PERFORMANCE OF SOVIET CHINCHILLA RABBIT ON DIET SUPPLEMENTED WITH INDIAN CORAL PLANT (*ERYTHRINA STRICTA*)

Thesis

submitted to

NAGALAND UNIVERSITY

in partial fulfillment of requirements for the Degree

of

Doctor of Philosophy

in

Livestock Production and Management

by

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2021

DECLARATION

I, Adelene Basaiawmoit, hereby declare that the subject matter of this thesis is the record of work done by me, that the contents of this thesis did not form the basis of the award of any previous degree to me or to the best of my knowledge to anybody else, and that the thesis had not been submitted by me for any research degree in any other university/institute.

This is being submitted to Nagaland University for the degree of Doctor of Philosophy (Agriculture) in Livestock Production and Management.

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CERTIFICATE – I

This is to certify that the thesis entitled **"Performance of Soviet Chinchilla rabbit on diet supplemented with Indian coral plant (*Erythrina stricta*)"** submitted to Nagaland University in partial fulfillment of the requirements for the award of degree of Doctor of Philosophy (Agriculture) in Livestock Production and Management is the record of research work carried out by Miss Adelene Basaiawmoit Registration No. Ph.D/LPM/00122 under my personal supervision and guidance.

The result of the investigation reported in the thesis have not been submitted for any other degree or diploma. The assistance of all kinds received by the student has been duly acknowledged.

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CERTIFICATE – II

VIVA VOCE ON THESIS OF DOCTOR OF PHILOSOPHY IN LIVESTOCK PRODUCTION AND MANAGEMENT

This is to certify that the thesis entitled "**Performance of Soviet Chinchilla rabbit on diet supplemented with Indian coral plant (*Erythrina stricta*)"** submitted by Ms. Adelene Basaiawmoit, Admission No. 232/17 Registration No. Ph.D/LPM/00122 to the NAGALAND UNIVERSITY in partial fulfillment of the requirements for the award of degree of Doctor of Philosophy (Agriculture) in Livestock Production and Management has been examined by the Advisory Board and External examiner on …….....

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ACKNOWLEDGEMENTS

Completion of this doctoral degree would not have been possible without the result of countless experiences I had encountered at various phases of my research; for their kind support whenever I approached them and I do hereby want to acknowledge all of them.

First and foremost, I would like to acknowledge my research guide and supervisor **Dr. M. Catherine Rutsa**, Associate Professor for introducing me to this field of work and for her dedicated help, moral advice, consistent encouragement and unconditional support throughout my entire Ph.D. course. She had made herself available to clarify my doubts despite her hectic schedules and I consider it as a great opportunity to have pursued my research programme under her guidance. Her personal helps and friendly nature made me feel at ease working with her and I could always look back on her for her assistance during my course. She and her **family members** were there for me with their supporting hands whenever I needed it the most.

Thanking **Prof. V.K. Vidyarthi**, the then former Head of Department and **Prof. Nizamuddin**, the present Head of Department of Livestock Production and Management for having consented to the experimental research; also for their guidance and moral support throughout the entire course work. I am deeply grateful to my research co-advisor and rabbit farm in-charge **Dr. Razouneinuo Zuyie**, Associate Professor for her constant support, guidance, encouragement, cooperation and allowing me to work and use the facilities available at the rabbit farm.

A word of appreciation expressed to **Prof. Jitendra Saharia**, external examiner from Assam Agricultural University, Jorhat; **Dr. N. Savino**, Associate Professor; **Prof. J. Longkumer**; **Prof. R. Nakhro** and **Dr. A. K. Sahu**, former Assistant Professor for their insightful suggestions, encouragement and guiding me with my work. They all have played a major role to rectify and polishing my research writing skills. To the **University's farm attendants and staffs** of the department for their immense help and support throughout my period of data recording. I am indebted to

all **my course teachers** because of their teaching and kindness I felt at different stages of semesters.

I would like to extend my gratitude to **Prof. T. Lanusosang**, the then former Pro-Vice Chancellor; **Prof. M. Aleminla Ao**, the present Pro-Vice Chancellor; **Prof. A. K. Makar**, the then former Dean and **Prof. Akali Sema**, the present Dean of School of Agricultural Sciences and Rural Development, for the permission to use the facilities to carry out the research work at the University. I thank the **School Board** for their meaningful suggestions at various phases of the programme. I am also grateful to the administration as well as library staffs for their academic cooperation. My hearty appreciation to **Mr. Yanpothung Murry** for always helping out academically without hesitation despite of his busy administrative schedules.

My special regards to **Kebengi**, **Thejavinuo**, **Lian** and **Emidaka** for a helping hand despite of their busy schedules; they were willing to extend their warmth and invaluable contribution without any hesitation. I would also like to thank all **my fellow batch mates** for always standing by my side and sharing great relationships as compassionate friends. I will always cherish those memorable moments and remember their timely help and support.

I owe my hearty gratitude towards **my parents and family members** as my consistent support till the completion of my doctoral programme and understanding my goals; their unconditional love, patience and sacrifice have always been my strength and will remain my inspiration throughout my life.

Place: Medziphema, Nagaland (Adelene Basaiawmoit)

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LIST OF ABBREVIATIONS

AD	-	*anno domini*
ADG	-	Average Daily Gain
ANOVA	-	Analysis of Variance
ARBA	-	American Rabbit Breeders Association
BC	-	before Christ
CP	-	crude protein
CRD	-	Completely Randomnized Design
CSWRI	-	Central Sheep and Wool Research Institute
DM	-	dry matter
EAA	-	essential amino acids
et al.	-	and all
FB	-	Flemish Black
FCE	-	Feed Conversion Efficiency
GG	-	Grey Giant
HSD	-	Honestly Significant Difference
i.e.	-	that is
ISO	-	International Organization for Standardization
NS	-	Non significant
NZW	-	New Zealand White
SC	-	Soviet Chinchilla
spp.	-	species
TEC	-	tonnes equivalent carcasses
USDA	-	United States Department of Agriculture
viz.	-	namely

ABSTRACT

The present study was conducted with an aim to study the beneficial effects of supplementing Indian coral plant (*Erythrina stricta*) on the productive and reproductive performance of Soviet Chinchilla rabbit. A total of twenty four weaned Soviet Chinchilla bunnies were selected and divided into four dietary treatment groups supplemented with Indian coral plant (*Erythrina stricta*) at levels of 0 per cent, 33 per cent, 66 per cent and 100 per cent. Statistical analysis indicated 66 per cent and 100 per cent supplemented groups to have improved performance ($P \leq 0.05$) in average body weight, average daily gain (ADG) and average daily feed intake having records of 2.62 kg and 2.51 kg; 19.94 g and 18.88 g; 131.86 g and 126.38 g, respectively. The average feed conversion efficiency (FCE) recorded in the treated groups ($P \geq 0.05$) was 3.59, 3.52, 3.46 and 3.54, respectively. The mean age of doe at first mating and age of doe at first kindling recorded for T_1, T_2, T_3 and T_4 groups ($P \geq 0.05$) was 180.20 days, 180.20 days, 179.40 days and 179.40 days and 211.20 days, 210.80 days, 209.80 days and 209.60 days, respectively. T_3 and T_4 groups recorded higher ($P \leq 0.05$) weight of doe at first mating and weight of doe at first kindling as 2.59 kg and 2.51 kg; 2.72 kg and 2.61 kg, respectively. Number of litter size at birth was recorded to be statistically significant ($P \leq 0.05$) with larger size of 6.76 and 6.72 reported in 66 per cent and 100 per cent supplemented groups. The mean litter weight at birth for T_1, T_2, T_3 and T_4 groups ($P \geq 0.05$) was recorded as 49.62 g, 49.41 g, 47.32 g and 46.26 g, respectively. Average number of litter size at weaning ($P \geq 0.05$) was recorded as 5.46, 5.86, 6.40 and 6.52, respectively. Statistical analysis indicated significant variation ($P \leq 0.05$) in mean litter weight at weaning with heavier litter weight of 496.46 g and 478.87 g recorded in T_4 and T_3 groups, respectively. Inter-kindling period ($P \geq 0.05$) recorded for T_1, T_2, T_3 and T_4

groups was 79.10 days, 78.65 days, 78.00 days and 78.50 days, respectively. Average number of crops per doe per year ($P \geq 0.05$) was recorded as 4.20, 3.80, 5.00 and 5.00, respectively. No cases of morbidity and mortality were reported up to six months of age giving 100 per cent liveability. Mortality rate recorded during the reproductive period in the treatment groups was 5.97 per cent, 3.96 per cent, 3.24 per cent and 2.85 per cent, respectively with liveability of 94.03 per cent, 96.04 per cent, 96.76 per cent and 97.15 per cent, respectively. The respondents reported that on inclusion of the Indian coral plant (*Erythrina stricta*); there had been better feed intake, improvement in the growth and reproductive performance and reduced health problems. The Indian coral plant (*Erythrina stricta*) has potential as an alternative feed resource that could improve the performance of rabbits in the farming community. The plant is therefore recommended to the farmers for utilization as a supplement at an inclusion of 66 per cent along with mixtures of locally available forages up to 100 per cent for optimum sustainable rabbit production.

Keywords: Productive performance, reproductive performance, Soviet Chinchilla rabbits, Indian coral plant (*Erythrina stricta*).

CHAPTER I

INTRODUCTION

INTRODUCTION

The European wild rabbit (*Oryctolagus cuniculus)* belonging to the family Leporidae and order Legomorpha was known to have existed since 1,100 B.C. as reported by Zoccarato (2008) where the Phoenician sailors who settled in Spain provided testimony about the rabbit, named the area “I-Sephan-im” (Land of Rabbits), subsequently latinized as “Hispania” and began trading rabbits from Spain towards the entire Mediterranean coastline and the Greek Aristotle raved about the importance of rabbit meat. Rabbits were also discovered in North America and Southern Europe and became prominent as a game animal for the Roman military soldiers. They began to rear rabbits in special enclosures or leporaria for economic interest, restricting the area of extending to the Iberian Peninsula. New born foetal rabbits known as Laurices were classified as fish in 600 A.D. by Pope Gregory I (The American Livestock Breeds Conservancy, 2005) and were allowed for burgeoning of cuniculture in monasteries and consumption as a table delicacy by the monks during the season of Lent. British colonials were also responsible for the new wave of diffusion of rabbits to different islands and continents, primarily raising rabbits aboard the ships as food for the crews.

During sixteenth century, wide varieties of breeds were identified and grouped as wild rabbit, semi-wild or "warren" and domesticated rabbit. Controlled breeding escalated across different areas of France, Italy, Flanders, England and rabbits were reared in hutches by poor farmers in the backyard nearing nineteenth century along with poultry for family income as well as meat production in western European countries (Lebas *et al.*, 1997). It was during this century that the fur procured from Argenté de Champagne and the wool from Angora breed was utilized as by products of rabbits. New Zealand White and Californian rabbits were also introduced for meat purposes.

The American Rabbit Breeders Association (ARBA) recognised forty eight unique breeds and one hundred ninety five varieties of rabbits (Rabbit breeds and varieties, 2016) with different coat colours and shades commonly bred for meat, wool, fur and pelt. Breeds like New Zealand White (NZW), Soviet Chinchilla (SC), Flemish Black (FB) and Grey Giant (GG) are suitable for meat purposes while Angora and Rex rabbits are reared for wool and fur, respectively. Rabbits are kept as pet animals, raised in cages or hutches for sustenance and used extensively as laboratory animals for biomedical research works. Intensive rabbit farming became prominent in every country during the twentieth century leaving an estimated record of 1,482,441 tonnes equivalent carcasses (TEC) in World rabbit meat production with Asia as the leading producer followed by Europe, Africa and America (Trocino *et al.*, 2019). China and Korea became the major countries in rabbit production both contributing 73.3 per cent to global volume in 2017 followed by Spain, Egypt, Italy, France and Germany.

Rabbits were first naturalized in India by the British during 1940's (Singh, 1987) commercially bred for meat and wool production in 1977 by Central Sheep and Wool Research Institute (CSWRI), Avikanagar, Rajasthan (Das *et al*., 2005), and by 1985 CSWRI initiated rabbit farming in the North Eastern region. The North Eastern region has been categorized as the highest meat consuming zone in the country because of diversity in food habits and the rabbit being cuniculture type of animal was found suitable for the North Eastern Hill region where people could rear as well as hunt for rabbit meat. Rabbit rearing had picked up in parts of Meghalaya, Manipur, Nagaland and Sikkim. The All India 20th Livestock Census (2019) recorded rabbit population of the country as 549,941 with Kerala as the leading state contributing to maximum number of rabbit production in the country holding a record of 92,693 followed by West Bengal, Nagaland, Uttar Pradesh, Bihar and Assam

with a total number of 76,131; 57,729; 35,704; 33,383 and 30,337, respectively.

Rabbit meat is soft and tender suitable for young children as well as elderly and aged people. Rabbit meat has no religious restriction for consumption. A rabbit can produce ten to fifteen times of its own body weight as recorded by United States Department of Agriculture (USDA, 1996) and is termed as biological refrigerator due to the ability of producing one kilogram of meat for a family of six in a single meal. Rabbit meat is considered as white meat and offered good dietary nutritional properties as per Hernández and Zotte (2010) with 22.4 per cent protein content concentrated in the loin which is the leanest cut of meat in the rabbit carcass. Rabbit meat has moderate energy values ranging from 600 to 900 kilojoules per 100 g including high levels of phosphorous and essential amino acids (EAA) giving rabbit meat their increased biological significance as reported by Zotte (2004). Furthermore, rabbit meat does not contain uric acid, has low purine, iron and sodium content as well as lesser levels of cholesterol than any other meat (Bini *et al.*, 1992). These are the plus points for the rabbit meat that is graded as suitable for patients suffering from hypertension and other post operative diet.

Rabbits are small in body size with adults weighing three to four kilogram body weight and are reared in the backyard either in cage or hutch system of housing. The housing system is simple and can use locally available materials like bamboo or wooden slats with less capital investment and space requirement. Proper housing protects the rabbits from inclement weather like heat, cold and rain including predators like cats, dogs, rats, snakes, etc. Rabbit faecal pellet contains good sources of nitrogen, phosphorus and potassium fit for vermin-composting as well as organic fertilizer for kitchen garden and in fish ponds. Having good growth rate the fryer rabbit is ready for table purpose

at three to four months of age. Rabbit is a potential micro livestock suited for backyard farming for small and marginal farmers with limited resources. Rabbit integrates well with other farming system and can also improve the rural livelihood.

Production and reproduction of rabbits gained momentous during the twentieth century owing to their rapid growth rate and high reproduction traits as compared to other livestock animals. Rabbits are docile animals, prolific in nature with a short gestation period of twenty nine to thirty two days. A healthy female doe could produce three to five litters per year with an average litter size of six bunnies per litter (Rajeshwari *et al*., 2011). Rabbits reach sexual maturity by five to six months of age and should acquire 80 to 85 per cent of the matured body weight at the time of mating (Dhandar, 1997). A female rabbit could be considered to be in heat when presenting a characteristic posture called lordosis (Lebas *et al.*, 1997) with the back arched downwards and raised hindquarters showing receptivity for copulation. Regular oestrus cycle is not observed in rabbit doe as seen in other mammals. Ovulation is induced by the stimuli of mounting or mating and shedding of ova occurs six to ten hours after successful breeding. This induced ovulation has a positive attribute for rabbit farmers where breeding can be done at any time as per the convenient and plan of the farmer.

Rabbits are simple stomach and herbivores in food habit. They are able to utilize the nutrients from undigested, unabsorbed feed materials for maintenance and production. Kitchen and garden wastes, flower and tree leaves, aquatic weeds and grain milling by-products which are non competitive to human are used by the rabbits round the year. Rabbits can utilize high fibre diets efficiently because of their unique behaviour called caecotrophy *i.e.* consumption of soft faeces pellets known as caecotrophs or night droppings as

a process of hindgut fermentation to assimilate essential nutrients mostly B vitamins from the feeds.

Growth and reproductive performance of rabbits depend largely on their ability to digest feed effectively. During pregnancy, 20 per cent of absorbed nitrogen is retained for foetal growth and doe body tissue accretion while milk yield during lactation is determined by protein level (Partridge and Allan, 1982). This has stimulated the search for alternative protein sources where leguminous tree forages have been highlighted as low cost locally available feeds for the rabbits in smallholder farming system. When given free choice forage feeding, rabbits exhibited their preferences to certain plants like *Erythrina stricta* also known as Corky coral or Indian coral tree belonging to Fabaceae family.

The Indian coral plant (*Erythrina stricta)* is a large spreading deciduous tree which is 15 to 20 m tall with light grey bark, whitish prickles and dense brilliant red spike-like cluster flowers giving the name of the tree as Tiger Claw. The plant is a useful agro-forestry species containing nitrogen fixing bacteria that promotes soil enrichment. Coral plants can be easily propagated from seeds or cuttings, grown under wide range of soil conditions and also a good fodder for green manuring. More than hundred species were identified worldwide in countries like India, Nepal, Burma, Thailand, Vietnam and China (Parveen and Jayshree, 2015). The coral tree contains 16 to 21 per cent crude protein with digestibility ranging from 45 to 60 per cent and is commonly cultivated as wind break, live fencing posts or shade tree for other crops. Regular pruning maximizes foliage production of the plant and can serve as an excellent fodder quality for livestock animals (Whistler and Elevitch, 2006) especially for rabbits.

The extracts from the Indian coral plant are effectively utilized in traditional medicine as laxative, diuretic, expectorant, dewormer and to

stimulate lactation. The coral plant seems to be an interesting tree species that grows naturally in abundance in the North Eastern region of the country. Over the years, research attempts had been carried out to discover the beneficial uses of the plant as an alternate feed resource for livestock production. The foliage can be advocated for economical feeding in rabbits and reduce the dependency on external inputs. However, there is paucity of published research works on the feeding effects of the coral plant on growth and reproductive performance of rabbits. Thus, it is imperative to explore the potential of the Indian coral plant that will help to generate information for better utilization and recommendation as cheap protein supplement for the benefit of rabbit farming community and livelihood upliftment. Therefore, the present study was conducted with the following objectives:

1. To study the productive performance of Soviet Chinchilla on diet supplemented with Indian coral plant (*Erythrina stricta*).
2. To study the reproductive performance of Soviet Chinchilla on diet supplemented with Indian coral plant (*Erythrina stricta*).
3. To study the morbidity and mortality of Soviet Chinchilla on diet supplemented with Indian coral plant (*Erythrina stricta*).
4. To study the performance of Soviet Chinchilla on diet supplemented with Indian coral plant (*Erythrina stricta*) at farmers' field.

CHAPTER II

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Review of literature collected related to the selected topic as per the objectives is presented under the following sub headings:

2.0. Indian coral plant (*Erythrina stricta*) as animal fodder

Raharjo (1987) conducted a feeding trial to evaluate the palatability of a number of tropical Indonesian forages, grasses and legumes and he reported that *Leucaena leucocephala*, *Erythrina lithosperma* and *Ipomea batatas* vines were palatable feeds for rabbits whereas *Setaria spp*., *Brachiaria spp*., *Pennissetum purpureum*, *Musa spp*. and *Carica papaya* leaves were poorly accepted and he concluded that rabbits preferred legumes over grasses and agricultural by-products.

The foliage of tree legumes *viz. Leucaena leucocephala*, *Gliricidia sepium*, *Sesbania grandiflora*, *Erythrina spp.* and *Calliandra calothyrsus* fed to ruminants complemented low quality native forages and crop residues during the dry season as reported by Aregheore (2000).

In an experimental trial conducted by Aregheore (2004) to find out the intake and digestibility of *Ischaemum aristatam* and *Erythrina variegata* combination by crossbred anglo-nubian goats, *Erythrina variegata* had been reported to have high forage quality that could effectively serve as cheap source of protein for ruminant livestock.

A feeding trial where goats were offered leaves of *Erythrina variegata*, *Ficus racemosa*, *Artocarpus heterophyllus*, *Zizipus jujube*, *Ceiba pentandra* and *Mangifera indica*, Kongmanila *et al.* (2008b) reported preference for *Erythrina variegata* which indicated the plant palatability to the goats, as they

are selective feeders and are known to eat from the most nutritious and palatable feeds.

Erythrina berteroana plants as per Orwa *et al.* (2009) were planted as nitrogen fixing trees to improve the soil and maintain its fertility; in addition the foliage and stem were utilized as forage and foliage for cattle, goats and rabbits.

Evaluating the nutritional composition of selected fodder trees and shrubs in Eastern Ethiopia, Debela *et al.* (2017) reported higher nutritional value as well as crude protein content of *Acacia brevispica* and *Erythrina abyssinica* and recommended as a species with high potential animal feed resources.

2.1. Productive performance

2.1.1. Body weight and Average daily gain (ADG) in body weight

Benavides (1986) reported that the supplementation of *Pennisetum purpureum* and green banana fruits with increasing amounts of *Erythrina poeppigiana*, *Morus spp.* and *Malvabiscus arborescens* foliages improved milk yields and daily gains in goats and lambs, respectively.

Substituting soyabean meal a traditional protein source Pineda (1986) recommended the addition of increasing levels of *Erythrina poeppigiana* foliage to dairy heifers weighing 48 kg live weight with good result.

An average daily growth rate of 11.50 g in New Zealand White rabbits weighing 1244 g was recorded by Solarte (1989) in a study trial allowing free access to *Erythrina glauca* along with sugarcane juice for fifty six days.

An experimental study on “The potential value of *Leucaena leucocephala*, *Erythrina spp.*, *Calliandra calothyrsus*, *Sesbania grandiflora*, *Gliricidia sepium*, *Spondias mombin*, bananas or plantain and *Mangifera*

indica" carried out by Devendra (1990) reported that the utilization of the feeds as supplements consistently increased live weight gain or milk production in ruminant livestock.

Pezo *et al.* (1992) reported that *Erythrina* foliage was less effective as a protein supplement in comparison to traditional protein supplements such as soybean meal or fish meal in improving the milk production or weight gains in lactating cows, calves, heifers, young bulls, lactating goats, kids and lambs.

Supplementing a diet of *Pennisetum purpureum* with *Erythrina abyssinica* foliage at levels of 0 g, 500 g, 1000 g per head per day resulted in linear increase ($P<0.01$) in live weight gains of stall-fed sheep and goats as reported by Larbi *et al.* (1993), they recommended the utilization of *Erythrina abyssinica* as cheap protein supplement to replace low quality diets during dry seasons for poor farmers.

The effects of feeding *Erythrina berteroana* as a grazing supplement and diet supplementation with green banana fruits on cattle productivity were evaluated by Ibrahim *et al.* (2005) and recorded an Average daily live weight gain of 21 per cent to 26 per cent higher with two hours daily browsing of *Erythrina berteroana* than those offered only grazing pasture.

A study conducted by Seneviratne *et al.* (2006) to evaluate the effect of feeding *Erythrina indica* on growth and carcass quality of New Zealand White rabbits reported an Average daily gain of 10.10 g and 6.58 g when coconut poonac was replaced with 50 per cent and 100 per cent *Erythrina* leaf meal, respectively.

Allard (2010) explored the potential use of *Erythrina variegata* as feeds for goat production in Laos and reported that the tree fodder could be utilized as a feed for promoting growth in goats during the dry season.

In an experimental trial to evaluate the effect of feeding varying levels of foliage from *Erythrina variegata* on the performance of growing goats, Kongmanila *et al.* (2012) reported an Average daily gain (ADG) of 51 to 63 g when 60 per cent of crude protein diet was replaced with crude protein from *Erythrina variegata* foliage with no signs of negative effect on growth rate in goats.

Yinnesu and Nurfeta (2012) conducted a study trial to evaluate replacing dried *Erythrina brucei* foliage at levels of 0 per cent, 33 per cent, 67 per cent and 100 per cent for cotton seed meal (CSM) on growth performance and carcass characteristics of twenty five yearling buck goats weighing an average of 15.8 kg. They reported higher weight gain in goats fed with cotton seed meal supplemented with *Erythrina brucei* as compared those fed with only cotton seed meal and concluded that *Erythrina brucei* could be supplemented with cotton seed meal under small holder production systems.

Mohamed and Abeyrathne (2015) carried out an experimental feeding trial to study the effect of supplementing tropical forages as alternative protein sources on growth performance of cross bred weaned rabbits irrespective of sex and recorded a significant daily weight gain of 19.06 g when 70 per cent layer pellet was added with 20 per cent *Erythrina indica* and 10 per cent *Panicum maximum*.

The growth performance of New Zealand White rabbits aged six to seven weeks was evaluated by Pasupathi *et al.* (2015) fed with extruded feed varieties of tree fodders using 15 parts, 17 parts, 25 parts and 15 parts of *Desmanthus virgatus*, *Leucaena leucocephala*, *Erythrina indica* and *Artocarpus heterophyllus* and reported an overall Average daily gain of 14.44 g, 12.51 g, 14.77 g and 13.25 g in the respective treatment groups.

An eight weeks trial was carried out by Pasupathi *et al.* (2017) to assess the growth performance of seven to nine weeks old New Zealand White rabbits

on tree forage as green fodder. The experimental diet provided was 50 per cent concentrate feed with 50 per cent tree leaves *viz. Desmanthus virgatus*, *Leucaena leucocephala*, *Erythrina indica* and *Artocarpus heterophyllus*. The overall Average daily gain (ADG) recorded in T_1, T_2, T_3 and T_4 groups was 15.17 g, 11.25 g, 15.71 g and 13.39 g, respectively with *Erythrina indica* reported to have better growth performance as compared to other tree forages.

An experimental trial conducted by Laiño *et al.* (2018) to evaluate the potential of including tropical forages an alternative feeds in thirty five days old New Zealand White male rabbits weighing 475.47 g recorded an average daily gain of 23.55 g when *Erythrina poeppigiana* foliage was fed *ad libitum* along with 50 g of commercial concentrate feed.

2.1.2. Feed intake and feed conversion efficiency (FCE)

Solarte (1989) recorded an average foliage intake of 214 g per day in New Zealand White rabbits when given free access to *Erythrina glauca* along with sugarcane juice and reported that the rate of feed intake tripled showing an increase from 50 per cent to 65 per cent as the trial progressed which could be because of the palatability of the *Erythrina* foliage.

Evaluating the potential of *Erythrina abyssinica* on intake, digestibility and growth rates for stall-fed goats and sheep, Larbi *et al.* (1993) reported reduced intake of *Pennisetum purpureum* when the animals were offered a basal diet of *Pennisetum purpureum* with *Erythrina abyssinica* foliage at increasing levels of 0 g, 500 g, 1000 g per head per day.

An organic matter digestibility of about 78 per cent with better feed conversion efficiency and a high daily weight of 33.3 g per day were reported by Kibria *et al.* (1994) when *Erythrina variegata* leaves were compared to other fodder leaves as goat feed.

Aregheore (2004) reported low forage intake of 100 per cent *Erythrina variegata* treatment diet, with no significant differences ($P \geq 0.05$) among 100 per cent *Ischaemum aristatum* group and the different combination groups of *Ischaemum aristatum* and *Erythrina variegata* indicating that *Erythrina variegata* alone would not promote good live weight gain but in combination with *Ischaemum aristatum* a high intake could be achieved.

The crude protein requirement for goats weighing 15 kg could be fulfilled by the consumption of *Erythrina variegata*, *Artocarpus heterophyllus* and *Ceiba pentandra* foliages according to Mandal *et al.* (2005) giving an Average daily gain of 75 g.

Foliages from *Acacia mangium*, *Manihot esculenta*, *Erythrina variegata*, *Flemingia macrophylla*, *Gliricidia sepium*, *Artocarpus heterophyllus*, *Leucaena leucocephala* and *Ipomoea aquatica* when offered as sole feeds to different farming systems of Asia and the Pacific region Van *et al.* (2005) reported a high feed intake, better digestibility and positive nitrogen (N) balance in small ruminants.

A feeding trial conducted by Seneviratne *et al.* (2006) to study the effect on growth and carcass quality of New Zealand White rabbits by replacing coconut poonac with *Erythrina* leaf meal at 50 per cent and 100 per cent level and reported an average daily feed intake of 69.98 g and 75.78 g, respectively.

Kongmanila and Ledin (2009) reported that the foliage intake of *Erythrina variegata*, *Ficus racemosa, Artocarpus heterophyllus, Zizipus jujube, Ceiba pentandra* and *Mangifera indica* was 613 g, 485 g, 650 g, 380 g, 609 g and 393 g, respectively after a study trial had been conducted to analyse the chemical composition of tree foliage species, their intake and digestibility by goats.

An experimental trial conducted by Kongmanila *et al.* (2012) to study the effect of feeding different levels of foliage from *Erythrina variegata* on the performance of growing goats reported that inclusion of 20 per cent to 60 per cent crude protein from *Erythrina variegata* improved feed intake and productivity with feed conversion ratio of 7.2 to 8.4 kg dry matter per kg live weight gain in goats.

The potential of dried *Erythrina brucei* leaf on growth performance and carcass characteristics of yearling buck goats was evaluated by Yinnesu and Nurfeta (2012) in an experimental diet and they reported that those goats supplemented with *Erythrina* foliage consumed more of total dry matter and organic matter than those fed with cotton seed alone.

Mohamed and Abeyrathne (2015) conducted an experimental forage trial in cross bred weaned rabbits of mixed sex containing a diet of T_1 - 100 per cent layer pellet; T_2 - 70 per cent layer pellet, 20 per cent *Erythrina indica*, 10 per cent *Panicum maximum*; T_3 - 65 per cent layer pellet, 20 per cent *Manihot esculenta Crantz*, 15 per cent *Panicum maximum*; T_4 - 92 per cent layer pellet, 7 per cent *Leucaena leucocephala*, 1 per cent *Panicum maximum* and recorded feed conversion ratio of 0.2135, 0.1588, 0.1580 and 0.2477 in the respective treatment groups.

An experiment carried out by Pasupathi *et al.* (2015) on complete extruder feed to study the performance of New Zealand White rabbits supplementing tree fodders at various levels *i.e.* 15 parts of *Desmanthus virgatus*, 17 parts of *Leucaena leucocephala*, 25 parts of *Erythrina indica* and 15 parts of *Artocarpus heterophyllus* along with concentrate feed recorded mean dry matter intake of 69.8 g, 64.52 g, 70.23 g and 64.54 g with average feed conversion efficiency of 5.07, 5.34, 4.91 and 5.98, respectively.

Pasupathi *et al.* (2017) assessed the growth performance of New Zealand White rabbits aged seven to nine weeks old fed on diet containing

50 per cent concentrate with 50 per cent tree fodders *viz. Desmanthus virgatus*, *Leucaena leucocephala*, *Erythrina indica* and *Artocarpus heterophyllus* and reported a better performance and feed conversion efficiency of 4.27 when fed with *Erythrina indica*.

Morus alba L., *Erythrina poeppigiana* and *Tithonia diversifolia* as alternative and potential forages were evaluated by Laiño *et al.* (2018) in New Zealand White male rabbit and recorded feed intake and feed conversion efficiency as 83.90 g, 75.99 g and 81.72 g; 3.34, 3.23 and 4.08, respectively.

2.2. Reproductive performances

2.2.1. Age and weight of doe at first mating

Roy *et al.* (2002) conducted an experimental research on twenty four New Zealand White crossbred growing rabbits aged 120 days to evaluate the effect of different protein sources *viz.* til oil cake, soybean meal and gram fed along with *ad libitum* green grasses on growth and reproductive performances of rabbit doe and recorded the age at first mating as 167.66 days, 169 days and 164.5 days in the respective treatment groups.

Das and Sikka (2007) reported age at first mating as 228 days in New Zealand White and Soviet Chinchilla does when offered concentrate mashed feed along with mixtures of roughages of *Brachieria ruziensis*, *Vigna umbellate*, *Glycine max*, *Ipomoea batatas*, *Panicum maximum*, *Brassica oleracea*, *Daucus carota*, *Raphanus radicula*.

The effect of *Moringa oleifera* at levels of 0 per cent, 25 per cent, 50 per cent, 75 per cent, 100 per cent replaced for *Centrosema pubescens* on the reproductive performance of New Zealand White, California White and Chinchilla breeds reported weight at first mating as 1.867 kg, 1.852 kg, 1.882 kg, 1.861 kg and 1.867 kg, respectively according to Odeyinka *et al.* (2008).

An experimental study was carried out by Ezea *et al.* (2015) to evaluate the effects of feeding T_1 - concentrate feed, T_2 - *Commelina diffusa* plants, T_3 - *Ficus ingens* leaves and T_4 - mixed forages of *Calopogonium mucunoides*, *Centrosema pubescens*, *Tridax procumbens*, *Panicum maximum* and *Gomphrena spp*. on the lactogenic and reproductive performance of New Zealand White doe and recorded weight at first mating of 1.58 kg, 1.84 kg, 1.82 kg and 1.60 kg in the treated groups, respectively.

Hassanien *et al.* (2020) studied the effects of supplementing *Hyphaenethebaica* at a quantity of 0 g, 0.3 g, 0.6 g, 0.9 g per kg diet on growth and reproductive performance of New Zealand White and Californian rabbit does where they reported the weight at first mating of the does as 3.150 kg, 3.155 kg, 3.158 kg, 3.155 kg, respectively.

2.2.2. Age and weight of doe at first kindling

Roy *et al.* (2002) recorded the age at first kindling as 202.3 days, 202.0 days and 201.0 days for dietary groups containing til oil cake, soybean meal and gram fed along with *ad libitum* green grasses, respectively with no significant difference among the treatment groups.

A study was carried out by Odeyinka *et al.* (2008) on the reproductive performance of New Zealand White, Californian White and Chinchilla breeds fed varying levels of 0 per cent, 25 per cent, 50 per cent, 75 per cent, 100 per cent *Moringa oleifera* as a replacement for *Centrosema pubescens* and indicated that the weight at first kindling recorded was 2.046 kg, 1.810 kg, 1.678 kg, 1.943 kg and 1959 kg in the respective treatment groups.

The potential of *Hyphaenethebaica* supplementation at 0 g, 0.3 g, 0.6 g, 0.9 g per kg rabbit diet evaluated by Hassanien *et al.* (2020) on the performance of New Zealand White and Californian does, recorded weight at

first kindling as 3.430 kg, 3.455 kg, 3.449 kg, 3.460 kg in the respective treatment groups.

2.2.3. Litter size and litter weight at birth

Raharjo (1987) pointed out that the reduction of dietary protein level from 21 per cent to 16 per cent did not significantly decrease the performance traits of the pre weaning litters. He also reported that the numbers of total kits born did not differ among treatment groups with average recorded litter size of 8.47, 7.86, 6.82 and 8.17 with mean weight of 61.3 g, 58.6 g, 63.8 g and 61.8g.

The average litter size and litter weight at birth recorded by Marykutty and Nandakumar (2000) on Soviet Chinchilla rabbits were 4.35 g and 226 g, respectively when fed a diet consisting of 20 per cent crude protein concentrate along with *ad lib* guinea grass to study the litter traits according to breed and sires within breed.

An experimental trial was conducted by Roy *et al.* (2002) in 120 days old New Zealand White crossbred rabbits to study the effect of various protein sources on growth and reproductive performances of rabbit doe and reported that the average litter size at birth of 2.7, 3.7 and 2.7 did not differ significantly among the dietary treatment groups containing til oil cake, soybean meal and gram offered with *ad libitum* green grasses, respectively.

A study carried out by Salma *et al.* (2004) to evaluate the effect of supplementing 13.17 per cent, 16.64 per cent and 21 per cent crude protein diet with *ad libitum* green grass *Hymenachne pseudointerrupta* on reproductive performance of rabbit doe, reported an average litter size of 2.0, 4.3 and 4.4 with litter weight of 60.0 g, 46.7 g and 49.0 g in the respective treatment groups.

A study on the effect of including concentrate with conventional diet on the reproductive performance of crossbred New Zealand White doe assessed

by Hasanat *et al.* (2006) reported no difference between the control and the treated group with recorded litter size of 2.5 and 3.25 with litter weight of 54.87 g and 55.50 g, respectively.

Erakpotobor *et al.* (2008) studied the effects of 20:80, 40:60, 60:40, 80:20 concentrate and *Stylosanthes hamata* combination on crossbred doe and recorded litter size of 4.20, 5.00, 4.67 and 4.80 with litter weight of 56.25 g, 52.25 g, 54.22 g and 54.35 g, respectively.

The effect of concentrate and *Talinum triangulare* combination percentage of 20:80, 40:60, 60:40 and 80:20 in New Zealand White rabbit doe on litter performance traits was evaluated by Iheukwumere (2008) and reported an average litter size at birth of 5.85, 6.18, 6.25 and 5.00 with mean litter weight of 261.85 g, 273.42 g, 311.45 g and 266.23 g, respectively.

Odeyinka *et al.* (2008) reported litter size of 5.12, 4.56, 4.06, 4.66 and 5.81 with litter weight of 228 g, 195 g, 185 g, 225 g, 232 g when *Centrosema pubescens* was replaced with 0 per cent, 25 per cent, 50 per cent, 75 per cent, 100 per cent *Moringa oleifera* to evaluate the reproductive performance of New Zealand White, Californian White and Chinchilla rabbit does.

A study was conducted by Alemede *et al.* (2014) to evaluate the reproductive performance of New Zealand White and American Chinchilla by inclusion of *Moringa oleifera* leaf meal at levels of 0 per cent, 10 per cent, 20 per cent and 30 per cent in rabbit diet and reported mean litter size at birth of 4.00, 4.17, 5.00 and 4.00 with an average litter weight of 32.10 g, 33.65 g, 38.07 g and 37.40 g, respectively.

An experimental trial on diet comprising of T_1 - concentrate feed, T_2 - *Commelina diffusa* plants, T_3 - *Ficus ingens* leaves and T_4 - mixed forages of *Calopogonium mucunoides*, *Centrosema pubescens*, *Tridax procumbens*, *Panicum maximum* and *Gomphrena spp*. was conducted by Ezea *et al.* (2015)

to assess the lactogenic and reproductive performance of New Zealand White doe and reported average litter size of 5.67, 6.00, 5.33 and 7.00 with mean litter weight of 51.67 g, 57.06 g, 54.64 g and 55.95 g, respectively.

A study to evaluate the reproductive performance of rabbits fed 0 per cent, 5 per cent, 10 per cent *Moringa oleifera* leaf meal and 10 per cent *Moringa oleifera* twigs resulted in litter size of 7.75, 9.25, 7.25 and 8.00 with litter weight of 48.75 g, 59.75 g, 62.75 g and 61.50 g, respectively as per the records of Oshibanjo *et al.* (2018).

An average litter size and weight of 5.8, 6.8, 8, 8.9 and 45.0 g, 46.0 g, 48.8 g, 50.0 g, respectively was recorded by Hassanien *et al.* (2020) who conducted a study on the effect of *Hyphaenethebaica* supplementation at levels of 0 g, 0.3 g, 0.6 g and 0.9 g per kg rabbit diet in New Zealand White and Californian breed.

2.2.4. Litter size and litter weight at weaning

A study to evaluate the effect of feeding tropical forages and by product feeds at various protein levels on growth and reproductive performance of rabbits was conducted by Raharjo (1987) and reported average litter size of 7.18, 6.75, 6.09 and 7.34 with mean litter weight of 472 g, 474 g, 532 g and 468 g.

Marykutty and Nandakumar (2000) studied the effect of breed and sires within breed on litter traits fed a diet of concentrate containing 20 per cent crude protein and *ad lib Panicum maximum* reported litter size and litter weight at weaning in Soviet Chinchilla rabbits as 1.18 g and 708 g, respectively.

An average litter weight of 355 g, 267 g and 285 g was recorded by Salma *et al.* (2004) at 28 days old when rabbit doe were provided with protein supplementation of 13.17 per cent, 16.64 per cent and 21 per cent with *ad lib Hymenachne pseudointerrupta* and further pointed out that higher growth rate

of kits on the low protein diet was because of few number of kits per litter which resulted in less competition for milk.

Hasanat *et al.* (2006) reported litter size of 1.37 and 2.37 with litter weight of 310.62 g and 408.12 g when assessing the effect of two dietary treatment groups *i.e.* conventional diet and conventional with concentrate on the reproductive performance of crossbred New Zealand White doe.

Feeding trials of concentrate and *Stylosanthes hamata* at different combinations of 20:80, 40:60, 60:40, 80:20 were incorporated by Erakpotobor *et al.* (2008) to study the effects on the performance of crossbred doe and recorded mean litter size of 3.67, 4.11, 4.25, 4.00 and litter weight of 413.35 g, 397.32 g, 349.90 g and 415 g in the respective treatment groups.

The effect of mixed feeding regime of concentrate and *Talinum triangulare* in New Zealand White rabbit doe on litter performance traits with treatment combinations of 20:80, 40:60, 60:40 and 80:20 was evaluated by Iheukwumere (2008) and reported an average litter size of 4.60, 5.13, 5.22 and 3.65 in the respective treatment groups.

An average litter size of 5.00, 2.87, 3.40, 4.46, 5.00 and litter weight of 1173 g, 742 g, 947 g, 1170 g, 1116 g was reported by Odeyinka *et al.* (2008) on assessing the performance of New Zealand White, California White and Chinchilla rabbit does fed *Moringa oleifera* at levels of 0 per cent, 25per cent, 50 per cent, 75 per cent and 100 per cent to replace *Centrosema pubescens* forage diet.

Alemede *et al.* (2014) carried out an experimental trial to evaluate the reproductive performance in New Zealand White and American Chinchilla rabbit breeds using *Moringa oleifera* leaf meal fed at different inclusion levels of 0 per cent, 10 per cent, 20 per cent and 30 per cent and indicated that the mean recorded values for litter size were 2.00, 2.33, 3.33 and 2.33 with

average litter weight of 401.60 g, 442.30 g, 462.52 g and 347.21 g, respectively.

When offered a diet of T_1 - concentrate feed, T_2 - *Commelina diffusa* plants, T_3 - *Ficus ingens* leaves and T_4 - mixed forages of *Calopogonium mucunoides*, *Centrosema pubescens*, *Tridax procumbens*, *Panicum maximum* and *Gomphrena spp*. Ezea *et al.* (2015) recorded mean litter size of 5.67, 5.67, 5.33 and 7.00 and average litter weight of 201.40 g, 207.14 g, 177.74 g and 196.43 g in New Zealand White doe.

A study to evaluate the reproductive performance of rabbits fed 0 per cent, 5 per cent, 10 per cent *Moringa oleifera* leaf meal and 10 per cent *Moringa oleifera* twigs Oshibanjo *et al.* (2018) recorded average litter weight of 718.00 g, 701.00 g, 727.00 g and 818.00 g in the respective treatment groups.

Hassanien *et al.* (2020) reported average litter size of 5, 6, 7.7, 8.6 and litter weight of 670 g, 733 g, 790 g, 820 g when diet was supplemented with *Hyphaenethebaica* 0 g, 0.3 g, 0.6 g, 0.9 g per kg to observe the effect on the growth and reproductive performance of New Zealand White and Californian rabbits.

2.2.5. Inter-kindling period

Average recorded values of inter-kindling ranged from 34.5 to 45.3 days, 34.8 to 53.0 days, 36.0 to 78.0 days and 34.5 to 64.7 days in does fed with T_1 -21 per cent crude protein, T_2 -16 per cent crude protein diet, T_3 -16 per cent crude protein diet with methionine and T_4 -16 per cent crude protein with urea supplementation, respectively as per Raharjo (1987).

A study was conducted on the reproductive performance of Soviet Chinchilla rabbit doe by Das and Bujarbaruah (2007) and reported inter-kindling of 79.87 days, 74.24 days, 72.68 days, 77.20 days in parental, first,

second and third generation fed with 50 per cent pelleted feed and 50 per cent green roughage.

Das and Sikka (2007) recorded inter-kindling of 85.12 days in New Zealand White and Soviet Chinchilla does fed with *Brachieria ruziensis*, *Vigna umbellate*, *Glycine max*, *Ipomoea batatas*, *Panicum maximum*, *Brassica oleracea*, *Daucus carota*, *Raphanus radicula* and mashed feed.

A study conducted on effect of breed on the reproductive performance of rabbit does indicated inter-kindling period in Soviet Chinchilla breed maintained under concentrate mash feed and *ad lib* green roughages was 98 days as per Das and Yadav (2007).

2.2.6. Number of crops per doe per year

Harris (1982) reported that nine litters could be obtained from the same doe in one year when re-mated one to fourteen days postpartum without affecting the performance of the rabbit, irrespective of the dietary treatments.

An experimental trial conducted by Das and Bujarbaruah (2007) on the reproductive performance of Soviet Chinchilla doe fed 50 per cent pelleted feed with 50 per cent green roughages reported total number of crops of 4.57, 4.92, 5.02, 4.73 per year in parental, first, second and third generation.

An average number of 4.29 crops per year was achieved when New Zealand White and Soviet Chinchilla rabbit does were offered mashed feed with roughages such as *Brachieria ruziensis*, *Vigna umbellate*, *Glycine max*, *Ipomoea batatas*, *Panicum maximum*, *Brassica oleracea*, *Daucus carota*, *Raphanus radicula* as per Das and Sikka (2007).

2.3. Morbidity and Mortality

In a study trial conducted by Solarte (1989) to observe the performance of New Zealand White rabbits fed with an experimental diet consisting of

Erythrina glauca and sugarcane juice for 56 days, reported no symptoms of digestive or metabolic upsets in rabbits.

A study conducted in Columbia to evaluate the potential of *Erythrina* as pig fodder indicated that the seeds of *Erythrina edulis* when cooked could be supplemented up to 60 per cent in the diet of lactating sows without reported cases of piglet mortality as per Pezo *et al.* (1992).

Higher pre weaning mortality of 84.9 per cent among litter mates from Soviet Chinchilla rabbit doe was recorded by Marykutty and Nandakumar (2000) when assessing pre weaning mortality according to breed and sires within breed with a diet consisting of concentrate and *ad lib Panicum maximum*.

An experimental trial conducted by Roy *et al.* (2002) to study the effect of various protein sources on growth and reproductive performances of New Zealand White crossbred rabbit doe reported pre weaning mortality of 87.5 per cent, 36.37 per cent and 12.5 per cent in dietary treatment groups containing til oil cake, soybean meal and gram offered with *ad lib* green grasses.

Aregheore (2004) reported no incidence of toxicity, forage refusals or digestive disturbances in the form of watery faeces in crossbred anglo-nubian goats of eight to ten months old throughout the experimental period when offered mixtures of *Ischaemum aristatum* and *Erythrina variegata* in the diet.

The recorded mortality rate in 167 Spanish rabbit farms was 6.3 per cent stillborn and 13.4 per cent suckling mortality as per Rossel (2005) and further illustrated that illness was not the cause of mortality, rather out of 100 per cent mortality loss, 38 per cent were stillborn, 19 per cent died of starvation and 17 per cent because of hypothermia.

The bark and fresh leaves of *Erythrina senegalensis* had been traditionally utilized as cost effective dewormers by the farmers in Vietnam as

an alternative to manufactured anthelmintics according to the reports of Viet and Kien (2005) and demonstrated that the sole utilization of *Erythrina senegalensis* leaves or in combination with cassava hay had reduced the proportion of internal parasitic infection and faecal egg count in cattle.

A study on the effect of including concentrate with conventional diet on the reproductive performance of crossbred New Zealand White doe carried out by Hasanat *et al.* (2006) reported pre weaning mortality of 45 per cent for conventional diet and 26.92 per cent for conventional with concentrate treatment group.

An experimental trial conducted by Iheukwumere (2008) to study the effects of mixed feeding regimes of concentrate and *Talinum triangulare* on litter performance traits with treatment combination of 20:80, 40:60, 60:40 and 80:20, recorded pre weaning mortality rate of 15.31 per cent, 14.65 per cent, 13.25 per cent and 18.24 per cent in the respective treatment groups.

Sonia *et al.* (2011) studied the alkaloid extracted from *Erythrina indica* foliage to be utilized as an antidiarrhoeal agent in experimental animals and pointed out the foliage has potential and could be incorporated as traditional antidiarrhoeal agent.

Alemede *et al.* (2014) reported neo natal mortality rate of 1.33 per cent, 0.33 per cent, 0.33 per cent and 0.50 per cent in New Zealand White and American Chinchilla rabbit does when fed a diet of *Moringa oleifera* leaf meal at levels of 0 per cent, 10 per cent, 20 per cent and 30 per cent and recorded survival rate of 50.00 per cent, 50.88 per cent, 66.60 per cent and 58.25 per cent, respectively up to weaning period.

Pre weaning mortality rate of 13.80 per cent, 11.80 per cent, 3.75 per cent and 3.40 per cent was recorded at 0 g, 0.3 g, 0.6 g, 0.9 g of

Hyphaenethebaica supplementation per kg diet as per Hassanien *et al.* (2020) when studied on productive and reproductive performance of rabbit doe.

2.4. Performance at farmers' field

Pezo *et al.* (1992) conducted feeding trials with lactating cows, calves, heifers, young bulls, lactating goats, kids and lambs on *Erythrina* foliage as a valuable protein supplement in animal production systems. Their objective was to reduce the dependency on external inputs and reported that the foliage was not as effective as traditional protein supplements such as fish meal or soybean meal in increasing milk production or weight gains. However, they recommended the use of *Erythrina* foliage for many farmers as a cheap protein supplement.

Phouthavong *et al.* (1998) interviewed farmers on the use of *Erythrina variegata* as livestock feed in areas of Lao and they reported that *Erythrina variegata* was commonly utilized by the farmers as a feed for livestock animals including the provinces of Oudomxay area.

Whistler and Elevitch (2006) reported that in both the north and south of Lao People's Democratic Republic, *Erythrina subumbrans* plant was cultivated by the farmers as a shade tree and as green manure for Arabica coffee plants. They also pointed out that *Erythrina subumbrans* plant was selected by the farmers because it had no thorns.

In an experimental study conducted by Kongmanila *et al*. (2008a) in the surrounding areas of Vientiane in Laos where sixty selected goat farmers were interviewed about the feeds they used for their goats and very few respondents used *Erythrina variegata* as an animal feed. They also indicated the reason as the lack of knowledge about its use as livestock feed or because of the availability of the plant in few areas despite considering its good nutritive

value, high protein content that could have positive influence on feed intake and performance.

Deb *et al.* (2009) reported that many of the farmers interviewed opined the utilization of *Erythrina variegata* and *Erythrina indica* as a multipurpose tree such as fencing around the houses or crop fields because of prickly stems while *Erythrina variegata* foliage was used as food or as traditional human medicine.

Many of the farmers interviewed as pointed out by Kongmanila *et al.* (2012) utilized *Erythrina indica*, *Erythrina subumbrans* and *Erythrina variegata* mainly as multipurpose trees such as fencing, shade and green manure and only a small number of the farmers offered *Erythrina* foliage as an animal feed. The authors further recommended the promotion of *Erythrina* foliage as a sole or supplementary feed to the ruminants in free grazing systems with poor pasture.

CHAPTER III

MATERIALS AND METHODS

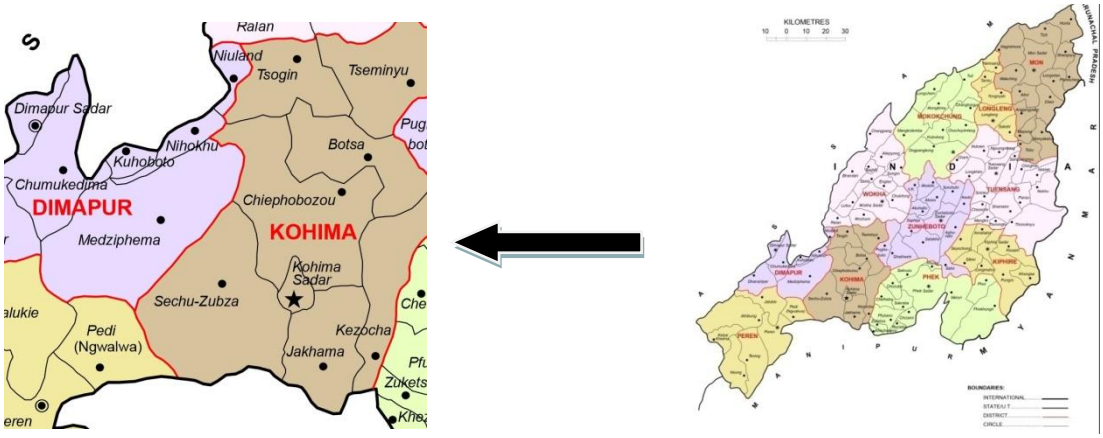
MATERIALS AND METHODS

The present study entitled “Performance of Soviet Chinchilla rabbit on diet supplemented with Indian coral plant (*Erythrina stricta*)” was undertaken to carry out a research experiment with the objective to assess the effect of the plant on growth and reproductive performance of Soviet Chinchilla rabbit in the organised farm and farmers’ field condition. The materials used and methodology followed in the study is discussed chronologically in this chapter under the following sub-headings.

3.1. Location and period of the experimental study

The experimental research work was conducted at the Instructional Livestock Farm, Rabbit Unit, Department of Livestock Production and Management, School of Agricultural Sciences and Rural Development (SASRD), Nagaland University, Medziphema Campus of Dimapur district. At farmers’ field the survey was carried out at Kohima and Zubza Sechü village of Kohima district (Fig.3.1). The experimental farm is situated at 93°20' E to 95°15' E longitude and latitude between 25°6' N to 27°40' N at an altitude of 310 meters above mean sea level. The villages selected for research survey are located at 25°40' N to 25°67' N latitude and 94°07' E to 94°12' E longitude at an elevation of 1261 meters above mean sea level. The experimental study commenced in the month of May 2018 and continued till September 2019.

Fig.3.1. Site location of Dimapur and Kohima district.



3.2. Experimental animals

A total of twenty four Soviet Chinchilla bunnies of sixty days old were randomly selected from the Instructional Rabbit Unit, Department of Livestock Production and Management, School of Agricultural Sciences and Rural Development (SASRD), Nagaland University, Medziphema Campus. The experimental animals were divided into four treatment groups marked as T_1, T_2, T_3 and T_4, respectively. Each experimental group consisted of five female and one male in the ratio of 5:1.

3.3. Housing and Management

The rabbit housing unit (Plate-1A) is an “A” type shed constructed using corrugated roofing sheets and cemented walls with one third side openings made of galvanized wire nettings. The galvanized wire nettings are covered with gunny bags during inclement weather and are raised open at daytime to allow sufficient entry of sunlight. The experimental shed has concrete flooring with provision of footbath at the entrance and drainage outlet for daily washing of the floor.

The experimental rabbit cages made of galvanized wire mesh measuring 70 cm length, 47 cm breadth and 65 cm height with wooden flooring were arranged in the rabbit shed. Naming plates of 10 cm length and 10 cm breadth with details such as sex, treatment group and replication numbers were fitted on the outer surface of each cage. All the animals selected for the experiment were allocated in individual cage up to six months of age (Plate-1B). The doe on attaining maturity weight and age was transferred and introduced in each galvanized wire mesh kindling cage (Plate-2A) having dimensions of 110 cm length, 60 cm breadth and 85 cm height with wooden flooring. Identification plates of 15 cm length and 10 cm breadth having particulars *viz.* treatment group and replication numbers, date of mating, date of kindling, weaning date were fixed on the outer side of every cage. A nest box of 45 cm length, 30 cm breadth and 10 cm height was provided to each kindling cage and were removed four weeks after parturition.

Sanitation procedures which includes cleaning of feeding bowls, plates and watering mugs, disinfecting the cages with solution of potassium permanganate, washing the floor and white washing the unit was carried out prior to the start of the research work. The footbath at the entrance of the rabbit unit was regularly cleaned and refilled with antiseptic solution of potassium permanganate (0.5 per cent). Cleaning of cages, equipments and floor were performed daily before feeding and watering. Soiled or wet nest beddings were replaced with fresh and clean ones. The nest boxes were routinely washed and disinfected after every weaning period. All the experimental rabbits were reared under standard management practices *i.e.* proper hygiene, sanitation, ventilation were ensured throughout the period of study.

3.4. Experimental diet and feeding schedule

Concentrate feed ingredients were procured from reputed commercial feed supplier Amar Roller Mill in Dimapur and computation was done in the

farm go-down on bi-weekly basis (Plate-2B) following the formulation as per Ranjhan (1993) given in Table 3.4.1. Indian coral plants (*Erythrina stricta*) consisting of the leaves and branches (Plate-3) along with other varieties of fodder plants were collected daily from the vicinity of the farm (Plate-4A).

Table 3.4.1. Physical composition of concentrate ration as per Ranjhan (1993)

Sl.no.	Feed ingredients	Quantity for 100 kg
1.	Grounded maize	30.00
2.	Groundnut cake	15.00
3.	Wheat bran	53.00
4.	Mineral mixture	1.00
5.	Salt	1.00
	Total	100.00

Feeding and watering of the rabbits were carried out as per cage wise. Measured quantity of concentrate feed (Plate-4B) in grams was provided to all the experimental animals of different age groups following feeding schedule as per Ranjhan (1993) shown in Table 3.4.2. The basal diet was moistened with clean water before feeding and was first provided twice daily with a proportion of one third in the morning and two third in the evening between 7.00-8.30 am and 3.00-4.30 pm to all the treatment groups. Mixtures of locally available foliages of banana (*Musa spp.*), jack fruit plants (*Artocarpus heterophyllus*), napier grasses (*Pennisetum purpureum*), hibiscus plants (*Hibiscus rosa-sinensis*), leaves and flowers of marigold (*Tagetes erecta*) were given to T_1 group at *ad libitum*, while Indian coral plants (*Erythrina stricta*) along with mixtures of locally available fodders were provided to T_2 and T_3 groups and only Indian coral plants (*Erythrina stricta*) were supplied *ad lib* to T_4 group.

PLATE-1

A. Rabbit farm unit

B. Individual cage allocation of experimental bunnies

PLATE-2

A. Transferring of rabbit doe in individual kindling cages

B. Formulated concentrate feed

PLATE-3

Collected Indian coral plants (Leaves and branches)

PLATE-4

A. Varieties of collected fodder plants

B. Measured quantity of concentrate feed

Fresh clean drinking water was provided *ad lib* to each animal every day. The details of the dietary treatment groups were as follows:

T_1 – basal diet + *ad lib* locally available fodders

T_2 – basal diet + 66 per cent locally available fodders + 33 per cent Indian coral plants (*Erythrina stricta*)

T_3 – basal diet + 33 per cent locally available fodders + 66 per cent Indian coral plants (*Erythrina stricta*)

T_4 – basal diet + 100 per cent Indian coral plants (*Erythrina stricta*)

Table 3.4.2. Feeding schedule of concentrate feed as per Ranjhan (1993)

Body weight (in kilograms)	Quantity per day (in grams)	Morning proportion (one third)	Evening proportion (two third)
Growers			
< 0.5	30.00	10.00	20.00
0.5 - 1.0	40.00	13.33	26.67
1.0 - 1.5	50.00	16.67	33.33
1.5 - 2.0	60.00	20.00	40.00
Adults			
2.0 - 2.5	50.00	16.67	33.33
2.5 - 3.0	60.00	20.00	40.00
> 3.0	70.00	23.33	46.67
Gestation period			
2.0 - 2.5	60.00	20.00	40.00
2.5 - 3.0	70.00	23.33	46.67
> 3.0	80.00	26.67	53.33
Lactation period			
2.0 - 2.5	140.00	46.67	93.33
2.5 - 3.0	150.00	50.00	100.00
> 3.0	160.00	53.33	106.67

3.5. Productive parameters

3.5.1. Body weight and Average daily gain (ADG) in body weight

The initial body weight of the experimental bunnies in kilograms was recorded at the onset of the experiment. The individual weight was measured using a digital weighing balance of Sumo Digi tech manufactured by Sumo Digital Incorporation, ISO 9001-2008 certified company, Govt. of India, having a capacity of minimum 20 g to maximum 30 kg weight. Each bunny was introduced in individual cage. Fortnightly recording of individual body weight in kilograms (Plate-5A) was taken up to six months of age and Average daily gain (ADG) in grams was calculated.

3.5.2. Daily feed intake and feed conversion efficiency (FCE)

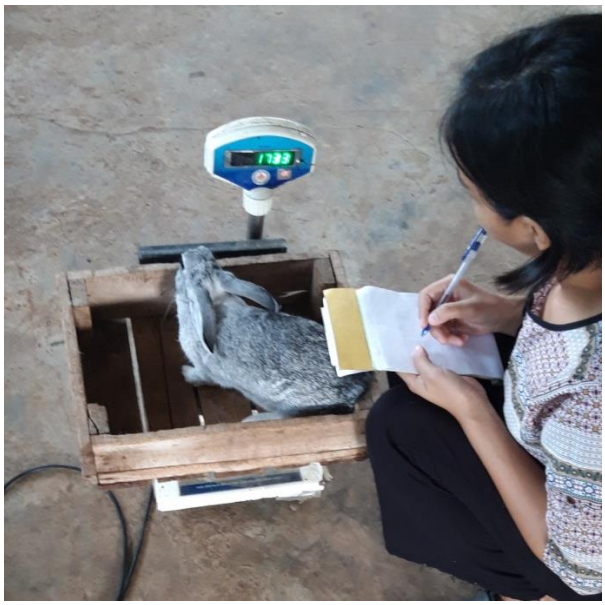
Measured quantity of concentrate feed and forages provided on daily basis in grams was recorded in all the experimental animals. The left over concentrate ration were collected before the next subsequent feeding, likewise with the left over fodder grasses and plants. The feed and fodder residues were weighed (Plate-5B) and recorded in grams. Total feed intake was obtained by subtracting the residue from the quantity of feed and forages provided to the experimental animals. The feed conversion efficiency (FCE) determines the quantity of feed consumed by a rabbit to gain one kilogram of body weight and was calculated using the following formula as per Ranjhan (1993):

$$\text{FCE} = \frac{\text{Quantity of feed consumed (g)}}{\text{Total gain in body weight (g)}}$$

3.6. Reproductive parameters

Rabbit sexual maturity age, signs of receptivity of female doe on introducing into the male cage, lordosis on mounting by the male was observed and recorded under the following sub-headings.

PLATE-5



A. Recording of individual body weight of growers

B. Recording left over fodder residues

3.6.1. Age and weight of doe at first mating

The method of breeding taken up for all the treatment groups was through natural mating (Plate-6A) by introducing the female doe into the cage of the rabbit buck once in the morning and once in the evening hours to increase the reproduction rate. Unreceptive doe was reintroduced into the buck's cage the following day. The age of each doe at first mating in days was noted down, body weight of the doe at first mating in kilograms was taken at the time of successful breeding using the digital weighing balance (Plate-6B) and the date of mating was entered in the record register.

3.6.2. Age and weight of doe at first kindling

Pregnancy diagnosis of the mated female rabbit was confirmed through abdominal palpation fourteen days after introducing the female into the male cage for coitus. Weight of the female rabbit was also recorded at the same time. The doe was re-mated again if negative for pregnancy diagnosis on abdominal palpation. The gestation period of a doe expressed in days is the total number of days from successful mating till the day of kindling. Nest boxes with nesting materials such as dried grasses, leaves and pieces of cut jute bags was prepared three days prior to kindling date to facilitate the doe to pull out some of her own fur (Plate-7A) for nest preparation (Plate-7B). On successful kindling (Plate-8A) the age and weight of the doe was recorded (Plate-8B) in days and kilograms, respectively.

3.6.3. Litter size and weight at birth

Total number of kits born alive (Plate-9A) and litter weight in grams was noted for every kindling of the experimental female rabbit. Proper care was taken not to disturb the doe with the kits at the time of parturition and suckling (Plate-9B).

PLATE-6

A. Depiction of natural breeding method

B. Body weight of doe at mating

PLATE-7

A. Fur pulling for nest preparation

B. Nest preparation prior to kindling

PLATE-8

A. Kindling in rabbit doe

B. Body weight of doe at kindling

PLATE-9

A. Litter size at birth

B. Suckling after parturition

3.6.4. Litter size and weight at weaning

Weaning is a method of separating the young ones from the mother after attaining a growing age where the young ones do not depend on the mother's milk for food. The process was carried out at forty five days old on all the experimental bunnies. Sexing was also performed simultaneously by gentle pressure on the genital orifice exposing the inner surface of the organ (Plate-10A). Total number of live bunnies was recorded on weaning day and body weight was also taken using the digital weighing balance from the treatment groups (Plate-10B).

3.6.5. Inter-kindling period

The experimental does for all the treatment groups were re-mated at forty seven days after parturition. Inter-kindling period expressed in days is the total number of days from one kindling to the following time of kindling and recorded by calculating the interval between two consecutive kindling.

3.6.6. Number of crops per doe per year

Number of crops per doe per year for all the treatment groups was calculated by finding out the total number of kindling recorded from every experimental doe.

3.7. Morbidity and Mortality

Commonly encountered disease symptoms were examined throughout the experimental period. Mortality rate in all the treatment groups expressed in terms of percentage was recorded for the entire research work and calculated using the following formula:

$$\text{Mortality rate} = \frac{\text{No. of rabbits died}}{\text{Total no. of live rabbits}} \times 100$$

PLATE-10

Male genital organ

Female genital organ

A. Sexing of bunnies at the time of weaning

B. Litter weight at weaning

Liveability was also calculated by subtracting the mortality rate from hundred.

3.8. Statistical tools and analysis

The descriptive data collected throughout the experimental study for productive and reproductive traits was recorded. In order to draw meaningful interpretation and conclusion of the research findings, data was fitted for statistical analysis through Analysis of Variance (ANOVA) using Completely Randomnized Design (CRD) as per Snedecor and Cochran (1998). Post hoc analysis using Tukey's Honestly Significant Difference (HSD) method was calculated for mean comparisons to identify significant differences ($P \leq 0.05$) among the treatment groups.

3.9. Sampling survey method at farmers' field

Villages selected for field survey were Kohima and Zubza Sechü of Kohima district. The selection was made based on the frequency of feeding Indian coral plants (*Erythrina stricta*) plants to the backyard rabbits. A total number of ten rabbit farmers were identified from the two selected villages. Five farmers were chosen from each village rearing four to five Soviet Chinchilla female rabbits with a breeding buck having similar housing and feeding system.

3.10. Field survey parameters

3.10.1. General profile of the farmers

The rabbit farmers' individual information such as name, gender, age was collected (Plate-11). In order to obtain a brief depiction on the socio-economic status of the respondents, characteristics which include level of education, family size of the respondent, main occupation, sources of media,

total number of livestock animals owned were recorded from each farmer through questionnaires and direct interaction.

3.10.2. General information on rabbit farming

General information on rabbit farming like feeding practices, housing and health management were collected from the respondents (Plate-12). Preferences for breed, housing type, feed ingredients, forages used, cost price of the adult rabbits and bunnies were some other particulars collected (Plate-13).

3.10.3. Performance at farmers' field

The knowledge and familiarity of using Indian coral plants (*Erythrina stricta*) as rabbit fodder were collected from the rabbit farmers at the door step (Plate-14). Primary data on the performance of Soviet Chinchilla rabbits fed Indian coral plants through questionnaires was collected from the selected two villages (Plate-15).

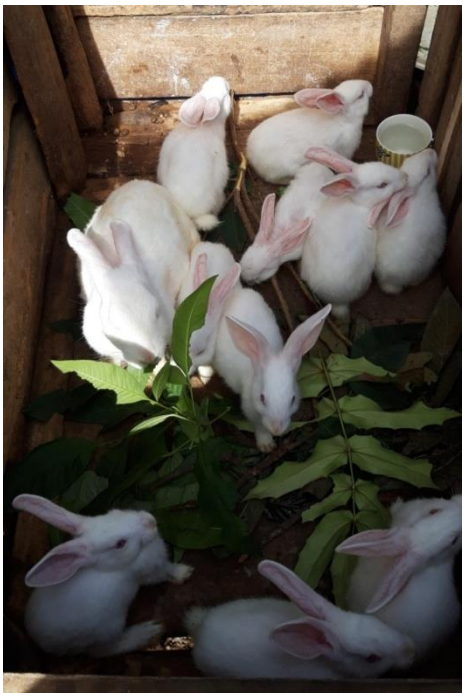
3.10.4. Analytical tools and techniques employed

Tabular representation was adopted based on the nature and extent of availability of data to compile the parameters and fulfil the specific objective of the field survey. Simple statistical tools like averages and percentages were used to compare, contrast and interpret results accurately.

PLATE-11

Interaction with rural rabbit farmers

PLATE-12



Recording general information on rabbit farming

PLATE-13

Recording preferences for breed, housing type and forages used

PLATE-14

Knowledge and familiarity on the utilization of Indian coral plants (*Erythrina stricta*)

PLATE-15

Primary data on the performance at farmers' field

CHAPTER IV

RESULTS AND DISCUSSION

RESULTS AND DISCUSSION

The present study entitled “Performance of Soviet Chinchilla rabbit on diet supplemented with Indian coral plant (*Erythrina stricta*)” was undertaken with twenty four experimental animals divided into four treatment groups with a sex ratio of 5:1 (female : male). The experimental diet consisted of T_1 - basal diet with *ad lib* locally available fodders, T_2 - basal diet with 66 per cent locally available fodders and 33 per cent Indian coral plant (*Erythrina stricta*), T_3 - basal diet with 33 locally available fodders and 66 per cent Indian coral plant (*Erythrina stricta*) and T_4 - 100 per cent Indian coral plant (*Erythrina stricta*), respectively. The results of the effect of supplemented diet at different levels on productive performance, reproductive performance, morbidity and mortality at experimental as well as at farmers’ field are given below under the following headings and sub-headings.

4.1. Productive performance

4.1.1. Body weight

The effect of Indian coral plant (*Erythrina stricta*) on average body weight of rabbits recorded fortnightly up to six months of age is represented in Table 4.1.1 and graphically depicted in Fig.4.1.1. Statistical analysis is shown in Appendix-A (ANOVA-1).

The initial mean body weight of the rabbits for T_1, T_2, T_3 and T_4 groups was recorded as 0.41 kg, 0.40 kg, 0.38 kg and 0.39 kg, respectively. The corresponding average body weight recorded at six months of age for the respective treatment groups was 2.24 kg, 2.34 kg, 2.62 kg and 2.51 kg. Total average body weight recorded for T_1, T_2, T_3 and T_4 groups was 1.29 kg, 1.33 kg, 1.52 kg and 1.51 kg, respectively. Analysis of variance showed

improved significant differences ($P \leq 0.05$) in body weight among the treatment groups. Treatment groups T_3 and T_4 were recorded to have improved growth rate followed by T_2 and T_1 groups.

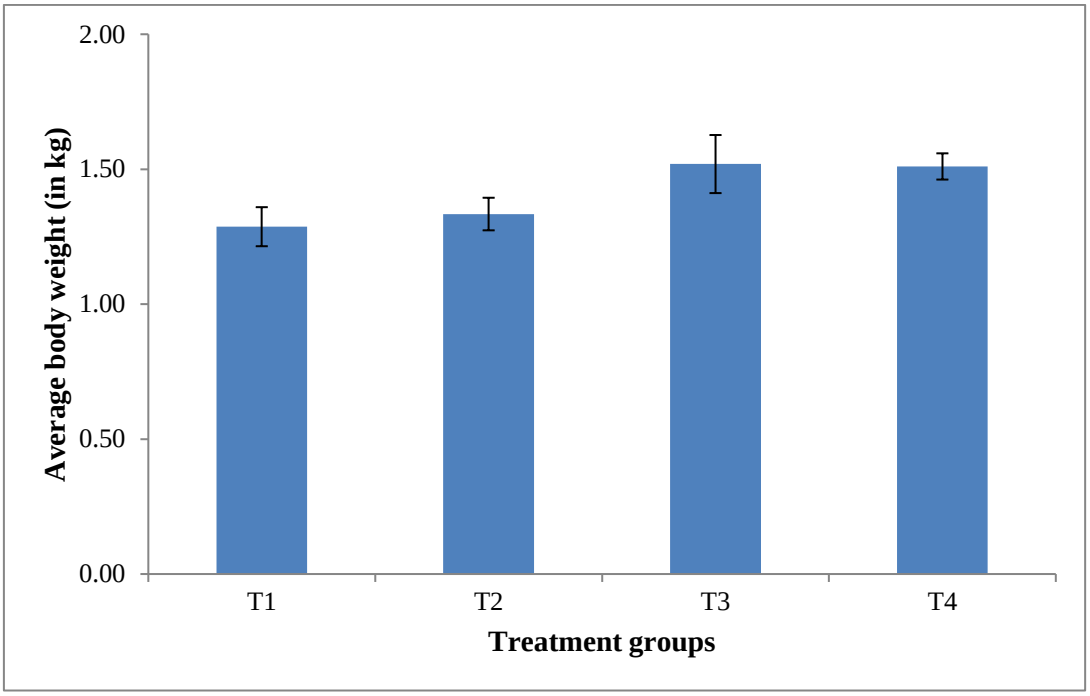
Similar findings were recorded by Solarte (1989) and Pasupathi *et al.* (2017) where they observed improved growth rate as well in *Erythrina* supplemented groups compared to other forages. Increased live weight in sheep and goats with no negative effects were also recorded by Larbi *et al.* (1993) and Kongmanila *et al.* (2012). Improved growth rate in T_3 and T_4 groups indicated better fodder quality of the Indian coral plant and showed no signs of regression in the body weight of the rabbits.

Table 4.1.1. Average body weight in kilograms up to six months of age in different treatment groups

Weeks	Treatment groups (Mean ± SE)			
	T_1	T_2	T_3	T_4
Initial	0.41±0.02	0.40±0.03	0.38±0.01	0.39±0.02
3rd	0.59±0.03	0.58±0.04	0.59±0.03	0.65±0.03
5th	0.77±0.03	0.79±0.04	0.89±0.05	0.94±0.04
7th	0.99±0.03	1.03±0.04	1.22±0.06	1.28±0.04
9th	1.26±0.04	1.31±0.03	1.57±0.07	1.59±0.04
11th	1.53±0.04	1.60±0.03	1.88±0.07	1.86±0.02
13th	1.77±0.05	1.85±0.04	2.15±0.05	2.08±0.01
15th	2.02±0.05	2.11±0.04	2.37±0.04	2.30±0.01
Final	2.24±0.04	2.34±0.04	2.62±0.03	2.51±0.01
Mean ± SE	1.29±0.03[a]	1.33±0.02[a]	1.52±0.04[b]	1.51±0.02[b]

SE - Standard error, each value is the mean of six observations
HSD critical range = 0.12
Means followed by a common superscript letter are not significantly different

Fig.4.1.1. Average body weight in kilograms up to six months of age in different treatment groups



T1 - Treatment one

T2 - Treatment two

T3 - Treatment three

T4 - Treatment four

4.1.2. Average daily gain (ADG) in body weight

The effect of Indian coral plant (*Erythrina stricta*) on average daily gain (ADG) in body weight of the rabbits up to six months of age is presented in Table 4.1.2. The pattern of daily gain in weight in different treatment groups is demonstrated in Fig.4.1.2 and the statistical analysis has been depicted in Appendix-A (ANOVA-2).

The recorded average daily gain (ADG) in body weight for T_1, T_2, T_3 and T_4 groups was 16.28 g, 17.36 g, 19.94 g and 18.88 g, respectively. Statistical analysis indicated significant variation ($P \leq 0.05$) among the treatment groups. Treatment groups T_3 and T_4 were observed to have better daily gain in body weight than T_1 and T_2.

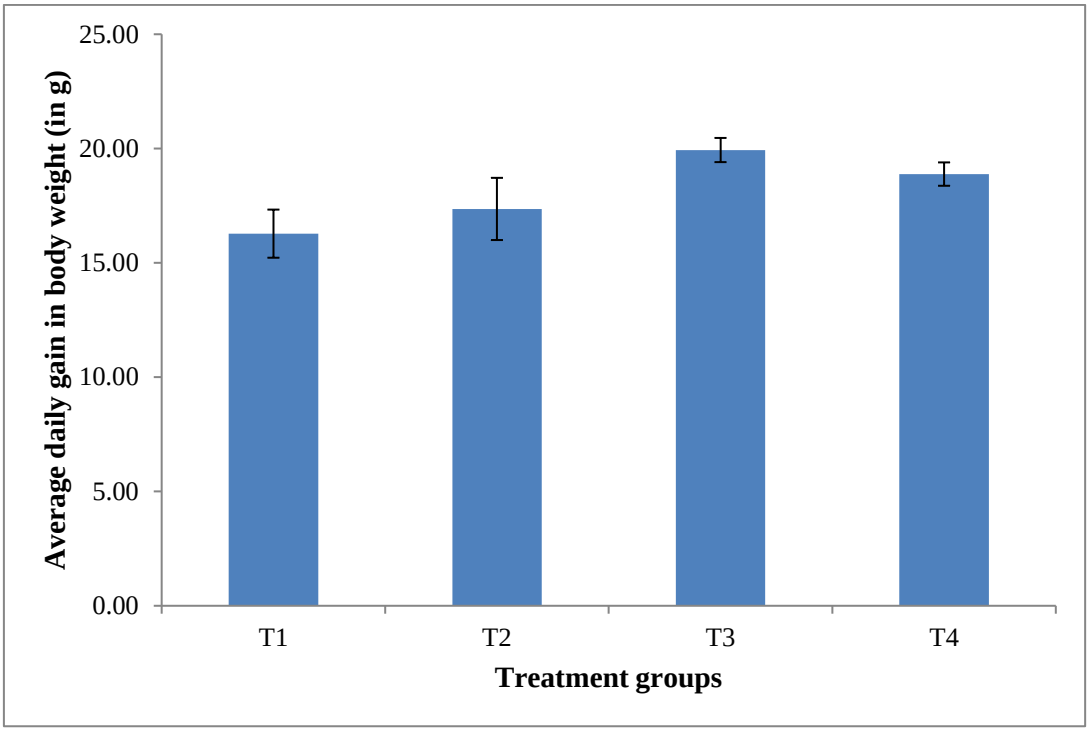
Average daily gain (ADG) in the present study were comparable with those reported in several papers (Mohamed and Abeyrathne, 2015; Pasupathi *et al.*, 2015; Pasupathi *et al.*, 2017 and Laiño *et al.*, 2018) with better average daily weight gain of 19.06 g, 14.77g, 15.71 g and 23.55 g, respectively on inclusion of *Erythrina spp.* at varying levels in rabbit diet. Higher weight gain in ruminants fed coral plants were also given by Devendra (1990), Kibria *et al.* (1994), Ibrahim *et al.* (2000) and Yinnesu and Nurfeta (2012). On the contrary, Solarte (1989) and Seneviratne *et al.* (2006) recorded lower average daily growth rate of 6 to 11 g when 50 to 100 per cent coral plant was replaced in the diet. Differences in values could be because of breed variation, experimental location, diet composition or species of the coral plant.

Table 4.1.2. Average daily gain (ADG) in grams up to six months of age in different treatment groups

Weeks	Treatment groups (Mean ± SE)			
	T_1	T_2	T_3	T_4
1^{st} - 2^{nd}	12.79±1.12	12.80±0.94	15.12±1.28	18.26±1.27
3^{rd} - 4^{th}	13.08±1.09	14.99±1.12	21.38±2.05	21.01±1.33
5^{th} - 6^{th}	15.33±1.09	17.45±0.72	23.12±0.88	23.71±0.81
7^{th} - 8^{th}	19.23±1.10	20.30±1.70	24.87±0.86	22.17±1.04
9^{th} - 10^{th}	19.40±1.16	20.26±1.34	22.55±1.42	19.29±1.53
11^{th} - 12^{th}	17.21±0.97	18.26±1.43	18.96±1.95	15.81±1.04
13^{th} - 14^{th}	17.85±0.82	18.12±0.75	16.14±0.94	15.56±0.39
15^{th} - 16^{th}	15.33±0.98	16.69±0.65	17.35±0.98	15.26±0.34
Mean ± SE	$16.28±0.43^{a}$	$17.36±0.56^{a}$	$19.94±0.22^{b}$	$18.88±0.21^{b}$

SE- Standard error, each value is the mean of six observations
HSD critical range = 1.51
Means followed by a common superscript letter are not significantly different

Fig.4.1.2. Average daily gain (ADG) in body weight in grams up to six months of age in different treatment groups



T1 - Treatment one

T2 - Treatment two

T3 - Treatment three

T4 - Treatment four

4.1.3. Feed intake

The effect of Indian coral plant (*Erythrina stricta*) on the average daily feed intake of rabbits up to six months of age is summarized in Table 4.1.3. The pattern of feed consumption has been graphically illustrated in Fig.4.1.3. and the statistical analysis is given in Appendix-A (ANOVA-3).

Data recorded for average daily feed intake in T_1, T_2, T_3 and T_4 was 115.83 g, 121.28 g, 131.86 g and 126.38 g, respectively. Analysis of variance (ANOVA) indicated significant variation ($P \leq 0.05$) among the treated groups. The treatment groups were significantly different from one another where T_3 group had higher feed intake among the four treatment groups followed by T_4, T_2 and T_1 groups. The results obtained in the present study were slightly higher than those recorded by Seneviratne *et al.* (2006), Pasupathi *et al.* (2015), Pasupathi *et al.* (2017) and Laiño *et al.* (2018) when *Erythrina spp.* was included at different levels in rabbit diet for a trial of two months (69 to 75 g). Difference in the amount of feed intake could be due to climate variability, age of the experimental animals or duration of the experimental study.

Higher feed intake observed in dietary groups supplemented with coral plants was in agreement with Solarte (1989) who had reported increased feed intake as the trial progressed. In addition, several authors had reported higher feed intake in small ruminants as compared to non supplemented *Erythrina* group (Larbi *et al.*, 1993; Van *et al.*, 2005, Kongmanila and Ledin, 2009; Yinnesu and Nurfeta, 2012). On introducing the plants, the experimental rabbits instantly nibbled the leaves, flowers and the thorns present on the stem and branches, indicating that the rabbits relished on the palatable coral plants. Similar reports had been made by Raharjo (1987) and Kongmanila *et al*. (2008b) that the coral plant was a palatable feed for rabbits and goats, respectively. Reduced feed intake observed in T_4 group confirmed the opinion of Aregheore (2004) who had reported low intake of 100 per cent

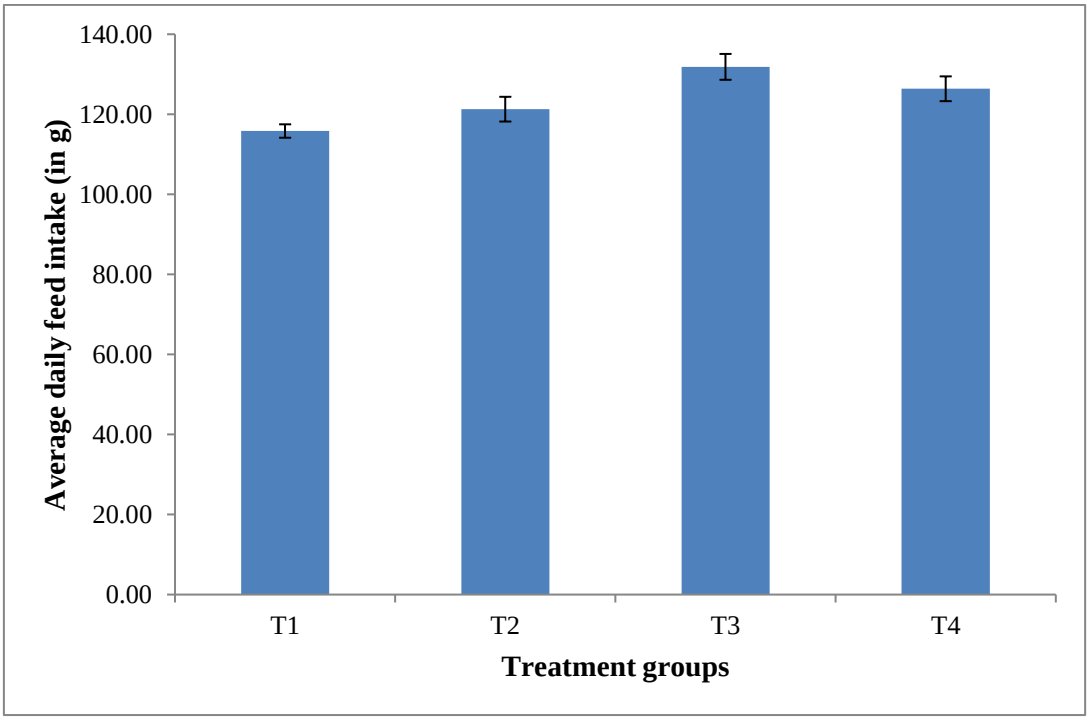
Erythrina forage treatment diet. Rabbits as per the present study prefer mixtures of various forages, dried grasses or hay apart from concentrate feed and do not favour sole feeds for long duration in their diet. Similar findings with T_4 group had been reported in the present study.

Table 4.1.3. Average daily feed intake in grams up to six months of age in different treatment groups

Weeks	Treatment groups (Mean ± SE)			
	T_1	T_2	T_3	T_4
1st	54.71±1.63	54.79±1.74	62.67±1.79	65.45±1.58
2nd	51.90±0.90	53.12±1.53	58.88±1.25	65.14±0.63
3rd	69.02±0.26	74.90±0.64	88.50±1.82	90.62±1.72
4th	79.02±1.29	86.88±0.88	100.31±0.68	102.02±2.13
5th	90.38±0.88	97.74±1.01	105.60±3.67	112.05±4.75
6th	93.45±2.03	105.05±4.18	111.74±7.07	122.62±0.57
7th	103.98±7.54	107.71±6.42	132.24±1.79	127.79±1.26
8th	123.14±0.68	125.76±0.93	145.93±1.03	130.88±1.33
9th	127.40±0.80	132.50±0.81	150.71±2.67	138.71±1.49
10th	135.86±1.78	140.38±1.46	155.45±3.22	143.07±1.17
11th	142.71±0.86	147.98±0.54	158.81±1.11	148.48±1.53
12th	145.88±2.05	153.62±1.86	162.55±1.55	151.57±1.02
13th	155.36±1.16	161.33±1.77	163.69±5.56	152.48±5.61
14th	158.50±1.71	165.00±3.63	166.74±9.73	152.26±7.19
15th	159.19±1.58	165.50±1.72	169.45±2.30	158.07±6.71
16th	162.69±4.28	168.29±6.00	176.43±4.17	160.93±7.29
Mean ± SE	115.83±0.68[a]	121.28±1.26[b]	131.86±1.32[d]	126.38±1.26[c]

SE- Standard error, each value is the mean of six observations
HSD critical range = 4.60
Means followed by a common superscript letter are not significantly different

Fig.4.1.3. Average daily feed intake in grams up to six months of age in different treatment groups



T1 - Treatment one

T2 - Treatment two

T3 - Treatment three

T4 - Treatment four

4.1.4. Feed conversion efficiency (FCE)

The effect of Indian coral plant (*Erythrina stricta*) on average feed conversion efficiency (FCE) of the rabbits up to six months of age is represented in Table 4.1.4 and is graphically shown in Fig. 4.1.4. The statistical analysis for different treatment groups is demonstrated in Appendix-A (ANOVA-4).

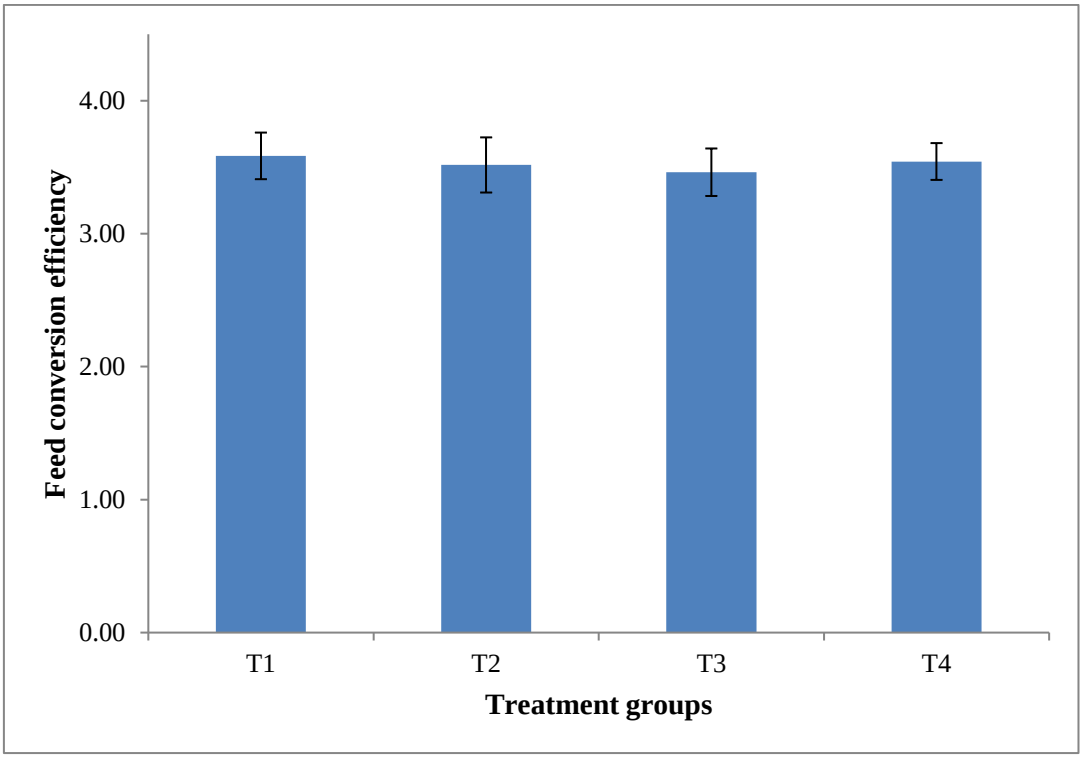
The average feed conversion efficiency (FCE) recorded in the treated groups was 3.59, 3.52, 3.46 and 3.54, respectively. Treatment groups did not vary significantly ($P \geq 0.05$) according to statistical analysis. However, Indian coral plant supplemented groups showed good feed conversion efficiency (FCE) compared to non supplemented groups. The present data recordings supported other research works with better feed conversion efficiency of 4.91, 4.27 and 3.23 (Pasupathi *et al.*, 2015; Pasupathi *et al.*, 2017 and Laiño *et al.*, 2018) when coral plant was included in rabbit diet as compared to non supplemented treatment groups. Similar observations were also reported by Kibria *et al.* (1994) and Kongmanila *et al.* (2012) where *Erythrina* foliage in comparison with other fodder leaves as goat feed showed better feed conversion efficiency.

Table 4.1.4. Average feed conversion efficiency (FCE) up to six months of age in different treatment groups

Weeks	Treatment groups (Mean ± SE)			
	T_1	T_2	T_3	T_4
1^{st} - 2^{nd}	2.17±0.20	2.16±0.15	2.10±0.21	1.84±0.16
3^{rd} - 4^{th}	2.95±0.29	2.77±0.20	2.31±0.21	2.33±0.14
5^{th} - 6^{th}	3.08±0.23	2.92±0.11	2.35±0.04	2.48±0.06
7^{th} - 8^{th}	2.98±0.12	2.97±0.24	2.81±0.09	2.95±0.15
9^{th} - 10^{th}	3.46±0.25	3.45±0.26	3.46±0.21	3.76±0.27
11^{th} - 12^{th}	4.26±0.26	4.27±0.36	4.46±0.44	4.85±0.33
13^{th} - 14^{th}	4.44±0.18	4.54±0.20	5.16±0.23	4.90±0.19
15^{th} - 16^{th}	5.34±0.28	5.05±0.26	5.06±0.27	5.22±0.15
Mean ± SE	3.59±0.07	3.52±0.08	3.46±0.07	3.54±0.06

SE- Standard error, each value is the mean of six observations

Fig.4.1.4. Average feed conversion efficiency (FCE) up to six months of age in different treatment groups



T1 - Treatment one

T2 - Treatment two

T3 - Treatment three

T4 - Treatment four

4.2. Reproductive performance

4.2.1. Age of doe at first mating

The effect of Indian coral plant (*Erythrina stricta*) on age of doe at first mating is presented in Table 4.2.1. The pattern in different treatment groups is demonstrated in Fig.4.2.1 and the statistical analysis has been depicted in Appendix-B (ANOVA-5).

The average age at first mating recorded for T_1, T_2, T_3 and T_4 groups was 180.20 days, 180.20 days, 179.40 days and 179.40 days. No significant difference ($P \geq 0.05$) was observed among the treatment groups as per statistical analysis. The present findings showed that breeding could be reached at an earlier age indicating positive result when compared with the reports made by Roy *et al.* (2002) in rabbit doe fed with til oil cake, soya bean, gram with *ad lib* grasses (167.66, 169.00 and 164.50 days) and Das and Sikka (2007) who reported age of doe as 228 days when offered concentrate mashed feed along with mixtures of roughages with no significant difference ($P \geq 0.05$).

4.2.2. Weight of doe at first mating

The effect of Indian coral plant (*Erythrina stricta*) on body weight of doe at first mating is represented in Table 4.2.2 and graphically depicted in Fig.4.2.2. Statistical analysis is shown in Appendix-B (ANOVA-6).

The mean body weight at first mating for T_1, T_2, T_3 and T_4 groups was recorded as 2.20 kg, 2.31 kg, 2.59 kg and 2.51 kg, respectively. Statistical analysis indicated significant variation ($P \leq 0.05$) among the treatment groups. Higher body weight at mating was reported in T_3 and T_4 compared to T_2 and T_1 groups. The present findings had higher recorded body weight at mating as compared to the reports made by Odeyinka *et al.* (2008) and Ezea *et al.* (2015) who worked on the forages of *Moringa oleifera*, *Commelina diffusa*, *Ficus ingens*, *Calopogonium mucunoides*, *Centrosema pubescens*, *Tridax*

procumbens, *Panicum maximum* and *Gomphrena spp*. (1.58 to 1.88 kg) which indicated that a convenient body weight of over 2.20 to 2.59 kg could be achieved for successful breeding when supplemented with the experimental diet. In contrast, Hassanien *et al.* (2020) reported a higher average weight at first mating as 3.15 kg when supplemented with *Hyphaenethebaica* at different levels of feeding and soyabean meal as one of the ingredients in the ration with no significant difference ($P \geq 0.05$) among the treatment groups. Heavier body weight at six months of age reported by the latter author could be because of the type of breed used for the study and composition of the experimental diet. Similar reports were made by Pineda (1986) and Pezo *et al.* (1992) who reported that *Erythrina* foliage was less effective when compared with soyabean meal or fish meal in improving the weight gain of lactating ruminants.

Table 4.2.1. Average age of doe in days at first mating in different treatment groups

	Treatment groups (Mean ± SE)			
	T_1	T_2	T_3	T_4
1st parity	180.20±0.20	180.20±0.37	179.40±0.24	179.40±0.24
2nd parity	257.60±0.51	258.00±0.45	256.20±0.37	256.40±0.68
3rd parity	319.50±16.51	335.33±1.33	333.20±0.37	334.00±0.63
4th parity	398.75±16.60	414.33±1.86	411.80±0.37	413.20±0.58
5th parity	477.50±16.84	494.00±1.00	490.60±0.51	492.20±0.37

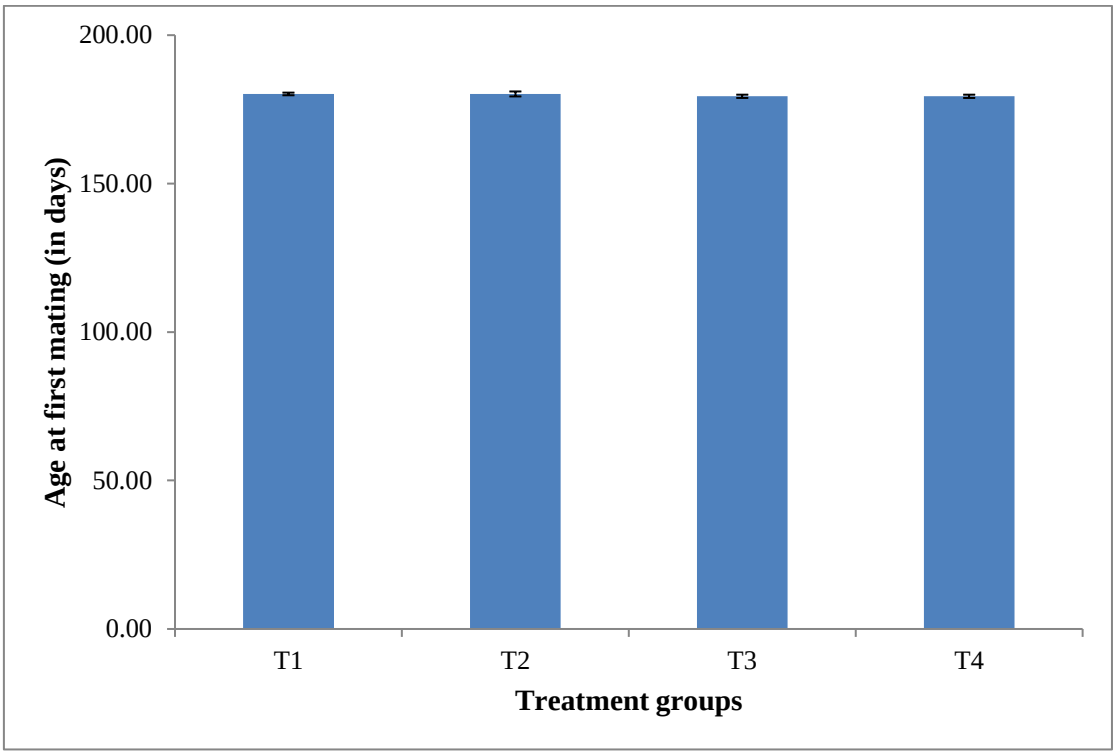
SE- Standard error, each value is the mean of five observations

Table 4.2.2. Average body weight of doe in kilograms at first mating in different treatment groups

	Treatment groups (Mean ± SE)			
	T_1	T_2	T_3	T_4
1st parity	2.20 ± 0.02^{a}	2.31 ± 0.03^{b}	2.59 ± 0.02^{c}	2.51 ± 0.01^{c}
2nd parity	2.22±0.04	2.36±0.05	2.64±0.02	2.53±0.01
3rd parity	2.30±0.03	2.48±0.02	2.66±0.03	2.54±0.02
4th parity	2.35±0.03	2.56±0.03	2.74±0.02	2.61±0.03
5th parity	2.43±0.03	2.63±0.02	2.79±0.02	2.66±0.03

SE- Standard error, each value is the mean of five observations
HSD critical range = 0.09
Means followed by a common superscript letter are not significantly different

Fig.4.2.1. Average age of doe in days at first mating in different treatment groups



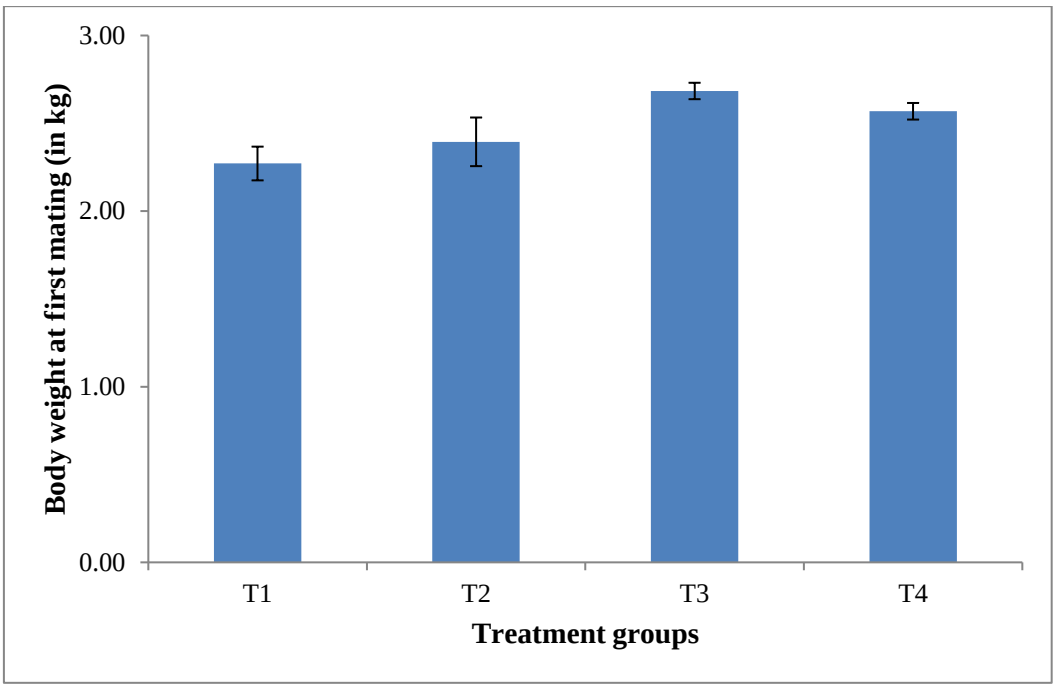
T1 - Treatment one

T2 - Treatment two

T3 - Treatment three

T4 - Treatment four

Fig.4.2.2. Average body weight of doe in kilograms at first mating in different treatment groups



T1 - Treatment one

T2 - Treatment two

T3 - Treatment three

T4 - Treatment four

4.2.3. Age of doe at first kindling

The effect of Indian coral plant (*Erythrina stricta*) on age of female doe at first kindling is presented in Table 4.2.3. The pattern in different treatment groups is demonstrated in Fig.4.2.3 and the statistical analysis has been depicted in Appendix-B (ANOVA-7).

Average age at first kindling in T_1, T_2, T_3 and T_4 groups did not differ significantly ($P \geq 0.05$) among the groups with a record of 211.20 days, 210.80 days, 209.80 days and 209.60 days, respectively. The results when compared with the works of Roy *et al.* (2002) who had reported no significant difference ($P \geq 0.05$) on age at first kindling (average 200 days) when doe were offered til oil cake, soybean meal and gram with *ad libitum* green grasses indicated that the supplementation of the Indian coral plant was observed to be better at achieving an earlier age at kindling.

4.2.4. Weight of doe at first kindling

The effect of Indian coral plant (*Erythrina stricta*) on the body weight of doe at first kindling is summarized in Table 4.2.4. The pattern has been graphically illustrated in Fig.4.2.4. and the results of the statistical analysis is given in Appendix-B (ANOVA-8). The mean body weight at first kindling for T_1, T_2, T_3 and T_4 groups was recorded as 2.32 kg, 2.46 kg, 2.72 kg and 2.61 kg, respectively. Statistical analysis showed significant differences ($P \leq 0.05$) among the treatment groups. Treatment groups T_3 and T_4 had higher recorded body weight at kindling followed by T_2 and T_1 groups as reported by Solarte (1989); Larbi *et al.* (1993); Kongmanila *et al.* (2012); Pasupathi *et al.* (2017). The recorded values had lower body weight than rabbit doe supplemented with *Hyphaenethebaica* having an average recorded kindling weight of 3.4 kg ($P \geq 0.05$) as per Hassanien *et al.* (2020). Differences in recorded kindling weight could be because of the type of breed and composition of the diet used for the experiment as reported by Pineda (1986) and Pezo *et al.* (1992).

Table 4.2.3. Average age of doe in days at first kindling in different treatment groups

	Treatment groups (Mean ± SE)			
	T_1	T_2	T_3	T_4
1st parity	211.20±0.58	210.80±0.37	209.80±0.37	209.60±0.51
2nd parity	288.50±0.29	288.40±0.81	286.40±0.51	286.80±0.73
3rd parity	350.75±16.26	367.00±1.53	364.40±0.60	365.20±0.49
4th parity	430.00±16.34	445.67±1.20	443.00±0.45	444.40±0.51
5th parity	508.75±16.60	525.67±0.67	521.80±0.49	523.60±0.75

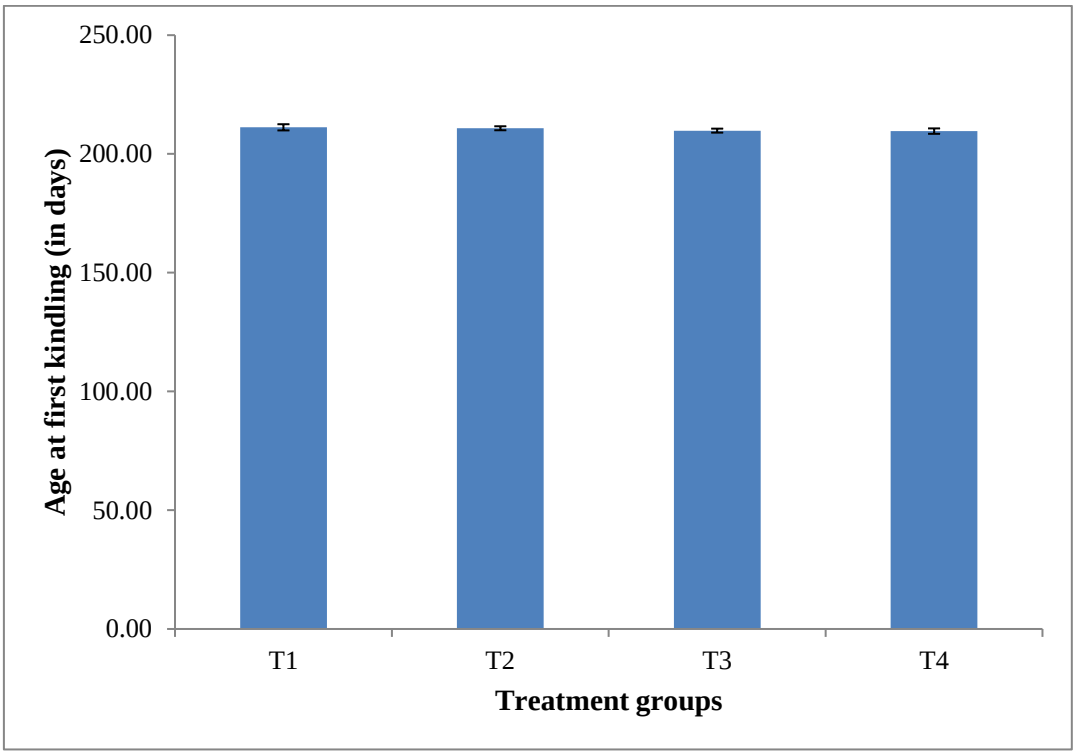
SE- Standard error, each value is the mean of five observations

Table 4.2.4. Average body weight of doe in kilograms at first kindling in different treatment groups

	Treatment groups (Mean ± SE)			
	T_1	T_2	T_3	T_4
1st parity	$2.32±0.03^a$	$2.46±0.05^b$	$2.72±0.02^c$	$2.61±0.01^c$
2nd parity	2.32±0.06	2.49±0.05	2.77±0.03	2.63±0.01
3rd parity	2.43±0.02	2.64±0.01	2.79±0.04	2.66±0.02
4th parity	2.52±0.02	2.75±0.05	2.90±0.03	2.73±0.04
5th parity	2.58±0.04	2.77±0.01	2.94±0.02	2.82±0.03

SE- Standard error, each value is the mean of five observations
HSD critical range = 0.12
Means followed by a common superscript letter are not significantly different

Fig.4.2.3. Average age of doe in days at first kindling in different treatment groups



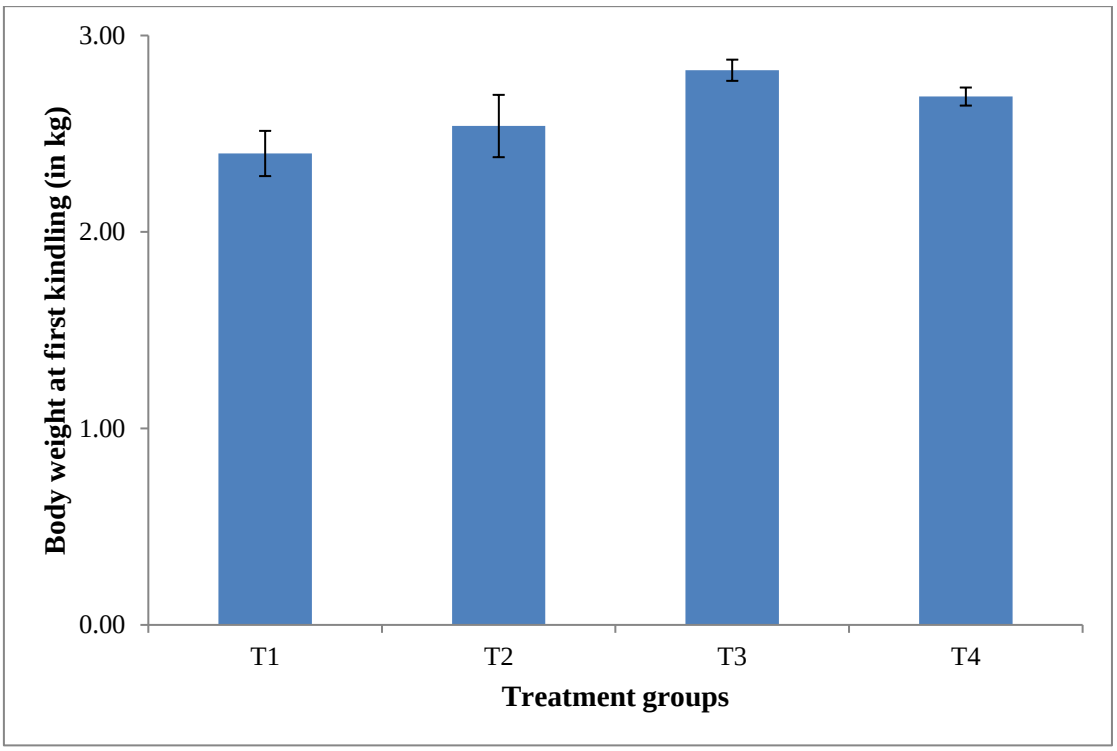
T1 - Treatment one

T2 - Treatment two

T3 - Treatment three

T4 - Treatment four

Fig.4.2.4. Average body weight of doe in kilograms at first kindling in different treatment groups



T1 - Treatment one

T2 - Treatment two

T3 - Treatment three

T4 - Treatment four

4.2.5. Litter size at birth

The effect of Indian coral plant (*Erythrina stricta*) on average litter size at birth is presented in Table 4.2.5. The pattern in different treatment groups is demonstrated in Fig.4.2.5 and the statistical analysis has been depicted in Appendix-B (ANOVA-9).

The mean number of litter size at birth recorded for T_1, T_2, T_3 and T_4 groups was 5.37, 6.02, 6.76 and 6.72, respectively. Statistical analysis indicated significant variation ($P \leq 0.05$) among the treatment groups where supplemented groups T_3, T_4 and T_2 had larger number of litter size compared to non supplemented T_1 group. Several other authors reported average number of litter size of 5 to 6 when rabbit doe were offered forages of *Stylosanthes hamata, Talinum triangulare, Moringa oleifera, Commelina diffusa, Ficus ingens, Calopogonium mucunoides, Centrosema pubescens, Tridax procumbens, Panicum maximum, Gomphrena spp* and *Hyphaenethebaica* at different levels (Erakpotobor *et al.*, 2008; Iheukwumere, 2008; Odeyinka *et al.*, 2008; Ezea *et al.*, 2015; Hassanien *et al.*, 2020). Therefore, feeding Indian coral plant (*Erythrina stricta*) to Soviet Chinchilla rabbit gave similar number of litter sizes of 5 to 6 when fed with other common forages.

4.2.6. Litter weight at birth

The effect of Indian coral plant (*Erythrina stricta*) on average litter weight at birth is represented in Table 4.2.6 and is graphically shown in Fig. 4.2.6. The statistical analysis for different treatment groups is demonstrated in Appendix-B (ANOVA-10).

The mean litter weight at birth for T_1, T_2, T_3 and T_4 groups was recorded as 49.62 g, 49.41 g, 47.32 g and 46.26 g, respectively. Analysis of variance (ANOVA) indicated no significant difference ($P \geq 0.05$) among the

treatment groups. The present findings was in agreement with the reports of Erakpotobor *et al.* (2008), Iheukwumere (2008), Odeyinka *et al.* (2008), Ezea *et al.* (2015) and Hassanien *et al.* (2020) who had recorded average litter weight ranging from 40 to 55 g when female rabbit doe were provided varying levels of forages such as *Stylosanthes hamata*, *Talinum triangulare*, *Moringa oleifera*, *Commelina diffusa*, *Ficus ingens*, *Calopogonium mucunoides*, *Centrosema pubescens*, *Tridax procumbens*, *Panicum maximum*, *Gomphrena spp.* and *Hyphaenethebaica*. Lower litter weight at birth recorded in *Erythrina* treated groups compared to non supplemented group was due to an inverse correlation between litter size and litter weight where kits of small litter size were observed to be heavier than kits from a large litter.

Table 4.2.5. Average number of litter size at birth in different treatment groups

	Treatment groups (Mean ± SE)			
	T_1	T_2	T_3	T_4
1st parity	4.60±0.24	5.40±0.40	5.80±0.37	5.60±0.24
2nd parity	5.00±0.41	5.60±0.40	6.20±1.39	6.60±0.40
3rd parity	6.25±0.63	7.33±0.67	6.80±0.37	7.40±0.40
4th parity	6.25±0.63	6.67±0.67	7.40±0.51	7.00±0.45
5th parity	6.00±0.41	6.33±0.88	7.60±0.68	7.00±0.45
Mean ± SE	$5.37±0.38^{a}$	$6.02±0.29^{ab}$	$6.76±0.41^{b}$	$6.72±0.14^{b}$

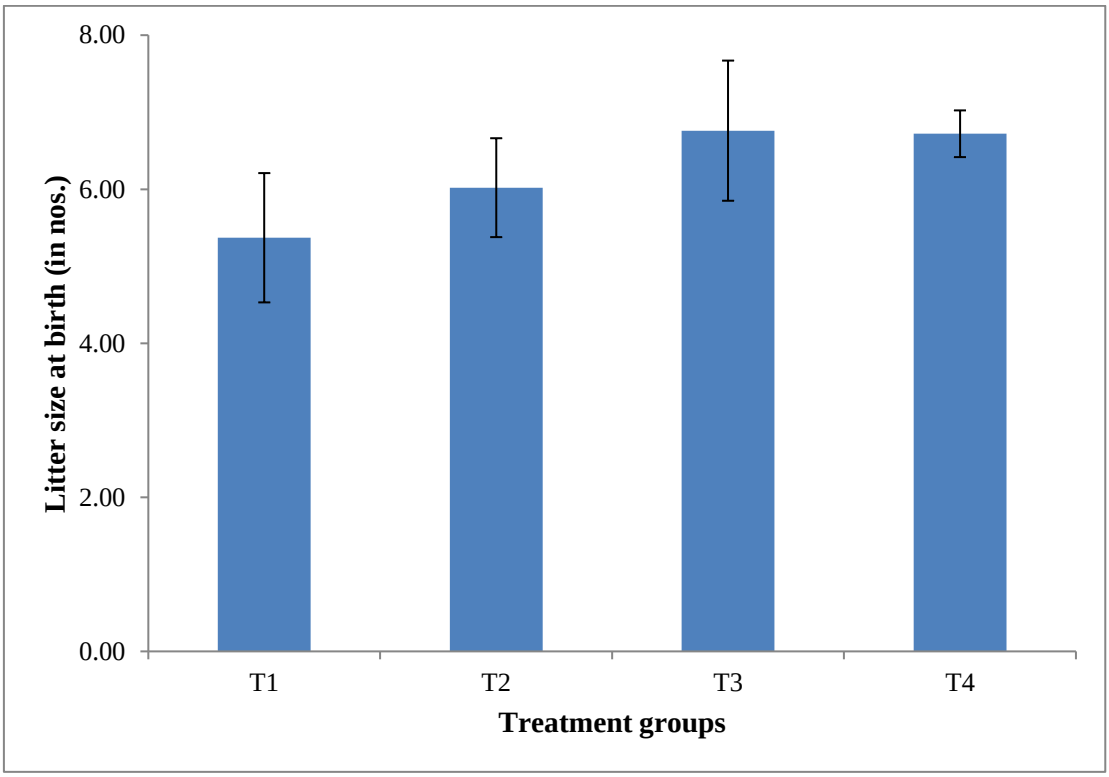
SE- Standard error, each value is the mean of five observations
HSD critical range = 1.29
Means followed by a common superscript letter are not significantly different

Table 4.2.6. Average litter weight in grams at birth in different treatment groups

	Treatment groups (Mean ± SE)			
	T_1	T_2	T_3	T_4
1st parity	51.65±0.62	67.16±1.83	50.12±1.31	50.45±0.88
2nd parity	49.38±1.82	49.43±1.66	49.11±4.66	47.14±2.21
3rd parity	47.82±1.50	45.47±3.01	47.69±2.51	45.05±1.84
4th parity	48.29±3.22	47.02±2.88	44.22±2.10	44.55±3.19
5th parity	48.78±2.44	49.14±4.07	45.46±3.42	44.13±2.65
Mean ± SE	49.62±0.83	49.41±1.20	47.32±1.00	46.26±0.75

SE- Standard error, each value is the mean of five observations

Fig.4.2.5. Average number of litter size at birth in different treatment groups



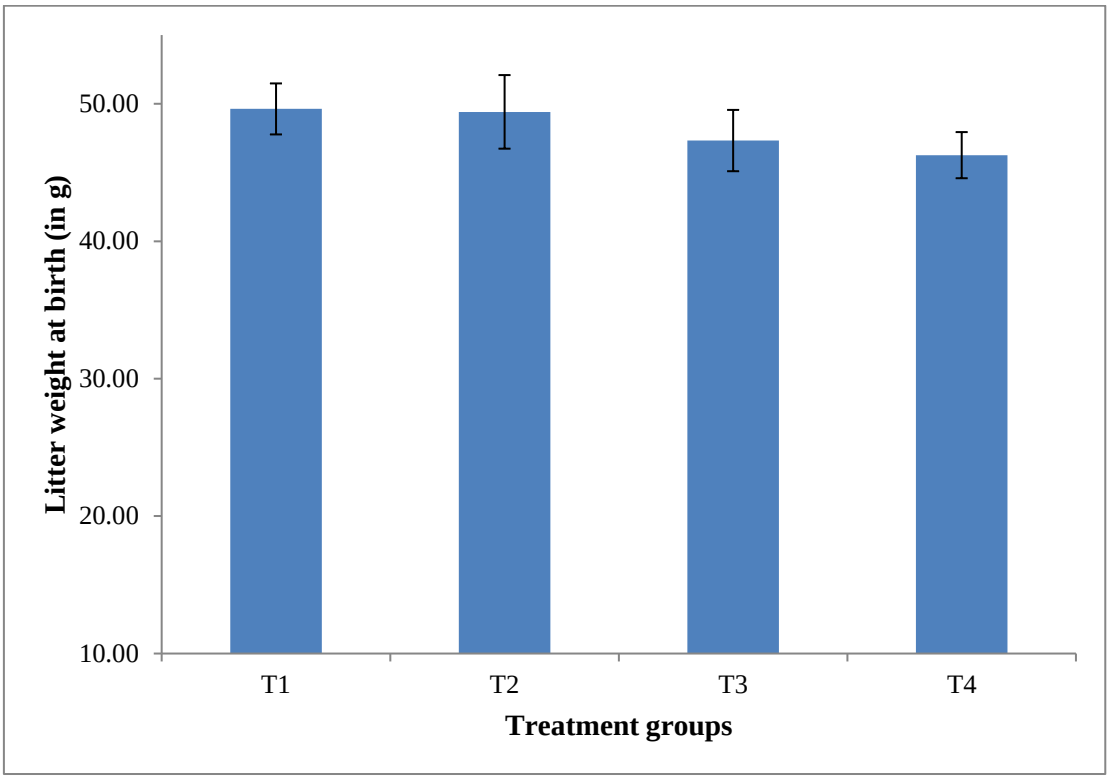
T1 - Treatment one

T2 - Treatment two

T3 - Treatment three

T4 - Treatment four

Fig.4.2.6. Average litter weight in grams at birth in different treatment groups



T1 - Treatment one

T2 - Treatment two

T3 - Treatment three

T4 - Treatment four

4.2.7. Litter size at weaning

The effect of Indian coral plant (*Erythrina stricta*) on average litter size at weaning is presented in Table 4.2.7. The pattern in different treatment groups is demonstrated in Fig.4.2.7 and the statistical analysis has been depicted in Appendix-B (ANOVA-11).

The mean number of litter size at weaning for T_1, T_2, T_3 and T_4 groups was recorded as 5.46, 5.86, 6.40 and 6.52, respectively. Litter size number was observed to be statistically in non-significant ($P \geq 0.05$) among the treatment groups. Similar number of litter sizes at weaning were obtained when fed forages of *Stylosanthes hamata*, *Talinum triangulare*, *Moringa oleifera*, *Commelina diffusa*, *Ficus ingens*, *Calopogonium mucunoides*, *Centrosema pubescens*, *Tridax procumbens*, *Panicum maximum*, *Gomphrena spp* and *Hyphaenethebaica* at different levels as reported by Erakpotobor *et al.* (2008), Iheukwumere (2008), Odeyinka *et al.* (2008), Ezea *et al.* (2015) and Hassanien *et al.* (2020), the present findings has confirmed that Indian coral plant (*Erythrina stricta*) can be used as a potential forage for nursing doe and suckling rabbit.

4.2.8. Litter weight at weaning

The effect of Indian coral plant (*Erythrina stricta*) on average litter weight at weaning is represented in Table 4.2.8 and is graphically shown in Fig. 4.2.8. The statistical analysis for different treatment groups is demonstrated in Appendix-B (ANOVA-12).

The mean litter weight at weaning for T_1, T_2, T_3 and T_4 groups was recorded as 420.02 g, 434.70 g, 478.87 g and 496.46 g, respectively. Statistical analysis indicated significant variation ($P \leq 0.05$) among the treatment groups. Heavier litter weight at weaning was recorded in T_4 group followed by T_3, T_2 and T_1 groups. The present study resulted in better weaning

weight of the litters as compared with Erakpotobor *et al.* (2008) who had reported average litter weight of 300 to 400 g when doe were provided different combinations of *Stylosanthes hamata*. Moreover, higher weight at weaning recorded in T_4 group fed with 100 per cent *Erythrina* forages indicated that the experimental plant could improve the performance of rabbit as also reported by Solarte (1989); Larbi *et al.* (1993); Kongmanila *et al.* (2012); Pasupathi *et al.* (2017).

Table 4.2.7. Average number of litter size at weaning in different treatment groups

	Treatment groups (Mean ± SE)			
	T_1	T_2	T_3	T_4
1st parity	4.75±0.25	5.20±0.37	4.80±0.73	5.40±0.24
2nd parity	5.00±0.41	5.20±0.20	5.80±1.24	6.20±0.20
3rd parity	6.25±0.63	7.00±0.58	6.80±0.37	7.40±0.40
4th parity	6.25±0.63	6.67±0.67	7.40±0.51	6.60±0.40
5th parity	6.00±0.41	6.33±0.88	7.20±0.37	7.00±0.45
Mean ± SE	5.46±0.41	5.86±0.18	6.40±0.33	6.52±0.17

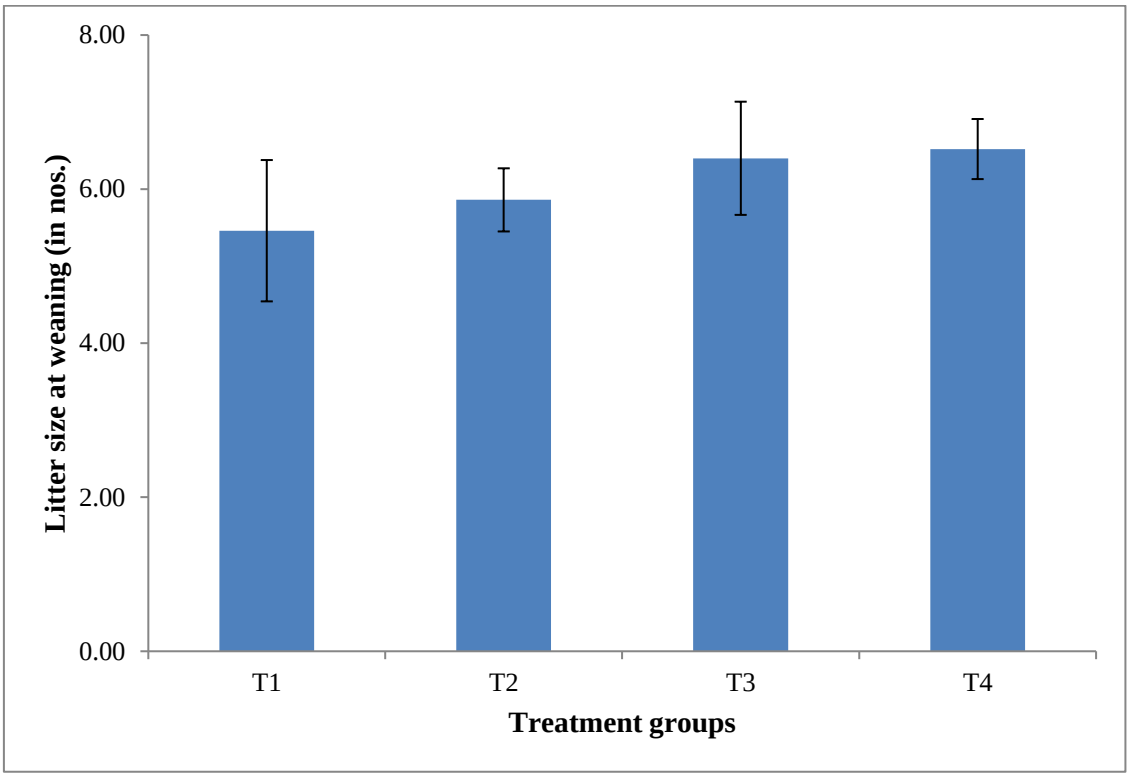
SE- Standard error, each value is the mean of five observations

Table 4.2.8. Average litter weight in grams at weaning in different treatment groups

	Treatment groups (Mean ± SE)			
	T_1	T_2	T_3	T_4
1st parity	420.04±14.98	451.90±18.64	541.57±15.45	561.25±4.86
2nd parity	422.17±20.60	458.69±2.74	528.99±51.28	538.42±15.00
3rd parity	419.80±26.56	372.23±29.35	421.09±21.41	367.48±11.90
4th parity	395.35±13.32	427.60±33.72	445.32±27.59	510.81±24.95
5th parity	407.31±20.85	421.23±33.57	457.39±19.29	504.35±22.39
Mean ± SE	$420.02±14.70^{a}$	$434.70±8.79^{ab}$	$478.87±14.68^{bc}$	$496.46±8.33^{c}$

SE- Standard error, each value is the mean of five observations
HSD critical range = 48.65
Means followed by a common superscript letter are not significantly different

Fig.4.2.7. Average number of litter size at weaning in different treatment groups



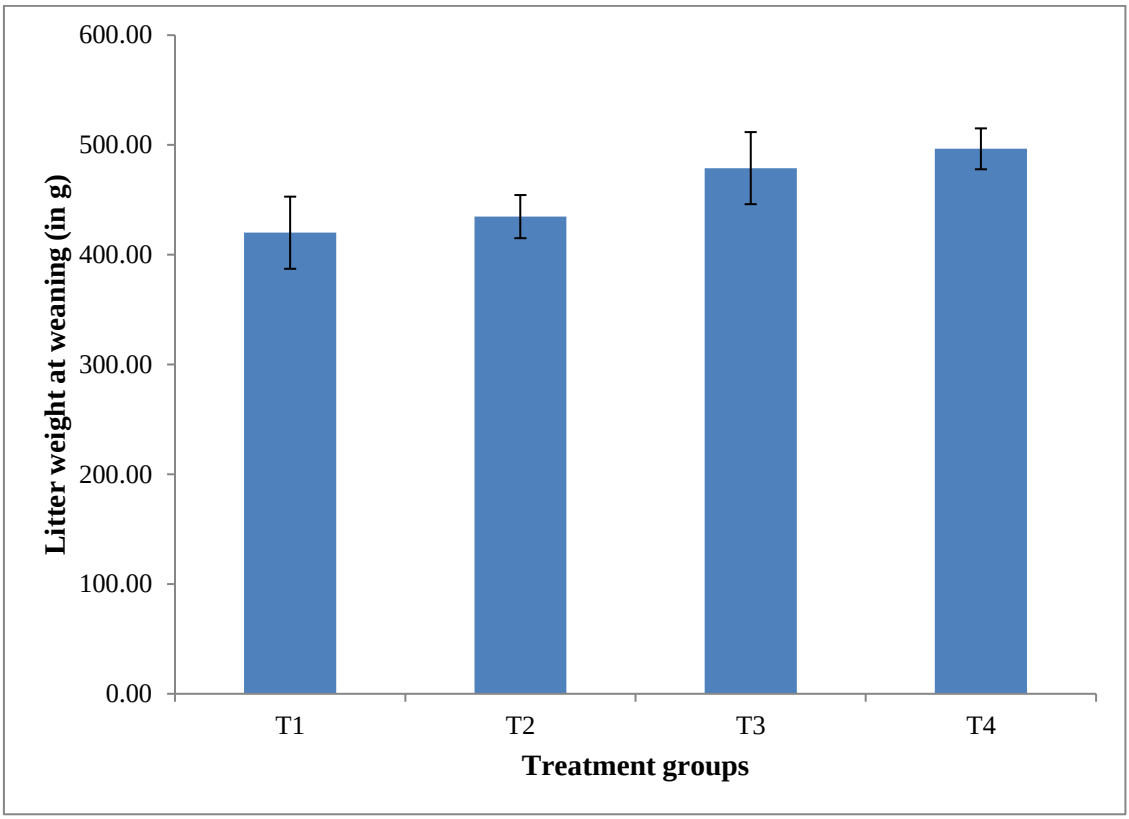
T1 - Treatment one

T2 - Treatment two

T3 - Treatment three

T4 - Treatment four

Fig.4.2.8. Average litter weight in grams at weaning in different treatment groups



T1 - Treatment one

T2 - Treatment two

T3 - Treatment three

T4 - Treatment four

4.2.9. Inter-kindling period

The results of the effect of Indian coral plant (*Erythrina stricta*) on inter-kindling period of female doe is represented in Table 4.2.9 and graphically depicted in Fig.4.2.9. Statistical analysis is shown in Appendix-B (ANOVA-13).

The mean inter-kindling period recorded for T_1, T_2, T_3 and T_4 groups was 79.10 days, 78.65 days, 78.00 days and 78.50 days, respectively. No significant variation ($P \geq 0.05$) was observed among the treatment groups. The result findings were similar with Das and Bujarbaruah (2007) who had reported inter-kindling of 70 to 80 days in rabbit doe fed with 50 per cent pelleted feed and 50 per cent green roughage.

4.2.10. Number of crops per doe per year

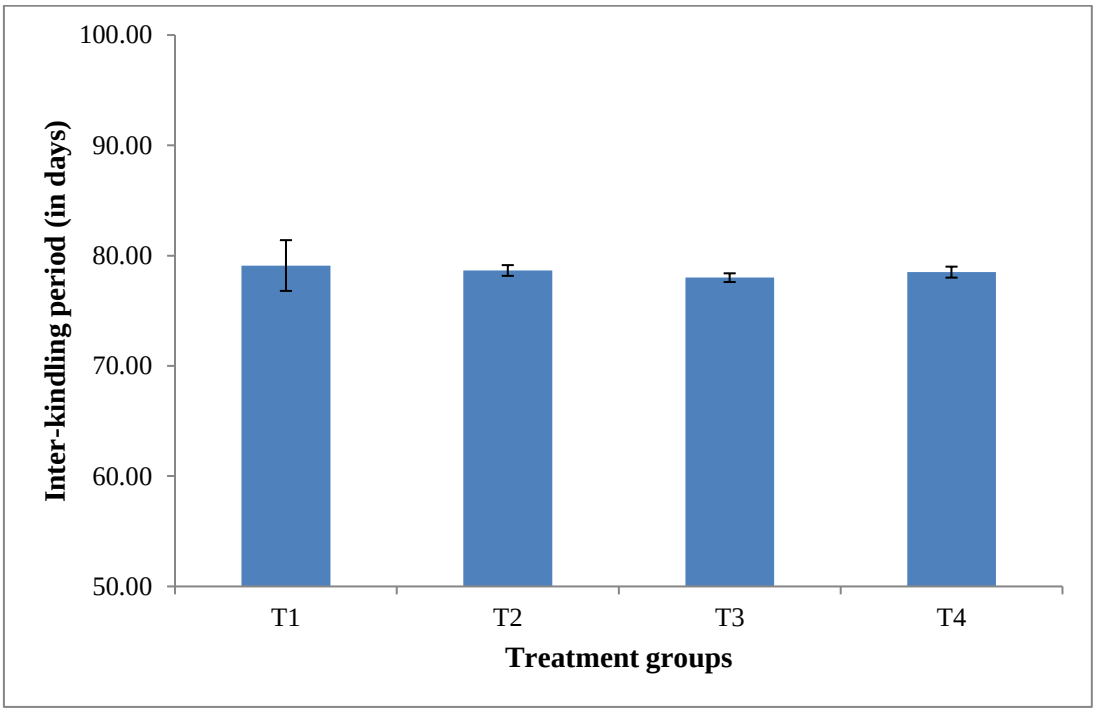
Data recorded for average number of crops per doe per year in T_1, T_2, T_3 and T_4 groups was 4.20, 3.80, 5.00 and 5.00, respectively. Analysis of variance as shown in Appendices (ANOVA-14) did not show any significant difference ($P \geq 0.05$) among the treatment groups. The present findings was in agreement with the recorded average number of crops per doe per year of 4 to 5 as reported by Das and Bujarbaruah (2007); Das and Sikka (2007) when green roughages was supplemented in the diet of Soviet Chinchilla rabbit doe. Therefore, Indian coral plants available in almost all parts of the region could be included in rabbit diet at various levels up to 100 per cent achieving similar results to the other common forages without exhibiting adverse effects.

Table 4.2.9. Average inter-kindling period in days of doe in different treatment groups

	Treatment groups (Mean ± SE)			
	T_1	T_2	T_3	T_4
1^{st} - 2^{nd} parity	80.80±3.07	77.60±0.93	76.60±0.40	77.20±0.66
2^{nd} - 3^{rd} parity	78.67±0.67	79.33±0.67	78.00±0.32	78.40±0.40
3^{rd} - 4^{th} parity	79.25±0.25	78.67±0.33	78.60±0.51	79.20±0.37
4^{th} - 5^{th} parity	78.75±0.75	80.00±0.58	78.80±0.66	79.20±0.49
Mean ± SE	79.10±1.03	78.65±0.22	78.00±0.18	78.50±0.22

SE- Standard error, each value is the mean of five observations

Fig.4.2.9. Average inter-kindling period in days of doe in different treatment groups



T1 - Treatment one

T2 - Treatment two

T3 - Treatment three

T4 - Treatment four

4.3. Morbidity and Mortality

4.3.1. Productive performance

The morbidity, mortality rate and liveability for productive performance in different treatment groups are shown in Table 4.3.1.

Cases of loose motion and diarrhoea were not observed during the experimental period which supported the findings of Sonia *et al.* (2011) who had reported that *Erythrina* foliage was used as an anti diarrhoeal herb for animals. The gut health of the rabbits improved with supplementation of the coral plant with no signs of digestive upset, intestinal stasis or toxicity from consuming the fodder. Other authors had reported the same when *Erythrina spp.* was supplemented in the diet (Solarte, 1989 and Aregheore, 2004). There were no reported cases of morbidity and mortality during the observation period up to six months of age from any of the treatment groups giving 100 per cent liveability.

4.3.2. Reproductive performance

The morbidity, mortality rate and liveability for reproductive performance in different treatment groups are given in Table 4.3.2 and graphically depicted in Fig 4.3.2. Mortality rate is statistically presented in Appendix-C (ANOVA-15).

Incidences of greyish brown scabs was observed in both the ear canals of rabbit does from T_1R_4, T_1R_5, T_2R_3, T_3R_1, T_3R_5, T_4R_3 and T_4R_4 during the experimental period. The affected rabbits were individually treated by removing the ear scabs with a dressing forceps and cleaned properly (Plate-16A) using cotton balls dipped in 3 per cent hydrogen peroxide solution and himax ointment was applied liberally and topically. The procedure was carried out only once during the experimental period with positive result. Rabbit doe from T_1R_2, T_2R_1 and T_2R_3 showed signs of lethargic movement

with reduced feed intake and could not be used further for breeding after the second crop. Loose motion (Plate-16B) and mortality was recorded in six kits from T_1R_4 and five kits from T_3R_3 group, total two kits from groups T_2R_4 and T_2R_5 each; three kits from T_3R_1 and one from T_3R_3 was stillbirth while four bunnies from T_4R_2 and one from T_4R_3 died with no signs of illness prior to weaning period. No cases of morbidity or mortality were reported after weaning period.

Overall mortality rate recorded throughout the reproductive period in the treatment groups was 5.97 per cent, 3.96 per cent, 3.24 per cent and 2.85 per cent, respectively with liveability of 94.03 per cent, 96.04 per cent, 96.76 per cent and 97.15 per cent, respectively. Analysis of variance (ANOVA) indicated no significant variation ($P \geq 0.05$) among the treatment groups.

When result findings were compared with the reports made by Alemede *et al.* (2014) who had recorded neo natal mortality rate of 1.33 per cent, 0.33 per cent, 0.33 per cent and 0.50 per cent when doe were fed a diet of *Moringa oleifera* leaf meal at different levels, Hassanien *et al.* (2020) who had recorded pre-weaning mortality percentage of 13.8, 11.8, 3.75, 3.4 when *Hyphaenethebaica* was supplemented in the diet as well as higher recorded pre-weaning mortality ranging from 10 to 80 per cent cited in various papers (Marykutty and Nandakumar, 2000; Roy *et al.*, 2002; Hasanat *et al.*, 2006; Iheukwumere, 2008) when rabbits doe were offered concentrate and *ad lib* guinea grass; til oil cake, soybean meal, gram with *ad lib* green grasses; conventional feeds with concentrate; concentrate and *Talinum triangulare*, respectively; the Indian coral plant had potential as alternative rabbit fodder giving low mortality rate.

PLATE-16

A. Scabs were removed and cleaned in adult rabbits

B. Loose motion in pre weaned kits

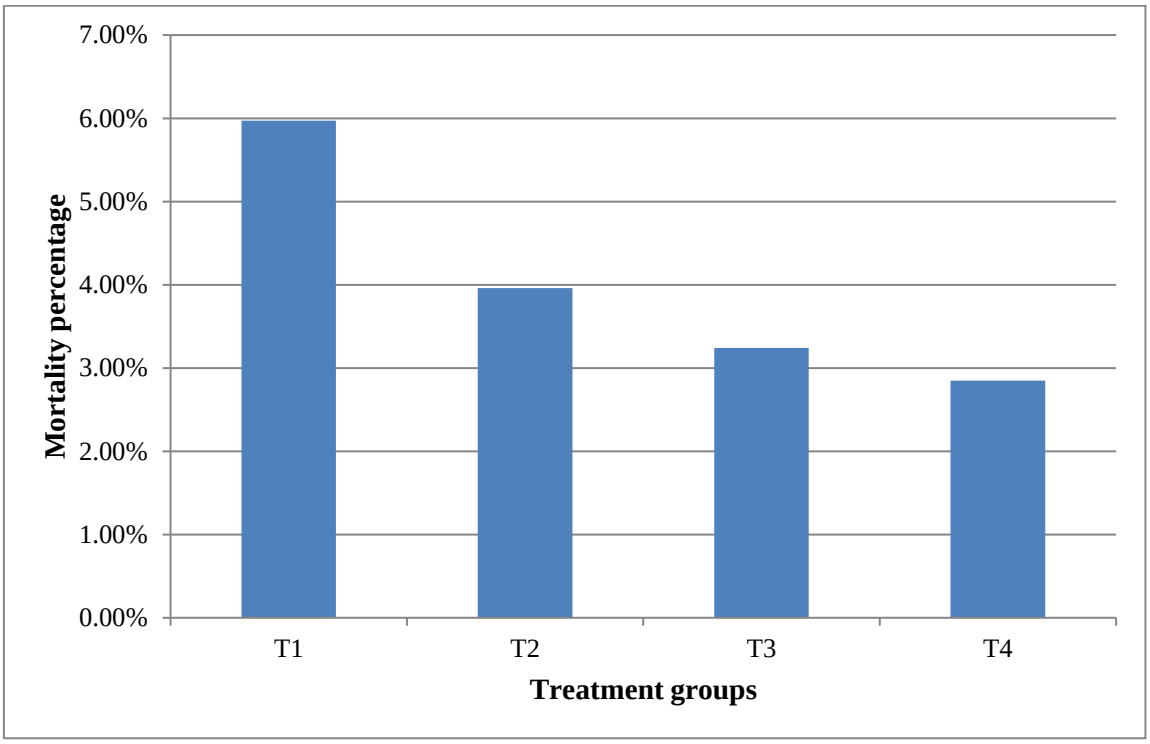
Table 4.3.1: Morbidity, mortality rate and liveability for productive performance in different groups

	Treatment groups			
	T_1	T_2	T_3	T_4
No. of bunnies died	Nil	Nil	Nil	Nil
Mortality rate	0.00	0.00	0.00	0.00
Liveability	100.00	100.00	100.00	100.00

Table 4.3.2: Morbidity, mortality rate and liveability for reproductive performance in different groups

Rabbits of different age groups	Treatment groups			
	T_1	T_2	T_3	T_4
Does/Bucks				
No. of diseased rabbits	3	3	2	2
No. of dead adult rabbits	Nil	Nil	Nil	Nil
Kits (Pre weaned)				
No. of diseased kits	6	4	9	5
No. of dead kits	6	4	9	5
Bunnies (Post weaned)				
No. of diseased bunnies	Nil	Nil	Nil	Nil
No. of dead bunnies	Nil	Nil	Nil	Nil
Mortality rate	5.97	3.96	3.24	2.85
Liveability	94.03	96.04	96.76	97.15

Fig.4.3.2. Mortality rate in different treatment groups



T1 - Treatment one

T2 - Treatment two

T3 - Treatment three

T4 - Treatment four

4.4. Performance at farmers' field

Primary data collected from the selected respondents through questionnaires is given in Appendix-D.

4.4.1. General profile of the farmers

General profile of the rural rabbit farmers is given in Table 4.4.1 and presented graphically in Fig. 4.4.1.

Women were also observed to be higher in number than male from the selected rabbit rearers in Kohima village with an age group of 40 to 60 years as majority. Family size ranged from 1 to 7 members. The respondents completed high school, graduate and post graduate studies. They were actively involved in the village council and had accessed to different sources of media. Most of the respondents were either in service or other self employed jobs as their primary occupation while livestock rearing was their secondary source of income. Livestock preference was given to rabbit farming followed by poultry and piggery. Annual family income ranged between ₹10,000 to ₹30,000 per month.

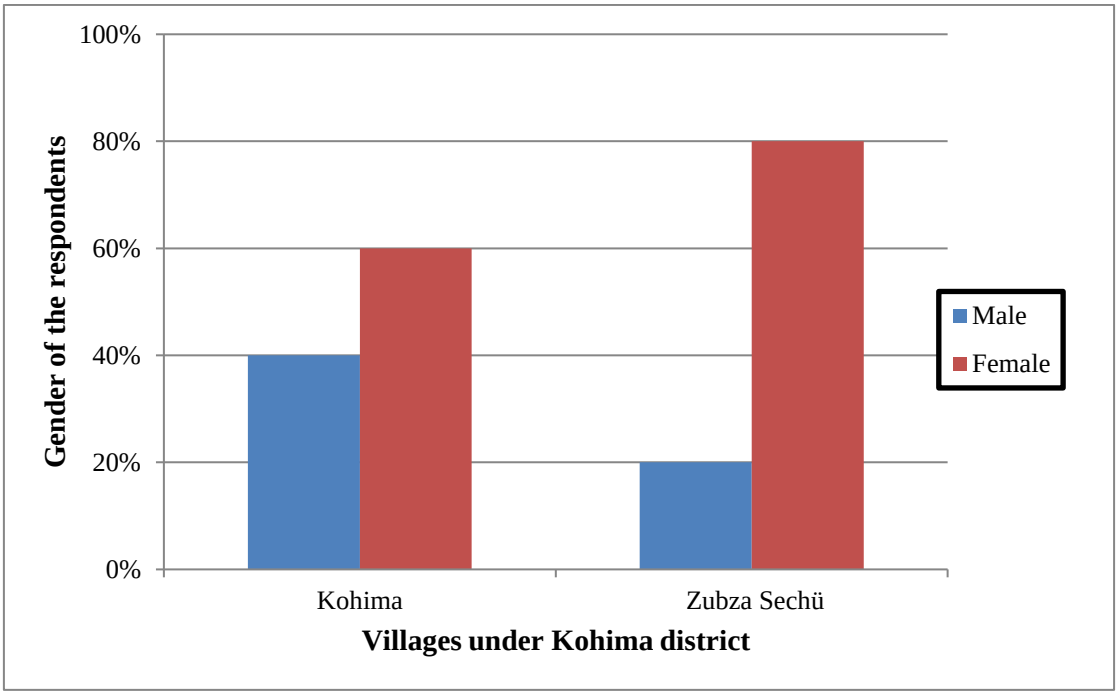
The primary data collected from Zubza Sechü village of Kohima district, the selected respondents mainly engaged in rabbit farming were female generally falling between the age group of 40 to 60 years. Family size ranged between 3 to 7 members. Majority of the respondents were literate, they had accessed to different sources of media like All India Radio and Doordashan and were active participants in the village council. The respondents were mainly dependent on livestock rearing with rabbit rearing as a subsidiary source of income followed by poultry, piggery and other services. Annual family income per month ranged between ₹1000 to ₹25,000.

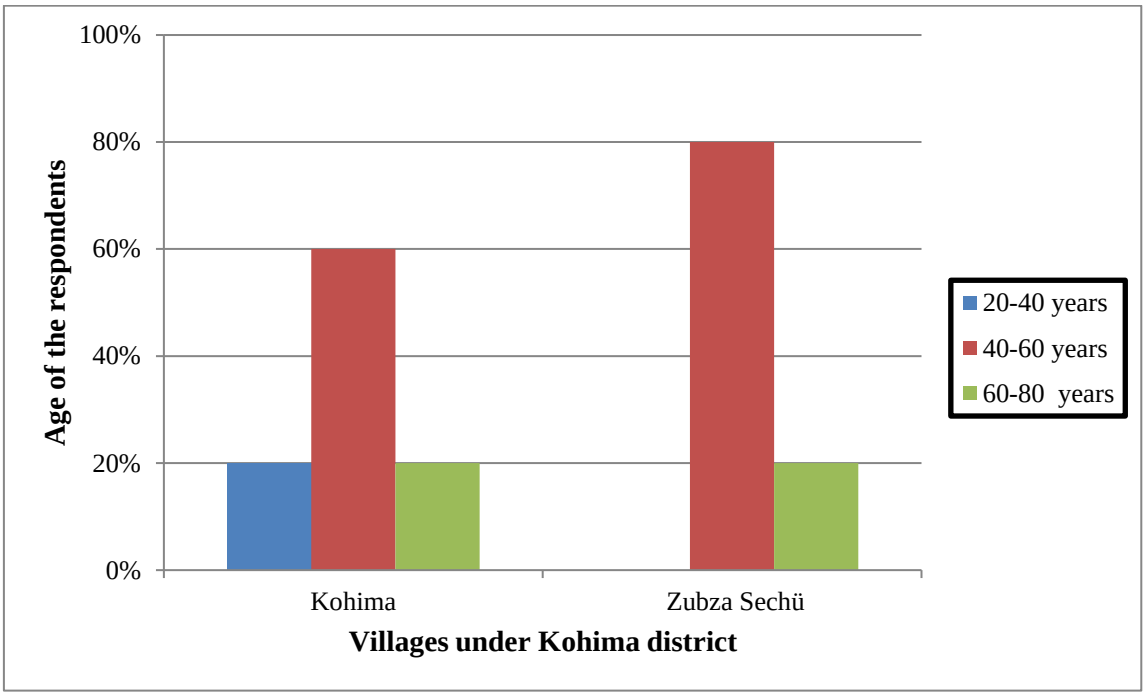
Table 4.4.1. General profile of the respondents

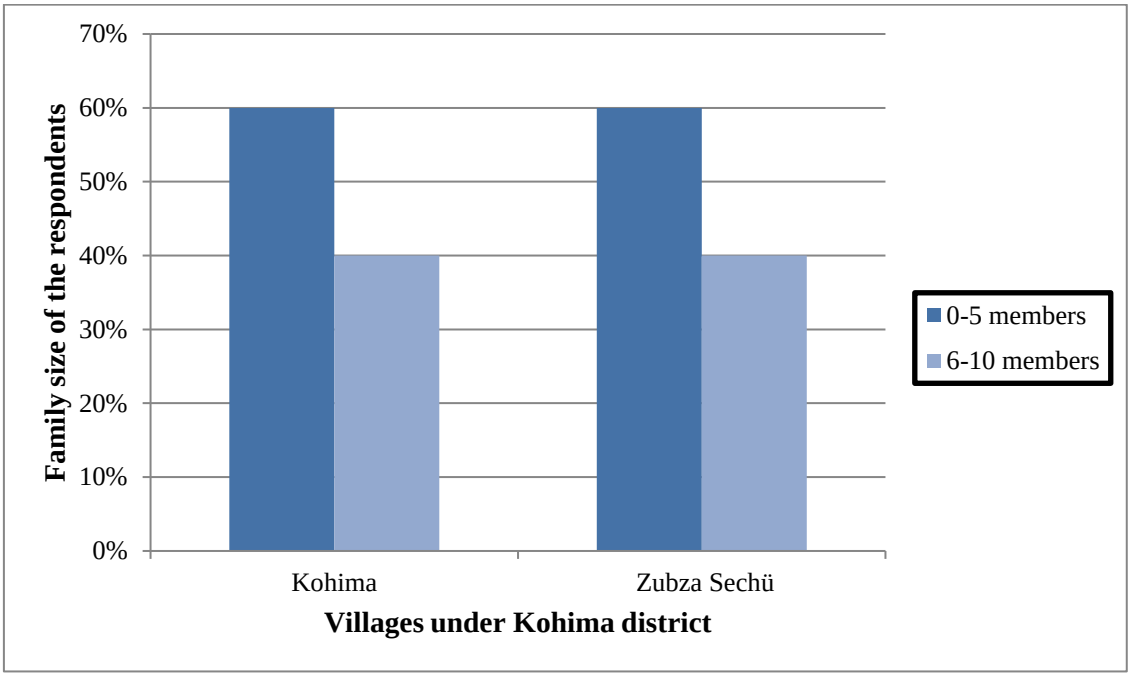
Sl.no.	Characteristics	Category	Zubza Sechü village		Kohima village	
			No.	Percentage	No.	Percentage
1.	Gender	Male	1	20	2	40
		Female	4	80	3	60
2.	Age	20-40	0	0	1	20
		40-60	4	80	3	60
		60-80	1	20	1	20
3.	Family size	0-5	3	60	3	60
		6-10	2	40	2	40
4.	Educational qualification	Illiterate	1	20	0	0
		Primary	0	0	0	0
		Secondary	1	20	0	0
		High school	2	40	2	40
		Graduate	1	20	2	40
		Post graduate	0	0	1	20
5.	Sources of media	Newspaper	4	80	5	100
		Television	4	80	3	60
		Radio	2	40	1	20

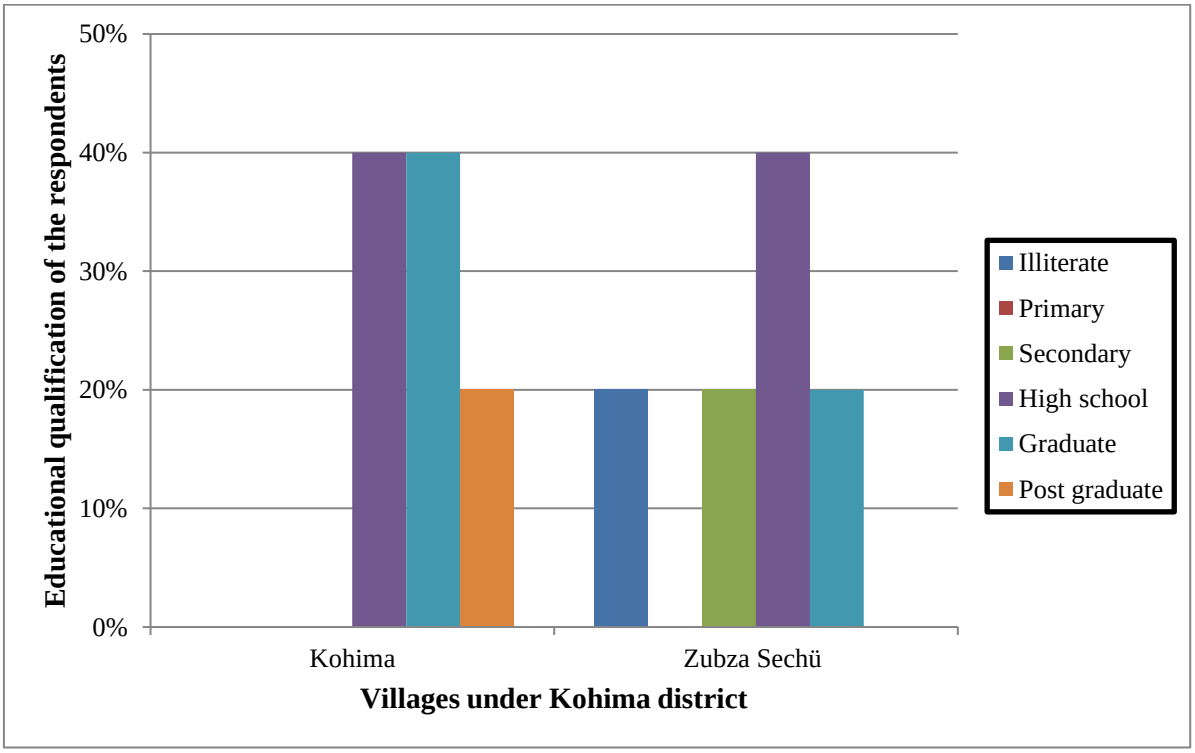
		Village council	2	40	2	40
6.	Main occupation	Agriculture	0	0	0	0
		Livestock	2	40	1	20
		Service	2	40	2	40
		Others	1	20	2	40
7.	Annual family income (per month)	₹1000-5000	1	20	0	0
		₹5000-10,000	2	40	0	0
		₹10,000-15,000	0	0	2	40
		₹15,000-20,000	1	20	2	40
		₹20,000-25,000	1	20	0	0
		₹25,000-30,000	0	0	1	20
8.	No. of livestock owned	Rabbits	44	59.46	68	82.93
		Poultry	28	37.84	12	14.63
		Pigs	2	2.70	2	2.45
		Cattle	0	0	0	0
		Goats	0	0	0	0

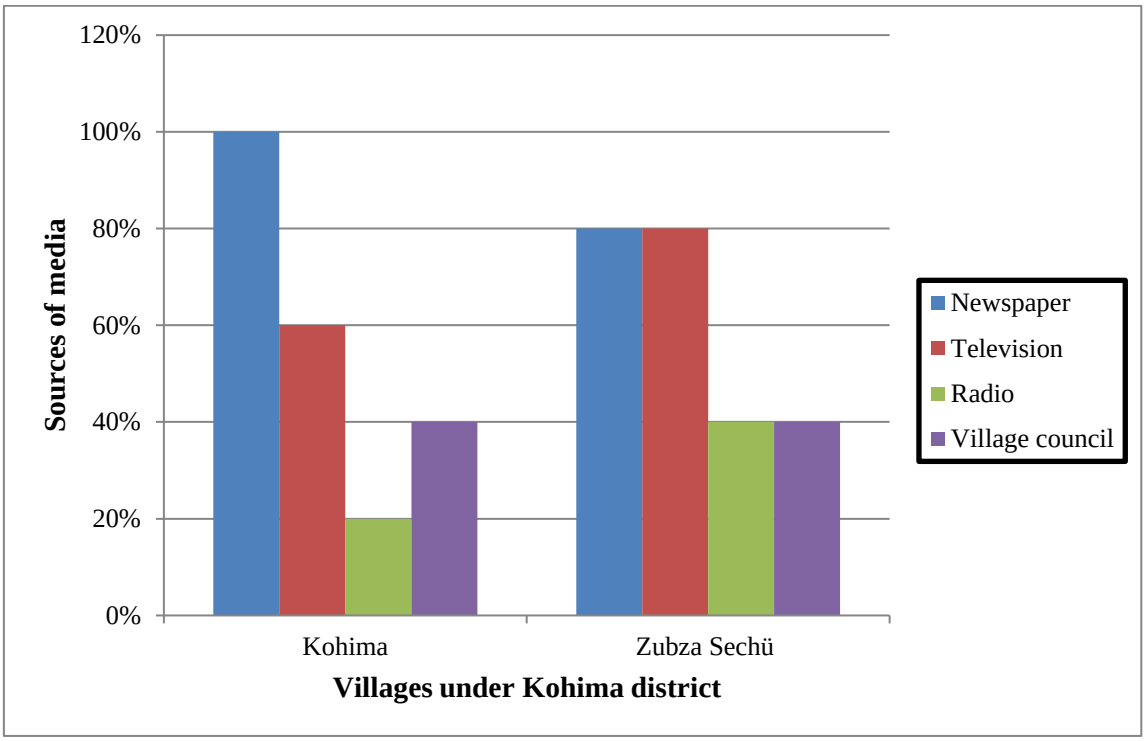
Fig. 4.4.1. General profile of the rural rabbit farmers

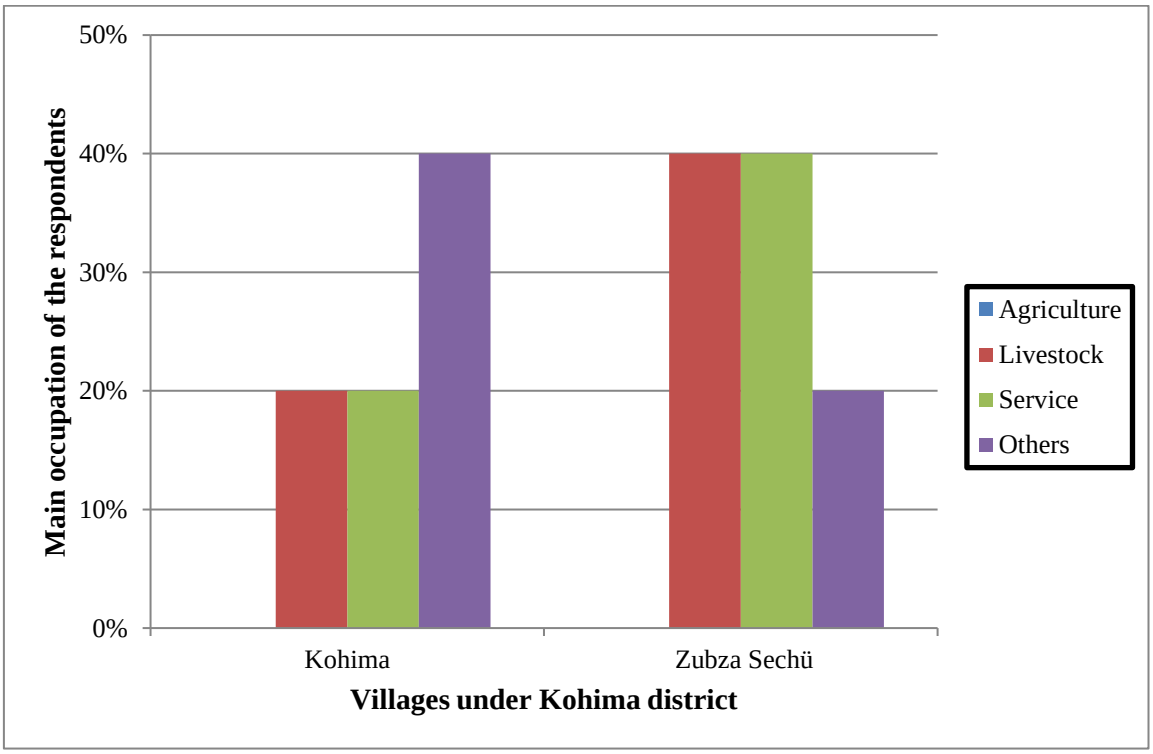


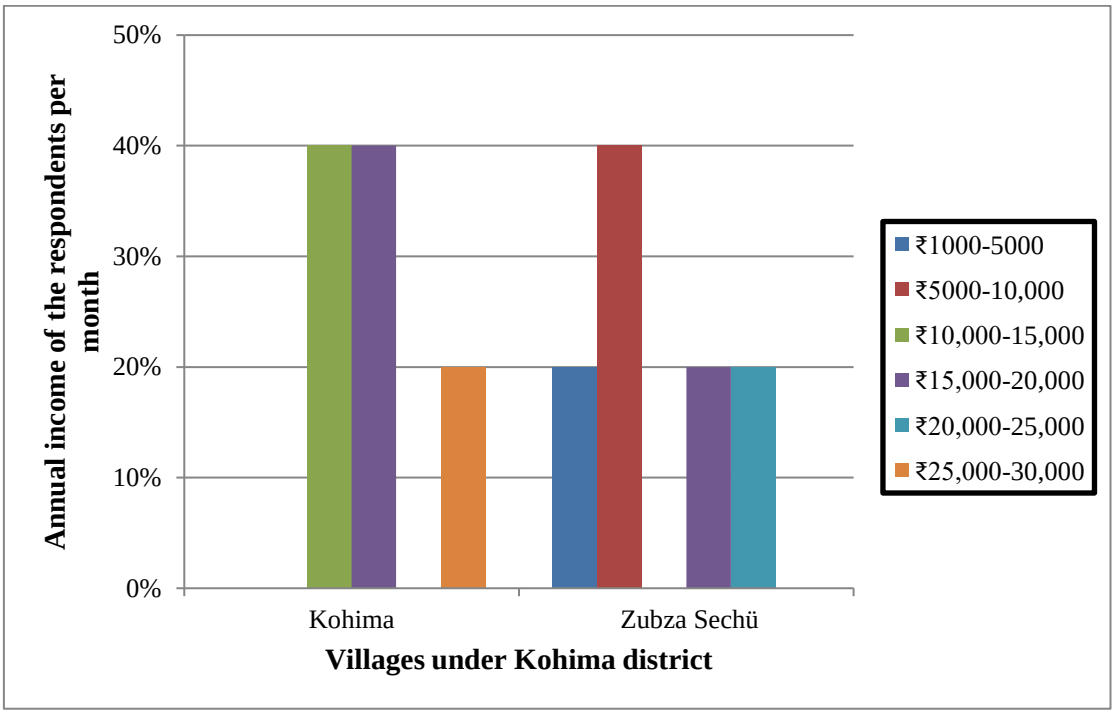


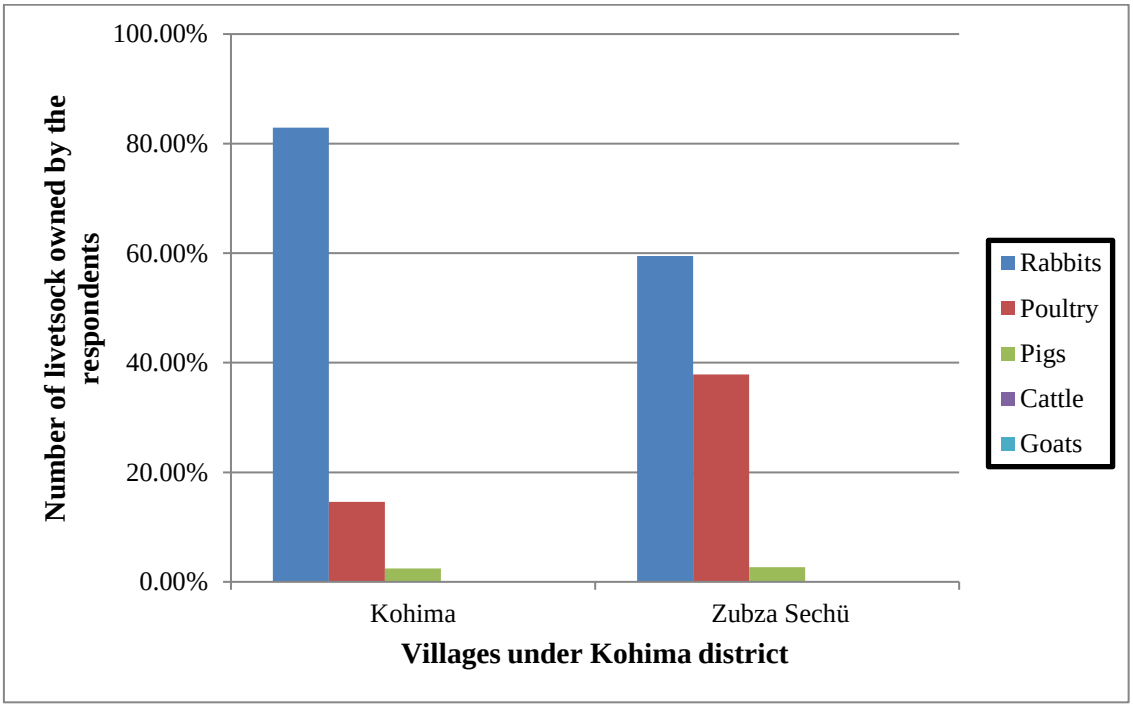

70%
60%
50%
40%
30%
20%
10%
0%
Family size of the respondents
0-5 members
6-10 members
Kohima
Zubza Sechü
Villages under Kohima district


50%
40%
30%
20%
10%
0%
Educational qualification of the respondents
Illiterate
Primary
Secondary
High school
Graduate
Post graduate
Kohima
Zubza Sechü
Villages under Kohima district


120%
100%
80%
60%
40%
20%
0%
Sources of media
Kohima
Zubza Sechü
Villages under Kohima district
Newspaper
Television
Radio
Village council


50%
40%
30%
20%
10%
0%
Main occupation of the respondents
Kohima
Zubza Sechü
Villages under Kohima district
Agriculture
Livestock
Service
Others


50%
40%
30%
20%
10%
0%
Annual income of the respondents per month
Kohima
Zubza Sechü
Villages under Kohima district
₹1000-5000
₹5000-10,000
₹10,000-15,000
₹15,000-20,000
₹20,000-25,000
₹25,000-30,000


100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
Number of livetsock owned by the respondents
Kohima
Zubza Sechü
Villages under Kohima district
Rabbits
Poultry
Pigs
Cattle
Goats

4.4.2. General information of rabbit farming

Primary field data on rabbit farming is presented in Table 4.4.2 and shown graphically in Fig.4.4.2.

Commonly preferred breed in Kohima village was Soviet Chinchilla followed by New Zealand White, Flemish Black and Grey Giant raised in wooden and wire netted cage while few used hutch system of housing. Feeds provided constituted mainly of kitchen wastes, local forages, wheat bran, boiled rice and soaked chickpea. Cost incurred were procurement of wheat bran at the rate of ₹30 per kg and bunnies at the rate of ₹430 per pair. Rabbits were raised for family consumption as well as sale in the market at an average rate of ₹660 per pair for bunny and ₹520 per kg adult weight.

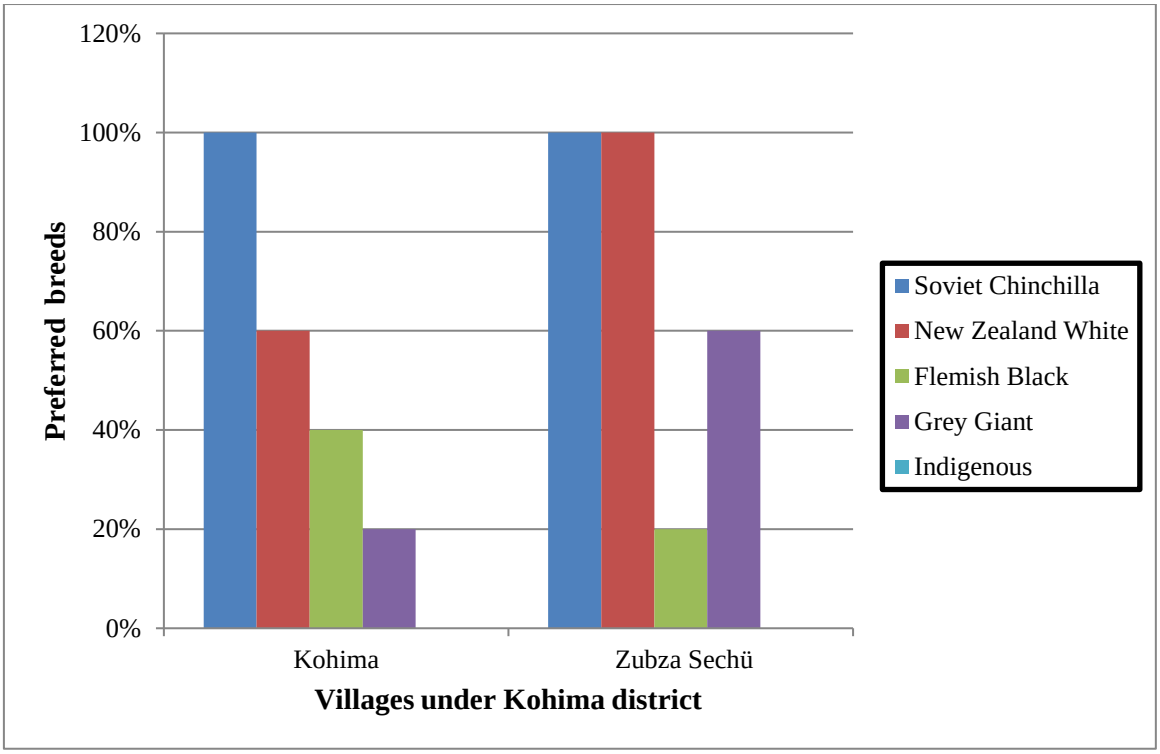
The selected respondents of Zubza Sechü village preferred breeds of Soviet Chinchilla and New Zealand White followed by Grey Giant and Flemish Black commonly reared in wooden cage or hutch system of housing constructed with locally available raw materials. Composition of the diet consisted of wheat bran, boiled rice, kitchen wastes, locally available leaves, soaked chickpea and grounded maize where cost inputs was only on wheat bran at the rate of ₹30 per kg and procurement of the bunnies at the rate of ₹470 per pair. Rabbits were reared for both family consumption as well as market demands with an average selling rate of ₹700 per pair for bunny and ₹560 per kg for adult rabbit.

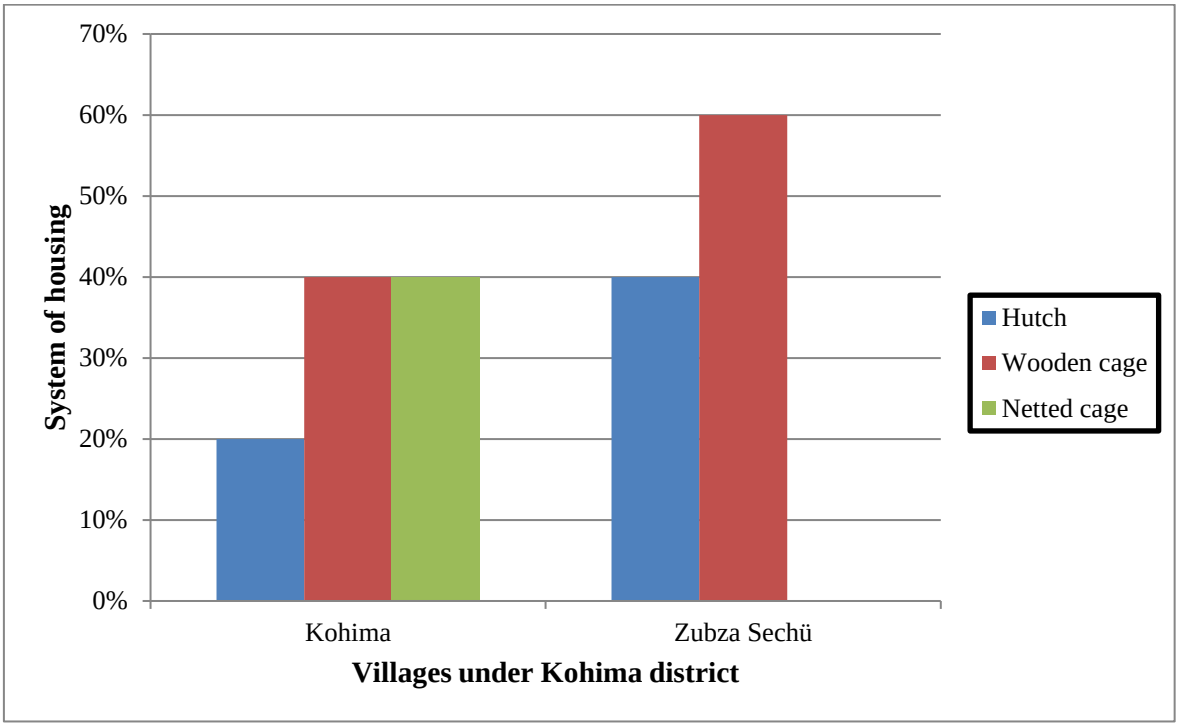
Table 4.4.2. General information on rabbit farming

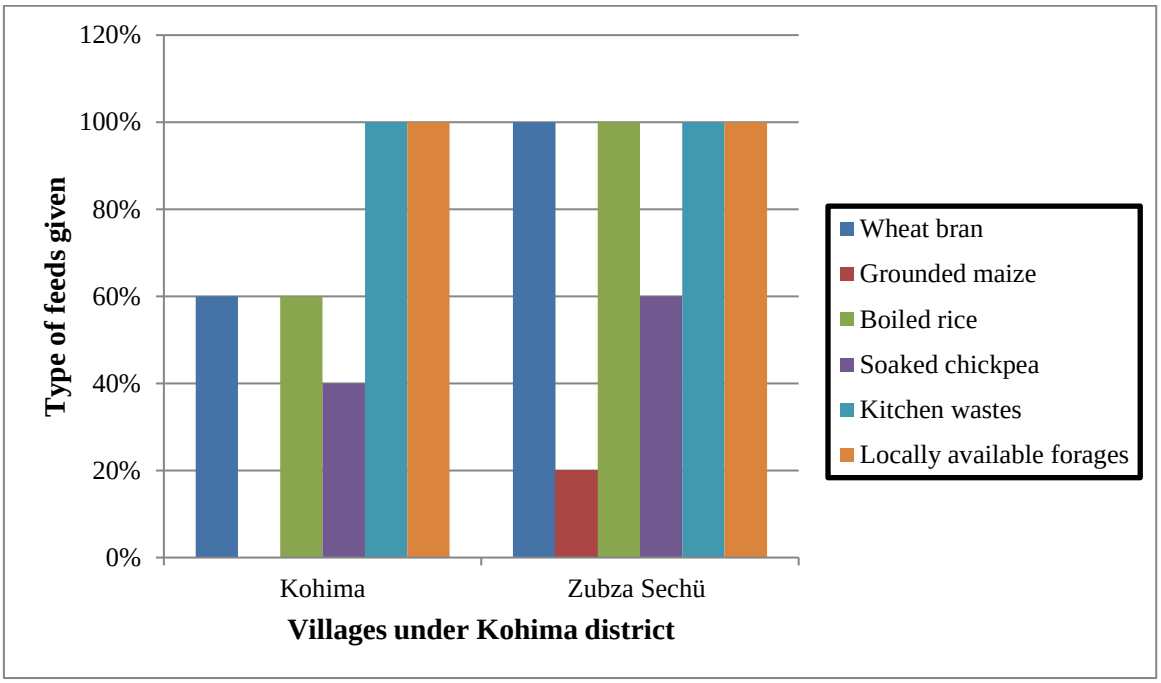
Sl.no.	Characteristics	Category	Zubza Sechü village		Kohima village	
			No.	Percentage	No.	Percentage
1.	Preferred breeds	Soviet Chinchilla	5	100	5	100
		New Zealand White	5	100	3	60
		Flemish Black	1	20	2	40
		Grey Giant	3	60	1	20
		Indigenous	0	0	0	0
2.	System of housing	Hutch	2	40	1	20
		Wooden cage	3	60	2	40
		Wire netted cage	0	0	2	40
3.	Type of feeds given	Wheat bran	5	100	3	60
		Grounded maize	1	20	0	0
		Boiled rice	5	100	3	60
		Soaked chickpea	3	60	2	40
		Kitchen	5	100	5	100

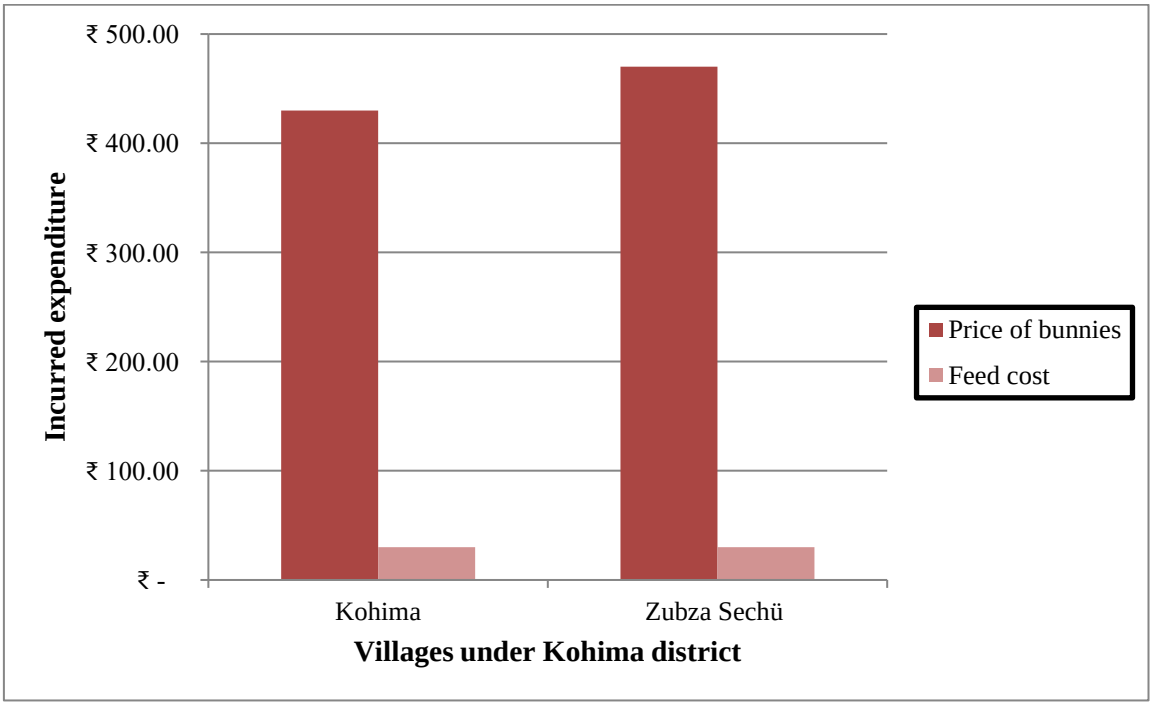
		wastes				
		Locally available leaves	5	100	5	100
4.	Incurred expenditure (Average rate)	Price of bunnies per pair	₹470	-	₹430	-
		Feed cost per kg	₹30	-	₹30	-
5.	Distribution of meat	Family consumption	3	60	3	60
		Market	5	100	5	100
6.	Selling price (Average rate)	Bunnies per pair	₹700	-	₹660	-
		Adults per kg	₹560	-	₹520	-

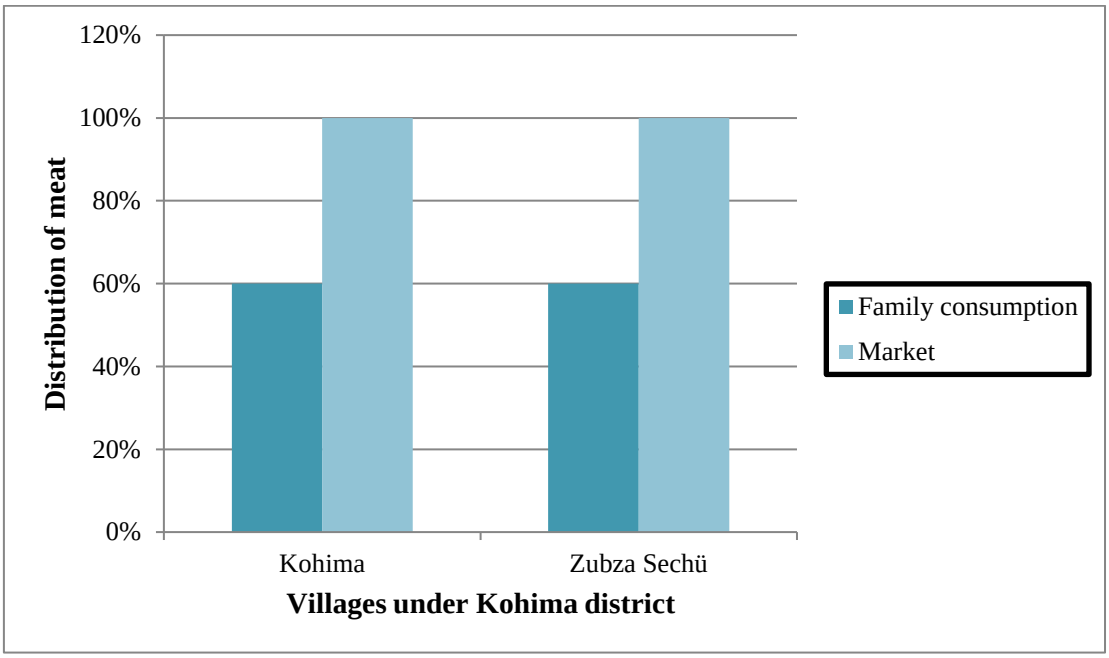
Fig. 4.4.2. General information on rabbit farming

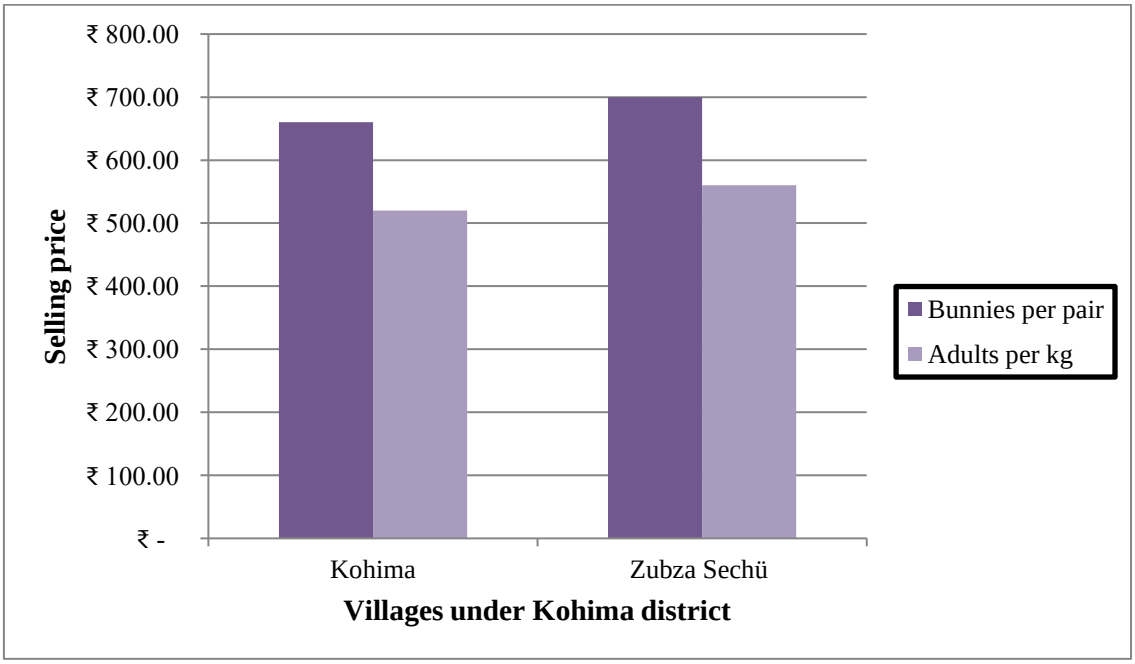





120%
100%
80%
60%
40%
20%
0%
Type of feeds given
Kohima
Zubza Sechü
Villages under Kohima district
Wheat bran
Grounded maize
Boiled rice
Soaked chickpea
Kitchen wastes
Locally available forages


₹ 500.00
₹ 400.00
₹ 300.00
₹ 200.00
₹ 100.00
₹ -
Incurred expenditure
Kohima
Zubza Sechü
Villages under Kohima district
Price of bunnies
Feed cost


120%
100%
80%
60%
40%
20%
0%
Distribution of meat
Kohima
Zubza Sechü
Villages under Kohima district
Family consumption
Market


₹ 800.00
₹ 700.00
₹ 600.00
₹ 500.00
₹ 400.00
₹ 300.00
₹ 200.00
₹ 100.00
₹ -
Selling price
Kohima
Zubza Sechü
Villages under Kohima district
Bunnies per pair
Adults per kg

4.4.3. Body weight and reproductive performance of Soviet Chinchilla rabbit fed Indian coral plants (*Erythrina stricta*)

Primary data on the Indian coral plant (*Erythrina stricta*) as rabbit forage is presented in Table 4.4.3.1 and graphically presented in Fig 4.4.3.1.

The Indian coral plant (*Erythrina stricta*) was found to be available in plenty and distributed across different areas both in Kohima and Zubza Sechü villages. The respondents residing in both the villages were well aware of the plant also known as "Hutuo" in local language and had been utilizing the fodder as rabbit forage. Positive responses were received from all the selected respondents of both the villages that the Indian coral plant (*Erythrina stricta*) when incorporated in the diet was reported to be relished and preferred by the rabbits over other forage plants.

The findings agreed with the reports made by Phouthavong *et al.* (1998) who had reported that *Erythrina variegata* was commonly utilized by the farmers as feed for livestock animals. In contradiction with the present study, only few respondents used *Erythrina variegata* as an animal feed due to lack of knowledge and availability of the plant (Kongmanila *et al*., 2008a; Kongmanila *et al*., 2012). Other authors (Whistler and Elevitch, 2006; Deb *et al.*, 2009) reported the use of *Erythrina spp.* as a multipurpose tree.

Primary data from the respondents on the body weight and reproductive performance of Soviet Chinchilla rabbit fed Indian coral plant (*Erythrina stricta*) is given in Table 4.4.3.2.

The primary data from the selected rabbit breeders from Kohima village, recorded an average values for initial and final body weight; age and weight at first mating; litter size at birth and weaning as: 0.62 kg, 2.30 kg; 7.00 months, 2.30 kg; 6.80 and 5.40, respectively. Cases of mortality at birth were reported by the respondents but there was no incidence of mortality after

weaning. Rabbit breeders from Zubza Sechü village recorded average values of initial and final body weight; age and weight at first mating; litter size at birth and weaning as 0.56 kg and 2.30 kg; 6.60 months and 2.30 kg; 6.20 and 5.00, respectively. The respondents reported incidences of dead kits foetus at birth. No mortality cases was reported after weaning.

The main reasons for kit mortality reported from both the villages were due to insufficient plucking of body hairs for nest making, trampling on the kits, stillbirth and the female doe not showing interest to nurse the new born during first two or three days and so the opined dead was due to starvation. Similar report was also made by Rossel (2005) who illustrated that the cause of mortality in kits were due to stillborn, starvation and hypothermia.

In view of the results recorded at farmers' field on supplementing Indian coral plant (*Erythrina stricta*) in rabbit diet, positive responses were received from the farmers. The respondents reported that on inclusion of the Indian coral plant (*Erythrina stricta*); there had been better feed intake and improvement of growth and reproductive performance and reduced health problems.

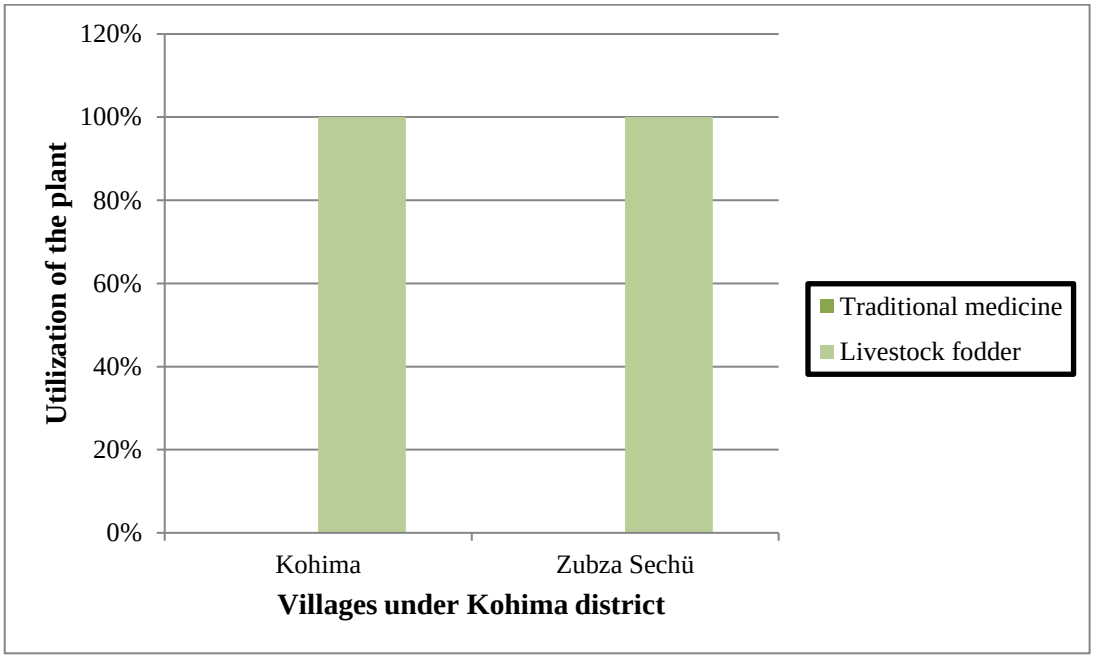
Table 4.4.3.1. Primary data on the Indian coral plant (*Erythrina stricta*) as rabbit forage

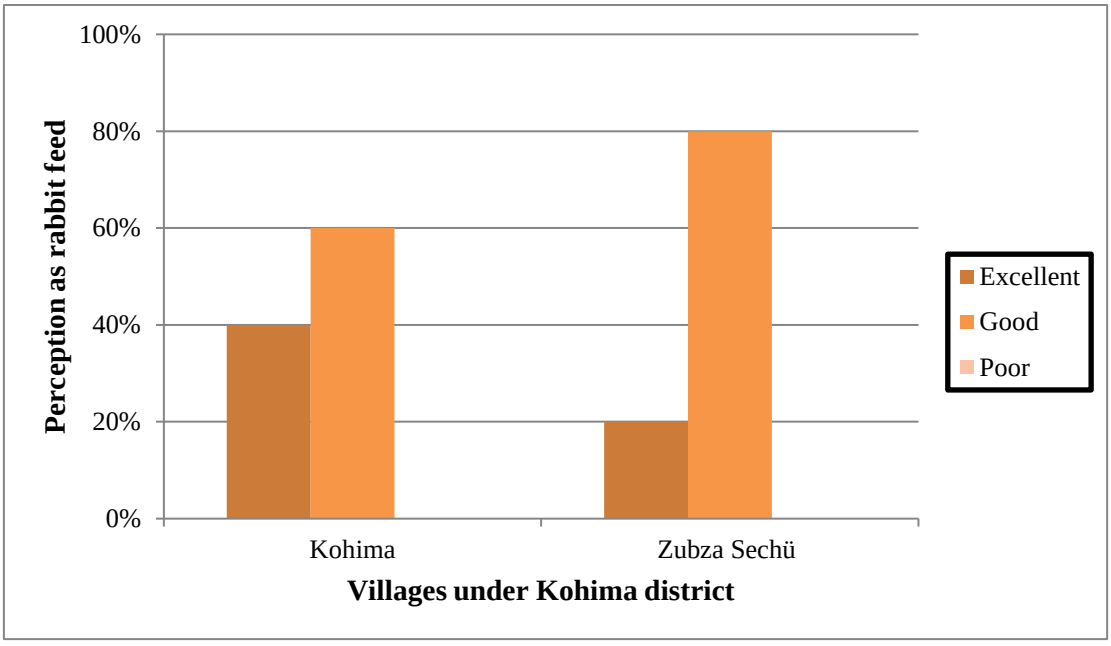
Sl.no.	Knowledge on Indian coral plant (*Erythrina stricta*)	Zubza Sechü village		Kohima village	
		No.	Percentage	No.	Percentage
1.	Availability of the plant	5	100	5	100
2.	Utilization of the plant				
	a) Traditional medicine	0	0	0	0
	b) Livestock fodder	5	100	5	100
3.	Perception as rabbit feed				
	a) Excellent	1	20	2	40
	b) Good	4	80	3	60
	c) Poor	0	0	0	0

Table 4.4.3.2. Body weight and reproductive performance of Soviet Chinchilla rabbits fed Indian coral plant (*Erythrina stricta*)

Sl.no.	Body weight and reproductive performance	Zubza Sechü village	Kohima village
1.	Average initial body weight (in kg)	0.56	0.62
2.	Average final body weight (in kg)	2.30	2.30
3.	Average age at first mating (in months)	6.60	7.00
4.	Average weight at first mating (in kg)	2.30	2.30
5.	Average litter size at birth (in nos.)	6.20	6.80
6.	Average litter size at weaning (in nos.)	5.00	5.40
7.	Mortality rate at birth	19.35	20.59
8.	Mortality rate at weaning	0.00	0.00

Fig. 4.4.3.1. Primary data on the Indian coral plant (*Erythrina stricta*) as rabbit forage





CHAPTER V

SUMMARY AND CONCLUSIONS

SUMMARY AND CONCLUSIONS

The present study entitled “Performance of Soviet Chinchilla rabbit on diet supplemented with Indian coral plant (*Erythrina stricta*)” was undertaken to carry out a research experiment with the objective to assess the effect of the plant on growth and reproductive performance of Soviet Chinchilla rabbit in the organised farm and farmers’ field condition.

The experimental research work was conducted at the Instructional Livestock Farm, Rabbit Unit, Department of Livestock Production and Management, School of Agricultural Sciences and Rural Development (SASRD), Nagaland University, Medziphema Campus of Dimapur district. A total of twenty four Soviet Chinchilla bunnies of sixty days old were randomly selected. The experimental animals were divided into four treatment groups marked as T_1, T_2, T_3 and T_4, respectively. Each experimental group consisted of five female and one male in the ratio of 5:1. All the animals selected for the experiment were allocated in individual cage up to six months of age. The female doe on attaining maturity weight and age was transferred and introduced in each galvanized wire mesh kindling cage. A nest box was provided to each kindling cage and was removed four weeks after parturition.

Measured quantity of concentrate feed in grams was provided to all the experimental animals of different age groups following feeding schedule as per Ranjhan (1993). Basal diet with mixtures of locally available foliages of banana (*Musa spp.*), jack fruit plants (*Artocarpus heterophyllus*), napier grasses (*Pennisetum purpureum*), hibiscus plants (*Hibiscus rosa-sinensis*), leaves and flowers of marigold (*Tagetes erecta*) were given to T_1 group at *ad libitum*, basal diet with mixtures of 66 per cent locally available fodders and 33 per cent Indian coral plants (*Erythrina stricta*) were provided to T_2 group,

basal diet with mixtures of 33 per cent locally available fodders and 66 per cent Indian coral plants (*Erythrina stricta*) were provided to T_3 groups and only Indian coral plants (*Erythrina stricta*) along with basal diet were supplied *ad lib* to T_4 group. Fresh clean drinking water was provided *ad lib* to each animal every day. Fortnightly recording of individual body weight in kilograms was taken up to six months of age and Average daily gain (ADG) in grams was calculated. Total feed intake was obtained by subtracting the residue from the quantity of feed and forages provided to the experimental animals. The feed conversion efficiency (FCE) was calculated from the quantity of feed consumed by the total gain in body weight.

The method of breeding taken up for all the treatment groups was through natural mating. The age of each doe at first mating in days was noted down and body weight of the doe at first mating in kilograms was taken at the time of successful breeding. Pregnancy diagnosis of the mated female rabbit was confirmed through abdominal palpation fourteen days after introducing the female into the male cage for coitus. Weight of the doe was also taken at the same time. On successful kindling the age and weight of the doe were recorded in days and kilograms, respectively. Total number of kits born alive and litter weight in grams were noted for every kindling of the experimental female rabbit. Weaning process was carried out at forty five days old on all the experimental bunnies. Sexing was also performed simultaneously. Total number of live bunnies was recorded on weaning day and body weight was also taken from the treatment groups. The experimental doe for all the treatment groups were re-mated at forty seven days after parturition. Inter-kindling period was recorded by calculating the interval between two consecutive kindling. Number of crops per doe per year for all the treatment groups was calculated by finding out the total number of kindling recorded from every experimental doe.

Commonly encountered disease symptoms were examined throughout the experimental period. Mortality rate was calculated from the number of dead rabbits by the total number of live rabbits times hundred. Liveability was also calculated by subtracting the mortality rate from hundred. The descriptive data was fitted for statistical analysis through Analysis of Variance (ANOVA) using Completely Randomnized Design (CRD) as per Snedecor and Cochran (1998). Post hoc analysis using Tukey's HSD method was calculated for mean comparisons to identify significant differences ($P \leq 0.05$) among the treatment groups.

At farmers' field the survey was carried out at Kohima and Zubza Sechü village of Kohima district. A total number of ten rabbit farmers were identified from the two selected villages. The rabbit farmers' individual information and socio-economic status were recorded from each farmer through questionnaires and direct interaction. General information on rabbit farming was collected from the respondents. The knowledge and familiarity of using Indian coral plants (*Erythrina stricta*) as rabbit fodder on the performance of Soviet Chinchilla were collected from the rabbit farmers at the door step from the two selected villages. Tabular representation was adopted to compile the parameters. Simple statistical tools like averages and percentages were used to compare, contrast and interpret results accurately.

5.1.1. Body weight

The initial mean body weight of the rabbits for T_1, T_2, T_3 and T_4 groups was recorded as 0.41 kg, 0.40 kg, 0.38 kg and 0.39 kg, respectively. The corresponding average body weight recorded at six months of age for the respective treatment groups was 2.24 kg, 2.34 kg, 2.62 kg and 2.51 kg. Total average body weight recorded for T_1, T_2, T_3 and T_4 groups was 1.29 kg, 1.33 kg, 1.52 kg and 1.51 kg, respectively. Analysis of variance showed improved significant differences ($P \leq 0.05$) in body weight among the treatment

groups. Treatment groups T_3 and T_4 were recorded to have improved growth rate followed by T_2 and T_1 groups.

5.1.2. Average daily gain (ADG) in body weight

The recorded Average daily gain in body weight (ADG) for T_1, T_2, T_3 and T_4 groups was 16.28 g, 17.36 g, 19.94 g and 18.88 g, respectively. Statistical analysis indicated significant variation ($P \leq 0.05$) among the treatment groups. Treatment groups T_3 and T_4 were observed to have better daily gain in body weight than T_2 and T_1.

5.1.3. Feed intake

Data recorded for average daily feed intake in T_1, T_2, T_3 and T_4 was 115.83 g, 121.28 g, 131.86 g and 126.38 g, respectively. Analysis of variance (ANOVA) indicated significant variation ($P \leq 0.05$) among the treated groups. The treatment groups were significantly different from one another where T_3 group had higher feed intake among the treatment groups followed by T_4, T_2 and T_1 groups.

5.1.4. Feed conversion efficiency (FCE)

The average feed conversion efficiency (FCE) recorded in the treated groups was 3.59, 3.52, 3.46 and 3.54, respectively. Treatment groups did not vary significantly ($P \geq 0.05$) according to statistical analysis. However, feed conversion efficiency (FCE) was observed to be better in T_3 and T_2 compared to T_4 and T_1 groups.

5.2.1. Age of doe at first mating

The average age at first mating recorded for T_1, T_2, T_3 and T_4 groups was 180.20 days, 180.20 days, 179.40 days and 179.40 days. No significant difference ($P \geq 0.05$) was observed among the treatment groups as per statistical analysis.

5.2.2. Weight of doe at first mating

The mean body weight at first mating for T_1, T_2, T_3 and T_4 groups was recorded as 2.20 kg, 2.31 kg, 2.59 kg and 2.51 kg, respectively. Statistical analysis indicated significant variation ($P \leq 0.05$) among the treatment groups. Higher body weight at mating was reported in T_3 and T_4 compared to T_2 and T_1 groups.

5.2.3. Age of doe at first kindling

Average age at first kindling in T_1, T_2, T_3 and T_4 groups did not differ significantly ($P \geq 0.05$) among the groups with a record of 211.20 days, 210.80 days, 209.80 days and 209.60 days, respectively.

5.2.4. Weight of doe at first kindling

The mean body weight at first kindling for T_1, T_2, T_3 and T_4 groups was recorded as 2.32 kg, 2.46 kg, 2.72 kg and 2.61 kg, respectively. Statistical analysis showed significant differences ($P \leq 0.05$) among the treatment groups. Treatment groups T_3 and T_4 had higher recorded body weight at kindling followed by T_2 and T_1 groups.

5.2.5. Litter size at birth

The mean number of litter size at birth recorded for T_1, T_2, T_3 and T_4 groups was 5.37, 6.02, 6.76 and 6.72, respectively. Statistical analysis indicated significant variation ($P \leq 0.05$) among the treatment groups where supplemented groups T_3, T_4 and T_2 had larger number of litter size compared to non supplemented T_1 group.

5.2.6. Litter weight at birth

The mean litter weight at birth for T_1, T_2, T_3 and T_4 groups was recorded as 49.62 g, 49.41 g, 47.32 g and 46.26 g, respectively. Analysis of

variance (ANOVA) indicated no significant difference (P≥0.05) among the treatment groups.

5.2.7. Litter size at weaning

The mean number of litter size at weaning for T_1, T_2, T_3 and T_4 groups was recorded as 5.46, 5.86, 6.40 and 6.52, respectively. Litter size was observed to be statistically in non-significant (P≥0.05) among the treatment groups.

5.2.8. Litter weight at weaning

The mean litter weight at weaning for T_1, T_2, T_3 and T_4 groups was recorded as 420.02 g, 434.70 g, 478.87 g and 496.46 g, respectively. Statistical analysis indicated significant variation (P≤0.05) among the treatment groups. Heavier litter weight at weaning was recorded in T_4 group followed by T_3, T_2 and T_1 groups.

5.2.9. Inter-kindling period

The mean inter-kindling period recorded for T_1, T_2, T_3 and T_4 groups was 79.10 days, 78.65 days, 78.00 days and 78.50 days, respectively. No significant variation (P≥0.05) was observed among the treatment groups.

5.2.10. Number of crops per doe per year

Data recorded for average number of crops per doe per year in T_1, T_2, T_3 and T_4 groups was 4.20, 3.80, 5.00 and 5.00, respectively. Analysis of variance did not show any significant difference (P≥0.05) among the treatment groups.

5.3.1. Morbidity and mortality

There was no case of morbidity and mortality during the productive period up to six months of age from any of the treatment groups giving 100 per cent liveability. Cases of morbidity was recorded among the treatment groups

during the reproductive experimental period. Overall mortality rate recorded throughout the reproductive period in the treatment groups was 5.97 per cent, 3.96 per cent, 3.24 per cent and 2.85 per cent, respectively with liveability of 94.03 per cent, 96.04 per cent, 96.76 per cent and 97.15 per cent, respectively. Analysis of variance (ANOVA) indicated no significant variation ($P \geq 0.05$) among the treatment groups.

5.4. Performance at farmers' field

The Indian coral plant (*Erythrina stricta*) was found to be available in plenty and distributed across different areas in both Kohima and Zubza Sechü villages. The respondents residing in both the villages were well aware of the plant also known as "Hutuo" in local language and had been utilizing the fodder as rabbit forage.

The primary data from the selected rabbit breeders from Kohima village, recorded an average values for initial and final body weight; age and weight at first mating; litter size at birth and weaning as: 0.62 kg, 2.30 kg; 7.00 months, 2.30 kg; 6.80 and 5.40, respectively. Cases of mortality at birth were reported by the respondents and no incidence of mortality after weaning. Rabbit breeders from Zubza Sechü village recorded average values of initial and final body weight; age and weight at first mating; litter size at birth and weaning as 0.56 kg and 2.30 kg; 6.60 months and 2.30 kg; 6.20 and 5.00, respectively. The respondents reported incidences of dead kits foetus at birth. No mortality cases were reported after weaning.

In view of the results recorded at farmers' field on supplementing Indian coral plant (*Erythrina stricta*) in rabbit diet, positive responses were received from the farmers. The respondents reported that on inclusion of the Indian coral plant (*Erythrina stricta*); there had been better feed intake and improvement of growth and reproductive performance and reduced health problems.

CONCLUSIONS

Based on the findings on the overall performance with respect to various parameters till completion of the experimental period, it was concluded that:

1. Improved body weight, daily gain in body weight and daily feed intake were reported in T_3 and T_4 groups with records of 2.62 kg and 2.51 kg; 19.94 g and 18.88 g; 131.86 g and 126.38 g, respectively. T_3 group showed good feed conversion efficiency.
2. Earlier age at first mating was observed in T_3 and T_4 groups. Weight at first mating was higher in T_3 and T_4 groups with a record of 2.59 kg and 2.51 kg, respectively.
3. Rabbit doe from T_4 and T_3 groups kindled at an earlier age compared to the other 2 groups. T_3 and T_4 test groups recorded heavier weight at first kindling as 2.72 kg and 2.61 kg, respectively.
4. Larger number of litter size at birth was recorded in T_3 and T_4 groups having an average of 6.76 and 6.72, respectively while litter weight was observed to be higher in T_1 and T_2 groups.
5. Number of litter size at weaning was larger in T_4 and T_3 groups. Average litter weight at weaning was better in T_4 and T_3 groups with a record of 496.46 g and 478.87 g, respectively.
6. Inter-kindling period was observed to be better in T_3 and T_4 groups attaining total number of 5 crops per doe per year.
7. No morbidity and mortality with 100 per cent liveability was recorded during growing period up to six months of age in all the treatment groups. Mortality during reproductive period was observed to be lowest in T_4 and T_3 groups giving liveability of 97.15 per cent and 96.76 per cent, respectively.

8. Average final body weight reported from both the villages was 2.30 kg. Average age at first mating, weight at first kindling, litter size at birth and litter size at weaning reported were 6.80 months, 2.30 kg, 6.50 and 5.20, respectively. The respondents reported that on inclusion of the Indian coral plant (*Erythrina stricta*); there had been improvement in the growth and reproductive performance in rabbit at farmers' field.

The overall experimental findings illustrated that the Indian coral plant (*Erythrina stricta*) has the potential as an alternative feed resource that could improve the performance of rabbit in the farming system. The plant is therefore recommended to the farmers for utilization as a supplement at an inclusion of 66 per cent along with mixtures of locally available forages up to 100 per cent for optimum sustainable rabbit production.

CHAPTER VI

REFERENCES

REFERENCES

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APPENDIX-A

ANOVA-1: Average body weight in kilograms

	R_1	R_2	R_3	R_4	R_5	R_6	Total	Mean
T_1	1.36	1.23	1.21	1.29	1.24	1.39	7.72	1.29
T_2	1.27	1.40	1.31	1.38	1.27	1.38	8.00	1.33
T_3	1.55	1.38	1.55	1.56	1.41	1.67	9.12	1.52
T_4	1.55	1.48	1.53	1.51	1.56	1.43	9.06	1.51
Total	5.73	5.50	5.59	5.74	5.48	5.86	33.90	
Mean	1.43	1.37	1.40	1.43	1.37	1.47		1.41

SOV	df	SS	MSS	f-ratio	f-critical	Logic
Treatment	3.00	0.26	0.09	15.03	3.10	Significant
Error	20.00	0.11	0.01			
Total	23.00	0.37				

Tukey's Honestly Significant Difference

Q table	3.96	Num df	4.00	Den df	20.00
	Comparison	ABS	Crit. Range	Result	
	T_1 to T_2	0.05	0.12	NS	
	T_1 to T_3	0.23	0.12	Significant	
	T_1 to T_4	0.22	0.12	Significant	
	T_2 to T_3	0.19	0.12	Significant	
	T_2 to T_4	0.18	0.12	Significant	
	T_3 to T_4	0.01	0.12	NS	

ANOVA-2: Average daily gain (ADG) in body weight in grams

	R_1	R_2	R_3	R_4	R_5	R_6	Total	Mean
T_1	15.99	16.17	15.11	15.66	16.56	18.18	97.67	16.28
T_2	15.98	16.37	16.54	17.64	17.96	19.65	104.15	17.36
T_3	19.51	19.62	19.79	19.90	19.83	20.97	119.62	19.94
T_4	18.72	18.24	18.88	19.21	18.56	19.70	113.30	18.88
Total	70.21	70.39	70.31	72.41	72.92	78.50	434.74	
Mean	17.55	17.60	17.58	18.10	18.23	19.63		18.11

SOV	df	SS	MSS	f-ratio	f-critical	Logic
Treatment	3.00	47.12	15.71	17.96	3.10	Significant
Error	20.00	17.49	0.87			
Total	23.00	64.61				

Tukey's Honestly Significant Difference

Q table	3.96	Num df	4.00	Den df	20.00
	Comparison	ABS	Crit. Range	Result	
	T_1 to T_2	1.08	1.51	NS	
	T_1 to T_3	3.66	1.51	Significant	
	T_1 to T_4	2.61	1.51	Significant	
	T_2 to T_3	2.58	1.51	Significant	
	T_2 to T_4	1.53	1.51	Significant	
	T_3 to T_4	1.05	1.51	NS	

ANOVA-3: Average daily feed intake in grams

	R_1	R_2	R_3	R_4	R_5	R_6	Total	Mean
T_1	115.15	115.04	113.71	116.96	115.59	118.51	694.96	115.83
T_2	118.52	122.63	119.80	120.33	119.49	126.93	727.71	121.28
T_3	133.92	130.54	129.29	137.42	129.11	130.87	791.13	131.86
T_4	125.65	126.75	130.27	124.68	121.76	129.20	758.30	126.38
Total	493.24	494.96	493.07	499.38	485.95	505.50	2972.10	
Mean	123.31	123.74	123.27	124.85	121.49	126.38		123.84

SOV	df	SS	MSS	f-ratio	f-critical	Logic
Treatment	3.00	848.88	282.96	34.98	3.10	Significant
Error	20.00	161.78	8.09			
Total	23.00	1010.66				

Tukey's Honestly Significant Difference

Q table	3.96	Num df	4.00	Den df	20.00
	Comparison	ABS	Crit. Range	Result	
	T_1 to T_2	5.46	4.60	Significant	
	T_1 to T_3	16.03	4.60	Significant	

T_1 to T_4	10.56	4.60	Significant
T_2 to T_3	10.57	4.60	Significant
T_2 to T_4	5.10	4.60	Significant
T_3 to T_4	5.47	4.60	Significant

ANOVA-4: Average feed conversion efficiency (FCE)

	R_1	R_2	R_3	R_4	R_5	R_6	Total	Mean
T_1	3.62	3.57	3.81	3.71	3.49	3.31	21.51	3.59
T_2	3.61	3.80	3.65	3.36	3.43	3.24	21.10	3.52
T_3	3.60	3.29	3.31	3.73	3.33	3.50	20.77	3.46
T_4	3.66	3.61	3.70	3.35	3.53	3.41	21.26	3.54
Total	14.49	14.27	14.47	14.15	13.79	13.47	84.65	
Mean	3.62	3.57	3.62	3.54	3.45	3.37		3.53

SOV	df	SS	MSS	f-ratio	f-critical	Logic
Treatment	3.00	0.05	0.02	0.51	3.10	NS
Error	20.00	0.62	0.03			
Total	23.00	0.67				

APPENDIX-B

ANOVA-5: Average age of doe in days at first mating

	R1	R2	R3	R4	R5	Total	Mean
T1	180.00	180.00	180.00	181.00	180.00	901.00	180.20
T2	181.00	180.00	179.00	180.00	181.00	901.00	180.20
T3	180.00	179.00	179.00	179.00	180.00	897.00	179.40
T4	179.00	179.00	180.00	179.00	180.00	897.00	179.40
Total	720.00	718.00	718.00	719.00	721.00	3596.00	
Mean	180.00	179.50	179.50	179.75	180.25		179.80

SOV	df	SS	MS	f-ratio	f-critical	Logic
Trt	3.00	3.20	1.07	2.84	3.24	NS
Error	16.00	6.00	0.38			
Total	19.00	9.20				

ANOVA-6: Average weight of doe in kilograms at first mating

	R_1	R_2	R_3	R_4	R_5	Total	Mean
T_1	2.27	2.19	2.13	2.20	2.22	11.00	2.20
T_2	2.22	2.31	2.27	2.42	2.33	11.54	2.31
T_3	2.58	2.52	2.64	2.61	2.59	12.94	2.59
T_4	2.50	2.46	2.50	2.54	2.53	12.53	2.51
Total	9.57	9.47	9.54	9.77	9.66	48.01	
Mean	2.39	2.37	2.38	2.44	2.41		2.40

SOV	df	SS	MSS	f-ratio	f-critical	Logic
Treatment	3.00	0.47	0.16	57.56	3.24	Significant
Error	16.00	0.04	0.00			
Total	19.00	0.52				

Tukey's Honestly Significant Difference

Q table	4.05	Num df	4.00	Den df	16.00
	Comparison	ABS	Crit. Range	Result	
	T_1 to T_2	0.11	0.09	Significant	
	T_1 to T_3	0.39	0.09	Significant	
	T_1 to T_4	0.30	0.09	Significant	
	T_2 to T_3	0.28	0.09	Significant	
	T_2 to T_4	0.20	0.09	Significant	
	T_3 to T_4	0.08	0.09	NS	

ANOVA-7: Average age of doe in days at first kindling

	R1	R2	R3	R4	R5	Total	Mean
T1	210.00	212.00	210.00	213.00	211.00	1056.00	211.20
T2	212.00	211.00	210.00	210.00	211.00	1054.00	210.80
T3	210.00	209.00	210.00	209.00	211.00	1049.00	209.80
T4	210.00	208.00	209.00	210.00	211.00	1048.00	209.60
Total	842.00	840.00	839.00	842.00	844.00	4207.00	
Mean	210.50	210.00	209.75	210.50	211.00		210.35

SOV	df	SS	MS	f-ratio	f-critical	Logic
Trt	3.00	8.95	2.98	2.71	3.24	NS

Error	16.00	17.60	1.10			
Total	19.00	26.55				

ANOVA-8: Average weight of doe in kilograms at first kindling

	R_1	R_2	R_3	R_4	R_5	Total	Mean
T_1	2.39	2.27	2.25	2.33	2.36	11.61	2.32
T_2	2.37	2.50	2.35	2.59	2.50	12.32	2.46
T_3	2.70	2.66	2.78	2.75	2.73	13.62	2.72
T_4	2.61	2.56	2.60	2.63	2.64	13.04	2.61
Total	10.07	9.99	9.99	10.30	10.23	50.58	
Mean	2.52	2.50	2.50	2.58	2.56		2.53
	SOV	df	SS	MSS	f-ratio	f-critical	Logic
	Treatment	3.00	0.46	0.15	36.29	3.24	Significant
	Error	16.00	0.07	0.00			
	Total	19.00	0.53				

Tukey's Honestly Significant Difference

Q table	4.05	Num df	4.00	Den df	16.00
	Comparison	ABS	Crit. Range	Result	
	T_1 to T_2	0.14	0.12	Significant	
	T_1 to T_3	0.40	0.12	Significant	
	T_1 to T_4	0.29	0.12	Significant	
	T_2 to T_3	0.26	0.12	Significant	
	T_2 to T_4	0.14	0.12	Significant	
	T_3 to T_4	0.12	0.12	NS	

ANOVA-9: Average number of litter size at birth

	R_1	R_2	R_3	R_4	R_5	Total	Mean
T_1	5.60	4.00	5.25	5.80	6.20	26.85	5.37
T_2	6.00	5.40	5.50	7.00	6.20	30.10	6.02
T_3	7.80	6.40	7.20	5.40	7.00	33.80	6.76
T_4	6.80	7.00	6.20	6.80	6.80	33.60	6.72
Total	26.20	22.80	24.15	25.00	26.20	124.35	
Mean	6.55	5.70	6.04	6.25	6.55		6.22

SOV	df	SS	MSS	f-ratio	f-critical	Logic
Treatment	3.00	6.52	2.17	4.27	3.24	Significant
Error	16.00	8.15	0.51			
Total	19.00	14.67				

Tukey's Honestly Significant Difference

Q table	4.05	Num df	4.00	Den df	16.00
	Comparison	ABS	Crit. Range	Result	
	T_1 to T_2	0.65	1.29	NS	
	T_1 to T_3	1.39	1.29	Significant	
	T_1 to T_4	1.35	1.29	Significant	
	T_2 to T_3	0.74	1.29	NS	
	T_2 to T_4	0.70	1.29	NS	
	T_3 to T_4	0.04	1.29	NS	

ANOVA-10: Average litter weight in grams at birth

	R_1	R_2	R_3	R_4	R_5	Total	Mean
T_1	50.66	51.60	50.47	47.15	48.24	248.12	49.62
T_2	50.21	52.49	50.74	45.53	48.08	247.05	49.41
T_3	46.86	48.84	44.85	50.29	45.77	236.61	47.32
T_4	45.02	44.72	48.86	45.80	46.91	231.31	46.26
Total	192.75	197.65	194.92	188.78	188.99	963.09	
Mean	48.19	49.41	48.73	47.19	47.25		48.15

SOV	df	SS	MSS	f-ratio	f-critical	Logic

Treatment	3.00	40.07	13.36	2.90	3.24	NS
Error	16.00	73.60	4.60			
Total	19.00	113.68				

ANOVA-11: Average number of litter size at weaning

	R_1	R_2	R_3	R_4	R_5	Total	Mean
T_1	5.60	4.00	5.25	6.25	6.20	27.30	5.46
T_2	6.00	5.40	5.50	6.40	6.00	29.30	5.86
T_3	7.20	6.40	6.00	5.40	7.00	32.00	6.40
T_4	6.80	6.20	6.00	6.80	6.80	32.60	6.52
Total	25.60	22.00	22.75	24.85	26.00	121.20	
Mean	6.40	5.50	5.69	6.21	6.50		6.06

SOV	df	SS	MSS	f-ratio	f-critical	Logic
Treatment	3.00	3.64	1.21	2.85	3.24	NS
Error	16.00	6.81	0.43			
Total	19.00	10.44				

ANOVA-12: Average litter weight in grams at weaning

	R_1	R_2	R_3	R_4	R_5	Total	Mean
T_1	420.83	471.88	416.93	409.27	381.19	2100.10	420.02
T_2	455.50	448.35	428.28	405.00	436.36	2173.50	434.70
T_3	449.24	474.24	492.59	527.96	450.32	2394.36	478.87
T_4	482.51	516.58	508.57	471.91	502.73	2482.30	496.46
Total	1808.09	1911.04	1846.36	1814.15	1770.60	9150.24	
Mean	452.02	477.76	461.59	453.54	442.65		457.51
	SOV	df	SS	MSS	f-ratio	f-critical	Logic
	Treatment	3.00	19496.21	6498.74	8.99	3.24	Significant
	Error	16.00	11567.92	722.99			
	Total	19.00	31064.13				

Tukey’s Honestly Significant Difference

Q table	4.05	Num df	4.00	Den df	16.00
	Comparison	ABS	Crit. Range	Result	
	T_1 to T_2	14.68	48.65	NS	
	T_1 to T_3	58.85	48.65	Significant	
	T_1 to T_4	76.44	48.65	Significant	
	T_2 to T_3	44.17	48.65	NS	
	T_2 to T_4	61.76	48.65	Significant	
	T_3 to T_4	17.59	48.65	NS	

ANOVA-13: Average inter-kindling period in days

	R_1	R_2	R_3	R_4	R_5	Total	Mean
T_1	78.50	77.00	83.00	78.00	79.00	395.50	79.10
T_2	78.00	78.50	79.00	79.25	78.50	393.25	78.65
T_3	78.25	78.50	77.75	78.00	77.50	390.00	78.00
T_4	78.75	78.75	79.00	77.75	78.25	392.50	78.50
Total	313.50	312.75	318.75	313.00	313.25	1571.25	
Mean	78.38	78.19	79.69	78.25	78.31		78.56

SOV	df	SS	MSS	f-ratio	f-critical	Logic
Treatment	3.00	3.08	1.03	0.69	3.24	NS
Error	16.00	23.77	1.49			
Total	19.00	26.86				

ANOVA-14: Average number of crops per doe per year

	R_1	R_2	R_3	R_4	R_5	Total	Mean
T_1	5.00	2.00	4.00	5.00	5.00	21.00	4.20
T_2	2.00	5.00	2.00	5.00	5.00	19.00	3.80
T_3	5.00	5.00	5.00	5.00	5.00	25.00	5.00
T_4	5.00	5.00	5.00	5.00	5.00	25.00	5.00
Total	17.00	17.00	16.00	20.00	20.00	90.00	
Mean	4.25	4.25	4.00	5.00	5.00		4.50

SOV	df	SS	MSS	f-ratio	f-table	Logic
Treatment	3.00	5.40	1.80	1.64	3.24	NS
Error	16.00	17.60	1.10			
Total	19.00	23.00				

APPENDIX-C

ANOVA-15: Mortality rate

	R_1	R_2	R_3	R_4	R_5	R_6	Total	Mean
T_1	0.00	11.11	0.00	18.75	0.00	0.00	29.86	5.97
T_2	7.69	0.00	8.33	8.33	3.13	0.00	27.48	3.96
T_3	7.50	0.00	16.22	0.00	0.00	0.00	23.72	3.24
T_4	0.00	11.11	3.13	0.00	0.00	0.00	14.24	2.85
Total	15.19	22.22	27.67	27.08	3.13	0.00	95.30	
Mean	3.80	5.56	6.92	6.77	0.78	0.00		4.01

SOV	df	SS	MSS	f-ratio	f-critical	Logic
Treatment	3.00	23.63	7.88	0.21	3.10	NS
Error	20.00	733.25	36.66			
Total	23.00	756.88				

APPENDIX-D

QUESTIONNAIRE

Respondent no: 1

Name of the village - Sechü RD block - Zubza Sechü

District - Kohima Population of the village - 4460

Total households engaged in rabbitry - 50+

A. General profile of the rabbit farmers

1. Name of the respondent - Kesuokhrienuo Mepfhüo

2. Gender - Female
3. Age (in years) - 55
4. Educational qualification - High school passed
5. Family size (in nos.)
    a) Male - 3
    b) Female - 2
6. Main occupation - Service
7. Annual family income (per month) - ₹15,000-20,000
8. Sources of media - Village council, radio, newspaper, television
9. Total number of livestock animals owned
    a) Pig - 0
    b) Poultry - 3
    c) Cattle - 0
    d) Goat - 0
    e) Rabbits - 5

B. General information on rabbit farming:

1. Commonly preferred breeds - Soviet Chinchilla, New Zealand White, Grey Giant
2. System of housing - Hutch type
3. Type of feeds given - Wheat bran, boiled rice, soaked chickpea, kitchen wastes, locally available leaves
4. Incurred expenditure
    a) Price of bunnies - ₹300 per pair
    b) Feed cost - ₹30 per kg (Wheat bran)
5. Distribution of rabbit meat - Family consumption
6. Selling price:
    a) Bunnies - Nil
    b) Adult rabbits - Nil

C. Performance at farmers' field

1. Availability of Indian coral plants in the village - Yes
2. If Yes, utilization of the plant by the farmer - Rabbit fodder
3. Quantity fed - *Ad libitum*
4. Frequency of usage - Regularly
5. Perception of the respondent towards the benefits of the plant as rabbit feed: Excellent fodder liked by rabbits
6. Monthly body weight (in kg)
    a) 2 months old - 0.50
    b) 3 months old - 0.50

c) 4 months old - 1.00
d) 5 months old - 1.50
e) 6 months old - 2.00
f) 7 months old - 2.50

7. Age at first mating (in months) - 7
8. Approximate weight at first mating (in kg) - 2.5
9. Average litter size at birth (in nos.) - 5
10. Average litter size at weaning (in nos.) - 5
11. Mortality rate at birth - No
12. Mortality rate at weaning - No
13. No. of crops per doe per year (in nos.) - 3

Respondent no: 2

Name of the village - Sechü RD block - Zubza Sechü

District - Kohima Population of the village - 4460

Total households engaged in rabbitry - 50+

A. General profile of the rabbit farmers

1. Name of the respondent - Duoü Tseiba
2. Gender - Female
3. Age (in years)- 75
4. Education qualification- Illiterate
5. Family size (in nos.)
    a) Male - 2
    b) Female - 1
6. Main occupation - Livestock rearing
7. Annual family income (per month) - ₹1000-5000
8. Sources of media - Radio
9. Total number of livestock animals owned
    a) Pig - 0
    b) Poultry - 0
    c) Cattle - 0
    d) Goat - 0
    e) Rabbits - 3

B. General information on rabbit farming:

1. Commonly preferred breeds - Soviet Chinchilla, New Zealand White, Grey Giant
2. System of housing - Wooden type
3. Type of feeds given - Wheat bran, boiled rice, kitchen wastes, locally available leaves
4. Incurred expenditure
    a) Price of bunnies - ₹250 per pair
    b) Feed cost - ₹30 per kg (Wheat bran)
5. Distribution of rabbit meat - Market and family consumption
6. Selling price:
    a) Bunnies - ₹700 per pair
    b) Adult rabbits - ₹500 per kg

C. Performance at farmers' field

1. Availability of Indian coral plants in the village - Yes
2. If Yes, utilization of the plant by the farmer - Rabbit fodder
3. Quantity fed - *Ad libitum*
4. Frequency of usage - Regularly
5. Perception of the respondent towards the benefits of the plant as a livestock feed: Good forage for rabbits
6. Monthly body weight (in kg)
    a) 2 months old - 0.50
    b) 3 months old - 1.00
    c) 4 months old - 1.50
    d) 5 months old - 2.00
7. Age at first mating (in months) - 5
8. Approximate weight at first mating (in kg) - 2
9. Average litter size at birth (in nos.) - 7
10. Average litter size at weaning (in nos.) - 4
11. Mortality rate at birth - Yes
12. Mortality rate at weaning - No
13. No. of crops per doe per year (in nos.) - 3

Respondent no: 3

Name of the village - Sechü

RD block - Zubza Sechü

District - Kohima

Population of the village - 4460

Total households engaged in rabbitry - 50+

A. General profile of the rabbit farmers

1. Name of the respondent - Mutiya Wanth
2. Gender - Male
3. Age (in years)- 50
4. Educational qualification - Graduate
5. Family size (in nos.)
    a) Male - 2
    b) Female - 3
6. Main occupation - Service
7. Annual family income (per month) - ₹20,000-25,000
8. Sources of media - Village council, television and newspaper
9. Total number of livestock animals owned
    a) Pig - 0
    b) Poultry - 10
    c) Cattle - 0
    d) Goat - 0
    e) Rabbits - 20

B. General information on rabbit farming:

1. Commonly preferred breeds - Soviet Chinchilla, New Zealand White, Grey Giant, Flemish Black
2. System of housing - Wooden type
3. Type of feeds given - Wheat bran, boiled rice, soaked chickpea, kitchen wastes, locally available leaves
4. Incurred expenditure
    a) Price of bunnies - ₹700 per pair
    b) Feed cost - ₹30 per kg (Wheat bran)
5. Distribution of rabbit meat - Market and family consumption
6. Selling price
    a) Bunnies - Nil
    b) Adult rabbits - ₹600 per kg

C. Performance at farmers' field

1. Availability of Indian coral plants in the village - Yes
2. If Yes, utilization of the plant by the farmer - Rabbit fodder
3. Quantity fed - *Ad libitum*
4. Frequency of usage - Often
5. Perception of the respondent towards the benefits of the plant as a livestock feed: Preferred by rabbits
6. Monthly body weight (in kg)

a) 2 months old - 0.80
b) 3 months old - 1.00
c) 4 months old - 1.00
d) 5 months old - 1.50
e) 6 months old - 2.00
f) 7 months old - 2.00
g) 8 months old - 2.50

7. Age at first mating (in months) - 8
8. Approximate weight at first mating (in kg) - 2.5
9. Average litter size at birth (in nos.) - 6
10. Average litter size at weaning (in nos.) - 5
11. Mortality rate at birth - Yes
12. Mortality rate at weaning - No
13. No. of crops per doe per year (in nos.) - 4

Respondent no: 4

Name of the village - Sechü RD block - Zubza Sechü

District - Kohima Population of the village - 4460

Total households engaged in rabbitry - 50+

A. General profile of the rabbit farmers

1. Name of the respondent - Hiyale Wanth
2. Gender - Female
3. Age (in years) - 45
4. Educational qualification - Secondary school passed
5. Family size (in nos.)
    a) Male - 3
    b) Female - 3
6. Main occupation - Others
7. Annual family income (per month) - ₹5000-10,000
8. Sources of media - Television and newspaper
9. Total number of livestock animals owned
    a) Pig - 0
    b) Poultry - 0
    c) Cattle - 0
    d) Goat - 0

e) Rabbits - 10

B. General information on rabbit farming:

1. Commonly preferred breeds - Soviet Chinchilla and New Zealand White
2. System of housing - Hutch type
3. Type of feeds given - Wheat bran, ground maize, boiled rice, soaked chickpea, kitchen wastes, locally available leaves
4. Incurred expenditure
    a) Price of bunnies - ₹500 per pair
    b) Feed cost - ₹30 per kg (Wheat bran)
5. Distribution of rabbit meat - Market and family consumption
6. Selling price
    a) Bunnies - Nil
    b) Adult rabbits - ₹600 per kg

C. Performance at farmers' field

1. Availability of Indian coral plants in the village - Yes
2. If Yes, utilization of the plant by the farmer - Rabbit fodder
3. Quantity fed - *Ad libitum*
4. Frequency of usage - Often
5. Perception of the respondent towards the benefits of the plant as a livestock feed: Good for rabbits
6. Monthly body weight (in kg)
    a) 2 months old - 0.50
    b) 3 months old - 1.00
    c) 4 months old - 1.50
    d) 5 months old - 2.00
7. Age at first mating (in months) - 5
8. Approximate weight at first mating (in kg) - 2
9. Average litter size at birth (in nos.) - 5
10. Average litter size at weaning (in nos.) - 5
11. Mortality rate at birth - No
12. Mortality rate at weaning - No
13. No. of crops per doe per year (in nos.) - 3

Respondent no: 5

Name of the village - Sechü RD block - Zubza Sechü

District - Kohima Population of the village - 4460

Total households engaged in rabbitry - 50+

A. General profile of the rabbit farmers

1. Name of the respondent - Nancy Sekhose
2. Gender - Female
3. Age (in years)- 46
4. Educational qualification - High school passed
5. Family size (in nos.)
    a) Male - 3
    b) Female - 4
6. Main occupation - Livestock rearing
7. Annual family income (per month) - ₹5000-10,000
8. Sources of media - Television and newspaper
9. Total number of livestock animals owned
    a) Pig - 2
    b) Poultry - 15
    c) Cattle - 0
    d) Goat - 0
    e) Rabbits - 6

B. General information on rabbit farming:

1. Commonly preferred breeds - Soviet Chinchilla and New Zealand White
2. System of housing - Wooden type
3. Type of feeds given - Wheat bran, boiled rice, kitchen wastes, locally available leaves
4. Incurred expenditure
    a) Price of bunnies - ₹600 per pair
    b) Feed cost - ₹30 per kg (Wheat bran)
5. Distribution of rabbit meat - Family consumption
6. Selling price
    a) Bunnies - Nil
    b) Adult rabbits - Nil

C. Performance at farmers' field

1. Availability of Indian coral plants in the village - Yes
2. If Yes, utilization of the plant by the farmer - Rabbit fodder
3. Quantity fed - *Ad libitum*
4. Frequency of usage - Regularly

5. Perception of the respondent towards the benefits of the plant as a livestock feed: Good fodder for rabbits
6. Monthly body weight (in kg)
    a) 2 months old - 0.50
    b) 3 months old - 0.50
    c) 4 months old - 1.00
    d) 5 months old - 1.50
    e) 6 months old - 1.50
    f) 7 months old - 2.00
    g) 8 months old - 2.50
7. Age at first mating (in months) - 8
8. Approximate weight at first mating (in kg) - 2.5
9. Average litter size at birth (in nos.) - 8
10. Average litter size at weaning (in nos.) - 6
11. Mortality rate at birth - Yes
12. Mortality rate at weaning - No
13. No. of crops per doe per year (in nos.) - 3

Respondent no: 6

Name of the village - Kohima village RD block - Kohima

District - Kohima Population of the village - 15,734

Total households engaged in rabbitry - 100+

A. General profile of the rabbit farmers

1. Name of the respondent - Sister Dominica Lakra
2. Gender - Female
3. Age (in years) - 50
4. Educational qualification- Graduate
5. Family size (in nos.)
    a) Male - 0
    b) Female - 1
6. Main occupation - Others
7. Annual family income (per month) - ₹15,000-20,000
8. Sources of media - Television and newspaper
9. Total number of livestock animals owned
    a) Pig - 0

b) Poultry - 0
c) Cattle - 0
d) Goat - 0
e) Rabbits - 8

B. General information on rabbit farming:

1. Commonly preferred breeds - Soviet Chinchilla, New Zealand White, Flemish Black
2. System of housing - Hutch type
3. Type of feeds given - Boiled rice, kitchen wastes, locally available leaves
4. Incurred expenditure
    a) Price of bunnies - ₹250 per pair
    b) Feed cost - No
5. Distribution of rabbit meat - Own consumption
6. Selling price:
    a) Bunnies - Nil
    b) Adult rabbits - Nil

C. Performance at farmers' field

1. Availability of Indian coral plants in the village - Yes
2. If Yes, uses of the plant by the farmer - Rabbit fodder
3. Quantity fed - *Ad libitum*
4. Frequency of usage - Often
5. Perception of the respondent towards the benefits of the plant as a livestock feed: Good fodder for rabbits
6. Monthly body weight (in kg)
    a) 2 months old - 0.50
    b) 3 months old - 1.00
    c) 4 months old - 1.00
    d) 5 months old - 1.50
    e) 6 months old - 2.00
    f) 7 months old - 2.00
    g) 8 months old - 2.50
7. Age at first mating (in months) - 8
8. Approximate weight at first mating (in kg) - 2.5
9. Average litter size at birth (in nos.) - 6
10. Average litter size at weaning (in nos.) - 5
11. Mortality rate at birth - Yes
12. Mortality rate at weaning - No
13. No. of crops per doe per year (in nos.) - 4

Respondent no: 7

Name of the village - Kohima village RD block - Kohima

District - Kohima Population of the village - 15,734

Total households engaged in rabbitry - 100+

A. General profile of the rabbit farmers

1. Name of the respondent - Kezevituo Sote
2. Gender - Female
3. Age (in years) - 51
4. Educational qualification - High school passed
5. Family size (in nos.)
    a) Male - 3
    b) Female - 4
6. Main occupation - Service
7. Annual family income (per month) - ₹10,000-15,000
8. Sources of media - Television and newspaper
9. Total number of livestock animals owned
    a) Pig - 0
    b) Poultry - 2
    c) Cattle - 0
    d) Goat - 0
    e) Rabbits - 6

B. General information on rabbit farming:

1. Commonly preferred breeds - Soviet Chinchilla
2. System of housing - Wooden type
3. Type of feeds given - Wheat bran, boiled rice, kitchen wastes, locally available leaves
4. Incurred expenditure
    a) Cost of bunnies - ₹500 per pair
    b) Feed purchase - ₹30 per kg (Wheat bran)
5. Distribution of rabbit meat - Family consumption
6. Selling price:
    a) Bunnies - Nil
    b) Adult rabbits - Nil

C. Performance at farmers' field

1. Availability of Indian coral plants in the village - Yes

2. If Yes, utilization of the plant by the farmer - Rabbit fodder
3. Quantity fed - *Ad libitum*
4. Frequency of usage - Regularly
5. Perception of the respondent towards the benefits of the plant as a livestock feed: Preferred by rabbits
6. Monthly body weight (in kg)
    a) 2 months old - 0.80
    b) 3 months old - 1.50
    c) 4 months old - 1.50
    d) 5 months old - 2.00
    e) 6 months old - 2.00
    f) 7 months old - 2.50
7. Age at first mating (in months) - 12
8. Approximate weight at first mating (in kg) - 2.5
9. Average litter size at birth (in nos.) - 5
10. Average litter size at weaning (in nos.) - 5
11. Mortality rate at birth - No
12. Mortality rate at weaning - No
13. No. of crops per doe per year (in nos.) - 3

Respondent no: 8

Name of the village - Kohima village RD block - Kohima

District - Kohima Population of the village - 15,734

Total households engaged in rabbitry - 100+

A. General profile of the rabbit farmers

1. Name of the respondent - Dr. Kekhriezolie
2. Gender - Male
3. Age (in years) - 30
4. Educational qualification - Post graduate
5. Family size (in nos.)
    a) Male - 2
    b) Female - 3
6. Main occupation - Service
7. Annual family income (per month) - ₹25,000-30,000
8. Sources of media - Village council, television and newspaper

9. Total number of livestock animals owned
    a) Pig - 0
    b) Poultry - 6
    c) Cattle - 0
    d) Goat - 0
    e) Rabbits - 18

B. General information on rabbit farming:

1. Commonly preferred breeds - Soviet Chinchilla and New Zealand White
2. System of housing - Netted cage type
3. Type of feeds given - Wheat bran, soaked chickpea, kitchen wastes, locally available leaves
4. Incurred expenditure
    a) Price of bunnies - ₹500 per pair
    b) Feed cost - ₹30 per kg (Wheat bran)
5. Distribution of rabbit meat - Market and family consumption
6. Selling price
    a) Bunnies - ₹700 per pair
    b) Adult rabbits - ₹600 per kg

C. Performance at farmers' field

1. Availability of Indian coral plants in the village - Yes
2. If Yes, utilization of the plant by the farmer - Rabbit fodder
3. Quantity fed - *Ad libitum*
4. Frequency of usage - Regularly
5. Perception of the respondent towards the benefits of the plant as a livestock feed: Excellent fodder for rabbits
6. Monthly body weight (in kg)
    a) 2 months old - 0.80
    b) 3 months old - 1.00
    c) 4 months old - 1.50
    d) 5 months old - 2.00
    e) 6 months old - 2.00
7. Age at first mating (in months) - 6
8. Approximate weight at first mating (in kg) - 2
9. Average litter size at birth (in nos.) - 8
10. Average litter size at weaning (in nos.) - 6
11. Mortality rate at birth - Yes
12. Mortality rate at weaning - No

13. No. of crops per doe per year (in nos.) - 4

Respondent no: 9

Name of the village - Kohima village RD block - Kohima

District - Kohima Population of the village - 15,734

Total households engaged in rabbitry - 100+

A. General profile of the rabbit farmers

1. Name of the respondent - Mezapu
2. Gender - Male
3. Age (in years) - 70
4. Educational qualification - Graduate
5. Family size (in nos.)
    a) Male - 3
    b) Female - 3
6. Main occupation - Livestock rearing
7. Annual family income (per month) - ₹15,000-20,000
8. Sources of media - Village council, radio, newspaper
9. Total number of livestock animals owned
    a) Pig - 0
    b) Poultry - 0
    c) Cattle - 0
    d) Goat - 0
    e) Rabbits - 30

B. General information on rabbit farming:

1. Commonly preferred breeds - Soviet Chinchilla, New Zealand White, Grey Giant, Flemish Black
2. System of housing - Netted cage type
3. Type of feeds given - Wheat bran, soaked chickpea, kitchen wastes, locally available leaves
4. Incurred expenditure
    a) Price of bunnies - ₹300 per pair
    b) Feed cost - ₹30 per kg (Wheat bran)
5. Distribution of rabbit meat - Market and family consumption
6. Selling price

a) Bunnies - ₹700 per pair
b) Adult rabbits - ₹450 per kg

C. Performance at farmers' field

1. Availability of Indian coral plants in the village - Yes
2. If Yes, utilization of the plant by the farmer - Rabbit fodder
3. Quantity fed - *Ad libitum*
4. Frequency of usage - Regularly
5. Perception of the respondent towards the benefits of the plant as a livestock feed: Excellent fodder for rabbits
6. Monthly body weight (in kg)
    a) 2 months old - 0.50
    b) 3 months old - 1.00
    c) 4 months old - 1.00
    d) 5 months old - 1.50
    e) 6 months old - 2.00
7. Age at first mating (in months) - 6
8. Approximate weight at first mating (in kg) - 2
9. Average litter size at birth (in nos.) - 8
10. Average litter size at weaning (in nos.) - 6
11. Mortality rate at birth - Yes
12. Mortality rate at weaning - No
13. No. of crops per doe per year (in nos.) - 4

Respondent no: 10

Name of the village - Kohima village RD block - Kohima

District - Kohima Population of the village - 15,734

Total households engaged in rabbitry - 100+

A. General profile of the rabbit farmers

1. Name of the respondent - Tounuo
2. Gender - Female
3. Age (in years) - 42
4. Educational qualification - High school passed
5. Family size (in nos.)
    a) Male - 1
    b) Female - 3

6. Main occupation - Others
7. Annual family income (per month) - ₹10000-15,000
8. Sources of media - Television and newspaper
9. Total number of livestock animals owned
    a) Pig - 2
    b) Poultry - 4
    c) Cattle - 0
    d) Goat - 0
    e) Rabbits - 6

B. General information on rabbit farming:

1. Commonly preferred breeds - Soviet Chinchilla
2. System of housing - Wooden type
3. Type of feeds given - Boiled rice, kitchen wastes, locally available leaves
4. Incurred expenditure
    a) Price of bunnies - ₹600 per pair
    b) Feed cost - Nil
5. Distribution of rabbit meat - Market and family consumption
6. Selling price
    a) Bunnies - ₹600 per pair
    b) Adult rabbits - Nil

C. Performance at farmers' field

1. Availability of Indian coral plants in the village - Yes
2. If Yes, utilization of the plant by the farmer - Rabbit fodder
3. Quantity fed - *Ad libitum*
4. Frequency of usage - Often
5. Perception of the respondent towards the benefits of the plant as a livestock feed: Good feed for rabbits
6. Monthly body weight (in kg)
    a) 2 months old - 0.50
    b) 3 months old - 0.50
    c) 4 months old - 1.00
    d) 5 months old - 1.50
    e) 6 months old - 1.50
    f) 7 months old - 2.00
    g) 8 months old - 2.50
7. Age at first mating (in months) - 8
8. Approximate weight at first mating (in kg) - 2.5

9. Average litter size at birth (in nos.) - 7
10. Average litter size at weaning (in nos.) - 5
11. Mortality rate at birth - Yes
12. Mortality rate at weaning - No
13. No. of crops per doe per year (in nos.) - 3