (2.20, 2.20 and 1.74 percent) respectively in cross bred and local cows as well as buffaloes. Interest on working capital, managerial cost, interest on fixed capital and depreciation contributed 11.37, 8.27, 7.95 and 5.71 percent

to the total Gross cost of production in crossbreds; 7.79, 7.54, 5.18 and 4.16 percent in local cows and 6.08, 7.72 and 3.08 percent in buffaloes accordingly. The cost of production per litre milk were Rs. 4.92, 4.38 and 6.09 in crossbred cows, local cows and buffaloes respectively. Results also revealed that crossbred cows were relatively the most profitable as it gave the maximum net profit of 17.0 percent over the investment.

Jahagir et al. (1994) analysed the economics of milk production in Bangaldesh and found that the variable and fixed cost items contributed 61.31 and 38.69 percent respectively to the total cost of milk production in crossbred cows. Among the fixed cost items capital cost contributed the highest (3.57%) followed by interest on running capital (3.68%), housing cost (1.90%) and cost of dairy equipments (0.54%). The contribution of the cost of feeds and fodder was found to be (41.71%) followed by labour cost (14.8%).

Kalara et al. (1994) analysed comparative economics of milk production in rural and urban areas of Haryana and reported that in Urban area the total fixed and variable costs in maintaining crossbred cows were 7.99 and 92.01% percent respectively. Among the variable cost items the cost of feeds and fodder accounted for (67.78%) followed by labour cost (15.50%), miscellaneous experiment (4.65%) and cost of annual repair (1.86%). They concluded that crossbred cows had an edge in term of returns over buffaloes owing to its high milk yield. Crossbred cows as well as buffaloes yielded more profit in rural than in Urban areas. However, the level of profit was not in accordance with the cost of feed and fodders and profit was relatively lower in rural area. Lower milk yield and interference of middle men in rural areas were attributed to such results.

Shah and Sharma (1994) conducted study on economic performance of milch animals of different genetic groups in rural conditions of Bulandshahar district of U.P. The district was divided in two areas, one covered by Dugdh Utapadak Sahkari Sangh (DUUS) and the other not covered by DUSS (NDUUS). The study revealed that the net income derived from bovines was much higher in DUSS area than in NDUSS. On an average the cost of feeding accounted for nearly 60 percent for all the breeds in both the sample pockets. The expenditure on human labour were 18.73, 20.75, 21.79 and 19.94 percent for Murrah buffalo, local buffaloes, local cow and crossbred cows respectively in the area covered under DUSS, while the corresponding values for the animals under the group NDUSS were 19.49, 20.96, 21.52 and 17.99 percent.

Sharma and Singh (1994) worked out the cost and return form different breeds/grades of milch animals maintained by different categories of farmers of Himachal Pradesh. They found that the average operational cost comprising of feed cost, human labour & miscellaneous expenditure in crossbred cows, local cows and graded buffaloes were 84.59, 83.35 and 84.74 percent of the total maintenance cost respectively. The fixed cost, comprising of depreciation on assets and interest on fixed capital, accounted for 15.41, 15.65 and 15.26 percent accordingly. Among the operational cost components, feed cost contributed 64.15, 61.33 and 66.14 percent while human labour contributed 19.03, 20.81 and 17.11 percent respectively in crossbred cows, local cows and graded buffaloes. The contribution of the miscellaneous cost varied from 1.41 to 2.21 percent. The finding also indicated that crossbred farming was relatively more profitable as compared to buffaloes and local cows.

Shiyani and Singh (1995) worked out the economics of milk production for members and non-members of dairy co-operatives in

Saurashtra region of Gujrat. Results revealed that on an average the cost of feeds & fodder varied from 70.63 – 71.24 percent in buffaloes and 64.98 – 65.94 percent in local cows. It was followed by labour cost ranging between 17.00-20.66 and 19.90-24.60 percent in buffalo & cows respectively. The cost of per litre milk production varied from Rs. 5.56-6.47 in buffalo. The corresponding range for local cows was Rs. 4.12-4.63. The milk yield of cows as well as buffaloes were maximum during winter season. For both the categories of milk producers the average cost of milk production was minimum during summer season while the production cost for cow milk was the lowest in the winter season.

Kalara et al. (1995) worked out the economics of milk production in rural areas of Haryana. Among the variable cost items, feed and fodder contributed the maximum (58.08, 56.22 and 63.64 percent) followed by labour cost (18.11, 19.45 and 16.64 percent) in buffaloes, crossbred and local cows respectively. The contribution of fixed cost was 17.95, 15.55 and 12.87 percent respectively in buffaloes, crossbreds and local cows. The cost of per litre milk production were estimated to be Rs. 4.95, 3.53 and 6.91 in buffalo, crossbred and local cows respectively.

Rao and Singh (1995) computed various cost components (variable and fixed) of cost of production of milk along with return for different categories of buffalo farms in Guntur district of Andhra Pradesh. They found that in the case of beneficiaries of Operation Flood Programme, feeds and fodders contributed 51.26 percent to the gross cost (30.25%) of milk production. It was followed by Labour cost and Miscellaneous expenditure (2.40%). The fixed cost comprising of interest on fixed capital and depreciation on fixed assests, contributed 7.69 and 8.40% to the gross of production relatively. The corresponding values for non-beneficiary household were 51.10, 26.64, 2.04, 10.81 and 9.41 percent respectively. The

cost of per kg milk production in beneficiary and non-beneficiary households varied from Rs. 2.58-3.08 and Rs. 3.37-4.86 respectively.

Sangu (1995) analysed the economics of milk production in different types of milch animals in villages and towns in western U.P. They found that variable cost comprising of feed cost, veterinary charges in crossbred and local cows as well as buffaloes were 68.99, 75.42 and 70.34 percent, miscellaneous cost in crossbred and local cow as well as buffaloes were 68.99, 75.22 and 70.34 percent for villages and 67.68, 74.04 and 68.99 percent for towns respectively. Feed cost alone accounted for 66.83, 73.51 and 68.64 percent in villages and 65.81, 72.01 and 64.45 percent in towns for crossbreds and local cows as well as buffaloes respectively. The contribution of fixed cost comprising of interest on capital; depreciation on building, machinery, electric and water installation as well as labour and electric charges for crossbred cows, local cows and buffalo were 31.01, 24.58 and 29.66 percent for villages. For towns the corresponding values were 32.12, 25.96 and 33.25 percent respectively. The production cost per kg of milk was Rs. 4.12 and 4.48 for buffaloes in villages and towns respectively. The corresponding values for desi and crossbred cows were Rs. 3.89 and 3.48 for villages and Rs. 4.10 and 3.88 for towns respectively.

Baruah et al. (1996) studied the economics of milk production in Assam. Among the variable cost items, the contribution of feed cost, labour cost, Veterinary charges and miscellaneous expenses to the Gross cost of milk production were estimated to be 70.59, 14.98, 0.57 and 1.23 percent respectively. Among fixed costs, the interest on fixed capital, depreciation on building/ shed, equipments and animals contributed 7.14, 0.13, 0.13, 0.15 and 5.21 percent respectively. The average cost of milk production, irrespective of herd-size, was estimated to be Rs. 8.28 per litre. Jersey graded cows maintained in the herd of 4-6 performed better from the economic

point of view in comparison to the cows in the herds of <4, 7-9, 10-12 and >12 cows.

Kumar & Balishter (1996) undertook an economic study of milk production in crossbred cows and Murrah buffalo in Firozabad district of U.P. They reported the estimates of the cost of production of milk in crossbred cows and buffalo to be Rs. 3.53 and Rs. 4.45 per litre respectively. Among variable cost items, feeding, labour and miscellaneous expenses contributed 54.70, 21.26 and 2.09 percent in crossbreds whereas, the respective contributions of those cost components in buffaloes were 57.80, 19.89 and 1.61 percent. Among fixed cost components, the contribution of depreciation on fixed assests and interest on fixed capital were 8.96 and 12.98 percent for cross bred cows and 12.50 and 21.20 percent for buffaloes respectively.

Badal & Dhaka (1998) made an attempt to work out the cost of milk production of different breeds of bovines in Gopalganj district of Bihar. Among the various components of cost of milk production, feed cost contributed maximum followed by labour cost, interest on fixed assests, depreciation on animal and Veterinary & miscellaneous expenditure, the range of contributions of those cost components in buffalo being 36.56-55.26, 16.33-44.30, 9.78-13.73, 8.08-11.64 and 1.18-3.04 percent respectively under different house hold categories. The corresponding values for crossbred cows ranged from 42.75-56.84, 13.62-35.68, 12.08-15.89, 8.53-11.0 and 0.96-2.25. For local cows the estimates ranged from 37.08-52.26, 17.24-28.28, 9.80-14.77, 8.17-12.53 and 1.17-3.20 percent respectively. The overall net cost of milk production (Rs. per litre) was reckoned to be the minimum (Rs. 5.67) in crossbred cows followed by buffaloes (Rs. 5.88) and the maximum in local cows (Rs. 7.10).

Chandra and Agarwal (2000) worked out the costs and returns from milk production of crossbred cows and buffaloes in Frarukhbad district of Uttarpradesh. Their findings revealed that in the case of crossbred cows and buffaloes, out of the variable cost items, feeds and fodder accounted for 69.8 and 68.2 percent of the gross cost of maintenance followed by labour cost (21.5 and 21.9 percent) and miscellaneous expenditure (1.0 and 0.8 percent) respectively. Among the fixed items, depreciation on fixed assets were 2.8 and 5.7 percent and interest on fixed capital accounted for 4.9 and 3.4 percent respectively in cows and buffaloes. The value of dung reduced the gross cost of milk by Rs. 0.46/litre in crossbred cows and Rs. 0.43/ litre in buffalo. The net cost of production of milk in crossbred cows and buffaloes were Rs. 6.83 and 7.58 respectively. Results indicated that the net cost of production per litre of milk was higher in buffaloes as compared to crossbred cows for small, medium and large farmers, while it was just reverse in the case of landless labourers.

Priya Raj (2002) conducted a study on cost of milk production in private dairy units in and around Patna and reported that the cost of production was significantly lower in Friesian crossbred cows in 3rd lactation managed in herds of 3-7 cows as compared to Jersey cows in same parity and management.

Hemalatha et al. (2003) reported that in Ahmadnagar district of Maharastra the average profit per animal was maximum in Jersey crossbred cows as compared to HF cross-breds. Even Buffaloes were not found to be more profitable. Among the various components of cost of milk production, feed cost contributed maximum followed by miscellaneous cost, veterinary cost and supervision cost, the range of their contributions being 60.84-68.88, 13.85-22.25, 8.25-13.50, 1.62-2.11, 0.72-2.00 and 1.07-1.86 percent respectively. The net cost of milk production (Rs. per litre) was minimum

(Rs. 4.03) in HF crossbreds followed Jersey crossbreds (Rs. 4.51), graded buffaloes (Rs. 7.43) and the maximum in non-descript cows (Rs. 8.10). Dairy farming was recommended to be a suitable venture to harvest constant and regular income from sale of milk unlike in crop production.

Bardhan et al. (2004) carried out a study in Udham Singh Nagar district of Uttarpranchal to analyse the cost and returns involved in milk production from indigenous cattle in different seasons for different categories of farmers. The results showed that milk production from indigenous cattles in the study area was a highly unprofitable business. Among the overall estimates of different cost components, feed cost was the highest (57.32%) followed by labour charges (19.50%), depreciation (8.42%), interest an fixed capital (6.24%), working capitals (3.12%) and Veterinary charges (2.25%).

Kumar (2005) analysed the data pertaining to cost of milk production in Desi, HF crossbred and Jersey crossbred cows managed in private sector in and around Patna and reported that genetic group and parity of lactation had significant influence on the Net cost of milk production. The average net cost of per kg milk produced by HF crossbreds was significantly (P<0.01) lower by Rs. 1.04 and Rs. 1.68 than that produced by Jersey crossbred and Desi cows respectively.

Raju et al. (2005) conducted a study on the cost of milk production in Institute Village Linkage Programme adopted villages in Bangalore district of Karnataka. The average total cost of milk production of crossbred cow per day was Rs. 71.76, fixed cost and variable cost accounting for 6.49 and 93.51% of total cost respectively. The average net returns per day for crossbred animal was worked out to be Rs. 52.61. Feed and labour cost accounted for more than 90% at all levels of production. The average cost

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per litre of milk at below 6 litres level of daily production was worked out to be Rs. 9.51, leaving a small margin of profit. It is apparent that the returns over cost at below 6 litres milk yield level is an uneconomic proposition at the current prices offered by the Dairy co-operative society.

Bardhan et al. (2005) studied the Economics of Buffalo milk production in different categories of farmers in different seasons in Tarai Area of Uttranchal. Large farmer incurred the highest annual expenditures (Rs. 21,054) in maintenance of their animals. The lowest expenditures were found to be made by the marginal farmers (Rs.17,071). Net returns over total expenditure were negative for all categories of farmers, except marginal farmers. The finding indicated that rearing of buffaloes for milk purpose was a non-remunerative and unprofitable venture in the study area. Some policy suggestions were made to overcome some of the constraints towards profitable milk production.

Ayub (2005) recorded cost of milk production in case of Desi, HF crossbred and Jersey crossbred cows to be 1050.09 ± 3.23, 882.30 ± 5.89 and 891.94 ± 5.26 paise per kg respectively in and around Muzaffarpur (Bihar). He also reported the influence of genetic group, parity and herd-size to be significant on cost of milk production.

Singh et al. (2006) reported that the income earning from dairy enterprises was more prominent in the dairy co-operative members as compared to the milk producers in non-cooperatives sector. The size of dairy herd, better animal management practices and fairness in dairy income receipt from the dairy co-operative societies were the important factors contributing to the higher earning of the milk producers registered to milk unions.

MATERIALS

METHODS

3. MATERIALS AND METHODS

3.1. SOURCE OF DATA :

This study was conducted in a radius of 10 kms in and around Hajipur (Vaishali), Bihar. Desi and Cross-bred cows as well as Buffaloes maintained under co-operative and non-cooperative sectors in the study area constituted the experimental animals for this investigation. Among the crossbreds, Jersey and HF crossbred cows, irrespective of the level of the exotic inheritance they possessed, were included. The data on some of the production & reproduction traits as well as economics of milk production were utilize to arrive at the conclusions in the light of objectives of this study.

3.2. GEOGRAPHICAL AND CLIMATOLOGICAL DETAILS OF THE AREA UNDER STUDY:

Hajipur is the Northern gateway of Patna, the capital of Bihar. It is located at $25^0 36'$ North (latitude) and $85^0 06'$ East (longitude) at an altitude of about 60 meters from the mean sea level. The climate of this zone is some what hot-humid. The climatological details of the study area have been summarized in Table-3.1.

3.3. PRIMARY SURVEY:

The private dairy units, popularly known as 'KHATALS', located in a radius of about 10 kms in and around Hajipur and consisting of at least 2 or more HF/Jersey cross-bred cows, desi cows and/or buffaloes, either alone or in combination, were enumerated through "door to door survey" method. In this investigation khatals were characterized as "small dairy units where cows and/or buffaloes are managed for milk production with the primary objective of profitable production". In most of the khatals, the animals were

managed under sub-optimal conditions of housing and sanitation. However, the farmers registered to State Milk Union through village dairy co-operatives were relatively more aware of approved dairy practices like A.I., feeding quality concentrates, mineral mixture, deworming, vaccination schedule for animals etc. than those under non-cooperative sector.

3.4. ZONES :

The whole area was divided into four zones on the basis of some geographical boundaries. The zones were delineated as follows:

Zone I	-	North Hjaipur (Rajauli, Tendeudi, Lalpokhar Shyampur bairo, Mansherpursarai areas).
Zone II	-	South Hajipur (Sahadullahpur, Diwan chauk, Saidpurganesh, Karnpura, Nawada areas).
Zone III	-	East Hajipur (Sasanpur, Gopalur, Nawatola Unnakhak, Hasilpur areas).
Zone IV	-	West Hajipur (Daudnagar, Mailpokar, Khilbat Dilalpur, Chakmahi areas).

3.5. SECTORS:

The khatals were categorized into two groups on the basis of its registration to the Federation of Milk Producer's Co-operatives (COMFED), Bihar.

The two sectors were :

(i) Co-operative sector – Dairy units covered by COMFED.

(ii) Non-cooperative sector – Dairy units not covered by COMFED.

Altogether 500 dairy units under co-operative & non-cooperative sectors consisting of two or more milch animals, were enumerated in the area under study. The number of desi cow, Jersey as well as HF cross-bred cows

and buffaloes, maintained in khatals enumerated were 402, 373, 358 and 477 respectively. Zone-wise distributions of the enumerated dairy units of different sizes and the number of milch animals of different genetic groups maintained therein are presented in Table 3.2 and 3.3 respectively.

Table 3.1 : Climatological Details of Hajipur (Vaishali), Bihar

| Months | Particulars | | | | | |
| | Air temp. (^{0}C) | | Mean relative humidity (%) | | Rain fall | |
	Max	Min.	Morning	Evening	Average	Heaviest in a day
January	23.3	9.2	76.0	57.0	18.9	104.9
February	26.5	11.6	66.0	45.0	10.7	62.5
March	32.6	16.4	50.0	30.0	11.4	52.0
April	37.7	22.3	44.0	23.0	7.6	38.9
May	38.9	25.2	56.0	32.0	33.3	132.3
June	36.7	26.7	70.0	54.0	134.2	343.3
July	33.0	26.2	83.0	74.0	305.8	664.7
August	32.4	26.1	84.0	77.0	274.4	474.7
September	32.3	25.4	82.0	76.0	226. 9	636.3
October	31.5	21.8	75.0	68.0	93.0	388.6
November	28.8	14.7	70.0	60.0	8.9	70.4
December	24.7	9.9	75.0	60.0	4.1	20.9
Mean	31.5	19.6	69.0	55.0	-	-

Source – Climatological Centre. Patna.

Table 3.2 : Zone-wise distribution of enumerated dairy units of different sizes in the area under study.

Location of Herd (zone)	Herd size (No. of milch animals)						Total
	Co-operative			Non-cooperative			
	(2-4)	(5-7)	(≥ 8 animals)	(2-4)	(5-7)	(≥ 8 animals)	
North	48	12	5	42	8	5	120
South	46	11	7	52	15	5	136
East	36	10	4	34	11	5	100
West	39	28	9	41	20	7	144
Total	169	61	25	169	54	22	500

Table 3.3 : Zone-wise distribution of milch animals of different genetic groups in enumerated dairy units under in the study area :

Location of herd (zone)	Genetic group								Total
	Cooperative sector				Non-cooperative sector				
	Desi cow	HFxB	JxB	Buffalo	Desi cow	HFxB	JxB	Buffalo	
North	38	35	40	57	32	33	35	50	320
South	50	45	42	60	60	40	48	55	400
East	34	28	38	38	38	32	30	42	280
West	80	75	65	90	70	70	75	85	610
Total	202	183	185	245	200	175	188	232	1610

3.6. RESPONDENT UNITS :

All the khatal owners did not respond to the investigator in providing data due to various reasons and the dairy units whose owners were positive in providing relevant information, were called "Respondent units". Such

units were sorted out for further approaches. Out of 500 enumerated units, 150 units (76 units of co-operative & 74 units of non-cooperative) possessing altogether 856 animals of different genetic groups were finally sorted out as Respondent units. Zone-wise distribution of Respondent unit of different sizes and the animals of different genetic groups therein, have been presented in Table 3.4 and 3.5 respectively.

Table 3.4 : Zone wise distribution of Respondent units of different size under the cooperative and non-cooperative sectors in the study area.

Zone	Herd-size (No. of milch animals						Total
	Cooperative sector			Non-cooperative sector			
	(2-4)	(5-7)	(≥8 animals)	(2-4)	(5-7)	(≥8 animals)	
North	06	7	5	14	6	4	42
South	10	5	4	5	5	6	35
East	8	4	6	7	7	3	35
West	12	6	3	8	5	4	38
Total	36	22	18	34	23	17	150

Table 3.5 : Zone-wise distribution of milch animals of different genetic group in the respondent units under co-operative and non-cooperative sectors in the study area.

Zone	Herd-size (No. of milch animals)								Total
	Co-operative sector				Non-cooperative sector				
	Desi Cow	HFxB	Jersey x B	Buffalo	Desi Cow	HF x B	Jersey x B	Buffalo	
North	20	27	29	36	25	27	26	33	223
South	25	25	19	36	21	25	22	37	210
East	20	32	22	29	26	25	21	30	205
West	28	23	25	34	20	28	26	34	218
Total	93	107	95	135	92	105	95	134	856

During the course of survey, a few Respondent units were found to be managed in exceptionally superior environmental conditions, particularly feeding, where economics of milk production was not at all the criteria of investment. Such units were excluded from the purview of this investigation. Animals were also discarded due to their non-identified genetic make-up and/or non-completion of one C.I. during the period of this study. Further, with an objective to have better control through close observation on each of the experimental units for accurate data recording, 60 percent of the respondent units were randomly selected. As such, 90 respondent units (45 each under the co-operative and non-cooperative sectors) having 456 animals were finally selected utilizing the procedure of "Stratified Random Sampling with Proportional allocation" (Snedecor and Cochran, 1967) for further studies.

The zone-wise distribution of selected Respondent units of different sizes and of different genetic categories are shown in tables 3.6 and 3.7 respectively.

Table 3.6 : Zone-wise distribution of selected respondent units under the co-operative and non-cooperative sectors of different sizes in the study area.

Zone (Location of herd)	Herd –size (No. of milch animals						
	Co-operative sector			Non-cooperative sector			Total
	(2-4)	(5-7)	(≥8animals)	(2-4)	(5-7)	(≥8 animals)	
North	4	4	3	6	3	2	22
South	6	3	2	5	5	3	24
East	3	5	3	4	4	3	22
West	7	3	2	5	3	2	22
Total	20	15	10	20	15	10	90

Table 3.7 : Herd-size-wise distribution of milch animals of different genetic groups finally selected under the co-operative and non-cooperative sectors for the study.

Herd-size	Genetic group								
	Co-operative sector				Non-cooperative sector				
	D cow	HFxB	JxB	Buffalo	D cow	HFxB	JxB	Buffalo	Total
(2-4)	12	15	14	19	13	16	13	18	20
(5-7)	18	20	18	20	17	19	18	20	150
(≥8animals	23	22	18	31	22	20	19	31	186
Total	53	57	50	70	52	55	50	69	456

3.7. A BRIEF NOTE ON GENERAL MANAGERIAL PRACTICES IN DAIRY UNITS (KHATALS) :

The managerial practices in all the khatals were not quite uniform. In most of the cases animals were stall fed and individual feeding was in practice. Concentrates were fed on the basis of body size, level of milk production and other physiological status of the animals like dry, pregnant etc. Except in a few, home made concentrate mixtures were fed in almost all the dairy units.

Chaffed paddy straw, Wheat-bhusha and Hay constituted the common items of dry fodder. Green Maize, Jowar, Barseem, Lucern, Barely and other cultivated grasses were the main source of green fodder. Linseed and / or Mustard cake along with cereals (wheat, maize and barley etc.), pulses chunies and wheat bran were the chief ingredients of concentrate mixture. Vitamins, Minerals, Molasses and Common salt were also added to balance the ration of the animals in most of the units but not all.

Owners of the khatals under co-operative sector were relatively better manager of their dairy units, because, besides the input support, the farmers under co-operative sector were subjected to short-term training programmes organized regularly by COMFED, Patna. The training programmes were mainly organized to make the farmers aware to the approved scientific practices of Veterinary Science & Animal Husbandry, particularly breeding, feeding, A.I., general management including housing & sanitation, disease control etc. of livestock. It could be noted that in general, the farmers under non-cooperative sector were not fully aware of the improved dairy practices of Veterinary and Animal Husbandry & as such the resources available with them were not utilized efficiently. The home-made concentrate mixture supplied to the animals of the khatals under non-cooperative sector were not properly balanced and their animals were either under or over fed.

On an average an adult cross-bred cow or buffalo was provided daily with 4-5 kg of dry fodder, 1-2 kg of concentrate mixture and available amount of greens as basal ration. A production ration @1.0 kg concentrate mixture for 2.5-3.0 kg of milk produced by an animals was supplied daily to cows & buffaloes, in addition to their basic ration. In some of the units, a "Letdown" ration @ 0.5-1.0 kg of concentrate was also provided to the animals at the time of milking, especially to heavy yielders, producing more than 10.0 kg of milk per day. An additional supply of concentrate mixture was made to a cow daily during the last two month of gestation. For a desi cow, the quantum of concentrate in basal ration was almost half of the quantum supplied to a crossbred cow or buffalo. However, the rate of supply of production ration to a desi cow was almost the same to the rate for crossbred cows & buffaloes. Animals were supplied with dry fodder *ad libitum.*

In co-operative sector, artificial insemination with good quality semen was in common practice to breed the animals. Prophylectic & curative measures against various disease were taken in time to keep the animals in sound health & production. But the animals under non-cooperative sector were neither regularly protected against the diseases nor attended promptly by a qualified/registered Veterinary practitioner when sick. Either khatal owners treat their animals themselves or utilize the services of quacks available in the locality. The complete package of scientific schedules & practices in Animal Husbandry were not strictly followed in a considerable number of dairy units in the both co-operative & non-cooperative sectors.

Housing pattern in the khatals was not in accordance with the scientific norms. Animals were housed in Kachcha, Half and three-fourth puccka and even Puccka houses. In this study, the types of houses provided to the animals in different units were classified as follows:-

Type A — Full puccka house

Type B — Half puccka house (only walls puccka without plaster)

Type C — Three-fourth puccka house (walls, floor and feeding trough puccka)

Type D — Full puccka house (roof of CA/CI sheets)

The marketing of raw milk produced at the khatals under co-operative sector was done through the net-work of COMFED, Patna. However, the sale of raw fluid milk was the main pattern of disposal of milk by the dairy units under non-cooperative sector; fixed households, hotels, sweet & tea shops in locality being the main consumers.

3.8. INFORMATION RECORDED :

The performance records of only fresh calvers under the defined genetic groups were only utilized in this study. Schedules and questionnaires were developed and supplied to the finally selected Respondent units to record the relevant information in the light of the objectives of this study. The Respondent units were approached frequently to collect and monitor the data recording. The information gathered through personal interviews were also incorporated. Milk recording was done weekly up to attainment of peak milk yield and then after the recording was done fortnightly.

The average daily milk yield was obtained by averaging the weekly and fortnightly records during the lactation. The lactation yield was obtained by multiplying the average daily yield with number of days the animals remained in milk. The rest of directly observed economic traits like lactation length, peak yield, days to attain peak yield, dry period and calving interval were recorded in the schedules supplied to the dairy units.

The values for derived traits like milk yield per day of lactation length & milk yield per day of calving interval were obtained by conventional statistical formulae.

The following details were promptly recorded/derived :

3.8.1. ABOUT THE DAIRY UNIT :

   (a)   Location of Herd in the defined zones

   (b)   Herd-size

   (c)   Sector (Co-operative or Non-cooperative)

3.8.2. ABOUT THE ANIMALS :

[i] **General :**

    (a)   Genetic group

    (b)   Season of calving

    (c)   Lactation order

[ii] **Measures of production efficiency :**

    (a)   Lactation milk yield (kg) - LMY

    (a)   Lactation length (days) - LL

    (b)   Peak milk yield (kg) – PMY

    (c)   Days to attain peak milk yield (days) - DAPMY

    (d)   Milk yield per day of lactation length (kg) – MY / LL

    (e)   Milk yield per day of calving interval (kg) – MY / CI

[iii] **Measures of reproduction efficiency:**

    (a)   Dry period (days) - DP

    (b)   Calving interval (days) - CI

[iv] **Measures of economic efficiency :**

    (a)   Cost of milk production (per kg) - CMP

3.9. ECONOMICS OF MILK PRODUCTION :

The "Net cost of maintenance of an animal for each kg of milk she produced per day of an inter-calving period" was taken as the measure of cost of milk production for that animal. Statistically, it was the ratio of average daily maintenance cost of an animal during an inter-calving period and average daily milk she produced during that inter-calving period". i.e.

$$\text{Cost per kg of milk production for an animal (Rs.)} = \frac{\text{Average daily maintenance cost (Rs.) of an animal during an inter-calving period}}{\text{Value of average daily milk produced by that animal during the inter-calving period}}$$

The different components of expenditure on maintenance of milch animals were broadly categorized into:

I.   Fixed cost items

II.   Variable cost items

III.   Miscellaneous cost items

3.9.1. FIXED COST ITEMS

3.9.1.1. DEPRECIATION ON ANIMALS :

It was worked out by straight line method based on the market value of the milch animals during the period of study. A general formula to estimate approximate market value of a lactating cow and buffalo in and around Hajipur, could be derived on the basis of the purchase cost of 102 milch animals (62 cows and 40 buffaloes) taking their milk yield and lactation order at the time of purchase into account. It has been presented as follows:

Lactation no.	Market value of Animals	
	Cows	Buffaloes
1st	Milk yield (kg) x 1500 = 00	Milk yield (kg) x 1800 = 00
2nd	Milk yield (kg) x 1400 = 00	Milk yield (kg) x 1700 = 00
3rd	Milk yield (kg) x 1200 = 00	Milk yield (kg) x 1500 = 00
4th	Milk yield (kg) x 900 = 00	Milk yield (kg) x 1200 = 00

s   * Animal beyond fourth lactation were excluded from this study

A sum of Rs. 500 and Rs. 800 was added to the cost of a cow having crossbred female calf of Jersey and Friesian origin respectively. The corresponding value to be added for a buffalo with female buffalo calf was Rs. 500.00.

The productive life of a milch animal was taken as of five lactations and depreciation on animal was calculated @ 12 percent of the estimated cost per calving interval under the assumption that the 60% of the cost of an animals is covered in 5 inter-calving periods and 40 percent of the animal's cost would be refundable even after completion of its 5th lactation as "salvage value". Per day depreciation value for a milch animal was calculated as the "Ratio of 12 percent of the estimated cost of the animal and its number of days in inter-calving period."

3.9.1.2. DEPRECIATION ON BUILDINGS/SHEDS:

As mentioned earlier, the animals in khatals were managed in sub-optimal conditions of housing and sanitation. Animals were provided with variable types of houses in different dairy units. For calculation of the cost of housing and depreciation on buildings/sheds, the houses provided to milch animals in different khatals were grouped into four types (Refer to Para 3.7).

On the basis of enquiries made to kahatal owner and information collected, classified and analysed, the following approximate rates could be derived to estimate the cost of different types of built up houses to run khatals in and around Hajipur:-

Type of housing	Cost to build up per sft. covered area (Rs.)	Cost of troughs etc. (Rs.)	Total cost of housing/animal (Rs.)
Type A	30 = 00	102 = 00	1302 = 00
Type B	48 = 00	195 = 00	2115 = 00
Type C	85 = 00	490 = 00	3890 = 00
Type D	118 = 00	500 = 00	5220 = 00

The basic assumption behind fixation of housing cost were to provide 40 sft covered area to each milch animal. The construction cost of trough etc. varied accordingly to the type of its construction. The total life of (A) and (D) type of houses were accounted to be 10 and 40 years respectively, while for (B) and (C) types it was 25 years. Depreciation on housing was calculated as the ratio of "Cost of housing per animal and the estimated life of that house in days". Depreciation on housing for per kg of milk produced by an animal was calculated as :

$$\text{Depreciation per kg milk produced by an animal} = \frac{\text{Housing cost for an animal}}{\begin{array}{c}\text{Estimated life of that house (in days)} \\ \times \text{ Av. Daily milk produced by that} \\ \text{animal during the calving interval}\end{array}}$$

3.9.1.3. DEPRECIATION ON FARM UTENCILS, MACHINERY, EQUIPMENTS AND OTHER ASSESTS EXCEPT ANIMALS AND HOUSING :

To estimate this depreciation value, the total costs of utensils, equipments, machinery and other assets of dairy use (chaff cutter, electric motor, canes, buckets, chains, milk pots, cycle etc.) in selected Respondent units were estimated. The annual depreciation was calculated @ 10 percent of the total cost. The depreciation per kg. of milk produced at the khatal was reckoned as the ratio of "10 percent of the total cost of utensils, equipments, machinery etc. x No. of animals included in the study / Total no. of animals in that unit x Average milk yield (kg.)/day of calving interval of that kahatal". This was done under the assumption that utensils, equipments, machineries etc at a khatal were equally used for every animal at that khatal irrespective of its level of milk production. As such this cost items has been taken as fixed for every animal in Respondent units.

3.9.1.4. INTEREST ON FIXED CAPITAL:

In this study, the fixed capital comprised the value of all the assests of a Respondent unit including cost of animals, housing, utensils, equipments and machinery etc. and the interest on the fixed capital was worked out @ 10.5 percent per annum.

3.9.2. VARIABLE COST ITEMS :

3.9.2.1. COST OF FEEDS AND FODDERS :

Particulars of feeding were recorded for individual animal. Where individual records of fodder fed to animals in one day was not available and there were no considerable differences in feeding schedules of different animals in a khatal, the daily record of total fodder, both dry and green supplied to the animals of that khatal under study was taken. Average quantity of fodder fed per animal daily was obtained as the ratio of the total quantity of fodder supplied and the number of animals fed. The prevailing market rates, including transportation cost, were taken as the purchase price for various green and dry fodders. Similarly, the cost of concentrates ration or its ingredients, purchased from the market together with its transportation cost, were taken into account for calculating the expenditure on concentrate. The dairy units under co-operative sector were supplied with concentrate mixture (Sudha Dana) @ Rs. 5.50/kg by the COMFED at their door step. For house grown feed and fodders the prevailing market rates were considered. The seasonal variation in the market rates of different feeds and fodders were also taken into prompt consideration while calculating feeding cost. Accordingly, average daily expenditure on feeds and fodders was worked out for each animal under the investigation.

3.9.2.2 LABOUR COST :

The aggregate of paid (hired) and unpaid (family) labours was taken as the total labour cost of milk production. For working out labour cost, the actual time spent on different operations concerned to milch animals, were recorded for each unit and apportioned suitably for each animal. For family labour, the actual time spent daily on looking after the animals and other farm operations by each of the family members, including women, were recorded and apportioned for each animal. The cost of family labour was also calculated at the rate of the wage paid to the hired labour i.e. @ Rs. 80.00 per day (8 hrs.)

3.9.2.3. COST OF A.I. AND VETERINARY AIDS :

This cost item comprised of the costs of medicines, vaccines, semen, and other sanitary items along with the remuneration paid to Veterinary Doctors, inseminators and other technical persons, whose services were utilized for taking prophylective and/or curative measures to keep the animal under sound physical and sexual physique. Farmers under co-operative sector were getting Veterinary & A.I. services by the COMFED, but this input & expertised support was not available to the dairy units under non-cooperative sector.

3.9.2.4. MISCELLANEOUS COST ITEMS :

Revenue of the land, electric and water tariff, cost of repair of buildings/utensils/machineries etc. as well as unforeseen minor contingent expenditure comprised the Miscellaneous cost item. In this study it was kept fixed @ 500.00/ animal/calving internal and the cost of this component of expenditure was apportioned for each kg of milk produced by an animal as follows:

$$\text{Miscellaneous cost/kg milk} = \frac{500.00}{\text{Inter-calving period (days) of an animal x Average milk yield per day of calving interval of that animal}}$$

3.9.3. GROSS COST OF MAINTENANCE :

The gross cost of maintenance of an animal was reckoned by adding the expenditures on all fixed and variable cost components.

3.9.4. INCOME :

Other than milk, dung as well as empty gunny bags were the source of income to the khatals. It was observed that in general the empty bags of Jute were used to cover the animals as well as windows, doors etc. of dairy sheds in winter to protect the animals from cold. The plastic bags were generally utilized for making ropes to tie the animals. However, it was in general practice to sale the animal dung or FYM time to time at reasonable price. It is pertinent to mention here that it could not be possible to have precised record of income from individual animal on account of the dung or FYM produced at the khatals. However, under the assumption that an adult cow excretes on an average 20 kg of wet dung daily (Reddy et al. 1972) and the current market rate of wet dung in and around Hajipur being on an average Rs. 10.00 per quintal, it was kept as a fixed income @ Rs. 2.00 per animal per day.

3.9.5. NET COST OF MAINTENANCE :

It was reckoned by deducing income of dung from the Gross cost of maintenance. The Net cost of maintenance per kg of milk produced per day of calving interval by a particular animal was termed as the "Cost of per kg milk production" for that cow or buffalo.

3.9.6. CLASSIFICATION OF DATA :

To study the effect of the different genetic and non genetic factors on the economic traits under study, the data were classified on the basis of location (zones) and size (Herd-size) of the unit; genetic group, season of calving and lactation order of the animals as well as herd constitution and sector (co-operative and non-cooperative). The various factors were subclassified as follows:

3.9.6.1. ZONES :

(i)   Zone – I

(ii)   Zone – II

(iii)   Zone – III

(iv)   Zone – IV

(As detailed in para 3.4)

3.9.6.2. HERD-SIZE :

The dairy units were grouped into the following three categories on the basis of number of milch animals (desi cows, cross-bred cows and graded buffaloes) it possessed :

(i)   Units having 2-4 milch animals

(ii)   Units having 5-7 milch animals

(iii)   Units having ≥ 8 animals

3.9.6.3. GENETIC GROUP OF THE ANIMALS :

The milch animals included in this investigation pertained to the following four Genetic groups:

(i)   Desi cows

(ii)   Friesian cross-bred cows

(iii) Jersey cross-bred cows

(iv)   Buffaloes

HF and Jersey cross-bred cows were identified on the basis of phenotypic characters of the animals and grouped irrespective of the level of exotic inheritance they possessed.

3.9.6.4. SEASON OF CALVING :

The year was classified into following three seasons on the basis of change in climate.

(i)   Hot-Dry (march-June)

(ii)   Hot-Humid (July-Oct)

(iii) Cold (Nov. – Feb)

3.9.6.5. LACTATION ORDER :

Performance records of the animals in 1st to 4th lactation were recorded and coded in the sequence of 1, 2, 3 and 4 accordingly.

3.9.6.6. HERD-CONSTITUTION :

On the basis of constitution of the herd i.e. the types of milch animals maintained at the khatals, the units were grouped into three types:

(i)   Units having only cows

(ii)   Units having only buffaloes

(iii) Units having cows and buffaloes both

It is worth mentioning here that during the primary survey, location of herd as well as season of calving were taken as non-genetic factor influencing economic traits & but after sampling of Respondents units the number of observations in one of the zone was very less to the extent of resulting sampling error. The classification of data according to season of calving also showed the similar trend. Moreover, the study area was in a radius of only 10 kms in and around Hajipur and there was time limit for completing the study. As such, the zone as well as season of calving were dropped out from the mathematical model constructed and utilized for statistical analysis of the data. The data on economic traits of the animals recorded in co-operative and non-cooperative sectors were analysed first separately & then compared.

3.9.7. STATISTICAL METHOD:

3.9.7.1. STRATIFIED RANDOM SAMPLING WITH PROPORTIONAL ALLOCATION :

Assuming that the population of size N is divided into K strata (zones) of sizes $N_1, N_2, N_3 \ldots\ldots N_k$ such that,

$$\sum_{i=1}^{k} N_i = N$$

Let, sample of sizes n1, n2, n3, ... nk be drawn from these strata respectively so that,

$$\sum_{i=1}^{k} n_i = N$$

Let $n_i \propto N_i$

or $n_i = CN_i$ .... [I]

Where,

C is the constant of proportionality.

After taking summation on both the sides,

We get;

$$\sum_{i=1}^{k} n_i = C \sum_{i=1}^{k} n_i$$

or $\quad n = CN$

Hence, $n/N = C$ (constant)

After substituting the value of C in the equation (I), we get:

$$n_i = \frac{(n) N_i}{(N)} \qquad (i = 1, 2, 3, \ldots\ldots, K)$$

Let Y_{ij} be the value of jth unit in the ith strata of population ($i = 1, 2, 3, 4\ldots$ K and J=1, 2, 3, $\ldots\ldots N_i$ and Y_{ij} be the corresponding sample observation. ($i = 1, 2, 3 \ldots$ k and $j = 1, 2, 3 \ldots\ldots n_i$), then population mean $\overline{Y}$ given by :

$$\overline{Y_{ij}} = 1/N \sum_{i=1}^{K} \sum_{i=1}^{N_i} \overline{Y_{ij}}$$

$$= 1/N \sum_{i=1}^{K} N_i \overline{Y_i}$$

Where,

$$\overline{Y_i} = 1/N \sum_{j=1}^{K} \overline{Y_{ij}} \text{, Which is the mean of the } i^{th} \text{ strata of the population.}$$

The population variance :

$$V(\overline{Y}) = \sum_{i=1}^{N_i} \left(\frac{N_i}{N}\right)^2 (1/n_i - 1/N_i) S_i^2$$

$$N_i$$

$$= \sum_{i=1} W_i^2 \, (1/n_i - 1/N_i) S_i^2$$

Where,

$$W_i = n_i/N \text{ and } S_i^2 = 1/(N-1) \sum_{j=1}^{N_i} (Y_{ij} - \overline{Y_i})^2$$

Similarly, the sample mean can be defined as :

$$\overline{Y} = 1/n_i \sum_{j=1}^{n_i} \overline{Y_i}$$

Where, $Y_i = 1/K \sum_{i=1}^{K} Y_{ij}$ i.e. the sample mean of the ith strata and

$$V(\overline{Y}) = \sum_{i=1}^{N_i} W_i^2 \, (1/n_i - 1/N_i) S_i^2$$

Since, $[E(S)^2 = S^2]$

$$S_i^2 = 1/n_i - 1 \sum_{j=1}^{n_i} (Y_{ij} - Y_i)^2$$

3.9.7.2. LEAST SQUARES ANALYSIS :

To study the effects of various genetic and non-genetic factors on different economic indicators, the data pertaining to co-operative & non-cooperative sectors were separately subjected to least squares analysis (Harvey, 1966) for which the following mathematical model was utilized:

$$Y_{ijklm} = \mu + G_i + HS_j + HC_k + P_l + e_{ijklm}$$

Where,

Y_{ijklm} = The value of mth individual under i^{th} genetic group, j^{th} herd-size, k_{th} herd constitutions and l^{th} Parity

μ = Population mean

G_i = Effect of ith genetic group

HS_j = Efefct of jth herd-size

HC_k = Effect of kth herd-constitution

P_l = Effect of lth parity

e_{ijklm} = Random error associated with m^{th} individual being randomly & independently distributed with mean zero and variance σ^2

The Duncan's Multiple Range (DMR) Test (Kramer, 1957) and C.D. Test (Snedecor & Chochran, 1967) were utilized for pair-wise comparison of the least squares means.

RESULTS

DISCUSSION

4. RESULTS AND DISCUSSION

4.1 MEASURES OF PRODUCTION :

In this study the lactation milk yield, lactation length, peak milk yield, days to attain peak milk yield, average daily milk yield per day of lactation length and per day of calving interval were taken as the measures of production in cattle and buffaloes. To estimate the different parameters of these economic indicators in the light of objectives of this study, the data were subjected to different statistical treatments including Least Squares analysis utilizing relevant mathematical models and the results are presented in the Tables 4.1 to 4.15.

4.1.1 LACTATION MILK YIELD :

Milk yielded by a cow/buffalo during the normal lactation period (150-350 days) was taken as lactation yield. The overall mean for milk yield in milch animals under co-operative & non-cooperative sectors were estimated to be 2121.54 ± 34.65 and 1864.85 ± 24.88 kg respectively, which were significantly different from each other (Table 4.2). High milk production was the objective of the farmers under both the sectors, but animals under co-operative sector produced more milk in a lactation period than animals under non-cooperative sector. Several workers including Shah & Sharma (1994), Singh (1995), Venkatasubranian and Fuzele (1996), Shrivastava et al. (1998) Singh (2000), Niraj (2004), Kumar (2005) and Ayub (2005) have conducted similar studies on cows & buffaloes of different genetic grades under private sector. But the average for lactation milk yield estimated by them may not be quite comparable with the estimates obtained in this study because of variable genetic constitution of the experimental animals and the agro-climatic conditions of the study areas.

However, in classical studies conducted by Shah & Sharma (1994) and Rao et al. (2000) it was concluded that Desi cows, Crossbred cows as well as Buffaloes performed better, if maintain under the guidance and supervision of the management through milk producers co-operatives as compared to the animals under non-cooperative management. It is in agreement with the findings of this investigation.

4.1.1.1 FACTORS AFFECTING LACTATION MILK YIELD :

Least squares analysis of variance (Table 4.1) revealed that genetic constitution of the animals and lactation order had highly significant (P<0.01) influence on lactation milk yield under both, the co-operative and non-cooperative sectors. The effects of herd-size and herd constitution on lactation milk yield were statistically not significant.

4.1.1.1.1 GENETIC GROUP :

Genetic group had highly significant ($P \leq 0.01$) influence on lactation milk yield for animals under both the sectors. Its contribution to the total variation in lactation milk yield for animals under the co-operative and non-cooperative sectors were 71.67 and 57.88 percent respectively (Table 4.1). The contribution of genetic group to the total variation in lactation yield was of higher magnitude in the case of co-operative sector as compared to that in non-cooperative sector. It may be attributed to the fact that the farmers under the co-operative sector were fully aware to the effect of genetic constitution of the animals on milk yield and were maintaining genetically superior stock, particularly of crossbred cattle & buffaloes. As evident from Table 4.2, among the animals managed is co-operative sector, the HF cross-breds had the highest average lactation milk yield (3034.65± 50.62 kg) followed by Jersey crossbreds (2414.76±50.25 kg), Buffaloes (1791.51± 37.66 kg) and Desi cows (1245.23±56.09 kg). A similar trend was recorded in non-

cooperative sector also, where the HF cross-breds had the highest lactation milk yield (2660.725± 38.49 kg) followed by Jersey crossbreds (2207.61± 44.94 kg), Buffalos (153.44± 32.16 kg) and Desi cows (1058.62±44.94 kg). The animals under different genetic groups differ significantly among themselves with respect to their lactation milk yield. Shah & Sharma (1994), Singh (1995), Venkatasubramanian and Fuzele (1996), Rao et al. (2000), Singh et al. (2000), Niraj (2004), Ayub (2005) also recorded the effect of genetic grade to be significant on total lactation milk yield in Desi cows, Crossbred cows as well as Buffaloes. The results were according to the genetic dogma that the Desi cows had relatively poor genetic potency of milk production in comparison to Crossbred cows and Buffaloes. Further, HF is genetically the best milk producing breed in the world and superiority of HF germplasm in combination with indigenous inheritance as compared to Jersey crossbreds was in accordance with the expectations.

Table 4.1 : Least squares analysis of variance showing effects of genetic and non-genetic factors on lactation milk yield of milch animals in and around Hajipur (Vaishali), Bihar.

Source of variation	Co-operative sector			Non-cooperative sector		
	d.f.	MSS	R^2 (%)	d.f.	MSS	R^2 (%)
Genetic grade	3	** 32384320.00	71.6756	3	** 20791470.00	57.8865
Herd-size	2	96431.39	0.1423	2	161150.00	0.2992
Herd-constitution	2	2773.61	0.0041	2	114445.60	0.2124
Lactation order	3	** 78008300.00	17.2654	3	** 11288420.00	31.4286
Residual	219	67541.34	10.9126	215	50986.57	10.1734

** P≤0.01

4.1.1.1.2 HERD-SIZE :

Herd size did not show any significant influence on lactation milk yield. The contribution of the herd-size to the total variation in lactation milk yield for the animals under the co-operative and non-cooperative sectors were 0.1423 and 0.2992 percent respectively (Table 4.1). However, among the animals under co-operative sector, the average lactation milk yield was highest (2155.98±50.45 kg) for the milch animals maintained in the larger herd i.e. the herd of ≥ 8 animals followed by those in herd of 5-7 animals (2130.92± 50.26 kg) and it was the lowest (2077.72± 32.24 kg) for the animals in relatively smaller herds of 2-4 animals. In non-cooperative sector, lactation milk yield was the highest (1922.87±35.53 kg) in herd of 5-7 animals followed by herd of ≥8 animals (1841.86±40.97 kg) and the lowest (1829.82± 26.05 kg) in herd of 2-4 animals (Table 4.2). No definite trend in variation in lactation yield due to variation in the size of the herd could be established in this study.

The results were in agreement with the findings of Ayub (2005) who has also recorded the effect of herd-size on lactation milk yield to be non-significant in case of Desi cows, HF crossbred and Jersey crossbred cows in and around Muzaffarpur (Bihar), the adjoining district of Vaishali (Bihar). However, the findings were contrary to the reports of Shrivastava et al.(1998), Singh et al. (2000) and Niraj (2004) who reported Herd-size to be a factor influencing lactation milk yield significantly. Such variation may be attributed to variation in variable genetic constitution of experimental animals and agro-climatic conditions of the study areas, besides class intervals in classifying herds on the basis of their size in different studies.

4.1.1.1.3 HERD-CONSTITUTION :

The contribution of the herd-constitution to the total variation in lactation yield for the animals under the co-operative and non-cooperative sectors were 0.0041 and 0.2124 percent respectively, which were statistically non-significant (Table 4.1). However, in the co-operative sector, the average lactation yield was the highest for the khatals having only cows (2134.65±32.79 kg) followed by those maintaining cows as well as buffaloes both (2123.05±29.26 kg) and only buffaloes (2106.91± 94.13 kg). As evident from table 4.2, the situation was slightly different in the case of animals managed under non-cooperative sector as the average lactation yield was the highest for the khatals having cattle and buffaloes both (1921.54±26.17 kg) followed by those maintaining only cows (1868.82±27.59 kg) and only buffaloes (1804.19 ± 64.17 kg). Niraj (2004) also recorded the effect of Herd-constitution to be non-significant on lactation milk yield in Desi cows, HF and Jersey crossbred cows as well as Buffaloes.

4.1.1.1.4 PARITY (Lactation order):

Results revealed that parity had highly significant (P≤0.01) influence on variation in average lactation milk yield, its contribution to the total variation under the co-operative and non-cooperative sectors being 17.2654 and 31.4286 percent respectively (Table 4.1). There was linear increase in average lactation milk yield from first to third lactation and then after it decreased. The animals in third lactation had the highest average lactation milk yield followed by those in fourth, second and first lactation. Under both the sectors, the average lactation milk yield for first to fourth lactation were significantly different from each other (Table 4.2). It was noted that the increase in milk yield was the maximum from 2nd to 3rd lactation followed by

1ˢᵗ to 2ⁿᵈ lactation (Table 4.2). The trend was similar for the animals under both the sectors. Deshmukh et al. (1995), Shrivastava et al. (1998), Singh et al. (2000) and Niraj (2004) also found the effect of lactation order on lactation milk yield to be significant in cows and buffaloes. A linear increase in average lactation milk yield from first to third lactation and then after a decrease was also recorded by Niraj (2004) in cattle & buffaloes in and around Darbhanga (Bihar). It was indicative of the fact that the lactation maturity in cattle and buffalo was attained in 3ʳᵈ lactation. It could be explained as there would have been an increase in number of functional genes responsible for milk yield with advancement in age of cattle and buffaloes and their expression could reach maximum around 3ʳᵈ lactation. Physically it may be correlated with increased functional activities of the secretory tissues of mammary glands with advancement in age, being maximum at the age coinciding with the 3ʳᵈ parity.

Table-4.2 : Least squares means± SE of lactation milk yield and lactation length of cattle & buffaloes in co-operative and non-cooperative sectors in and around Hajipur (Vaishali), Bihar

Particulars	Lactation Milk yield (kg) (Mean±SE)		Lactation length (day) (Mean±SE)	
	Co-operative	Non-cooperative	Co-operative	Non-cooperative
n	230	226	230	226
Population Mean μ	$2121.54^A \pm 34.65$	$1864.85^B \pm 24.88$	$318.83^A \pm 1.49$	$309.86^B \pm 1.74$
Genetic Grades				
Desi cow	$1245.23^a \pm 56.09$	$1058.62^a \pm 44.94$	$290.15^a \pm 2.42$	$279.77^a \pm 3.14$
HF x B	$3034.65^b \pm 50.62$	$2660.72^b \pm 38.49$	$331.68^b \pm 2.18$	$322.14^b \pm 2.69$
J x B	$2414.76^c \pm 50.25$	$2207.61^c \pm 40.94$	$328.97^{bc} \pm 2.17$	$325.08^b \pm 2.86$
Buffalo	$1791.5^d \pm 37.66$	$1532.44^d \pm 32.16$	$324.53^c \pm 1.63$	$312.36^c \pm 2.24$
Herd – size				
2-4 Animal	2077.71 ± 32.24	1829.82 ± 26.05	319.11 ± 1.39	308.97 ± 1.82
5-7 Animal	2130.92 ± 50.26	1922.87 ± 35.53	318.43 ± 2.17	311.31 ± 2.48
≥ 8 Animal	2155.98 ± 50.45	1841.86 ± 40.97	318.95 ± 2.18	309.24 ± 2.86

Herd Constitution				
Cattle	2134.65±32.79	1868.82±27.59	318.04±1.42	304.64^a±1.93
Cattle & Buffalo	2123.05±29.26	1921.54±26.17	319.94±1.26	315.31^b±1.83
Buffalo	2106.91±94.13	1804.19±64.17	318.51±1.42	309.55^b±4.49
Lactation order				
1st	1619.87^a±51.39	1233.91^a±40.17	302.59^a±2.21	296.85^a±2.81
2nd	1985.28^b±50.60	1762.56^b±35.82	315.58^b±2.19	305.15^b±2.50
3rd	2607.70^c±37.74	2460.07^c±37.09	330.57^c±1.63	319.84^c±2.59
4th	2273.29^d±50.63	2002.86^d±41.07	326.59^c±2.19	317.51^c±2.87

* Values with different superscripts (in small letter) row wise differed significantly (P<0.05).

* Values with different superscripts (in capital letter) column wise differed significantly (P<0.05).

* n denoted number of observations.

4.1.2 LACTATION LENGTH :

Lactation period is one of the important factors affecting economics of dairy enterprises. Either too long or two short lactation period is not desirable from economic point of view. The ideal lactation length has been regarded as 305 days in cattle and buffaloes. The overall least squares means for lactation length in cows, irrespective of their genetic groups and buffaloes under co-operative and non-cooperative sectors were estimated to be 318.8±1.49 and 309.86±1.74 days respectively (Table 4.2).

4.1.2.1 FACTOR AFFECTING LACTATION LENGTH :

Least squares analysis of variance (Table 4.3) revealed that genetic group and order of lactation had highly significant (P≤0.01) influence on lactation length of the animals under both the co-operative and non-cooperative sectors. The effect of herd size on this trait was non-significant. However, herd constitution had non-significant effect on lactation period for the animals under the co-operative sector, but was significant (P≤0.05) for those managed under non-cooperative sector.

4.1.2.1.1 GENETIC GROUP :

Genetic group had highly significant (P≤0.01) influence on lactation length for the animals under co-operative and non-cooperative sectors, its contribution to the total variation in the trait being 51.6591 and 38.7229 percent respectively (Table 4.3). As evident from Table-4.2 in co-operative sector, the HF-cross-breds had the longest average lactation length (331.68±2.18 days) which did not differ significantly from that for Jersey crossbreds (328.97±2.17 days). However, crossbred cows (HFxB) were significantly different from desi cows (290.15±2.42 days) and buffaloes (324.53±1.63 days) in respect to their average lactation length. In non-cooperative sector, the situation was slight different and the Jersey crossbreds had the longest average lactation length (325.08±2.86 days) which did not differ significantly from that of HF crossbreds (322.14±2.69), but in this case also the crossbreds were significantly different from the desi cows (279.77±3.14 days) and buffaloes (312.36±2.24 days). However, the average lactation length of desi cows was the shortest & significantly different from the averages for other milch animals under both the sectors. Prasad et al. (1991), Dev Raj & Gupta (1994), Shah & Sharma (1994), Rao et al. (2000), Singh et al. (2000), Hemlatha (2003), Niraj (2004) & Ayub (2005) also recorded the effect of genetic group to be significant on average lactation length in case of Desi cows, Crossbred cows as well as buffaloes managed under private sector. However, Singh (1995) recorded this effect to be non-significant on average lactation length in the cows of only one genetic constitution i.e. HF x Zebu crossbreds possessing different levels of exotic inheritance.

Table –4.3 : Least squares analysis of variance showing affects of genetic and non-genetic factors on lactation length of milch animals in and around Hajipur (Vaishali) Bihar.

Source of variation	Co-operative			Non-cooperative		
	df	MSS	R^2 (%)	df	MSS	R^2 (%)
Genetic group	3	** 18132.71	51.6591	3	** 15537.11	38.7229
Herd-size	2	7.27	0.0138	2	102.43	0.1702
Herd-constitution	2	66.56	0.1264	2	* 1955.13	3.2485
Lactation order	3	7709.16**	21.9629	3	** 5357.12	13.3514
Residual	219	126.16	26.2378	215	249.18	44.5069

* = $P \leq 0.05$, ** = $P \leq 0.01$

4.1.2.1.2 HERD-SIZE :

Herd-size did not show any significant influence on lactation length (Table-4.3). The contribution of the herd size to the total variation in lactation length of the animals under the co-operative and non-cooperative sectors were 0.0138% and 0.1702% respectively. However, among the animals under co-operative sector, the average lactation length was longest (319.11±1.39 days) for the milch animals maintained in the herd of 2-4 animals followed by those in ≥8 animals (318.95±2.18 days). It was the lowest (318.43±2.17 days) in herd-size of 5-7 animals. In non-cooperative sector, the average lactation length was the longest (311.31±2.48 days) for the animals kept in herd of 5-7 animals followed by those in herd of ≥8 (309.24±2.86 days) and herd of 2-4 (308.97±1.82 days) animals (Table 4.2). Shrivastava et al. (1998) recorded the effect of herd-size on this trait in crossbred cows to be significant. However, Niraj (2004) and Ayub (2005) reported the herd-size effect to be non-significant on lactation length in case of Desi and Crossbred cows as well as buffaloes in and around

Darbhanga and Muzaffarpur (Bihar). Such variation may be attributed to the probable reasons given in para 4.1.1.1.2.

4.1.2.1.3 HERD-CONSTITUTION :

The contribution of the herd constitution to the total variation in lactation length for cows & buffaloes under the co-operative sector was 0.1264% which was statistically non-significant, but the corresponding values for the animals under non-cooperative sector was 3.2485% which was statistically significant at 5% level of probability (Table-4.3).

In the co-operative sector, the average lactation length was the highest for the khatals having cows in combination with buffaloes (319.94 ± 1.26 days) followed by those maintaining only buffaloes (318.5 ± 1.41 days) and only desi cows (318.04 ± 1.42 days). As evident from the Table-4.2, the situation was similar in the case of animals managed under non-cooperative sector as the average lactation length was the highest for the khatals having cows and buffaloes both (315.31 ± 1.83 days), followed by those maintaining only buffaloes (309.55 ± 4.49 days) and only desi cows (304.64 ± 1.93 days). Table 4.2 also revealed that the average lactation length of milch animals under the non-cooperative sector was the shortest in the herds having only Desi cows which was significantly different from the khatals maintaining Cows & Buffaloes both and Buffaloes. Niraj (2004) recorded the effect of herd constitution to be non-significant on average lactation length in case of Desi cows, Crossbred cows and Buffaloes in and around Darbhanga (Bihar) which was contrary to the findings for the animals managed under co-operative sector in this study but were in agreement to the findings for those managed under non-cooperative sector.

4.1.2.1.4 PARITY (Lactation Order) :

Results revealed that parity had highly significant (P≤0.01) influence on lactation length. Its contribution to the variation in lactation length for the animals under the co-operative and non-cooperative sectors were 21.9629 and 13.3514 percent respectively (Table 4.3). Results (Table-4.2) revealed that there was linear increase in average lactation length from first to third lactation and then after it decreased. The animals in third lactation had the longest average lactation length followed by those in fourth, second and first lactation under both the sectors. However, under both the sectors, the average 1st lactation length was the shortest and significantly different from second, third and fourth lactation lengths. There was no significant difference between 3rd and 4th lactation lengths in both the sectors. Shrivastava et al. (1998), Singh et al. (2000), Niraj (2004) and Ayub (2005) also recorded the effect of parity to be significant on this trait in case of Desi cows, Crossbred cows and Buffaloes which was in corroboration to the findings of this investigation. The trend recorded for lactation length was very much reflected by the trend of total lactation milk yield of the animals in different lactations.

4.1.3 PEAK MILK YIELD (Kg) :

Peak milk yield is a directly observed economic indicator of very high practical significance in the dairy sector, because it has direct bearing on total milk produced by an animal in one lactation. It can also be used as a measure of indirect selection for milk yield in cows and buffaloes as it is expressed early in the lactation period. The overall Least Squares mean for peak milk yield in local and crossbred cows as well as buffaloes under the co-operative and non-cooperative sectors were 9.87±0.17 kg and 8.74±0.11 kg respectively, the difference being statistically significant (Table 4.5).

4.1.3.1 FACTOR AFFECTING PEAK MILK YIELD (Kg) :

Least squares analysis of variance revealed that genetic group and order of lactation had highly significant (P≤0.01) influence on peak milk yield of the animals under both the co-operative and non-cooperative sectors. The effects of herd-size and herd-constitution on peak yield were non-significant under both the sectors (Table 4.4).

4.1.3.1.1 GENETIC GROUP :

The genetic group had highly significant (P≤0.01) influence on peak milk yield of the animals under both the sectors. Its contribution to the total variation in the trait under the co-operative and non-cooperative sectors were 70.77233 and 56.8954 percent respectively (Table-4.4).

As evident from Table-4.5 in the co-operative sector the HF cross-breds had the highest average peak milk yield (13.81±0.24 kg) followed by Jersey crossbreds (10.99±0.23 kg), Buffaloes (8.29±0.18 kg) and Desi cows (6.40±0.27 kg). The corresponding values for non-co-operative sector were 12.11±0.17, 9.99±0.18, 7.17±0.14 and 5.69±0.19 kg respectively. The animals of different genetic constitutions differ significantly among themselves with respect to their peak milk yield under both the sectors. It was in accordance with the expectations because Friesian cross-bred cow is the highest milk producer in the world and its crosses must prove superiority over Jersey crossbreeds. Most of the buffaloes included in this study were graded with Murrah, the best milk producer among the buffalo breeds and as such, the buffalo occupied third position in respect to peak yield among the milch animals of different genetic groups included in this study. The desi

cows were mostly non-descript having the lowest potency to produce milk among the animals of different genetic grades.

Results revealed that cows and buffaloes managed under the guidance of milk co-operatives had relatively higher peak milk yield than those managed under non-cooperative sectors in and around Hajipur (Vaishali), Bihar. It may be attributed to the superior technical and quality input support to the farmers through milk co-operatives. Singh (1995), Shrivastava et al. (2000), Singh et al. (2000), Dutt & Bhushan (2001), Priya Raj (2002), Niraj (2004) and Ayub (2005) also reported the effect of genetic group to be significant on average peak milk yield in Desi cows, Crossbred cows and Buffaloes managed under farmers' management.

Table 4.4 : Least squares analysis of variance showing effects of genetic and non-genetic factors on peak milk yield in cows and buffaloes in and around Hajipur (Vaishali), Bihar.

Source of variation	Co-operative sector			Non-cooperative		
	df	MSS	R^2(%)	df	MSS	R^2(%)
Genetic group	3	** 5634512.00	70.77233	3	** 3470780.00	56.8954
Herd-size	2	33159.61	0.2775	2	29734.00	0.3250
Herd-constitution	2	3376.90	0.02826	2	16068.35	0.1756
Lactation order	3	** 1233866.00	15.4873	3	** 1913239.00	31.3631
Residual	219	14715.62	13.4837	215	9568.37	11.2410

** = P$\leq$0.01

4.1.3.1.2 HERD-SIZE :

The contribution of the herd-size to the total variation in peak milk yield for the animals under co-operative and non-cooperative sectors were 0.2775 and 0.3250 percent respectively and statistically not significant (Table-4.4). However, in the animals under co-operative sector the average peak milk yield was the highest (10.03$\pm$0.24 kg) for milch animals maintained in the herds of $\geq$8 animals followed by those in herds of 5-7 animals (9.98$\pm$023 kg) and 2-4 animals (9.61$\pm$0.15 kg). In non-cooperative sector the peak yield was highest (8.97$\pm$0.15 kg) for the animals in herd of 5-7 followed by those in groups of $\geq$8 (8.69$\pm$0.18 kg) and 2-4 (8.56$\pm$0.11 kg) animals (Table- 4.5). Niraj (2004) & Ayub (2005) also recorded the effect of herd-size to be non-significant on average peak milk yield in case of Desi cows, Crossbred cows and Buffaloes. However, the findings were contrary to the reports of Shrivastava et al. (1998) who reported herd-size to be a factor influencing the Peak milk yield significantly but in the case of crossbreds in plateau region of Chotanagpur.

4.1.3.1.3 HERD CONSTITUTION :

The contribution of the herd constitution to the total variation in peak milk yield for the animals under both the co-operative and non-cooperative sectors were 0.02826 and 0.1756 percent respectively which were statistically non-significant (Table 4.4). However, in the co-operative sector the average peak milk yield was the highest in the animals in the khatals having only cows (9.97$\pm$0.15) followed by those maintaining only buffaloes (9.83$\pm$0.18 kg) and cattle & buffalo both (9.82$\pm$0.14 kg). As evident from Table 4.5, the situation was slightly different in the case of animals managed

under non-cooperative sector, as the average peak yield was the highest for the units having cattle and buffalo both (8.94±0.11 kg) followed by those maintaining only cattle (8.87+0.12 kg) and only buffalo (8.42±0.28 kg). Niraj (2004) also recorded the influence of herd-constitution on average peak milk yield to be significant in Desi & Cross-bred cows as well as Buffaloes.

4.1.3.1.4 PARITY (Lactation Order) :

Results revealed that parity had highly significant ($P \leq 0.01$) influence on peak milk yield. Its contribution to the total variation in peak milk yield for the animals under the co-operative and non-cooperative sectors were 15.4873 and 31.3631 percent respectively (Table 4.4). Under both the sectors, there was gradual increase in average peak milk yield from first to third lactation and then after it decreased. The animals in third parity had the highest average peak yield followed by those in fourth, second and first lactation. However, under both the sectors the average peak milk yield for first to fourth lactation were significantly different from each other (Table-4.5). The trend of variation in peak milk yield was similar to the trend of variation in lactation milk yield recorded in this study and the explanation for the former trait (Para 4.1.1.1.4) would also stand valid for peak milk yield. Shrivastava et al. (1998), Singh et al. (2000), Niraj (2004), Ayub (2005) also recorded the effect of parity on average peak milk yield to be significant in cases of Desi & Crossbred cows as well as Buffaloes which corroborated the findings of this investigation.

Table 4.5 : Least squares means±SE of PMY and DAPMY Cattle & Buffaloes in co-operative and non-cooperative sectors in and around Hajipur (Bihar)

Particulars	Peak milk yield (kg) (Means±SE)		Days to attain peak milk yield (Means±SE)	
	Co-operative	Non-cooperative	Co-operative	Non-Cooperative
n	230	226	230	226
Population Mean (μ)	$9.87^A \pm 0.17$	$8.74^B \pm 0.11$	40.81 ± 0.39	42.38 ± 0.39
Genetic Grade				
Desi cow	$6.40^a \pm 0.27$	$5.69^a \pm 0.19$	$36.03^a \pm 0.64$	$37.48^a \pm 0.71$
HF x B	$13.81^b \pm 0.24$	$12.11^b \pm 0.17$	$42.69^b \pm 0.58$	$44.71^b \pm 0.61$
J x B	$10.99^c \pm 0.23$	$9.99^c \pm 0.18$	$43.84^c \pm 0.57$	$44.61^b + 0.65$
Buffalo	$8.29^d \pm 0.18$	$7.17^d \pm 0.14$	$40.70^d \pm 0.43$	$42.72^c \pm 0.51$
Herd-size				
2-4 Animal	9.61 ± 0.15	8.56 ± 0.11	41.38 ± 0.37	42.92 ± 0.41
5-7 Animal	9.98 ± 0.23	8.97 ± 0.15	40.62 ± 0.57	41.96 ± 0.56
$\geq$ 8 Animal	10.03 ± 0.24	8.69 ± 0.18	40.45 ± 0.58	42.25 ± 0.65
Herd constitution				
Cattle	9.97 ± 0.15	8.87 ± 0.12	40.34 ± 0.37	$41.21^h \pm 0.41$
Cattle & Buffalo	9.82 ± 0.14	8.94 ± 0.11	39.98 ± 0.33	$42.41^{ab} \pm 0.44$
Buffalo	9.83 ± 0.18	8.42 ± 0.28	42.13 ± 1.07	$43.52^a + 1.02$
Lactation order				
1st	$7.89^a \pm 0.24$	$6.20^a \pm 0.17$	$43.95^a \pm 0.59$	$45.95^a \pm 0.63$
2nd	$9.29^b \pm 0.24$	$8.27^b \pm 0.16$	$41.64^b \pm 0.58$	$42.66^b + 0.56$
3rd	$11.85^c + 0.18$	$11.28^c \pm 0.16$	$39.89^c \pm 0.57$	$41.56^c \pm 0.65$
4th	$10.45^d \pm 0.23$	$9.20^d \pm 0.18$	$37.77^d \pm 0.43$	$39.33^d \pm 0.58$

* Values with different superscripts (in small letter) row wise differed significantly (P<0.05)

* Values with different superscripts (in capital letter) column wise differed significantly (P<0.05)

* n denoted number of observations.

4.1.4 DAYS TO ATTAIN PEAK MILK YIELD :

A milch animal is supposed to be economical if she attains peak milk yield shortly after calving and has higher persistency of peak milk yield. The over all Least Squares Means for days to attain peak milk yield in local and cross-bred cows as well as buffaloes managed in the co-operative and non-cooperative sectors were estimated to be 40.81 ± 0.39 and 42.38 ± 0.39 days respectively (Table 4.5). The difference was statistically not significant. Findings revealed that the animals under co-operative sector take relatively shorter period in attaining peak yield than the animals under non-cooperative sector.

4.1.4.1 FACTORS AFFECTING DAYS TO ATTAIN PEAK MILK YIELD :

Least squares analysis of variance (Table 4.6) revealed that under both the sectors of management, genetic constitution of the animals and lactation order had highly significant ($P \leq 0.01$) influence on days to attain peak milk yield. The effect of herd size on this indicator was non-significant under both the sectors. Further, the effect of the herd-constitution on days to attain peak milk yield for animals under co-operative sector was non-significant whereas, it was statistically significant ($P \leq 0.05$) for the animals under non-cooperative sector. Least Squares Means for different levels of the factors affecting days to attain peak milk yield are presented in Table 4.5.

4.1.4.1.1 GENETIC GROUP :

Genetic group had highly significant ($P \leq 0.01$) influence on days to attain peak milk yield under both the sectors. Its contribution to the total

variation on days to attain peak milk yield for the animals under the co-operative and non-cooperative sectors were estimated to be 38.2007 and 24.5384 percent respectively (Table-4.6). As evident from Table 4.5, under the co-operative sector, the Jersey crossbred took on average the longest days in attaining peak milk yield (43.84±0.57 days) after calving followed by HF crossbreds (42.69±0.58 days), Buffaloes (40.70±0.43 days) and Desi cows (36.03±0.64 days). In non-cooperative sector, the average days to attain peak milk yield was the longest in HF cross-breds (44.71±0.65 days) followed by Jersey crossbreds (44.61±0.65), Buffaloes (42.72±0.51) and Desi cows (37.48±0.71 days). However, both the HF and Jersey crossbred cows did not differ significantly from each other in respect to this trait, but buffaloes and desi cows were significantly different from crossbred cows as well as they differed significantly from each other also in this regard (Table 4.5).

From persistency of lactation point of view, 42-45 days to attain peak yield is optimum and the results of this study revealed that the animals in both the co-operative and non-cooperative sectors were more or less ideal in this regard, except the desi cattle, which attained peak yield significantly earlier. It is normal physiology that the low producing animals attain peak milk yield and dry too earlier as compared to heavy milk yielders. Niraj (2004) & Ayub (2005) also reported the effect of genetic group to be significant on average days to attain peak milk yield in case of Desi cows, Crossbred cows and Buffaloes which was in agreement with the findings of this study.

Table 4.6 : Least Squares analysis of variance showing effects of genetic and non-genetic factors on Days to attain peak milk yield in cattle & buffaloes in and around Hajipur (Vaishali), Bihar.

Source of variation	Co-operative sector			Non-cooperative sector		
	df	MSS	R²(%)	df	MSS	R²(%)
Genetic group	3	598.84**	38.2007	3	417.55**	24.5384
Herd-size	2	15.21	0.6468	2	18.28	0.7162
Herd-constitution	2	23.14	0.9841	2	49.56*	1.9417
Lactation order	3	** 303.73	19.3756	3	320.11**	19.3998
Residual	219	8.76	40.7313	215	12.68	53.4040

*P≤0.05, **P≤0.01

4.1.4.1.2 HERD-SIZE :

Herd-size did not show any significant influence on days to attain peak milk yield. The contribution of the herd size to the total variation in this trait for the animals under the co-operative and non-cooperative sectors were 0.6468 and 0.7162 percent respectively (Table 4.6). The average days to attain peak milk yield was the longest (41.38±0.37 days) the milch animals maintained in the smaller herd size i.e. the herd of 2-4 animals followed by those in herd of 5-7 animals (40.62±0.57 days) and it was the shortest (40.45±0.58 days) for the animals in relatively larger herd-size i.e. of ≥8 animals under the co-operative sector. In non-cooperative sector the average days to attain peak milk yield was the longest (42.92 days) in herd of 2-4 animals followed by herd of ≥8 animals (42.25±0.65 days) and the shortest (41.96±0.56 days) in herd of 5-7 animals (Table 4.5). Niraj (2004) and Ayub (2005) also recorded the effect of herd-size to be non-significant on average days to attain peak milk yield respectively in and around Darbhanga and Muzaffarpur (Bihar).

4.1.4.1.3 HERD-CONSTITUTION :

The contribution of the herd constitution to the total variation in days to attain peak milk yield for the animals under the co-operative sector was 0.9841 percent which was statistically non-significant. While the contribution of the same factor for the animals under non-cooperative sector was 1.9417 percent which was statistically significant (Table 4.6).

In the co-operative sector, the average days to attain peak milk yield per unit of milch animals was the longest in the khatals having only buffaloes (42.13±1.07 days) followed by those maintaining only cows (40.34±0.37 days) and cows + buffaloes (39.98±0.33 days). The situation was slightly different in the case of animals managed under non-cooperative sector as the average days to attain peak milk yield was the longest for the khatals having only buffaloes (43.52±1.02 days) followed by those maintaining cows + buffalo (42.41±0.44 days) and only cows (41.21±0.41 days). Under the non-cooperative sector the effect of herd-constitution on days to attain peak milk yield of khatals having only graded buffaloes was significantly different from those having only cows but did not differ significantly from the khatals maintaining cattle and buffaloes both (Table 4.5).

Niraj (2004) recorded the effect of herd-constitution to be non-significant on days to attain peak milk yield in Desi cows, Crossbred cows and Buffaloes in and around Darbhanga. Such variation in the results, obtained in this study may be attributed to sampling error.

4.1.4.1.4 PARITY (Lactation Order) :

Results revealed that parity had highly significant ($P \leq 0.01$) influence on days to attain peak milk yield under both the co-operative & non-

cooperative sectors, its contribution to the total variation being 19.3756 and 19.3998 percent respectively (Table 4.6).

Finding revealed that the average days to attain peak milk yield gradually decreased from first to fourth lactation under both the sectors and the average from first to fourth lactation were significantly different from each other (Table 4.5). From the table 4.5, it is also evident that in the co-operative sector the animals in first lactation took significantly the longest (43.95±0.59 days) days to attain peak milk yield followed by those in second (41.64±0.58 days), third (39.89±0.57 days) and fourth (37.77±0.43 days). In the case of non-cooperative sector it was longest in first lactation (45.95±0.63 days) followed by second (42.66±0.56 days), third (41.56±0.65 days) and fourth (39.3±0.58 days). Niraj (2004) & Ayub (2005) also recorded the effect of parity to be significant on average days to attain peak milk yield and recorded almost similar trend of variation in this trait due to variable lactation sequence.

4.2 MEASURES OF MILK PRODUCTION EFFICIENCY :

4.2.1 MILK YIELD (Kg) PER DAY OF LACTATION LENGTH (MY/LL) :

It (MY/LL) was derived as "the ratio of total milk yield (kg) and total days in milk during that lactation" of that animal excluding the abnormal lactation period of less than 170 days and more than 350 days. The overall least squares mean for milk yield per day of lactation length in local and cross-bred cows as well as buffaloes managed in the co-operative and non-cooperative sectors were estimated to be 6.56±0.09 and 5.89±0.07 kg respectively. The difference was statistically significant and the animals under the co-operative sector produced relatively more milk per day of its lactation than animals under non-cooperative sector (Table - 4.8).

4.2.1.1. FACTOR AFFECTING MY / LL :

Least squares analysis of variance revealed that genetic group and lactation order had significant (P≤0.01) influence on milk yield per day of lactation length under both the sectors. The effects of herd-size and herd-constitution on this yield trait were statistically not significant (Table - 4.7).

4.2.1.1.1 GENETIC GROUP :

The genetic constitution of the animals contributed significantly to the total variation on MY/LL, the magnitudes of the contribution for animals under the co-operative and non-cooperative sectors being 73.8404 and 59.8700 percent respectively (Table 4.7). The HF cross-breds had the highest (9.14±0.14) average daily milk yield followed by Jersey cross-breds (7.33±0.13), Buffaloes (5.47±0.11) and Desi cows (4.28±0.16) under the co-operative sector. The corresponding values for the animals under non-cooperative sector were (8.22±0.11), (6.77±0.12), (4.86±0.09) and (3.72±0.13) respectively (Table-4.8). The animals of different genetic constitutions differed significantly among themselves with respect to their milk yield per day of lactation length in the agro-climatic conditions under the prevailing feeding & management technology in and around Hajipur (Bihar), under both the sectors. The results re-substantiated the genetic dogma that Friesian crossbred cows were the most suitable exotic bred for higher average daily milk yield. Priya Raj (2002), Niraj (2004) and Ayub (2005) also recorded the effect of genetic group to be significant on average MY/LL in case of Desi cows, Crossbred cows and Buffaloes which was in close agreement to the findings of this study.

Table 4.7 : Least squares analysis of variance showing effects of genetic and non-genetic factors on milk yield (kg) per day of lactation length of milch animals in and around Hajipur (Vaishali), Bihar

Source of variation	Co-operative sector			Non-cooperative sector		
	df	MSS	R^2(%)	df	MSS	R^2(%)
Genetic group	3	** 2451269.00	73.8404	3	** 1672487.00	59.8700
Herd-size	2	6419.47	0.1289	2	12276.62	0.2930
Herd-constitution	2	327.85	0.0066	2	3815.08	0.09105
Lactation order	3	* 483548.70	14.5662	3	* * 833913.50	29.8516
Residual	219	5210.56	11.4580	215	3856.81	9.8945

*P$\leq$0.05, **P$\leq$0.01

4.2.1.1.2 HERD-SIZE :

Herd size did not show any significant influence on MY/LL, the magnitude of its contribution to the total variation being 0.1289 and 0.2930% respectively for the animals under the co-operative & non-cooperative sectors. However, under the co-operative sector, the average milk yield per day of lactation length was the highest (6.62$\pm$0.14 kg) for the animals maintained in the herd of 5-7 animals followed by those in $\geq$ 8 animals (6.60$\pm$0.14 kg) and its was the lowest (6.44$\pm$0.09 kg) for the animals in the herds of 2-4 animals. In non-cooperative sector there was a similar trend and the corresponding averages for the herds of different sizes were 6.06$\pm$0.10, 5.18$\pm$0.11 and 5.81$\pm$0.07 (Table-4.8).

The results were contrary to findings of Niraj (2004) & Ayub (2005) who recorded the effect of herd-size on MY/LL to be significant in case of Desi cows, Crossbred cows and Buffaloes in and around Darbhanga and

Muzaffarpur (Bihar) respectively. Such variation may be attributed to the variation in genetic constitution of experimental animals as well as agro-climatic and ecological conditions of the study areas, besides the sample sizes.

4.2.1.1.3 HERD-CONSTITUTION :

The contribution of the herd-constitution to the total variation in milk yield per day of lactation length (MY/LL) for the animals under both the co-operative and non-cooperative sectors were 0.006 and 0.091 percent respectively which were statistically not significant (Table 4.7). However, in the co-operative sector the average milk yield per day of lactation length was the highest for the khatals having only buffaloes (6.58 ± 0.26 kg) followed by those maintaining only cows (6.56 ± 0.09 kg) and cattle & buffaloes both (6.53 ± 0.08 kg). The situation was slightly different in the case of animals managed under non-cooperative sector and the average MY/LL was the highest for the khatals having cattle and buffaloes both (5.99 ± 0.07 kg) followed by those maintaining only cows (5.95 ± 0.08 kg) and only buffaloes (5.74 ± 0.17 kg). Niraj (2004) also recorded the effect of herd-constitution on milk yield per lactation length to be non-significant in case of Desi cows, Crossbred cows and Buffaloes in and around Darbhanga (Bihar).

4.2.1.1.4 PARITY (Lactation order) :

Results revealed that parity had significant influence on milk yield per day of lactation length for the animals under both co-operative & non-cooperative sectors. Its contribution to the total variation in this efficiency trait for the animals under the co-operative and non-cooperative sectors were 14.5662 and 29.8516 percent respectively (Table 4.7). There was gradual increase in MY/LL from first to third lactation and then after it decreased. The animal in third lactation had the highest average daily milk yield followed by those in fourth, second and first, which were significantly

different from each other. Similar trend was recorded for the animals under non-cooperative sector (Table-4.8). Niraj (2004) & Ayub (2005) also recorded the effect of parity to be significant on average MY/LL in milch animals in and around Darbhanga & Muzaffarpur. The results followed the trend similar for both the component traits i.e. milk yield and lactation length used in deriving this efficiency indicator.

Table 4.8 : Least squares means±SE of milk MY/LL and MY/CI of Cattle & Buffalo in co-operative and non-cooperative sectors in and around Hajipur (Bihar)

Particulars	Milk yield (kg) per day of lactation length (Mean±SE)		Milk yield (kg) per day of Calving Interval (Mean±SE)	
	Co-operative	Non-cooperative	Co-operative	Non-cooperative
n	230	226	230	226
Population Mean μ	6.56^A+0.09	5.89^B+0.07	4.85^A+0.09	4.23^B+0.07
Genetic Grade				
Desi cow	4.28^a+0.16	3.72^a+0.13	2.92^a+0.15	2.44^a+0.11
HF x B	9.14^b+0.14	8.22^b+0.11	6.94^b+0.13	6.04^b+0.09
J x B	7.33^c+0.13	6.77^c+0.12	5.48^c+0.13	4.99^c+0.10
Buffalo	5.47^d+0.11	4.86^d+0.09	4.06^d+0.10	3.43^d+0.08
Herd-size				
2-4 Animal	6.44+0.09	5.81+0.07	4.75+0.08	4.20+0.06
5-7 Animal	6.62+0.14	6.06+0.10	4.88+0.13	4.36+0.09
$\geq$ 8 Animal	6.60+0.14	5.81+0.11	4.93+0.13	4.12+0.10
Herd constitution				
Cattle	6.56+0.09	5.95+0.08	4.89+0.09	4.28+0.07
Cattle & Buffalo	6.53+0.08	5.99+0.07	4.86+0.08	4.34+0.06
Buffalo	6.58+0.26	5.74+0.17	4.79+0.25	4.05+0.16
Lactation order				
1st	5.30^a+0.14	4.16^a+0.11	3.73^a+0.14	2.77^a+0.10
2nd	6.24^b+0.14	5.66^b+0.09	4.49^b+0.13	4.03^b+0.09
3rd	7.77^c+0.11	7.51^c+0.10	5.99^c+0.09	5.63^c+0.09
4th	6.29^c+0.15	6.24^d+0.11	5.19^d+0.13	4.47^d+0.10

* Value with different superscripts (in small letter) row wise differed significantly (P˂0.05).
* Values with different superscripts (in capital letter) column wise differed significantly (P˂0.05).
* n denoted number of observations.

4.2.2 MILK YIELD (Kg) PER DAY OF CALVING INTREVAL (MY/CI) :

Average milk yielded by a cow/buffalo during per day of its one calving interval was taken as another criterion to compare their milk production efficiency. It was "the ratio of total lactation milk yield and corresponding inter-calving period." The overall Least Squares means for MY/CI in local and crossbred cows as well as buffaloes managed in the co-operative and non-cooperative sectors were 4.85 ± 0.09 and 4.23 ± 0.07 kg respectively (Table 4.8). The difference was statistically significant and animals under the co-operative sector produced more milk per day of calving interval than animals under non-cooperative sector.

4.2.2.1 FACTORS AFFECTING (MY/CI) :

Least squares analysis of variance (Table 4.9) revealed that genetic constitution of the animals and lactation order had highly significant ($P\leq0.01$) influence on milk yield per day of calving interval for animals under both the sectors. The effects of herd-size and herd-constitution on this economic trait were statistically not significant for both the sectors.

4.2.2.1.1 GENETIC GROUP :

The contribution of Genetic group to the total variation on MY/CI for animals under the co-operative and non-cooperative sectors were 68.5534 and 56.2620 percent respectively (Table 4.9). Under the co-operative sector the HF crossbreds had the highest MY/CI (6.94 ± 0.13 kg) followed by Jersey cross-breds (5.48 ± 0.13 kg), Buffaloes (4.06 ± 0.10 kg) and Desi cows (2.92 ± 0.15 kg). A similar trend was recorded for the animals under non-cooperative sector, the corresponding averages being (6.04 ± 0.09 kg), (4.99 ± 0.10 kg), (3.43 ± 0.08 kg) and (2.44 ± 0.11 kg). The animals of different genetic constitutions differ significantly among themselves with respect to their MY/CI. Shrivastava et al. (2000), Priya Raj (2002), Niraj (2004) &

Ayub (2005) also recorded the effect of genetic group to be significant on average MY/CI.

4.2.2.1.2 HERD-SIZE :

Herd size did not show any significant influence on MY/CI. The contribution of the herd size to the total variation in MY/CI for the animals under the co-operative and non-cooperative sectors were 0.1498 and 0.2539 percent respectively (Table 4.9). However, in the case of animals under co-operative management, the MY/CI was the highest (4.93 ± 0.13) in the herd of ≥ 8 and more animals followed by those in herd of 5-7 (4.88 ± 0.13) and 2-4 (4.75 ± 0.08 kg). The corresponding values for the animals managed under non-cooperative sectors were 4.12 ± 0.10, 4.36 ± 0.09 and 4.20 ± 0.06 kg respectively (Table-4.8). The results were contrary to the findings of Niraj (2004) & Ayub (2005) who recorded the effect of herd-size on MY/CI to be significant. Such variation may be attributed to the variation in genetic constitution of experimental animals and agro-climatic conditions of the study areas.

Table 4.9 : Least squares analysis of variance showing effects of genetic and non-genetic factors on milk yield (kg) per day of calving interval in cows and buffaloes in and around Hajipur (Vaishali), Bihar.

Source of variation	Co-operative sector			Non-cooperative sector		
	df	M.S.S.	R^2(%)	df	M.S.S.	R^2(%)
Genetic group	3	** 1641936.00	68.5534	3	** 1062466.00	56.2620
Herd-size	2	5382.33	0.1498	2	7191.71	0.2539
Herd-constitution	2	313.82	0.0087	2	5245.63	0.1852
Lactation order	3	** 407405.40	17.0098	3	** 598858.20	31.7120
Residual	219	4684.66	14.2783	215	3053.17	11.5870

**P$\leq$0.01

4.2.2.1.3 HERD-CONSTITUTION :

The contribution of the herd-constitution to the total variation in MY/CI for the animals under both the co-operative and non-cooperative sectors were 0.0087 and 0.1852 percent respectively which were statistically non-significant (Table-4.9). However, in the co-operative sector average MY/CI was the highest for the dairy units having only cattle (4.89±0.09 kg) followed by those maintaining cattle and buffaloes both (4.86±0.08 kg) and only buffaloes (4.79±0.25 kg). The situation was slightly different in the case of animals managed under non-cooperative sector as the average MY/CI was the highest for the khatals having cattle and buffaloes both (4.34±0.06 kg) followed by those maintaining only cows (4.28±0.07 kg) and only buffaloes (4.05±0.16 kg). Niraj (2004) also recorded the effect of herd constitution to be non-significant on MY/CI.

4.2.2.1.4 PARITY (Lactation order) :

Results revealed that lactation order had highly significant ($P \leq 0.01$) influence on milk yield per day of calving interval, the magnitude of its contributions to the total variation in co-operative and non-cooperative sectors being 17.0098 and 31.7120 percent respectively (Table 4.9). There was gradual increase in average MY/CI from first to third lactation and then after it decreased. The animals in the third lactation had the highest average MY/CI under both the sectors. Under both the sectors, the least squares means for MY/CI in first to fourth lactation were significantly different from each other (Table 4.8). The trend of variation in MY/CI due to parity effect also followed the trend of variation in lactation milk yield, recorded in this study (para 4.1.1.1.4). Shrivastava et al. (2000), Niraj (2004) & Ayub (2005) also recorded the effect of parity to be significant on average MY/CI in milch animals including crossbred and desi cattle as well as buffaloes.

4.3 MEASURES OF REPRODUCTION TRAITS :

4.3.1 DRY PERIOD :

The overall least squares means for dry period in local and crossbred cows as well as buffaloes managed in the co-operative and non-cooperative sectors were estimated to be 117.18±2.49 and 129±1.75 days respectively (Table 4.11). The difference was statistically significant. The dry period recorded in this study was higher than the optimum range desirable for profitable milk production. The probable reason behind it could be the practice of taking out milk from the milch animals even in late gestation and not subjecting even advance pregnant animals to force drying 60-70 days earlier to the expected date of their subsequent calving.

4.3.1.1 FACTOR AFFECTING DRY PERIOD :

Least squares analysis of variance Table (4.10) revealed that genetic group and lactation order had highly significant (P≤0.01) influence on dry period under both the sectors of management. The effect of herd-size on dry period of the animals under the co-operative sector was not significant, but the herd-size contributed significantly to the total variation in dry period of the animals under the non-cooperative management system. However, the effect of herd-constitution on dry period was not significant in the case of the animals under both the sectors.

4.3.1.1.1 GENETIC GROUP:

Genetic group had highly significant (P≤0.01) influence on dry period in cattle & buffaloes managed under both the co-operative & non-cooperative sectors, its contribution to the total variation being 18.7918 and 19.9818 percent respectively (Table 4.10). Among the animals under co-operative sector, the HF crossbreds had the shortest (107.23±3.64 days)

average dry period followed by Jersey crossbreds (109.53$\pm$3.61 days), Buffaloes (118.32$\pm$2.71 days) and Desi cows (133.66$\pm$4.02). The situation was slightly different in the case of animals managed under non-cooperative sector as the average dry period was the shortest in Jersey crossbreds (118.79$\pm$2.88 days) followed by HF crossbreds (119.92$\pm$2.71 days), Buffaloes (128.88$\pm$2.26 days) and the longest in Desi cows (146.49$\pm$3.16 days). It was recorded that among the animals in both the systems of management the Desi cows had the longest average dry period which was significantly different from averages for HF and Jersey crossbreds which were not significantly different from each other, but differed significantly from the average dry period of Buffaloes (Table-4.11).

Although dry period is supposed to be influenced mainly by non-genetic causes, in the present study, the experimental animals were genetically highly divergent which might have resulted into variation in dry period due to genetic causes to be significant. Shrivastava et al. (1996), Niraj (2004) and Ayub (2005) also recorded the effect of genetic group to be significant on average dry period.

4.3.1.1.2 HERD-SIZE :

Herd-size did not show any significant effect on dry period for the animals managed under co-operative sector, but its influence on dry period in the case of the animals managed under non-cooperative sector was significant (Table 4.10). The contribution of the herd size to the total variation in dry period for the animals under the co-operative and non-cooperative sectors were 0.4790 and 2.2853 percent respectively. In the co-operative sectors the average dry period was the longest (118.70$\pm$3.61 days) in the animals maintained in herd of 5-7 animals followed by the averages for those in groups of $\geq$ 8 (118.07$\pm$3.62 days) and 2-4 animals (114.78$\pm$2.32 days). In non-cooperative sector, the average dry period was the longest

(133.62±2.88 days) in the animals in larger herd i.e. the herd of ≥8 animals followed for those in herds of 5-7 (128.88±2.49 days) animals and it was shortest (125.27±1.83 days) for the animals in relatively smaller herds of 2-4 animals (Table 4.11). Results revealed that the animals in larger herds (≥ 8 animals) were significantly different in respect to their dry period as compared to those in the herds of sizes 2-4 and 5-7 animals which did not differ significantly from each other in this regard (Table-4.11). Niraj (2004) recorded the effect of herd-size to be non-significant on average dry period which was in agreement to the findings of animals managed in co-operative sector in this study. However, Ayub (2005) recorded the herd-size-effect to be significant on average dry period which was in agreement to the findings of this study pertaining to the non-cooperative sector. Results revealed that the present management technology sustained herds of 5-7 milch animals for lower dry period in and around Hajipur (Vaishali).

Table 4.10 : Least squares analysis of variance showing effects of genetic & non-genetic factors on Dry period (days) of milch animals in and around Hajipur (Vaishali)

Source of variation	Co-operative sector			Non-cooperative sector		
	df	M.S.S.	R^2(%)	df	M.S.S.	R^2(%)
Genetic group	3	7476.52**	18.7918	3	6255.58**	19.9818
Herd-size	2	285.85	0.4790	2	1073.16*	2.2853
Herd-constitution	2	200.42	0.3358	2	241.59	0.5145
Lactation order	3	6541.04**	16.4406	3	6103.46**	19.4960
Residual	219	348.55	63.9528	215	252.15	57.7225

*P≤0.05. **P≤0.01

4.31.1.3 HERD-CONSTITUTION :

The contribution of the herd constitution to the total variation in dry period for the animals under both the co-operative and non-cooperative sectors were 0.3358 and 0.5145 percent respectively which were statistically not-significant (Table 4.10). However, in the co-operative sector the average dry period was the longest for the animals in khatals having only buffaloes (118.59±6.76 days) followed by those maintaining only cows (117.94±2.36 days) and cattle & buffaloes both (115.01±2.10 days). The corresponding values for the average dry period in the animals of non-cooperative sector were 132.79±4.51, 128.28±1.94 and 126.70±1.84 days respectively (Table-4.11). Niraj (2004) recorded the effect of herd-constitution to be non-significant on average dry period in Desi cows, Crossbred cows and Buffaloes which was in agreement to the findings of this study. However, Ayub (2005) recorded the effect of herd constitution to be significant on the average dry period in case of Desi and Crossbred cows in and around Muzaffarpur (Bihar). Such variation may be attributed to the variation in genetic constitution of the experimental animals as well as agro-climatic and ecological conditions of the study areas.

4.3.1.1.4 PARITY (Lactation order):

Results revealed that the parity had highly significant (P≤0.01) influence on dry period. The contribution of parity effect to the total variation in dry period for the animals under the co-operative and non-cooperative sectors were 16.4406 and 19.4960 percent respectively (Table-4.10). There was a linear decrease in average dry period from first to third lactation and then after it increased. The animals in first parity had the

longest average dry period (131.86±3.69 & 144.25±2.82 days) followed by those in second (121.04±3.63 & 115.01±2.61 days), fourth (111.24±3.64 & 129.03±2.52 days) and third parity (104.59±2.71 & 128.75±2.89 days) in the co-operative and non-cooperative sector respectively. Niraj (2004) recorded the effect of parity to be significant on average dry period which was in agreement with the findings of this study. However, Ayub (2005) recorded the same effect to be non-significant on average dry period which was contrary to the findings of this study. Such variation may be attributed to the variation in different genetic constitution of experimental animals and agro-climatic conditions of the study areas, besides the size of samples.

Table 4.11 : Least squares means±SE of CI and DP of Cattle & Buffaloes in and around Hajipur (Vaishali), Bihar

Particulars	Calving Interval (Days) (Means±SE)		Dry period (Days) (Means±SE)	
	Co-operative	Non-Cooperative	Co-operative	Non-Cooperative
n	230	226	230	226
Population Mean (μ)	436.31^A±2.40	439.06^B±1.84	117.18^A±2.49 318.83	129.26^B±1.75 309.86
Genetic Grade				
Desi cow	424.07^a±3.88	426.43^a±3.31	133.66^a±4.02	146.49^a±3.16
HF x B	439.26^b±3.51	442.27^b±2.84	107.23^b±3.64	119.92^b±2.71
J x B	439.18^b+3.48	443.84^b±3.02	109.53^b+3.61	118.79^b+2.88
Buffalo	442.73^b±2.61	443.71^b±2.37	118.32^c±2.71	128.88^c±2.26
Herd-size				
2-4 Animal	434.14±2.23	434.68^a±1.92	114.78±2.32	125.27^a±1.83
5-7 Animal	437.65±3.48	440.39^b±2.62	118.70±3.61	128.88^a±2.49
≥ 8 Animal	437.13±3.49	442.12^b±3.02	118.07±3.62	133.63^b±2.88

Herd-constitution				
Cattle	435.95±2.27	432.79^a±2.04	115.01±2.10	126.70±1.84
Cattle & Buffalo	435.06±2.03	442.38^b±1.93	117.94±2.36	128.28±1.94
Buffalo	437.92±6.52	442.09^b±4.73	118.59±6.76	132.79±4.51
Lactation order				
1st	434.89±3.56	440.81^a±2.96	131.86^a±3.69	144.25^a±2.82
2nd	437.05±3.50	446.34^b±3.03	121.04^b±3.63	115.01^b+2.61
3rd	435.89±2.61	435.45^c±2.74	104.59^c±2.71	128.75^c±2.89
4th	438.17±3.51	433.66^c±2.64	111.24^c+3.64	129.03^c +2.52

* Values with different superscripts (in small letter) row wise differed significantly (P<0.05)

* Value with different superscripts (in capital letter) column wise differed significantly (P<0.05)

* n denoted the number of observations.

4.3.2 CALVING INTERVAL (days):

The overall least squares means for average calving interval in the local and cross-bred cows as well as buffaloes managed in the co-operative and non-cooperative sectors were estimated to be 436.31±2.40 and 439.06±1.84 days. The difference was statistically significant (Table-4.11).

4.3.2.1 FACTORS AFFECTING CALVING INTERVAL :

Least squares analysis of variance revealed that the influence of genetic group on calving interval was highly significant (P≤0.01) under both the sectors. The effects of herd-size, herd-constitution and lactation order on calving interval for animals managed under co-operative sector were non-significant while the effects were significant in the case of animals under non-cooperative sector (Table-4.12).

4.3.2.1.1 GENETIC GROUP :

Genetic group had highly significant ($P \leq 0.01$) influence on calving interval for animals under both the sectors. Its contribution to the total variation on calving interval for the animals under the co-operative and non-cooperative sectors were 10.5528 and 9.6407 percent respectively (Table-4.12). As evident from Table 4.11, the Buffaloes had the longest average calving interval (442.73$\pm$2.61 days) followed by HF crossbreds (439.26$\pm$3.48 days) and Desi cows (424.07$\pm$3.88 days) managed under the co-operative sector. In non-cooperative sector the Jersey crossbred had the longest average calving interval (443.84$\pm$3.02 days) followed by Buffaloes (443.71$\pm$2.37 days), HF crossbreds (442.27$\pm$2.84 days) and Desi cows (426.43$\pm$3.31 days). Desi cows had the shortest average calving interval and significantly different from the average calving interval of HF cross-breds, Jersey crossbreds and Buffaloes. In spite of relatively longer dry period in Desi cows, the calving interval was the shortest only due to relatively shorter lactation length. However, the average calving interval of HF crossbreds, Jersey cross-breds and buffaloes did not differ significantly from each other (Table-4.11). Shrivastava et al. (1998), Rao et al. (2000), Singh et al. (2000), Hemlatha (2003), Niraj (2004) and Ayub (2005) also recorded the effect of genetic group to be significant on average calving interval in the animals of similar genetic constitutions and managed in private sector.

4.3.2.1.2 HERD-SIZE :

Herd-size did not show any significant influence on calving interval for animals under the co-operative sector, while this effect was significant ($P \leq 0.05$) in the case of animals managed under non-cooperative sector (Table 4.12). The contribution of the herd-size to the total variation in calving interval for the animals under both the sectors were 0.522 and 2.7840

percent respectively. In co-operative sector, the average calving interval was the longest (437.65±3.48 days) for the milch animals maintained in the herd of 5-7 animals followed by those in herd of ≥8 animals (437.13±3.49 days) and it was the shortest (434.14±2.23 days) for the animals in smaller herd i.e. of 2-4 animals. In non-cooperative, average calving interval was the longest (442.12±3.02 days) for the animals in larger herd i.e. the herd of ≥8 animals followed by those in the herd of 5-7 animals (440±2.62 days) and the lowest (434.68±1.92 days) in the animals managed in herds of 2-4 animals (Table-4.11).

The non-significant effect of herd-size on calving interval in co-operative sector might be due to uniform management practices under guidance and supervision of milk co-operative societies. Shrivastava et al. (1996) & Singh et al. (2000) recorded the effect of herd-size on calving interval to be significant. However, Niraj (2004) & Ayub (2005) recorded this effect to be non-significant. Such variation may be attributed to the variation in genetic constitution of experimental animals and agro-climatic conditions of study areas selected in the different studies.

4.3.2.1.3 HERD-CONSTITUTION :

The effect of herd constitution did not show any significant influence on calving interval for the animals in co-operative sector while this effect was highly significant (P≤0.01) in the animals managed under non-cooperative sector (Table-4.10). The contributions of the herd-constitution to the total variation in calving interval for the animals under the co-operative & non-cooperative sectors were 0.1263 and 3.9566 percent respectively. In the co-operative sector the average calving interval was the longest for the khatals having only buffaloes (437.92±6.52 days) followed by those maintaining only cows (435.95±2.27 days) and cows and buffalo both

(435.06±2.03 days). Under non-cooperative sector the average calving interval was the longest in the animals in the khatals having cattle and buffaloes both (442.38±1.93 days) followed by those having only buffaloes (442.09±4.73 days) and only cows (432.79±2.04 days). The animals in the khatals under non-cooperative sector having only cows were significantly different from the calving interval of the animals in khatals having cows and buffaloes both and only buffaloes. The inter-calving periods of buffaloes managed alone and in combination with cows did not differ significantly from each other. The trend of variation in calving interval with variation in herd constitution was more or less similar to the trend recorded in lactation length and dry period, the component traits of calving interval. The non-significant effect of herd constitution in co-operative sector might be due to uniform management in different types of herds under guidance of one agency i.e. milk co-operatives. Niraj (2004) also recorded the effect of herd-constitution on calving interval to be non-significant in cattle & buffaloes under private sector.

Table-4.12 : Least squares analysis of variance showing effects of genetic and non-genetic factors on calving interval of milch animals in and around Hajipur (Vaishali), Bihar

Sources of variation	Co-operative sector			Non-cooperative sector		
	df	MSS	R^2(%)	df	MSS	R^2(%)
Genetic group	3	2833.03**	10.5528	3	2477.46**	9.6407
Herd-size	2	230.41	0.5722	2	1077.16*	2.7840
Herd-constitution	2	50.85	0.1263	2	1530.87**	3.9566
Lactation order	3	178.950	0.6666	3	1699.34**	6.5881
Residual	219	323.93	88.0822	215	277.38	77.0665

*$P \leq 0.05$, **$P \leq 0.01$

4.3.2.1.4 PARITY (Lactation order):

The contribution of parity to the total variation in calving interval for the animals under co-operative was 0.66 percent which was statistically non-significant. The same for the animals under non-cooperative sector was 6.5881 percent which was statistically highly significant (Table-4.12). Findings revealed that in co-operative sector the average calving interval was the longest in the animals of fourth parity (438.17±3.51 days) followed by those in second (437.05±3.50 days), third (435.89±2.61 days) and first parity (434.89±3.56 days). The situation was some what different in the case of animals managed under non-cooperative sector, as the average calving interval was the longest for the animals in 4th parity followed by those in 2nd, 3rd and 1st parities. The average inter-calving periods for the animals in 1st and 2nd parities were significantly different from each other and also from those for the animals of 3rd and 4th parities which did not differ significantly from each other in this regard (Table 4.11).

The non-significant effect of parity on calving interval might be because of uniform approved managemental practices adopted for the animals in different lactations in co-operative sector under guidance and supervision of milk co-operative societies and it was lacking in non-cooperative sector.

Choudhary et al. (1995), Singh et al. (2000), Niraj (2004) and Ayub (2005) also recorded the effect of parity to be significant on calving interval.

4.4 ECONOMIC OF MILK PRODUCTION :

The data on different cost components and their relative contribution to the Gross cost of per kg milk produced by the milch animals of different genetic grades in the khatals maintained under co-operative and non-cooperative sectors in and around Hajipur (Vaishali) were promptly recorded

and compiled. The data were subjected to Least Squares Analysis of variance (Harvey, 1966) to quantify the effect of genetic and various non-genetic factors on the cost of milk production. The results have been summarized in Table-4.13, 4.14 and 4.15.

4.4.1 COST COMPONENTS :

The overall Least Squares Means for Gross cost of milk production of milch animals under the co-operative and non-cooperative sectors were 910.88 ± 1.78 and 949.36 ± 3.28 paise per kg respectively. On an average dung reduced the cost of production in the two sectors by 32.33 and 32.42 paise / kg of milk. Resultantly the overall Net cost of milk production from milch animals, irrespective of their genetic constitutions, under co-operative and non-cooperative sectors of management were estimated to be 878.55 ± 3.41 and 916.94 ± 3.26 paise / kg respectively. Average Gross cost and Net cost of milk production, along with the relative contribution of different cost components under the two sectors of management are presented in Table-4.13a and 4.13b respectively.

Among the different cost items, the overall contribution of feeds and fodder was maximum (66.80 & 63.97%) followed by those on human labour (13.44 and 13.66%), interest on fixed capital (9.08 & 10.93%), depreciation on fixed assetts (4.88 & 4.62%), Veterinary & A.I. costs (3.10 & 3.84%) and miscellaneous items (2.70 & 3.06%) respectively in the cases of animals under co-operative and non-cooperative sectors (Table 4.13a & 4.13b). The trend of variation in the contributions of different cost components was almost similar in the animals of different genetic groups except the Veterinary and A.I. cost which was relatively very low (1.98%) in Desi cows under co-operative sector. It may be attributed to the fact that the animals of

this genetic constitution are relatively more resistant to harsh weather conditions as well as diseases, if maintained under slightly improved management like that of the farmers registered to COMFED. The results were in agreement with the findings of Priya Raj (2002), Niraj (2004) and Asad Ayub (2005) who conducted similar studies in Patna, Darbhanga and Muzaffarpur districts of Bihar, of course in the private dairy units only under non-cooperative sector.

When taken genetic group and sector-wise, in the co-operative sector the cost of feeds and fodder contributed 68.22, 66.04, 65.10 and 67.4 percent to the Gross cost of milk production, respectively in Desi cows, Jersey crossbreds, Friesian crossbreds & Buffaloes. The corresponding percent contributions under non-cooperative sector were 65.10, 63.5, 62.80 and 64.25 respectively (Table 4.13a & 4.13b).

Human labour was the second major component accounting to 13.25, 14.10, 13.50 and 13.0 percent to the Gross cost of Milk production in Desi cows, Jersey crossbreds HF crossbreds and Buffaloes respectively under the co-operative sector. The corresponding contributions in non-cooperative sector were 13.10, 13.60, 13.60 and 14.30 percent respectively. The contribution of interest on fixed capital to the Gross cost of Milk production in Desi cow, HF crossbred and Jersey crossbred as well Buffalo managed under the co-operative sector were reckoned to be 9.90, 9.10, 9.04 and 8.32 percent. The corresponding values in non-cooperative sector were 11.85, 11.00, 10.75 and 10.20 percent respectively.

Table-4.13a : Average of different cost components and their relative contribution to the gross cost of milk production in animals of different genetic groups under co-operative sector in the area of investigation.

Cost items	Means+SE (paise per kg of milk)				
	Desi	**Jesrey x B**	**HF x B**	**Buffaloes**	**Overall**
Feed cost	661.56±6.12 (68.22)	598.62±5.12 (66.04)	492.49±5.08 (65.10)	681.29±6.10 (67.4)	608.49±5.60 (66.80)
Labour cost	128.49±3.92 (13.25)	127.81±3.02 (14.10)	102.13±2.96 (13.50)	131.40±3.52 (13.0)	122.46±3.34 (13.44)
Depreciation on fixed assets	38.79±0.36 (4.00)	47.13±0.48 (5.20)	45.99±0.62 (6.08)	46.10±4.08 (4.56)	44.50±4.96 (4.88)
Veterinary A.I. cost	19.20±0.29 (1.98)	27.92±0.40 (3.08)	25.59±0.32 (3.25)	40.40±0.43 (4.00)	28.28±0.36 (3.10)
Interest on fixed capital	96.00±3.50 (9.90)	82.48±2.76 (9.10)	68.39±3.06 (9.04)	84.10±4.04 (8.32)	82.74±3.34 (9.08)
Miscellaneous cost	25.70±2.60 (2.65)	22.48±1.36 (2.48)	22.92±1.26 (3.03)	25.59±2.72 (2.72)	24.67±2.72 (2.70)
Gross cost of production (A)	969.74±2.88 (100.00)	906.44±2.60 (100.00)	756.52±2.58 (100.00)	1010.83±1.93 (100.00)	910.88±2.49 (100.00)
Income from dung (B)	28.12 (2.90)	30.10 (3.32)	29.66 (3.90)	41.44 (4.10)	32.33 (3.55)
Net cost of milk production (A-B)	941.62±2.26	876.34±3.04	726.86±3.16	969.39±2.88	878.55±3.41

Table-4.13 b : Average of different cost components and their relative contribution to the gross cost of milk production in animals of different genetic groups under non-cooperative sector in the area of investigation.

Cost items	Means±SE (paise per kg of milk)				
	Desi	Jesrey x B	HF x B	Buffaloes	Overall
Feed cost	644.69±4.88 (65.10)	597.79±3.56 (63.5)	515.38±3.78 (62.80)	671.44±5.62 (64.25)	607.32±4.46 (63.97)
Labour cost	129.73±2.98 (13.10)	128.03±2.76 (13.60)	111.61±3.20 (13.60)	149.44±3.80 (14.30)	129.70±3.18 (13.66)
Depreciation on fixed assets	37.63±0.38 (3.80)	45.19±0.42 (4.80)	45.14±0.48 (5.50)	43.06±0.44 (4.12)	43.96±0.43 (4.62)
Veterinary A.I.cost	31.68±0.26 (3.20)	37.66±0.32 (4.00)	34.88±0.30 (4.25)	41.80±0.38 (4.00)	36.51±0.31 (3.84)
Interest on fixed capital	117.35±4.10 (11.85)	103.55±3.68 (11.00)	88.23±3.50 (10.75)	106.60±3.86 (10.20)	103.93±3.78 (10.93)
Miscellaneous cost	29.21±1.60 (2.95)	29.19±1.22 (3.10)	25.44±1.35 (3.10)	32.71±1.32 (3.13)	29.13±1.37 (3.06)
Gross cost of production (A)	990.31±5.93 (100.00)	941.41±5.40 (100.00)	820.68±5.08 (100.00)	1045.05±4.25 (100.00)	949.36±5.16 (100.00)
Income from dung (B)	27.73 (2.80)	30.60 (3.25)	29.54 (3.60)	41.80 (4.00)	32.42 (3.41)
Net cost of milk production (A-B)	962.58±3.24	910.81±2.96	791.14±2.58	1003.25±4.26	916.94±3.26

In this study depreciation on fixed assets included depreciations on animals, housing, equipments and machineries and were taken together as one cost item. The overall contribution of average depreciation to the Gross cost of production was estimated to be 4.88 and 4.62 percent respectively under the co-operative and non-cooperative sectors. Among the milch animals of different genetic groups under the co-operative sector, depreciation contributed 4.00, 5.20, 6.08 and 4.56 percent to the Gross cost of milk production in Desi cows, HF crossbred and Jersey crossbred cows as well as Buffaloes respectively, while the corresponding contributions under non-cooperative sector were 3.80, 4.80, 5.50 and 4.12 percent respectively (Table 4.13a and 4.13b).

The contribution of Veterinary and A.I. cost to the Gross cost of milk production in Desi cows, HF and Jersey cross bred cows as well as Buffaloes under the co-operative sector were 1.98, 3.08, 3.25 and 4.00 percent while the respective contributions in the animals under non-cooperative sector 3.20, 4.00, 4.25 and 4.00 percent.

Miscellaneous recurring expenditure contributed the least to the Gross cost of milk production, the magnitudes of contribution being 2.65, 2.48, 3.03 and 2.72 percent under the co-operative sector, while 2.95, 3.10, 3.10 and 3.13 percent under non-cooperative sector for Desi cows, HF crossbred cows, Jersey cross bred cows and Buffaloes respectively. The corresponding overall average values were 2.70 and 3.06 percent respectively for co-operative and non-cooperative sectors (Table 4.13a and 4.13b).

The dung was taken as the only source of income to the khatals, other than milk. The income from dung was estimated and deduced from the Gross cost of milk production in order to get the estimate of Net cost of milk production. In this study, the income from dung was recorded to reduce the Gross cost of milk production by 2.90, 3.32, 3.90 and 4.10 percent in Desi

cows, HF crossbred cows, Jersey cross bred cows and Buffaloes respectively under the co-operative sector, while 2.80, 3.25, 3.60 and 4.00 percent accordingly under non-cooperative sector. The estimates of percent contribution of different cost items to the Gross cost of milk production in this study were more or less similar to the findings of Karala et al. (1995), Kumar and Balishter (1996), Badal and Dhaka (1998) Chanda and Agarwal (2000), Priya Raj (2002) and Niraj (2004). It may not be any significance to compare the estimates of percent contributions of different cost components to the total variation in Gross cost of milk production, obtained in this investigation, with the corresponding estimates reported by other workers in different parts of the country because of the following plausible reasons:

(i)   The reports reviewed and referred pertained to the studies made in agro-climatic regions, some different from that of study area of this investigation and were not contemporary to this study.

(ii)   Different degrees of sampling errors might be associated with different reports due to variable sample size in different studies.

(iii)   Variable managemental practices in different dairy units and availability of different feeds and fodder in different ecological regions.

(iv)   Periodical change in degree of demand of milk from place to place influencing price of milk and

(v)   Variation in the genetic constitution of the animals included in different studies.

Indeed, the above noted factors are the prime determinants of the cost of milk production in milch animals. However, the trend in contribution of fixed as well as variable cost items, recorded, in this study, were in agreement with the Shah and Sharma (1994), Dev Raj and Gupta (1994),

Karla et al. (1994), Shiyani et al. (1995), Sangu (1995), Kumar and Balishter (1996), Badal and Dhakala (1998) Chandra and Agarwal (2000), Priya Raj (2002) and Niraj (2004) with minor variations in the magnitude of contributions for the different cost items. All the aforesaid workers conducted their studies on cattle and buffaloes under private sectors (Non-cooperative) managed under farmer's managemental condition but this study was conducted for cattle & buffaloes managed under both the co-operative and non-cooperative sectors.

4.4.2. FACTORS (OTHER THAN COST COMPONENTS) AFFECTING NET COST OF MILK PRODUCTION :

Least squares analysis of variance (Table 4.14) revealed that genetic group and lactation order had highly significant (P≤0.01) influence on cost of milk production under both the sectors. The effect of herd-size and herd-constitution on cost of milk production were statistically not significant. Least Squares Means for different levels of the factors affecting cost of milk production are presented in Table 4.15.

4.4.2.1 GENETIC GROUP :

The genetic constitution of milch animals had highly significant (P≤0.01) influence on the Net cost of milk production under both the sectors. Its contribution to the total variation on cost of milk production under the co-operative and non-cooperative sectors were 96.0834 and 83.1918 percent respectively (Table 4.14). As evident from table 4.15, the Buffaloes had the highest average cost of milk production followed by Desi cows, Jersey crossbred and HF crossbred cows. Animals of different genetic constitutions were significantly different from each other under both the sectors in respect

to this economic trait. However, milk produced in co-operative sector was in general cheaper as compare to that produced in non-cooperative sector (Table 4.15). Results further revealed that yield was the prime factor determining the Cost of milk production in genetically different types of milch animals in the study area. On the basis of the findings of this study it could be recommended that crossbred cows (HF cross-bred & Jersey crossbred) as well as Buffaloes would be ideal, of course in descending order of rank, for economic milk production in and around Hajipur (Vaishali). Niraj (2004) and Ayub (2005) also recorded the effect of genetic group to be significant on cost of milk production in case of Desi cows, Crossbred cows and Buffaloes

4.4.2.2 HERD-SIZE :

Herd-size did not show any significant influence on cost of milk production. The contribution of the herd-size to the total variation in cost of milk production for the animals managed under the co-operative and non-cooperative sectors were 0.0118 and 0.2404 percent respectively (Table 4.14). However, under the co-operative sector the average cost of milk production was highest (912.63±2.59 paise/kg) for the milch animals maintained in the herd of ≥8 animals followed by those in herd of 2-4 animals (910.43±1.64 paise/kg) and it was the lowest (909.59±2.58 pasie/kg) for the herd of 5-7 animals. In non-cooperative sector the cost of milk production was the highest (952.80±3.44 paise/kg) in herd of 2-4 animals followed by in the herd of ≥8 animals (952.37±5.41 paise/kg) and the lowest (942.91±4.69 paise/kg) in the herd of 5-7 animals (Table-4.15).

Table 4.14 : Least squares analysis of variance showing effect of genetic non-genetic factors on cost of milk production in and around Hajipur (Vaishali), Bihar.

Source of variation	Co-operative sector			Non-cooperative sector		
	df	M.S.S.	R^2(%)	df	M.S.S	R^2(%)
Genetic group	3	620210.50	96.0834**	3	436559.90	83.1918**
Herd-size	2	114.66	0.0118	2	1892.44	0.2404
Herd-constitution	2	321.52	0.0332	2	1910.46	0.2427
Lactation order	3	1998.64	1.8589**	3	21977.41	4.1881**
Residual	219	117.97	2.0127	215	888.71	12.1370

**P$\leq$0.01

4.4.2.3 HERD-CONSTITUTION :

The contribution of the herd-constitution to the total variation in cost of milk production under co-operative and non-cooperative sectors were 0.0332 and 0.2427 percent respectively, the difference being statistically non-significant (Table 4.14). However, in the co-operative sector, the average cost of milk production was the highest for the khatals having only buffaloes (916.13$\pm$4.83 paise/kg) followed by those maintaining only cows (908.70$\pm$1.68 paise/kg) and cattle and buffalo both (907.81$\pm$1.50 paise/kg). The situation was slightly different in the case of animals managed under non-cooperative sector as the average cost of milk production was the highest in the khatals having only cows (955.76$\pm$3.64 paise/kg) followed by those maintaining only buffaloes (947.33$\pm$8.47 paise/kg) and cattle &

buffaloes both (944.99±3.45 paise/kg). Niraj (2004) recorded herd-constitution to be a factor influencing cost of milk production significantly which may be attributed to the variation in quality of genetic constitution of experimental animals in terms of the type and level of exotic inheritance therein.

Table 4.15 : Least squares means±SE of cost production (paise per litre) in and around Hajipur (Vaishali), Bihar

Particulars	Cost of milk production (Paise/kg) (Mean±SE)	
	Co-operative	Non-cooperative
n	230	226
Population Mean (μ)	$910.88^A \pm 1.78$	$949.36^B \pm 3.28$
Genetic Grade		
Desi cow	$969.74^a \pm 2.88$	$990.31^a \pm 5.93$
HF x B	$756.52^b \pm 2.60$	$820.68^b \pm 5.08$
J x B	$906.44^c \pm 2.58$	$941.41^c \pm 5.40$
Buffalo	$1010.83^d \pm 1.93$	$1045.05^d \pm 4.25$
Herd-size		
2-4 Animal	910.43±1.64	952.80±3.44
5-7 Animal	909.59±2.58	942.91±4.69
$\geq$ 8 Animal	912.63±2.59	952.37±5.41
Herd-constitution		
Cattle	908.70±1.68	955.76±3.64
Cattle & Buffalo	907.81±1.50	944.99±3.45
Buffalo	916.13±4.83	947.33±8.47
Lactation order		
1st	$930.70^a \pm 2.64$	$975.50^a \pm 5.31$
2nd	$915.52^b \pm 2.60$	$958.43^b \pm 4.73$
3rd	$906.10^d \pm 2.60$	$924.99^c \pm 4.89$
4th	$891.20^c \pm 1.93$	$938.52^c \pm 5.42$

* Values with different superscripts (in small letter) row wise differed significantly (P<0.05).

* Values with different superscripts (in capital letter) column wise differed significantly (P<0.05).

* n denoted number of observations.

4.4.2.4 PARITY (Lactation Order) :

Results revealed that parity had highly significant ($P \leq 0.01$) influence on cost of milk production under both the sectors. Its contribution to the total variation in cost of milk production for the animals under the co-operative and non-cooperative sectors were 1.8589 and 4.1881 percent respectively (Table 4.14). It could be recorded that there was linear decreased in average cost of milk production from first to third order of lactation and then after it increased under both the sectors. The cost of milk production was the highest for the animals in first lactation (930.70 ± 2.64 paise/kg) followed by those in second (915.52 ± 2.60 paise/kg), third(891.20 ± 1.93 paise/kg) and fourth (906.10 ± 2.60 paise/kg)lactation and were significantly different from each other under the co-operative sector. In non-cooperative sector also the cost of milk production was maximum for the animals in first lactation(975.50 ± 5.31 paise/kg) followed by those in second (958.43 ± 4.73 paise/kg), fourth (938.52 ± 5.42 paise/kg) and third (924.99 ± 4.89 paise/kg) lactation. The cost of milk production in 3rd and 4th lactations did not differ significantly from each other in the case of animals under non-cooperative sector. A critical review of the estimate (Table - 4.15) further revealed that the cost of milk production was the highest in the animals in first lactation order and the lowest in those in third order for both the sectors. However, average costs of milk production in the milch animals in first to fourth lactations was relatively lower in the co-operative sector as compared to those in non-cooperative. Quality input and expertised support to the farmers under co-operative sector may be attributed to such results. Niraj (2004) & Ayub (2005) also recorded the effect of parity to be significant on cost of milk production in case of Desi cows, Crossbred cows and Buffaloes in and around Darbhanga & Muzaffarpur (Bihar).

5.1 SUMMARY

This study pertained to a genetic analysis of crossbred cattle, local cattle and buffaloes in and around Hissar (Haryana). Since the study...

SUMMARY AND CONCLUSION

5. SUMMARY AND CONCLUSION

5.1 SUMMARY :

This study pertained to a genetic analysis of economic efficiency of cattle and buffaloes in and around Hajipur (Vaishali), Bihar through estimation of phenotypic parameters and magnitude of variation in different measures of production, reproduction and economic efficiencies, including cost of milk production, due to genetic and some of the non-genetic causes. The impact of dairy co-operative in terms of variation in economic performance of cattle and buffaloes was also assessed and finally a suitable package of dairy practices for economic milk production in the study area was suggested.

The study was conducted on altogether 456 animals out of which 230 were managed under co-operative and 226 under non-cooperative sector. In co-operative sector 53, 57, 50 and 70 milch animals belonged to Desi cows, HF crossbred cows, Jersey crossbred cows and Buffaloes while the corresponding numbers of the animals of different genetic constitutions in non-cooperative sector were 52, 55, 50 and 69. The experimental animals were maintained in 90 sampled respondent dairy units out of which 45 were under co-operative and 45 under non-cooperative sector. The khatals were grouped into three groups on the basis of number of milch animals they possessed and delineated as herds of sizes 2-4, 5-7 and $\geq$ 8 animals. To study the effect of diversity in genetic constitution of the animal in a group, the herds were classified into three types i.e. units having only cows, only buffaloes and cows as well as buffaloes together. Performance records of milch animals in first to fourth lactation and calved once during the period of this study were only included. On the basis of the sector adopted by farmers,

the unit were classified into two registered i.e. to milk co-operatives and not registered to milk cooperatives.

Lactation milk yield (kg) , Lactation length (days), peak yield (kg), Days to attain peak yield (days), Milk yield (kg) per day of lactation length and Milk yield (kg) per day of calving interval were the economic traits taken as the measures of production efficiency. Dry period and Calving interval were included as measures of reproduction efficiency. The cost of milk production reckoned in terms of "Net cost of milk produced by an animal for per day of her calving interval" was taken as measure of economic efficiency for the animals of different genetic groups.

Stratified random sampling with proportional allocation was adopted for selection of respondent units for detailed studies in this investigation. The data on various economic indicators were analysed according to Least squares analysis of variance utilizing appropriate mathematical model. DMR and C.D. tests were was utilized for pair-wise comparisons of the Least squares means.

The results of Least squares analysis revealed that the genetic group had significant influence on LMY, LL, PMY, DAPMY, MY/LL, MY/CI, DP, CI and CMP for animals managed under both the co-operative and non-cooperative sectors.

The herd-size did not have any significant influence on production, reproduction and economic traits under both the sectors except DP and CI which were significantly ($P \leq 0.05$) influenced by herd-effect in the case of animals under the non-cooperative sector.

The effect of herd-constitution did not have significant effect on production, reproduction and economic traits for animals under both the co-operative and non-cooperative sectors except LL, DAPMY and CI in the

case of non-cooperative sector, which were significantly influenced by herd-constitution-effect.

The parity effect was significant on production, reproduction and economic traits for animals under both the sectors except CI which was not significantly influenced by parity-effect in co-operative sector

In economic study, the Net cost of milk production in the animals of different genetic groups varied between 756.52±2.60 and 1010.83±1.93 paise/kg in co-operative sector, while in non-cooperative sector between, 820.68±5.08 and 1045.05±4.25 paise/kg. It was the lowest for HF crossbreds and highest for Buffaloes under both the sectors. The genetic group-wise as well as overall contributions of fixed and variable cost items to the Gross and Net cost of per unit milk production were also reckoned.

5.2 CONCLUSION :

On the basis of findings of this study it could be concluded that in the agro-climatic condition of Hajipur (Vaishali), the HF crossbred followed by Jersey crossbred and Graded buffaloes were the animals of choice for higher milk yield and peak milk yield as well as optimum lactation length and days to attain peak milk yield. However, Desi cows may also be maintained for conservation of local genetic resources. It could also be revealed that for profitable production, farmers should register their animals to the COMFED. Although the effect of Herd-size was statistically not significant on production traits but finding revealed that for commercial milk production, the herd of minimum 8 animals may be maintained. Farmers may maintain crossbred cattle alone or in combination with buffaloes. For profitable production animals in 1st - 3rd lactation should be preferred. For better reproduction efficiency smaller herds were found more suitable but for production efficiency minimum 8 milch animals would be optimum.

ahir, N.L. and Singh, P.K. (1994). Production and marketing decisions of milk producers of heavy rainfall zone of Gujarat. *Indian J. Dairy Sci.* 47(8):658-661.

Ahlier, F., T.C. and Das, B. (2003). studies on some production and reproduction traits in Holstein-Friesian cattle. Indian Vet. J. 80 : 451-454.

Ayub, A. (2005). M.V.Sc. Thesis entitled "Genetic studies on efficiency of milk production of cattle in an around Muzaffarpur (Bihar)" submitted to RAU, Pusa (Samastipur) Bihar.

Bajal, R.S. and Yadav, J.P. ..., economic analysis of buffalo owned and milk production ...

Bardhan, D., Srivastva, R.S.L. and Davas, V.P.S. (2004). An economic analysis of milk production from indigenous cow in Udham Singh Nagar district of Uttanchal. *Indian Dairyman* 56(2): 11-18.

Bardhan, D., Srivastva, R.S.L. and Davas, V.P.S. (2005) Economics of buffalo milk production in Tarai Area of Uttanchal. Indian J. Dairy Sci., March, April 58(2)

Barman, D.K., Sad..., A.N. and Bora, N.N. (1996) A study of milk production in Assam. *Indian J. Econ.* 48 : 117-23.

Chandra, A. and Agarwal, S.B. (2006) Constraints analysis in milk production in Farrukhabad district of U.P. *Indian J. Dairy Sci.* 58(5):310-313.

Deshmukh, K.B., Deshmukh, O.S. and Deshpande, S.S. (1995). Genetic studies on reproductive traits in Jersey, Sunwal and Jersey X Sahiwal

BIBLIOGRAPHY

Ahir, N.J. and Singh, P.K. (1994). Production and marketing decisions of milk producers of heavy rainfall zone of Gujarat. *Indian J. Dairy Sc.* **47**(8):658-662.

Akhter, F; T.C. and Das, B. (2003). studies on some production and reproduction traits in Holstein-Friesian cattle, Indian Vet. J. 80 : 453-454.

Ayub, A. (2005). M.V.Sc. Thesis entitled "Genetic studies on efficiency of milk production of cattle in an around Muzaffarpur (Bihar)" submitted to RAU, Pusa (Samastipur) Bihar.

Badal, P.S. and Dhaka, J.P. (1998). An analysis of feeding pattern and cost of milk production Gopalganj district in Bihar. *Indian J. Dairy Sc.* **51**(2):121-126.

Bardhan, D.; Srivastava R.S.L. and Dabas, Y.P.S. (2004). An economic analysis of milk production from indigenous cow in Udham Singh Nagar district of Uttranchal. *Indian Dairyman.* **56**(3):31-38.

Bardhan, D.; Srivastava, R.S.L. and Davas, Y.P.S. (2005) Economics of buffalo milk production in Tarai Area of Uttaranchal Indian J. Dairy Sci., March, April **58**(2).

Baruah, D.K. Sarker, A.B. and Bora, N.N. (1996). A study of milk production in Assam. *Indian J. Dairy Sc.* **49**(1):17-23.

Chandra, A. and Agarwal, S.B. (2000). Cost and return from milk production in Farrukhabad district of U.P. *Indian J. Dairy Sc.* **53**(4):310-316.

Chaudhary, K.B.; Deshmukh, D.P. and Despande, K.S. (1995). Genetic studies on reproductive traits in Jersey, Sahiwal and Jersey X Sahiwal crossbreds. *Indian J. Dairy Sc.* **48**(2):172-173.

Deshmukh, D.P.; Chaudhary, K.B. and Deshpande, K.S. (1995). Genetic studies on some economic traits of Jersey, Sahiwal and Jersey X Sahiwal crossbred cows. *Indian J. Dairy Sc.* **48**(2):129-133.

Dev Raj and Gupta, J.N. (1994). An economic analysis of milk production in Churu district in Rajasthan. *Indian J. Dairy Sc.* **47**(4):294-301.

Dutt, T. and Bhushan, B (2001). Peak yield and its association with production and reproduction traits in crossbreds. *Indian J. Anim. Sc.* **71**(9):872-873.

Harvey, W.R. (1966). Least squares analysis of data with unequal subclass members, USDA, ARS, H-4.

Hemalatha, B.; Prashanth, V.R.N and Reddy, Y.V.R. (2003). Economics of milk production of different breeds of bovines in Ahmednagar district of Mahrashtra. *Indian Dairyman.* **55**(10)-41-44.

Indian Dairy-Perspective 2010 (2004). Paper presented at state level seminar on meeting challenges in dairy development through credit (Nabard) held on 27th Feb. 2004 at Patna Dairy Project, Phulwarisharif.: 118-120.

Jahagir, A.; Akteruzzaman, M.; Rahman, A. and Ahmad, Z. (1994). Comparative performance of local and crossbred cows in Bangladesh. *Indian J. Dairy Sc.* **47**(2):112-117.

Kalra, K.K.; Singh, R. and Chauhan, A.K. (1994). Comparative economics of milk production in rural and Urban areas of Haryana. *Indian Dairyman.* **46**(2):751-756.

Kalra. K.K.; Singh, R and Chauhan, A.K. (1995). Economic analysis of milk production and disposal in rural areas of Haryana. *Indian J. Dairy Sc.* **48**(9):546-550.

Kramer, C.Y. (1957) Extension of multiple range tests to group corrected adjusted means, Biometrics, 13; 13-18.

Niraj, K. (2004). M.V.Sc. Thesis entitled "Genetic analysis of milk production efficiency in cattle and buffaloes in and around Darbhanga, (Bihar)" submitted to RAU, Pusa (Samastipur) Bihar.

Kumar, P. and Balishter (1996). Economics of crossbred and Murrah buffalo-A study in Firozabad district in U.P. *Indian J. Dairy* **49**(6):371-375.

Kumar, R. (2005). M.V.Sc. Thesis entitled "Studies on genetic and non-genetic factors effecting milk production efficiency of cattle in and around Patna (Bihar)" submitted to RAU, Pusa (Samastipur) Bihar.

Pathodiya,O.P.; Jain, L.S.; Tailor, S.P.; Singh, Bachcha (1998). Effect of period of calving on different trait in Surati buffalo. *Indian J. Dairy Sc.* **25**(3)1998.

Prasad, V.S.; G.N.; Satyanarayana, A.; Rao, M.R. and Jayaramkrishna, V(1991) Performance of indigenous and crossbred cows under village conditions in Chittoor District of Andhrapradesh. *Indian J. Dairy Sci*, **44**(2) 194-195.

Priya Raj (2002). M.V.Sc. Thesis entitled "Studies on milk production and its economics in crossbred cows under farmer's managemental conditions of Patna (Bihar)" submitted to RAU, Pusa (Samastipur) Bihar.

Raju, S.S.; Anantharam, K. and Sampath, K.T. (2005) cost of milk production institute - village linkage programme in Bangalore district. *Indian J. Dairy Science* Sept.' - Oct. 58(5).

Rao, B.D. and Singh, C.B. (1995). Impact of O.F.P. on economics of the buffaloes milk production in Guntur district Andhra Pradesh. *Indian Dairyman*. 7(4):47-50.

Rao, S.J.; Rao, B.V.R. and Rao, G.N. (2000). Performance of crossbred cows and buffaloes under village conditions of Vishakhapattnam district of Andhra Pradesh. *Indian J. Dairy Sc.* **53**(3):222-226.

Rao, S.J.; Rao, B.V.R., Rao and G.N. (2000). Performance of crossbred cows & buffaloes under MPCS and Non-MPCS in Vishakhapattnam, *Indian J. Dairy Sc.,* **53**(3).

Sangu, K.P.S. (1995). Comparative economics of milk production for buffalo, desi cow and crossbred cow village and town conditions. *Indian J. Dairy Sc.* **48**(4):266-270.

Sasidhar, P.V. K.; Rao, B.S. and Kumar, R.V. Suresh (2000). Production trait in Murrah buffalo in field condition in Andhra pradesh *Indian J. Dairy Sc.,* May-June 239-240.

Shah, D and Sharma, K.N.S. (1994[a]). Economics of milk production in Bulandshahar district of U.P. *Indian J. Dairy Sc.* **47**(12):937-944.

Shah, D. (2000). An enquiry into producers member perception towards working of milk co-operatives in Maharastra. Indian Dairyman, **56**(2), 31-41.

Shah, D. and Sharma, K.N.S. (1994[b]). Determinants of profit in milk production enterprise. *Indian J. Dairy Sc.* **47**(12):1016-1021.

Shah, Deepak; Jain D.K. and Sharma. K.N.S. (1996). Impact of Dairy co-operative on marketing pattern of milk in Bulandshahr district Indian dairyman June, 37-41.

Sharma, V.P. and Singh, R.V. (1994[a]). An economic analysis of milk production by different breeds of milch animals in Humid-Temprate zone of H.P. *Indian J. Dairy Sc.* **47**(9):749-755.

Shiyani, R.L. and Singh, R.V. (1995). Economic analysis milk production by different breeds of milch animals in Humid-Temperate zone of H.P. *Indian J. Dairy Sc.* **48**(1):21-26.

Shrivastava, A.K.; Singh, C.S.P. (2000). Factors effecting efficiency of milk production in Friesian x Zebu crossbred in un-organized herds. *Indian Vet. Med. J.* **24**(1):11-14.

Shrivastava, A.K.; Singh, C.S.P.; and Verma, S.K (1998). A study on the effects of various factors on production traits in Zebu x Friesian crossbred cows maintained under un-organized farming system. *Indian Vet.Med. J.* **22**(1):19-22.

Shrivastava, A.K.; Singh, C.S.P.; Verma; S.K. and Singh, R.A. (1996). Effect of various factors on dry-period and calving-interval in Zebu x Friesian crossbred cows maintained under framers managemental conditions. *Indian Vet. Med. J.* **20**(3):202-206.

Singh, S. K. and Nagarcenkar, R. (2000). Genetic and phenotypic relationship among growth and production traits in sahiwal herd. Indian Vet. Med. J., 24(1): 25-28.

Singh N.P.; Yadav, M.C. Kushwah B.P. and Sachan, C.B. (2006). factors affecting milk production efficiency traits in Holstein x Sahiwal maintained in Militray farm Merrut & Agra *Indian J. Dairy Sc.*, **59**(3).

Singh, K.; Khanna, A.S. and Kanaudia, A.S. (2000). Factor effecting lactation performance and persistency in crossbred cattle. *Indian J. Dairy Sc.* **53**(5):354-360.

Singh, S.R. (1995). Varaiation in some performance traits in Friesian x Zebu cows. *Indian J. Dairy Sc.* **48**(1):27-30.

Snedecor, G.W. and Cochran, W.G. (1968). Statistical methods. 6th Edn., Iowa State Univ. Press, Ames, U.S.A.

Srivastava, D.K.; Verma, D.N. and Singh, S.P. (2001). Effect of shower on milk production and its composition in crossbred cows. *Indian Vet. Med. J.* **25**(1):81-92.

Thakur, Y.P.; Singh, P.K. and Singh, B.P. (2000). Phenotypic time trend for milk yield and production efficiencies traits in Jersey crossbreds. *Indian Vet. Med. J.* **24**(20):147-148.

Tomar, A.K.S.; Joshi; Sidhu, N.S. and Bisht., G.S. (1998). Crossbreeding effects on performance traits of Holstein x Sahiwal half-bred in Indian Tarai belt. *Indian Vet. Med. J.* **22**(1):23-26.

Venkatasubramanian, V. and Fulzele, RM.(19996). Factors affecting the production performance of crossbred and indigenous cattle under field conditions. *Indian Dairy Sc.* **49**(5):301-306.

Verma, O.P. and Kherde, R.L. (1995). Productive and reproductive performance of buffaloes in upper Gangetic plain. *Indian J. Dairy Sci.* **48**(5):330-335.

Verma, S.R. and Sharma, F.L. (2003). Impact of dairy union in the adoption of improved Animal husbandry practices in Rajasthan. Indian Dairyman, **55**(1), 57-61.