EVALUATION OF NATIVE CHICKEN OF NORTHERN KERALA

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requirement for the degree of

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DECLARATION

I hereby declare that the thesis entitled "**EVALUATION OF NATIVE CHICKEN OF NORTHERN KERALA"** is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associate ship, fellowship or other similar title, of any other University or Society.

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CERTIFICATE

Certified that the thesis entitled "**EVALUATION OF NATIVE CHICKEN OF NORTHERN KERALA"** is a record of research work done independently by **P. Girish Kumar,** under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to him.

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Dr. P. Girish Kumar

Dedicated to my children

Dheeraj and Thejus

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Introduction

1. INTRODUCTION

India is bestowed with rich and diverse resources of chicken germplasm. India and neighbouring countries have been referred to as the original home of Red Jungle fowl (*Gallus gallus* Linn.). The present-day domestic fowl is believed to have descended from the Red Jungle Fowl. The earliest evidence of domestication of fowl is from Mohenjodaro (Randhawa, 1982). Aseel or Malay fowl is reported to have given rise to all the present-day breeds of poultry. There is substantial evidence to show that these birds moved through Middle-East to Europe and gave rise to present day European breeds, about 2000 years ago. It has been documented from extensive survey that there are 20 indigenous (*desi*) breeds in India (Mohapatra and Panda, 1981).

The rural people in Kerala largely depend on farming for their main income; most often mixed crop livestock system of farming is practiced. In terms of chicken wealth, the native fowls are of socio-economic importance to the households of this state. Keeping a small flock of birds to satisfy the nutritional need of their family and monitory need of the housewives is being followed. Backyard chicken farming is considered as a way of utilizing kitchen waste and agricultural byproducts for the production of animal proteins. Chicken production remains largely as a backyard business as large scale chicken production is not practical because of very high feed and labour cost compared to that of neighbouring states like Tamil Nadu and Karnataka.

The small holder chicken sector is traditionally based on extensive production systems which are free range systems where the birds find most of their feed through scavenging. Small farming families, landless labourers and people with income below the poverty line are able to rear chickens with low inputs and harvest the benefits like egg and meat via scavenged feed resources (Robert and Gunaratne, 1992; Sonaiya, 2005). Low input poultry production is characterized by slower growth rates and higher culling rates during the growing stage, which has made such systems less viable commercially. Native chicken has contributed immensely to the backyard poultry production in the state. The total native chicken of the state is 72.2 lakhs and is more than double the population (30.5 lakhs) of improved varieties (Anon., 2003). Natural

selection in their habitats over millions of years against the vagaries of nature made them the best adapted stock for the different agro-climatic conditions of Kerala. They are resistant to diseases and can survive well on scavenging and the leftover feed in the houses. During the process of evolution, these populations were also subjected to artificial selection for egg production in their home tracts by man.

In the recent period, due to indiscriminate extensive introduction of exotic breeds of chicken for productivity improvement by the public sector and Non-Government Organizations (NGO), the diversity of chicken population is being depleted at an alarming rate. Unfortunately, no efforts were put in the past to characterize and conserve the native birds. Now, with the modern scientific methods available, it is time to focus on the genetic improvement of native chicken population for their production and other qualities. Apart from improving the birds, improvement of village chicken production requires a good understanding of regional and traditional practices of village chicken husbandry and trade and the identification of major constraints to production (Sonaiya and Swan, 2004). Without such understanding, utilizing and enhancing local resources, practices and attitudes, aid projects to improve the welfare of the rural population are prone to failure.

Kerala is endowed with naturally diverse plant and animal genetic resources. It has been documented that 'Tellichery' breed of chicken in Kerala has originated in Malabar region of this state (Acharya and Bhatt, 1984). Up-to-date information on this chicken breed of Kerala is scarce. Vij *et al.* (2007) studied the salient features of Tellichery breed of chicken in Kerala and documented that these birds are found mainly in the not so well developed interiors of Calicut (now Kozhikode), Kannur and Malappuram districts of Kerala and Mahe district of Pondicherry (now Puducherry).

Therefore it was planned to conduct a scientific study to characterize and evaluate the native chicken in Kannur and Kozhikode districts of northern Kerala (Malabar region), with the following objectives:

1. To document the morphological characteristics and management practices of native chicken
2. To evaluate the egg quality, egg production and carcass characteristics of native chicken

Review Of Literature

2. REVIEW OF LITERATURE

2.1 ORIGIN OF DOMESTIC CHICKEN

The present-day domestic fowl (*Gallus gallus murghi*) is believed to have descended from the Red Jungle fowl (Crawford, 1990). India and the neighbouring countries have been referred to as the original home of Red Jungle fowl *(Gallus gallus Linn*.). Aseel or Malay fowl is reported to have given rise to all the present-day breeds of poultry. Recent archaeological discoveries in China indicate that chickens had been domesticated by 5400 B.C. Chickens from the Harappan culture of the Indus valley (2500 to 2100 B.C.) may have been the main source of diffusion through the world (Crawford, 1990). There is substantial evidence to show that these birds moved through Middle-East to Europe and gave rise to the present-day European breeds, about 2000 years ago (Acharya and Bhat, 1984).

According to Gueye (1998), although there are reports of distinct local breeds of chickens in Africa, it might be that these so-called breeds are just phenotypic descriptions. It has been estimated that still more than 80 per cent of the global poultry population occurs in traditional family-based production systems and that contribute up to 90 per cent of the total poultry products in many countries (Mack *et al*., 2005).

2.2 NATIVE CHICKEN OF KERALA

According to Mohapatra and Panda (1981), the breeds of indigenous type present in India are Aseel , Kadaknath, Ghagus, Busra, Chittagong (Malay), Miri, Daothigir, Brown *Desi*, Danki, Titri, Harringhatta Black, Kashmir Favorolla, Kalasthi, Lolab, Naked Neck, Punjab Brown, Tani, Tellichery, Ankleshwar and Nicobari.

The replacement of local breeds that are adapted to the local conditions with the single- purpose highly productive exotic breeds may lead to their extinction and hence to an unrecorded loss of genetic variation (Singh and Singh, 2004).

The 15 defined chicken populations in India can be grouped into eight

clusters. Cluster one consists of Ankleshwar and Busra populations. Cluster two consisting of Aseel, Danki, Ghagus and Kalasthi (all game birds). The cluster three has populations of North Eastern India (Chittagong, Daothigir and Miri). Cluster four has two populations of Nicobari and Punjab Brown. Remaining populations of Kashmir Favorolla, Tellichery, Kadaknath and Haringhata Black formed independent clusters (Tantia *et al*., 2006b).

Tellichery breed derives its name from the name of a place 'Tellichery' in Kannur district of Kerala. Presently, these birds are found mainly in Kozhikode, Kannur and Malappuram districts of Kerala and Mahe district of Pondichery (Vij *et al*., 2007).

2.3 SOCIOECONOMIC STATUS OF POULTRY FARMERS

2.3.1 Community

Ghagus breed of chicken is mainly reared by Kukarni community of Karnataka and Andhra Pradesh (Tantia *et al*., 2005b).

According to Vijh *et al*. (2005a), the name of the Miri breed in upper Assam is derived after the name of the tribe rearing them (Miri or Mising). The birds play an important role in the daily life of the tribe and are the integral part of their social, religious and cultural activities.

Daothigir birds are reared by the Bodo Community of Assam region (Vij *et al*., 2006b).

2.3.2 Occupation

Halima *et al.* (2007b) reported that mostly the women of north-west Ethiopia, whether in male-headed or female-headed households, are responsible for chicken rearing; while, the men are responsible for crop cultivation and other off-farm activities.

Yousef and Al-Yousef (2007) documented that about 23 per cent of the owners of large Baladi projects of Saudi Arabia were poultry producers, raising native chickens as the main source of their income under intensive system; whereas, for 77 per cent of owners, raising of chickens as a secondary economical

activity (of which, eight per cent were farmers, 23 per cent were government employees and 46 per cent were merchants).

2.3.3 Members of Family Engaged in Poultry Rearing

Mcainsh *et al.* (2004) found that women were the owners of chicken in eight out of 10 farms in Zimbabwe. In two families, there was a common ownership between several household members (women, men and children). Sometimes children owned some birds in the flock and were allowed to take decisions regarding these particular birds. Women carried out most of their daily work and were the main decision-makers on chicken production.

Mack *et al*. (2005) observed that nearly all at the village level, even the poor and landless families, are owners of poultry in developing countries. Furthermore, poultry are mainly owned and managed by women households.

Halima *et al.* (2007b) found that majority of the poultry farmers in north-west Ethiopia were females (74. 16 %).

Mengesha *et al*. (2008) documented in a study on Socio-economical contribution and labor allocation of village chicken production of Jamma District, South Wollo, Ethiopia that, more than around 70 per cent of overall care-taking and feeding of chickens, cleaning of birds-quarter (coops), treating of sick birds and decision for selling of poultry products were the responsibility of women.

2.3.4 Other Animal Husbandry Activities

The farmers of Andhra Pradesh maintain crossbred cows as dairy enterprise and the leftover concentrate from these dairy animals is being fed to the Ghagus birds they rear (Tantia *et al.*, 2005b).

Das *et al.* (2008) reported that a household flock in Bangladesh is usually comprised of two or more varieties of poultry species (*i.e*., chicken, ducks and/or pigeon). Occasionally farmers keep geese, but quails are mainly kept as a hobby.

2.3.5 Land Holdings

As suggested by Das *et al*. (2008), based on the land holdings (acre) in Bangladesh, the average number of chicken per household was found to be 5.6, 7.5, 8.6 and 11.4 for landless (0 to 0.5), small (0.51 to 2), medium (2.01 to 5) and large (>5) scale farmers.

2.3.6 Main Agricultural Activity

Mcainsh *et al*. (2004) documented that most often a mixed crop livestock farming system is being practiced by the farmers of Zimbabwe.

2.3.7 Source of Birds

Ngo Thi Kim Cuc *et al*. (2006) found that majority (87.7 per cent) of Vietnamese H'mong chickens were hatched from within the household flocks, while 7.78 per cent were received as gifts from neighbours and 5.56 per cent brought in as gifts from relatives.

2.4 REARING PRACTICES RELATED TO NATIVE CHICKEN

2.4.1 Purpose of Rearing

According to Mcainsh *et al*. (2004), the reasons given by the farmers of Zimbabwe for keeping chickens in descending order of importance was meat, cash, manure and eggs.

Tantia *et al*. (2005a) found that the Kashmir Favorolla birds are being reared for meat and egg production and constitute one of the major sources of animal protein for the households.

Vijh *et al*. (2005a) found that the Miri birds are being used primarily for meat and egg purposes. They could also observe that the tribes use these birds invariably in their social and religious rituals.

Vijh *et al*. (2005b) documented that Kalasthi birds of Andra Pradesh are being mainly kept for meat purpose and cocks are occasionally being used for fighting. The utility of these birds for egg production is not much due to very small number of eggs (30 to 40 eggs) per year.

Vij *et al*. (2005) found that Danki birds of Andra Pradesh are being used mainly for game purpose (fighting), but also for meat purpose. Eggs of Danki chicken are not being sold but kept for hatching.

According to Vijh *et al*. (2006), Nicobari fowl of Nicobar Island is mainly used for egg purpose, producing highest number of eggs among all the indigenous breeds of India under free range condition with supplementary feeding.

According to Tantia *et al*. (2006a), Ankleshwar birds of Gujarat are being mainly kept for meat and egg purposes.

From a field study on Daothigir birds, Vij *et al*. (2006b) found that these birds are being reared mainly for meeting the domestic requirements of meat and eggs.

Kumar and Kumar (2007) documented that Local Hill Fowl of Uttarakhand is being used for both egg and meat production and also for cultural and religious purposes.

2.4.2 Culling Age of Cocks

Vijh *et al*. (2006) reported that age at culling of Nicobari cocks was nine months under the field conditions.

2.4.3 Culling Age of Hens

From a survey on Nicobari birds under free range system, Vijh *et al*. (2006) reported that the hens are being culled at 24 months of age.

2.4.4 Economic Feasibility

Muchenje and Sibanda (1997), from a survey reported that the farmers of Zimbabwe ranked chicken as first among the livestock species, followed by goats and cattle, in terms of their contribution to the total farm income.

According to Mcainsh *et al*. (2004), the biggest problem in village chicken production as perceived by farmers of Zimbabwe was losses through mortality especially caused by predation and diseases.

2.4.5 System of Rearing

According to Mcainsh *et al*. (2004), the small holder chicken sector of Zimbabwe is traditionally based on extensive free-range production systems, where the birds find most or all of their feed through scavenging.

According to Vijh *et al*. (2005a), Miri birds are being reared under backyard farming, freed during day time and looked after by lady members of the family.

Vij *et al*. (2006a) reported that Punjab Brown birds are reared under backyard system, set free in the morning for scavenging in the vicinity of the farmers' house before returning to their enclosures in the evening and shelter is being provided mostly during night. About 10 per cent of farmers keep the birds confined both during the day and at night.

Vij *et al*. (2006b) found that Daothigir birds are being kept in the open system of rearing; where, these birds roam freely in the forest area and eat whatever available in the form of grains, seeds, vegetation, insects, etc. before they come back in the evening to the owners' house.

Vijh *et al*. (2006) documented that in Andaman and Nicobar group of islands, the Nicobari birds are mostly being kept in free range; where, they go to the nearby forest after laying, in search of feed and come back at dusk. In free range condition, the birds fulfill their nutritional requirement for maintenance and production by scratching and consuming feed around the households or in the forests.

Tantia *et al*. (2006a) from his study stated that the Ankleshwar birds are being reared in free range backyard system and only small shelters adjoining the house are provided to save the birds from predators**.**

Kumar and Kumar (2007) documented that majority of the poultry keepers of Local Hill Fowls of Uttarakhand follows confinement housing and graze them in open to fulfill their body requirements and to minimize the feeding cost. Nomad farmers of Tarai and Bhabar area follow free range rearing system.

Vij *et al*. (2007) reported that Tellichery chicken is being kept under free range system of rearing at their home tract, Northern Kerala.

2.5 FLOCK SIZE AND COMPOSITION

In a study on five villages of Namakkal District of Tamilnadu, Selvam (2004) found that the average number of non-descript type of birds reared per household was 6.8.

From a study on traditional chicken production in Zimbabwe, Mcainsh *et al*. (2004) found that the cockerel to hen ratio was 1:6; the average number of mature hens per farm was four. Cocks were kept in 68 per cent of the farms and 12 per cent of farmers kept two or more cocks. All the farms did not keep cocks and this reflected that farm flocks were not closed production units. They also found the proportion of female chickens was larger (79 per cent) than the proportion of males (21 per cent) for chickens older than 12 weeks.

Vijh *et al*. (2005a) found that the average flock size of Miri birds reared at their home tract, Assam, was 25.2 birds per household consisting of 11 male and 14 female birds.

According to Tantia *et al*. (2005b), the flock composition (in percentage) of Ghagus chicken was 31, 11 and 58 for hens, cocks and chicks, respectively.

Average flock size of Danki birds as reported by Vij *et al*. (2005) was 16.7, ranging from 6 to 42; on an average, flock comprised of 55.7, 17.6 and 26.7 per cent of chicks, hens and cocks, respectively.

There were about 6.5 birds of Kashmir Favorolla breed per household (Tantia *et al*., 2005a).

Vijh *et al*. (2005b) found that average flock size of Kalasthi birds was 13.6, ranging from 3 to 53; the flock composed of 56.6, 28.1 and 15.3 per cent of chicks, hens and cocks, respectively.

Tantia *et al*. (2005b) estimated that the average flock size of Ghagus birds was 27, ranging from 10 to 60 birds.

Ngo Thi Kim Cuc *et al*. (2006) found that the Flock size of Vietnamese H'mong chickens per household averaged 14.44 ± 7.38 birds.

According to Tantia *et al*. (2006a), the flock size of Ankleshwar birds ranged from five to 10.

The data collected from a study on rural poultry production in Meghalaya revealed that on an average, 15.85±1.60 *desi* birds per family were reared and majority (94.57±4.47) of farmers were not satisfied with their present stock of birds (Gupta *et al*., 2006).

Vij *et al*. (2006a), in their study found that the number of Punjab Brown birds per household mostly varied from three to 15, which comprised of 24.7, 17.6 and 57.7 per cent chicks, cocks and hens, respectively in Punjab; while, that in Haryana was 49.5, 9.7 and 40.8 per cent, respectively .

Vij *et al*. (2006b), from their study stated that flock size of Daothigir birds in Daothigir breeding area ranged from 10 to 60 with an average of about 23. They reported the flock composition of cocks, hens and chicks as 21, 15 and 64 per cent, respectively.

According to Kumar and Kumar (2007), all the poultry farmers rearing Local Hill Fowls of Uttarakhand had small sized flocks. The average flock size per household was 7.55 birds; the flock composition was 17.10 per cent chicks, 23.89 per cent pullets, 12.38 per cent cockerels, 34.82 per cent hens and 11.79 per cent cocks.

Flock size of Tellichery chicken, as reported by Vij *et al*. (2007), ranged from two to 16 with an average of about 5.5 birds per household.

According to Kugonza *et al*. (2008), the average flock size per household of indigenous chickens of Kumi district in Eastern Uganda was three cocks, six hens and four chicks.

2.6 HOUSING MANAGEMENT

According to Mcainsh *et al*. (2004), local chickens of Zimbabwe are being confined in coops mainly made from locally available materials like wooden poles, branches or bricks with one or more sides were with mesh wire doors. The roof is often thatched, but also iron sheets, asbestos sheets and canvas roofing are being used. They observed that the flooring of houses was soil or if raised from the ground, wood. They found that the houses are being placed either on the ground or raised by approximately 1m. They documented that only a few pens of

local chicken of Zimbabwe were fitted with perches and also they found no litter materials are being used inside the houses.

Tantia *et al*. (2005a) found that housing is being provided to the Kashmir Favorolla birds only during night. The houses being used for Kashmir Favorolla birds are Kutcha with thatched roof having no arrangement for light and ventilation and the floor is not being padded.

Tantia *et al*. (2005b) documented that housing of Ghagus birds are open. Sometimes the shelter is being provided under the dry fodder stack kept at a height of about 1 to1.5 ft. above the ground on stone pillars. Birds use this space to keep away from sun and predators.

Vijh *et al*. (2005b) found that housing of Kalasthi birds are being open. They also documented that the birds are being allowed to spend their nights on the trees or roof tops and the fighting cocks are being kept individually under baskets.

According to Vij *et al*. (2005), housing of Danki birds is both confinement as well as open. Cocks being more ferocious are usually being restrained in houses made up of thatched roof on wooden pillars to protect the birds from sun; while, hens and chicks mostly remain in the open.

The Miri birds are being provided housing only during night in the form of cages made up of cane and bamboo (Vijh *et al*., 2005a).

Vij *et al*. (2006a) reported that the enclosures for Punjab Brown chicken are small, mostly made of mud (68 per cent); while, about 30 per cent are of bricks and 2 per cent are of wood.

Vijh *et al*. (2006) observed that housing for Nicobari birds is being provided only at night; the houses are being made up of low cost local materials. In some cases they stayed on trees during night.

Kumar and Kumar (2007) documented that the hilly farmers rearing Local Hill Fowls of Uttarakhand use confinement housing, litter floor and wooden cages. The houses were made *pucca* or *kutcha* and mostly single storied and also made with local material and wire mesh for poultry. The chicks were being protected from predators by keeping them inside the basket made by local material such as bamboo and splinters of *Sahtoot* etc. In some cases the birds were

housed in the *goth* or room at ground floor or in the storehouse. In Tarai Bhabar area, the nomads support the fowls to reach at the branches of tree by helping with a long log in evening. Some barriers were made around the stem such as thorny and spiny bushes to prevent climbing of predators on trees. Some of the households used small hen houses.

Halima *et al*.(2007b) documented that almost all farmers of north-west Ethiopia provided night shelter for native chicken, in part of the kitchen (1. 36 per cent), in the main house (39. 07 per cent), in hand-woven baskets (7. 29 per cent), in bamboo cages (1. 51 per cent) or in a separate shed purpose-made for chickens (50. 77 per cent).

Shelter is being provided for Tellichery chicken in wooden houses raised two to three ft. above the ground (Vij *et al*., 2007).

Chicken houses in rural areas of Bangladesh are usually made with materials that are locally available, like wooden planks, bamboo, mud or mud bricks (Das *et al*., 2008).

2.7 LAYING NESTS

Mcainsh *et al*. (2004) documented that most of the farmers (8 out of 10) of Zimbabwe provided their chickens with nests. They were most commonly placed outside the chicken house and raised at least 1.5 m above the ground to prevent access for predators. The nests could be wooden constructions, round woven straw nests, cardboard boxes or buckets. The nesting material was usually grass.

Vijh *et al*. (2005a) documented that during laying period, the Miri hens are kept in cages with paddy straw bedding called "Pekang".

Vijh *et al*. (2006) documented that Nicobari birds are provided with bamboo basket in the corners of the house for egg laying.

2.8 FEEDING AND WATERING MANAGEMENT

2.8.1 Feeding Management

Mcainsh *et al*. (2004) found that in addition to the scavenging feed resource base, farmers of Zimbabwe provided chickens with limited supplementation

consisting of household waste and, if available, some home grown feeds like maize, sorghum, millet and pumpkin seeds but other feeds were also given often during harvest and some months after harvest.

According to Vij *et al*. (2005), scavenging with supplementation of kitchen waste was the most common feeding system in Danki breed of chicken. Some farmers feed the Danki birds with ragi, oats, jowar, broken rice, rice bran etc., but the quantity was very little. They also reported the practice of boiling these feedstuffs sometimes to feed them in a semi-solid state. Feeding them with goats' spleen weekly to improve digestion has also been reported. In addition, the cocks were fed with almonds, raisins, eggs and milk.

According to Tantia *et al*. (2005a), very little supplementation in the form of broken rice and maize was provided for Kashmir Favorolla birds. The birds also feed in the agricultural fields during the lean periods from September to March.

Vijh *et al*. (2005a) reported that no specific feed was supplied to the Miri birds and the birds scavenge in the surroundings.

Tantia *et al*. (2005b) found that scavenging with supplementation of kitchen waste and grains like Ragi, wheat and broken-rice was the most common feeding system of Ghagus birds.

Vijh *et al*. (2005b) found that scavenging with supplementation of kitchen waste was the most common feeding system practiced in case of Kalasthi birds, in addition grains like paddy and bajra were also fed.

Vijh *et al*. (2006) from their observation on Nicobari birds stated that the owners provide supplemental feed like rice, wheat, kitchen waste and coconut grating.

Tantia *et al*. (2006a) documented that **s**cavenging with supplementation of grains or kitchen waste was the most common feeding system of Ankleshwar birds. They observed that the birds were fed with 30 to 40 g of cereal grains like jowar, rice, bajra and wheat with no supplementary feeding of vitamins and minerals**.**

Vij *et al*. (2006b) found that Daothigir birds roam freely in the forest area to forage for grains, seeds, vegetation, insects and other natural resources. Some farmers feed paddy also but commercial poultry feed were not fed.

A study on rural poultry production in Meghalaya by Gupta *et al*. (2006) revealed that most of the poultry farmers offered self produced cereal grains and kitchen waste in addition to day time scavenging of 6 to 8 hours per day.

According to Halima *et al*. (2006), the mean total feed intake under intensive system of rearing for the seven identified native chicken ecotypes named as Tilili, Gellilia, Debre-Ellias, Mello-Hamusit, Gassay, Guangua and Mecha and RIR chicken at the end of their growth phase were 13.80, 15.16, 13.44, 13.25, 13.81, 13.36, 14.11 and 12.83 kg respectively. There was no significant ($P<0.05$) difference in total feed consumption among the tested chicken lines.

Halima *et al*. (2007b) documented that about 99 per cent of the respondents of north-west Ethiopia gave supplementary feeds to their chickens.

Yousef and Al-Yousef **(**2007) found that poultry owners depended mainly on concentrate mixture (88 per cent) for their Saudi Baladi birds; while, 12 per cent used agricultural products like barley, rice, wheat barn and alfalfa from their own farms.

Kumar and Kumar (2007) documented that some farmers of Local Hill Fowls of Uttarakhand followed supplementary feeding in addition to grazing by providing about 25 to 30 g of feedstuffs like *kadan, manduwa, jhangora*, wheat, rice and maize per day.

As per the observations of Vij *et al*. (2007), Tellichery chicken in Kerala roams and eats whatever available in the form of grains, seeds, vegetation, insects, etc.; however, no commercial poultry feed is being fed.

Most rural families of Bangladesh provide a small amount of feed twice a day; once in the morning when the birds leave their night shelter and again in the evening when they return home. The scavengeable feedstuffs consumed by native chicken of Bangladesh varied from 9 to 27 g per bird per day (Das *et al*., 2008).

2.8.2 Watering Management

Mcainsh *et al*. (2004), in their study stated that drinkers and feeders for local chicken of Zimbabwe were made out of old tyres, plastic containers, cups and plates. Most farmers (8 out of 10) provided chickens with drinkers, but only few farmers (3 out of 10) provided water *ad libitum*.

Kumar and Kumar (2007) documented that watering of Local Hill Fowls of Uttarakhand was mainly done in metallic pots from sources like *naula*, water spring and pipes of Government supply. During summer, they provided water twice and during winter once daily.

Kugonza *et al*. (2008) found that the majority of the farmers (87.5 per cent) of Kumi district in eastern Uganda provided indigenous chickens with drinking water.

2.9 NATURAL INCUBATION

Roy *et al*. (2004) documented that a broody hen can hatch a maximum of 16–18 eggs with an average of 12 on small holder poultry farming with the hatchability of 92 per cent.

Mcainsh *et al*. (2004) observed that the average number or eggs incubated by local chicken of Zimbabwe per setting was 10.6 eggs (6 to15); average hatchability of eggs being 73 per cent.

Vij *et al*. (2005) reported that bamboo baskets are being hung from the roof and broody Danki hens sit on eggs in these baskets for incubation.

Tantia *et al*. (2005b) documented that the hanging bamboo basket with paddy straw bedding is being used for hatching of chicks of Ghagus birds.

According to Kumar and Kumar (2007), poultry keepers provide basket (made from locally available material) to the fowl for natural hatching and place them in darker areas of the house. The broody hens are being provided feed and water during incubation and the farmers do not allow any type of disturbance.

Hatchability on total egg set basis of Tellichery breed of chicken ranges from 70 to 80 per cent (Vij *et al*., 2007).

The hens of rural poultry of Bangladesh are being placed on bamboo basket or

wooden box, where wood shavings or rice straw are being used as bedding material for natural incubation. Depending upon the body size of the birds, about eight-12 eggs are being set under the hen (Das *et al*., 2008).

Biswas *et al*. (2008) reported that the maximum number of chicks hatched and brooded by a broody hen of Sonali chicken of Bangladesh was 14.

Kugonza *et al*. (2008) found that egg hatchability of indigenous chickens of Kumi district in eastern Uganda varied widely among farmers with an overall mean of 90 per cent.

2.10 BEHAVIOURAL CHARACTERS

According to Kumar and Kumar (2007), flocks of Local Hill Fowls of Uttarakhand produce more sound noise in comparison to commercial flock. They also reported the tendency of these birds to sit on the top of the house during morning and evening times. Its lighter body with strong wings gives a greater chance of avoidance from predators by fast running and flying to a safer place.

2.11 MORTALITY

Disease is considered to be the prime cause of mortality in commercial chickens in Bangladesh (Talha *et al*., 2001).

Mcainsh *et al*. (2004) reported that diseases and predation were the major causes of death among local chickens of Zimbabwe. The main predators were birds of prey, wild cats and domestic dogs, but also snakes and rats were reported to eat chickens.

Tantia *et al*. (2005a) from a comparison of Kashmir Favorolla with commercial broiler birds under the same management identified that the commercial birds suffered a heavy mortality of above 60 per cent from an infectious disease (bacterial) over three weeks time, while Kashmir Favorolla birds virtually escaped the outbreak. They also estimated that mortality in Kashmir Favorolla chicken up to one week was 7.3 per cent.

Vijh *et al*. (2005a) documented that the mortality of Miri birds was around 11 per cent during the first four weeks.

Vij *et al*. (2005) found that mortality of Danki birds ranged from 20 to 30 per cent up to the age of two months. It was high in winter (up to 50 per cent) as compared to that in summer.

The results of the study by Halima *et al*. (2006) showed that the lowest and highest rate of mortality in per cent recorded from day-old to four weeks were in RIR (7.4) and in Debre-Ellias (33.5), from five to eight weeks in Debre-Ellias (1.5) and in Gassay (6.2) and from 20 to 22 weeks in RIR (8.5) and in Mello-Hamusit (39.8). The causes for mortality were Coccidiosis, *Escherichia coli* infection and confinement rearing.

A study on rural poultry production in Meghalaya revealed that the average mortality was 22.35±2.73 per cent (Gupta *et al*., 2006)

According to Vij *et al*. (2006b), mortality was very low almost nil in Daothigir birds.

In Tellichery chicken under free range conditions, Vij *et al*. (2007) reported that the mortality was found to be very low, almost nil.

According to Halima *et al*. (2007b), the major causes of death of chickens of north-west Ethiopia during the study were seasonal outbreaks of Newcastle disease (locally known as fengele) and predation.

Yousef and Al-Yousef (2007) estimated that most of the chick mortality (58 per cent) in Baladi chickens occurred during the first week of age; while, 21 per cent of the mortality occurred at the growing period. More number of mortality occurred in the winter (63 per cent) than that occurred in the summer (37 per cent).

Kugonza *et al*. (2008) documented that in indigenous chicken flocks of Eastern Uganda, death was prevalent in chick stage (73 per cent) and was mainly attributed to Newcastle disease (70 per cent).

According to Biswas *et al*. (2008), the survival rate of chicks was 62.9 per cent, which might be improved if balanced supplementary feed was given. They found that the crow and the eagle were the two predominant aerial predators of Bangladesh, while, the mongoose was the major terrestrial predator. Aerial predators are important for the small chicks starting to scavenge and forage

themselves. They also reported that simple fencing made from materials like bamboo sticks around the rearing places could prevent the attacks of air-borne predators and mongoose; however, other predators like foxes, jackals and wild cats are nocturnal and could penetrate fencing either by climbing over or digging under.

2.12 COMMON DISEASES AND THEIR MANAGEMENT

2.12.1 Common Diseases

Rai and Ahlawat, (1995) found that Nicobari birds were resistant to most of the common poultry diseases compared to White Leghorn.

In a study on rural poultry production in Meghalaya, major diseases recorded by Gupta *et al*. (2006) were Coccidiosis, Salmonellosis, Ranikhet disease, chronic respiratory disease (CRD), Marek's disease and fowl pox.

The common diseases prevalent in the region of Ankleshwar birds as reported by Tantia *et al*. (2006a) were Ranikhet and Fowl pox.

Vij *et al*. (2006b) in his study stated that Coccidiosis and Ranikhet were the common diseases found in Daothigir birds' tract.

Biswas *et al*. (2008) reported that the incidence rates of loss of chicks per month on small holder households per cent in Bangladesh during the brooding period of upto two months of age were disease (10.2), predation (8.6), selling (0.9) and slaughtering (0.2). The common predators causing loss were crows (1.8), mongooses (1.6) and eagles (1.0). Colibacillosis (both single and mixed infections) contributed to highest mortality of 21 per cent of dead chicks collected followed by Newcastle disease (14) and salmonellosis (12).

Iqbal and Pampori (2008) reported that mortality recorded in Indigenous chicken of Kashmir was 41 per cent from day one to one year, mostly due to predation and New Castle disease.

2.12.2 Season of Disease Occurrence

Yousef and Al-Yousef (2007), in a study in Baladi chicken found that more per cent of mortality occurred in the winter (63) compared to summer (37).

Kugonza *et al*. (2008) reported that in indigenous chicken of Kumi district in eastern Uganda, the death per cent was prevalent in chick stage (73) and was mainly attributed to Newcastle disease (70), with most of the mortality being observed during the dry season (62).

2.12.3 Disease Control Measures

Mcainsh *et al*. (2004) found that none of the farmers of Zimbabwe vaccinated their chicken.

According to Vijh *et al*. (2005b), Kalasthi birds are being vaccinated against Fowl pox and Ranikhet.

Vij *et al*. (2005) found that majority of the farmers never vaccinate Danki birds against any disease.

Tantia *et al*. (2005a) documented that Kashmir Favorolla birds are being vaccinated against Ranikhet and fowl cholera. The mortality recorded by them was around seven per cent up to one week.

Tantia *et al*. (2005b) documented that Ghagus birds are being vaccinated against Fowl pox and Ranikhet.

Vijh *et al*. (2005a) documented that no vaccination, deworming and other health care measures are being followed by the tribals for rearing Miri birds.

Tantia *et al*. (2006a) observed that despite the prevalence of Ranikhet and Fowl pox in the region of Ankleshwar birds, they are not being vaccinated against any disease.

According to Vijh *et al*. (2006), Nicobari fowl is comparatively resistant to diseases like Ranikhet, Marek's, infectious bursal disease (IBD), Salmonella, *Escherichia coli* and Coccidiosis. Generally, vaccination against poultry diseases is not being provided to the birds.

Vij *et al*. (2006b) found that Daothigir birds are being vaccinated against Ranikhet and Fowl pox.

According to Kumar and Kumar (2007), the farmers of Kumaon region of Uttarakhand rearing Local Hill Fowls did not follow deworming and vaccination programmes.

Vij *et al*. (2007) observed that Tellichery chicken in their native tract is not being

vaccinated against any disease.

Iqbal and Pampori (2008) found that the losses due to mortality in Indigenous chicken of Kashmir were reduced in backyard scavenging system because of little health care.

2.12.4 System of Medicine for Treating Diseases

Mcainsh *et al*. (2004) reported that some farmers of Zimbabwe used local plant, "*gavakava*", of the aloe family, when treating diarrhoea and swollen eyes. The majority of farmers (7 out of 10) of Zimbabwe used commercial drugs like antibiotics for curative purposes.

2.13 QUALITATIVE CHARACTERS

2.13.1 Plumage colour

Acharya and Bhat (1984) reported that the Tellichery chicken is having plumage colour variable from black to grey and sometimes with various colour combinations.

The characterisation revealed that the local chickens of Zimbabwe, in general, was relatively dark in plumage colour but varied greatly in appearance due to their different features, like crested heads or naked necks (Mcainsh *et al*., 2004).

Singh and Singh (2004), in their study stated that plumage pigmentation of native chicken tends mainly towards blackish and brownish colours showing extended and pied colourations.

According to Bhuiyan *et al*. (2005), *Desi* chickens of Bangladesh are characterized by black (75 per cent) and red (25 per cent) plumage colours.

Tantia *et al*. (2005a) reported that Kashmir Favorolla poultry have no specific plumage color. The birds with plumage of all shades, varying from jet black, dark brown and golden to pure white are available. Most of the birds have mixed plumage color.

Miri birds have no standard plumage colour and majority of the birds are white followed by brown and black, while, some are mixed coloured (Vijh *et al*., 2005a).

Tantia *et al*. (2005b) found that the predominant plumage colour seen in Ghagus birds is brown followed by black. Cocks have shinning bluish black feathers on breast, tail and thighs. Hens are generally brown or black in colour.

According to Vijh *et al*. (2005b), the predominant plumage colour of Kalasthi birds is bluish black followed by brown. Cocks have shining bluish black feathers. Neck is long and is covered with golden feathers. Brown colored birds have dark brown feathers on neck and bluish black or dark brown on tail.

Vij *et al*. (2005) documented that the predominant plumage colour observed in Danki breed is brown followed by black. Some red, white or golden yellow birds are also seen. Cocks usually have shinning bluish black feathers on wings, breast, tail and thighs.

Duguma (2006) reported the percentages of plumage colour of three indigenous chicken of Ethiopia. The Horro ecotype chickens had red brown (25.7) plumage followed by white (21.8), red (19.5) and black (13.2). The Tepi ecotype had of red (29.9) plumage colouration followed by gray (29.5), black (16.2) and white (11.4). The Jarso ecotype was dominated by red (21.5) and gray (21.0) colours followed by white (18.7) then red brown (15.5).

Vijh *et al*. (2006) documented that Nicobari fowl has black plumage tipped with brown shade giving brownish matt appearance. Black or white birds are also found.

Vij *et al*. (2006a) recorded that the plumage colour of native Punjab Brown breed of chicken is mostly brown. Some black or white coloured birds with a golden colour on their neck, wings and tail are also available.

Tantia *et al*. (2006a) reported that plumage colour of Ankleshwar bird ranges widely; combinations of white or light grey with brown and golden colours are most prevalent. Golden yellow plumage is predominant in cocks while, black golden is more common in hens**.**

According to Vij *et al*. (2006b), Daothigir birds' plumage colour is mostly black interspersed with white feathers; nevertheless, white with black or brown with white colours are also common. Wings and tail have black or brown feathers. Neck and back have golden yellow or brown feathers in brown coloured birds.

Kumar and Kumar (2007) reported that Local Hill Fowls of Uttarakhand mainly have white, brown, black with white spotted and black mixed colours in their plumage.

Yousef and Al-Yousef (2007) documented that White (18 per cent), red (21 per cent), brown (22 per cent), black (20 per cent) and gray or golden (17 per cent) are the possible plumage colours of local (Baladi) chickens of Saudi Arabia available in the Western province of the Kingdom (Jedda and Makkah).

According to Halima *et al*. (2007a), large phenotypic variability among chicken populations of north-west Ethiopia was observed for plumage color. About 25.49, 22.3, and 16.4 per cent of the chickens had white, grayish and red plumage colors, respectively. The rest showed a considerable heterogeneity like black, multicolor, black with white tips, red brownish and white with red striped plumage colors.

Plumage colour of Tellichery chicken is black with shining bluish tinge on hackle, back and tail feathers. Few birds have golden plumage mixed with bluish feathers on neck (Vij *et al*., 2007).

Khan (2008) stated that Aseel breed exhibits nine types of plumage colours and the Kadaknath breed have a basic black plumage with yellow, brown and solid black pencilled neck feathers. Native non-descript strains have multi-colour plumage, and a mixture of brown, yellow and black are widely seen all over the country.

Iqbal and Pampori (2008) in their study found that the indigenous chicken of Kashmir was multicoloured; 55 per cent chickens were having barred plumage, 35 per cent: black and 10 per cent: white.

2.13.2 Primary and Secondary Plumage Patterns

As suggested by Kimball (1953), the primary pattern refers to the zonal or regional location of black pigment on the body and may include several feather tracts or as few as one. The secondary patterns are those that affect the distribution of eumelanin within individual feathers.

According to Bhuiyan *et al*. (2005), *desi* chickens of Bangladesh are characterized by no definite pattern (61 per cent); while, lacing feather pattern constitutes 17 per cent.

Vij *et al*. (2005) found that the plumage pattern of Danki males is generally patchy; while, that of females is usually spotted. Some birds with solid pattern (brown or black) are also seen.

Vijh *et al*. (2005a) documented that the most common pattern seen in Miri birds is solid; however, few spotted and striped patterns are also found.

Tantia *et al*. (2005a) reported that the plumage pattern of Kashmir Favorolla poultry varies from solid to dull striped and spotted.

Tantia *et al*. (2006a) reported that plumage pattern of Ankleshwar birds is generally stripped or spotted with golden yellow feathers having black tips.

Vijh *et al*. (2006) documented that the plumage pattern of Nicobari birds is solid.

According to the morphological characters recorded by of Vij *et al*. (2006b), Daothigir birds have stripped or spotted plumage.

Vij *et al*. (2006a) recorded that the plumage pattern of native Punjab Brown birds is usually solid but sometimes it was spotted or striped. Males, in particular, have black spots or stripes on their neck, wings and tail. The neck is darker in colour (brown or golden) than the rest of the body.

2.13.3 Colour of Body Parts

The information found in the literature on qualitative traits of body part colours of native chicken and ecotype chicken populations is reviewed and listed in the followingtable

Breed	Author	Skin colour	Shank colour	Eye colour	Beak colour
Sole coloured Lesotho native fowl	Nthimo, 2004	White	Black legs and feet	Large, bright and dark brown eyes	Black shading towards the tip
Danki	Vij *et al*., 2005	White or pinkish white with large patches of rose red colour on breast, thigh and wing.	Mostly yellow, but greyish in black colored birds	Black; sometimes brown. Eye ring is red in colour	Short and yellow
Miri	Vijh *et al*., 2005a	White to yellow	White or yellow	Brown	-
Kashmir Favorolla	Tantia *et al*., 2005a	White	Mainly yellow but few are black (4%).	-	-
Kalasthi	Vijh *et al*., 2005b	White or pinkish	Greyish in black birds and yellow in brown birds	-	Small and yellow
Ghagus	Tantia *et al*., 2005b	-	Yellow	-	-
Punjab Brown	Vij *et al*., 2006a	White	Yellow	-	-
Ankleshwar	Tantia *et al*., 2006a	Yellow or pinkish	Yellow	Black with yellow reddish ring	Yellow
Daothigir	Vij *et al*., 2006b	Creamy slightly towards pink	Yellow	Red eye ring	Yellow
Nicobari	Vijh *et al*., 2006	Pinkish white	Pinkish white	-	-
Local hill fowl of Uttarakhand	Kumar and Kumar, 2007	White and yellow	White, black, yellow, and light pink	Yellow and black, brown and black, and grey and black	-
Tellichery	Vij *et al*., 2007	Greyish	Blackish grey in colour, featherless	Blackish Red	-

2.13.4 Characters of Skin Appendages

The observations recorded in the literature with regard to characters of skin appendages like comb, wattles and earlobes on indigenous chicken breeds or ecotypes are reviewed and tabulated hereunder.

Breed	Author	Earlobe colour and size	Comb colour and size	Comb type and position	Wattle colour and size
Sole colored Lesotho native fowl	Nthimo, 2004	Red	Medium size, red	Single and pea combs, erect,	Red
Danki	Vij *et al*., 2005	Red; large in cocks and small in hens	Red; large in cocks than hen	Mostly pea; single or strawberry combs in few cases. Positioned high on the head	Absent
Miri	Vijh *et al*., 2005a	Mostly red	Red	Single	-
Kashmir Favorolla	Tantia *et al*., 2005a	White (93%)	Mostly red	Mostly single	-
Kalasthi	Vijh *et al*., 2005b	Red; large in cocks and small in hens	Red	Pea or mixed type. Single comb is also seen	Red, small in size
Ghagus	Tantia *et al*., 2005b	Mostly red	Red	Pea or single	Red, small in size
Punjab Brown	Vij *et al*., 2006a	Brown; at times white or grey depending on plumage colour.	-	-	Red, large in males small in females
Ankleshwar	Tantia *et al*., 2006a	White; large in cocks and small in hens	Red	Single or rose comb	-
Daothigir	Vij *et al*., 2006b	Mostly red sometimes white or white mixed with red	-	Single, erect and large in size	Red, large in size
Nicobari	Vijh *et al*., 2006		Red	Mostly single; rarely pea comb	Pinkish
Tellichery	Vij *et al*., 2007	Red with white markings; sometimes creamy white	Red, but blackish red in typical birds	Single. Large in size. Erect in cocks; floppy in hens	Red

2.14 QUANTITATIVE CHARACTERS

2.14.1 Body Weight

The literature with regard to body weight in native chicken is reviewed and presented in tabular form below.

Breed	Author	Body weight	
		Cock(kg)	Hen(kg)
Danki	Vij *et al*., 2005	3.12±09	2.2±0.06
Miri	Vijh *et al*., 2005a	1.525±0.048 (overall)	
Kashmir Favorolla	Tantia *et al*., 2005a	1.875±0.318	1.415± 0.31
		1.716± 0.356 (overall)	
Kalasthi	Vijh *et al*., 2005b	2.48±0.13	1.85±0.10
Ghagus	Tantia *et al*., 2005b	2.16±0.25	1.43±0.81
Punjab Brown	Vij *et al*., 2006a	2.15±0.94	1.57±0.04
Ankleshwar	Tantia *et al*., 2006a	1.76±0.007	1.49±0.006
Daothigir	Vij *et al*., 2006b	1.79±0.13	1 .63±0.l 3
Nicobari brown	Vijh *et al*., 2006	1.200	0.900 to 1.000
Nicobari black			
Nicobari white			
Tellichery	Vij *et al*., 2007	1.62±0.16	1.24±0.10
Local hill fowl of Uttarakhand	Kumar and Kumar, 2007	1537.50±33.60 g (overall)	

2.14.2 Egg Weight

The egg weight of native chickens reported in the literature is compiled in the following table

Breed	Author	Egg Weight (g)
Tanzania local chicken	Msoffe *et al*., 2002	41.6
Fulani	Fayeye *et al*., 2005	40.73 (27 to 72)
Danki	Vij *et al*., 2005	46.16 ±1.72 (37 to 54)
Miri	Vijh *et al*., 2005a	42.06±0.17
Kashmir Favorolla	Tantia *et al*., 2005a	45.76± 2.19
Kalasthi	Vijh *et al*., 2005b	42.91 ±1.94
Ghagus	Tantia *et al*., 2005b	40.25±2.39

Breed	Author	Egg Weight (g)
Punjab Brown	Vij *et al*., 2006a	46.0±1.19
Ankleshwar	Tantia *et al*., 2006a	35.09±0.14
Daothigir	Vij *et al*., 2006b	44.42±1.35 (42 to 48)
Nicobari brown	Vijh *et al*., 2006	50.93±0.91
Nicobari black	Vijh *et al*., 2006	52.01±0.83
Nicobari white	Vijh *et al*., 2006	54.39±0.87
Indigenous Kashmir chicken	Iqbal and Pampori, 2008	46.06 ± 3.96

2.14.3 Age at First Egg, Annual Egg Production, Eggs per Laying Cycle and Shell Colour

The literature on egg production and related characters in native chicken is reviewed and given in the table below.

Breed		Author	Age at first egg	Annual egg production (nos.)	Eggs per laying cycle	Shell colour
Danki		Vij *et al*., 2005	7.37 ± 0.034 months	25 to 35	10.60 ±0.48 (8 to 12)	LB- 8%; B- 58%; DB- 34%
Desi Chicken of Bangaladesh		Bhuiyan *et al*., 2005	175 days	45 to 50	-	-
Miri		Vijh *et al*., 2005a	212 days	62	15 to 25	LB- 62%; B- 37%; DB- 1%
Kashmir Favorolla		Tantia *et al*., 2005a	210 days	60 to 85		LB- 65%; B-19%; DB- 16%
Kalasthi		Vijh *et al*., 2005b	7.16± 0.24 months (5 to 9)	34	11.3	LB- 36%; B-45%; DB-19%
Ghagus		Tantia *et al*., 2005b	5 to 8 months	45 to 60	25 to 30	Mostly brown.
Punjab Brown		Vij *et al*., 2006a	5 to 6 months	-	-	LB- 60.7%; B- 25%; DB- 14.3%.
Ankleshwar		Tantia *et al*., 2006a	179.95±0.24 days	79.35 ± 0.29		Cream -65.5%; B- 33.4%; White-1.1%.
Daothigir		Vij *et al*., 2006b	5 to 8 months (6.0±0.32)	60 to 70	20.0±1.02 (15 to 28)	LB- 54.5%; B- 18.2%; DB- 9.1% Creamy- 18.2%.
Nicobari	Brown	Vijh *et al*., 2006	201.6±0.78 days (143 to 280)	148.7±1.09 (112 to 237)	-	White or creamy white,
	Black					White or LB
	White					White or brownish white
Tellichery		Vij *et al*., 2007	6 months (5 to 8)		20 to 25	LB- 45%; B- 33%; Creamy white 22%.
Local Hill Fowl of Uttarakhand		Kumar and Kumar, 2007	-	90 to 150	-	-
Desi chicken of Bangladesh		Das *et al*., 2008	-	35 to 40	-	-

LB = Light Brown; B = Brown; DB = Dark Brown

2.14.4 Clutch Size

Average clutch size in Miri birds was reported to be four to five eggs (Vijh *et al*., 2005a).

Tantia *et al*. (2005b) documented that the clutch size of Ghagus birds was four to six eggs.

According to Ngo Thi Kim Cuc *et al*. (2006), the estimated mean clutch size of Vietnamese H'mong chickens was 12 eggs.

Tellichery breed of chicken lays about four to six eggs continuously and then there is a gap of one to two days after which it again starts laying (Vij *et al*., 2007).

Clutch sizes of indigenous chickens of Kumi district in eastern Uganda ranged between four to 19 eggs per clutch, with a mean of 13 eggs (Kugonza *et al*., 2008).

2.14.5 Length of Laying Cycle

Vij *et al*. (2005) recorded that it takes about four months to complete one laying cycle in Danki hen.

Vij *et al*. (2006b) estimated that one laying cycle takes around 3.5 to four months in Daothigir birds and they produced around three to 3.5 cycles in a year.

The duration of one laying cycle in Tellichery breed of chicken, between the start of two broodiness, is about 3.7 to four months (Vij *et al*., 2007).

2.14.6 Broodiness and Natural Brooding

The desi hens of Bangladesh have excellent broodiness (Ahamed, 2002).

Natural brooding is an usual practice in Danki birds (Vij *et al*., 2005). After natural incubation, the hen brood the chicks for about two and a half to three months.

Natural brooding was found to be usual in Kalasthi birds (Vijh *et al*., 2005b).

Tantia *et al*. (2005b) found that brooding in Ghagus birds is common.

According to Vijh *et al*. (2006), under field condition, broodiness was found sometimes in Nicobari birds; whereas, in deep litter condition, the character was rarely expressed.

Natural brooding period is about two to 2.5 months in Daothigir birds (Vij *et al*., 2006b).

Brooding is a usual practice in Tellichery chicken (Vij *et al*., 2007).

2.14.7 Morphometric Traits

2.14.7.a Spur length

Vij *et al*. (2005) observed that spur was long and sharp in cocks and short in hens of Danki birds. They also found that the spur is large sometimes that the bird was unable to walk and it has to be burnt.

According to Bhuiyan *et al*. (2005), *Desi* chickens of Bangladesh are characterized by rudimentary spur (98%).

2.14.7.b Beak length

Vij *et al*. (2005) documented that beak is generally shorter in Danki birds.

Vijh *et al*. (2005b) found that beak of Kalasthi birds is small.

Tantia *et al*. (2006a) stated that beak of Ankleshwar birds is small.

2.14.7.c Shank length

Msoffe *et al*. (2002) estimated that mean shank length for hens and cocks of free-ranging local chickens in Tanzania was 9.7 (7 to 12) and 12.7cm (8.5 to 15), respectively.

According to Tantia *et al*. (2005a) the shank length of Kashmir Favorolla males and females was 9.00± 0.76 and 7.50±0.58cm respectively, the overall being 7.74 ± 0.87cm.

2.14.7.d Wattle size

Vij *et al*. (2006b) from their characterization study on Daothigir birds found that the wattles are medium to large in size and are of red in colour.

Wattles of Tellichery chicken are reported to be medium in size (Vij *et al*., 2007).

2.15 FERTILITY AND INCUBATION CHARACTERS

Fayeye *et al*. (2005) documented that fertility and hatchability of Fulani chicken were 76 and 47 per cent, respectively. They also documented that there were 75 per cent live germs at 18th day of incubation.

Bhuiyan *et al.* (2005) found that *Desi* chickens of Bangladesh had average fertility of 83 per cent.

Vij *et al*. (2005) documented that hatchability on total egg basis of Danki birds was 71.93 per cent (70 to 85). It was as low as 50 per cent in summer and as high as 100 per cent in winter.

Bhuiyan *et al*. (2005) found that *Desi* chickens of Bangladesh had average hatchability of 52 per cent.

Hatchability of Miri birds on total egg basis was 79 per cent (Vijh *et al*., 2005a)

Tantia *et al*. (2005a) found that hatchability of Kashmir Favorolla breed on total egg basis was 64 per cent.

According to Vijh *et al*. (2005b), Kalasthi birds had the hatchability of 72.14 per cent (60 to 85) on total egg basis.

Vij *et al*. (2006b) reported that hatchability on total egg basis of Daothigir birds was 80 to 85 per cent.

Vijh *et al*. (2006) documented that hatchability of fertile eggs of Nicobari birds under deep litter condition was 76.61±1.01 (62 to 86) per cent. Hatchability on total eggs of Nicobari birds under field condition and deep litter condition were 76.02± 1.60 (40 to 46) and 68.87±1.32 (60 to 86) per cent respectively.

Ngo Thi Kim Cuc *et al*. (2006) from their study in three villages found that the Hatchability of Vietnamese H'mong chickens ranged from 81.69 to 84.72 per cent.

Tantia *et al*. (2006a) reported that hatchability of Ankleshwar birds on total and fertile egg basis was 84.4 and 92.41 per cent respectively.

Iqbal and Pampori (2008) observed that the hatchability of eggs of indigenous chicken of Kashmir was 77 to 81 per cent and on an average 12 to 13 eggs were incubated per hen.

2.16 EGG TRAITS

2.16.1 Egg Dimensions

According to Fayeye *et al*. (2005), the mean value for egg length and width of Fulani-ecotype chicken was 37.91 and 23.59mm, respectively; egg index was 1.48.

Iqbal and Pampori (2008) reported that the average shape index of eggs was 0.455 in indigenous chicken of Kashmir.

2.16.2 Egg Quality

The mean values of different egg quality parameters published in the literature has been presented in the following table

Breed	Author	Egg quality parameters												
		AWt (g)	**A%**	**AH (mm)**	**AW**	**AI**	**YWt (g)**	**Y%**	**YH (mm)**	**YW (mm)**	**YI**	**ST (mm)**	**SWt (g)**	**S%**	**HU**
Fulani	Fayeye *et al*., 2005	-	-	4.92	-	-	13.03	-	14.27	24.68	-	0.58	5.12	-	75.53
Danki	Vij *et al*., 2005	24.43	-	4.01 ±0.19	70.33 ±3.41	0.059 ±0.002	16.0	-	11.83 ±0.82	42.30 ± 0.88	0.275 ± 0.01	0.40± 0.001	5.73	-	66.81 ±2.54
Miri	Vijh *et al*., 2005a	-	51	-	-	0.102 ±0.007	-	36	-	-	0.445 ±0.002	0.30± 0.001	-	13	81.64 ±0.32
Kashmir Favorolla	Tantia *et al*., 2005a	23.67 ± 1.63	51	-	-	0.068 ±0.001	17.0 ± 1.76	37	-	-	0.47± 0.036	0.25± 0.007	5.8 ± 1.4	12	70.26 ± 11.77
Kalasthi	Vijh *et al*., 2005b	21.84	51	4.28 ±0.29	78.29 ± 2.4	0.05 ±0.00	16.05	37	14.83 ±0.57	42.75 ±1.08	0.35 ± 0.02	0.37± 0.001	5.02 ±0.3	12	68.81 ±2.19
Ghagus	Tantia *et al*., 2005b	-	56	4.83 ±0.18	70.30 ± 3.5	0.069 ±0.001	-	37	15.20 ±0.38	39.20 ±0.86	0.389 ±0.001	0.35± 0.007	-	11	76.79 ±2.93
Punjab Brown	Vij *et al*., 2006a	24.4 ±0.63	52.9	-	-	0.10 ±0.006	16.2 ± 0.48	35.3	-	-	0.41 ±0.005	0.33± 0.007	5.4 ±0.21	11.8	82.80 ±0.98
Ankle-shwar	Tantia *et al*., 2006a	16.46	47	-	-	0.088 ±0.006	12.99	37	-	-	0.36 ±0.001	0.30± 0.001	5.64	16	83.68 ±0.02
Daothigir	Vij *et al*., 2006b	23.19 ±0.82	-	-	-	0.068 ±0.005	-	-	-	-	0.29 ±0.0	0.33± 0.009	5.09 ±0.21	-	76.35 ±1.16
Nicobari brown	Vijh *et al*., 2006	24.41 ±0.54	-	-	-	0.094± 0.006	18.81 ±0.87	-	-	-	0.29 ± 0.01	-	5.84 ±0.12	-	-
Nicobari black	Vijh *et al*., 2006	24.99 ±0.67	-	-	-	0.078 ±0.004	17.63 ±0.67	-	-	-	0.30 ±0.0l	-	6.00 ±0.20	-	-
Nicobari white	Vijh *et al*., 2006	26.67 ±0.83	-	-	-	0.071 ±0.003	18.02 ±0.47	-	-	-	0.34 ±0.01	-	6.63 ±0.12	-	-

AWt = Albumen Weight, A% = Albumen Per cent, AH = Albumen Height, AW = Albumen Width, AI = Albumen Index, YWt = Yolk Weight, Y% = Yolk Per cent, YH = Yolk Height, YW = Yolk Width, YI = Yolk Index, ST = Shell Thickness, SWt = Shell Weight, S% = Shell Per cent, HU = Haugh Unit

2.16.3 Egg Cholesterol

Ingr *et al*. (1987) reported that the yolk cholesterol content in eggs of White Hisex laying hybrid from three specialized commercial farms averaged 1230, 1330 and 1230 mg per 100 g of yolk over an 11 months laying period. They also reported that the average cholesterol content of Babcock B-380, Moravia SSL, Shaver Starcross 288, and Hisex HX-1, varied from 1200 to 1360 mg per 100 g of yolk. Throughout the egg-laying period, the yolk cholesterol content fluctuated rather irregularly and showed great variability with the variation coefficient of 9.7 to 18.2 per cent.

From a study on yolk cholesterol of eggs from different breeds, Campo (1995) reported that there were differences among breeds ($P<0.001$). The cholesterol concentration was significantly lower in the cross between Castellana and Buff Prat (13.14 ±0.26 mg per g yolk) than in the other breeds. The egg yolk cholesterol content in White Leghorn was 16.30±0.26mg per g. The eggs from the Vasca (Spanish breed) contained significantly more cholesterol (19.09±0.26 mg per g yolk) than all other breeds.

2.17 PROCESSING YIELDS AND LOSSES

The information available in the literature pertaining to processing yields and losses was compiled and presented below.

Breed	Author	LW (g)	Bl%	F%	Dr%	EW(g)	Gb%	Gz%	H%	L%	N%	B%	Br%	W%	Ds%	T%
Thai Native	Jaturasitha *et al*., 2002	1,200[b]	4.77[b]	2.90[b]	64.54	-	3.71	-	0.44[b]	2.17	10.01[*]	-	-	14.64	16.33	16.04[a]
Broiler		1,967[a]	7.85[a]	4.67[a]	65.64	-	3.23	-	0.56[a]	2.11	10.03[*]	-	-	12.21	14.41	15.02[b]
Miri	Vijh *et al*., 2005a	-	-	-	65-74	-	-	4.9	0.7	2.9	6.4	21	21.5	11.6	14.9	16.0
Ankle-shwar	Tantia *et al*., 2006a	-	-	-	62.44	-	-	3.14	1.12	2.91	6.69	20.94	22.76	9.54	16.59	16.31
LHFU (male)	Kumar and Kumar, 2007	2312.5 ±34.3	-	-	1612.5 ±24.70[#]	1381.3 ± 26.80	67.25 ±2.61[$]	-	-	-	-	-	-	-	-	-

Differences between the means of Thai native and broiler bearing different superscripts within each column are significant (P<0.01)
LHFU= Local Hill Fowl of Uttarkhand, LW =Live Weight, Bl% = Blood per cent, F%=Feather per cent, Dr% = Dressing Per cent, EW = Eviscerated weight, Gb% = Giblet per cent Gz% = Gizzard per cent, H% = Heart per cent, L% =Liver per cent, N% =Neck per cent, B%. = Back per cent, Br% = Breast per cent, W% = Wing per cent, Ds% = Drumstick per cent, T% = Thigh per cent
[*] includes both head and neck; [#] dressed weight; [$] giblet weight

2.18 HAEMATOLOGICAL PARAMETERS

In chicken the total leuococyte count for all ages was 30.4×10^3 per ml; the differential count values for lymphocytes, heterophils, eosinophils, basophils and monocytes were 73.3, 15.1, 0, 2.7 and 6.3 respectively (Cook, 1937).

Olson (1937) reported that the erythrocyte count for adult males and females were 3.32×10^6 and 2.72×10^6 respectively.

Olson (1937) reported that in adult male and female chicken, the total leuococyte count was 19.8×10^3 per ml. while the differential count values in adult male for lymphocytes, heterophils, eosinophils, basophils and monocytes were 59.1, 27.2, 1.9, 1.7 and 10.2; whereas, in adult female, it was 64.6, 22.8, 1.9, 1.7 and 9 respectively.

Lucas and Jamroz (1961) documented that, in chicken, the erythrocyte count reported was 3.8×10^6 for adult males and 3.0×10^6 for adult females.

The packed cell volume reported was 40 and 31 per cent for mature male and female chicken respectively (Lucas and Jamroz, 1961).

Sturkie and Griminger (1986) reported that in most poultry species, there was a difference in erythrocyte numbers and packed cell volume between sexes with a higher level in males, the exceptions being goose and pheasants, in which no difference was seen between sexes.

Wels and Horn (1965), cited by Sturkie and Griminger (1986), found that in adult chicken, the haemoglobin values were ranged from 8.9 to9.2 g per 100ml.

Pilaski (1972), cited by Sturkie and Griminger (1986), observed that in 210 days of age, the haemoglobin values were 11.4g per 100ml for males and 8.6g per 100ml for females.

2.19 ECONOMICS

Mcainsh *et al*. (2004) stated that the extensive chicken production system of Zimbabwe could be described as a low input–low output system; where, the birds are being given limited amounts of feed to supplement what they find to eat while scavenging. This type of chicken production represents a balanced production where relatively low outputs are being produced with a minimum of resources.

Selvam (2004), in a study conducted in five villages of Namakkal district of Tamilnadu on free range poultry rearing , estimated that the average annual income from the sale of eggs and birds were Rs. 2667.90, Rs. 6971.04 and Rs. 15273.44 for small, medium and large farms having average flock size of 5, 12 and 26 respectively.

Vij *et al*. (2005) estimated that breeders rear Danki birds for commercial purpose and sell chicks or adults to earn money. The chicken is being sold at Rs. 50 to 150 per a three day old chick and Rs. 300 to 500 for a four month old pullet or cockrel and Rs. 600 to 3000 for one year old bird. Eggs are not being sold but kept for hatching.

Vij *et al*. (2006b) documented that male Daothigir birds are being castrated (caponized) at about two to four months of age for fattening. This is being done with a view that caponized birds have faster growth and better meat quality as compared to the uncaponized ones. The caponized males fetch higher price than the uncaponized ones.

According to Kugonza *et al*. (2008), chickens and eggs are being mainly used to generate household income and for home consumption. In some households, chickens are exchanged for goats and subsequently, for cattle. They also found that the indigenous chicken is a major resource in Teso, Uganda.

Das *et al*. (2008) reported that the traditional free range ‘backyard’ and scavenging poultry are being reared by women and children of rural Bangladesh, plays an important role in generating family income in addition to improving the nutritive value of family's diet with eggs and meat.

Materials and Methods

3. MATERIALS AND METHODS

A study on backyard poultry farming systems and evaluation of native chicken of northern Kerala was carried out among poultry farmers of Kannur and Kozhikode districts. Preliminary studies were conducted in these districts to identify the suitable panchayats for the study. Based on the preliminary studies, Chekkiad Panchayat in Kozhikode district and Thrippangottur Panchayat in Kannur district were found suitable for the study. These panchayats are endowed with pure populations of native chicken by virtue of their remoteness, on the basis of history of non-mixture of exotic germplasm in the past and also based on the phenotypic characters of the birds true to the native chicken.

The primary objective of the study was to record phenotypic and production characters of total 200 birds, 100 each from Kozhikode and Kannur districts. The survey study was also conducted simultaneously from these households, in which, the phenotypic characters and production performance of birds were recorded. Therefore, no minimum number of households was fixed for survey study and all the households till covering 100 birds for phenotypic characterization from each district were surveyed. The questionnaire for this purpose was prepared based on 'Descriptor list for poultry' given in FAO Animal Production and Health Paper (FAO, 1983) with modifications to suit the rearing practices of native chicken of this locality is given at the end of this chapter.

The study encompassed three parts:

1) A field study included a) evaluation of 100 adult birds each from these panchayats by physical examination to record the qualitative and quantitative characters, b) recording of flock size and composition, c) observations on coops used for shelter, d) studies on fertility and hatchability parameters under natural incubation on 15 settings, e) recording of average egg weight from each household and f) egg production recording from females from 21 to 60 weeks of age (n=27).

2) A survey study using a well designed questionnaire to gather information on socioeconomic status of backyard poultry farmers, feeding and watering practices, natural incubation, other practices related to poultry rearing, behavioural characters of native chicken, common diseases and their prevention and control and mortality patterns. These information were collected from the households, in which, the evaluation of birds for phenotypic and production characters were carried out.

3) Laboratory investigations were conducted to assess a) egg quality parameters of 100 eggs, b) processing yields and losses of 16 birds and c) haematological parameters of 16 birds.

3.1 FIELD STUDY

3.1.1 Flock Size

The number of birds in each household was recorded in five categories. The number of chicks up to eight weeks of age was enumerated together irrespective of their sexes, since sexing at this age is difficult. The numbers of males and females were recorded separately in cases of growers (nine to 20 weeks) and adults (above 20 weeks). The birds under all the five categories were added up to work out the total flock size. From this data the composition of the flock in the native chicken population was calculated.

3.1.2 Coops

The coops used for providing the night shelter were examined to record their construction and dimension details. The type of flooring, roofing and the materials used for making their walls were recorded. The height (ft.) of the coop was measured as the height from the floor to the eave of the coop. The height of the floor of the coop from the ground, distance between the coop and the house and the total floor area (sq. ft.) of each coop were measured. The minimum floor area provided per adult bird was calculated for each and every coop based on its floor area and maximum number of adult chickens were housed by the farmer in that particular coop. The approximate cost incurred by the farmer to construct the structure was also recorded.

3.1.3 Average Egg Weight

The eggs available in each farmers' house at the time of visit were weighed to record the average egg weight (g) of the indigenous chicken per household. This data from all the households were then averaged to calculate the overall mean egg weight of native chicken.

3.1.4 Morphological Characters

Phenotypic characters, both qualitative and quantitative, of 100 adult chickens from each districts comprising of both male and female birds were recorded. The

existence of sexual dimorphism has been reported for many morphological characters; therefore sex-separate classification of the data was done to reveal the sex effect. Photographs of each bird were taken for reference.

3.1.4.1 Qualitative Characters:

Qualitative characters recorded include plumage colour and pattern, skin colour, shank colour, ear lobe colour, eye colour, comb colour, comb type, comb position, wattle colour, beak colour and shell colour.

3.1.4.1.a Plumage colour and pattern

The Plumage colour was recorded based on the base plumage colour of the bird, which included black, white, red, gold and brown. The birds having more than one colour were grouped under multicolour.

The colour distribution among the different body parts was examined to group them under the following categories of primary feather pattern: Solid black, Birchen, Wheaten, Wild, Brown and Columbian. Non specific were categorized separately. Since the males belonging to the genotypes wheaten, wild and brown exhibits only wild phenotype; they were categorized as Wild.

The feathers on the anterior part of the back region of each bird was carefully examined to record the secondary plumage patterns, that is, the colour distribution within each feather; which included stippling, barring, single lacing, double lacing, mottling, tricolour and non-specific. The structural variations like frizzling and silkiness were also recorded.

3.1.4.1.b Skin colour

The non-feathered part of skin underneath the wings was examined to record the skin colour. The birds were categorized as white, yellow and black, on the basis of the skin colour.

3.1.4.1.c Shank colour

Shank colour was recorded under six categories, viz. white, yellow, black, green, yellow with black and blue.

3.1.4.1.d Ear lobe colour

Based on ear lobe colour, the birds were listed either as white or red or yellowish white or greyish blue or admixture of patches of white and red or white with red and black or red with yellow.

3.1.4.1.a Eye colour

The birds were classified for eye colour based on the colour of retina visible on physical examination. The eye colour categories were black, yellow and yellowish red.

3.1.4.1.b Comb colour

The comb of each bird was inspected to categorize the birds based on its colour into black, red, yellow and blackish red.

3.1.4.1.c Comb type:

The birds were examined individually to record the type of the comb, viz., single, pea, rose etc.

3.1.4.1.d Comb position

The birds were categorized based on the position of the comb, either erect or floppy.

3.1.4.1.e Wattle colour

The wattles were also examined individually to document their wattle colour under the categories of red, blackish red and yellow.

3.1.4.1.f Beak colour

According to the colour of the beak, the birds were categorized as yellow or black or yellow with black or blue beaked.

3.1.4.1.k. *Egg shell colour*

The eggs available in the household during the time of visit were examined to classify them into four shell colour groups *viz*., dark brown, medium brown, light brown and white.

3.1.4.1 Quantitative Characters

The phenotypic characters of metric nature like wattle size, shank length, beak length, spur length and body weight were recorded in metric units.

3.1.4.2.a Wattle size

The wattle size was measured as the length from its attachment on the lower beak to the edge on the ventral perimeter. Then the birds were categorized as those having small (up to 1cm), medium (1.1 to 2cm) and large (above 2cm) wattles.

3.1.4.2.a Shank length

The length (mm) of the shank between hock and tarso-metatarso-phalangial joint was measured individually using Vernier calipiers.

3.1.4.2.b Beak length

Beak length (mm) was measured individually from the angle of the beaks to the tip of the upper beak using Vernier calipers.

3.1.4.2.c Spur length

Spur length (mm) was measured using Vernier calipers from all the birds. The spurs less than 1 mm in length were considered as rudimentary.

3.1.4.2.d Body weight

The birds were weighed individually to record their weight to the accuracy of 20g.

3.1.5 Natural Incubation

The fertility under natural mating and the hatchability under natural incubation were studied from 15 natural settings, of which, 8 settings in Kozhikode and 7 settings in Kannur Districts. The natural incubations were arranged in 15 different farmers' houses. The farmers were allowed to follow the normal procedures, they adopt during natural incubation. The number of eggs set under each bird, nest boxes and nest materials used for natural setting were documented. After 21 days of natural incubation with a broody hen, the number of chicks hatched was recorded from each setting. All the unhatched eggs were break opened to classify them either as fertile or as infertile. The fertile unhatched eggs were then examined to identify the stage of embryonic mortality. The fertility was expressed as the percentage of fertile eggs out of total eggs set of each setting. The hatchability was expressed in terms of total egg set (TES) and fertile egg set (FES). The hatchability on TES was calculated as the percentage of chicks hatched to the total number of eggs incubated; while, hatchability on FES was arrived as the percentage of good chicks hatched to the total number of fertile egg set.

3.1.6 Daily Field Egg Recording

A total of 27 adult females nearing maturity with their hatch dates known were identified from the both the districts. The farmers willing to cooperate in daily egg production data collection were given egg production performance sheets to mark the daily egg production of these identified hens. The egg recording was continued from these birds till they reach 60 weeks (420 days) of age. During the course of the study, the mortality, if any and their causes were also documented. The broodiness, if

occurred was also documented. At the completion of the egg recording, the egg production from 21 to 60 weeks of age was divided into 10 periods of four weeks each. The number of birds at the start of 21st week of age was considered as housed birds to calculate the hen-housed egg production. The mean egg production for every period was calculated on both hen-day and hen-housed basis. The mean egg production in terms hen-housed and hen-day basis was calculated for egg number up to 40 and 60 weeks. The survivor egg production was also calculated at the end 60 weeks of age. From the egg production data, the other parameters like age at first egg in the flock and mean values of age at first egg, length of broodiness, clutch size, length of pause, number of clutches per cycle and number of eggs per cycle were arrived at. The livability per cent was calculated for the period from 21 to 60 weeks of age.

3.2 SURVEY

3.2.1 Socioeconomic Status of Poultry Farmers

The socioeconomic details of the farmers like community, major occupation, member of the family engaged in poultry keeping, animal husbandry activities other than poultry, land holdings and main agricultural activity were documented from all the families under study.

3.2.2 Practices Related to Backyard Poultry Rearing

Survey was conducted to record the experience of farmers in each household in poultry rearing, the original source of chicken they rear at present, purpose of rearing and culling age and mode of culling of males and females. The active participant of poultry keeping (males or females or children or all) in each household was also documented. The farmers' response on economic feasibility of poultry rearing was also recorded.

3.2.3 Egg Production and Related Characters

By survey, the average age at first egg (AFE) was recorded in two ways: firstly, from the general idea the farmers have on the approximate age at which generally they get first egg from their birds and the values from all the households were averaged, secondly, accurate data on AFE was collected from individual birds,

the farmers rear at the time of survey and the available data was averaged to get mean AFE.

The other egg production associated traits studied by survey were prevalence and length of broodiness, clutch size, number of clutches per laying cycle (between the start of two broodiness) and egg production per laying cycle. These data were collected on individual bird basis from as many birds as the farmers can provide accurate information.

3.2.4 Feed and Water Management

The details collected on feeding management included the reasoning for supplemental feeding as perceived by the farmers, time of feeding and type and quantity (per bird) of feed being used. The details collected by survey on watering management included the source of water and type of waterer used in providing water to the birds.

3.2.5 Natural Incubation

Survey was done to record the practices followed in natural incubation like the nest box and nest materials commonly used, number of eggs set under a broody hen and hatchability percentage on total egg set.

3.2.6 Behavioural Characters

Flight height and distance were recorded based on the response obtained from the farmers on how high and how far their birds can fly in a single flight. The territory area was recorded as an average radius the birds travel from their coops. The ability of broody hen in nurturing the baby chicks and protecting them from predation was considered as the mothering ability. The brooder chick survivability at the end of four weeks of age was taken as the measure of assessing the mothering ability of that broody hen. The data was collected on as many as mother hens, the farmers were able to provide.

3.2.7 Diseases

The common diseases prevalent in the survey area were documented from the response of the native chicken keepers. The scientific name of the disease was construed from the description of symptoms provided by the farmer and the local

name. The season of the disease occurrence from their perception, the control measure followed, system of medicine chosen for treatment and the veterinary services availed were recorded.

3.2.8 Mortality

The farmers were interviewed to collect details of mortality in native chicken up to 72 weeks of age. For this purpose the information on mortality of a recent hatch they reared from day-old to up to 72 weeks was retrieved. This information was collected only from those farmers who can provide correct data in this respect on a hatch they reared in the recent past or at present. The data was then pooled to calculate mortality at chick (up to eight weeks), grower (nine to 20 weeks) and layer (above 21 weeks) stages.

3.3 LABORATORY INVESTIGATIONS

3.3.1 Artificial Incubation

The hatchability of native chicken eggs under artificial incubation was carried out in University Poultry Farm, Mannuthy. A total of seventy six hatching eggs collected from the farmers were artificially incubated in two batches. A first batch of 22 eggs and second batch of 54 eggs were incubated under standard conditions in an incubator and the fertility and other hatchability traits as those studied in natural incubation were recorded.

3.3.2 Egg Quality

Fifty fresh eggs were collected from each district and subjected for egg quality studies. Egg weight was recorded using an electronic weighing balance of sensitivity 0.0001g. Egg length and breadth were measured using Vernier calipers for calculating Shape Index (Shape Index = egg breadth/egg length X 100)

The yolk diameter and albumen length and width were measured after breaking the eggs and dribbling the contents over a leveled glass plate. The albumen and yolk height were measured using Ames micrometer.

The shell weight was taken individually after drying the empty shells in hot air oven at 130^0C for five hours. The shell thickness was the average of shell thickness measured at broad and narrow ends and middle piece using a screw gauge.

The egg shape index was calculated by dividing egg length by egg width. Albumen index was calculated by dividing the albumen height by average albumen width and expressed in percentage. The yolk index was calculated by dividing the height of the yolk by its width and expressed in percentage. Haugh Unit Score (HU) was computed as per the formula, HU = 100 log ($H+7.57-1.7W^{0.37}$), where H is the albumen height in millimeters and W, the weight of the egg in grams. Yolk index was calculated by dividing yolk width by yolk height. Shell, albumen and yolk weight percentages were also calculated.

The cholesterol content of egg yolk of 10 eggs from each districts were estimated by Wybenga and Pileggi method (Wybenga *et al*., 1970).

3.3.3 Carcass Characters

Carcass characters were studied from four adult males and four adult females from each district. The birds were fasted overnight, slaughtered and the parameters observed were live weight, blood per cent, feather per cent, dressed per cent, eviscerated per cent, ready-to-cook (R-to-C) (g) and R-to-C yield per cent. The R-to-C carcass was then cut into parts as per the standard procedure to record the weights of gizzard, heart, liver, neck, back, breast, wing, leg, drumstick and thigh. The percentages of cutup parts from each carcass were calculated as their proportion of R-to-C.

3.3.4 Haematological Parameters

Blood (5ml) was collected from all the birds that were utilized for carcass studies (four adult males and four adult females from each district) before slaughtering in a vial containing anticoagulant for estimating the blood parameters like RBC count, Hb content and PCV per cent. The blood smears from all these birds were stained with Leishman's stain and examined under oil immersion to record the differential count.

3.3.5 Economics of Native Chicken Rearing

The study on economics of native chicken was conducted in 20 batches of chicken spread in 20 households, who could provide complete information regarding the different aspects of cost and return of native chicken rearing. The total cost of all the 20 coops were taken as the housing cost. This also formed the total nonrecurring

cost. The total number of chicks hatched in all the twenty batches was taken as the total flock size initially started. The average chick cost was calculated based on the information on total eggs set in these 20 hatches, egg cost and feeding cost of broody hen during incubation. The feed cost was calculated based on the total feed, type of feed and cost per kg they feed generally for chick, grower and layer stages. The revenue from surplus male birds sold out from these 20 hatches was considered as income. The information on average eggs produced from these birds for one week was collected and the total egg for a laying year (21 to 72 weeks) was projected. The value of eggs produced during one laying year was taken as income from eggs. However, since the practice of culling the females for meat purpose was rare, the value of spent hen was not considered as income. From these details total and net returns and income per adult female bird were calculated.

3.4 STATISTICAL ANALYSIS

Data collected on various parameters were statistically analyzed as per the methods described by Snedecor and Cochran (1994).

Questionnaire - A
(Flock Data)

A. Socioeconomic status of poultry farmer

1. Name and address :
2. Phone no. :
3. Community :
4. No. of family members :
5. Occupation :
6. Member engaged in poultry :
7. Other AH activities :
8. Land holding :
9. Agricultural activities :

B. Rearing practices related to poultry farming

1. No. of years of poultry rearing :
2. Source of the birds :
3. Origin : Desi / Exotic / Improved
4. Purpose of Rearing : Eggs / Meat / Both / Others (specify)
5. Age of culling
   Males :
   Females :
6. Mode of culling
   Males :
   Females :

C. Flock information (no. of birds)

Age	Male	Female	
0-8 weeks			
9-20 weeks			
>20 weeks			
Total			

Sex Ratio allowed :

C. Type of Rearing

1. Intensive :
2. Backyard :

D. Housing Management

1. Location :
2. Shelter : During Night / Day & Night / None
3. Flooring : Litter /Wooden/ Slat / Wire / Cage / Battery/ Cement
4. Roof Type :
5. No. of birds/ house :
6. Floor area :
7. Height :
8. Ht. from ground :
9. Materials used :
10. Apprx. cost of House :

E. Feeding Management

1. In free ranging : No supplemental feeding/ with supplemental feeding
2. In Confinement : Full feeding with local feeds / manufactured conc. / both
3. Time of feeding :
4. Feed given

	Name	Quantity/day	Price /Kg
Green fodder			
Concentrate			
Kitchen waste			
Grains			
others			

F. Watering Management

Source :
Quantity/Day :
Waterers used, if any :

G. Disease Management

1. Flock Mortality Pattern

Age group	Mortality (no. out of total)	Causes
0 to 8 weeks		
9-20 weeks		
>20 weeks		

2. Common diseases : New Castle /Fowl Pox /Coccidia /Eye Infections/ Resp. Diseases/ Ecto Parasite/ EndoParasite /Others ……..
3. Season of Occurrence :
4. Control Measures :
5. Vaccinations, if any :
6. Deworming :
7. Treatment : Allopathic / Indigenous / Herbal
8. Veterinary service :

G. Nest Management

1. Nest boxes for laying birds :
2. Nest box material :
3. Nest material :

H. Additional Information

1. Any qualities/ traits preferred for breeding :
2. Economic feasibility according to farmer :
3. Any indigenous methods / techniques followed in poultry rearing :
4. Any other information

Questionnaire – B
(Individual Bird Data)

A. Morphological characteristics

1) Plumage Colour : White / Black / Red / Blue / Gold / Brown……..
2) Plumage pattern
Primary : Solid black/Birchen/Wheaten/ Wild/ Brown/Columbian/Mahogany/ Dark Brown……
Secondary : Stippling/ Pencilling/ Barring/Butter cup/ Single/ Lacing/ Double lacing/ Spangling/ Mottling/ Tricolour
3) Skin colour : White / Yellow / Black / Blue / Green / ……
4) Shank colour : White / Yellow / Red / Black / White and Red /…
5) Ear lobe colour : White / Red / Black / White and Red / ……
6) Eye colour : Grey / Black / Brown / …….
7) Comb colour : Black / Red / ……..
8) Comb type : Single / Pea /Rose / Walnut /Cushion / Strawberry/ Duplex / V-shaped / Double
9) Comb position : Erect/ Floppy
10) Wattle colour : Red/ White/ Black
11) Wattle size : Small/ Medium/ Large
12) Shank length :
13) Beak length :
14) Beak colour : Yellow/ Black/ Grey/ Brown/Others
15) Spur length :
16) Body weight :
17) Age :
18) Sex :
19) Any distinct/ unique character :

B. Performance characteristics

1. Egg production

i. Age at first egg (Weeks) :
ii. Age at 50% pdn (Weeks :
iii. Age at culling (Months) :
iv. Total eggs (nos.) :
v. Egg wt (g) :
vi. Egg shell colour :

2. Reproduction

i. Broodiness : Usual / Sometimes / Rare /……..
ii. Length of broodiness :
iii. Brooding season, if any :
iv. Average Clutch size :
v. Egg production between two broodiness :

3. Mothering ability

No. of chicks hatched :
No. of chicks survived at 4 weeks :

Questionnaire – C
(Hatching results)

1. Nest box used for Hatching :
2. Nest material used for Hatching :
3. No. of eggs incubated :
4. No of infertile eggs :
5. No. of chicks hatched :
6. Details of Embryonic death :

	Type of Embryonic death	Number
1	Early embryonic death(upto 6days)	
2	Dead germs (7 to 18)	
3	Dead in shells (19 to 21)	
	Total	

Name and Address																																
Month																																
Sl. No.	Identification of birds	Date of Hatch	te																													

Results

The results of survey on socio-economic profile of poultry farmers of Northern Kerala and flock size, feeding, watering and housing managements, natural incubation, behavioural characters, mortality pattern and occurrence of diseases and its management in native chicken are presented in this chapter. The documented details on qualitative and quantitative characters, egg quality, processing yields and losses and haematological parameters of native chicken and economics of native chicken rearing in Northern Kerala has also been included.

The main objective of the study was to record the phenotypic characters of 100 birds each from Kozhikode and Kannur districts. This was accomplished from 43 and 21 households, from Kozhikode and Kannur districts, respectively. The reason for the disparity in number of households between the districts was that the poultry farmers in the study area in Kannur district held comparatively large sized flocks than those of Kozhikode district.

4.1 SOCIOECONOMIC PROFILE OF POULTRY FARMERS OF NORTHERN KERALA

The survey results of a total of 64 households of two districts of Northern Kerala, namely, Kozhikode (43) and Kannur (21), on the socio-economic profile of poultry farmers such as community, occupation, the members of the family who is engaged in poultry rearing, other animal husbandry activities, land holdings and the main agricultural activity they perform are presented in Table 1. The illustrations are shown in Plate 1.

The classification of farmers based on community showed that, out of total 64 households, the majority belonged to Thiya community (56), followed by Muslim (4), Nair (2) and Scheduled caste (2); the overall per cent for these communities being 87.5, 6.25, 3.13 and 3.13, respectively.

The classification based on occupation of the head of the family revealed that out of 64 households surveyed, the agricultural workers (15) were most

Table 1.Socioeconomic status of poultry farmers (n=64)

Sl.No.	Parameters	Categories	Number of households			
			KKD	KNR	Overall	
					No.	Percent
1	Community	Thiya	36	20	56	87.50
		Nair	2	-	2	3.13
		Muslim	3	1	4	6.25
		Scheduled Caste	2	-	2	3.13
		Total	**43**	**21**	**64**	**100.00**
2	Occupation	Nil	1	3	4	6.25
		Agriculturist	7	1	8	12.50
		Agricultural worker	15	-	15	23.44
		Mason	5	1	6	9.38
		Business (small scale)	5	4	9	14.06
		Job abroad	1	1	2	3.13
		Coolie	8	3	11	17.19
		Others*	1	8	9	14.05
		Total	**43**	**21**	**64**	**100.00**
3	Members engaged in poultry rearing	Males	1	1	2	3.13
		Females	39	18	57	89.06
		All	3	2	5	7.81
		Total	**43**	**21**	**64**	**100.00**
4	Other Animal Husbandry (AH) activities	No other AH activities	15	13	28	43.75
		Goat	7	1	8	12.50
		Cattle	10	5	15	23.44
		Goat and Cattle	11	-	11	17.19
		Goose, Turkey and Cattle	-	2	2	3.12
		Total	**43**	**21**	**64**	**100.00**
5	Land holdings (cents)	Below 25	18	7	25	39.06
		26 to 50	19	11	30	46.88
		51 to 75	2	-	2	3.13
		Above	4	3	7	10.93
		Total	**43**	**21**	**64**	**100.00**
6	Main agricultural activity	No agricultural activity	22	9	31	48.44
		Coconut	5	11	16	25.00
		Plantain	2	-	2	3.13
		Vegetables	2	-	2	3.13
		Mixed farming #	12	1	13	20.31
		Total	**43**	**21**	**64**	**100.00**

* Others (9) include driver (3), tailor (1), welder (2) and teacher (3)

Consist of tapioca, plantain and coconut

Plate 1. Topography and farming systems

a. Location

b. Plantation

c. Free range system

d. Chicken with other poultry

e. Other AH activity - Goat farming

f. Other AH activity - Dairy farming

g. Flock Composition

h. Scavenging

prevalent, followed by coolies (11), small scale businessmen (9), agriculturists(8), masons (6), and persons employed abroad (2). Four of the farmers (6.25 per cent) did not have any occupation. The nine farmers classified under 'others' consisted of driver (3), teacher (3), welder (2) and tailor (1). The overall per cent were 23.44, 17.19, 14.06, 12.50, 9.38, 4.69, 4.69, 3.13, 3.13 and 1.56 for agricultural workers, coolies, small scale businessmen, agriculturists, masons, drivers, teachers, welders, persons employed abroad and tailors respectively.

The study on the member of the family actively engaged in poultry rearing in each household revealed that among 64 total families, poultry rearing is the chore of the females in 57 (89.06 per cent), males in two (3.13 per cent) and all the family members in five (7.81 per cent) households.

The other animal husbandry activity of poultry farmers were cattle rearing in 15 (23.44 per cent) households, both cattle and goat rearing in 11 (17.19 per cent) and goat rearing alone in 8 (12.50 per cent); while, 28 (43.75 per cent) households had no other animal husbandry activities. Two households (3.12 per cent) reared cattle, goose, turkey and chicken together (plate 1. d, e and f).

The classification of the poultry farmers based on the land holdings showed that 25 farmers (39.06 per cent) had only below 25 cents, 30 (46.88 per cent) had 26 to 50 cents and nine (14.06 per cent) had more than 50 cents.

The main agricultural activity, out of 64 households, was coconut cultivation (16) followed by mixed farming (13), plantain (2) and vegetable (2) cultivation; while, many of them (31) had no agricultural activity, the per cent values for these figures being 25.00, 20.31, 3.13, 3.13 and 48.44 respectively.

4.2 PRACTICES RELATED TO NATIVE CHICKEN REARING

The details related to different practices pertaining to native chicken rearing such as farmers' experience in native chicken rearing, source of birds, culling age and mode of disposal of birds and farmers' opinion on economic feasibility is presented in Table 2. The classification of farmers based on their experience (in

years) in poultry rearing revealed that out of 64 total farmers, 10.94 per cent (7) of poultry farmers had only below five years of experience; while, 32.81 per cent (21) : from five to ten, 10.94 per cent (7) : from 11 to 15, 18.75 per cent (12) : from 16 to 20, 21.88 per cent (14) : from 21 to 25 and 4.69 per cent (3) : above 25. The average years of experience (Table16) in Kozhikode and Kannur districts were 15.40±1.57 and 17.71±2.26 respectively, the overall mean being 16.16±1.29 years.

The study on the original source of birds they reared at the time of survey showed that out of 64 families, 47 (73.44 per cent) got these birds in the past from within the panchayat; while 11 (17.19 per cent): from within the district and six (9.37 per cent): from outside the district.

Among 64 farmers, 20 (31.25 per cent) of them were in opinion of that the birds were reared for mainly eggs; while, 44 (68.75 per cent) of them opined that it was for both egg and meat. The study on the culling age of surplus male birds showed that 38 households (59.38 per cent) had the practice of culling the male birds from seven months to one year of age, 18 (28.13 per cent): from one to 1.5 years and eight (12.5 per cent): above 1.5 years. No farmer cull and dispose the male birds before six months of age. The mean culling age of cocks (Table16) in Kozhikode and Kannur districts were 12.07± 0.82 and 10±0.59 months respectively, the overall being 11.39± 0.59.

The classification of farmers based on the culling age of surplus female birds showed that only three households (4.69 per cent) had the practice of culling the females from one to two years, eight (12.50 per cent): from two to three, and three (4.69 per cent): above three years. But majority, *i.e.*, 50 (78.13 per cent) households never practiced culling of their surplus female birds but rear them till they die naturally due to senility or other means. The mean culling age of hens (months) (Table16) among the households in which culling was practiced in Kozhikode and Kannur districts were 35.33±3.78 and 38.00±2.00 respectively, the overall being 35.79±3.23.

Table 2. Practices related to rearing of native chicken (n=64)

Sl. No.	Parameters	Categories	Number of house holds			
			KKD	KNR	Overall	
					No.	Percent
1	Experience in native chicken rearing (years)	Below 5	6	1	7	10.94
		5 to 10	15	6	21	32.81
		11 to 15	7	-	7	10.94
		16 to 20	5	7	12	18.75
		21 to 25	8	6	14	21.88
		Above 25	2	1	3	4.69
		Total	**43**	**21**	**64**	**100.00**
2	Source of birds reared at present	Within Panchayat	30	17	47	73.44
		Within District	10	1	11	17.19
		Outside District	3	3	6	9.37
		Total	**43**	**21**	**64**	**100.00**
3	Purpose of rearing	Eggs	17	3	20	31.25
		Eggs and meat	26	18	44	68.75
		Total	**43**	**21**	**64**	**100.00**
4	Culling age of male birds	Up to 6months	-	-	-	0.00
		7months to 1 yr.	25	13	38	59.38
		1yr to1yr. 6months	11	7	18	28.13
		Above 1yr. 6months	7	1	8	12.50
		Total	**43**	**21**	**64**	**100.00**
5	Culling age of female birds (years)	Up to 1	-	-	-	0.00
		Between 1and 2	3	-	3	4.69
		Between 2and 3	7	1	8	12.50
		Between 3and 4	2	1	3	4.69
		Natural death (No culling)	31	19	50	78.13
		Total	**43**	**21**	**64**	**100.00**
6	Mode of culling of male birds	Self use	18	14	32	50.00
		Sale	8	7	15	23.44
		Religious rites	3	-	3	4.69
		Sale and self use	14	-	14	21.87
		Total	**43**	**21**	**64**	**100.00**
7	Mode of culling of female birds	Self use	4	1	5	7.81
		Sale	3	1	4	6.25
		Sale and self use	5	-	5	7.81
		No culling	31	19	50	78.13
		Total	**43**	**21**	**64**	**100.00**
8	Farmers' opinion on economic feasibility	Profitable	40	21	61	95.31
		No specific opinion	3	-	3	4.68
		Total	**43**	**21**	**64**	**100.00**

The survey on the mode of disposal of surplus male birds revealed that 50 per cent (32) of the households eliminate them by slaughter for self use, 23.44 per cent (15): by sale, 21.87 per cent (14): by both self use and sale and 4.69 per cent(3): by sacrificing them for religious rites.

In case of female birds, 7.81 per cent (5) of the families discard the surplus female birds by slaughtering for self use, 6.25 per cent (4): by sale and 7.81 per cent (5): by both sale and self use; while, 78.13 per cent (50) practiced no culling and allow the natural death to occur.

4.3 FLOCK SIZE AND COMPOSITION OF NATIVE CHICKEN

The average flock size in terms of total birds and also birds at different stages per household was calculated by enumeration and presented in Table 3. The corresponding graphical representations are shown in Fig. 1and 20. Photograph of a typical flock is shown in plate 1.g.

The total flock size ranged from one to 16 birds per household (Table 3). The total number of birds available at the time of survey in all the 64 households together was 342. The mean number (Table16) of birds per household in Kozhikode was only 4.35±0.39, while, that of Kannur district was 6.90±1.02; the mean values between districts differ significantly ($P \leq 0.01$). The overall mean number of birds per household was 5.37±0.44.

The number of chicks (zero to eight weeks) (Table 3) recorded from the households under survey, ranged from zero to 11. The mean number of chicks per household (Table16) in Kozhikode district was 1.19±0.26 and that of Kannur district was 2.43±0.73. There were a total of 102 chicks present in only 29 households out of total 64 when survey was conducted; thus making the overall mean number of chicks per household at 1.59± 0.30.

Table 3. Flock size in native chicken (n=64)

No. of birds reared	Number of house holds				Number of house holds			
	KKD	KNR	Overall		KKD	KNR	Overall	
			No.	Percent			No.	Percent
1. Total number of birds					2. Chicks (male + female) (0 to 8 weeks)			
0	-	-	0	0.00	24	11	35	54.69
1	3	-	3	4.69	5	1	6	9.38
2	9	5	14	21.88	4	2	6	9.38
3	6	1	7	10.94	6	1	7	10.94
4	8	1	9	14.06	2	-	2	3.13
5	3	-	3	4.69	1	1	2	3.13
6	3	3	6	9.38	-	2	2	3.13
7	5	2	7	10.94	1	1	2	3.13
8	2	2	4	6.25	-	1	1	1.56
9	1	1	2	3.13	-	-	-	-
10	1	-	1	1.56	-	-	-	-
11	1	1	2	3.13	-	1	1	1.56
12	1	2	3	4.69	-	-	-	-
14	-	1	1	1.56	-	-	-	-
16	-	2	2	3.13	-	-	-	-
Total	**43**	**21**	**64**	**100.00**	**43**	**21**	**64**	**100.00**
3. Grower males (9 to 20 weeks)					4. Grower females (9 to 20 weeks)			
0	37	21	58	90.63	35	19	54	84.38
1	5	-	5	7.81	1	1	2	3.13
2	1	-	1	1.56	5	-	5	7.81
3	-	-	-	-	2	-	2	3.13
4	-	-	-	-	-	1	1	1.56
Total	**43**	**21**	**64**	**100**	**43**	**21**	**64**	**100.00**
5. Adult males (Above 20 weeks)					6. Adult females (Above 20 weeks)			
0	27	10	37	57.81	3	-	3	4.69
1	10	6	16	25.00	11	1	12	18.75
2	5	4	9	14.06	16	4	20	31.25
3	-	1	1	1.56	10	2	12	18.75
4	-	-	-	-	2	6	8	12.50
5	1	-	1	1.56	1	5	6	9.38
7	-	-	-	-	-	3	3	4.69
Total	**43**	**21**	**64**	**100.00**	**43**	**21**	**64**	**100.00**

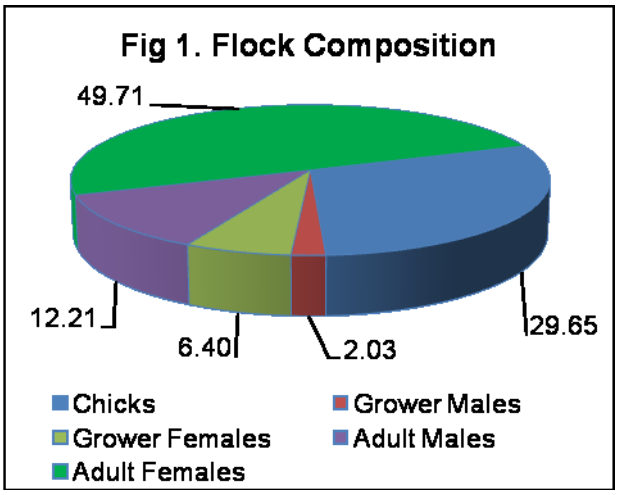


Fig 1. Flock Composition
49.71
12.21
6.40
2.03
29.65
Chicks
Grower Males
Grower Females
Adult Males
Adult Females

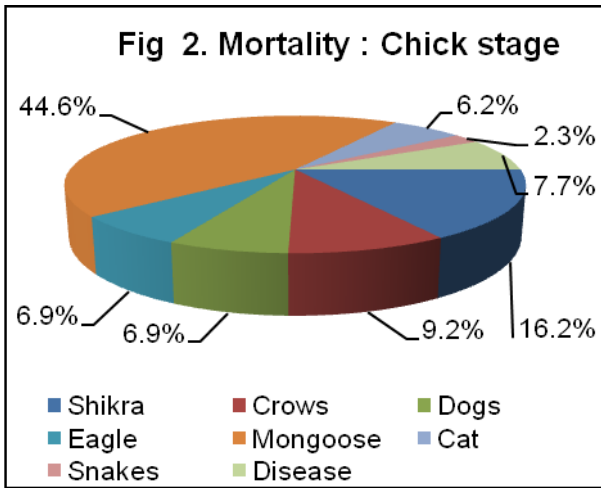


Fig 2. Mortality : Chick stage
44.6%
6.2%
2.3%
7.7%
6.9%
6.9%
9.2%
16.2%
Shikra
Crows
Dogs
Eagle
Mongoose
Cat
Snakes
Disease

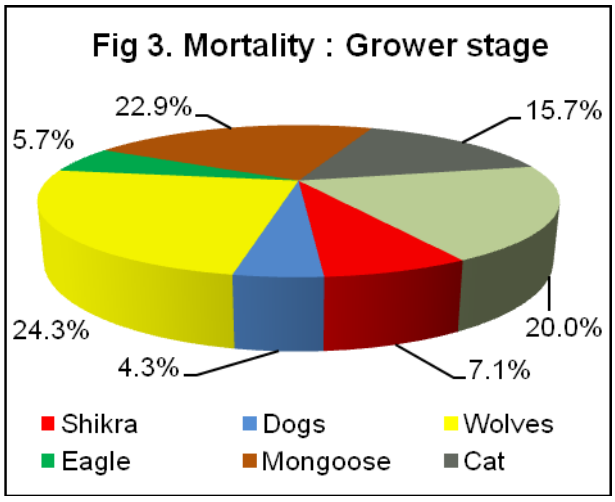


Fig 3. Mortality : Grower stage
22.9%
15.7%
5.7%
24.3%
20.0%
4.3%
7.1%
Shikra
Dogs
Wolves
Eagle
Mongoose
Cat

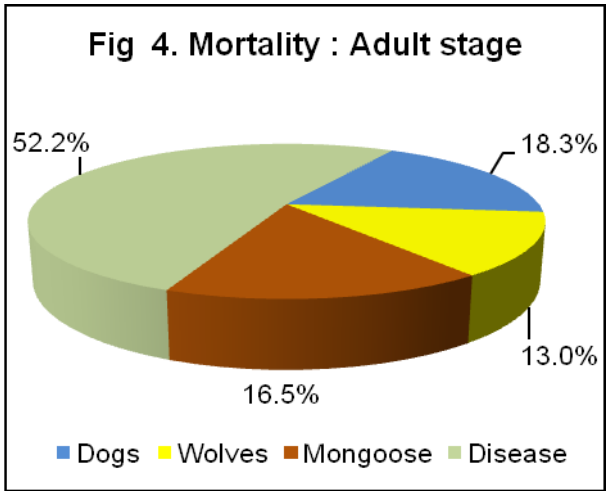
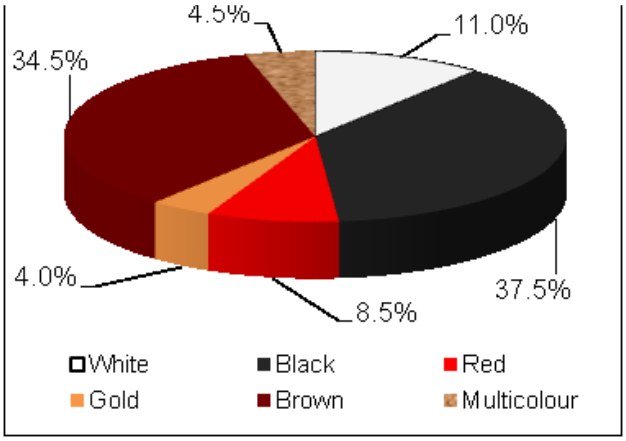


Fig 4. Mortality : Adult stage
52.2%
18.3%
13.0%
16.5%
Dogs
Wolves
Mongoose
Disease


4.5%
11.0%
34.5%
4.0%
8.5%
37.5%
White
Black
Red
Gold
Brown
Multicolour

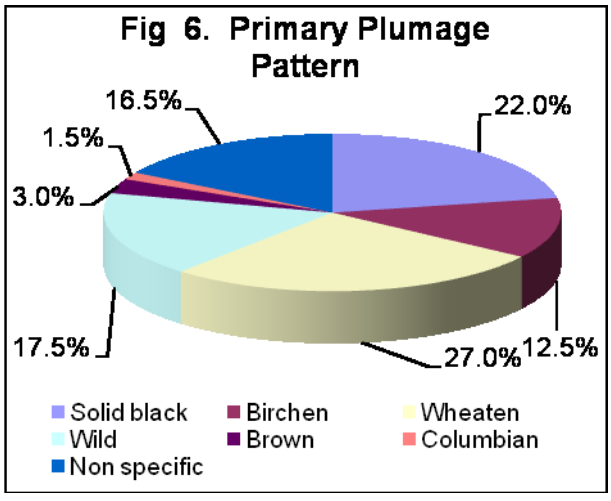


Fig 6. Primary Plumage Pattern
16.5%
22.0%
1.5%
3.0%
17.5%
27.0%
12.5%
Solid black
Birchen
Wheaten
Wild
Brown
Columbian
Non specific

The study revealed that the number of grower males (9 to 20 weeks) (Table 3) per household ranged from zero to two in Kozhikode district; while, no male at this stage was found in Kannur district. In total there were only seven grower males in the survey area. The mean number of grower males per household (Table16) in Kozhikode district was 0.16±0.07, the overall mean being 0.11±0.05.

The number of grower females (nine to 20 weeks) (Table 3) per household in the study area ranged from zero to four. The enumeration of grower females from all the 64 households under study revealed that there were a total of 22 birds in this stage. The average number of females of grower stage per household (Table16) in Kozhikode and Kannur districts was 0.40±0.13 and 0.24±0.19, respectively, with the overall mean of 0.34±0.11.

The survey on number of cocks (above 20 weeks) (Table 3) revealed that there was zero to five cocks per household. Twenty five per cent (16) of the households kept one cock and 14.06 per cent (9): two. Only one household had three (1.56 per cent) cocks and another one (1.56 per cent) household kept five cocks; whereas, 57.81 per cent (37) of the households did not maintain cock. Thus there were a total of 40 adult male birds all together in the surveyed households. The mean cock number (Table16) per household was 0.58±0.15 and 0.71±0.20 in Kozhikode and Kannur districts respectively, the overall mean being 0.66±0.12.

The number of adult females (above 20 weeks) per household (Table 3) ranged from zero to seven. Out of 64 households, a total of 12 families (18.75 per cent) had one bird each, 20 (31.25 per cent): two birds, 12 (18.75 per cent): three birds, eight (12.50 per cent): four birds, six (9.38 per cent): five birds and three (4.69 per cent): seven birds, altogether there were 171 adult females. In Kozhikode district the mean hen number (Table16) was only 2.02±0.16; while, in Kannur it was 4.05±0.37, showing significant ($P \leq 0.01$) difference between districts, the overall mean being 2.67±0.20.

4.4 HOUSING MANAGEMENT

The results of the studies on the coops used in rearing native chicken in Northern Kerala are presented in Table 4. The different types of coops are displayed in plate 2 (a). Of the 64 households studied, all had provided coops for night shelter except one; wherein, the birds were allowed to roost on the trees during night.

The study on floor types of total 63 coops revealed that a majority were made up of wood (39), followed by mud (11), cement (7), and slat (6); the per cent values for these figures being 61.90, 17.46, 11.11 and 9.52 respectively.

The popular roofing material used in construction of the coops was tiles (21), followed by thatch (15), plastic sheet (9), stone and mud (9), wood (5), concrete (3) and asbestos (1), the per cent values for the above categories in the same order were 33.33, 23.81,14.29, 14.29, 7.94, 4.76 and 1.59 respectively.

The materials used for the construction of walls of the coops included wood (44), bricks (8), stone and mud (6), wire mesh (3) wood and wire mesh (2); the per cent values for the above figures being 69.84, 12.70, 9.52, 4.76 and 3.17 respectively.

With regard to the distance of the coop from the house of the farmers, 49.20 per cent (31) of them placed the coops less than 5 m away from the house, 28.57 per cent (18) from 5 to 10m, and 9.51 per cent (6) from 10 to 15m; while, 12.72 per cent (8) of the farmers placed the coops attached to their houses. The mean distance (m) of the coop from the house among the unattached ones (Table 16) was 6.44±0.60 and 4.42±0.78 in Kozhikode and Kannur districts respectively, the overall mean being 5.75±0.49m.

With regard to the height of the coop from the ground, 12.70 per cent (8) of farmers kept the coop at a height of up to one foot, 23.81 per cent (15): from 1.1 to two ft., 20.63 per cent: (13) from 2.1 to three ft. and 6.35 per cent (4): above three ft.; while, 36.50 per cent (23) of farmers kept their coops at the

Table 4. Details of coops in native chicken rearing (n=63)

Sl.No.	Parameters	Classes	Number of coops			
			KKD	KNR	Overall	
					No.	Percent
1	Coop flooring	Slat	5	1	6	9.52
		Wood	28	11	39	61.90
		Mud	8	3	11	17.46
		Cement	1	6	7	11.11
		Total	**42**	**21**	**63**	**100.00**
2	Coop roofing	Tiles	12	9	21	33.33
		Thatch	13	2	15	23.81
		Plastic sheet	6	3	9	14.29
		Concrete	1	2	3	4.76
		Wood	3	2	5	7.94
		Stone and mud	7	2	9	14.29
		Asbestos	-	1	1	1.59
		Total	**42**	**21**	**63**	**100.00**
3	Construction materials used for walls	Wood	32	12	44	69.84
		Bricks	4	4	8	12.70
		Wire mesh	-	3	3	4.76
		Wood and wire mesh	2	-	2	3.17
		Stone and mud	4	2	6	9.52
		Total	**42**	**21**	**63**	**100.00**
4	Distance of coop from the house (m)	0 (attached)	6	2	8	12.72
		0.1 to 5	16	15	31	49.20
		5.1 to 10	16	2	18	28.57
		10.1 to15	4	2	6	9.51
		Total	**42**	**21**	**63**	**100.00**
5	Coop's height from the ground (feet)	0 (ground level)	13	10	23	36.50
		0.1 to 1	6	2	8	12.70
		1.1 to 2	10	5	15	23.81
		2.1 to 3	10	3	13	20.63
		Above 3	3	1	4	6.35
		Total	**42**	**21**	**63**	**100.00**
6	Coop's height (feet)	Up to 1	3	2	5	7.94
		1.1 to 1.5	14	5	19	30.16
		1.6 to 2.0	22	6	28	44.44
		Above 2.0	3	8	11	17.46
		Total	**42**	**21**	**63**	**100.00**
7	Total coop area (sq. feet)	2 to 4	6	2	8	12.70
		4.1 to 6	16	3	19	30.16
		6.1 to 8	13	4	17	26.98
		8 to 20	7	12	19	30.16
		Total	**42**	**21**	**63**	**100.00**
8	Coop area per bird (sq. feet)	Up to 0.5	10	4	14	22.22
		0.51 to 1.0	25	12	37	58.73
		1.1 to 1.5	5	4	9	14.29
		Above 1.5	2	1	3	4.76
		Total	**42**	**21**	**63**	**100.00**
9	Approximate cost of the coop (Rs.)	up to 250	11	1	12	19.05
		251 to 500	24	12	36	57.14
		501 to 750	6	3	9	14.29
		above 750	1	5	6	9.52
		Total	**42**	**21**	**63**	**100.00**

Plate 2. Housing, watering and incubation

a. Poultry Coops

i. For chicken & other species

ii. Wire mesh with asbestos

iii. Wooden with tiled roof

iv. Attached to house

v. Brick and cement

vi. Laterite stone, ventilated

vii. Wooden, sheet roofed

viii. Wooden, thatched roof

ix. wooden, wire meshed

b. Waterers

i. Steel utensil

ii. Coconut shell

iii. Earthen container

c. Natural setting

d. Natural incubation

e. Natural brooding

f. Nest boxes for incubation

i. Steel pan

ii. Earthern pot base

iii. Plastic can

g. Break-open study

ground level. The mean height of the coop from the ground (Table16) in Kozhikode and Kannur districts was 1.53±0.23 and 1.00±0.26 ft, respectively, with the overall mean of 1.35±0.18 ft. among the elevated 32 coops. The coops were elevated from ground by piling three to four laterite stones.

The observations on the height of the coops, measured from the floor to the eaves revealed that the height was up to one foot in case of 7.94 per cent (5) of coops, from 1.1 to 1.5 ft. in 30.16 per cent (19), from 1.6 to two ft. in 44.44 per cent (28) and above two ft. in 17.46 per cent (11). The mean height (ft.) of the coop (Table 16) in Kozhikode district was 1.63± 0.06, while, in Kannur it was 2.36±0.29 and the values differed significantly ($P \leq 0.01$). The overall mean was 1.87± 0.11 ft.

The classification of coops based on the floor area (sq. ft.) showed that 12.70 per cent of the coops had floor area of up to four, 30.16 per cent: from 4.1 to six, 26.98 per cent: from 6.1 to eight and 30.16 per cent: more than eight; the number of coops that fell in the above categories were 8, 19, 17 and 19 respectively. The mean coop area (Table16) in Kozhikode (6.23±0.35 sq. ft.) was significantly ($P \leq 0.01$) lower than that of Kannur (10.13±1.17 sq. ft.) district; the overall coop size was 7.46±0.50 sq. ft.

The average floor area of coop provided per bird by each farmer was calculated for each and every coop from the data on its total floor area and the maximum number of adult birds the farmer house in that coop. The results revealed that 22.22 per cent (14) of the farmers provided a minimum of up to 0.5 sq. ft. per bird, 58.73 per cent (37): from 0.51 to one sq. ft., 14.29 per cent (9): from 1.1 to 1.5 sq. ft. and 4.76 per cent (3): more than 1.5 sq. ft. The average coop area per bird (Table16) in Kozhikode and Kannur districts was 0.82±0.09 and 0.97±0.18 sq. ft. respectively, the overall mean being 0.87± 0.08 sq. ft.

The classification based on the approximate cost of construction of coop revealed that 19.05 per cent (12) of the coops cost up to Rs. 250, 57.14 per cent (36): from Rs. 251 to 500, 14.29 per cent (9): from Rs.501 to Rs.750, while 9.52 per cent (6): above Rs.750. The mean construction cost of the coop in rupees

(Table16) in Kannur (697.22± 145.44) was significantly (P≤0.01) higher than that of Kozhikode (395.24±29.85) district, the overall mean being Rs.485.83± 50.86.

Majority of the farmers did not provide any nests for laying eggs. Some farmers provide wooden crates (tomato boxes) spread with paddy straw. Birds usually lay their eggs on paddy straws in the cattle barns or inside the house. Some of the farmers confine the birds under bamboo baskets when they are in search of safe places for laying their eggs; they will be set free just after laying.

Out of the total 63 coops studied, seven coops (0.11 per cent) were provided with perches. This enables the farmers to accommodate more number of birds in a given floor space and also allow the bird to express their natural perching behaviour.

Only in two wooden coops (3.17 per cent) out of total 63, litter material was spread on the floor over a plastic sack. The litter material used in both the coops was sand.

4.5 FEEDING AND WATERING MANAGEMENT

The survey details from 64 households of two districts of northern Kerala on feeding and watering management of the native chicken are presented in Table 6 and illustrations in Plate 2.b and 5.f

The purpose of supplemental feeding (Plate 5.f) as perceived by the farmers revealed that 19 of them were in opinion that the supplemental feeding was essential for adequate nutrition and to encourage some behavioural activities, 12 farmers feed their birds only for behavioural reasons and another 10 farmers for nutritional reasons alone; while, 23 households did not provide any supplemental feeding for their birds. The per cent values for the above categories in the same order were 29.69, 18.75, 15.63, and 35.94.

The classification of poultry farming households based on the time of feeding showed that out of 41 households providing supplemental feeding, two households (4.88 per cent) provided supplemental feeding in the morning, nine

Table 5. Age at first egg and average egg weight

Sl.No.	Parameters	Classes	Number of house holds			
			KKD	KNR	Overall	
					No.	Percent
1	Age at first egg (months) (survey data)	Up to 5	2		2	5.13
		6th	14	10	24	61.54
		7th	6	5	11	28.21
		Above 7	1	1	2	5.12
		Total	**23**	**16**	**39**	**100.00**
2	Average egg weight (g) (observed data)	30.00 to 35.00	4	0	4	16.67
		35.01 to 40.00	4	1	5	20.83
		40.01 to 45.00	2	6	8	33.33
		45.01 to 50.00	3	4	7	29.17
		Total	**13**	**11**	**24**	**100**

Table 6. Feeding and watering management (n=64)

Sl. No.	Parameters	Classes	Number of households			
			KKD	KNR	Overall	
					No.	Percent
1	Reason for Supplemental feeding	No supplemental feeding	13	10	23	35.94
		Nutrition alone	10		10	15.63
		Nutritional and Behavioral reasons	14	5	19	29.69
		Behavioural reasons alone	6	6	12	18.75
		Total	**43**	**21**	**64**	**100.00**
2	Time of feeding	Morning	2	-	2	4.88
		Noon	7	2	9	21.95
		Evening	7	-	7	17.07
		Morning, noon and evening	4	-	4	9.76
		After laying	2	-	2	4.88
		No specific timing	8	9	17	41.46
		Total	**30**	**11**	**41**	**100.00**
3	Type of feed	No supplemental feed	13	10	23	35.94
		Wheat	4	2	6	9.38
		Rice	23	7	30	46.88
		Ragi	2	-	2	3.13
		Beaten rice	1	1	2	3.13
		Concentrates	-	1	1	1.56
		Total	**43**	**21**	**64**	**100.00**
4	Quantity of feed per bird (g)	No feed	13	10	23	35.94
		up to 10	6	7	13	20.31
		10.1 to 20	10	0	10	15.63
		20.1 to 30	9	4	13	20.31
		Above 30	5	0	5	7.81
		Total	**43**	**21**	**64**	**100.00**
5	Water source	No water provided	16	10	26	40.63
		Well water	26	11	37	57.81
		River water	1	-	1	1.56
		Total	**43**	**21**	**64**	**100.00**
6	Type of waterer	No waterer	17	10	27	42.19
		Coconut shell	11	4	15	23.44
		Broken earthen pots	5	-	5	7.81
		Steel plates	6	5	11	17.19
		Plastic utensils	3	1	4	6.25
		Rubber containers	1	1	2	3.13
		Total	**43**	**21**	**64**	**100.00**

(21.95 per cent) at around noon, seven (17.07 per cent) in the evening hours, four (9.76 per cent) in three times a day, and two (4.88 per cent) immediately after laying. However, 17 families (41.46 per cent) followed no specific timing. No supplemental feeding was provided by 35.94 per cent (23) households. Of the remaining 64.06 per cent (41) households, 46.88 per cent households (30) were giving rice, 9.38 per cent (6) were providing wheat, 3.13 per cent (2) each were giving ragi and rice flakes (*aval*) and 1.56 per cent (1) were feeding with concentrate poultry feed.

The classification based on the quantity of feed (g) given per bird per day revealed that out of total 64 households, the number of households giving less than 10 was 13 in number, from 10.1 to 20 was 10, from 20.1 to 30 was 13 and more than 30 was five. The respective values in percentage of total number were 20.31, 15.63, 20.31and 7.81. The remaining 23 farmers (35.94 per cent) did not provide supplement feeding. The mean values among all the households in two districts varied significantly ($P \leq 0.05$) with 17.36±2.68 and 7.06±2.09g in Kozhikode and Kannur districts respectively, the overall mean being 13.81±2.00g. The mean quantity of feed (g) among only those provided supplemental feeding was 21.98±2.85, 12.84±2.78 and 19.53±2.29 respectively.

The study on the source of water used to their chicken revealed that 37 households (57.81 per cent) provided well water in containers and in one household (1.56 per cent) the birds had direct access to the nearby river; while, the rest 26 households (40.63 per cent) did not have any provision for watering their birds.

Among the 37 households provided drinking water in containers, majority used coconut shell (15), followed by steel plates (11), broken earthen pots (5), plastic utensils (4) and rubber containers (2). Out of 57.81 per cent farmers using containers, the farmers using different materials in the above order were 23.44, 17.19, 7.81, 6.25 and 3.13 per cent. (Plate 2.b)

4.6 NATURAL INCUBATION

The fertility and incubation parameters were studied from the native chicken population by both direct and indirect methods. In indirect method, a survey study was conducted in which, the farmers provided information based on their experience on natural incubation of native chicken. The results of different aspects of natural incubation collected by survey are presented in Table 7 and the photographs in Plate 2. c, d, f and g. In direct method, a field experiment was conducted in the farmers' house in 15 settings, eight in Kozhikode and seven in Kannur district, and the fertility, hatchability and embryonic mortality estimated are presented in Table 18.

The survey study on nest box used for natural incubation (Plate 2f) revealed that out of 64 farmers, 21.88 per cent (14) used plastic cans, 17.19 per cent (11) used rubber baskets used in construction works, 14.06 per cent (9) used steel pans used in construction works, 12.50 per cent (8) used base portion of damaged earthen pots, 9.38 per cent (6) used wooden crates meant for transportation of vegetables, and 1.56 per cent (1) used spathe of areca nut palm; while, 23.44 per cent (15) did not provide any nest box, but setting the eggs directly on the ground for incubation.

The survey on nest material used by the farmers showed that nine households (14.06 per cent) provided no nest material. In the remaining 55 households (85.94 per cent), the most common nest material used was sand (33) followed by paddy husk (10), straw (8), clothes (2), and ash and coir fiber (1) one each; the per cent values for the above categories in that order was 51.56, 15.63, 12.50, 3.13, 1.56 and 1.56 respectively.

The information on number of eggs per setting, received from 44 farmers (by survey) showed that five to eight eggs per setting was being practiced by six (13.64 per cent) households, nine to12 eggs by 31 (70.45 per cent), 13to16 eggs by six (13.64 per cent) and 16 to 20 by one (2.27 per cent). The mean number of

Table 7. Natural incubation in native chicken (n=64)

Sl.No	Parameters	Classes	Number of house holds			
			KKD	KNR	Overall	
					No.	Percent
1	Nest box commonly used	No nest box provided	12	3	15	23.44
		Plastic can	9	5	14	21.88
		Earthen pots' base	6	2	8	12.50
		Steel pan	5	4	9	14.06
		Wooden crates	6	-	6	9.38
		Rubber basket	5	6	11	17.19
		Spathe	-	1	1	1.56
		Total	**43**	**21**	**64**	**100.00**
2	Nest material commonly used	No nest material	8	1	9	14.06
		Sand	21	12	33	51.56
		Straw	6	2	8	12.50
		Paddy husk	6	4	10	15.63
		Clothes	2	-	2	3.13
		Ash	-	1	1	1.56
		Coir fibre	-	1	1	1.56
		Total	**43**	**21**	**64**	**100.00**
3	Number of eggs per setting	5 to 8	5	1	6	13.64
		9 to 12	16	15	31	70.45
		13 to 16	3	3	6	13.64
		16 to 20	0	1	1	2.27
		Total	**24**	**20**	**44**	**100.00**
4	Hatchability percentage on TES	0	5	0	5	11.36
		1 to 20	2	1	3	6.82
		21 to 40	0	2	2	4.55
		41 to 60	3	2	5	11.36
		61 to 80	5	2	7	15.91
		81 to 99	3	5	8	18.18
		100	6	8	14	31.82
		Total	**24**	**20**	**44**	**100.00**

eggs per setting (Table 16) in Kozhikode and Kannur districts was 9.71±1.25 and 11.25±0.65 respectively, the overall mean being 10.41±0.74.

The average number of eggs per setting recorded from the field natural incubation experiment (Table 18) were 10.25±1.11 and 9.86±0.80 respectively for Kozhikode and Kannur districts with the overall value of 10.07± 0.68. The fertility per cent (Table 18) in Kozhikode and Kannur districts were 86.96±4.90 and 59.80±18.18 respectively, the overall mean being 74.29±9.26 per cent.

The hatchability details collected from the survey (indirect method) revealed that only 44 farmers could provide this information from one of their recent settings in the past. The study revealed that the hatchability per cent on total egg set ranged from zero to 100. One hundred per cent hatchability was reported from 14 households, 81 to 99 per cent from eight, 61 to 80 per cent from seven, 41 to 60 per cent from five, 21 to 40 per cent from two, one to 20 per cent from three and zero per cent from five. The per cent values for the above values in the same order were 31.82, 18.18, 15.91, 11.36, 4.55, 6.82 and 11.36 respectively. The mean hatchability per cent on total egg set basis (Table 16) in Kozhikode and Kannur districts were 60.23±7.97 and 79.05±6.27 respectively, the overall mean being 68.78±5.33. The same parameter (Table 18) studied in the field experiment (direct method) from 15 arranged settings in the farmers household showed that values were 69.20±8.96, 56.17±18.34 and 63.12±9.57, respectively, on total egg set (TES) and 80.21±10.08, 87.78±9.69 and 83.12±7.04 respectively on fertile egg set (FES).

The field experiment (direct method) (Plate 2.g) showed that the early embryonic death (per cent) (Table 18) in Kozhikode and Kannur districts were 1.04±1.04 and 12.22±9.69 respectively, the overall mean being 5.34±3.86. The mean dead germ (per cent) was 14.06±11.22 and zero respectively, with overall value of 8.65±7.00 and dead in shells (per cent) were 1.56±1.56 and zero respectively, with the overall mean of 0.96±0.96.

The artificial incubation studies (Table 18) conducted on 76 eggs collected from this area in two settings showed a fertility per cent of 79.55±6.82. The

hatchability per cent on TES and FES were 67.05±5.68 and 84.29±0.08 respectively. The per cent of early embryonic death, dead germs and dead in shells were 3.13±3.13, 4.20±1.07 and 8.39±2.14 respectively.

4.7 BEHAVIOURAL CHARACTERS

The results of survey on flight height, flight distance, territory radius and mothering ability are presented in Table 8 and illustrations in Plate 3a and b

A total of 26.92 per cent (14) farmers opined that the birds can fly up to a height of three meters in a single flight, 46.15 per cent (24): three to four meters, 23.08 per cent (12): four to five meters, one (1.92 per cent): five to six meters and another one (1.92 per cent): more than 6 meters. The mean flight height (Table 16) as reported by the farmers between the districts varied significantly ($P<0.01$), the values being 3.58±0.14m and 4.74±0.23m for Kozhikode and Kannur districts respectively, the overall mean being 4.00±0.14m. (Plate 3a)

Regarding flight distance, 9.61 per cent (5) households reported that the birds can fly only to a distance of below 10m at a single flight, 80.77 per cent (42): 10 to 15m, 5.77 per cent (3): 16 to 20 m and 3.85 per cent (2): more than 20m. The mean flight distance (Table 16) of native chicken in Kozhikode and Kannur districts were 12.85±1.26 and 14.05±0.83m respectively, the overall mean being 13.29±0.85m.

The radius of the territory the birds cover from their respective houses documented in this study as observed by the farmers revealed that it was up to 50 m as per 16 households, 50 to 100 meters: 15, 100 to 150m: six, 150 to 200m: 14, and more than 200: one. The percentage out of 52 households was 30.77, 28.85, 11.54, 26.92 and 1.92 in that order. The mean distance (Table 16) of travel as reported by farmers in Kozhikode and Kannur districts varied significantly ($P<0.01$), the values being 139.39±11.46 and 89.47±11.20m respectively, with the overall mean of 121.15±8.94m.

Table 8. Behavioural characters in native chicken

Sl. No	Parameters	Classes	Number of house holds			
			KKD	KNR	Overall	
					No.	Percent
1	Flight height (m) (n=52)	Less than 3	14	0	14	26.92
		3.1 to 4	15	9	24	46.15
		4.1 to 5	4	8	12	23.08
		5.1 to 6	0	1	1	1.92
		Above 6	0	1	1	1.92
		Total	**33**	**19**	**52**	**100.00**
2	Flight distance (m) (n=52)	Below 10	5	0	5	9.61
		10 to 15	26	16	42	80.77
		16 to 20	1	2	3	5.77
		Above 20	1	1	2	3.85
		Total	**33**	**19**	**52**	**100.00**
3	Territory radius (m) (n=52)	Up to 50	7	9	16	30.77
		51 to 100	8	7	15	28.85
		101 to 150	5	1	6	11.54
		151 to 200	12	2	14	26.92
		Above 200	1	0	1	1.92
		Total	**33**	**19**	**52**	**100.00**
4	Brooder chick survivability* (n=61)	0 to 25	4	2	6	9.84
		26 to 50	13	4	17	27.87
		51 to 75	7	6	13	21.31
		76 to 100	14	11	25	40.98
		Total	**38**	**23**	**61**	**100.00**

* as a measure of mothering ability

Plate 3. Behaviour, plumage colour and primary plumage pattern

a. Perching Behaviour

b. Mothering Behaviour

c. Plumage Colour

i. White

ii. Black

iii. Red

iv. Gold

v. Brown

vi. Multicolour

d. Primary plumage Pattern

i. Solid black

ii. Birchen

iii. Wheaten

iv. Wild

v. Brown

vi. Columbian

The mothering ability of broody hens (Plate 3b) was assessed as the percentage of chicks that could be saved from death by that particular hen at the end of one month from hatch. The observations revealed that out of information collected from 61 broody hen, 9.84 per cent broody hens (6) could save only zero to 25 per cent of their hatch from depletion by predation and other means, 27.87 per cent hens (17): 26 to 50 per cent, 21.31 per cent (13): 51 to 75 per cent and 40.98 per cent (25): 76 to 100 per cent. The mean survival rate of chicks (Table 16) in Kozhikode and Kannur district was 62.91± 4.78 and 68.41± 5.68 respectively, the overall mean being 64.98±3.66 per cent.

4.8 DISEASE PREVALENCE AND ITS MANAGEMENT

The results of survey study from 64 households on disease occurrence and other related practices in control and treatment are presented in Table 9.The photographs of the usually used herbs for treating the native chicken are depicted in plate 5 g.

The important disease conditions in native chicken as per the perception of all 64 farmers, arranged in descending order of significance are respiratory disease (25 per cent), Ranikhet disease (23.44 per cent), fowl pox (12.50 per cent), ectoparasitism (6.25 per cent) and thin shelled eggs (1.56 per cent); the number of farmers responded for the above categories in the same order was 16, 15, eight, four and one, respectively. However, another 20 households (31.25 per cent) deemed none of the disease conditions was important in native chicken rearing.

The survey on more prone season for disease occurrence as perceived by the farmers revealed that out of 68.75 per cent (44) households where disease occurrence was recorded 40.63 per cent (26) opined that it was summer season, 12.50 per cent (8): rainy season, 15.63 per cent (10): no specific season; whereas, the remaining 31.25 per cent (20) did not report any disease occurrence.

Table 9. Disease prevalence and its management (n=64)

Sl.No	Parameters	Classes	Number of house holds			
			KKD	KNR	Overall	
					No.	Percent
1	Common diseases reported	No diseases	12	8	20	31.25
		Ranikhet disease	8	7	15	23.44
		Respiratory diseases	12	4	16	25.00
		Fowl pox	6	2	8	12.50
		Ectoparasitism	4	-	4	6.25
		Thin shelled eggs	1		1	1.56
		Total	**43**	**21**	**64**	**100.00**
2	Season of disease occurrence	No disease reported	12	8	20	31.25
		Summer season	17	9	26	40.63
		Rainy season	5	3	8	12.50
		Any season	9	1	10	15.63
		Total	**43**	**21**	**64**	**100.00**
3	Disease control measures commonly practiced	No measures taken	39	19	58	90.63
		Herbal	3	1	4	6.25
		Biosecurity (daily disinfection of coops)	1	-	1	1.56
		Antibiotics	-	1	1	1.56
		Total	**43**	**21**	**64**	**100.00**
4	System of medicine chosen for treatment	No treatment	16	5	21	32.81
		Allopathic	7	6	13	20.31
		Indigenous	14	6	20	31.25
		Combination	6	4	10	15.63
		Total	**43**	**21**	**64**	**100.00**
5	Veterinary services adopted	No services	13	4	17	26.56
		Govt. institution	11	5	16	25.00
		Self treatment	19	12	31	48.44
		Total	**43**	**21**	**64**	**100.00**

On disease control measures, 90.63 per cent (58) of total 64 households did not practice any control measures and 6.25 per cent (4) depended on herbals like *tulsi* (*Ocimum sanctum*), garlic (*Allium sativum*), turmeric (*Curcuma longa*), *narimunja* (*Premna serratifolia*), *kaitha (Pandanus species)* and some other aromatic plants (Fig. 49), one household (1.56 per cent) carried out daily disinfection of coops and another one household (1.56 per cent) depended on antibiotics as a prophylactic measure. No farmers in the surveyed area practiced deworming of their chicken.

Classification of farmers based on the system of medicine they choose for treatment was as follows: 31.25 per cent (20) depended on indigenous methods, 20.31 per cent (13) depended on allopathic treatment and 15.63 per cent (10) adopted a combination of both; whereas, treatment measures were not taken by 32.81 per cent (21) of the farmers.

The study on veterinary services the farmers avail in native chicken rearing revealed that only 25 per cent (16) depended on Government veterinary institutions, 48.44 per cent (31) followed self treatment and 26.56 per cent (17) adopted no services.

4.9 MORTALITY PATTERN

The details on mortality in native chicken was collected from the farmers by survey, on as many birds as the farmers can provide accurate information from hatch to 72 weeks of age. Only 41 farmers could provide the required information on a total of 454 birds through stages, chick (0 to 8 weeks), grower (9 to 20 weeks) and adult (21 to 72 weeks). The results are presented in Table 10 and the graphical representation is shown in Fig. 2 to 4.

Out of 454 chicks, 130 died in chick stage (0 to 8 weeks); the mortality per cent was 28.63. Out of 130 total mortality, only 10 (7.69 per cent) was due to disease, while the rest 120 (92.31 per cent) was by predation. Out of 130 total

Table 10. Causes of mortality in native chicken

Cause of mortality	Chicks				Growers				Adults				Overall	
	KKD	KNR	Total		KKD	KNR	Total		KKD	KNR	Total			
			No	Per cent*			No.	Per cent*			No.	Per cent*	No.	Per cent
Birds at start	278	176	454		188	136	324		133	121	254			
Shikra	21	-	21	16.15	5	-	5	7.14	-	-	-	-	26	8.25
Crows	12	-	12	9.23	-	-		-	-	-	-	-	12	3.81
Dogs	9	-	9	6.92	3	-	3	4.29	10	11	21	18.26	33	10.48
Wolves	-	-	-	-	17	-	17	24.29	12	3	15	13.04	32	10.16
Eagle	9	-	9	6.92	4	-	4	5.71	-	-	-	-	13	4.13
Mongoose	30	28	58	44.62	1	15	16	22.86	12	7	19	16.52	93	29.52
Cat	6	2	8	6.15	11	-	11	15.71	-	-	-	-	19	6.03
Snakes	3	-	3	2.31	0	-	0	0.00	-	-	-	-	3	0.95
Disease	-	10	10	7.69	14	-	14	20.00	34	26	60	52.17	84	26.67
Total mortality	**90**	**40**	**130**	**100**	**55**	**15**	**70**	**100**	**68**	**47**	**115**	**100**	**315**	**100**

deaths, the death by predation due to mongoose was the most prevalent (44.62 per cent), followed by *shikra* (*Accipter badius* and *A.virgatus*) (16.15 per cent), crows (9.23 per cent), eagles and dogs (6.92 per cent each), cat (6.15 per cent) and snakes (2.31 per cent). The number of birds died in each category was 58, 21, 12, nine, eight and three respectively.

During growing stage (9 to 20 weeks), 70 out of 324 growers were died, the mortality per cent being 21.60. The death toll due to disease was 20 per cent (14), while the rest 80 per cent was due to predators. The highest predation recorded in this stage was due to wolf (24.29 per cent), followed by mongoose (22.86 per cent), cat (15.71 per cent), shikra (7.14 per cent), eagle (5.71 per cent) and dogs (4.29 per cent), the number of birds died under each category was 17, 16, 11, 5, 4 and 3 respectively.

During adult stage (21 to 72 weeks), 115 adults died out of a total 254, the mortality per cent was 45.28. The mortality due to disease, out of total mortality, was 60 (52.17 per cent) and due to predation was 47.83. Out of 115 birds died, 18.26 per cent was due to dogs, 16.52 per cent due to mongoose and 13.04 per cent was due to wolves; the number of birds died due to different predators in the same order was, 21, 19 and 15.

The livability per cent estimated directly from field egg recording study from 21 to 60 weeks of age was 77.78 (Table 20).

4.10 PLUMAGE COLOUR AND PATTERN

The age-wise classification separately for sexes, of a total of 200 birds, 100 each for Kozhikode and Kannur districts subjected for phenotypic characterization has been given in Table 11. The graphical representation is given in Fig. 5, 6 and 7 and the photographs in Plates 3 (c and d) and 4 (a and b)

The results of colour and primary and secondary patterns of plumage documented from 200 adult native chicken, 100 each from Kozhikode and Kannur districts comprising of 36 cocks and 164 hens are presented in Table 12.

Table 11. Age and sex-wise distribution of native chicken subjected for phenotypic characterization

Age (months)	Number of birds									
	Males				Females				Overall	
	KKD	KNR	Total		KKD	KNR	Total			
			No.	%			No.	%	No.	%
4 to 7	16	4	20	55.56	21	12	33	20.12	53	26.50
8 to 12	3	9	12	33.33	20	37	57	34.76	69	34.50
13 to 15	0	0	0	0.00	2	1	3	1.83	3	1.50
16 to 18	2	1	3	8.33	8	19	27	16.46	30	15.00
19 to 24	0	1	1	2.78	14	9	23	14.02	24	12.00
Above 24	0	0	0	0.00	14	7	21	12.80	21	10.50
Total	**21**	**15**	**36**	**100.00**	**79**	**85**	**164**	**100.00**	**200**	**100.00**

Table 12. Plumage colour and pattern of native chicken

Sl. No.	Parameters	Categories	Number of birds								Overall	
			Males				Females					
			KKD	KNR	Total		KKD	KNR	Total			
					No.	Per cent			No.	Per cent	No.	Per cent
1	Plumage colour	White	1	1	2	5.56	4	16	20	12.20	22	11.00
		Black	4	3	7	19.44	40	28	68	41.46	75	37.50
		Red	10	7	17	47.22					17	8.50
		Gold	-	2	2	5.56	3	3	6	3.66	8	4.00
		Brown	6	-	6	16.67	30	33	63	38.41	69	34.50
		Multicolour	-	2	2	5.56	2	5	7	4.27	9	4.50
		Total	**21**	**15**	**36**	**100**	**79**	**85**	**164**	**100**	**200**	**100.00**
2	Primary plumage pattern	Solid black	3	1	4	11.11	23	17	40	24.39	44	22.00
		Birchen	4	1	5	13.89	10	10	20	12.20	25	12.50
		Wheaten	-	-	0	-	22	32	54	32.93	54	27.00
		Wild	11	11	22	61.11	10	3	13	7.93	35	17.50
		Brown	-	-	0	-	5	1	6	3.66	6	3.00
		Columbian	-	-	0	-	1	2	3	1.83	3	1.50
		Non specific	3	2	5	13.89	8	20	28	17.08	33	16.50
		Total	**21**	**15**	**36**	**100**	**79**	**85**	**164**	**100**	**200**	**100.00**
3	Secondary plumage pattern	Stippling	1	1	2	5.56	19	9	28	17.07	30	15.00
		Barring	-	-	0	-	7	7	14	8.54	14	7.00
		Single lacing	-	-	0	-	6	12	18	10.98	18	9.00
		Double lacing	-	-	0	-	1		1	0.61	1	0.50
		Tricolour	-	-	0	-	-	1	1	0.61	1	0.50
		Nonspecific	20	13	33	91.67	46	55	101	61.58	134	67.00
		Frizzling	-	1	1	2.78	-	1	1	0.61	2	1.00
		Total	**21**	**15**	**36**	**100**	**79**	**85**	**164**	**100**	**200**	**100.00**

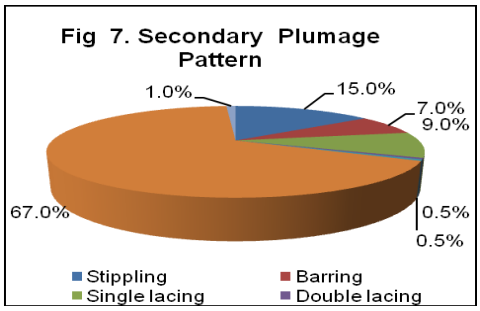


Fig 7. Secondary Plumage Pattern
1.0%
15.0%
7.0%
9.0%
67.0%
0.5%
0.5%
Stippling
Barring
Single lacing
Double lacing

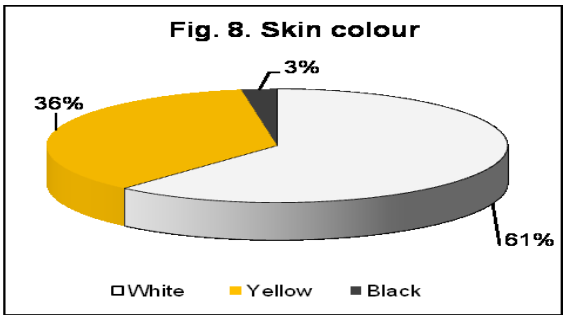


Fig. 8. Skin colour
3%
36%
61%
White
Yellow
Black

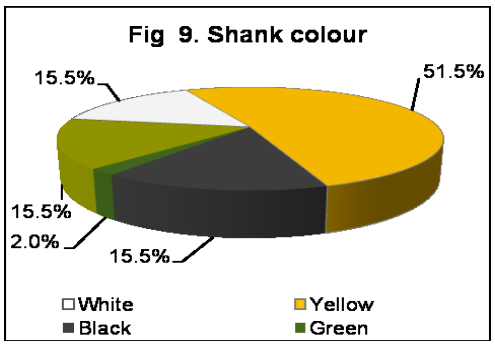


Fig 9. Shank colour
15.5%
51.5%
15.5%
2.0%
15.5%
White
Yellow
Black
Green

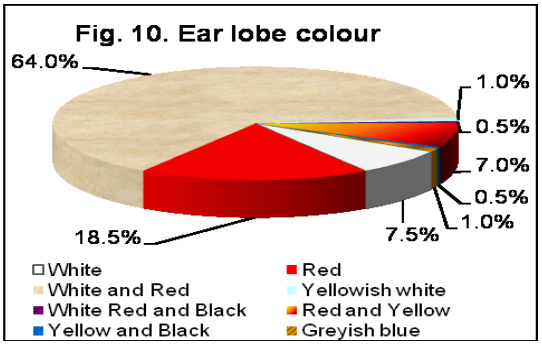


Fig. 10. Ear lobe colour
64.0%
1.0%
0.5%
7.0%
0.5%
1.0%
18.5%
7.5%
White
Red
White and Red
Yellowish white
White Red and Black
Red and Yellow
Yellow and Black
Greyish blue

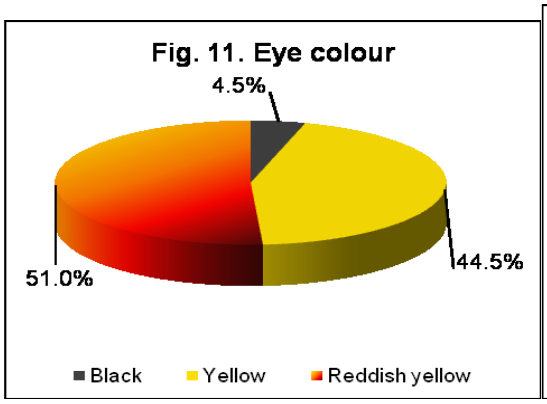


Fig. 11. Eye colour
4.5%
51.0%
44.5%
Black
Yellow
Reddish yellow

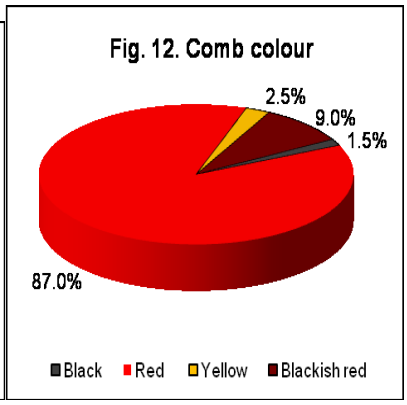
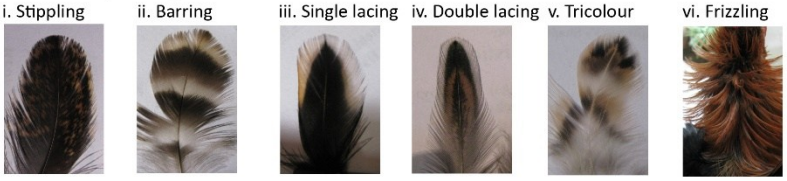


Fig. 12. Comb colour
2.5%
9.0%
1.5%
87.0%
Black
Red
Yellow
Blackish red

Plate 4. Secondary plumage pattern, varieties and colour of body parts

a. Secondary Plumage Pattern

i. Stippling ii. Barring iii. Single lacing iv. Double lacing v. Tricolour vi. Frizzling



b. Varieties

i. Laced ii. Solid iii. Barred

c. Shank colour

i. White ii. Yellow iii. Black iv. Green v. Yellow with black vi. Blue

d. Ear Lobe Colour

i. White ii. Red iii. White & Red iv. White, Red & Black v. Red & Yellow vi. Greyish blue

e. Eye colour

i. Black ii. Yellow iii. Yellowish red

f. Wattle colour

i. Red ii. Blackish red iii. Yellow

Plate 5. Morphology of comb and beak, shell colour, feeding and herbs used

a. Comb type

i. Single ii. Pea

b. Comb colour

i. Black ii. Red iii. Yellow iv. Blackish red

c. Comb position

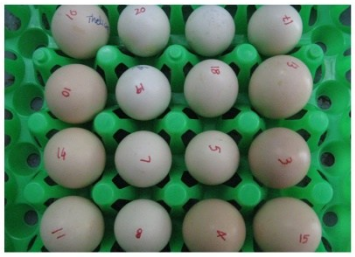
i. Erect ii. Floppy

d. Beak colour

i. Yellow ii. Black iii. Yellow with Black iv. Blue

e. Egg shell colour

Dark brown to white



f. Supplemental feeding

g. Herbs used for treatment

i. Tulsi

ii. Garlic

iii. *Pandanus species*

iv. *Premna species*

In males, the plumage colour documented is as follows; red (47.22 per cent), black (19.44 per cent), brown (16.67 per cent), white (5.56), gold (5.56) and multi-colour (5.56), the number of birds fell in to the above groups, in that order was 17, seven, six, two, two and two. In females, the six plumage colour groups in the descending order of its prevalence were black (41.46 per cent), brown (38.41 per cent), white (12.20 per cent), multi-colour (4.27 per cent) and gold (3.66 per cent), the number of hens being 68, 63, 20, seven and six respectively. The overall values in the descending order of its

prevalence were black (37.50 per cent), brown (34.50 per cent), white (11.0 per cent), red

(8.5 per cent), multi-colour (4.5 per cent) and gold (4 per cent); the number of birds being 75, 69, 22, 17, nine and eight respectively.

The classification of males based on primary plumage pattern showed that 61.11 per cent (22) of the birds were of wild, 13.89 per cent (5): birchen, 13.89 per cent (5): non-specific and 11.11 per cent (4): solid black. The seven groups of females with respect to primary plumage pattern in the descending order of its prevalence were wheaten (32.93 per cent), solid black (24.39 per cent), non-specific (17.04 per cent), birchen (12.20 per cent), wild (7.93 per cent), brown (3.66 per cent) and columbian (1.83 per cent); the number of birds fell into different colour groupings in the above order was 54, 40, 28, 20, 13, six and three respectively. The overall values in the descending order of its prevalence were wheaten (27 per cent), solid black (22 per cent), wild (17.5 per cent), non-specific (16.5 per cent), birchen (12.5 per cent), brown (3 per cent) and columbian (1.50 per cent).

The examination of feathers for secondary plumage pattern showed that in males there were two birds with stippling (5.56 per cent), one with frizzling (2.78 per cent) and all the others (33) were non-specific (91.67 per cent). The classification of females based on secondary plumage pattern of back feathers revealed that 61.58 per cent (101) were of non-specific, 17.07 per cent (28): stippled, 10.98 per cent (18): single laced, 8.54 per cent (14): barred and 0.61 per cent (1) each: double lacing, tricolor and frizzling. The overall value in the

descending order of its prevalence were non-specific (67.00 per cent), stippled (15.00 per cent), single laced (9.00 per cent), barred (7.00 per cent), frizzling (1.00 per cent), double lacing (0.50 per cent) and tricolor (0.50 per cent); the number of birds under each category being 134, 30, 18, 14, two, one and one respectively.

There were two birds (one male and one female) with naked necks of heterozygous state, out of 200 total birds (1 per cent).

4.11 QUALITATIVE CHARACTERS

The results documented with regard to qualitative characters in native chicken of Northern Kerala are presented in Table 13. The graphical representation is shown in Fig. 8 to16 and 19 and photographs in Plate 4c to Plate 5d.

There were two skin colours recorded in males; out of 36 males, 55.56 per cent (20) were of yellow skinned, while, 44.44 per cent (16) were of white skinned; whereas, from out of 164 females studied, there were three colour groups; white skinned consisted 65.24 per cent (107), yellow skinned: 31.71 per cent (52) and black: 3.05 per cent (5). The overall values in descending order of prevalence were white (61.5 per cent), yellow (36.0 per cent) and black (2.5 per cent), the number of birds being 123, 72 and five respectively.

Based on the shank colour, the 36 males examined, were grouped into four; namely, 72.22 per cent (26) were of yellow shanked, 13.89 per cent (5): white shanked, 8.33 per cent (3): black shanked and 5.56 per cent (2): yellow with black shank. In case of females, the total 164 birds were grouped into six; 46.95 per cent (77) belonged yellow shanked variety, 17.68 per cent (29): yellowish black shanked, 15.85 per cent (26): black shanked, 15.85 per cent (26): white shanked, 2.44 per cent (4): green shanked and 1.22 per cent (2): blue shanked. The overall values in descending order of prevalence were 51.5 per cent (103): yellow shanked variety, 15.5 per cent (31): yellow with black, 14.5 per cent (29): black, 15.5 per cent (31): white, 2 per cent (4): green and 1 per cent (2): blue.

Table 13.Distribution of qualitative characters in native chicken

Sl. No.	Chara-cters	Categories	Number of birds									
			Males				Females				Overall	
			KKD	KNR	Total		KKD	KNR	Total			
					No.	%			No.	%	No	%
1	Skin colour	White	12	4	16	44.44	59	48	107	65.24	123	61.50
		Yellow	9	11	20	55.56	18	34	52	31.71	72	36.00
		Black	-	-	0	-	2	3	5	3.05	5	2.50
		Total	**21**	**15**	**36**	**100**	**79**	**85**	**164**	**100**	**200**	**100**
2	Shank colour	White	4	1	5	13.89	18	8	26	15.85	31	15.50
		Yellow	15	11	26	72.22	32	45	77	46.95	103	51.50
		Black	1	2	3	8.33	11	15	26	15.85	29	14.50
		Blue	-	-	-	-	-	2	2	1.22	2	1.00
		Green	-	-	-	-	4	-	4	2.44	4	2.00
		Yellow & black	1	1	2	5.56	14	15	29	17.68	31	15.50
		Total	**21**	**15**	**36**	**100**	**79**	**85**	**164**	**100**	**200**	**100**
3	Ear lobe colour	White	-	-	-	-	8	7	15	9.15	15	7.50
		Red	9	9	18	50.00	13	6	19	11.59	37	18.50
		White and Red	12	6	18	50.00	51	59	110	67.07	128	64.00
		Yellowish white	-	-	-	-	2	-	2	1.22	2	1.00
		White,Red& Black	-	-	-	-	1	-	1	0.61	1	0.50
		Red and Yellow	-	-	-	-	4	11	15	9.15	15	7.50
		Greyish blue	-	-	-	-	-	2	2	1.22	2	1.00
		Total	**21**	**15**	**36**	**100**	**79**	**85**	**164**	**100**	**200**	**100**
4	Eye colour	Black	1	-	1	2.78	3	5	8	4.88	9	4.50
		Yellow	14	7	21	58.33	33	35	68	41.46	89	44.50
		Yellowish red	6	8	14	38.89	43	45	88	53.66	102	51.00
		Total	**21**	**15**	**36**	**100**	**79**	**85**	**164**	**100**	**200**	**100**
5	Comb colour	Black	-	-	-	-	3	-	3	1.83	3	1.50
		Red	21	15	36	100.00	66	72	138	84.15	174	87.00
		Yellow	-	-	-	-	4	1	5	3.05	5	2.50
		Blackish red	-	-	-	-	6	12	18	10.98	18	9.00
		Total	**21**	**15**	**36**	**100**	**79**	**85**	**164**	**100**	**200**	**100**
6	Comb type	Single	21	14	35	97.22	78	82	160	97.56	195	97.50
		Pea	-	1	1	2.78	1	3	4	2.44	5	2.50
		Total	**-**	**15**	**15**	**100**	**79**	**85**	**164**	**100**	**200**	**100**
7	Comb position	Erect	21	15	36	100.00	43	40	83	50.61	119	59.50
		Floppy	-	-	-	-	36	45	81	49.39	81	40.50
		Total	**21**	**15**	**36**	**100**	**79**	**85**	**164**	**100**	**200**	**100**
8	Wattle colour	Red	21	15	36	100.00	68	76	144	87.80	180	90.00
		Blackish red	-	-	-	-	10	8	18	10.98	18	9.000
		Yellow	-	-	-	-	1	1	2	1.22	2	1.00
		Total	**21**	**15**	**36**	**100**	**79**	**85**	**164**	**100**	**200**	**100**
9	Beak colour	Yellow	8	5	13	36.11	29	35	64	39.02	77	38.50
		Black	5	4	9	25.00	36	19	55	33.54	64	32.00
		Black shaded yellow	8	6	14	38.89	14	29	43	26.22	57	28.50
		Blue	-	-	-	-	-	2	2	1.22	2	1.00
		Total	**21**	**15**	**36**	**100**	**79**	**85**	**164**	**100**	**200**	**100**

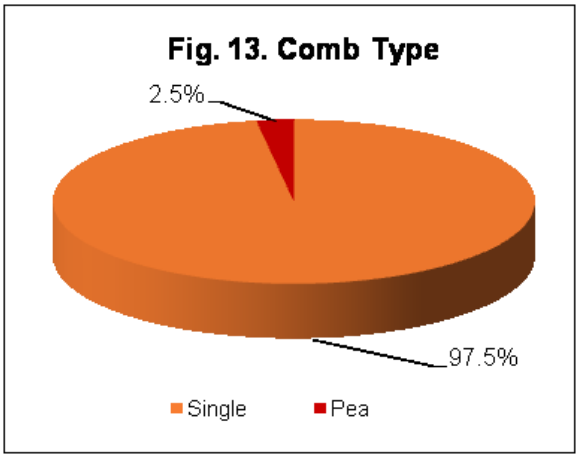


Fig. 13. Comb Type
2.5%
97.5%
Single
Pea

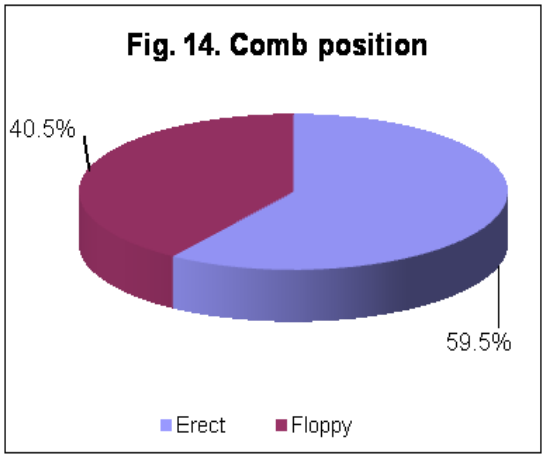


Fig. 14. Comb position
40.5%
59.5%
Erect
Floppy

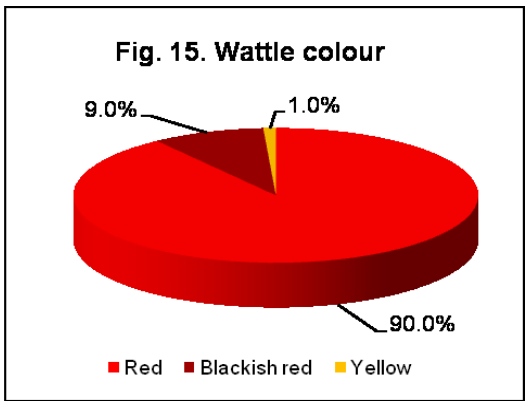


Fig. 15. Wattle colour
9.0%
1.0%
90.0%
Red
Blackish red
Yellow

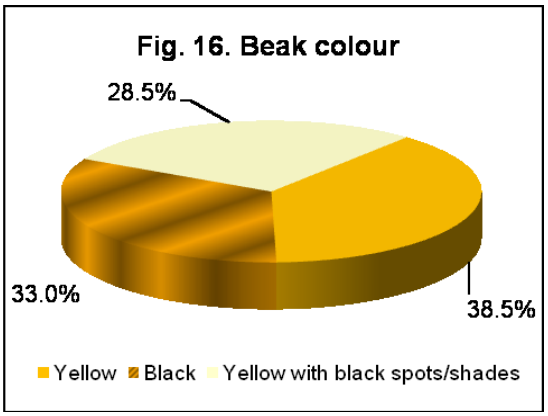


Fig. 16. Beak colour
28.5%
33.0%
38.5%
Yellow
Black
Yellow with black spots/shades

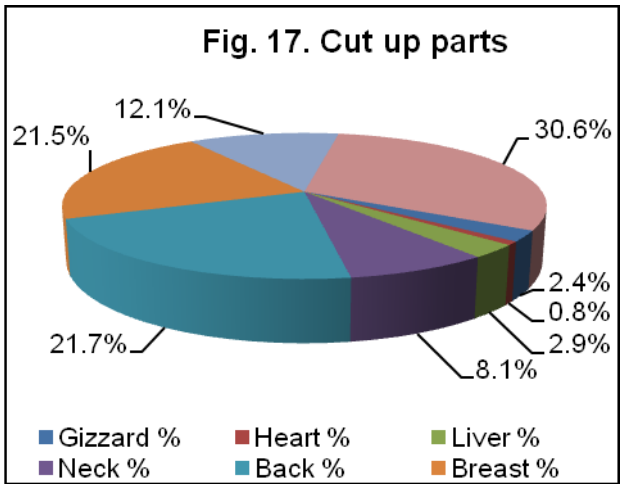


Fig. 17. Cut up parts
12.1%
21.5%
30.6%
2.4%
0.8%
2.9%
8.1%
21.7%
Gizzard %
Heart %
Liver %
Neck %
Back %
Breast %

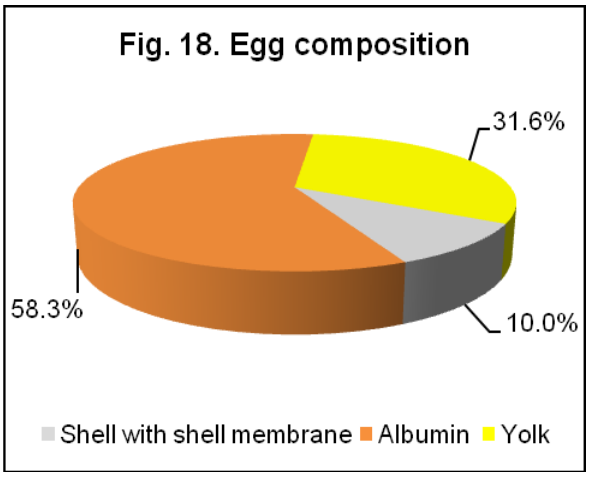


Fig. 18. Egg composition
31.6%
58.3%
10.0%
Shell with shell membrane
Albumin
Yolk

Based on the ear lobe colour, the males were grouped into two, of which, 50 per cent (18) had red ear lobes and another 50 per cent (18) had ear lobes with admixture of red and white colours; while the females had eight kinds of ear lobe colour, namely, admixture of white and red consisting 67.07 per cent (110), red: 11.59 per cent (19), white: 9.15 per cent (15), admixture of red and yellow: 9.15 per cent (15), yellowish white: 1.22 per cent (2), Grayish blue: 1.22 per cent (2) and admixture of white, red and black: 0.61 per cent (1). The overall values in descending order of prevalence were admixture of white and red consisting 64 per cent (128), red: 18.50 per cent (37), white: 7.5 per cent (15), admixture of red and yellow: 7.5 per cent (15), yellowish white: 1.00 per cent (2), greyish blue: 1.00 per cent (2), and admixture of white, red and black: 0.50 per cent (1).

The prevalence of three eye colours namely; black, yellow and reddish yellow were 2.78 (1), 58.33 (21) and 38.89 per cent (14), respectively in males and 4.88 (8), 41.46 (68) and 53.66 per cent (88), respectively, in females. The overall values in descending order of prevalence were yellowish red (51 per cent), yellow (44.5 per cent) and black (4.5 per cent) the number of birds being 102, 89 and nine respectively.

The comb colour of all the males examined was of red (plate 5b), whereas, in case females, there were four categories, namely, red consisting 84.15 per cent (138), blackish red: 10.98 per cent (18), yellow: 3.05 per cent (5) and black: 1.83 per cent (3). The overall values in descending order of prevalence were red consisting 87.00 per cent (174), blackish red: 9.00 per cent (18), yellow: 2.5 per cent (5) and black: 1.5 per cent (3).

There were two comb types (Plate 5a) observed in the population. In males, the combs of 35 (97.22 per cent) birds were of single and one (2.78 per cent) of pea. In females, the same were 160 (97.56 per cent) and 4 (2.44 per cent), respectively. The overall per cent for single and pea were 97.5 (195) and 2.5 (5) respectively.

Regarding comb position (Plate 5c), all were erect in males; while, in females, 50.61 per cent were erect (83) and 49.39 per cent were floppy (81). The overall per cent for erect and floppy were 59.5 (119) and 40.5 (81) respectively.

Regarding wattle colour (Plate 4f) all the males had red colour wattles; while, in females, 87.80 per cent (144) were red, 10.98 per cent (18): blackish red and 1.22 per cent (2): yellow. The overall values in descending order of prevalence were 90 per cent (180) were red, 9 per cent (18): blackish red and 1 per cent (2): yellow.

With regard to beak colour (Plate 5d), in males, the beaks of 13 birds were of yellow in colour, nine: black and 14: yellow with black; the per cent values of above categories were 36.11, 25 and 38.89 respectively. In females, the beaks of 39.02 per cent (64) of birds were yellow coloured, 33.54 per cent (55): black, 26.22 per cent (43): yellow with black and 1.22 per cent (2): blue. The overall values in descending order of prevalence were 38.50 per cent (77): yellow coloured, 32 per cent (64): black, 28.5 per cent (57): yellow with black and one per cent (2): blue.

4.12 QUANTITATIVE CHARACTERS

4.12.1 Morphometric Characters

The metric characters in native chicken of northern Kerala such as wattle size, shank length, beak length, spur length and body weight were measured and presented in Table 14.

Based on the wattle size, the birds were grouped into three: small (up to 1 cm), medium (1.1 to 2cm) and large (above 2 cm). In case males, out of 36 birds, 63.89 per cent (23) had large and 36.11 per cent (13) had medium sized wattles. In females, 54.27 per cent (89) belonged to small, 38.41 per cent (63) to medium and 7.32 per cent (12) to large wattle categories.

The shank length in males ranged from 78 to 109 mm. The number of male birds fell in the shank length category of from 76 to 80 were three (8.33 per cent), 81 to 85: one (2.78 per cent), 86 to 90: 10 (27.78 per cent), 91 to 95: seven

Table 14. Morphometric characters of native chicken

Characters	Categories	Number of male birds				Number of female birds				Overall	
		KKD	KNR	Total		KKD	KNR	Total			
				No.	%			No.	%	No.	%
1.Wattle size	Small	-	-	-	-	40	49	89	54.27	89	44.50
	Medium	8	5	13	36.11	34	29	63	38.41	76	38.00
	Large	13	10	23	63.89	5	7	12	7.32	35	17.50
	Total	**21**	**15**	**36**	**100.00**	**79**	**85**	**164**	**100.00**	**200**	**100.00**
2. Shank length (mm)	Below 70	0	-	0	0.00	7	2	9	5.49	9	4.50
	70 to 75	0	-	0	0.00	32	8	40	24.39	40	20.00
	76 to 80	3	-	3	8.33	25	18	43	26.22	46	23.00
	81 to 85	0	1	1	2.78	11	29	40	24.39	41	20.50
	86 to 90	8	2	10	27.78	1	21	22	13.41	32	16.00
	91 to 95	5	2	7	19.44	3	5	8	4.88	15	7.50
	96 to 100	4	3	7	19.44	0	2	2	1.22	9	4.50
	Above 100	1	7	8	22.22	0	0	0	0.00	8	4.00
	Total	**21**	**15**	**36**	**100.00**	**79**	**85**	**164**	**100.00**	**200**	**100.00**
3. Beak length(mm)	Below 30	2	0	2	5.56	30	32	62	37.80	64	32.00
	30 to 32	13	7	20	55.56	43	43	86	52.44	106	53.00
	33 to 35	5	6	11	30.56	6	10	16	9.76	27	13.50
	36 to 38	1	2	3	8.33	0	0	0	0.00	3	1.50
	Total	**21**	**15**	**36**	**100.00**	**79**	**85**	**164**	**100.00**	**200**	**100.00**
4. Spur length (mm)	Rudimentary	9	4	13	36.11	68	78	146	89.02	159	79.50
	1 to 5	8	4	12	33.33	11	7	18	10.98	30	15.00
	6 to 10	3	4	7	19.44	-	-	0	0.00	7	3.50
	11 to 15	0	1	1	2.78	-	-	0	0.00	1	0.50
	16 to 20	0	2	2	5.56	-	-	0	0.00	2	1.00
	20 to 25	1	0	1	2.78	-	-	0	0.00	1	0.50
	Total	**21**	**15**	**36**	**100.00**	**79**	**85**	**164**	**100.00**	**200**	**100.00**
5. Body weight (g)	Below 1000	1	-	1	2.78	5	3	8	4.88	9	4.50
	1000 to 1250	3	-	3	8.33	29	29	58	35.37	61	30.50
	1251 to 1500	9	4	13	36.11	26	22	48	29.27	61	30.50
	1501 to 1750	3	3	6	16.67	7	19	26	15.85	32	16.00
	1751 to 2000	3	4	7	19.44	7	7	14	8.54	21	10.50
	2001 to 2250	1	1	2	5.56	5	4	9	5.49	11	5.50
	2251 to 2500	0	3	3	8.33	0	1	1	0.61	4	2.00
	2501 to 2750	1	0	1	2.78	0	0	0	0.00	1	0.50
	Total	**21**	**15**	**36**	**100.00**	**79**	**85**	**164**	**100.00**	**200**	**100.00**

(19.44 per cent), 96 to 100: seven (19.44 per cent) and above 100: eight (22.22 per cent). The shank length in females ranged from 62 to 97mm. The number of birds fall into the shank length categories of below 70, 70 to 75, 76 to 80, 81 to 85, 86 to 90, 91 to 95 and 96 to 100 were nine (5.49 per cent), 40 (24.39 per cent), 43 (26.22 per cent), 40 (24.39 per cent), 22 (13.41 per cent), eight (4.88 per cent) and two (1.22 per cent). The mean shank length in males and females (Table 17) was significantly ($P \leq 0.01$) different at 93.91±1.34 and 79.64±0.55 mm respectively, the overall mean shank length being 82.14±0.64.

The beak length of males ranged from 28 to 37mm. The number of birds in the four beak length groups, namely, less than 30, 30 to 32, 33 to 35 and 36 to 38 were two (5.56 per cent), 20 (55.56 per cent), 11 (30.56 per cent) and three (8.33 per cent), respectively. The mean beak length (Table 17) in males was 32.04±0.40mm. The beak length of females ranged from 26 to 35mm. The number of birds in the three beak length groups, namely, less than 30, 30 to 32 and 33 to 35 were 62 (37.80 per cent), 86 (52.44 per cent) and 16 (9.76 per cent), respectively. The mean beak length (Table 17) in females was 29.95±0.22. The mean beak length between sexes differ significantly ($P \leq 0.01$). The overall beak length in the population was 30.38±0.20mm.

The spur length in males ranged from rudimentary to 24mm. The maximum number of birds (13) had rudimentary spur (36.11 per cent). There were 12 birds (33.33 per cent) had spur length from 1 to 5mm, 7 birds (19.44 per cent) from 6 to 10mm, 2 birds (5.56 per cent) from 16 to 20mm and one each (2.78 per cent) from 11 to 15 and also from 20 to 25mm. The mean spur length in males (Table 17) was 4.37±0.95mm considering rudimentary spur length as zero millimeter. The spur length in females ranged from rudimentary to 4mm. The maximum number of 146 birds (89.02 per cent) had rudimentary spur; while, the remaining 18 birds (10.98 per cent) had spur length of from 1 to 5mm. The mean spur length (Table 17) in females was 0.32±0.11mm. The mean spur length between males and females differ significantly ($P \leq 0.01$). The overall spur length in the population was 1.03±0.22 mm.

The body weight (g) of adult males ranged from 800 to 2650. The number of birds fell into the body weight categories, namely, below 1000, 1001 to 1250, 1251 to 1500, 1501 to 1750, 1751 to 2000, 2001 to 2250, 2251 to 2500 and above 2500 were one, three, thirteen, six, seven, two, three and one; the per cent values out of total 36 males in the respective categories were 2.78, 8.33, 36.11, 16.67, 19.44, 5.56, 8.33 and 2.78. The mean body weight of males (Table 17) was 1659.71±70.38g. The body weight of females ranged from 700 to 2500g. The number of birds fell into the body weight (g) categories, namely, below 1000, 1001 to 1250, 1251 to 1500, 1501 to 1750, 1751 to 2000, 2001 to 2250 and 2251 to 2500 were eight, 58, 48, 26, 14, nine and one; the per cent values out of total 164 females in the respective categories were 4.88, 35.37, 29.27, 15.85, 8.54, 5.49 and 0.61. The mean female body weight (Table 17) was 1400.30±26.31g. The mean body weights between males and females differ significantly ($P \leq 0.01$), the overall mean being 1445.70±25.84g.

4.12.2 Egg Production and Related Characters

The farmers were enquired about the egg production and related characters up to one year of age on individual chicken basis with the idea of collecting information on as much number of chicken as they can provide. The 64 households surveyed could be able to provide complete information on a total of 164 hens and the results are presented in Table 15.

The age at first egg (AFE) was studied in native chicken in three ways. In the first method, the household-wise response on approximate AFE in native chicken was collected by survey. Only 39 households could provide the information on approximate AFE in native birds. The AFE studied from these households (Table 5) revealed that the age at first egg reported to be during sixth month of age by maximum number of respondents (61.54 per cent), followed by seventh month by 11 (28.21 per cent), and above seventh month and below fifth month by two each (5.13 per cent). The overall mean AFE (Table 16) in native chicken as per the general idea of the farmers was 6.45±0.12months.

Table 15. Egg production and related characters in native chicken

Sl. No.	Characters	Categories	KKD	KNR	Overall	
					No.	percent
1	Age at first egg(days) (n=40)	140 to 167	1	1	2	5.00
		168 to 181	8	6	14	35.00
		182 to 195	8	1	9	22.50
		196 to 223	7	5	12	30.00
		224 and above	2	1	3	7.50
		Total	**26**	**14**	**40**	**100**
2.	Egg shell colour (n=98)	Dark Brown	2		2	2.04
		Medium Brown	4	8	12	12.24
		Light Brown	34	38	72	73.47
		White	4	8	12	12.24
		Total	**44**	**54**	**98**	**100.00**
3.	Broodiness (n=105)	Frequent	42	61	103	98.10
		Occasional	2	0	2	1.90
		Total	**44**	**61**	**105**	**100.00**
4.	Length of broodiness (days) (n=99)	Below 8	3	14	17	17.17
		8 to 14	6	8	14	14.14
		15 to 21	8	15	23	23.23
		22 to 28	16	10	26	26.26
		29 to 45	3	-	3	3.03
		46to 60	5	7	12	12.12
		Above 60		4	4	4.04
		Total	**41**	**58**	**99**	**100.00**
5.	Clutch size (number of eggs) (n=102)	1	2	7	9	8.82
		2 to 4	2	7	9	8.82
		5 to 8	28	27	55	53.92
		9 to 12	4	10	14	13.73
		13 to 16	5	7	12	11.76
		17 to 20	0	2	2	1.96
		21 to 25	0	1	1	0.98
		Total	**41**	**61**	**102**	**100.00**
6	Number of clutches per cycle (n=102)	1	9	20	29	28.43
		2	9	10	19	18.63
		3	17	22	39	38.24
		4	3	2	5	4.90
		Above 4	3	7	10	9.80
		Total	**41**	**61**	**102**	**100.00**
7.	Egg production per cycle (n=102)	Below 5	0	1	1	0.98
		5 to 10	5	9	14	13.73
		11 to 15	21	31	52	50.98
		16 to 20	13	16	29	28.43
		21 to 25	2	1	3	2.94
		26 to 30	0	3	3	2.94
		Total	**41**	**61**	**102**	**100.00**

Table 16 Mean ±SE values (district-wise) of various parameters

Sl. No.	Parameters	Number of house holds		
		KKD	KNR	Overall
1	Experience in poultry rearing (years)	15.40±1.57	17.71±2.26	16.16±1.29
2	Culling age of male birds (months)	12.07± 0.82	10.00± 0.59	11.39± 0.59
3	Culling age of female birds (months)	35.33±3.78	38.00±2.00	35.79±3.23
4	Number of birds per household	4.35±0.39^{b}	6.90±1.02^{a}	5.37±0.44
5	Number of chicks per household	1.19±0.26	2.43±0.73	1.59±0.30
6	No. of grower males per household	0.16±0.07	0.00±0.00	0.11±0.05
7	No. of grower females per household	0.40±0.13	0.24±0.19	0.34±0.11
8	No. of adult males	0.58±0.15	0.71±0.20	0.66±0.12
9	No. of adult females per household	2.02±0.16^{b}	4.05±0.37^{a}	2.67±0.20
10	Distance of coop from the house (m)	6.44±0.60 ^{x}	4.42±0.78 ^{y}	5.75±0.49
11	Coop's height from the ground (feet)	1.53±0.23	1.00±0.26	1.35±0.18
12	Coop's height (feet)	1.63±0.06^{b}	2.36±0.29^{a}	1.87±0.11
13	Total coop area (sq. feet)	6.23±0.35^{b}	10.13±1.17^{a}	7.46±0.50
14	Coop area per bird (sq. feet)	0.82±0.09	0.97±0.18	0.87±0.08
15	Approximate cost of the coop (Rs.)	395.24± 29.85^{b}	697.22± 145.44^{a}	485.83± 50.86
16	Quantity of feed/ bird – I (g)$^{\#}$	17.36±2.68^{x}	7.06± 2.09^{y}	13.81±2.00
17	Quantity of feed/ bird – II (g)$^{\$}$	21.98±2.85	12.84±2.78	19.53±2.29
18	Number of eggs per setting	9.71±1.25	11.25±0.65	10.41±0.74
19	Hatchability percentage	60.23±7.97	79.05±6.27	68.78±5.33
20	Flight height (m) (n=52)	3.58± 0.14^{b}	4.74± 0.23^{a}	4.00± 0.14
21	Flight distance (m) (n=52)	12.85±1.26	14.05±0.83	13.29±0.85
22	Territory radius (m) (n=52)	139.39± 11.46^{a}	89.47±11.20^{b}	121.15± 8.94
23	Brooder chick survivability (n=61)	62.91±4.78	68.41±5.68	64.98±3.66
24	AFE (Months) (household basis)	6.39±0.14	6.53±0.20	6.45±0.12
25	AFE (days) (individual bird basis)	175.97±6.64	181.00±5.58	177.60±4.81
26	Length of broodiness (days) (survey)	28.78±2.36	27.28±3.00	27.90±2.00
27	Clutch size (number of eggs) (survey)	7.41±0.55	7.84±0.64	7.67±0.44
28	Number of clutches in a cycle (survey)	2.93±0.38	3.48±0.51	3.48±0.51
29	Egg production per cycle (survey)	16.02±0.69	15.15±0.65	15.50±0.48
30	Egg weight (g) (observed data)	41.29±1.79	43.35±0.96	42.19±1.09

$^{\#}$Average of all households

$^{\$}$ Average of supplemental feed given households

^{a,b} The mean values for districts bearing different superscripts within the row differ significantly ($P\leq 0.01$)

^{x,y} The mean values for districts bearing different superscripts within the row differ significantly ($P\leq 0.05$)

Table 17. Mean ±SE values of morphometric parameters

Sl. No.	Parameters	Males			Females			Overall
		KKD	KNR	Total	KKD	KNR	Total	
1	Shank length (mm)	90.52 ±1.40^{b}	99.00 ±1.96^{a}	93.91 ±1.34^{A}	75.77 ±0.68^{d}	83.19 ±0.65^{c}	79.64 ±0.55^{B}	82.14 ±0.64
2	Beak length (mm)	31.86 ±0.48^{b}	33.21 ±0.64^{a}	32.04 ±0.40^{A}	30.08 ±0.20^{c}	29.84 ±0.37^{c}	29.95 ±0.22^{B}	30.38 ±0.20
3	Spur length (mm)	3.38 ±1.17^{b}	5.86 ±1.55^{a}	4.37 ±0.95^{A}	0.34 ±0.10^{c}	0.30 ±0.18^{c}	0.32 ±0.11^{B}	1.03 ±0.22
4	Body weight (g)	1528.10 ±87.72^{b}	1857.14 ±98.18^{a}	1659.71 ±70.38^{A}	1385.19 ±36.91^{b}	1414.19 ±37.53^{b}	1400.30 ±26.31^{B}	1445.70 ±25.84

Table 18. Fertilty, hatchability and embryonic mortality of native chicken under natural (n=15) and artificial incubation (n=2)

Parameters	Natural incubation			Artificial incubation (n=2)
	KKD (n=8)	KNR (n=7)	Overall	
No of eggs set	10.25±1.11	9.86±0.80	10.07±0.68	33.00±11.00
Fertility per cent	86.96±4.90	59.80±18.18	74.29±9.26	79.55±6.82
Hatchability on TES per cent	69.20±8.96	56.17±18.34	63.12±9.57	67.05±5.68
Hatchability on FES per cent	80.21±10.08	87.78±9.69	83.12±7.04	84.29±0.08
Early embryonic death per cent	1.04±1.04	12.22±9.69	5.34±3.86	3.13±3.13
Dead germs per cent	14.06±11.22	0.00±0.00	8.65±7.00	4.20±1.07
Dead in shells per cent	1.56±1.56	0.00±0.00	0.96±0.96	8.39±2.14

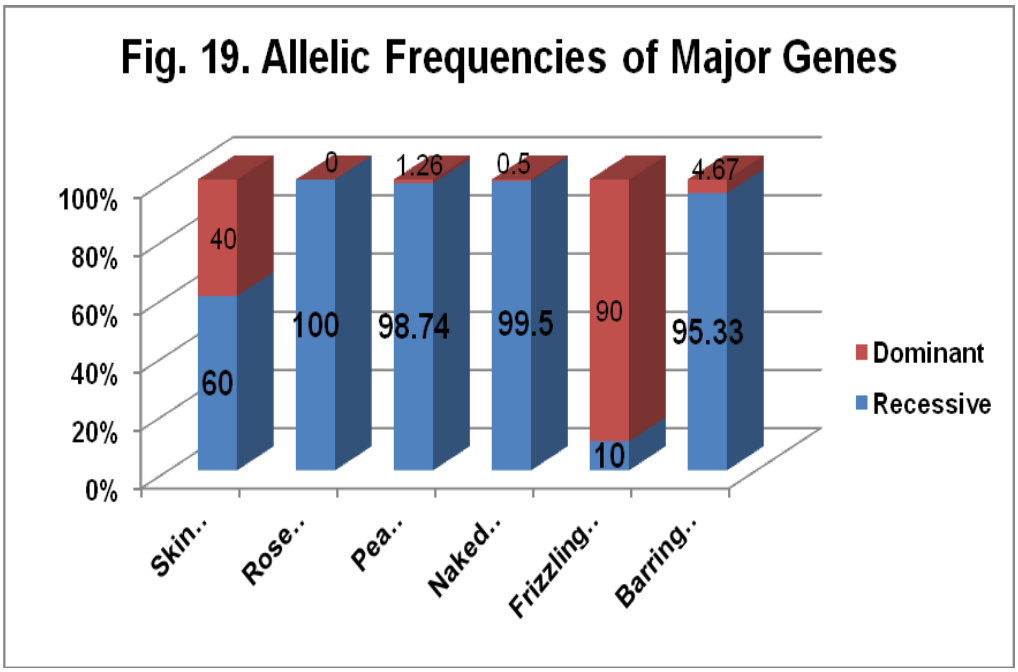


Fig. 19. Allelic Frequencies of Major Genes
100%
80%
60%
40%
20%
0%
40
60
0
100
1.26
98.74
0.5
99.5
90
10
4.67
95.33
Skin..
Rose..
Pea..
Naked..
Frizzling..
Barring..
Dominant
Recessive

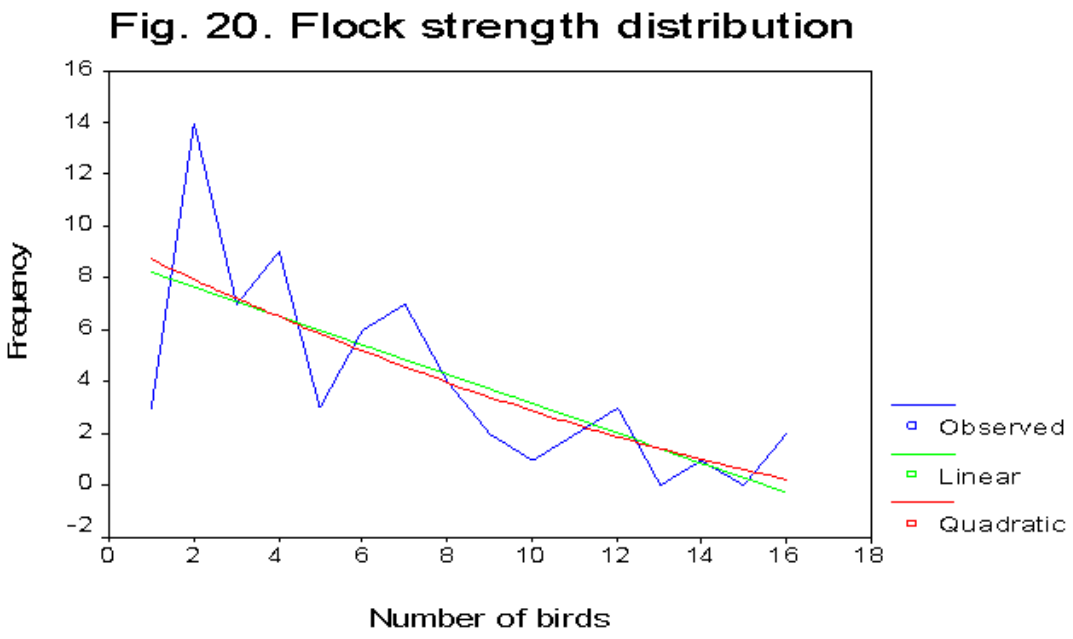


Fig. 20. Flock strength distribution
Frequency
16
14
12
10
8
6
4
2
0
-2
0
2
4
6
8
10
12
14
16
18
Number of birds
Observed
Linear
Quadratic

Fig 21. Hen-day Egg Production

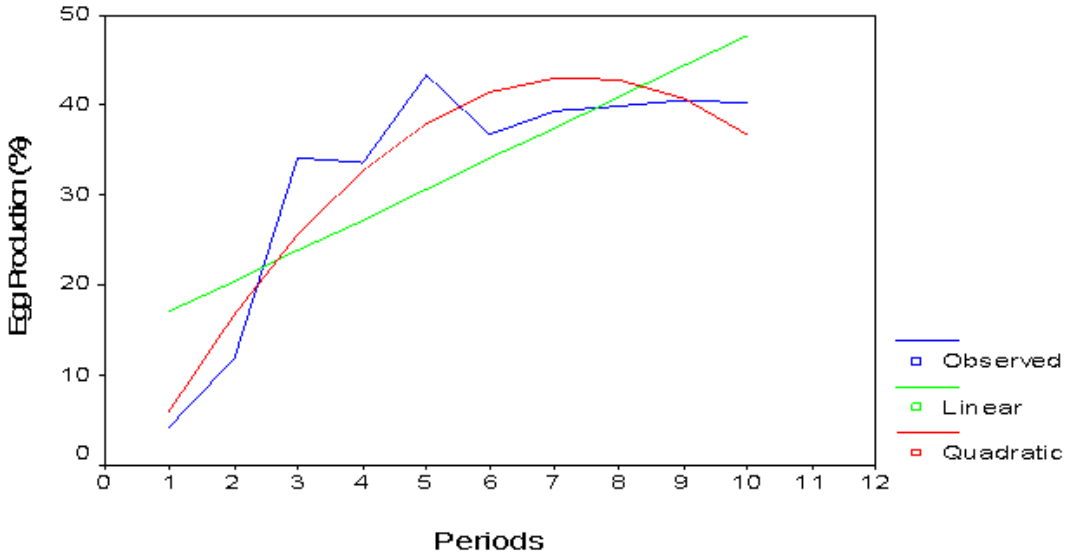
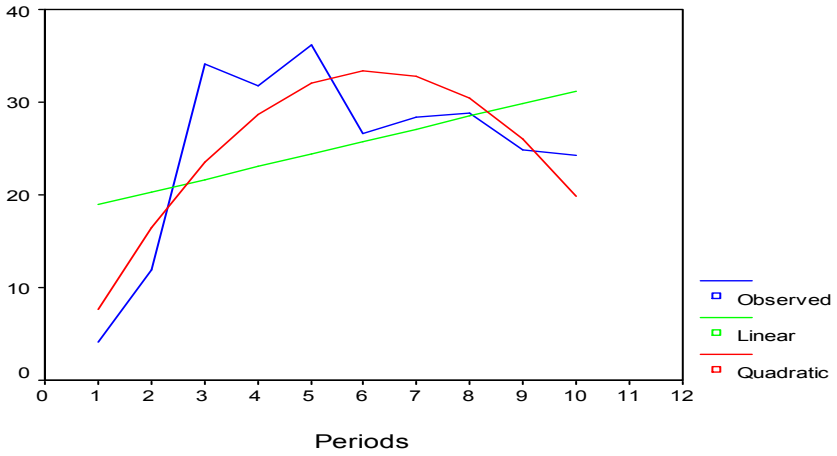


Fig 22. Hen-housed Egg Production



In the second method, the age at first egg (AFE) was recorded based on the accurate information, the farmers could provide on the birds individually they reared in the past. It was possible to collect this detail on a total of 40 birds. The results (Table 15) revealed that the AFE ranged from 144 to 230 days. The data were classified into different classes, namely, 140 to 167, 168 to 181 182 to 195, 196 to 223 and above 223 days. The bird counts in the above classes in that order were two, 14, nine, 12 and three; the respective percentages were five, 35, 22.5, 30 and 7.5. The mean age at first egg from the report on individual birds (Table 16) was 177.60±4.81days.

In the third method, AFE was estimated directly from 24 birds, in which daily field egg recording study was carried out up to 60 weeks of age. From this study (Table 20), the mean age at first egg was found to be 199.26±4.99 days.

Regarding shell colour, among 98 eggs examined, 2.04 per cent (2) of eggs were dark brown in colour, 12.24 per cent (12): medium brown, 73.47 per cent (72): light brown and 12.24 per cent (12): white (Table 15 and Plate 5e).

Regarding broodiness, the survey revealed that out of 105 birds, 98.10 per cent (103) were habitual brooders, whereas 1.9 per cent (2) showed broodiness occasionally (Table 15 and Plate 2e).

The length of broodiness from available survey data on 99 birds (indirect method) revealed that the length ranged from 7 to 65 days with 17 birds (17.17 per cent) less than eight days, 14 birds (14.14 per cent) from 8 to 14 days, 23 birds (23.23 per cent) from 15 to 21 days, and 26 birds (26.26 per cent) from 22 to 28 days, three birds (3.03 per cent) from 29 to 45days, 12 birds (12.12 per cent) from 46 to 60 days and 4 birds (4.04 per cent) more than 60 days. The mean length of broodiness from the survey data on individual birds (Table 16) was 27.90±2.00 days. But on daily field egg recording study (direct method), the value of mean length of broodiness was estimated as 22.38±3.29 days (Table 20).

The survey on clutch size (indirect method) showed a range of one to 25 eggs per clutch. From the available survey data on 102 birds, nine birds (8.82 per

cent) had a clutch size of one egg, another nine birds (8.82 per cent) with a clutch size of two to four eggs, 55 birds (53.92 per cent) had a clutch size of five to eight eggs, 14 birds (13.73 per cent) with a clutch size of nine to 12 eggs, 12 birds (11.76 per cent) with a clutch size of 13 to 16 eggs, two birds (1.96 per cent) with a clutch size of 17 to 20 eggs and one bird (0.98 per cent) with a clutch size of 21 to 25 eggs. The mean clutch size (Table 16) from the survey data was 7.67±0.44 eggs. The same parameter recorded directly from the daily field egg recording study (Table 20) showed a value was 7.27±0.63 eggs.

The mean length of pause (Table 20) estimated directly from14 birds on which daily field egg recording was carried out was 1.11±0.05 days.

The survey on number of clutches in a laying cycle (Table 15) from 102 collected records showed that it ranged from one to 16. The data revealed that 29 (28.43 per cent) birds were having only single clutch in a laying cycle, 19 (18.63 per cent) birds with two clutches, 39 birds (38.24 per cent) had three clutches, five birds (4.90 per cent) with four clutches and ten birds (9.80 per cent) with more than four clutches. The mean clutch number per cycle (Table 16) was 3.48±0.51. The same trait recorded directly from the daily field egg recording study (Table 20), showed a value of 2.13±0.17.

The survey data of 102 records collected from the farmers showed that egg production in a laying cycle (between two broodiness) (Table 15) ranged from four to 30 with one bird (0.98 per cent) having egg production of less than five eggs, 14 birds (13.73 per cent): five to 10, 52 birds (50.98 per cent): 11 to 15, 29 birds (28.43 per cent): 16 to 20, three birds each (2.94 per cent): 21 to 25 and 26 to 30. The mean egg number per cycle (Table 16) was 15.50±0.48. The calculated value of the same parameter from the data on field egg recording study (Table 20) was 14.32±0.53.

The length of incubation and natural brooding was assessed in field egg recording study. A total of eight out of 27 birds studied were used as broody hens for natural incubation by their owners. The mean combined length of natural incubation and brooding was found to be 121.75±5.62 days (Table 20).

Table 19. Period-wise egg production of native chicken under daily field egg recording study

Period	Duration (days)	Number of birds	Hen-day		Hen-housed	
			HDEP	HDEP per cent	HHEP	HHEP per cent
1	141-168	18	1.17	4.17	1.17±0.80	4.17
2	169-196	18	3.33	11.90	3.33±1.11	11.90
3	197-224	18	9.56	34.13	9.56±1.66	34.13
4	225-252	17	9.41	33.61	8.89±1.4	31.75
5	253-280	15	12.13	43.33	10.11±1.66	36.11
6	281-308	13	10.31	36.81	7.44±1.55	26.59
7	309-336	13	11.00	39.29	7.94±1.64	28.37
8	337-364	13	11.15	39.84	8.06±1.51	28.77
9	365-392	11	11.36	40.58	6.94±1.75	24.80
10	393-420	11	11.27	40.26	6.78±1.6	24.21
EN40	141-280	18	34.59	24.71	33.06±3.53	23.61
EN60	141-420	18	86.12	30.76	70.33±10.43	25.12

Table 20.Egg production and related parameters of native chicken under daily field egg recording study from 21 to 60 weeks of age

Parameter	n	Mean+SE
Age at first egg in the flock (days)	27	155
Average age at first egg	19	199.26±4.99
Average length of broodiness(days)	14	22.38±3.29
Average clutch size (days)	14	7.27±0.63
Average length of pause(days)	14	1.11±0.05
Average number of clutches per cycle	14	2.13±0.17
Eggs per laying cycle	14	14.32±0.53
Length of incubation and natural brooding	8	121.75±5.62
Livability percent	27	77.78
EN60 (Survivor)	13	93.77± 9.56

The data on field egg recording study was analysed and the mean values of egg production and related parameters are given in Table 19 and the graphical representation is presented in Fig. 21 and 22. The study revealed that the mean egg number up to 40 weeks of age on hen day (HD) and hen housed (HH) basis in native chicken was 34.59 and 33.06±3.53 and that of egg number up to 60 weeks of age was 86.12 and 70.33±10.43 respectively. The egg production per cent in terms of HD and HH up to 40 weeks were 24.71 and 23.61 and up to 60 weeks were 30.76 and 25.12 respectively. The egg number up to 60 weeks of age in terms of survivor egg production (Table 20) was 93.77±9.56. The age at first egg in the birds was 155 days. The egg recording was conducted from 21 to 60 weeks of age. The entire 40 weeks duration was divided into 10 four-weeks (28 days) periods and the production during each period has been presented in Table 19. The results showed that the egg production in terms of both HD and HH was highest at fifth period (253 to 280 days).

4.13 HAEMATOLOGICAL PARAMETERS

The haematological parameters estimated from 16 adult native chicken (four for each sex from each district) are presented in Table 21.

The number of red blood corpuscles (RBC) count (million per ml) of blood of males ranged from 2.60 to 3.88 with a mean value of 3.43±0.15, whereas, in females, it ranged from 2.54 to 2.93, with a mean of 2.78±0.06. The mean values between male and female differ significantly ($P \leq 0.01$). The overall mean red blood corpuscles (RBC) count in native chicken in the present study was 3.11±0.11.

The mean haemoglobin (gram per cent) of males (12.70±0.99) was significantly ($P \leq 0.05$) higher than that of females (9.91±0.36); the range of values in the respective sexes were 8.60 to 15.50 and 8.70 to 10.70. The overall mean haemoglobin content in native chicken was 11.31±0.62 g per cent.

Table 21. Haematological parameters of native chicken

[a,b] Means bearing different superscripts within each row differ significantly (P≤ 0.01)

Parameters	KKD			KNR			Total		Over-all
	Male	Female	Total	Male	Female	Total	Male	Female	
RBC ×10^6	3.37 ±0.08	2.66 ±0.09	3.01 ±0.15	3.50 ±0.30	2.90 ±0.01	3.20 ±0.18	3.43 ±0.15[a]	2.78 ±0.06[b]	3.11 ±0.11
Hb (g per cent)	11.83 ±1.17	9.18 ±0.48	10.50 ±0.77	13.58 ±1.63	10.65 ±0.03	12.11 ±0.94	12.70 ±0.99[x]	9.91 ±0.36 [y]	11.31 ±0.62
PCV (per cent)	42.65 ±1.68	32.48 ±1.61	37.56 ±2.20	43.25 ±4.09	37.15 ±0.10	40.20 ±2.22	42.95 ±2.05 [a]	34.81 ±1.16 [b]	36.88 ±1.55
Lymphocytes	60.50 ±3.18	75.50 ±1.94	68.00 ±3.32	58.50 ±2.40	72.25 ±2.56	65.38 ±3.06	59.50 ±1.88 [b]	73.88 ±1.61 [a]	66.69 ±2.21
Heterophils per cent	31.00 ±2.48	13.75 ±1.03	22.38 ±3.49	30.00 ±3.24	19.00 ±2.97	24.50 ±2.90	29.25 ±1.58 [a]	16.38 ±1.76 [b]	23.44 ±2.21
Monocytes per cent	4.00 ±0.91	6.00 ±0.41	5.00 ±0.60	5.75 ±0.48	4.50 ±0.87	5.13 ±0.52	4.88 ±0.58	5.25 ±0.53	5.06 ±0.38
Eosinophils per cent	2.75 ±1.03	3.00 ±0.58	2.88 ±0.55	3.25 ±0.25	2.75 ±0.48	3.00 ±0.27	3.00 ±0.50	2.88 ±0.35	2.94 ±0.30
Basophils per cent	1.75 ±0.48	1.75 ±0.48	1.75 ±0.31	2.50 ±0.50	1.75 ±0.48	2.13 ±0.35	2.13 ±0.35	1.75 ±0.31	1.94 ±0.23

[x,y] Means bearing different superscripts within each row differ significantly (P≤ 0.05)

Table 22. Egg quality parameters of native chicken (n=100)

Sl. No.	Parameters	KKD	KNR	Overall
1	Egg weight(g)	40.71±0.69[y]	42.91±0.59[x]	41.81±0.46
2	Egg length(mm)	50.74±0.55[b]	53.07±0.40[a]	51.90±0.36
3	Egg breadth(mm)	37.65±0.22	38.24±0.22	37.95±0.16
4	Shape index	74.53±0.72[x]	72.21±0.55[y]	73.37±0.47
5	Albumen weight(g)	23.56±0.52	25.11±0.51	24.35±0.37
6	Albumen percent	57.52±0.55	58.92±0.51	58.23±0.38
7	Albumen index	4.17±0.18[b]	5.16±0.23[a]	4.67±0.15
8	Yolk weight(g)	13.23±0.34	13.20±0.26	13.21±0.21
9	Yolk percent	32.35±0.52	31.10±0.50	31.72±0.37
10	Yolk index	31.72±0.64	32.07±0.74	31.89±0.49
11	Shell thickness (mm)	0.40±0.01[a]	0.36±0.00[b]	0.38±0.01
12	Shell weight(g)	4.13±0.10	4.24±0.06	4.18±0.06
13	Shell percent	10.11±0.16	9.92±0.13	10.01±0.10
14	Haugh unit score	61.33±1.33[b]	67.35±1.27[a]	64.41±0.97
15	Cholesterol (mg per g of yolk)	14.39±0.43	14.88±0.31	14.67±0.25

The packed cell volume (PCV) per cent of males (42.95±2.05) was significantly (P≤ 0.01) higher than that of females (34.81±1.16). The values ranged from 31.1 to 48.9 in males and from 30.6 to 37.4 in females. The overall mean PCV was 36.88±1.55 per cent.

In differential count, the lymphocyte per cent of males ranged from 52 to 69 with a mean value of 59.50±1.88, whereas in females, it ranged from 67 to 80, with a mean of 73.88±1.61. The mean values between sexes differed significantly (P≤ 0.01). The overall mean lymphocyte per cent was 66.69±2.21.

Another differential count parameter, the heterophils per cent of males and females were 29.25±1.58 and 16.38±1.76, respectively; the difference between mean values of sexes was significant (P≤ 0.01). The values for males and females ranged from 23 to 37 and from 11 to 24 respectively. The overall mean heterophils per cent in native chicken was 23.44±2.21.

The monocytes per cent, another differential count parameter in males (4.88±0.58) and females (5.25±0.53) were statistically similar. The values in males varied from 2 to 7, while that of females from three to seven. The overall mean monocyte per cent was 5.06±0.38 in native chicken.

The eosinophil per cent of differential count in males ranged from one to five with a mean value of 3.00±0.50; whereas, in females, it ranged from two to four with a mean of 2.88±0.35. The mean values between male and female showed no significant difference. The overall mean eosinophil per cent was 2.94±0.30.

The other differential count parameter, namely, mean basophil per cent was 2.13±0.35 in males and 1.75±0.31 in females. The values for the respective sexes ranged from one to four and from one to three, respectively. The overall mean basophil per cent in the present study was 1.94±0.23.

4.14 EGG QUALITY PARAMETERS

The egg quality parameters of native chicken of northern Kerala were studied from 100 eggs (50 eggs from each district) and the observations are presented in Table 22.

The egg weight was recorded in two ways. The eggs available in each household at the time of survey were weighed and the average egg weight was recorded in the first method. The mean egg weight recorded from each household ranged from 30 to 48.19g (Table 5) and the overall mean (Table 16) was 42.19±1.09g. The egg weight was also measured in the second method, from 100 eggs collected for egg quality studies (Table 22) ranged from 31.52 to 50.04g and the mean egg weight was 41.81±0.46g.

The egg length (mm) and breadth (mm) recorded in this study ranged from 40.58 to 59.9 and 33 to 41.2, respectively, with the overall mean 51.90±0.36 and 37.95±0.16 respectively. The egg shape index of native chicken ranged from 62.64 to 90.39. The overall mean shape index was found to be 73.37±0.47.

The albumen weight (g) in native chicken eggs ranged from 18.73 to 31.86 with the mean value of 24.35±0.37. The egg albumen per cent in the whole egg ranged from 51.63 to 64.93 per cent with the overall mean of 58.23±0.38. The mean albumen index in native chicken eggs was found to be 4.67±0.15; the minimum and maximum albumen index values were 2.29 and 10.16.

The egg yolk weight (g) ranged from 10.14 to 17.5 and the overall mean was found to be 13.21±0.21. The egg yolk per cent ranged from 24.78 to 39.28, the mean being 31.72±0.37. The mean yolk index in native chicken eggs being 31.89±0.49; the range was from 19.77 to 42.35

The egg shell thickness (mm) ranged from 0.28 to 0.48; the overall mean being 0.38±0.01. The egg shell weight (g) ranged from 2.19 to 5.84, the overall mean being 4.18±0.06. The egg shell per cent out of total egg weight ranged from 5.75 to 11.90. The overall mean egg shell per cent of native chicken eggs was found to be 10.01±0.10.

The Haugh Unit Score ranged from 34.07 to 80.37, with the overall mean of 64.41±0.97.

The cholesterol content (mg per g) of egg yolk of native chicken ranged from 12.08 to 16.51. The overall mean was found to be 14.67±0.25 mg per g.

4.15 PROCESSING YIELDS AND LOSSES

The processing yields and losses estimated from eight males and eight females (four for each sex in each district) are presented in Table 23. The graphical representation is given in Fig. 17.

The live weight (g) of males ranged from 1609.8 to 1815.6, with a mean weight of 1706.94±25.63; whereas in females, it ranged from 907.6 to 1747.2, with mean weight of 1463.48±113.25. The overall mean live weight in native chicken was 1585.21±64.29.

The blood per cent of males ranged from 3.41 to 4.36, with a mean value of 4.05± 0.12; whereas in females, it ranged from 3.67 to 6.48, with a mean of 4.73±0.35. The overall mean blood per cent in native chicken was 4.39±0.20.

The feather per cent calculated from males ranged from 4.84 to 7.03, the mean value being 5.81±0.27. In case of females, the values ranged from 4.78 to 11.44, the mean value being 7.14± 0.83. The overall feather per cent in native chicken was 6.48±0.45.

The dressed per cent of males ranged from 89.19 to 91.45, with a mean value of 90.13±0.30, whereas in females, it ranged from 83.78 to 91.55, with a mean of 88.13±1.09. The overall mean defeathered carcass per cent in native chicken was 89.13±0.60.

Table 23. Processing yields and losses and cutup parts of native chicken (n=16)

Para-meters	KKD			KNR			Overall		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Live Weight (g)	1705.45 ±35.79	1530.20 ±144.46	1617.83 ±76.44	1708.42 ±42.22	1396.75 ±189.78	1552.58 ±107.56	1706.94 ±25.63	1463.48 ±113.25	1585.21 ±64.29
Blood per cent	3.83 ±0.16	4.80 ±0.59	4.31 ±0.34	4.28 ±0.05	4.65 ±0.47	4.46 ±0.23	4.05 ±0.12	4.73 ±0.35	4.39 ±0.20
Feather per cent	5.73 ±0.45	6.54 ±0.98	6.13 ±0.52	5.90 ±0.37	7.74 ±1.41	6.82 ±0.76	5.81 ±0.27	7.14 ±0.83	6.48 ±0.45
Dressed per cent	90.45 ±0.48	88.67 ±1.57	89.56 ±0.83	89.81 ±0.34	87.59 ±1.70	88.70 ±0.91	90.13 ±0.30	88.13 ±1.09	89.13 ±0.60
Eviscerated per cent	72.35 ±0.42	67.60 ±1.24	69.97 ±1.09	72.12 ±0.59	64.29 ±1.70	68.20 ±1.70	72.24 ±0.34[a]	65.94 ±1.16[b]	69.09 ±1.00
R-to-C (g)	1298.23 ±32.69	1115.28 ±120.87	1206.75 ±67.49	1304.35 ±28.20	972.57 ±150.09	1138.46 ±94.49	1301.29 ±20.02[x]	1043.93 ±93.20[y]	1172.61 ±56.78
R-to-C per cent	76.11 ±0.49	72.53 ±1.29	74.32 ±0.93	76.37 ±0.46	68.98 ±1.63	72.67 ±1.60	76.24 ±0.32[a]	70.76 ±1.17[b]	73.50 ±1.62
Giblet per cent	4.93 ±0.32	6.81 ±0.19	5.87 ±0.40	5.55 ±0.21	6.82 ±0.30	6.19 ±0.30	5.24 ±0.21[b]	6.82 ±0.17[a]	6.03 ±0.24
Gizzard per cent	1.54 ±0.09	2.97 ±0.17	2.25 ±0.29	1.90 ±0.13	3.02 ±0.23	2.46 ±0.25	1.72 ±0.10[b]	3.00 ±0.13[a]	2.36 ±0.18
Heart per cent	0.82 ±0.05	0.68 ±0.06	0.75 ±0.05	0.82 ±0.03	0.77 ±0.10	0.79 ±0.05	0.82 ±0.03	0.72 ±0.06	0.77 ±0.03
Liver per cent	2.57 ±0.30	3.17 ±0.15	2.87 ±0.19	2.84 ±0.15	3.03 ±0.11	2.93 ±0.10	2.71 ±0.16	3.10 ±0.09	2.90 ±0.10
Neck per cent	9.39 ±0.15	6.52 ±0.09	7.95 ±0.55	9.35 ±0.26	6.76 ±0.44	8.05 ±0.54	9.37 ±0.14[a]	6.64 ±0.21[b]	8.00 ±0.37
Back per cent	19.14 ±0.37	23.58 ±0.12	21.36 ±0.86	19.09 ±0.42	24.24 ±1.18	21.85 ±1.18	19.12 ±0.26[b]	23.91 ±0.56[a]	21.51 ±0.69
Breast per cent	18.59 ±0.31	24.94 ±0.23	21.76 ±1.21	17.76 ±0.33	24.10 ±0.64	20.93 ±1.25	18.17 ±0.26[b]	24.52 ±0.35[a]	21.35 ±0.85
Wing per cent	13.99 ±0.23	9.78 ±0.19	11.89 ±0.81	14.29 ±0.06	10.07 ±0.40	12.18 ±0.82	14.14 ±0.12[a]	9.93 ±0.21[b]	12.03 ±0.56
Leg per cent	33.51 ±0.54	27.58 ±0.28	30.55 ±1.15	33.67 ±0.70	26.68 ±1.59	30.18 ±1.55	33.59 ±0.41[a]	27.13 ±0.77[b]	30.36 ±0.93
Drumstick per cent	15.91 ±0.18	12.79 ±0.19	14.35 ±0.60	16.34 ±0.40	12.70 ±0.87	14.52 ±0.82	16.13 ±0.22[a]	12.74 ±0.41[b]	14.44 ±0.49
Thigh per cent	17.60 ±0.40	14.79 ±0.40	16.20 ±0.59	17.33 ±0.36	13.98 ±0.72	15.66 ±0.73	17.46 ±0.26[a]	14.39 ±0.41[b]	15.93 ±0.46

[a,b] Means bearing different superscripts within each row between sexes differ significantly ($P \leq 0.01$)

[x,y] Means bearing different superscripts within each row between sexes differ significantly ($P \leq 0.05$)

The eviscerated carcass per cent was also calculated separately for sexes. The males had mean eviscerated carcass per cent of 72.24±0.34 with the range from 71.03 to 73.77. In females, the mean was 65.94±1.16 and the range was from 59.52 to 69.76 The mean values between sexes showed significant difference (P≤ 0.01). The native chicken had an overall mean eviscerated carcass per cent of 69.09±1.00 per cent.

The ready to cook yield weight (R-to-C) (g) of males ranged from 1221.0 to 1377.6, with a mean value of 1301.29±20.02, whereas in females, it ranged from 584 to 1285.6, with a mean of 1043.93±93.20. The mean values between male and female differ significantly (P≤0.05). The overall mean was 1172.61±56.78g. The R-to-C yield in terms of per cent (R-to-C per cent) live weight in males revealed that the values ranged from 75.07 to 77.68 with a mean value of 76.24±0.32. The range in females for this parameter was from 69.39 to 74.91 with a mean of 70.76±1.17. The R-to-C per cent of males was significantly (P≤ 0.01) higher than that of females. The overall mean was 73.50±1.62 per cent.

The giblet per cent of males ranged from 4.01 to 6.07 with a mean value of 5.24±0.21, whereas in females, it ranged from 6.17 to 7.56 with a mean of 6.82±0.17. The mean values between males and females showed significant difference (P≤ 0.01). The overall mean giblet per cent was 6.03± 0.24 per cent.

The mean gizzard per cent of males was 1.72±0.10 with the range from 1.28 to 2.27. In females the mean value was 3.00±0.13 and the range was from 2.52 to 3.63. The mean gizzard per cent in male was significantly (P≤ 0.01) lower than that of females. The overall mean gizzard per cent was 2.36±0.18 per cent.

The mean heart per cent in males (0.82± 0.03) was not significantly different from that of females (0.72±0.06). The range of the values in males and females were 0.69 to 0.90 and 0.58 to 1.03, respectively. The overall mean heart per cent was 0.77±0.03.

The liver per cent of males ranged from 1.83 to 3.23 with a mean value of 2.71±0.16; whereas, in females, it ranged from 2.80 to 3.44 with a mean of

3.10±0.09. The mean values between male and female showed no significant difference. The overall mean liver per cent was 2.90± 0.10.

The mean neck weight per cent of males and females were 9.37±0.14 and 6.64±0.2, respectively; the difference in mean values was significant (P≤ 0.01) between sexes. The range of values in males was from 8.79 to 10.02, and the same in females was from 5.98 to 8.01. The overall mean neck per cent in native chicken was 8.00±0.37.

The back per cent of males (19.12±0.26) was significantly (P≤ 0.01) lower than that of females (23.91±0.56) The range of values for the respective sexes were 18.05 to 20.09 and 21.65 to 27.34. The overall mean back per cent was 21.51±0.69 in native chicken.

The breast per cent of males ranged from 17.24 to 19.19 with a mean value of 18.17±0.26; whereas, in females, it ranged from 22.80 to 25.86 with a mean of 24.52±0.35. The mean values between male and female differ significantly (P≤ 0.01). The overall mean was 21.35±0.85 per cent.

The mean wing per cent of males and females were 14.14±0.12 and 9.93±0.21, respectively; the mean values between sexes had significant (P≤ 0.01) difference. The range of values in the respective sexes was 13.55 to 14.53 and 9 to 10.68, respectively. The overall mean wing per cent in native chicken was 12.03±0.56 per cent.

The mean leg per cent of males (33.59±0.41) was significantly (P≤ 0.01) higher than that of females (27.13± 0.77); the range in the respective sexes being 31.60 to 34.71 and 23.65 to 30.44. The overall mean leg per cent was 30.36±0.93 in native chicken.

The mean drumstick per cent of males and females was 16.13±0.22 and 12.74±0.41, respectively. Statistical comparison of mean values revealed significant (P≤ 0.01) difference between sexes. The values ranged from 15.32 to 17.09 in males and from 11.12 to 14.88 in females. The overall mean drumstick per cent in native chicken was 14.44±0.49.

The thigh per cent of males ranged from 16.28 to 18.35 with a mean value of 17.46±0.26; whereas in females, it ranged from 12.53 to 15.87 with a mean of 14.39±0.41. The mean values between males and females showed significant (P≤ 0.01) difference. The overall mean for this trait was 15.93±0.46 per cent.

4.16 ECONOMICS OF NATIVE CHICKEN REARING

On economic feasibility of native chicken rearing, out of 64 farmers, 95.31 per cent (61) opined that native chicken rearing was profitable while the rest of 4.68 per cent (3) had no specific opinion to offer (Table 2).

The economics of native chicken rearing of Northern Kerala calculated from a total of 57 adult birds distributed in 20 households are given in Table 24. The average chick cost based on the inputs of 20 settings studied was worked out to be Rs. 4.94. The cost of feed incurred in these 20 hatches during chick and grower (0-20 weeks) and adult (21 to 72 weeks) were found to be 291.7 and 1750 rupees respectively. The income from the sale of eggs @ Rs 3 was worked out to be Rs 20,904 and from the sale of 48 numbers of males @ Rs 300 per bird was Rs 14,400. The total and net return from these 20 hatches put together was Rs 35,304 and 31,978 respectively. It was found that the poultry farmers got a return of Rs. 561.02 per adult female bird up to 72 weeks of age.

Table 24. Economics of Native Chicken Rearing
Number of households : 20
Total number of adult birds : 57

Particulars	Rs
Non-recurring Expenditure	
Housing	11650
Total non-recurring expenditure	11650
Recurring Expenditure (72 weeks)	
1 Chicks cost @ Rs. 4.94 for 260 day-old chicks	1284.4
2. Feed cost	
a. Chick and grower (0 - 20 weeks)	291.7
b. Adult (21 - 72 weeks)	1750.0
Total recurring expenditure	**3326.1**
Return	
1. Egg (134 nos. per week) for 52 weeks @Rs. 3	20904
2. By sale of males 48 males @ Rs.300	14400
Total Return	**35304**
Net Return	**31977.9**
Return per female up to 72 weeks	**561.02**

Discussion

5. DISCUSSION

The results of present study on the status of backyard poultry farmers, poultry rearing practices, characters of native birds, properties of egg and meat etc., are discussed in this chapter.

The main objective of the study was to evaluate 200 adult birds from Northern Kerala, 100 each from Kozhikode and Kannur districts. The area identified for this study was the central region of Malabar tract, which is reported to be the home tract of native breed, 'Tellichery' (Vij *et al*., 2007). Every precaution was taken to identify and characterize only the pure native chicken of this area with the aim of throwing light on the characters of this ecotype population because the details regarding this population is very sparse in the literature. To obtain the required number of adult birds mentioned above, 43 households had to be surveyed in Kozhikode district and 21 in Kannur district. The reason being, the survey area in Kozhikode district was remote and the average adult flock size was just half (2.02) compared to that of Kannur district (4.05) (Table 16). Though the average flock strength was small, the prominent feature found was that almost all the households in Kozhikode district indulge in backyard poultry keeping in contrast to only selected farmers in the survey area of Kannur district.

5.1 SOCIOECONOMIC PROFILE OF POULTRY FARMERS OF NORTHERN KERALA

Out of 64 households selected for the study 56 belonged to Thiya community (Table 1) because of the fact that they are the main inhabitants of this region. It was observed during the study that the other community people were also involved in poultry keeping. The reports of Tantia *et al.* (2005b), Vijh *et al.* (2005a) and Vij *et al*. (2006b) showed that the rearing of indigenous chickens like Ghagus, Miri and Daothigir respectively, was the activity of people of certain communities.

The main occupation of the poultry farmer observed in this study was as agricultural worker (23.44 per cent) (Table1). The survey area has fertile cultivable land and that was the reason for involvement of more number of agricultural workers among the poultry farmers. Moreover, traditionally the main occupation of Thiya community is agriculture. Nevertheless, it was also documented in the present study that the people from all walks of life rear poultry. Similarly Yousef and Al-Yousef (2007) also reported that 77 per cent of farmers raising chickens as a secondary economical activity, of which, 8 per cent were farmers, 23 per cent were government employees and 46 per cent were merchants.

The majority of the poultry farmers (53.13 per cent) of this region keep livestock like cattle and goat as their main animal husbandry activity (Table 1 and Plate1 e and f). However, a large number of households (43.75 per cent) had poultry rearing as the only animal husbandry activity. Having a small flock of poultry or any other animal was considered by the farmers as the way of utilizing kitchen waste and other agricultural byproducts. Similarly, Tantia *et al.*, (2005b), also reported that Ghagus birds were being reared by the farmers along with dairy animals and were fed by left over concentrates from dairy animals. However, the results revealed that unlike the common practice of keeping a household flock comprised of two or more varieties of poultry species like ducks and pigeon along with chicken in Bangladesh (Das *et al*., 2008), only 3.12 per cent of farmers in the present study had more than one type of poultry component in their backyards. There is a belief among the farmers that birds' droppings will make the dairy animals sick, if consumed accidentally; therefore, some dairy farmers stay away from keeping poultry.

A vast majority of the poultry farmers (85.94 per cent) had less than 50 cents of land (Table 1) because the people in this area are mainly agricultural workers of low income group. However, the study revealed that there was no preference among the people of different landholdings towards poultry rearing.

The study also showed that 51.56 per cent of the farmers had any one or more of the agricultural farming like plantain, coconut and/or vegetables (Table 1 and Plate1b). Chicken is considered to be destructive to vegetable but not to

plantain and coconut cultivation, therefore only 3.13 per cent farmers having vegetable cultivation near their homestead had poultry rearing; whereas, majority of the chicken farmers had plantain or coconut cultivation. The remaining 48.44 per cent people had no agricultural activity. The income from poultry was considered as the subsidiary one to their main farm income from crop cultivation or to the wage from agricultural work. Mcainsh *et al*. (2004) also reported that a mixed crop-livestock farming system is being practiced by the farmers in Zimbabwe, which is in agreement with the present findings.

The reasons for keeping chicken as cited by the poultry farmers were a) chicken rearing provides subsidiary income to the family, more importantly to the housewives b) the eggs are also considered as a nutritional food for the family, especially children c) agricultural byproducts and kitchen wastes can be effectively utilized and d) for religious sacrificing and offering.

It was observed in the present study that mostly the women (89.06 per cent) are engaged in chicken rearing while the men are involved in agricultural work and other off farm activities. Similar findings were reported by Halima *et al.* (2007b) in north-west Ethiopia (74.16 per cent). Similarly, participation of women to a greater extent (70.00 per cent) in all activities related to chicken rearing has earlier been reported in Ethiopia by Mengesha *et al*. (2008). Most of the housewives in the survey area of this study are the members of a self-help group (SHG) supported by Kerala Government called *Kudumbasree.* They have to remit a small fixed amount every week in the respective units as their savings. It was evident from the survey that most of the women raise this money in full or a part from the income of chicken rearing.

5.2 PRACTICES RELATED TO NATIVE CHICKEN REARING

The data collected with respect to experience in poultry rearing (Table 2) revealed that around 90 per cent of the farmers had more than five years of experience, of which, more than 50 per cent had above 10 years of experience in native chicken rearing. This showed that the poultry farmers in this area are traditional poultry keepers, well adept in managing native chicken. The interaction

with the farmers revealed that they are very much satisfied with keeping native birds rather than improved varieties. This kind of keeping only nondescript birds from time to time has been reported by Selvam (2004) in a study on free range poultry rearing in five villages of Namakkal district of Tamilnadu.

The history pertaining to the source of birds (Table 2) tracked back more than two decades in all the households studied and only pure native birds descended over generations were subjected for the present study. In very rare instances exotic breeds or improved varieties were encountered. These birds and also the birds with uncertain history were avoided in this study. The majority (73.44 per cent) of chicken present in this region was either reproduced in the same household from earlier generations or added from the neighbourhood households of the same Panchayat. Few others (26.56 per cent) included new native birds with good productivity from nearby Panchayat or from nearby districts. Nevertheless, no bird was brought in from outside the State. The history showed that the chickens reared are pure native chickens which are not mixed by exotic blood. It can be concluded that these birds are the original indigenous chicken of northern Kerala. Therefore, it is presumed that these birds ought to belong to the Tellichery breed of chicken. Ngo Thi Kim Cuc *et al*. (2006) recorded similar observation in Vietnamese H'mong chickens, where, majority (87.70 per cent) of chickens hatched from within the household flocks, while 7.78 per cent were received as gifts from neighbours and 5.56 per cent brought in as gifts from relatives. The reasons of native chicken for being preferred against exotic varieties, as stated by the farmers were a) hardiness to diseases, b) ability to thrive by scavenging and scrap feeding, c) capacity to withstand harsh climates, d) capability to evade predation by flight or fright e) broodiness for self-propagation and f) premium price for their meat and eggs.

The survey data on purpose of poultry rearing (Table 2) revealed that 68.75 per cent of the farmers rear chicken for both egg and meat; while, only 31.25 per cent rear them for eggs alone and no one reared for meat purpose alone. The results showed that majority of the farmers considered the utility of native chicken was dual. The egg and meat of native chicken are considered nutritious

than those produced commercially and are liked by the people for its taste and flavour. The eggs of native chicken usually costs double than that of White Leghorn and an adult chicken costs more than rupees 300. Similar opinion about the utility of different native chicken breeds of India has already been reported earlier (Tantia *et al*., 2005a; Vijh *et al.,* 2005a; Vijh *et al.,* 2006; Tantia *et al.,* 2006a; Vij *et al.,* 2006b; Kumar and Kumar, 2007). On the other hand, Kalasthi birds (Vijh *et al.*, 2005b) and Danki birds (Vij *et al.*, 2005) are mainly kept for meat and game purposes (cock fighting). In addition to egg and meat, Mcainsh *et al.* (2004) reported that the farmers of Zimbabwe kept chicken for manure also.

The majority of the farmers (59.38 per cent) eliminate the surplus male birds (Table 2) only after six months but before one year; and more than 87.00 per cent of the farmers cull them before one and half years of age. This indicates that the males attain their maximum economic value before one and half years of age. The mode of culling of male birds (Table 2) was mainly for self use (50.00 per cent) followed by sale (23.44 per cent). The culling age of male cocks was in agreement with the culling age of nine months reported in Nicobari cocks by Vijh *et al.* (2006). The farmers in this study opined that the males are ready for slaughter at around one year and will be killed for meat purpose at anytime thereafter for occasions like festivals or for serving the guests or will be sold out during seasons as decided by the housewives. The farmers do not wish to postpone the culling beyond that period as the male birds do not give income unlike females but have the possibility of losing them to predators. The decision on selling is being mostly taken by the housewives and the revenue goes to them only. Mengesha *et al*. (2008) also documented that decision for selling of poultry products were the responsibility of women.

The striking difference with regard to culling of females (Table 2) from males was that majority of farmers (78.13 per cent) did not cull their female birds and usually maintain them till their death; and if they are culled (21.87 per cent), it is done mostly (17.19 per cent) after two years. This indicated that the females are sacrificed for meat purpose after their high rate of production in the initial couple of years. The surplus females are eliminated by sale and/or by self use for

home consumption. The culling age of females observed in this study was 24 months which is similar to that reported in Nicobari hens (Vijh *et al.,* 2006).

A vast majority (95.31 per cent) of the farmers opined that rearing native chicken is profitable (Table 2) because of the low input requirement for the local hens and good demand and high price for the products of native chicken throughout the year are the major factors that contribute for the profit. Interestingly, none of the farmer was in view that native chicken rearing is unprofitable. Muchenje and Sibanda (1977) also documented the farmers of Zimbabwe ranking chicken rearing as the highest income generating animal husbandry activity compared to goat and cattle.

The system of farming practiced by farmers of native chicken of Northern Kerala was free range system by providing shelter only at night (Plate 1c). Vij *et al.* (2006a) also documented similar farming system earlier in the same population of Tellichery chicken in the same geographical location. This system of rearing has been reported in various local Indian breeds of chicken like Miri, Nicobari, Ankleshwar, Daothigir, local hill fowl of Uttarakhand and Punjab Brown (Vijh *et al.*, 2005a; Vijh *et al.,* 2006; Tantia *et al*., 2006a; Vij *et al.*, 2006b; Kumar and Kumar, 2007; Vij *et al.*, 2006a).

5.3 FLOCK SIZE AND COMPOSITION OF NATIVE CHICKEN

The total flock size (Table 3 and Fig.1and 20; Plate 1g) ranged from one to 16 among the households with a mean value of 5.18 (Table16). The value is akin to the flock size of 5.5 (2 to 16) reported in Tellichery chicken earlier by Vij *et al. (*2007). Selvam (2004) also reported similar average flock size per house hold (6.8) in a village study in Namakkal, Tamil Nadu, India. The mean flock size was much smaller when compared to those of other indigenous poultry breeds like Ghagus (27), Kalasthi (13.6), Danki (16.7), Miri (25.2) and Daothigir (23) (Tantia *et al.,* 2005b; Vijh *et al.,* 2005b; Vij *et al., 2*005; Vijh *et al., 2*005a; Vij *et al., 2*006b). The small sized flock observed in this study may be due to dense human population of this state leaving comparatively less grazing area per household and also may be due to high depletion of flock due to predation, as the survey area is

adjoining to the hilly forest terrain (Plate 1a and b). The flock size was found to be a self limiting one decided by the following factors

1. Average land holdings
2. Prevalence of predators
3. Acceptance by neighbourhood

The number of chicks (Table 3) in the surveyed households (64) revealed that there were no chicks (below 8 weeks of age) in 54.69 per cent (35) of the households. The number of chicks per household ranged from zero to eleven. On the other hand, a vast majority of 90.63 per cent (58) families had no grower males (9 to 20 weeks) in their flocks. Out of remaining six households, five had one bird each and one had two birds. This study also revealed that 84.38 per cent (54) households had no grower females (9 to 20 weeks). The remaining households had one to four birds of this stage in their flocks. There were 37 (57.81 per cent) households with not even single cock (above 21weeks) in their flock. Out of remaining 27 families, most (25) had one or two cocks; however, one each had three and five cocks. The survey on number of hens (above 21weeks) per household among the families revealed that there were only 4.69 per cent (3) with no bird of this stage. The hens were distributed among the remaining households at the strengths of one to seven. The strength of birds of different stages documented from each household in the present study revealed that a huge majority of surveyed families had hens in their flocks. However, the birds of other stages have not been distributed well across the households and also the total number of birds of other stages was also less. The literature provides not much information on distribution of native chicken of different age groups to make any useful comparison.

The flock composition in terms of chicks, grower males, grower females, adult males and adult females in the native chicken of northern Kerala (Table16 and Fig. 1) recorded in the study was 1.59, 0.11, 0.34, 0.66 and 2.67 respectively. There were 29.82 per cent chicks, 13.74 per cent males (grower + adult) and 56.44 per cent females (grower + adult) in the flock. This was similar to those reported in Punjab Brown chicken in the Punjab state of India (Vij *et al*., 2006a). The flock

composition in Daothigir birds (21, 15 and 64 per cent, respectively) was also in similar line to those of present study (Vij *et al*., 2006b). In contrast to the low proportion of chicks (29.82 per cent) in the present study, many earlier workers (Tantia *et al.,* 2005b; Vijh *et al.,* 2005b; Vij *et al.,* 2005; Vij *et al.*, 2006b) recorded more than 50 per cent chicks in the flocks of Ghagus, Kalasthi, Danki, and Daothigir. In these populations the strength of adult females was also less than 35 per cent unlike 56.44 per cent recorded in this study. High hen strength observed in the population could be due to the practice of not culling them; on the other hand, less chick number might be due the more prevalent predation loss in this area owing to the geography of the location.

5.4 HOUSING MANAGEMENT

Of the 64 households of poultry rearers of Northern Kerala, all except one provided coops for night shelter (Table 4 and Plate 2a). One allowed open housing where the birds spend their nights on trees or roof tops. The result of this study was in agreement of those of Vijh *et al.* (2006), who also reported that housing for Nicobari birds was provided only at night and in some cases, the birds were staying on trees during night. Similar night housing for native chicken was reported by Tantia *et al.* (2005a) in Kashmir and by Halima *et al.* (2007b) in north–west Ethiopia. However, complete open housing system has also been recorded in certain native chicken populations of India (Tantia *et al.,* 2005b; Vij *et al.,* 2005b). Kumar and Kumar (2007) documented open housing in Tarai Bhabar area; where, the nomads help the Local hill fowl of Uttarakhand with a long log to reach the branches of tree for stay at night and making barriers around the stem of the tree with thorny and spiny bushes to protect them from predators. The provision of coop for night shelter was considered very essential by the farmers in the study because of highly prevalent nocturnal predators like wolf in this area from nearby jungle.

The most popular flooring of coops of native chicken of Northern Kerala was of wood (61.90 per cent) (Table 4). Similarly, wooden enclosures have been reported by Mcainsh *et al.* (2004) for housing the local chicken in Zimbawe and

by Kumar and Kumar (2007) in Uttarakhand state of India. The reason being that wood is the cheapest and more easily available material as the survey area is hilly region with thick vegetation.

The roofing of coops of native chicken in northern Kerala is mainly of tiles (33.33 per cent) and thatched (23.81 per cent) but also plastic sheet, stone and mud, wood, concrete and asbestos were used (Table 4). Perusal of literature revealed that it seems none of the earlier authors has reported the usage of tiles for roofing. However, thatched roofing in coops meant for native chicken rearing has been reported in India (Tantia *et al.,* 2005a; Vij *et al.,* 2005) and in other countries (Mcainsh *et al.*, 2004). The poultry farmers are increasingly using tiles nowadays instead of thatch due to the fact that they are more durable and also that the partially damaged tiles removed from their houses can be effectively utilized for this purpose. As discussed earlier, this study also revealed that among different agricultural farming, coconut plantation is very common with the poultry farmers; therefore, coconut leaves are the cheap thatch material readily available at the homesteads in this area.

The walls of coops of native chicken of northern Kerala (Table 4) were found to be made of wood in most of the cases (69.84 per cent). The wooden coops for housing native chickens have been reportedly used in India (Kumar and Kumar, 2007) and in other countries (Mcainsh *et al.,* 2004). Because of mountainous topography of this area, wood is a cheap and readily available material in the households to be used as construction material.

Regarding the distance of the coop from the house (Table 4), majority of poultry farmers of Northern Kerala (87.28 per cent) kept the poultry coops a little away from the house and the mean distance was 4.94 m from the house. The most distant coop in this study was 15m away from the house. The farmers reported that keeping the coops at a distance is essential to stay away from the ectoparasites affecting poultry and to avoid the off odour emanating from the droppings. However, the distance was found to be not too far, so that the farmers can have easy watch on the coop to minimize the incidences of predation. The less landholding of farmers of this area also seems to allow the farmers to provide only

a short distance between their houses and poultry coops. The information regarding the distance of coop from the house is sparse in the literature to make any useful corroboration.

The present study revealed that most of the poultry coops of native chicken of Northern Kerala were kept raised from the ground (63.50 per cent), while 36.50 per cent were in ground level with the support of wooden and stone pillars (Table 4); the mean height of the coops from the ground was 1.35 ft. The highest elevated of coop recorded in this study was placed at a height of 6.7ft. The farmers opined that constructing the coops above the ground level can prevent the damage caused by termites on wooden parts and also rusting of metallic parts like wire mesh. They also felt that this prevents the water seepage in the floor and water splashing into the coop during rainy season. In another study on the chicken population of Tellichery, the height of the coops from the ground was reported to be slightly higher at 2.30 ft. (Vij *et al.*, 2007). The elevation of shelter for local chicken of Zimbabwe, as reported by Mcainsh *et al.* (2004), was one meter from the ground.

The height of individual coop from its floor to the eaves (Table 4) was a minimum of one foot to a maximum of six ft. and the average height was 1.87 ft. The advantage of more height was that the farmers can provide perches inside; therefore, more birds can be accommodated even if the floor area was less.

The floor area of the coops (Table 4) ranged from 2 to 20 sq. ft. and the mean area was 7.46 sq. ft. The floor area per bird allowed by the farmers was calculated for every coop based on maximum number of birds that can be accommodated in that as reported by the farmer. The mean coop floor area per bird was 0.87 sq. ft. This floor space is much less when compared to two sq. ft. normally given for adult layer type chicken under intensive deep litter system (Panda and Mohapatra, 1989).

The average construction cost of the coop (Table 4) was found to be Rs. 485.83. The average floor area of coops recorded in this area was 7.46 sq. ft. Therefore, the coop cost per sq. ft. worked out to Rs. 65.12 only. The construction of coops at low cost could only be possible by utilizing the available household

materials and workmanship. These findings agreed with the report by Vijh *et al.* (2006), who reported that low cost houses are made using local materials for Nicobari birds.

5.5 FEEDING AND WATERING MANAGEMENT

It was found that only 64.06 per cent of the households provided supplementary feeding (Table 6 and Plate 5f); of which, only 15.63 per cent feed their birds to improve the nutritional status. Another 18.75 per cent farmers feed the birds to encourage some behavioural characters, while the remaining 29.69 per cent farmers feed them for both nutritional and behavioral reasons. Supplemental feeding for nutritional reasons is commonly being practiced in female birds during high rate of lay and also in broody hens when they are incubating the eggs or when they are brooding the young chicks. Some households practiced feeding the birds just after laying, so that the birds will always come for feed after laying and the owner could understand that the egg had been laid. This behavior assists the farmer to collect the eggs immediately after laying, thereby, losing them to crows, snakes etc. can be minimized. Some farmers feed the birds in the evening so that the birds develop the habit of returning from scavenging and nesting in their houses before dusk thereby protected from predators. The farmers call the birds by making a peculiar sound before giving feed; thereby the birds are conditioned to their call right from the young age. The birds assemble near the caller from far off places immediately after hearing the sound. The farmers call their birds mainly to give feed or any kitchen waste.

The survey on the time of feeding (Table 6) showed that many farmers follow no specific timing (41.46 per cent) for feeding; while some other feed the birds in the morning (4.88 per cent) or around noon (21.95 per cent) or evening (17.07 per cent) or at all the three times (9.76 per cent). Few farmers (4.88 per cent) feed them after laying. In general there is no rigid timing is necessary in native chicken rearing unlike intensive system of rearing. This allows the households to take care of their birds at the leisure time. A study on rural families in Bangladesh revealed the practice of feeding twice a day, once in morning

when birds leave night shelter and again in the evening when they return has been reported by Das *et al.* (2008).

The data on type of feed (Table 6) given revealed that 46.88 per cent feed rice as supplementary feed. Rice is the common feed in Kerala, so as in this area, therefore rice is the readily available grain in the households. It is also noted that out of 64 farmers, except one, none of the farmers used compound poultry feed. In addition, the left over feed and kitchen waste are fed to the bird. The earlier report also confirmed that feeding commercial feed is not common in the same population of Tellichery chicken (Vij *et al*., 2007). Perusal of literature revealed that the farmers feed their chicken with the grains they cultivate, available in plenty locally or they commonly use as food (Mcainsh, *et al.*, 2004; Tantia *et al.,* 2006a). This agreed with the findings of Gupta *et al.* (2006), who reported that rural poultry farmers of Meghalaya provided self produced cereal grains and kitchen waste in addition to day time scavenging.

The mean quantity of feed supplemented to the birds (Table16) is found to be 13.81g among all the households and 19.53g among only those providing supplemental feeding. The quantity observed in the study was lower than those reported earlier by Tantia *et al.*, (2006a) in Ankleshwar birds and Kumar and Kumar (2007) in local hill fowl of Uttarakhand. The extensive chicken production system of Zimbabwe was described as a low input – low output system by Mcainsh *et al.* (2004), where the birds were given limited amounts of feed to supplement what they find to eat in scavenging.

The study showed that majority of the farmers (57.81 per cent) use well water for their poultry (Table 6). The rest did not provide any water. This showed that the birds in these households have to satisfy with the water available in the foraged feedstuffs from plant and animal sources. The scavenged feed of plant and animal origins in general contains more than three-fourth water (Plate 1h). The physiological need of chicken is around double the quantity of water to that of feed and its ability to excrete the metabolic end products of protein in the form of uric acid comes handy in coping up with the conditions of less available water. Earlier, Kumar and Kumar (2007) had reported that *naula*, water spring and

Government water pipes are the common water sources for Local hill fowl of Uttarakhand.

Of 47.89 per cent farmers using different containers as waterers (Table 6 and Plate 2b), more than 30 per cent use either coconut shell or steel utensils for this purpose, however, earthen, rubber and plastic utensils are also minimally used. According to Kumar and Kumar (2007), the waterers used for the local hill fowls of Uttarakhand were metallic pots. But in Zimbabwe the farmers use old tyres, plastic containers, cups and plates (Mcainish *et al.*, 2004). This showed that the poultry farmers of native chicken do not use any specialized drinkers similar to those used in commercial units but only use locally available material that can hold water.

5.6 NATURAL INCUBATION

The farmers are in opinion that the native chicken are good brooders and mothers; the character very essential for self-propagation. The farmers incubate few numbers of eggs from good producers whenever they want to replenish the depleted stock. Thereby the farmers are doing artificial selection in native chicken population for egg production and other preferred traits in their homesteads. The study revealed that most popular nest box they used for natural incubation (Table 7) was plastic cans (21.88) with one side cut open. It is also found that the farmers also use other locally available materials like rubber basket and steel pan commonly used in civil construction works, earthen pot's base, wooden crate (tomato boxes), mud nests and spathe of areca nut palm (*paala)* for incubating the eggs (Plate 2f). Kumar and Kumar (2007) reported that people in Uttarakhand use basket from locally available material as nest box for incubating the eggs. The use of bamboo baskets for this purpose has also been reported earlier in India (Vij *et al.,* 2005; Tantia *et al.,* 2005b) and in other countries (Das *et al*., 2008). It was interesting to note that a good number of farmers (23.44 per cent) use no nest box, but directly set the eggs on the floor in the corner of their house.

The nest material used by majority (51.56 per cent) of the poultry farmers of native chicken of northern Kerala (Table 7) was sand followed by paddy husk,

straw, clothes, coir fiber and even ash (Plate 2c). However, the scan of literature provided no evidence of using sand as nesting material in any part of the world. Some households (14.06 per cent) did not even provide any nest material. As reported by Vijh *et al.* (2005a), in indigenous Miri birds, paddy straw bedding was provided; whereas, in Zimbabwe it was grass (Mcainsh *et al.*, 2004) and in Bangladesh it was wood shavings or paddy straw (Das *et al*., 2008).

The survey (indirect method) on number of eggs per setting in native chicken of northern Kerala (Table 7 and Plate 2 c, d), revealed that majority of the households (70.45 per cent) kept nine to 12 eggs. The mean value was 10.41 eggs per setting. The same parameter recorded from field natural incubation study on 15 arranged settings (direct method), was 10.07 eggs. A very closer value of 10.60 eggs has been recorded in local chicken of Zimbabwe (Mcainsh *et al.,* 2004). However, a higher value of 12 eggs has also been reported in the literature (Roy *et al*., 2004). Similar to the practice followed by majority of the farmers of this area (9 to 12 eggs), native chicken farmers of Bangladesh incubate eight to 12 eggs per setting (Das *et al*., 2008).

The break open study of the unhatched eggs (Table 18 and Plate 2g) revealed that the fertility was 74.29 per cent from the field natural incubation experiment and 79.55 per cent from the artificial incubation experiment. The fertility recorded in this study was higher than that of Nicobari birds reared in deep litter condition (Vijh *et al*., 2006) but much lower than that of exotic layer type chicken under artificial incubation (Anon, 2009). Interestingly, majority of the farmers (57.81 per cent) do not maintain even a single cock in their homestead (Table 3), despite the fact that they are well aware of the importance of cocks in producing fertile eggs. More interestingly, the farmers having no cock in their flock also incubate their eggs for producing new generation. In these conditions, they believe that the hens of their flock should have been mated by the cocks from the neighbourhood. Moreover, another reason for poor fertility could be that the farmers have the practice of keeping a particular cock for many years without replacing it with young one (spiking).

The survey (indirect method) on hatchability per cent in natural incubation revealed a range of zero to 100 (Table 7) with a mean value of 68.78 on TES (Table 16). From the field natural incubation study (direct method) (Table 18), the mean was 63.12 on TES and 83.12 on FES. Similar values have been reported in Tellichery chicken of Kerala (70 to 80 per cent) by Vij *et al.* (2007) and in local chickens of Zimbabwe (73 per cent) by Mcainsh *et al.* (2004). However, higher hatchability values of 90 (Kugonza *et al.*, 2008) and 92 per cent (Roy *et al.*, 2004) have also been reported from the natural incubation. The hatchability per cent of native chicken eggs subjected to artificial incubation was 67.05 and 84.29 on the basis of TES and FES respectively (Table 18). These values are closer to those observed in natural incubation indicating the ability of the brooding hens to provide optimum incubation conditions to the hatching eggs as that of modern equipments. Many of the farmers believe that thunder and lightning can reduce the hatchability of chicken eggs. The farmers have the practice of placing iron and coal pieces along with the eggs; these articles are believed to prevent the reduction in hatchability due to thunder and lightning.

The incidences of early embryonic death, dead germs and dead in shells (Table 18) in field natural incubation experiment (direct method) were 5.34, 8.65 and 0.96 per cent respectively. The respective values from artificial incubation were 3.13, 4.20 and 8.39. The very low incidence of dead in shell in natural incubation compared to that of artificial incubation (0.98 versus 8.39) revealed that modern incubators are probably not so efficient as broody hen in providing the optimum conditions towards the end of incubation. The information in the literature is scant on these parameters to make any meaningful corroboration.

5.7 BEHAVIOURAL CHARACTERS

The survey data on the flight height (Table 8) reported by farmers showed that 69.23 per cent of farmers were in opinion of that birds can fly to a height of three to five meters. The ability of native bird to fly to a higher place in one takeoff unlike exotic birds, which are able jump only to a lower height, helps the birds from evading the attack of terrestrial predators. Similar observation had

been made by Kumar and Kumar (2007), in case of Local hill fowls of Uttarakhand. The farmers opined that this quality of native birds greatly help the birds to survive in the hilly terrain. The farmers also opined that the improved varieties lack this ability and perish easily to the predators in these conditions; therefore not preferred by them. The survey on flight distance (Table 8 and Plate 3a) revealed that 80.77 per cent of farmers of Northern Kerala reported that the native chicken can fly up to a distance of 10 to 15 min a single flight; the overall average flight distance was 13.29m. This quality of native chickens helps them to run into a hideout quickly when there is a danger from aerial predators. Similar results were reported by Kumar and Kumar (2007) in case of Local hill fowls of Uttarakhand that the lighter body with strong wings has a greater chance of avoidance from predators by fast running and flying to a safer place.

The radius of territory the birds covered (Table 8) as observed by 67.29 per cent of the farmers was from 50 to 200m. The overall mean distance was 121.15m (Table 16). This long distance covered by the birds allows them to scavenge more area, however, the chance of getting attacked by predators is also more. Majority of households do not own a cock; therefore, they are considered as open flocks mated by the neighbourhood cocks. It is also observed that the cocks from one household travel to a long distance to cover the open flocks in the surrounding neighbourhoods. This resulted in wider sex ratio above the optimum of 1: 8 to 10, and the lower fertility observed in the study could be due to this migratory behaviour of males.

The ability of broody mothers in saving the young chicks up to four weeks of age was considered as a measure of assessing the mothering ability of that hen (Plate 3b). The data showed (Table 8) that 40.98 per cent of broody chickens saved more than 75 per cent of the chicks from depletion; with the overall mean survivability of 64.98 per cent. This shows that the native chickens of northern Kerala are having good mothering ability in this highly predator prone area.

5.8 DISEASE PREVALENCE AND ITS MANAGEMENT

The survey revealed that the most common disease conditions the farmers encountered (Table 9) were Respiratory diseases (25 per cent) and Ranikhet disease (Local name: *Kozhi vasantha*) (23.44 per cent) followed by fowl pox (Local name: *Aakkurippu*) (12.5 per cent), ectoparasitism (Local name: *Kozhi paen*) (6.25 per cent), thin shelled egg (Local name: *Thoal mutta*) (1.56 per cent). The incidence of Ranikhet disease and/or fowl fox in native chicken populations has been reported in India and abroad by many earlier workers (Gupta *et al.*, 2006; Tantia *et al.*, 2006a; Vij *et al.*, 2006b; Biswas *et al.*, 2008; Iqbal and Pampori, 2008), However, other diseases like Marek's Disease (Gupta *et al.*, 2006), chronic respiratory disease (Gupta *et al.*, 2006) and Coccidiosis (Vij *et al.*, 2006b) have also been reported in different native chicken populations. The respiratory syndrome reported by the farmers might be due to the combined infection of organisms like *E. coli*, *Mycoplasma sp*., *Pasteurella sp.* etc.

The seasonal influence on occurrence of disease was also surveyed (Table 9) and most of the farmers (40.63 per cent) opined that occurrence was more in summer season. Kugonza *et al.* (2008) reported similar observation in native chicken of Kumi district in eastern Uganda with 62 per cent mortality in dry season. In sharp contrast, Yousef and Al Yousef (2007), from a study in Baladi chicken of Saudi Arabia reported that the mortality was less in summer.

Survey on disease control measures (Table 9) adopted revealed that 90.63 per cent households did not practice any control measures and few used herbals (6.25 per cent) or disinfected their coop daily (1.56 per cent) when they foresee any outbreak or when there are some disease conditions in the surrounding households. The common herbals used for this purpose were *tulsi (Ocimum sanctum)* leaves, bulb of garlic (*Allium sativum*) and tuber of turmeric (*Curcuma longa*). The farmers were not impressed upon vaccination when explained; but felt predation is the grave problem causing more mortality than diseases. Similar observation of no vaccination against any of the diseases on the same population of Tellichery chicken has been reported by Vij *et al.* (2007). However, in case of other indigenous birds like Kashmir Favorolla, Ghagus, Kalasthi, Ankleshwar and

Daothigir, birds are being vaccinated against the diseases like Ranikhet and/or fowl pox and/or fowl cholera (Tantia *et al*., 2005a; Tantia *et al*., 2005b; Vijh *et al*., 2005b; Tantia *et al*., 2006a; Vij *et al*., 2006b) in case of respective breeds. However, the practice of deworming either using allopathic medicines or indigenous substances has been reportedly followed in this area.

The system of medicine chosen for treatment (Table 9) revealed that nearly one-third (32.81 per cent) of the farmers did not treat the birds during disease outbreak; while, another one-third (31.25 per cent) of the farmers depend on indigenous method. Few others depend on allopathy (20.31 per cent) or combination of all the above methods (15.63 per cent). The indigenous herbs (Plate 5g) used in treatment are garlic juice and *tulsi* leaves for respiratory problems, turmeric for external application on wounds and also given internally when the birds were sick and an aromatic shrub *Premna serratifolia* (*Narimunja*) for ectoparasitism. The fruit of a thorny plant of *Pandanus sp. (*kaitha*),* which is having a very pungent smell, was also used inside the coops to control ectoparasites; some farmers even give alcohol when the birds are sick. In a similar study from Zimbabwe, it has been reported that some farmers use a local plant called as "*gavakava*" of the aloe family for treating diarrhoea and swollen eyes (Mcainsh *et al.* 2004).

Regarding the services adopted for treatment (Table 9), only one-fourth (25 per cent) of the farmers sought Government institutions and the rest practiced self-treatment (48.44 per cent), while the remaining around one-fourth (26.56 per cent) of the farmers adopted no services. The reason cited by the farmers for not using the facilities at Government veterinary dispensary was that it was far away and not easily accessible.

5.9 MORTALITY PATTERN

The mortality per cent in chick stage (Table 10 and Fig. 2) was 28.63 and among the mortality in chick stage, the death due to diseases was only 7.69 while the rest was due to predators (92.31 per cent). This result was in contrary with the report of Vij *et al.* (2007), who stated that the mortality in the same population of Tellichery chicken was very low and almost nil. However, in Danki birds, Vijh *et al.* (2005b) documented a mortality rate of around 20 to 30 per cent during first two month of age, similar to the result of present

study. This study also revealed that the predators like mongoose, *shikra* (*Accipiter badius* and *A. virgatus*) (local name-*Prappidiyan*), crows, dogs, eagle, cat and snakes are prevalent in this area.

The mortality in grower stage (Table 10 and Fig. 3) was 21.6 per cent; out of total mortality, 80 per cent was due to predators and 20 per cent was due to disease. A very closer value of 21 per cent mortality was documented in Baladi chicken at grower stage in Saudi Arabia (Yousef and Al- Yousef, 2007). At this stage, it was found from this study that wolf attack was the most common one followed by the attack of mongoose, cat, *shikra*, eagle and dogs.

In adult stage the mortality per cent (Table 10 and Fig. 4) was 45.28; out of which, 52.17 per cent of death was due to disease, and the rest by predators mainly dogs followed by mongoose and wolves. Similarly, Biswas *et al.* (2008) earlier reported that crow, eagle and mongoose are the main predators of day; while foxes, jackals and wild cats are the main predators of night.

In general, the mortality of native chicken population at chick, grower and layer stages in northern Kerala is due to predation to a greater extent. Among the predators of chick stage, aerial predators like *shikra*, crows and eagle were more common next to mongoose; nevertheless disease was of minor importance. When it comes to growing stage, the aerial predators were becoming less significant, whereas, terrestrial predators like wolves, mongoose, cats and dogs gained importance in the destruction of the flock. In adult stage, the highest damage was caused by diseases followed by terrestrial predators like dogs, mongoose and wolves. Since the risk of death due to predators was very high in the chick stage, it was felt by the farmers that the projects from government agencies and other voluntary organizations to rear the chicks during the initial couple of months under intensive system before distributing to the farmers can help the farming community, thereby the native chicken population in villages can be increased.

5.10 PLUMAGE COLOUR AND PATTERN

The plumage colour and pattern are influenced by sex in poultry (sexual dimorphism). Therefore, these characters are studied separately for sexes apart from analyzing the population in total.

In the present study, it was found that the plumage colours in males (Table 12) can be classified into six, the most prevalent being red (47. 22 per cent); however, none of the females had this plumage colour. The other five plumage colours in males were black, brown, white, gold and multicoloured. In case of females based on the plumage colour there were five groups, namely, black (41.46 per cent) the most predominant one followed by brown, white, multicoloured and gold. The other predominant colour of females was brown (38.41 per cent). In the overall population consisting of both the sexes, most of the birds (37.50 per cent) had black plumage followed by brown (34.50 per cent) (Fig. 5 and Plate 3c). Similar observation of plumage colour variable from black to grey and some times with various colour combinations has earlier been reported in this population of Tellichery breed by Acharya and Bhat (1984). However, Vij *et al.* (2007) reported that the plumage colour in Tellichery chicken is black with shining bluish tinge on hackle, back, and tail feathers. It has been reported by many earlier workers that the plumage colours are nonspecific to indigenous chicken populations of India and other countries, but consisted of several colours (Tantia *et al*., 2005a; Vijh *et al*., 2005a; Duguma, 2006; Yousef and Al-Yousef**,** 2007).

Based on primary plumage pattern (Table 12, Fig. 6 and Plate 3d), the male birds can be grouped into four, predominantly wild (61.11 per cent) followed by Birchen, Solid Black and nonspecific; whereas, females came under seven groups, predominantly wheaten (32.93 per cent) followed by solid black, nonspecific, Birchen, Wild, Brown and Columbian. The overall population had wheaten (27 per cent) and solid black (22 per cent) as the common primary patterns. The prevalence of other patterns like wild (17.5 per cent), nonspecific (16.5 per cent) and birchen (12.5 per cent) are also significant, however, that of brown (3 per cent) and Columbian (1.5 per cent) patterns are insignificant. The details on primary pattern documented in other indigenous poultry populations

were scant in the literature; therefore, no valuable corroboration could be made. The multiple alleles in the E locus are responsible for plumage colour and pattern in chicken. The alleles in this locus in the descending order of dominance is *E* (extended black), E^R (birchen), e^+ (wild), e^b (brown), e^s (speckled), e^{bc} (buttercup) and e^y (recessive wheaten). All male phenotypes, except *E* and E^R, have the black breasted red colour/pattern (Smyth, 1990).

The feathers were examined for the secondary plumage pattern (Table 12 and Fig.7, Plate 4 a and b), *i.e*., colour distribution within individual feather. Majority of males (91.67 per cent) were nonspecific while 5.56 per cent showed stippling and another 2.78 per cent showed frizzling. In females, 61.58 per cent were nonspecific, 17.07 per cent stippled, 10.98 per cent single laced and 8.54 per cent barred. The presence of double lacing, tricolour and frizzling were of minor importance. The population in total had 67 per cent nonspecific and 15 per cent stippling patterns. Bhuiyan *et al.* (2005), reported that 61 per cent of *desi* chicken of Bangladesh were without any definite pattern while 17 per cent with lacing. The previous workers also reported no breed specific secondary plumage pattern in indigenous populations of India (Vij *et al*., 2005; Tantia *et al*., 2006a; Vij *et al*., 2006a). The secondary plumage pattern is mainly due to the interaction of the genes *Pg* (pattern gene), *Ml* (melanotic), *Db* (dark brown), *mo* (moulting), *B* (barring), *Co* (columbian) and *Er* (Erminette) along with *E* alleles. (Smyth, 1990).

There were two birds with frizzled (*ff*) plumage among the 200 birds. Therefore the phenotypic frequency of this character in this population was one per cent. The character 'frizzing' was inherited as an autosomal recessive character. The gene frequencies worked out from this information as per Falconer (1989) for '*F'* and '*f*' genes were 90 and 10 per cent respectively.

There were 14 females showed barred plumage (*B_*), however, the entire males were found to be non-barred (*bb*). Being inherited by sex-linked autosomal dominant inheritance, the gene frequencies calculated for *'B'* and *'b'* genes (Falconer, 1989) in this population were 4.67 and 95.33 in this population.

The survey also revealed the presence of two heterozygous naked neck birds (*Na na*) in the population. This character is inherited by incomplete

dominance, with homozygous dominant having complete nakedness but the heterozygotes are characterized by the presence of a bunch of feathers at the lower middle part of the naked neck. Therefore, the frequencies of *'Na'* and *'na'* genes in this population were worked out to be one and 99 per cent (Falconer, 1989).

The graphical representation of the allelic frequencies of the major genes is presented in Fig. 19.

5.11 QUALITATIVE CHARACTERS

The overall population had 61.5 per cent birds with white skin, while 36 per cent had yellow and 2.5 per cent had black skin (Table 13 and Fig.8). Pigmentation of non feather tissue (skin, beak and shank) involves the carotenoids and melanins which are responsible for yellow and black colour respectively. Vij *et al.* (2007) reported that the Tellichery chicken, a breed of northern Kerala, is having greyish skin; while, Acharya and Bhat (1984) documented the skin colour of this breed as black. White and/or yellow skin colours have commonly been documented in other indigenous chicken populations (Nthimo, 2004; Vijh *et al*., 2005a; Vij *et al*., 2006a; Kumar and Kumar, 2007). However, other skin colours like grey and/or pink alone or along with white and yellow have been reported in some other indigenous chicken populations (Vij *et al*., 2005; Vijh *et al*., 2005b; Tantia *et al*., 2006a; Vijh *et al*., 2006; Vij *et al*., 2006b).

The predominant shank colour in the local chicken population of northern Kerala, Tellichery was yellow (51.5 per cent) followed by equal number of white, and yellow with black (each 15.5 per cent) and black (14.5 per cent) (Table 13 and Fig.9 and 39). However, rare characters of green (2 per cent) and blue shanks (1 per cent) were also noted in this population. The birds had mostly featherless shanks, but at very rare instances sparsely feathered. This was in contrast with the observation of Vij *et al.* (2007), who reported only featherless blackish grey shanks in these birds. Most of the indigenous breeds have yellow shanks (Tantia *et al*., 2005b; Vij *et al*., 2006a; Tantia *et al*., 2006a; Vij *et al*.,

2006b) or yellow with greyish colour (Vij *et al*., 2005; Vijh *et al*., 2005b; Kumar and Kumar, 2007).

The beak colour in the Tellichery population as observed in this study was predominantly yellow (38.5 per cent), followed by black (32 per cent), yellow with black shades (28.5 per cent) and a rare character of blue (1 per cent) (Table 13 and Fig.16 and Plate 5d). It seems no earlier report on beak colour of this population is available in the literature. However yellow coloured beaks have been documented in Danki (Vij *et al*., 2005), Kalasthi (Vijh *et al*., 2005b), Ankleshwar (Tantia *et al*., 2006a) and Daothigir (Vij *et al*., 2006b) birds.

The major determiners of carotenoid deposition in the skin are the autosomal white (W^+) and yellow (*w*) alleles, where the white skin gene acts to prevent the transfer of carotenoids into the skin (Smyth, 1990). The allelic frequency of 'W^+' and '*w*' in this Tellichery population calculated were 40 and 60 per cent respectively (Falconer, 1989) from the phenotypic frequency of 64 per cent white ($W^+W^+ + W^+w$) and 36 per cent yellow (*ww*) observed in the study. The white, yellow, black, green and blue colouration on the skin and shank are due to the allelic combination of 'W^+W^+ *IdId ee*', '*ww IdId ee*', '*ww idid EE*', '*ww idid ee*' and 'W^+W^+ id^+id^+ e^+e^+' respectively (Smyth, 1990).

Eye colour of Tellichery birds (Table 13,Fig.11 and Plate 4e) in this study showed three variants; 51 per cent of the birds were of yellowish red, followed by yellow (44.5 per cent) and black (4.5 per cent) coloured eyes. The results of this study was not fully in agreement with the findings of Vij *et al.* (2007), who reported that the Tellichery chicken has blackish red eye ring. The other eye colours of indigenous chicken reported in the literature were different shades of brown, black and grey (Nthimo, 2004; Vij *et al*., 2005; Vijh *et al*., 2005a; Kumar and Kumar, 2007). There is a surprising lack of information on the subject of the inheritance of eye colour. The black colour seen in the population is wild–type eye characterized by a heavily melanized retina and posterior surface of the iris. The id^+ or id^M alleles enhance dermal shank and eye pigmentation and thus eye color is closely related to shank color. Eye color can also be modified by *Br*

(inhibitor of brown eye), *br* (allows melanin deposition in the eye), *c* (recessive white), *I* (dominant white), *E* (extended black), E^R (birchen) and e^{Wh} (wheaten).

The earlobe colour (Table 13, Fig.10 and Plate 4d) found in this population was admixture of white and red in majority of the birds (64 per cent), followed by red (18.5 per cent). The other colours of minor importance were white, yellowish white, admixture of white, red and black, admixture of red and yellow and greyish blue. This result was in conformity with the report of Vij *et al.*, (2007), who found that the earlobe colour of Tellichery chicken was mostly red with white markings. Red earlobe with white markings has also been documented in Daothigir chicken (Vij *et al*., 2006b). The red jungle fowl, progenitor of present day chicken, also shows the mixture of red and white with predominantly red colored ear lobe (Smyth, 1990).

A vast majority of Tellichery birds in this study (Table 13, Fig.12 and Plate 5b) were found to have red combs (87.0 per cent); yet, small proportions of birds had blackish red (9.0 per cent), yellow (2.5 per cent) and black (1.5 per cent). A similar observation of red coloured combs and blackish red combs in typical birds has been recorded in the same population by Vij *et al.* (2007). Almost all Indian breeds have red comb colour (Vijh *et al*., 2005a; Tantia *et al*.,2005a; Vijh *et al*., 2005b; Tantia *et al*., 2005b; Tantia *et al*., 2006a; Vij *et al*., 2006a) except Kadaknath, which has purple (Mohapatra and Panda, 1981).

The documentation of comb type (Table 13 and Fig.13 and Plate 5a) revealed that majority of the birds (97.5 per cent) had single (*rrpp*), while, 2.5 per cent had pea comb (*rrP_*). The comb patterns in chicken are produced by the interaction of alleles of two loci namely, P and R. From the observed phenotypic frequencies the frequencies of *R, r, P* and *p* genes in Tellichery chicken calculated as per Falconer (1989) were zero, 100, 1.26 and 98.74 per cent respectively. Despite the presence of a very small proportion of pea comb observed in the study, Vij *et al.* (2007) reported that the comb type in Tellichery chicken was only single. As per the literature, indigenous populations had mostly single comb with or without the presence of other combs like pea, rose and strawberry (Nthimo, 2004; Vij *et al*., 2005; Tantia *et al*., 2005a; Vijh *et al*., 2005b).

A clear sexual dimorphism was observed for comb position (Table 13 and Fig.14 and Plate 5c). In case of males, the comb position was completely erect; while, in females, 50.61 per cent of the combs were erect and the remaining 49.39 per cent were floppy. From the results of this study, it could be concluded that the comb position in this population is a sex influenced trait. Vij *et al.* (2007) reported that the Tellichery cocks have erect which agreed well with the result of the present study; while, they reported floppy combs in hens; which is not in conformity with the present finding (Vij *et al.*, 2006). Erect comb has earlier been reported in some of the native chicken breeds like Daothigir (Tantia *et al*., 2006a) and Sole colored Lesotho native fowl (Nthimo, 2004).

Similar to comb position, sexual dimorphism was also found in wattle colour (Table 13 and Fig.15 and Plate 4f) in this population. Even though wattle colour of all the males was red; that of females was of three types, namely, red (87.8 per cent), blackish red (10.98 per cent) and yellow (1.22 per cent). Vij *et al*. (2007) earlier reported that the wattles of Tellichery chicken are red in colour; their results agreed only with the wattle colour observed in males in this study. In Nicobari birds, the wattles are pink in colour (Vijh *et al.,* 2006); while, the wattles are absent in Danki birds (Vij *et al.,* 2005). Genetically wattle colour is inherited as a polygenic trait involving variation in pigmentation of carotenoid and melanin pigments.

5.12 QUANTITATIVE CHARACTERS

5.12.1 Morphometric Characters

The quantitative traits of conformation nature in chicken are bound to show sexual dimorphism sexes. Therefore these traits were also analyzed to reveal sex effects also.

The sexual dimorphism was evident in wattle size also (Table 14); the wattles were large in majority of the cases (63.89 per cent); whereas in females, majority were small (54.27 per cent). The sexual dimorphism in wattle size was also reported by Vij *et al.* (2006a) in Punjab brown chicken. The overall population had large, medium and small wattles in the proportion of 44.5, 38 and

17.5 per cent in the present study. Vij *et al.* (2007), from visual grading reported that the wattle size of Tellichery chicken was medium. Similarly, Vij *et al*. (2006b), from visual grading stated that Daothigir birds had medium to large wattles.

The mean shank length (Table 14) in males (93.91mm) was significantly ($P \leq 0.01$) higher than that of females (79.64mm); the overall mean in the population being 82.14mm. Similar observation of 90 and 75cm in males and females has been reported in Kashmir Favorolla birds (Tantia *et al.,* 2005a). However, higher values of 12.7cm in cocks and 9.7cm in hens were reported by Msoffe *et al.* (2002) in local chickens of Tanzania. The difference in conformation between sexes in chicken with males having highly set body with long legs is the reason for the sexual difference observed in this trait.

The beak length (Table 14) of males (32.04mm) and females (29.95 mm) had significant difference. The overall mean was 30.38 mm in the population. However, the details on measurement of beak length in the literature for native chicken breeds were scarce. On objective scale, the beak length was reported as short in Danki (Vij *et al.*, 2005), Kalasthi (Vijh *et al.*, 2005b) and Ankleshwar (Tantia *et al*., 2006a) birds.

The spur length (Table 14) in males (4.37mm) and females (0.32mm) showed a wide variation with significant difference between them; the overall mean value being 1.03mm. The length of spur of native chicken recorded in metric scale could not be cited in the literature. On objective scale, it has been reported that the Danki birds had long and sharp spurs (Vij *et al.*, 2005) and 98 per cent of *desi* chicken of Bangladesh had rudimentary spurs (Bhuiyan *et al.*, 2005).

The body weight (Table 14) of males ranged from 800 to 2650 g. with a mean weight of 1659.71. The female body weight ranged from 700 to 2500 g with a mean of 1400.3g; the mean values between sexes differ significantly. The overall mean body weight of the Tellichery chicken observed in this study was 1445.7g. Similar body weight in males (1.62 kg) and slightly lower value in females (1.24 kg) has been reported earlier in this breed by Vij *et al.* (2007).

Most of the native chicken breeds like Kashmir Favorolla, Ankleshwar and Daothigir were having body weights similar or slightly higher than those observed in this study (Tantia *et al.*, 2005a; Tantia *et al*., 2006a; Vij *et al.*, 2006b). However, higher body weight of 3.12 and 2.2kg respectively in males and females was reported in Danki birds (Vij *et al*., 2005). The genetic makeup and the low level of nutrition in the range conditions might be the reasons for lower adult body weights. Since body weight being a quantitative trait, it is more likely to be influenced by environment. The lighter body weight of native chicken enables them to fly or run quickly into a hideout to evade the attack of predators.

5.12.2 Egg Production and Related Characters

The age at first egg (AFE) recorded from survey on household basis (Table 5) ranged from five to eight months with a mean value of 6.45 months (Table 16); whereas, the survey on individual bird basis revealed a range of 144 to 230 days (Table 15) with a mean value of 177.6 days. From the field egg recording study, the mean value recorded was 199.26 days (Table 20). Vij *et al.* (2007) reported that the Tellichery breed of chicken had an age at sexual maturity which ranged from 150 to 240 days with a mean value of 180 days which was in accordance with the results of present study. Similar findings were reported in indigenous breeds like Ankleshwar (179.95 days) and Daothigir (6 months) (Tantia *et al.*, 2006a; Vij *et al*., 2006b). However, higher values of 210 or more days has also been reported in the literature in native chicken breeds (Vij *et al*., 2005; Vijh *et al*., 2005a; Tantia *et al*., 2005a; Vijh *et al*., 2006). The higher values of age at first egg might be due to genetics as well as environment in terms of lower plane of nutrition available for these birds. The negative correlation between egg production and AFE is well established in chicken. This native population had low egg production (86.12 eggs HDEP up to 60 weeks) and therefore higher AFE is bound to occur.

The shell colour (Table 15 and Plate 5e) of Tellichery chicken documented in this study was of light brown (73.47 per cent) or medium brown (12.24 per cent) or white (12.24 per cent) or dark brown (2.04 per cent). In partial agreement

with these findings, Vijh *et al.* (2007) earlier reported that the shell colour of Tellichery breed was mostly light brown (45 per cent) followed by brown (33 per cent) and creamy white (22 per cent). Similar to the findings of the present study, a large proportion (more than 60 per cent) of light brown shell has been reported in some other indigenous breeds, like Miri, Kashmir Favorolla and Punjab brown also (Vijh *et* al., 2005a; Tantia *et al*., 2005a; Vij *et al*., 2006a). However, lighter shades of creamy colour in shells of Ankleshwar breed (Tantia *et al*., 2006a) and whitish colour in those of Nicobari breed (Vij *et* al., 2006a) has been reported in the literature. The white or brown shell colour is genetically inherited as a multifactorial trait and may be influenced by modifying genes (Washburn, 1990).

The present study revealed that broodiness is a behavioural character commonly found in almost entire population (98.10 per cent) (Table 15). Vij *et al.* (2007) also documented brooding as a usual practice in Tellichery chicken. This character is a property of Asiatic breeds. Most of the native chicken breeds of this subcontinent were also reported to be broody (Ahamed, 2002; Vij *et al*., 2005; Vij *et al*., 2006b; Vijh *et al*., 2005b) except Nicobari (Vijh *et al.*, 2006). This behaviour is essential for self-propagation of these populations under village conditions; therefore, farmers reportedly resist the introduction of any improved variety which lacks this quality, though they are good in egg production.

The length of broodiness (days) in native chicken of Northern Kerala measured indirectly by survey method revealed a range of seven to 65 (Table 15) with a mean value of 27.9 and that measured directly from egg recording study was 22.38. Iqbal and Pampori (2008) reported lower value of 12 to15 days in indigenous chicken of Kashmir. When the broody birds are allowed for incubation, the period of broodiness will prolong through incubation till it completes brooding of chicks up to around two months of age. It was observed that the birds return to the next cycle of production after natural incubation and brooding in about 121.75days (Table 20). This period includes incubation (three weeks) brooding (two to three months) and recuperation periods after brooding (around one month). The common practices to interrupt broodiness and to expedite the resumption of next cycle followed by the local people are dipping in

water frequently, disturbing the bird from settling in nest, introducing new cocks, keeping the bird tied in unfamiliar surroundings and even making the bird restless by inserting a quill feather through and through the nostrils.

Survey on clutch size in native chicken showed a range of one to 25 eggs with the mean value of 7.67 eggs (Table 16). This value was slightly higher than four to six eggs reported earlier by Vij *et al.* (2007) in the same population of Tellichery breed of chicken. In Ghagus bird, the clutch size reported was four to six eggs (Tantia *et al*., 2005b).

The number of clutches in one cycle (between two broodiness) of native chicken of Northern Kerala (Table 15) ranged from one to 16 with a mean value of 3.48 (Table 16). From field egg recording study the value was found to be 2.13 (Table 20). The information on this trait available in the literature was scarce; therefore, no useful comparison could be made.

The egg production in one laying cycle (Table 15) surveyed from individual birds showed a range of four to 30 eggs with a mean of 15.50 eggs. The field egg recording study showed a value of 14.32 eggs. The scanning of the literature showed higher value of 20 to 25 eggs in same population of Tellichery (Vij *et al.,* 2007). Higher range of 15 to 20 eggs in Ghagus hens (Tantia *et al.,* 2005b) and lower range of eight to 12 eggs (10.6) in Danki hens (Vij *et al.*, 2005) have also been recorded in the literature.

The total egg production (Table 20 and Fig. 21 and 22) up to 40 weeks of age on hen day and hen housed basis were 34.59 and 33.06 eggs and up to 60 weeks of age, the values were 86.12 and 70.33 eggs respectively. As the egg production was not conducted up to 72 weeks of age (one year of egg production period) in this study, the comparison has been difficult. However, the *desi* hen of Bangladesh was reported to lay 40 to 54 eggs per year (Ahmed and Hasnath, 1983); while, in Daothigir it was 60 to 70 (Vij *et al.,* 2006b), in Ankleshwar it was 79.35 (Tantia *et al.,* 2006a), and in indigenous chicken of Kashmir, it was 75 to 90 (Iqbal and Pampori, 2008). However, high egg production of 148.7 eggs per year has been reported in Nicobari birds by Vijh *et al.* (2006). The egg production being a qualitative trait, can easily be influenced by environment; low level of

nutrition available to these birds could be cited as a reason apart from their genetic make up. As it is well established that egg production is negatively correlated with age at first egg, length of broodiness and length of pause, in chicken; the higher values of these traits observed in this population is bound to have negative impact on egg production.

5.13 HAEMATOLOGICAL PARAMETERS

The mean red blood corpuscles (RBC) count (million per ml of blood) (Table 21) of males (3.43) was significantly higher than that of females (2.78); the overall mean being 3.11. Sturkie and Griminger (1986) reported that in most avian species, there was a difference in erythrocyte numbers between sexes with a higher level in males, which binds with the results obtained in native chicken also. The erythrocyte count (million per ml of blood) of chicken reported by Lucas and Jamroz, (1961) ranged from 3.26 to 3.80 in adult males and from 2.72 to 3.00 in adult females .The values obtained in this study also falls within this range.

In native chicken of northern Kerala, the mean haemoglobin content of blood (gram per cent) (Table 21) of males (12.70) was significantly higher than that of females (9.91); the overall mean being 11.31. The values were comparable to the observations of Pilaski (1972), cited by Sturkie and Griminger (1986) who reported values of 11.40 and 8.60 for the respective sexes in adult chicken.

In native chicken of northern Kerala, the mean packed cell volume (PCV) per cent (Table 21) of males (42.95) was significantly higher than females (34.81). The overall mean was 38.88. The PCV recorded from the native chicken of northern Kerala was slightly higher than the earlier report of 40 and 31 per cent for mature male and female chicken respectively (Lucas and Jamroz, 1961). They also reported difference in PCV between sexes, which binds with the results of the present study.

The differential count in males of native chicken of Northern Kerala (Table 21) showed that the counts of lymphocytes, heterophils, eosinophils, basophils and monocytes were 59.50, 29.25, 3.00, 2.13 and 4.88 respectively and those of females were 73.88, 16.38, 2.88, 1.75 and 5.25 respectively. The lymphocytes and

heterophils count between sexes showed significant difference. Oslon (1937) reported similar values of differential count for the respective cells in adult male (59.1, 27.2, 1.9, 1.7 and 10.2); whereas, in adult female the values were 64.6, 22.8, 1.9, 1.7 and 9 respectively.

5.14 EGG QUALITY PARAMETERS

The mean egg weight (g) taken from each household during survey (Table16) ranged from 30 to 48.19 with the overall mean of 42.19. The egg weight measured from 100 eggs (Table 22) collected for egg studies ranged from 31.52 to 50.04g and the mean egg weight was found to be 41.81g. The mean egg weight reported in literature was between 40 and 45g in most of the breeds of native chicken of India and other countries (Msoffe *et al*., 2002; Fayaye *et al.*, 2005; Tantia *et al.*, 2005a; Vijh *et al.*, 2005a; Tantia *et al.*, 2005b; Vijh *et al.*, 2005b; Vij *et al.,* 2006b). Nevertheless, higher (Vij *et al.*, 2005; Vij *et al.,* 2006a; Vijh *et al*., 2006) and lower (Tantia *et al*., 2006a) values beyond this range has also been reported in the literature. The lower weight of eggs observed in this study compared to that of commercial origin from improved varieties (Anon. 2009) could be due to genetics and low level of nutrition, in which they are maintained. The lower body weight of females may also be another reason; the positive correlation between these two traits is well established.

The egg length (Table 22) ranged from 40.58 to 59.9 mm with a mean of 51.9 mm. the egg breadth ranged from 33 to 41.2 mm with a mean of 37.95mm. The shape index ranged from 62.64 to 90.39, the mean value being 73.37. The egg length, breadth and egg index of Fulani chicken were reported to be lower than that of present study at 37.91 mm, 23.59mm and 0.62 respectively (Fayaye *et al.* 2005). The shape index of indigenous chicken of Kashmir have a mean value of 0.455 (Iqbal and Pampori, (2008). The shape index of improved varieties like Vanaraja and Gramapriya were reported to be 76.18 and 78.33 respectively (Niranjan *et al.,* 2008)

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The egg albumen weight (Table 22) ranged from 18.73 to 31.86 g with a mean of 24.35 g. The albumen per cent ranged from 51.63 to 64.93, the mean value being 58.23. The result observed in this study was in close conformity with those of indigenous breeds like Danki, Kashmir Favorolla, Punjab Brown, Daothigir and Nicobari (Vij *et al.,* 2005; Tantia *et al*., 2005a; Vij *et al.,* 2006a; Vij *et al.,* 2006b, Vijh *et al.,* 2006).

The average albumen per cent (Table 22 and Fig. 18) recorded in the present study was 58.23 with the range of 51.63 to 64.93. The observed values were slightly higher than those reported in the literature for indigenous breeds like Miri (51), Kashmir Favorolla (51), Kalasthi (51), Ghagus (56), Punjab Brown (52.9) and Ankleshwar (46) (Vijh *et al.,* 2005a; Tantia *et al*., 2005a; Vijh *et al.,* 2005b; Tantia *et al*., 2005b; Vij *et al.,* 2006a; Tantia *et al*., 2006a).

The average albumen index (Table 22) was 4.67 ranging from 2.28 to 10.17. However, the earlier reports on this parameter were of higher magnitude ranging from 5.9 to 8.8 in other indigenous breeds like Danki, Ghagus and Ankleshwar (Vij *et al.,* 2005; Tantia *et al*., 2005b; Tantia *et al*., 2006a).

The yolk weight (Table 22) ranged form 10.14 to 17.5g with a mean value of 13.21. Except those reported in Fulani chicken (13.03) by Fayeye *et al* . (2005) and in Ankleshwar (12.99) by Tantia *et al.* (2006a), the value observed in Tellichery chicken in the present study was lower than those of Danki (16), Kashmir Favorolla (17) and Kalasthi (16.05) (Vij *et al.,* 2005; Tantia *et al*., 2005a; Vijh *et al.,* 2005b).

The yolk per cent (Table 22 and Fig. 18) observed in this study was in the range of 24.78 to 39.28 with an overall mean value of 31.27. The yolk per cent observed in this study was less compared to those of other indigenous breeds like Miri, Punjab brown and Ankleshwar (Vijh *et al.,* 2005a; Vij *et al.,* 2006a; Tantia *et al*., 2006a), which range from 35.30 to 37.00 per cent.

The mean yolk index (Table 22) recorded in Tellichery chicken in this study was 31.89, with the values ranging from 19.77 to 42.35. Except for Danki (27.5), Daothigir (29) and Nicobari (29) birds (Vij *et al.,* 2005; Vij *et al.,* 2006b; Vijh *et al.,* 2006), the yolk index of eggs of Tellichery chicken observed in this study was

lower than those of Kashmir Favorolla (47), Ghagus (38.9), Kalasthi (35) and Ankleshwar (36) breeds of indigenous chicken (Tantia *et al*., 2005a; Tantia *et al*., 2005b; Vijh *et al.,* 2005b; Tantia *et al*., 2006a).

The shell thickness (Table 22) ranged from 0.28 to 0.48 mm, the mean being 0.38mm. A closer value of 0.37 and a slightly higher value of 0.40 have been reported in Kalasthi (Vijh *et al.,* 2005b) and Danki (Vij *et al.,* 2005) birds respectively. This shell thickness recorded in the present study was higher when compared to those of all other Indian *desi* breeds (Vijh *et al.,* 2005a; Tantia *et al*., 2005a; Vij *et al.,* 2006a; Tantia *et al*., 2006a).

The average shell weight (Table 22) recorded in this study was 4.18g with the values ranging from 2.19 to 5.84g. On the other hand, higher values of more than five have been reported in all other breeds of indigenous type (Tantia *et al*., 2005a; Vijh *et al.,* 2005b; Tantia *et al*., 2006a; Vijh *et al.,* 2006)

The shell per cent (Table 22 and Fig.18) ranged from 5.75 to 11.90, the mean being 10.01. The mean values recorded in the literature for different indigenous breeds were higher than the present observation ranging from 11 to 16 (Vijh *et al.,* 2005a; Tantia *et al*., 2005a; Vijh *et al.,* 2005b; Tantia *et al*., 2005b; Vij *et al.,* 2006a; Tantia *et al*., 2006a).

The mean Haugh unit score (Table 22) observed in this study was 64.41 with the values ranging from 34.07 to 80.37. The mean value was almost similar to the values of 66.81 and 68.81 recorded in Danki and Kalasthi birds respectively (Vij *et al*. 2005; Vijh *et al*., 2005b). However, all the other indigenous breeds reportedly had higher values ranging from 70.26 to 83.68 (Vijh *et al.,* 2005a; Tantia *et al*., 2005a; Tantia *et al*., 2005b; Vij *et al.,* 2006a; Tantia *et al*., 2006a).

The egg yolk cholesterol (mg per g) ranged from 12.08 to 16.51, the mean being 14.67. Slightly lower values of egg yolk cholesterol have been reported in the literature among different hybrid layers (Ingr *et al*. (1987) and in a crossbreed (Campo, 1995). However, higher values have also been reported in white Leghorn (16.30) by Campo (1995). As the yolk per cent of the Tellichery chicken observed in this study was lower than those of other indigenous breeds, the cholesterol content per egg would be less in the eggs of Tellichery chicken

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5.15 PROCESSING YIELDS AND LOSSES

The mean live weight of males and females of native chicken of northern Kerala (Table 23) were 1706.94 and 1463.48g respectively; the overall mean being 1585g. The live weight of native chicken observed in this study was lower than that of broilers (1967 kg) reported by Jaturasitha *et al.* (2002). Live body weight, as reported by Kumar and Kumar (2007) of Local hill fowl of Uttarakhand at six months of age for males was 2312.5g which is also very high comparatively.

The mean blood loss per cent of males and females (Table 23) were 4.05 and 4.73 respectively with the overall mean of 4.39. Jaturasitha *et al.* (2002) reported a similar value 4.77 per cent in Thai native chicken; however, the blood loss in broilers reported by them (7.85 per cent) was higher than that of present study.

The mean feather loss per cent (Table 23) of males was 5.81 and that of females was 7.14, the overall mean value being 6.48. Compared to the result of present study, Jaturasitha *et al.* (2002) reported much lower feather per cent in Thai native chicken (2.90) and broilers (4.67). The presence of thick feather covering in native chicken to withstand all adverse conditions, well developed primary and secondary wing feathers for flight and long tail feathers in native chicken could be attributed as reasons for higher feather loss than broilers.

The mean dressed per cent (Table 23) of males was 90.13 and that of females was 88.13, overall mean value being 89.13. The value was found similar when compared with broilers (91.85 per cent) (Balaji, 2008).

The average eviscerated per cent (Table 23) in males (72.24) was significantly higher than that of females (65.94); the overall mean being 69.09 per cent. This was in par with the results in broilers (69.88) reported by Balaji (2008). The low eviscerated per cent in females is due to high liver (3.1vs 2.71) and gizzard (3 vs 1.72) per cent in females and also probably due to high intestine length and high visceral fat content.

The mean R-to-C yield weight (Table 23) of males (1301.29g) was significantly higher than that of females (1043.93g); the mean being 1172.61g.

The R-to-C yield per cent (Table 23) of males was 76.24 and that of females was 70.76, the overall average was found to be 73.50. The per cent mean value between the sexes was found to be significantly different. The value was found similar when compared with broilers (74.01 per cent) (Balaji, 2008).

The giblet weight per cent (Table 23) of males was 5.24 and that of females was 6.82, showing significant difference between them. The overall mean was 6.023. Balaji (2008) reported a lower value of 4.13 per cent in broilers. The hypertrophied gizzard muscles and highly active liver are the reasons for higher giblet weight in females compared to males.

The mean gizzard per cent (Table 23) of males was significantly lower (1.72) than that of females (3), with the overall mean of 2.36 (Fig.17). The females are generally the voracious foragers to meet their requirements for egg production. It also consumes lot of grit materials made of calcium and sand/ silica for meeting their calcium requirement and for effective grinding in the gizzard. This makes the gizzard muscles hypertrophied and therefore weigh more in females. However, the gizzard per cent in the present study was lower than that of Thai native chicken (3.71) and broiler (3.23) reported by Jaturasitha *et al.* (2002) and that of Miri birds (4.90) reported by Vijh *et al.* (2005a). In another study on Ankleshwar birds, Tantia *et al*., (2006a) found that the gizzard was 3.14 per cent but this was on dressed weight, not on ready to cook (R-to-C) weight unlike the present study.

The mean heart per cent (Table23) of males and females were 0.82 and 0.72 respectively, with the overall value of 0.77 (Fig.17). The heart per cent in Miri chicken (0.70) reported by Vijh *et al.* (2005a) was similar to that of Tellichery birds observed in the present study. The heart per cent in Thai native birds and broiler was reported to be 0.44 and 0.56 (Jaturasitha *et al.*, 2002), which is lower than that observed in the present study. A higher heart per cent of 1.12 per cent as a proportion of dressed weight has been reported by Tantia *et al.* (2006a).

The liver weight as a per cent of R-to-C weight (Table 23) in males and females of local Tellichery chicken of northern Kerala were 2.71 and 3.10; the overall mean being 2.90 (Fig.17). The overall value was in close agreement with

those reported in Miri (2.90) and Ankleshwar (2.91) birds (Vijh *et al.*, 2005a; Tantia *et al.*, 2006). The liver weight per cent of Thai Native chicken (2.17) and of broiler (2.11) reported by Jaturasitha *et al.* (2002) was lower than the value observed in Tellichery chicken in this study.

The mean neck weight per cent to R-to-C weight (Table 23) in males (9.37) was significantly higher than that of females (6.64), the overall mean being eight per cent (Fig.17). The difference in carcass conformation between sexes; males being long necked could be the reason for the difference in neck per cent between sexes. Perusal of literature revealed earlier reports of higher overall neck per cent of 10.01 and 10.03 in Thai native chicken and broilers respectively (Jaturasitha *et al.*, 2002) and lower values of 6.4 per cent in Miri birds (Vijh *et al.*, 2005a) and 6.69 per cent in Ankleshwar birds (Tantia *et al*., 2006a).

The mean back weight per cent out of R-to-C weight (Table 23) of females (23.91) was significantly higher than males (19.12 per cent); the overall average being 21.52 (Fig.17). The reason for higher back per cent might be due to the fact that the back bones are well developed in females due to the influence of estrogen hormone; moreover, the bones in females acts as calcium reservoir for the laying hen. The overall back per cent observed in this study was in close conformity with those of earlier reports on Miri (21) and Ankleshwar (20.94) birds (Vijh *et al.*, 2005a; Tantia *et al*., 2006a).

The mean breast per cent in the R-to-C weight (Table 23) of females (24.52) was also significantly higher than males (18.17), the overall average being 21.35 (Fig.17). Earlier studies on Miri (Vijh *et al.*, 2005a) and Ankleshwar (Tantia *et al*., 2006a) showed similar values of 21.5 and 22.76 per cent, respectively.

The mean wing per cent in the R-to-C weight (Table 23) of males (14.14) was significantly higher than females (9.93), the overall mean being 12.03 (Fig.17). The wing per cent observed in the present study was comparable to that reported in broiler (12.21) by Jaturasitha *et al.* (2002) and in a native type chicken, namely, Miri (11.6) by Vijh *et al*. (2005a). On the other hand, a higher value of 14.64 (Jaturasitha *et al.*, 2002) and a lower value of 9.54 (Tantia *et al*.,

2006a) have also been reported in Thai native chicken and Ankleshwar chicken respectively.

The mean leg weight per cent to R-to-C (Table 23 and Fig.17) of male was 33.59, of which, 16.13 was drumstick and 17.46 was thigh. The respective values in females were significantly lower at 27.13, 12.74 and 14.39. Significant difference existed between sexes for leg, drumstick and thigh per cent, with males having higher values than females in all traits. The reason could be that the males being taller with highly set bodies on long legs. The overall mean leg per cent in the population was 30.37, of which, 14.44 and 15.93 were drumstick and thigh respectively. The drumstick per cent was in close agreement of those reported in broiler (Jaturasitha *et al.*, 2002) and Miri (Vijh *et al*., 2005) birds. However, higher values of drumstick per cent have been reported in Thai native chicken (Jaturasitha *et al.*, 2002) and Ankleshwar birds (Tantia *et al*., 2006a) compared to those of present study. However, the thigh per cent of broiler, Thai native chicken, Miri and Ankleshwar birds were similar to that found in this study. (Jaturasitha *et al.,* 2002, Vijh *et al*. 2005a, Tantia *et al*., 2006a).

5.16 ECONOMICS OF NATIVE CHICKEN REARING

A majority (Table 2) of 95.31 per cent of the farmers had opined that the native chicken rearing was profitable. It was found that the eggs are not sold from households where there are children because the eggs are used to meet the nutritional needs of the children. The main advantage of chicken rearing is that the kitchen wastes can be effectively utilized by converting them into nutritional food. The supplementary feed is given by only few farmers and the birds mainly depend on scavenging; thereby, the feed cost is considerably reduced. From the work done by Kugonza *et al.* (2008) in Teso, Uganda, it was reported that the chickens and eggs are mainly used to generate household income and for human consumption. Das *et al.* (2008) studied that free range backyard and scavenging poultry are traditionally reared by rural women and children in Bangladesh. Mcainsh *et al.* (2004) reported that rural poultry production in Zimbabwe is low

output agricultural activity with the minimum resources. These findings stay true with regard to native chicken production of Northern Kerala.

The cost of straight run day-old chick from the home hatches was found to be only Rs 4.94, which is only half to that of commercial birds. The feed cost up to 20 weeks of rearing for the total 150 chicks subjected to the study on economics was only Rs. 292. This was also much lower compared to around Rs. 14,000, if the same number of commercial layer type chicks are grown in intensive system of rearing up to 20 weeks of age. The feed cost during layer stage (21 to 72 weeks) worked out in this study was only Rs 1750, which is also much lower than the feed cost of same number of commercial layers under intensive system. The savings in feed cost is mainly due to the less quantity of feed used, availability of feed grains through public distribution system from govt. at very low prices and availability of kitchen wastes and scavengeable feedstuff in the free range. The native chicken eggs are sold at the rate of Rs. 3 per egg, which is also high compared to the eggs of commercial origin. The male native bird weighing around 1.75 kg costs Rs 300, which is also more than double the price when compared to the cost of broiler of same weight. The net income per bird observed in this study was Rs 561, which is more than four times to that of a commercial layer. However, the limitation in native chicken rearing is less scavenging area and resistance from the neighbours, which limits the flock strength of adult hens to a maximum of around 10 per household. The strength of adult hens maintained is generally between two and five per household, therefore the amount generated from the total flock ranges from Rs.1122 to 2805 per year. The monthly income of around Rs. 150 is being generated from this activity by the housewives with this flock strength. The amount remitted as the weekly installments of savings in the self-help group (*kudumbhasree)* can be totally or partially met from this income.

5.17 CONCLUSION

Eventhough there was a report of existence of a native chicken breed namely Tellichery, as early as 1984 (Acharya and Bhat, 1984), no scientific study was carried out to characterize and evaluate this population. A very few reports published till date regarding the character of this population have not given a complete picture on characters of these birds. Moreover they greatly contradict to each other.

Recently, the National Bureau of Animal Genetic Resources (NBAGR), Karnal, has reported that the Tellichery birds are found mainly in the remote areas of Kozhikode, Kannur and Malappuram districts of Kerala and Mahe district of Puducherry (Vij *et al*., 2007). Therefore the native chicken present in this area ought to belong to the breed Tellichery. The introduction of exotic germ plasm as a part of productivity enhancement by various agencies has occurred only in the recent past, that is, within 15 years.

This study was conducted to throw more light on the characters of this breed. The results revealed that Tellichery breed of chicken has predominantly black plumage with multicolour combinations as reported by Acharya and Bhat (1984), with predominantly white skin, yellow shank, white with red ear lobe and single comb. These birds are light in weight (1445g) producing around 86 eggs up to 60 weeks of age with average egg weight of around 42g. The prominent varieties were found to be solid black, brown, white, barred and laced. However few birds were nonspecific.

The results of the present study called for the need of more detailed studies *in situ* and also refinement of this population in *ex situ.* This population had very unique characters of disease resistance, ability of freight and flight to evade predators, ability to thrive in adverse conditions by scavenging, broodiness and mothering. These characters make them very suitable for low-input poultry farming under village conditions. Efforts must be taken to conserve this germ plasm from extinction. Moreover molecular characterization and genetic similarity / divergence with other Indian and exotic breeds have to be undertaken.

Summary

6. SUMMARY

A study on backyard poultry farming systems and evaluation of native chicken of northern Kerala was carried out among poultry farmers of remote villages in Kozhikode and Kannur districts which is the native tract of Tellichery birds. Data were collected directly on the characters of native chicken, their eggs and meat and indirectly from poultry farmers by personal interview using standard questionnaire.

The main objectives of the study were to document the morphological characteristics of 200 adult native chickens and to record the managemental practices followed by poultry farmers of this region. The study also aimed to evaluate the reproductive and behavioural characters of native chicken as well as the egg quality, egg production, carcass characteristics and haematological parameters of native chicken and economics of poultry rearing.

The salient observations obtained in this study were as follows:

Majority of the households rearing poultry in this area belonged to Thiya community (87.50 per cent) but other communities were also equally involved in poultry keeping. The main occupation of the poultry farmers was agricultural work (23.44 per cent). Majority (53.13 per cent) of them rear poultry along with large animals like cattle and goat, while 43.75 per cent households have poultry rearing as the only animal husbandry activity. A vast majority of the poultry farmers (85.94 per cent) had only less than 50 cents of land. Only 3.13 per cent of poultry farmers had vegetable cultivation, because chicken is considered to be destructive to vegetable and therefore farmers engaged in other cultivation like coconut and plantain kept chicken along with. It was observed that mostly women (89.06 per cent) are responsible for poultry rearing.

Majority of households (89.06 per cent) had more than five years of experience in poultry rearing. Most of the families (73.44 per cent) reproduced their chicken from earlier generations or procured from neighbourhood, while few others had brought their chicken either from neighbouring panchayat or districts and none procured birds from outside the state. Most of the households (68.75 per cent) reared the poultry for both egg and meat and 78.13 per cent farmers did not cull their female birds. Surplus male birds are being culled at the age between seven months to one year by 59.38 per cent of households and are mainly for self use (50 per cent).

The average flock size was 5.37 birds per household and 57.81 per cent of households had not even a single adult male. The male-female ratio in the whole survey area was found to be 1: 4.05

The majority of the coops (63.5 per cent) were placed above the ground level with average height of 1.35 ft. and 77.77 per cent households constructed the coops at a distance between two and ten meters from their houses. Majority of the roofs (33.33 per cent) were of tiles, 61.9 per cent flooring were of wooden and 72.13 per cent coop walls were made of wood. Most of the coops (44.44 per cent) were having a height between 1.6 and 2.0 ft. (average 1.87ft) with 58.73 per cent of farmers were providing a coop area of 0.51 to 1sq. ft. per bird as night shelters. The average coop area per bird was 0.87 sq. ft. The average approximate construction cost of the coop was Rs. 485.83.

Only 45.32 per cent of households provided supplementary feeding for nutritional reasons. The average supplementary feed given per bird was only 13.81g and rice was the main grain used for this purpose (46.88 per cent). Only 59.37 per cent households provide water for their birds and 40.63 per cent used either coconut shell or steel plates as waterers.

The nest boxes used for natural incubation were mostly of cut open plastic cans (21.88 per cent) while 23.43 per cent of households did not use nest box for setting the eggs. The most common nest material was sand (51.56 per cent) and an average number of 10.41 eggs were set per setting. The hatchability per cent on TES was 63.12 and that on FES was 84.29.

The mean flight height and flight distance of native chicken were 4m and 13.29m respectively. The mean radius of territory the birds cover was found to be 121.51m. The broody hens showed good mothering ability indicated by an overall mean chick survivability of 64.98 per cent at one month of age.

The most common diseases encountered by the farmers were respiratory disease (25 per cent), Ranikhet disease (23.44 per cent) and fowl pox (12.5 per cent). The majority of the farmers (40.63 per cent) opined that the occurrence was more in summer season and 90.63 per cent of them did not practice any disease control measures. Indigenous methods of treatment by using *tulsi* leaves, bulb of garlic, tuber of turmeric etc. are being adopted by 31.25 per cent of farmers.

The mortality per cent in chick stage was 28.63 of which 92.31 per cent of death was due to predators, while, in grower stage the mortality per cent was 21.60 with 80 per cent death due to predators. But in adult stage, up to one year of age the mortality per cent was 45.28; among which, 52.17 per cent was due to diseases and only 47.83 per cent was due to predators.

Regarding the plumage colour and pattern, the most prevalent plumage colour in case of males was red (47.22) and of females was black (40.85). In case of primary plumage pattern, in males, the most common one was wild type (61.11 per cent) and in females it was wheaten (32.93) and solid black (24.39 per cent). The examination for secondary plumage pattern showed that 91.67 per cent in males and 61.58 per cent in females were non specific. A total of 17.07 per cent females showed stippling and 10.98 per cent showed single lacing.

Among the qualitative characters, the most prevalent ones with respect to skin colour was white (61.5 per cent), shank colour was yellow (51.5 per cent), ear lobe colour was reddish yellow (51 per cent), comb colour was red (87 per cent), wattle colour was red (90 per cent), and beak colour was yellow (38.5 per cent). The most common comb type was single (97.5 per cent), the remaining being pea. The comb position was erect (59.5 per cent) or floppy (40.5 per cent).

The morphometric characters measured were shank, beak and spur lengths and body weight and the average values for males were 93.91mm, 32.04mm, 4.37mm and 1659.71g and for females the values were 79.64mm, 29.95mm,0.32mm and 1400.32g respectively and the values differ significantly ($P \leq 0.01$) between sexes.

The average age at first egg from survey on household basis was 6.45 months, from individual birds it was 177.60 days and from actual egg recording study it was 199.26 days. The present study revealed that broodiness is a behavioural character found in almost entire population (98.1 per cent). The average length of broodiness (days) measured indirectly by survey method was 27.9 days and directly from field egg recording study was 22.38. Survey on clutch size showed a mean value of 7.67 eggs. The number of clutches in a laying cycle recorded from survey showed a mean value of 3.48, while that of direct egg recording study was 2.13 clutches. The mean egg production in a laying cycle on survey study was found to be 15.5 eggs, while in field egg recording study it was

14.32 eggs. The total egg production up to 40 weeks of age on hen day and hen housed basis were 34.59 and 33.06 eggs and up to 60 weeks of age, the values were 86.12 and 70.33 eggs respectively. The egg shell colour was light brown in majority (73.40 per cent) of the eggs.

The egg quality parameters studied were egg weight (g), egg length (mm), egg breadth (mm), shape index, albumen weight (g), albumen per cent, albumen index, yolk weight (g), yolk per cent, yolk index, shell thickness (mm), shell weight (g), shell per cent, Haugh unit score and yolk cholesterol (mg per g), the mean values being 41.81, 51.90, 37.95, 73.37, 24.35, 58.23, 4.67, 13.21, 31.72, 31.89, 0.38, 4.18, 10.01, 64.41 and 14.67 respectively.

The processing yields and losses estimated were live weight (g), blood per cent, feather per cent, dressed per cent, eviscerated per cent, R-to-C weight (g), R-to-C per cent, giblet per cent, gizzard per cent, heart per cent, liver per cent, neck per cent, back per cent, breast per cent, wing per cent, leg per cent, drumstick per cent and thigh per cent; the values for males were 1706.94, 4.05, 5.81, 90.13, 72.24, 1301.29, 76.24, 5.24, 1.72, 0.82, 2.71, 9.37, 19.12, 18.17, 14.14, 33.59, 16.13 and 17.46 respectively and for females the values were 1463.48, 4.73, 7.14, 88.13, 65.94, 1043.93, 70.76, 6.82, 3.00, 0.72, 3.10, 6.64, 23.91, 24.52, 9.93, 27.13, 12.74 and 14.39 respectively. The corresponding overall mean values were 1585.21, 4.39, 6.48, 89.13, 69.09, 1172.61, 73.50, 6.03, 2.36, 0.77, 2.90, 8.00, 21.51, 21.35, 12.03, 30.36, 14.44 and 15.93 respectively.

The haematological parameters estimated were erythrocyte count, haemoglobin (g per cent), packed cell volume (per cent), lymphocytes per cent, heterophils per cent, monocytes per cent, eosinophils per cent and basophils per cent; the values for males the values were 3.43×10^6, 12.70, 42.95, 59.50, 29.25, 4.88, 3.00 and 2.13 and for the females the corresponding values were 2.78×10^6, 9.91, 34.81, 73.88, 16.38, 5.25, 2.88 and 1.75; the overall values being 3.11, 11.31, 36.88, 66.69, 23.44, 5.06, 2.94 and 1.94 respectively.

Regarding the economics of native chicken rearing, the majority of the households (95.31 per cent) opined that the native poultry rearing was profitable and on analysis it was found that they got a return of Rs. 561.02 per adult hen when reared up to 72 weeks of age.

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EVALUATION OF NATIVE CHICKEN OF NORTHERN KERALA

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ABSTRACT

A study on morphological, reproductive and behavioural characteristics of native chicken, the management practices followed by poultry farmers, as well as the egg quality, egg production, carcass characteristics, haematological parameters of native chicken and economics of poultry rearing were carried out in remote villages of Kozhikode and Kannur districts which is the native tract of Tellichery breed of chicken, covering 64 households and 342 birds, which included 200 adult chicken in which the morphological study was also conducted.

The birds were reared by Thiya community and others with the women taking the responsibility and 89 per cent of the households had more than five years of experience in poultry rearing. The birds were produced by their own or procured from neighbourhood or nearby districts and almost all the birds were having broodiness character. The birds also had a mean flight height, flight distance and territory radius of 4m, 13.29m and 121.51m respectively. The farmers provide coops for providing night shelter and during day time the birds are let free for scavenging. Only 45.32 per cent households provided supplementary feeding and rice was the major feed with an average of 13.81g per bird per day. The majority of coops were made of wood with tiled roofs and the average floor area given per bird by the farmers was found to be 0.87 sq. ft. The average cost per coop was Rs. 485.85. Majority of the households (76.66 per cent) provided nest boxes for incubation with sand as the main nest material and an average of number of eggs incubated per setting was 10.41.

The most common diseases encountered by the farmers were respiratory ailments (25 per cent), Ranikhet disease (23.44 per cent) and fowl pox (12.50 per cent) and the disease occurrence was more in summer season. No disease control measures were being practiced. The mortality per cent in chick, grower and adult up to one year was 28.63, 21.60 and 45.28 respectively and the death due to predators in these stages was 92.31, 80.00 and 47.83 per cent respectively. A high mortality per cent of 52.17 was due to diseases in adult stage.

The most prevalent plumage colour in case of males was red (47.22 per cent) and that of females was black (40.85 per cent). In case of primary plumage pattern, in males the most common one was wild type (61.11 per cent) and in female it was wheaten (32.93 per cent) and solid black (24.39 per cent). Among specific secondary plumage patterns in females, 17.07 per cent showed stippling and 10.98 per cent showed single lacing. Among the qualitative characters, the most prevalent skin colour was white (61.5 per cent), shank colour was yellow (51.5 per

cent), ear lobe colour was reddish yellow (51 per cent), comb colour was red (87 per cent), wattle colour was red (90 per cent) and beak colour was yellow (38.5 per cent). The most common comb type was single (97.5 per cent) and comb position was erect (59.5 per cent). The morphometric characters measured were shank, beak and spur lengths and body weight and the overall average values were 82.14mm, 30.38mm, 1.03mm and 1445.7g.

The average age at first egg from survey was 177.60 days and from actual egg recording study it was 199.26 days. The average length of broodiness (days) measured indirectly by survey method revealed value of 27.9 days and that recorded directly from egg recording study was 22.38. Survey on clutch size showed a mean value of 7.67 eggs and the mean number of clutches in a laying cycle was 3.48, the respective values in direct egg recording study were 7.27 eggs and 2.13 clutches. The mean egg production in a laying cycle from survey study was found to be 15.5 while that from field egg recording study was 14.32 eggs. The total egg production up to 40 weeks of age on hen day and hen housed basis were 34.59 and 33.06 eggs and up to 60 weeks of age, the values were 86.12 and 70.33 eggs respectively. The egg shell colour was light brown in 73.4 per cent of eggs.

The egg quality parameters evaluated were egg weight (g), egg length (mm), egg breadth (mm), shape index, albumen weight (g), albumen percent, albumen index, yolk weight (g), yolk percent, yolk index, shell thickness (mm), shell weight (g), shell percent, Haugh unit score and yolk cholesterol (mg per g), the mean values being 41.81, 51.90, 37.95, 73.37, 24.35, 58.23, 4.67, 13.21, 31.72, 31.89, 0.38, 4.18, 10.01, 64.41 and 14.67 respectively.

The processing yields and losses were estimated in terms of live weight (g), percentages of blood, feather, dressed carcass and eviscerated carcass, R-to-C weight (g) and percentages of R-to-C, giblet, gizzard, heart, liver, neck, back, breast, wing, leg, drumstick and thigh, the overall mean being 1585.21, 4.39, 6.48, 89.13, 69.09, 1172.61, 73.50, 6.03, 2.36, 0.77, 2.90, 8.00, 21.51, 21.35, 12.03, 30.36, 14.44 and 15.93 respectively.

The overall haematological parameters for erythrocyte count, haemoglobin (g per cent), packed cell volume (per cent), lymphocytes per cent, heterophils per cent, monocytes per cent, eosinophils per cent and basophils per cent were 3.11, 11.31, 36.88, 66.69, 23.44, 5.06, 2.94 and 1.94 respectively.

On analysis of the economics of native chicken rearing it was found that the poultry farmers got a return of Rs. 561.02 per adult hen when reared up to 72 weeks of age.