PERFORMANCE OF 'GRAMALAKSHMI' AND 'GRAMASREE' CHICKEN LAYERS UNDER BACKYARD SYSTEM

B. AJITH BABU

Thesis submitted in partial fulfilment of the requirement for the degree of

Master of Veterinary Science

Faculty of Veterinary and Animal Sciences
Kerala Agricultural University, Thrissur

2010

Department of Poultry Science
COLLEGE OF VETERINARY AND ANIMAL SCIENCES
MANNUTHY, THRISSUR-680651
KERALA, INDIA

DECLARATION

I hereby declare that the thesis entitled **"PERFORMANCE OF 'GRAMALAKSHMI' AND 'GRAMASREE' CHICKEN LAYERS UNDER BACKYARD SYSTEM"** 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.

Mannuthy
19.04.10

B. AJITH BABU

CERTIFICATE

Certified that the thesis entitled "**PERFORMANCE OF 'GRAMALAKSHMI' AND 'GRAMASREE' CHICKEN LAYERS UNDER BACKYARD SYSTEM**" is a record of research work done independently by **B. Ajith Babu,** 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.

Mannuthy

19.04.10

19.4.2010

Dr. P. A.Peethambaran
(Chairman, Advisory Committee)
Professor and Head,
CAS in Poultry Science,
College of Veterinary and Animal Sciences,
Mannuthy, Thrissur

CERTIFICATE

We, the undersigned members of the Advisory Committee of **B. Ajith Babu,** a candidate for the degree of Master of Veterinary Science in Poultry Science, agree that this thesis entitled **"PERFORMANCE OF 'GRAMALAKSHMI' AND 'GRAMASREE' CHICKEN LAYERS UNDER BACKYARD SYSTEM"** may be submitted by **B. Ajith Babu,** in partial fulfillment of the requirement for the degree.

19.4.2010

Dr. P. A.Peethambaran
(Chairman, Advisory Committee)
Professor and Head
CAS in Poultry Science,
College of Veterinary and Animal Sciences,
Mannuthy, Thrissur

19-04-10

Dr. A. Jalaludeen,
Professor and head,
Department of Poultry Science,
College of Veterinary and
Animal Sciences, Pookot, Wayanad.
(Member)

Dr. Leo Joseph,
Professor and Head,
University Poultry Farm,
College of Veterinary and Animal Sciences,
Mannuthy - 680 651.
(Member)

Dr.V. Ramnath
Associate Professor,
Department of Veterinary Physiology,
College of Veterinary and Animal Sciences,
Mannuthy - 680 651.
(Member)

28/6/10

External Examiner
(S.T. SELVAN)
ASSOCIATE PROFESSOR
INCHARGE OSTRICH RESEARCH UNIT
LIVESTOCK RESEARCH STATION
KATTUPAKKAM-603 203.
KANCHEEPURAM DISTRICT

ACKNOWLEDGEMENTS

In the first place I would like to record my gratitude to the Chairman of the Advisory Committee ***Dr. P.A.Peethambaran,*** *Professor and Head, Centre for Advanced Studies in Poultry Science, College of Veterinary and Animal Sciences, Mannuthy for his supervision, advice, and guidance from the very early stage of this research. He always enlightened me by providing simple but accurate solutions for the problems which I faced during the period. Above all and the most needed, he extended unflinching encouragement and support in various ways even by keeping aside his personal matters. His scientist intuition has made him as a constant oasis of ideas and passions in science, which exceptionally inspire and enrich my growth as a student and a researcher want to be. I am indebted to him more than he knows.*

I am extremely thankful to ***Dr. A. Jalaludeen,*** *Professor and Head, Department of Poultry Science, College of Veterinary and Animal Sciences, Pookot and member of advisory committee, for his wholehearted support, valuable advice and the consideration rendered throughout the course of my study.*

I place my profound gratitude to ***Dr. Leo Joseph,*** *Professor and Head, University Poultry Farm, College of Veterinary and Animal Sciences, Mannuthy, for his inspiring advices, pleasant co-operation and affection given to me for the completion of my work.*

I would like to thank ***Dr. V.Ramnath,*** *Associate Professor, Department of Veterinary Physiology, College of Veterinary and Animal Sciences, Mannuthy and member of the advisory committee for his keen interest, supervision of the work and valuable suggestions accorded throughout my postgraduate study.*

I extend my heartfelt thanks to ***Dr. K. Narayanankutty,*** *Senior Scientist, AICRP on Poultry for eggs, College of Veterinary and Animal Sciences, Mannuthy,* ***Dr. P. Anitha,*** *Associate Professor, Centre for Advanced Studies in Poultry Science and* ***Dr. R. Richard Churchil,*** *Assistant Professor, AICRP on poultry for eggs for their personal attention, keen interest and affectionate encouragement throughout the tenure of the study.*

As such, it is imperative to thank ***Dr.K.Karthiayini,*** *Associate Professor,* ***Dr. D. Anish, Dr. C Binoj Chacko*** *and* ***Dr. Deepa Menon*** *(Assistant Professors), College of Veterinary and Animal Sciences, Mannuthy for their meticulous concern and valuable suggestions.*

*I sincerely acknowledge the help rendered by **Dr. E. Nanu,** Dean i/c, Faculty of Veterinary and Animal Sciences, Mannuthy, for providing me the facilities for my research work.*

*I sincerely thank **Dr. V.K.P.Mohan kumar,** Senior Veterinary Surgeon, Vattamkulam, **Dr. Jinu. K. Joy,** Hatchery Manager, R.F.H. and **Sri. T. Jayan,** Live stock inspector, Vattamkulam for their unlimited support for the field study. I thank the authorities of Panchayath and 'Kudumbasree' units and the poultry farmers of Vattamkulam for their whole hearted support in the successful completion of the field study in Vattamkulam Panchayath.*

*I am in short of words to express my deep sense of gratitude to my great friends **Drs. Padwal Navnath Popat, Girish kumar, S. Sheeja, Stella cyriac, K.V.Sabna, Saritha Thankachan** and **Sabitha Antony** who were always supporting me and without whom I could not successfully complete my research work.*

*I am also thankful to the non- teaching staff of Centre for Advanced Studies in Poultry Science, Revolving Fund Hatchery, University Poultry Farm, Central laboratory and, especially, **Sri. Raffi, Sri. Ashraf, Smt. Ramadevi, Smt. Rajani** and **Miss Deepthi** for the love and co-operation rendered to me during my study.*

*I am thankful to **Government of Kerala** and the authorities of **Animal Husbandry Department** for deputing me for the M.V.Sc course.*

*I am so glad and proud to say that the present research work had been selected for the reputed award of Dr. B. V. Rao M.V.Sc research grants, 2008-2009 by the internationally well known **Dr. B.V. Rao Poultry Research Foundation, Pune,** which enabled us to accomplish the research works efficiently. With great pleasure and gratitude I express my sincere courtesy to the authorities of the foundation for selecting me for the scholarship.*

*No phrase or words in any language can ever express my deep sense of love and gratitude to my beloved **father, mother, wife, children, relatives** and all my **friends** for being always with me through thick and thin.*

*Above all, I bow my head before **God The Almighty,** for the blessings showered on me... for all the things I have and I don't... for helping me to reach the shore safely... through the love and prayers of my family, friends and teachers.*

Dr. B.Ajith Babu

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

1. INTRODUCTION

Poultry sector is a fast growing and most flexible enterprise among the livestock throughout the world. The major structural changes which occurred in poultry production and marketing in the past two decades have driven the consumer to opt for chicken egg and meat as a cheap source of animal protein. As a result, a strong and internationally integrated poultry industry has evolved utilizing the economies of scale and advanced technology in poultry production. But, in developing countries, majority of the poultry are still kept by small holders in rural village households in less intensive systems. In the 'family poultry' production system, the small flock of chicken serves as a safe means to acquire asset and to move out of poverty.

According to Mehta and Nambiar (2007), Indian Poultry Industry produces 45.2 billion eggs and 1.7 million tonnes of poultry meat per year. It is estimated that the annual per capita consumption of eggs was 48 and that of poultry meat was 1.73 kg per person in the year 2005.

In Kerala, even though the demand of poultry egg and meat as a source of low cost protein is more, the intensive system of poultry production on commercial basis is not common. The factors like high population density, hot and humid climatic conditions and the higher cost of inputs pose challenges to the commercial production. In this situation, poultry production under backyard system of rearing in rural households utilizing the naturally available feed resources is of social and economic significance. The low input technology of rural poultry production has vast potential in our State in relation with the food security programme. The homestead eco-system in our state varies widely and the seasonal variations pose threats in certain regions.

It is reported in the livestock census report (2005) that the total population of fowls in Kerala was 109.92 lakhs consisting of 77.36 lakhs desi fowls and 32,56 lakhs improved fowls. The district wise fowl population was the highest in Malappuram district (14.44 lakhs) with 11.99 lakhs Desi fowls and 2.45 lakhs improved varieties of fowls (Anon, 2005). The Government provides financial support to various poultry production and welfare schemes every year and it is implemented by the technical support from Department of Animal Husbandry. From the census report it is evident that the poultry population in Kerala consists mainly of desi birds with low production potential in terms of egg and meat. In order to tap the maximum yield, Kerala Agricultural University Poultry Farm has evolved two cross bred layers for the backyards, viz., 'Gramalakshmi' and 'Gramasree'. A comprehensive study on the production performance, management practices and cost effectiveness of these hens under backyard system is lacking. In addition, the impacts of rearing homestead chicken, in terms of production and welfare has to be evaluated by using modern tools of cost benefit analysis.

Thus a study was planned to evaluate the 'Gramalakshmi' and 'Gramasree' hens distributed to the beneficiaries under a 'backyard chicken rearing' scheme financed by Department of Animal Husbandry, Govt. of Kerala in Vattamkulam panchayath of Malappuram district. The objectives of the present study are

1. To evaluate the management practices, health status, production performance and livability of Gramalakshmi and Gramasree hens and
2. To estimate the costs and returns from 'Gramalakshmi' and 'Gramasree' chicken layers under backyard system of rearing.

2. REVIEW OF LITERATURE

2.1 History of poultry domestication

India and the neighbouring countries have been referred to as the original home tract of Red Jungle fowl *(Gallus gallus*). It is reported that Aseel or Malay fowl have given rise to all the present-day breeds of chicken. Recent archaeological discoveries in China indicate that chicken had been domesticated as early as 5400 B.C. Chicken from the Harappan culture of the Indus valley (2500 to 2100 B.C.) may have been the main source of diffusion to the other parts of the world (Crawford, 1990). There is substantial evidence to show that these genotypes 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), the distinct local breeds of chicken in Africa are not specific breeds but are just phenotypic descriptions. It has been estimated that more than 80 per cent of the global poultry population occurs in traditional family-based production systems and that contribute about 90 per cent of the total poultry products in many countries (Mack *et al.*, 2005).

2.2 Backyard system of rearing chicken

Anon (2005) reported that the total population of fowls in Kerala was 109.92 lakhs consisting of 77.36 lakhs desi fowls and 32.56 lakhs improved fowls during the year 2003. The district-wise fowl population was the highest in Malappuram district (14.44 lakhs) with 11.99 lakhs Desi fowls and 2.45 lakhs improved varieties of fowls.

According to Mehta and Nambiar (2007), Indian Poultry Industry produces 45.2 billion eggs and 1.7 million Tonnes of poultry meat per year. It is estimated that the annual per capita consumption of eggs is 48 and that of poultry meat is 1.73 kg per person in the year 2005.

Sonaiya (2007) stated that family poultry generates 19.50 per cent of rural family income, makes up 77 per cent of natural flock and contribute 98% of poultry products consumed in the villages of the developing African countries.

Aklilu *et al.* (2008) reported that rural poultry significantly contributed to the livelihood of poor households economically as starter capital, as a means to recover from disasters, as an accessible protein source and for disposable income and for exchange purposes and socio-culturally for mystical functions, hospitality and exchange of gifts to strengthen social relationships.

2.3 Rearing practices in backyard poultry

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.

Mcainsh *et al.* (2004) stated that the reasons given by the farmers of Zimbabwe for keeping chicken was meat, cash, manure and eggs in descending order of importance and the biggest problem in village chicken production as perceived by farmers of Zimbabwe was losses through mortality especially caused by predation and diseases. They also reported that 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.

Vijh *et al.* (2005) documented that Indian Miri birds are being reared under backyard farming, freed during day time and looked after by lady members of the family and are primarily used for meat and egg purposes. Also the tribes use these birds invariably in their social and religious rituals.

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 and these birds are mainly used for egg purpose, producing the highest number of eggs among all the indigenous breeds of India under free range condition with supplementary feeding.

Kumar and Kumar (2007) documented that Local Hill Fowls of Uttarakhand were used for both egg and meat production and also for cultural and religious purposes and majority of the poultry keepers followed confinement housing and graze them in open to fulfill their body requirements and to minimize the feeding cost.

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

2.4 Socioeconomic status of poultry farmers

Mcainsh *et al.* (2004) documented that most often a mixed crop livestock farming system is being practiced by the farmers of Zimbabwe. Regarding the ownership of the birds they 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 in chicken rearing 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 chicken in developing countries. Furthermore, chicken are mainly owned and managed by women in households.

According to Vijh *et al.* (2005), 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.

Halima *et al.* (2007) found that 74. 16 % of the poultry farmers in north-west Ethiopia were females and mostly the women, 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 chicken as the main source of their income under intensive system. Whereas, 77 per cent of owners were raising chicken as a secondary economical activity of which, eight per cent were farmers, 23 per cent were government employees and 46 per cent were merchants.

Das *et al.* (2008) reported that a household flock in Bangladesh usually comprised 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.

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 70 per cent of overall care-taking and feeding of chicken, cleaning of birds-quarter (coops), treating of sick birds and decision for selling of poultry products were the responsibility of women.

Girishkumar (2009) reported that the classification based on occupation of the family revealed that the main occupations were agricultural workers, coolies, small scale businessmen, agriculturists, masons, drivers, teachers, welders, persons employed abroad and tailors and 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 respectively. Four of the farmers (6.25 per cent) did not have any occupation. Study on the family member actively engaged in poultry rearing in each household revealed that, 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. According to him 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. According to him 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.

2.5 Land holding and Flock size

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.

Vijh *et al.* (2005) 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.

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 per cent) of farmers were not satisfied with their present stock of birds (Gupta *et al.*, 2006).

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

Vij *et al.* (2006) studied Punjab brown chicken reared in the backyard system and observed that the average flock size reported in the study was 8.7.

According to Kumar and Kumar (2007), all the poultry farmers rearing Local Hill Fowls of Uttarakhand had small size flocks and the average flock size per household was 7.55 birds.

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.

Das *et al.* (2008), observed that 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.

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

Girishkumar (2009) in his study on native chicken of northern Kerala recorded that that the classification of the poultry farmers based on the land holdings showed that out of 64 households , 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 study on the flock size revealed that the number of adult females (above 20 weeks) per household ranged from zero to seven and the average number of hens per family was 2.02±0.16 in Kozhikode and it was 4.05±0.37 in Kannur district.

2.6 Housing management

Panda and Mohapatra(1989) reported that floor area of two sq. ft. is normally given for adult layer type chicken under intensive deep litter system.

According to Mcainsh *et al.* (2004), local chicken of Zimbabwe are being confined in coops mainly made from locally available materials like wooden poles and branches or bricks with one or more sides with wire mesh doors. The roof is often thatched, but iron sheets, asbestos sheets and canvas roofing are also 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 height. 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. Also most of the farmers (8 out of 10) provided their chicken with nests.

Tauson (2005) observed that the vast majority of layers in the world are still kept in conventional cages although they are likely to be banned in most of Europian countries in 2012 according to the EU directive .

The Miri birds are being provided housing only during night in the form of cages made up of cane and bamboo but during laying period they are kept in cages with paddy straw bedding called "Pekang" (Vijh *et al.*, 2005).

Vij *et al.* (2006) observed that the shelter provided to Punjab brown chicken reared in the backyard system was made up of mud and wood.

Vijh *et al.* (2006) observed that housing for Nicobari birds is being provided only at night and the houses are being made up of low cost local materials. In some cases the birds stayed on trees during night. These birds are provided with bamboo basket in the corners of the house for egg laying.

Halima *et al.* (2007) 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 chicken (50. 77 per cent).

Kumar and Kumar (2007) documented that the farmers in hilly areas 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. The chicks were being protected from predators by keeping them inside the basket made by local material such as bamboo and splinters of *Sahtoot*. 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 the 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.

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).

Girishkumar (2009) reported that 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 providing a coop area of 0.51 to 1sq. ft. per bird as night shelters. The average approximate construction cost of the coop was Rs. 485.83. Out of the 64 households 12.70 per cent of the coops had floor area (sq.ft.) 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. He also reported that majority of the farmers did not provide any nests , some provide wooden crates (tomato boxes) spread with paddy straw, some of the farmers confine the birds under bamboo baskets when they are in search of safe places for laying their eggs. According to him seven coops (0.11 per cent) were provided with perches which enables the farmers to accommodate more number of birds in a given floor space and in two wooden coops (3.17 per cent), litter material was spread on the floor over a plastic sack.

2.7 Feeding and watering practices

Jayanthy (1992) recorded the mean daily feed consumption of 106.61 and 104.95 g in Desi x New Rock and Desi x Austro-White crosses respectively during 21-40 weeks of age.

Tadelle (1996) reported that non supplemented local birds in Ethiopia showed a hen day production of 14 per cent but the production increased to 30 per cent by supplementation of a combination of 15g maize and 15g Noug (Guzotia abssinica) cake / bird / day in the short rainy and dry seasons. He stated that supplementation of the feed for local birds, with protein and energy nutrient sources had given sufficient improvements in egg production.

Sridharan (1998) reported that the overall mean daily feed intake in Austra

white and Rhode-white hens for the period from 20 to 44 weeks of age in deep litter system was 113.2g and 113.66g.

According to Tadelle et al. (2002) the crop contents of scavenging local hens of Ethiopia included seeds, plants, worms, insects and other items averaging 30.9 ± 7.9, 23.3 ± 6.0, 6.7 ± 4.5, 11.1 ± 4.5 and 23.9 ± 4.6 (g) respectively on per cent fresh basis.

Mcainsh *et al.* (2004) found that in addition to the scavenging feed resource base, farmers of Zimbabwe provided chicken 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. He also found 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 chicken with drinkers, but only few farmers (3 out of 10) provided water *ad libitum.*

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

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.

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.

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

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. He observed that watering of these birds 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.

As per the observations of Vij *et al.* (2007), Tellichery chicken in Kerala roam and eat whatever available in the form of grains, seeds, vegetation, and insects but no commercial poultry feed is being fed to these birds.

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

The scavengeable feedstuffs consumed by native chicken of Bangladesh varied from 9 to 27 g per bird per day (Das *et al.*, 2008). 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 (Das *et al.*, 2008).

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

Girishkumar (2009) in his study on native chicken of northern Kerala reported that 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 as supplemental feed. According to him the mean values of quantity of feed per day per bird among all the households in two districts were 17.36±2.68 and 7.06±2.09g in Kozhikode and Kannur districts respectively, the overall mean being 13.81±2.00g. His 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.

2.8 Behavioral characters

Alders and Spradbrow (2001) reported that village chicken have more adaptability than commercial chicken due to their good flight skills, their ability to escape from predators and their ability to scavenge own food.

Fiks-vanNiekerk (2001), reported that cannibalism and feather pecking are the major problems in Dutch organic farming mainly because beak trimming is not allowed in this production.

Vande and Elson (2006) studied the effect of rearing conditions on injurious feather pecking and concluded that stocking density and feeding strategies during rearing period influenced feather pecking.

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.

According to Kumar and Kumar (2007), flocks of Local Hill Fowls of Uttarakhand produce more sound 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.

Iqbal and Pampori (2008) reported lower broody period of 12 to15 days in indigenous chicken of Kashmir. The common practices followed by the local people to interrupt the broodiness and to expedite the resumption of the next cycle 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 the nostrils.

Semmaran *et al.*(2008) collected data from 120 farmers in Mysore and Mandya districts of Karnataka state and analyzed the adoption behaviour of Giriraja ,a

coloured backyard poultry of Karnataka state and found that adoption was medium to high with significant increase in flock size.

According to Girishkumar (2009), the mean flight height, flight distance and territory radius of local chicken of Kozhikode and Kannur districts were 3.58±0.14m and 4.74±0.23m, 12.85±1.26 and 14.05±0.83m and 139.39±11.46 and 89.47±11.20m respectively.

2.9 Health care and bio security measures

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

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. He also reported that none of the farmers of Zimbabwe vaccinated their chicken.

Tauson (2005) observed that disease levels regarding endo parasitic infestations are greatly affected by the hygienic conditions and thus, access to litter or free range implies a higher potential to these diseases.

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

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.

Vijh *et al.* (2006) stated that 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.

Kumar and Kumar (2007) found that 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.

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

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 the 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. They also found that the losses due to mortality in Indigenous chicken of Kashmir because of little health care were reduced in backyard scavenging system.

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).

Girishkumar (2009) reported that the important disease conditions in scavenging native chicken were 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). He (2009) also reported that 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.

According to Guerne et al. (2009), in villages it will be important to develop a community based approach because, in situations where poultry are free ranging, their protection depends as much as the actions of the keeper's neighbours as of the keepers themselves. They also opined that housing of backyard poultry for biosecurity seemed ignored because, housing birds would change the system from a low input / low output scavenging system to one dependant on constant inputs of feed and a higher labour cost.

2.10 Body Weight

Radhakrishnan and Ramakrishnan (1982) recorded body weight of ALP x WL as 1142g and in RIRxWL as 1134 g at 20 weeks of age where as 1570 and 1472 g at 40 weeks of age in the crosses respectively under backyard system of rearing .

Khan and Krishna (1983) found that the body weight at 20 weeks of age was 1390g in WL , 1530g in RIR and 1450g in the cross between RIR x WL.

The mean body weight at 20 weeks of age observed by Jayanthy (1992) for Desi x Austra White cross was 1007.29g and the body weight at 40 weeks of age was 1445.36g.

Beena (1995) stated that the body weight was 944.05g at 20 weeks of age and 1346.67g at 40 weeks of age in 'F' strain of White Leghorn.

Sridharan (1998) recorded that the overall mean body weight in Austra-white and Rhode-white reared on deep litter system at 20 week age was 1181.5 ± 9.15g and 1178±8.91g which were comparable and that at 44 weeks age was 1477.45g and 1539.79g and the latter was significantly higher.

Singh *et al.* (1999) reported that the average body weight of naked neck layers was 1152.13 g and that of Dahlem red layers was 1285.52 g at 20 weeks of age.

Leo *et al.* (2006a and 2006b) found that the average body weight of Gramalakshmi hens at the age of 20 week is 1200 g. and that in Gramasree is 1500 g.

Vij *et al.* (2006) studied Punjab brown chicken reared in the backyard system and found that the mean body weight was 1.57 kg in hens.

Mohan *et al.* (2008a) studied the production performance characteristics of 60 Aseel peela desi hens of same hatch under normal system of rearing and observed the mean body weight as 2120±55g.

Singh and Kumar (2008) conducted a study on 160 pullets of native fowl of Garhwal Himalayas and found the average body weight at sexual maturity was 1396.5±19.20g.

Doley *et al.* (2009) conducted a study on 648 numbers 8th week old male and female chicks of indigenous chicken of North-Eastern region of India, about the production performance under intensive, semi-intensive and extensive rearing systems. The body weight (g) at age at sexual maturity was found to be 1215.76±9.2, 1068.68±7.94 and 1077±9.24 under intensive, semi-intensive and extensive rearing systems respectively.

2.11 Age at first egg

Radhakrishnan and Ramakrishnan (1982) observed the overall mean age at first egg of ALP x WL as 161days and that of RIRxWL as 161.2 days under backyard system of rearing . They also found that the age at 50 per cent production averaged 171 and 177.2 days for ALP x WL and RIR x WL respectively in an experiment with White Leghorn, Black Australorp,Rhode Island Red and their reciprocal breed crosses under backyard conditions.

Khan and Krishna (1983) concluded that the age at sexual maturity averaged 174, 196 and 188 days in White Leghorn, Rhode Island Red and Rhode- White hens (RW) respectively.

Nair and Bhattacharyya (1984) observed that the age at first egg averaged 147.6 days in ALP x WL crossbred hens under backyard system.

Sridharan (1998) reported that the age at first egg averaged 161.63 ± 1.20days in Austra-white and 159.75 ±1.63 days in Rhode-white under deep litter system of rearing. The mean age at 10 per cent production was 166.25 days in AW and 163.00 days in RW with the range of values from 161 to 169 days in AW and 158 to 169 days in RW. The overall mean age at 50 per cent production was 179.13 days in AW and 176.75 days in RW with a variation from 172 to 184 days in AW and 175 to 180 days in RW.

Leo *et al.* (2006a and 2006b) observbed that the average age at first egg of Gramalakshmi hens is 160 days and that of Gramasree hens is 159 days.

Vij *et al.* (2006) studied Punjab brown chicken reared in the backyard system wherein the age at sexual maturity was found to be about five to six months of age.

Yousef and Al-Yousef (2007) studied the distribution and characteristics of the local (baladi) chickens of Saudi Arabia. They concluded that these birds were small in size and the average age at sexual maturity was 22.76 weeks and continued laying for 78.9 weeks producing 170 eggs.

Singh and Kumar (2008) conducted a study on 160 pullets of native fowl of Garhwal Himalayas and found the average age at sexual maturity to be 176.20±2.76 days.

Girishkumar (2009) reported that the overall mean age at first egg was found to be 199.26±4.99 days in scavenging native chicken .

Kalita *et al.* (2009) conducted a study on production and reproduction performance of indigenous chicken maintained by the farmers in different villages of 3 districts namely Kamrup, Nagaon and Sibsagar. The sexual maturity of indigenous chicken was found to vary from 160.63± 4.61 to 177.27± 4.88 days.

2.12 Egg production

Jayanthy (1992) reported that the progenies from Austra-White hens on crossing with naked neck male desi males produced 47.81 eggs per bird during 21 to 40 weeks of age.

Sridharan (1998) reported that the overall mean hen housed egg number and per cent in Austra-white hens under deep litter system for the period from 20 to 44 weeks of age was 82.98 and 49.39 and that in Rhode- white hens were 98.8 and 58.81. The overall hen day egg number in AW and RW were 85.72 and 101.21 eggs and per cent were 51.02 and 60.24 per cent. He also stated that the peak production in AW birds was attained at 32nd week and that in RW birds were at 31st week.

Leo *et al.* (2006a and 2006b) reported that the mean annual egg production of Gramalakshmi hen is 180 to 200 and that of Gramasree hen is 180 eggs. They also stated that fifty per cent production will be attained in 180 days of age in Gramalakshmi birds and in 175 days in Gramasree birds.

Vij *et al.* (2006) studied Punjab brown chicken reared in the backyard system wherein the shelter was made up of mud and sometimes of wood. The age at sexual maturity was about five to six months of age and the average egg production was 60-80 eggs per year.

Khan (2008) reported genetic improvements in non-descript chicken by selection for seven generations. The egg production was increased from 106.1 to 135.4 per bird per year registering an increase of 19 eggs per bird per annum with an increase of 4 g egg weight from 43.3 to 47.3 g.

Mohan *et al.* (2008a) studied the production performance characteristics of 60 Aseel peela desi hens of same hatch and similar body weight under normal system of rearing. The bodyweight, egg weight, egg production, daily egg production at peak production (55-58weeks) was reported as 2120±55g, 51.12±1.35g,.79±0.25 and 54.13±5.1 respectively.

Singh and Kumar (2008) conducted a study on 160 pullets of native fowl of Garhwal Himalayas. The average annual egg production was found to be 168.20±6.27 eggs.

According to Girishkumar (2009) the mean egg number up to 40 weeks of age on hen day (HD) and hen housed (HH) basis in native chicken of northern Kerala

was 34.59 and 33.06±3.53 and egg production per cent in terms of HD and HH up to 40 weeks were 24.71 and 23.61 .

Kalita *et al.* (2009) conducted a study on production and reproduction performance of indigenous chicken maintained by the farmers in different villages of 3 districts namely Kamrup, Nagaon and Sibsagar and found that the egg production per laying cycle and annual egg production ranges from 11.18 ±0.48 to 15.49 ±0.45 and 59.90± 1.86 to 70.09± 2.25 numbers respectively.

2.13 Egg Weight

Nair and Bhattacharyya (1984) recorded the average egg weight of 52g with range of 40 to 60 g at 40 weeks of age in WL x Austrolorp cross under backyard system .

Jayanthy (1992) observed that the initial egg weight at 21-24 weeks of age was 36.25 g and at 37-40 weeks of age it was 44.88g in Desi x Austra white cross bred layers.

Sharma et al. (1992) stated that the egg weight at 32 weeks of age was 48.57g in RIR x Wl cross.

Mishra (1996) reported an average egg weight of 50g recorded in RIR x WL cross named Kalinga Brown, developed at Bhubaneswar.

Sridharan (1998) reported that the mean egg weight of Austra-white hens at 32 and 40 weeks of age were 49.22 ±0.50g and 49.59 ±0.58g and that in Rhode-white hens were 47.44 ±0.22g and 47.71 ±0.59g under deep litter system of rearing .

Haunshi *et al.* (2006) conducted a comparative study on egg quality traits of dual purpose Vanaraja chicken with that of White Leghorn chicken and the mean egg weight at 40 weeks of age was 60.79±0.78g and 54.29±0.73g respectively .

Leo et al. (2006a and 2006b) recorded that the average egg weight of Gramalakshmi and Gramasree hens was 50 g each under backyard system of rearing.

Khan (2008) reported genetic improvements in non-descript chicken by selection for seven generations. The egg production was increased from 106.1 to

135.4 per bird per year registering an increase of 19 eggs with an increase of 4 g egg weight from 43.3 to 47.3g.

Singh and Kumar (2008) reported that the mean egg weight of feathered local hill fowl was 49.82±0.37g and that of clean shank strain was 56.77±0.56g under intensive system of rearing.

Mohan *et al.* (2008a) studied the production performance characteristics of 60 Aseel peela desi hens of same hatch and similar body weight under normal system of rearing and the egg weight was 51.12±1.35g.

Mohan *et al.* (2008b) studied 120 healthy adult kadakanath hens from the same hatch and nearly similar bodyweight for the general performance profile and found that the egg weights at 21 weeks and 52 weeks were 32.50±0.70 and 46.11± 1.25g respectively.

According to Girishkumar (2009) the mean egg weight of scavenging native chicken in 64 households of northern Kerala ranged from 30 to 48.19g.

Kalita *et al.* (2009) conducted a study on production and reproduction performance of indigenous chicken maintained by the farmers under different villages of 3 districts namely Kamrup, Nagaon and Sibsagar and observed that the egg weight ranged from 36.68± 1.23 to 40.00 ±1.20g.

Yadev *et al.* (2009) collected 50 eggs of chicken reared under backyards system in Bareilly district to evaluate the internal and external parameters and found that the mean egg weight was 52.95±0.59g.

2.14 Clutch Size and Length of Laying Cycle

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

According to Ngo *et al.* (2006), the estimated mean clutch size of Vietnamese H'mong chicken 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).

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).

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

2.15 Mortality pattern

Radhakrishnan (1981) found that the livability per cent upto 40 weeks of age was 96 per cent in ALP x WL hens and that in RIR x WL cross it was 92 per cent under backyard system.

Nair and Bhattacharyya (1984) found that the mortality from 20 to 40 weeks of age was 3.4 per cent with the range of 2-5 per cent in WL x Australorp cross under backyard system.

Sridharan (1998) observed that the livability per cent in Austra-white and Rhode-white hens for the period from 21 to 44 weeks of age under deep litter system of rearing was 89.17 and 95.83 per cent.

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

Padhi *et al.* (2003) documented that the mortality due to diseases ranged from 0 to 6.48 per cent and that due to predators ranged from 0.22 to 7.88 per cent in three groups of cross bred chicken during the period from 8 to 20 weeks of age.

Singh et al. (2003) observed that more than 40 per cent of total death that occurred in the poultry farm at Rajasthan College of Agriculture during the period from 1961 to 1996 was due to coryza, followed by CRD 10.26%, Enteritis 8.83%, Avian leukosis 7.56%, Coccidiosis 6.00%, Spirochaetosis 5.95 % , Ranikhet Disease5.71% and less than 4.00 per cent due to other causes.

Mcainsh *et al.* (2004) reported that diseases and predation were the major causes of death among local chicken of Zimbabwe. The main predators were birds of

prey, wild cats and domestic dogs, but also snakes and rats were reported to eat chicken.

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

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

The results of the study by Halima *et al.* (2006) in Ethiopia showed that the lowest and the 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.

Leo *et al.* (2006a and 2006b) reported that the mortality per cent in Gramalakshmi hen is 4 per cent and that in Gramasree is 5 per cent.

Halima *et al.* (2007) found that the major causes of death of chicken of north-west Ethiopia during the study were seasonal outbreaks of Newcastle disease (locally known as fengele) and predation.

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

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.

Biswas *et al.* (2008) observed that 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.

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).

Girishkumar (2009) reported that in scavenging native chicken the mortality due to disease, out of total mortality, was 52.17 per cent and that due to predation was 47.83 per cent. Out of 115 bird deaths, 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.

2.16 Hematological and Biochemical parameters

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

Singh *et al.* (1983) noted that chicken having higher plasma ALP grew faster, matured earlier and produced heavier eggs and plasma ALP activity was more in pullets selected for high production.

Kansal and Gangwar (1984) reported a decrease in plasma ALP and ACT activities in layers as age advanced which may be due to the greater demand , transportation and utilization of Ca for shell calcification from bone consequent to lower blood Ca level.

Sturkie and Griminger (1986) cited the observation of Wels and Horn (1965), that in adult chicken, the haemoglobin values ranged from 8.9 to 9.2 g per 100ml. They also cited the finding of Pilaski (1972) that in 210 days of age, the haemoglobin values were 11.4g per 100ml for males and 8.6g per 100ml for females.

Kalitha *et al.* (1993) reported that ALP was one of the most common variants in the body and was a catalyzing non- specific multi molecular enzyme which act by releasing phosphate from many organic phospho mono esters at an optimum p^h (p^h 9-10). All the metabolic processes in the body were under the direct influence of this enzyme and the level of this enzyme was influenced by sex.

Durotoye *et al.* (2000) studied the diurnal variation of haematological and serum biochemical parameters in Nigerian local chicken during the 24 h period of the day. They found the highest values of PCV per cent and hemoglobin (Mg/dl) were 33.30±3.80 and 11.33±0.29.They also estimated that Calcium (Mmol/l), Phosphorous

(Mmol/l), Alkaline Phosphatase(IU/L) and Alanine amino transferase(IU/L) were 8.70±1.00, 4.30±0.60, 168.5±10.4 and 23.1±1.7 respectively.

Sethu (2003) reported that Hb content (g%) of egg type male chicken at the age of 7th and 8th month were 12.75 ± 0.19 and 12.37 ± 0.22 and the per cent of PCV at the same age were 31.06 ± 0.49 and 32.68 ± 0.58 .

Karthiayini (2007) observed ALT content (IU /L) of broiler chicken at the age of 8th week during summer was 44.83±2.32 and that in rainy season was 44.92 ± 2.57.

Darsana (2008) found the Hb content, PCV per cent, serum ALT content and serum Calcium of broiler chicken at the age of 7th week were 8.53 ± 0.12 (g%), 34.07 ± 0.67 per cent, 19.07 ± 0.73 (IU/L) and 1.97 ± 0.05 Mmol/L respectively.

Girishkumar (2009) reported that the mean haemoglobin (gram / dL) of native hens of northern Kerala was 9.91±0.36 and the mean packed cell volume (PCV) per cent was 36.88±1.55.

2.17 Cost and returns of backyard rearing of GL and GS hens

DZARC (1984) reported that in order to fetch higher price and acceptability, birds are offered a ration comprising 5 % alfalfa meal and they laid eggs with yolk colour intensity comparable to that of local eggs from scavenging chicken, without any loss in their egg yield and other parameters.

Alemu and Tadelle (1997) opined that very small sized eggs from scavenging local chicken with deep yellow colour fetch much higher prices compared with larger eggs of improved strains with pale yolks.

Sridharan (1998) reported that the feed consumed by the Austra-white (AW) and Rhode-white (RW) birds under deep litter system of rearing for the period from 21 to 40 weeks of age was 2054.83kg and 2095.39kg and the cost of feed consumed per egg was Rs 1.53 in AW and Rs 1.31 in RW.

Tadelle *et al.* (2002) observed that every egg or quantity of poultry meat produced under the scavenging system represents a net increment to the family food

supply in addition to the small cash income and other social functions it provides for the household.

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 were being given limited amounts of feed to supplement what they find to eat while scavenging.

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.

Das *et al.* (2008) reported that the traditional free range 'backyard' and scavenging poultry 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.

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

Alders and Pym (2009) observed that output of village poultry in terms of weight gain and number of eggs per hen per year is often low, but there was minimal input in terms of housing, disease control, management and supplemental feeding.

Bell (2009) reported that profitability is important, not the profitability per farm or per bird, but the profitability per unit of money invested- the benefit/ cost ratio. In this aspect small scale free roaming poultry is advantageous over its commercial kin, as the small family poultry finds its own feed.

Girishkumar (2009) calculated that the total and net return from scavenging native chicken in two districts were Rs 35,304 and 31,978 respectively and the

poultry farmers got a return of Rs. 561.02 per adult female bird up to 72 weeks of age.

Sonaiya (2009) stated that small holder family poultry producers had poor levels of knowledge regarding how productivity and the rate of output / input was affected by various socio economic factors such as motives for keeping poultry , flock size and economic cost (of stock, feed and health maintenance) which led to the reduced productivity and profitability.

3. MATERIALS AND METHODS

A study was conducted to assess the production performance and management practices adopted for rearing 'Gramalakshmi' and 'Gramasree' chicken layers under backyard system. Costs and returns involved in this rearing system were also studied.

3.1 THE BIRDS UNDER STUDY

The crossbred chicken layers 'Gramalakshmi' and 'Gramasree' are two important germplasms developed by KAU for exploitation of their productivity under field conditions. The Gramalakshmi (GL) is a crossbred chicken with Australorp breed as male line and White Leghorn as female line and was released in 1980. The Gramasree (GS) progenies are composite breed crosses of different breeds namely Barred Plymothrock, Rhode Island Red, New Hampshire and Desi breed of chicken.

The GL and GS progenies are supplied as partly grown chicks at the age of 8 weeks for backyard rearing in Vattamkulam panchayat in Malappuram district. These chicks were further reared by the beneficiaries under backyard system in the scheme sponsored by Animal Husbandry Department, Government of Kerala. These pullets at the age of 20 weeks were utilized for the present study. The period of the study was during the period from 20 to 40 weeks of age. The study was conducted from March to July 2009.

The study was conducted in 30 households which reared 'Gramalakshmi' (GL) and 30 households that reared 'Gramasree' (GS) layers. Altogether, sixty households were selected. Households having a minimum of five pullets at the beginning of the experiment were included under the study. These household units were selected from the adjacent wards in the panchayath with almost same geographical conditions in order to provide uniform environment for rearing the birds under backyard system. The entire study comprised field experiments to study the production performance of GL and GS hens, survey among the farmers to assess the socio economic status and management practices adopted in back yard rearing and laboratory investigations to assess the health status of the hens..

3.2 FIELD STUDY

3.2.1 Body weight

The body weight of all the GL and GS pullets in the 60 households was recorded individually at 20th and 40th week of age by visiting the households under study. The body weight was recorded using a weighing balance to the nearest 20g accuracy.

3.2.2 Coops

The coops used for providing the night shelter were examined in each household to record their type of construction, dimension, floor area and location in the homestead. The orientation and direction of the coop with regard to the farmer's house was also recorded. The type of flooring, roofing and the materials used for making walls and roof were recorded. The height of the coop was measured in detail at the eaves and ridge. The clearance of the coop from the ground and distance between the coop and the farmer's house was ascertained. Total floor area of each coop was measured. The floor area provided per bird was calculated in each of the units based on the number of chickens housed at the beginning .

3.2.3. Egg production

All the 60 beneficiaries selected under the scheme were given egg production performance sheets to record the daily egg production from onset of laying. The egg recording was continued till the birds reached 40 weeks (280 days) of age.

During the course of the study, the mortality, if any, and the cause of death was also recorded for deriving the hen-day egg production.

At the end of every week, the egg production records were collected from all households and compiled systematically for statistical analysis and interpretation of results. The egg production from 21 to 40 weeks of age was divided into five periods of four weeks each. The number of hens present in each household on 5th March 2009 i.e., at the beginning of 21 weeks of age was taken into account to calculate the hen housed egg production. The week-wise and household-wise mean egg production was calculated both on hen-housed (HH) and hen-day (HD) basis in each household. The

mean egg production in respect of survivors was calculated as survivor average egg production. HH and HD basis was calculated weekly and household wise and from these data the cumulative per cent production and egg number up to 40 weeks of age in GL and GS groups was arrived.

The egg production calculated week-wise and household- wise and at the end of 40 weeks of age compared with the HHN and HDN in other households. From the egg production performance data, length of pause or broodiness if any, exhibited in households, was recorded separately and monitored periodically. The livability per cent was recorded on daily basis and the cumulative mortality week-wise was ascertained and presented as percentages during the period from 21 to 40 weeks of age.

3.2.4 Egg Weight

The weight of seven eggs collected at start of lay, 30^{th} and 40^{th} week of age in each household was recorded and the average egg weight (g) in GL and GS households was estimated for all the three periods. These data from 30 households were pooled to calculate the overall mean egg weight in GL and GS group during the respective age groups.

3.3 SURVEY

3.3.1 Socioeconomic Status of Farmers

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

3.3.2 Rearing practices of GL and GS hens under backyard system

Survey was conducted to record the experience of farmers in each household in poultry rearing, the source of cross bred chicken, and purpose of rearing. 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. The time allotted for the birds for scavenging was also recorded.

3.3.3 Flock size and distribution

The flock size of GL and GS hens under backyard system of rearing was studied. The ward wise distribution of the birds was observed to document the geographical environment available for the birds for scavenging under backyard system.

3.3.4 Feeding and Watering practices

The details pertaining to feeding practices including the hand feeding system adopted and type of feeding and quantity (per household) of feed used in households were assessed. Quantity and type of all the ingredients fed was recorded separately in the questionnaire. The details collected by the survey on watering management included the source of water used for the hens.

3.3.5 Behavioural Characters

Behavioural characters of Gramalakshmi and Gramasree chicken under backyard system of rearing were studied by visiting the households periodically. The capacity of flight of birds was estimated by recording the height and distance covered by hens during flight as explained by farmers. The ability of GL and GS hens for scavenging, their aggressiveness and other behavioural peculiarities were studied by interviewing the farmers. The vices showed by the birds and their scavenging pattern were studied through questionnaire.

3.3.6 Age at First Egg

Data pertaining to the actual age at first egg (AFE) was collected from all the households under study and the data was averaged to get mean AFE and the average age at sexual maturity was worked out. The age at 10 and 50 per cent production was arrived from the daily egg production data collected from households. Other traits associated with egg production under backyard system were studied during survey.

The prevalence and length of broodiness, if any, clutch size, number of clutches per laying cycle (between the start of two broodiness) and egg production per laying cycle were collected from as many farmers as possible.

3.3.7 Health care measures

The health care measures adopted by the farmers were ascertained through the services of Veterinary support extended by the nearby Veterinary dispensary. The major diseases of concern of the farmers during the study period area were documented from the response of the farmers and Veterinary doctor as well. The name of the disease was construed from the description of symptoms provided by the farmer and the local Veterinarian. 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. The biosecurity measures adopted by the farmers in the rearing of GL and GS hens also were recorded.

3.3.8 Mortality pattern

The details of mortality among hens in various households were monitored daily. The reason for death and number of hens died in each household were monitored closely and collected on daily basis. The data was then pooled to calculate mortality rate for the period from 20^{th} to 40^{th} week of age in different periods. The stress factors prevailing in each households and the relationship between management practices and production performance of GL and GS lines were studied.

3.3.9 Cost and returns of backyard poultry rearing

The study on economics of backyard poultry rearing was conducted in 60 households by gathering complete information regarding the different aspects of cost and return. Since all the farmers utilized their existing low cost coops for providing night shelter, the investment on housing cost was not taken into account. The cost of supplemental feeding was calculated from the data collected on the quantity and unit price of the items fed in all the 60 households by survey method. The information on

average number of eggs produced from these birds from 21 weeks was collected and the total eggs for part year from 21 to 40 weeks was recorded. The value of eggs produced during the study period was taken as income from eggs. Margin of returns from the sale of eggs over hand feeding cost in all the households were calculated separately for GL and GS units. From these findings the margin of returns from each egg produced was derived. The cost benefit ratio also was estimated to find out the profitability of Gramalakshmi and Gramasree hens under backyard system of rearing.

3.4 LABORATORY INVESTIGATIONS

3.4.1 Hematological parameters

Whole blood (2ml) was collected from 25 birds each from both GL and GL hens in a vial containing EDTA Di Potassium salt as anticoagulant for estimating the blood values of Hemoglobin content and Packed cell volume at 30^{th} and 40^{th} week of age.

3.4.2 Serum biochemical studies

Blood (2.5ml) was collected from 25 birds each from both GL and GS birds for serum separation and subsequent *in vitro* quantitative determination of Alkaline Phosphatase (ALP), Alanine Amino Transferase (ALT), serum Calcium (Ca) and Phosphorus (P) at 30^{th} and 40^{th} week of age. For estimation of ALP and ALT Biochemical analyzer was used and for Ca and P Spectro photo meter was used.

3.5 STATISTICAL ANALYSIS

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

4. RESULTS

The present study was conducted to assess the performance of Gramalakshmi and Gramasree hens (GL and GS hens) under backyard system of rearing. The data collected through survey among farmers, observations recorded in the field study and the results obtained in the laboratory estimations are presented in this chapter. For effective comparison of the performance of both groups, households lying in the same geographical area were selected. The wards selected for the present study in Vattamkulam Panchayath is shown in Plate 1.

4.1 Socio economic status of farmers

The study on the occupation of the farmers rearing GL hens (Table 1) revealed that out of the total 30 households, 14 were agricultural workers, four were coolies, four were small scale business men, three were having job abroad, two were drivers and one was mason. Two farmers were having no specific occupation. In the case of GS households, out of 30 farmers 15 were agricultural workers, five were coolies, three were small scale business men, three having job abroad and one each were driver, tailor and teacher. One farmer was not having any specific occupation.

The land holding of farmers presented in Table 1 revealed that the average size of land holding of farmers rearing GL hens was 35.75 cents and that in GS group was 24.52 cents. The area of land holding ranged from six cents (GL-20) to 175 cents (GL-6) and that in GS group varied from seven cents (GS-6 and 14) to 71 cents (GS 25).

The study on the member of family actively engaged in chicken rearing in GL households (Table 1 and Plate 2) revealed that among the 30 families, the rearing is managed by the females in 23 (76.67 per cent), males in four (13.33 per cent) and all members in three (10.0 per cent) households. In GS group, females were engaged in poultry rearing in 25 (83.33 per cent), males in three (10.0 per cent) and all members in two (6.67 per cent) households. In households where the head of family is having job abroad, the dependants were managing the hens.

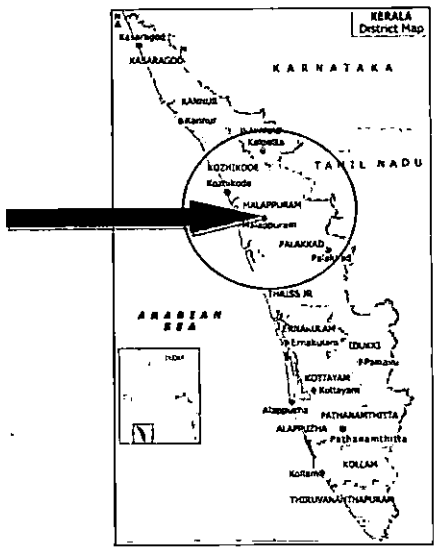
Table 1. Occupation, land area and other agricultural activities of farmers rearing Gramalakshmi and Gramasree hens under backyard system in GL-1 to 30 and GS-1 to 30 households.

Gramalakshmi (GL)						Gramasree (GS)					
Code no.	Occupation of farmers	Land area (cents)	Flock management	AH activity	Agri. Activity	Code no.	Occupation of farmers	Land area (cents)	Flock management	AH activity	Agri. Activity
GL-1	Coolie	16	F	C	Nil	GS-1	Abroad	16.5	F	G	P
GL-2	Driver	14	F	Nil	P	GS-2	Business	12	F	OP	Cn
GL-3	Business	69	M	Nil	Mx	GS-3	AW	11	A	Nil	Nil
GL-4	Driver	89	F	CG	V	GS-4	Driver	11	F	C	P
GL-5	Business	150	F	C	P	GS-5	Coolie	14	F	G	V
GL-6	AW	175	F	C	P	GS-6	AW	7	F	G	P
GL-7	AW	14.5	A	G	Cn	GS-7	AW	10	F	Nil	Cn
GL-8	AW	13.5	F	Nil	Cn	GS-8	AW	16	F	Nil	Nil
GL-9	Abroad	10	M	Nil	Nil	GS-9	AW	50	F	Nil	Cn
GL-10	Coolie	13	F	C	Cn	GS-10	Nil	10	F	CG	Mx
GL-11	Business	46	F	C	Cn	GS-11	Abroad	60	F	C	V
GL-12	AW	30	F	Nil	Cn	GS-12	AW	20	F	Nil	Cn
GL-13	AW	31	F	G	Nil	GS-13	AW	26	F	CG	Mx
GL-14	AW	12	F	Nil	P	GS-14	Teacher	7	M	C	P
GL-15	Abroad	16	F	G	Mx	GS-15	AW	8	F	Nil	Nil
GL-16	AW	25	F	Nil	V	GS-16	AW	12	F	Nil	Nil
GL-17	AW	35.5	M	CG	Nil	GS-17	Coolie	10	M	CG	P
GL-18	Mason	40	F	CG	V	GS-18	AW	54	F	G	V
GL-19	AW	27	F	Nil	V	GS-19	AW	23	F	Nil	Nil
GL-20	AW	6	F	Nil	P	GS-20	AW	17	F	OP	P
GL-21	AW	14	F	Nil	P	GS-21	Abroad	40	A	CG	P
GL-22	AW	20	M	G	P	GS-22	Coolie	17	F	Nil	Nil
GL-23	AW	16	F	C	P	GS-23	AW	19	F	Nil	Nil
GL-24	Business	90	A	OP	Nil	GS-24	Business	26	M	C	P
GL-25	AW	16	F	Nil	Mx	GS-25	Tailor	71	F	C	P
GL-26	Nil	18	F	Nil	P	GS-26	AW	18	F	C	P
GL-27	Nil	20	F	Nil	Nil	GS-27	AW	70	F	Nil	Nil
GL-28	Coolie	19	F	G	Mx	GS-28	Business	24	F	G	P
GL-29	Abroad	16	F	C	Nil	GS-29	Coolie	21	F	CG	P
GL-30	Coolie	11	A	Nil	P	GS-30	Coolie	35	F	G	Nil
Mean		35.75						24.52			

A- All members AW-Agricultural worker C- Cattle CG- Cattle and goat
Cn- Coco nut F- Female G - Goat M - Male Mx - Mixed farming
OP - Other poultry P - Plantain V - Vegetables

Plate 1. Area under study

Malappuram district



Vattamkulam Panchayath

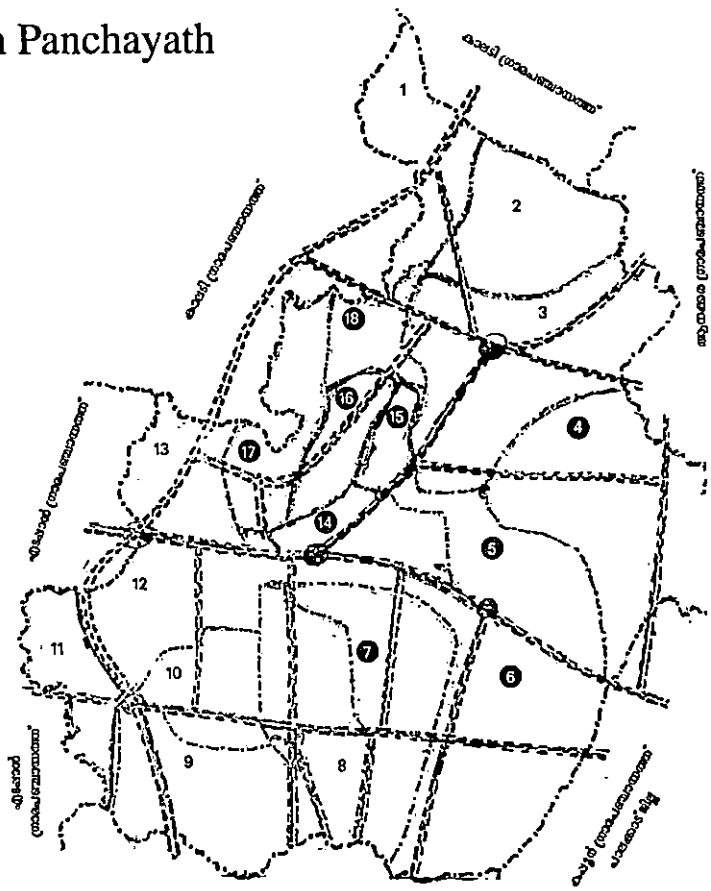
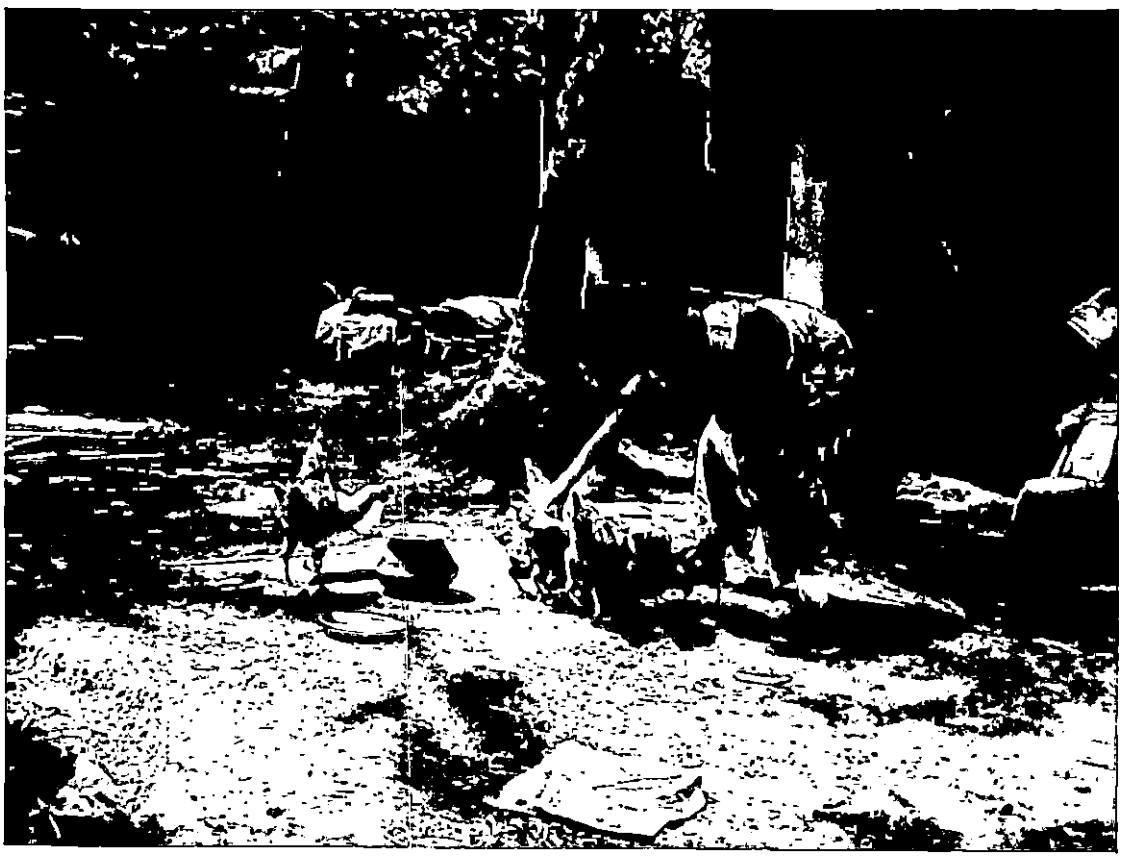


Plate 2. Flock management in back yard poultry rearing is done by women



With respect to other animal husbandry activities of farmers in GL group (Table 1and Plate 3), out of the 30 households, 14 (46.67 per cent) were having no animal husbandry activities. Cattle rearing were practiced in seven households, goat rearing in five units, both cattle and goat rearing in three units and other poultry in one household. In GS households, 11 (36.67 per cent) were having no animal husbandry activities. Cattle rearing and goat rearing were practiced in six households (20.0 per cent) each. In five households cattle and goat were reared together and other poultry was maintained by two families. In both the groups the other poultry species reared by the farmers included turkey and duck.

The main agricultural activity of the farmers in GL group (Table 1 and Plate 3) was plantain cultivation in 10 households followed by coconut farming in five. Vegetable cultivation and mixed farming were practiced in four households each. Seven farmers had no agricultural activity. The per cent values for these figures being 33.33, 16.67, 13.33(2) and 23.33 respectively. In GS group the main agricultural activity was plantain cultivation in 12 households (40.0 per cent) followed by coconut farming in four (13.33), vegetable cultivation in three (10.0) and mixed farming in two (6.67 per cent) households. Nine farmers (30.0 per cent) had no agricultural activity.

4.2 Flock size of Gramalakshmi and Gramasree hens

The flock size of GL and GS hens in 30 households each at the time of the study was calculated by enumeration and presented in Table 2. Photographs of a typical flock in GL and GS hens are shown in Plate 4.

The flock size at the start of study ranged from five to nine birds per household in GL group and five to 10 in GS group. The total number of birds in all the 30 households put together in GL group was 226 and that in GS group was 233. The average number of birds per household in GL was 7.5 and that in GS was 7.8. All the households in the study were from nine wards with ward numbers 4, 5, 6 and 7 in the eastern side and 14, 15, 16, 17 and 18 in the western side of the Panchayath (Plate 1). In both groups, 16 households were selected from eastern wards and 14 households were selected from the western wards.

Table 2. Flock size and details of coops regarding Gramalakshmi and Gramasree hens under backyard system of rearing in GL-1 to 30 and GS-1 to 30 households.

Gramalakshmi (GL)						Gramasree (GS)					
		Coop						Coop			
Code no.	No of hens	Distance from home (m)	Type of coop	Roofing material	Floor area (sq m)	Code no.	No of hens	Distance from home (m)	Type of coop	Roofing material	Floor area (sq m)
GL-1	7	5.0	W	T	1.75	GS-1	9	4.5	W	TH	0.75
GL-2	7	10.0	W	T	0.60	GS-2	10	4.0	WM	TH	0.80
GL-3	9	5.0	B	T	1.26	GS-3	9	4.5	W	T	1.35
GL-4	8	6.0	WM	C	1.13	GS-4	7	5.0	WM	A	0.50
GL-5	6	8.0	WM	TH	0.75	GS-5	8	4.0	W	T	0.50
GL-6	6	Nil	W	T	0.75	GS-6	8	Nil	B	T	1.20
GL-7	5	Nil	B	TH	1.31	GS-7	8	6.0	W	T	1.13
GL-8	7	4.0	W	T	0.75	GS-8	8	4.5	WM	A	1.04
GL-9	8	5.0	B	C	1.40	GS-9	8	5.0	W	TH	1.58
GL-10	7	7.5	W	T	0.41	GS-10	6	3.0	B	T	1.75
GL-11	8	6.0	B	A	1.13	GS-11	7	6.0	W	T	0.94
GL-12	8	10.0	W	T	1.35	GS-12	8	4.5	B	C	0.60
GL-13	8	5.0	W	T	0.70	GS-13	7	4.0	W	Plastic	0.60
GL-14	8	4.5	W	TH	0.94	GS-14	7	Nil	B	TH	0.75
GL-15	9	7.0	B	T	0.75	GS-15	5	Nil	W	T	0.75
GL-16	7	4.0	WM	A	0.75	GS-16	8	8.0	WM	A	1.20
GL-17	7	12.0	B	TH	0.94	GS-17	8	4.0	W	T	0.50
GL-18	9	9.0	W	A	0.72	GS-18	7	Nil	W	T	1.13
GL-19	8	6.5	W	T	0.94	GS-19	8	6.0	WM	TH	0.45
GL-20	9	10.0	B	T	0.94	GS-20	7	2.0	W	T	1.00
GL-21	9	Nil	W	T	0.90	GS-21	8	10.0	B	C	1.13
GL-22	7	Nil	B	T	0.94	GS-22	8	Nil	W	A	0.90
GL-23	8	4.5	W	T	0.75	GS-23	8	5.5	W	T	0.60
GL-24	8	6.5	WM	TH	1.58	GS-24	8	5.0	WM	TH	0.60
GL-25	6	Nil	B	T	0.75	GS-25	8	3.0	W	T	0.80
GL-26	7	4.0	W	TH	1.20	GS-26	9	8.0	B	T	0.80
GL-27	7	4.5	W	T	0.90	GS-27	9	5.0	W	TH	0.80
GL-28	8	0.0	B	C	0.90	GS-28	7	Nil	W	A	1.13
GL-29	7	2.0	WM	T	0.90	GS-29	8	12.0	WM	T	1.13
GL-30	8	8.5	W	T	0.48	GS-30	7	2.0	W	T	0.75
Mean	7.5	5.2			1.00	Mean	7.8	4.2			0.90

A - Asbestos B - Brick C - Concrete T - Tile TH - Thatched W - Wooden WM - Wire mesh

Plate 3 .Animal husbandry activities of backyard poultry farmers included goat rearing and cattle rearing. Main agricultural activity of farmers was plantain cultivation.

Plate 4. Gramalakshmi birds are having white with intermittent black plumage. Gramasree hens have multi coloured plumage.

4.3 Management practices adopted in back yard rearing

4.3.1 Housing

The details pertaining to the studies on the night shelters used in rearing GL and GS hens are presented in Table 2. The different types of coops are displayed in Plate 5. All the 60 households under study had provided coops.

Measurement of distance of the coops from the farmer's house (Table 2) showed that out of the 30 coops, 16.7 per cent (5) of coops in GL and 20.0 per cent (6) in GS groups were adjacent to the farmer's house. The distance was between 0.1 to 4m. in 26.7 per cent (8) of GL coops and 30.0 per cent (9) of GS coops. The distance was between 4.1 to 8 m. in 36.7 per cent (11) of GL coops and 43.3 per cent (13) of GS coops and the remaining 20.0 per cent (6) in GL and 6.7 per cent (2) in GS were at a distance of 8.1 to 12m. away from the farmers residence. The average distance in GL households was 5.2 m. and that in GS households was 4.2 m.

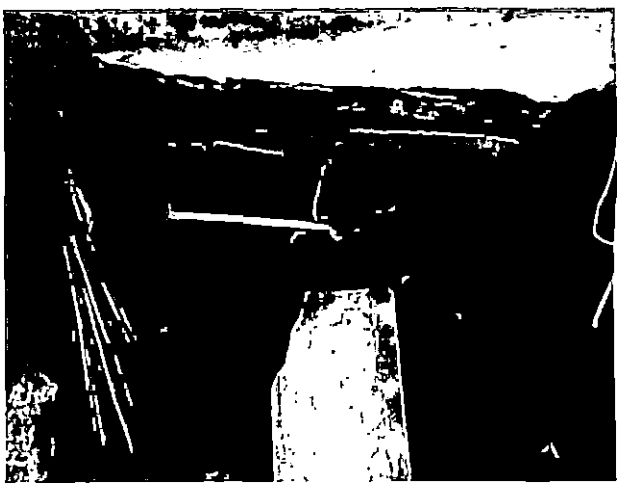
The materials used for the construction of the night shelter of the birds included wood, wire mesh, brick and mud (Table 2 and Plate 5). Wood was used in 50.0 per cent (15) of the GL and 56.7 per cent (17) of GS night shelters. Wire mesh was used in 16.7 per cent in GL and 23.3 per cent in GS and brick was used in 33.3 and 20.0 per cent of GL and GS coops.

The popular roofing material used in construction of the coops (Table 2) was tiles with 60.0 per cent (18) in GL and 50.0 per cent (15) in GS groups followed by thatched roof (20.0 per cent (6) in GL and 23.3 per cent (7) in GS), asbestos (10.0 per cent (3) in GL and 16.7 per cent (5) in GS group) and other materials like plastic sheet and concrete were used in 10.0 per cent (3) coops in both units.

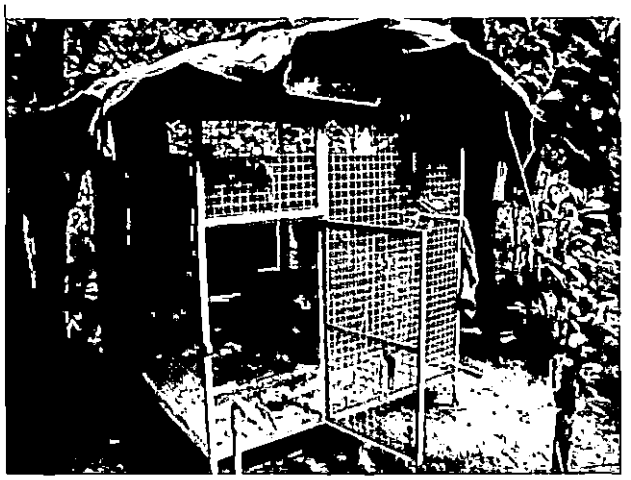
The study on floor area of night shelter (Table 2) showed that 63.3 per cent (19) of the coops in GL group and 50.0 per cent (15) in GS group were having area between 0.6 to 1 sq. m. followed by 23.3 per cent (7) in GL and 30.0 per cent (9) in GS group between 1.1 to 1.5 sq m. \

Plate 5. Different types of coops used in GL and GS rearing.

Common wooden coop with tiled roof



Made with brick, cement and concrete



Made with iron wire mesh and plastic roof

Two tier coop with wood and wire mesh

Wooden coop with asbestos roof and elevated from ground with laterite stones

Low cost coop with mud

The floor area was below 0.5sq.m. in 6.7 per cent (2) of GL coops and 13.3 per cent (4) of GS coops. In both the groups, 6.7 per cent was having floor area above 1.51 sq.m. The average floor area in GL households was 1.0 sq. m. and that in GS households was 0.9 sq.m.

Separate laying nests were not provided by the farmers in both GL and GS hens. Out of the total 60 coops studied in both the groups, none of the coops were provided with perches and litter materials inside the shelters.

4.3.2 Watering Practices

The study on the source of drinking water used to their chicken (Table 3 and Plate 6) revealed that in GL group, 73.33 per cent of the households (22) used well water, 16.67 per cent (5) used tap water and 10.0 per cent (3) used water from natural sources like ponds. In GS group, 80.0 per cent households (24) used well water, 13.33 per cent (4) used tap water and 6.67 per cent (2) used water from ponds. Farmers used coconut shell, broken earthen pots, used steel plates and plastic utensils as waterers.

4.3.3 Health care measures adopted

The study on the veterinary services that farmers usually depend upon (Table 3) revealed that in GL group 6.7 per cent (2) were not availing any services, 50.0 per cent farmers (15) were availing services from Government Veterinary Dispensary in the Panchayath and 43.3 per cent (13) depended on indigenous herbal medications for treating their chickens. In the case of GS group, 16.7 per cent (5) were not availing any services, 56.7 per cent farmers (17) were availing services from Government Veterinary Dispensary and 26.7 per cent (8) depended on indigenous medications. For indigenous treatment the farmers traditionally use locally available herbals like tulsi (*Ocimum sanctum*), garlic (*Allium sativum*), turmeric (*Curcuma longa*) and some other aromatic plants.

The major ailments encountered by the 30 households of GL group as reported by the farmers were Respiratory affections in eight households, Enteritis in six, Fowl pox in two, and Ectoparasitism in 14 households.

Table 3. Details regarding source of drinking water, veterinary services and major ailments of concern in Gramalakshmi and Gramasree hens in GL-1 to 30 and GS-1 to 30 households.

Gramalakshmi (GL)				Gramasree (GS)			
Code number	Water source	Veterinary Services	Major ailments reported	Code number	Water source	Veterinary Services	Major ailments reported
GL-1	Well	VD	Respiratory	GS-1	Well	VD	Respiratory
GL-2	Well	VD	Respiratory	GS-2	Well	VD	Ecto parasitism
GL-3	Tap	VD	Respiratory	GS-3	Well	VD	Respiratory
GL-4	Well	VD	Ecto parasitism	GS-4	Tap	NS	Respiratory
GL-5	Well	IN	Fowl pox	GS-5	Well	NS	Respiratory
GL-6	Well	VD	Ecto parasitism	GS-6	Well	VD	Ecto parasitism
GL-7	Well	IN	Ecto parasitism	GS-7	Well	IN	Respiratory
GL-8	Well	VD	Respiratory	GS-8	Tap	VD	Respiratory
GL-9	Well	VD	Ecto parasitism	GS-9	Well	VD	Enteritis
GL-10	Pond	NS	Ecto parasitism	GS-10	Well	IN	Ecto parasitism
GL-11	Well	VD	Ecto parasitism	GS-11	Well	VD	Ecto parasitism
GL-12	Well	IN	Ecto parasitism	GS-12	Pond	IN	Respiratory
GL-13	Well	IN	Respiratory	GS-13	Well	IN	Respiratory
GL-14	Well	IN	Fowl pox	GS-14	Well	VD	Ecto parasitism
GL-15	Pond	IN	Ecto parasitism	GS-15	Well	VD	Ecto parasitism
GL-16	Well	IN	Ecto parasitism	GS-16	Well	VD	Fowl pox
GL-17	Well	VD	Respiratory	GS-17	Well	NS	Respiratory
GL-18	Tap	VD	Enteritis	GS-18	Tap	VD	Ecto parasitism
GL-19	Well	VD	Enteritis	GS-19	Well	NS	Enteritis
GL-20	Tap	NS	Enteritis	GS-20	Well	VD	Respiratory
GL-21	Well	VD	Ecto parasitism	GS-21	Well	VD	Respiratory
GL-22	Well	IN	Ecto parasitism	GS-22	Well	IN	Ecto parasitism
GL-23	Pond	VD	Enteritis	GS-23	Well	IN	Enteritis
GL-24	Well	VD	Enteritis	GS-24	Tap	IN	Fowl pox
GL-25	Well	IN	Ecto parasitism	GS-25	Well	IN	Ecto parasitism
GL-26	Tap	VD	Respiratory	GS-26	Well	NS	Enteritis
GL-27	Well	IN	Ecto parasitism	GS-27	Well	VD	Ecto parasitism
GL-28	Well	IN	Respiratory	GS-28	Well	VD	Ecto parasitism
GL-29	Well	IN	Enteritis	GS-29	Pond	VD	Enteritis
GL-30	Tap	IN	Ecto parasitism	GS-30	Well	VD	Ecto parasitism

IN - Indigenous methods NS - No services VD - Veterinary Dispensary

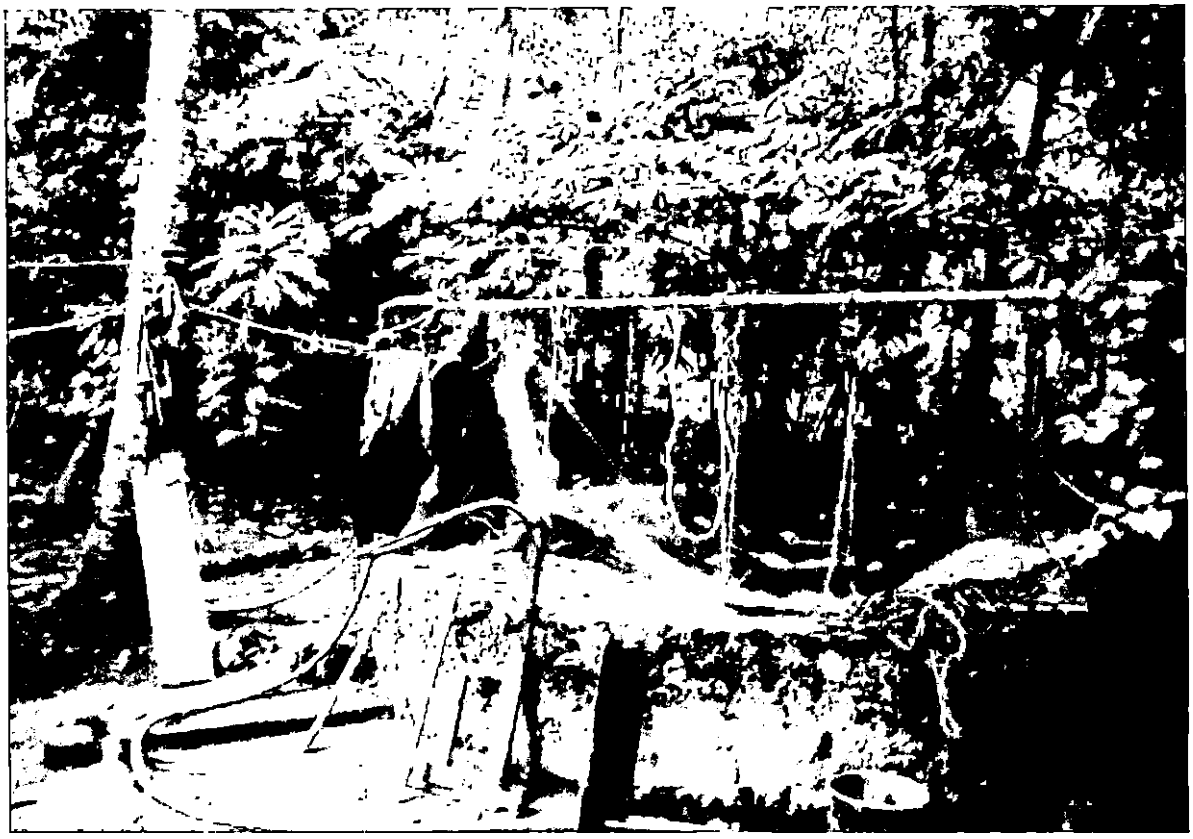


Plate 6. Drinking water sources used by farmers rearing GL and GS hens under backyard system of rearing

The per cent were 26.7, 20.0, 6.7 and 46.7 respectively. In case of GS group the ailments were Respiratory affections in 11 households, Enteritis in five, Fowl pox in two, and Ectoparasitism in 12 households. The percentages were 36.7, 16.7, 6.7 and 40.0 respectively.

4.3.4 Feeding Practices

All the hens in both groups were let out for scavenging in day time in the backyards (Plate 7). In almost all the households the birds were let out by 7:00 am in the morning. In addition to the feed resources available on the backyards, the birds were also fed with kitchen waste and left over house hold food items including cooked rice which were not quantified.

Hand feeding was practiced in all the households (Plate 7). The hand feeding pattern of GL and GS hens under backyard system for the period from 21-40 weeks of age including the items fed and the quantity of each item is furnished in Table 4 and 5. Most of the farmers hand fed their hens two times a day and the timing was in the morning and in evening. Some farmers fed the hens immediately after laying also. In majority of the households no separate feeders were used for the hens.

The farmers used paddy or rice, rice bran, wheat, wheat bran, maize bran, layer feed and cattle feed for supplemental feeding in varying amounts. Most of the farmers used rice bran for hand feeding followed by wheat and maize bran. The farmers selected the feed items based on the previous experiences, the local availability of the feed items and the cost of the items. The average quantity of all the feed items hand fed per bird per day basis in GL group ranged from 16.3 g (GL-26) to 30.2 g (GL-1) with a mean of 22.8 ± 5.0 g (Table 4), and that in GS group ranged from 15.8 g (GS-23) to 36.4 g (GS- 11) with a mean of 24.1± 6.5g (Table 5). The quantity of feed items given daily in a house hold ranged from 100 g (GL-5) to 230 g (GL-28) in GL group, and from 125g (GS -4, GS-6 and GS-15) to 250 g (GS-1, and GS-21) in GS group.

Table 4. Hand feeding pattern of Gramalakshmi hens in house holds GL-1 to 30 for the period from 21 to 40 weeks age under back yard system of rearing

Code no.	Paddy /Rice (g)	Rice bran (g)	Wheat (g)	Wheat bran (g)	Maize bran (g)	Layer feed (g)	Cattle feed (g)	Qnty /bird /day (g)	Quantity /house /day (g)	21-40 wk (Kg)
GL-1		8.6		8.6		13.0		30.2	175	24.50
GL-2	7.6		7.6				11.3	26.5	175	24.50
GL-3		6.1			6.1		7.3	19.4	160	22.40
GL-4	6.3		9.5		6.3			22.1	175	24.50
GL-5		10.2	10.2					20.4	100	14.00
GL-6		6.7	8.3				8.3	23.3	140	19.60
GL-7	10.0			10.0	10.0			30.0	150	21.00
GL-8	8.8	8.8			8.8			26.3	150	21.00
GL-9			7.3		7.3	7.3		22.0	150	21.00
GL-10		9.2			11.1			20.3	110	15.40
GL-11		6.5	6.5			9.8		22.9	175	24.50
GL-12		10.9	7.3		7.3			25.4	175	24.50
GL-13		7.2	5.7		10.8			23.7	165	23.10
GL-14	9.9		6.6			6.6		23.0	175	24.50
GL-15		8.8					8.2	17.0	145	20.30
GL-16		8.5			4.2		8.5	21.2	125	17.50
GL-17		6.6	8.2		8.2			23.0	140	19.60
GL-18	8.4		2.8			9.0		20.2	180	25.20
GL-19		6.7	6.7		6.7			20.1	150	21.00
GL-20	5.8				5.8		5.8	17.4	150	21.00
GL-21		5.6			5.6		8.3	19.4	175	24.50
GL-22	10.7		7.1				10.7	28.6	200	28.00
GL-23		6.3			7.6		6.3	20.2	160	22.40
GL-24		7.7		7.7		13.9		29.4	190	26.60
GL-25		8.3			8.3		8.3	25.0	150	21.00
GL-26		8.9					7.4	16.3	110	15.40
GL-27		7.9				11.8		19.7	125	17.50
GL-28		5.0	6.3			11.3	6.3	28.8	230	32.20
GL-29		7.1	7.1	7.1				21.4	150	21.00
GL-30		7.6	6.3				6.3	20.2	160	22.40
Mean								22.8±5.0		

Table 5. Hand feeding pattern of Gramasree hens in house holds GS-1 to 30 for the period from 21 to 40 weeks age under back yard system of rearing

Code no.	Paddy /Rice (g)	Rice bran (g)	Wheat (g)	Wheat bran (g)	Maize bran (g)	Layer feed (g)	Cattle feed (g)	Qnty /bird /day (g)	Quantity /house /day (g)	21-40 wk (Kg)
GS-1		11.3	5.6				11.3	28.2	250	35.00
GS-2		5.3				5.3	10.6	21.3	200	28.00
GS-3		5.8	8.7			11.6		26.1	225	31.50
GS-4		8.4			12.5			20.9	125	17.50
GS-5		6.3		9.5	6.3			22.1	175	24.50
GS-6	10.0		6.7					16.7	125	17.50
GS-7		6.6	6.6			9.8		22.9	175	24.50
GS-8	9.8		5.2			6.5		21.6	165	23.10
GS-9		9.9	6.6		9.9			26.3	200	28.00
GS-10			9.1	9.1			9.1	27.3	150	21.00
GS-11		16.2			8.1		12.1	36.4	225	31.50
GS-12		6.3	6.3		6.3			18.9	150	21.00
GS-13		8.4		8.4	12.6			29.4	175	24.50
GS-14		7.1			8.6		14.3	30.0	210	29.40
GS-15			15.0		10.0			25.0	125	17.50
GS-16		7.0	7.0		7.0			20.9	150	21.00
GS-17		12.6					6.3	19.0	150	21.00
GS-18	7.1	7.1				14.3		28.6	200	28.00
GS-19	6.3	6.3		6.3				18.9	150	21.00
GS-20		7.1		7.1	14.3			28.6	200	28.00
GS-21	6.8		6.8			13.7	6.8	34.2	250	35.00
GS-22	6.6	13.2			6.6			26.3	200	28.00
GS-23	9.5		6.3					15.8	125	17.50
GS-24		6.7	6.7			13.3		26.6	200	28.00
GS-25		9.8		6.5			6.5	22.9	175	24.50
GS-26			5.6		5.6	5.6	5.6	22.3	200	28.00
GS-27				6.0		11.9		17.9	150	21.00
GS-28		10.7	7.1				7.1	25.0	175	24.50
GS-29		7.0			8.4		7.0	22.4	160	22.40
GS-30	7.1				7.1		7.1	21.4	150	21.00
								24.1±6.5		

Plate 7. All the birds were let out for scavenging in vegetations and backyards. Hand feeding with locally available cereals and left over food items from the households was practiced in all the households.

4.3.5 Bio security measures

The bio security measures adopted by the farmers rearing GL and GS hens under backyard system of rearing were studied and are presented in Table 6.

Weekly disinfection of coop was done in four households in GL group and five households in GS group. For disinfection farmers used phenyl lotion available at Veterinary Dispensary or from local purchase. Confinement of affected hens was practiced in 17 households (56.67 per cent) in GL group and 14 households (46.67 per cent) in GS group. Affected hens in the flock will be separated from the group and will be housed in separate coops or temporary shelters. Scientific disposal of the carcass of the hens was practiced in nine households in GL group and 11 households in GS group. Farmers used lime in the disposal pits. Confinement of hens on the report of outbreaks in the neighbouring houses was practiced in 18 households (60.0 per cent) in GL and 16 households (53.33 per cent) in GS group. The hens will not be let free for scavenging and will be confined in its night shelter itself in day time also and will be hand fed on those days. Regular deworming of the hens was done in 11 households in GL group and 14 households in GS group. The deworming medicines were available at local Veterinary Dispensary in the Panchayath. Use of external ecto prasiticides on hens and coops was practiced in 12 households in GL group and 10 households in GS group. The medicines were purchased from the local medical stores on the prescription of the veterinarian.

4.4 Behavioral characters

The result of survey on behavioural characters of GL and GS hens under backyard system of rearing is presented in Table 7.

The Gramalakshmi hens were having white with intermittent black plumage and tinted egg shell colour. The Gramasree hens were having multi coloured plumage and brown shelled eggs (Plate 8). The flight height and flight distance was more with Gramalakshmi than Gramasree hens. Gramalakshmi hens were more aggressive than Gramasree. Foraging on vegetation in the household premises were more with Gramalakshmi birds. These birds were reported to fly high in air and feed on banana leaves.

Table 6. Bio security measures adopted for the rearing of Gramalakshmi and Gramasree hens under back yard system in GL-1 to 30 and GS-1 to 30 households.

Gramalakshmi (GL)							Gramasree (GS)						
Code no.	A	B	C	D	E	F	Code no.	A	B	C	D	E	F
GL-1		●		●	●	●	GS-1	●	●		●	●	●
GL-2		●		●			GS-2		●	●	●	●	●
GL-3							GS-3						
GL-4	●	●	●	●	●	●	GS-4		●	●	●	●	
GL-5							GS-5	●	●	●	●	●	●
GL-6							GS-6				●		
GL-7		●		●	●	●	GS-7						
GL-8				●			GS-8		●		●	●	
GL-9		●	●	●	●	●	GS-9						
GL-10				●			GS-10						
GL-11		●		●			GS-11						
GL-12							GS-12		●	●	●	●	●
GL-13		●	●	●	●		GS-13		●	●	●	●	●
GL-14							GS-14		●	●	●	●	
GL-15		●	●	●	●	●	GS-15				●		
GL-16		●		●		●	GS-16						
GL-17	●	●	●	●	●	●	GS-17		●				
GL-18		●		●			GS-18	●	●	●	●	●	
GL-19		●	●	●	●	●	GS-19						
GL-20							GS-20					●	●
GL-21	●	●	●	●	●	●	GS-21	●	●	●	●	●	●
GL-22							GS-22						
GL-23		●					GS-23						
GL-24	●	●	●	●	●	●	GS-24	●	●		●	●	●
GL-25				●			GS-25		●	●	●	●	
GL-26							GS-26			●	●		●
GL-27							GS-27		●	●	●	●	●
GL-28		●	●	●	●		GS-28						
GL-29						●	GS-29						
GL-30		●				●	GS-30						
Count	4	17	9	18	11	12		5	14	11	16	14	10

A . Weekly disinfection of coops and premises

B . Isolation of affected birds

C . Scientific disposal of dead birds

D . Confinement of birds on outbreaks

E . Regular deworming of the birds

F . Use of ecto prasiticides

Table 7. Behevioural parameters of Gramalakshmi and Gramasree hens under backyard system of rearing.

Sl. no.	Parameters	Gramalakshmi (GL)	Gramasree (GS)
1	Plumage colour	White with intermittent black	Multi coloured
2	Egg shell colour	Tinted	Brown
3	Flight height	More	Less
4	Flight distance	More	Less
5	Aggressiveness	More	Less
6	Foraging on vegetation	Exellent	Low
7	Scratching ability	Low	Exellent
8	Perching behaviour	More	Less
9	Broody appearance	Short duration	Short duration

Table 8. Number of hens showing broody appearance and its percentage over hendays in Gramalakshmi and Gramasree hens under backyard system in GL 1-30 and GS 1-30 households for the period from 21 to 40 weeks of age

Gramalakshmi							Gramasree						
	Broody appearance days							Broody appearance days					
Code no.	No. of hens	May	June	July	Total	% over hendays	Code no.	No. of hens	May	June	July	Total	% over hendays
GL-1	1	8			8	1.21	GS-1	1		10		10	0.95
GL-2	1		10		10	1.30	GS-2	1			6	6	0.57
GL-3	2	7		6	13	1.34	GS-3	2	7		7	14	1.37
GL-4							GS-4						
GL-5	1	6			6	1.42	GS-5	2		8	6	14	1.60
GL-6							GS-6						
GL-7							GS-7	2	8		7	15	1.73
GL-8	1		7		7	1.09	GS-8	1		7		7	0.89
GL-9	1			9	9	1.18	GS-9	1	8			8	1.00
GL-10							GS-10	2		6	6	12	2.60
GL-11							GS-11	2	6	12		18	2.50
GL-12	1	7			7	0.89	GS-12	2	7		9	16	1.92
GL-13							GS-13	2		6	7	13	1.89
GL-14							GS-14	1		7		7	0.85
GL-15	2		7	6	13	1.29	GS-15	1	8			8	1.74
GL-16							GS-16	1		6		6	0.93
GL-17	1	7			7	1.01	GS-17	1			7	7	0.96
GL-18							GS-18	2	7	8		15	1.80
GL-19	1		8		8	0.92	GS-19	1		9		9	1.08
GL-20	1			7	7	0.77	GS-20						
GL-21	1	7			7	0.66	GS-21	2	8		6	14	1.64
GL-22	1		8		8	1.11	GS-22	1		6		6	0.76
GL-23	1			6	6	0.75	GS-23	2	7		5	12	1.35
GL-24							GS-24	2		11	5	16	1.85
GL-25	1		7		7	1.00	GS-25						
GL-26	1		7		7	0.88	GS-26	1			5	5	0.55
GL-27	1	6			6	0.81	GS-27	1		8		8	0.92
GL-28	1	8			8	0.84	GS-28						
GL-29	2		6	7	13	2.02	GS-29	2		8	7	15	2.47
GL-30							GS-30						
Total	22	56	60	41	157	1.05		36	66	112	83	261	1.35

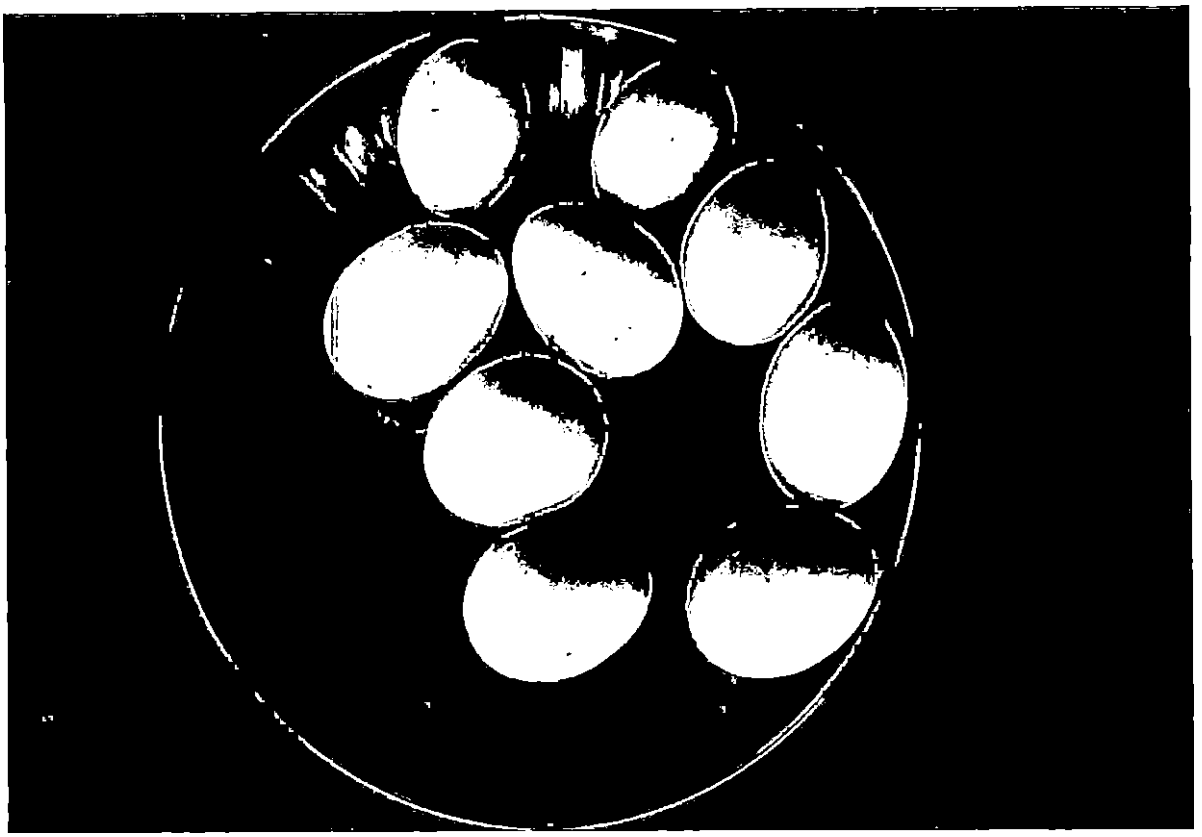


Plate 8. Gramalakshmi eggs were with tinted egg shell colour

Gramasree eggs were having brown egg shell colour

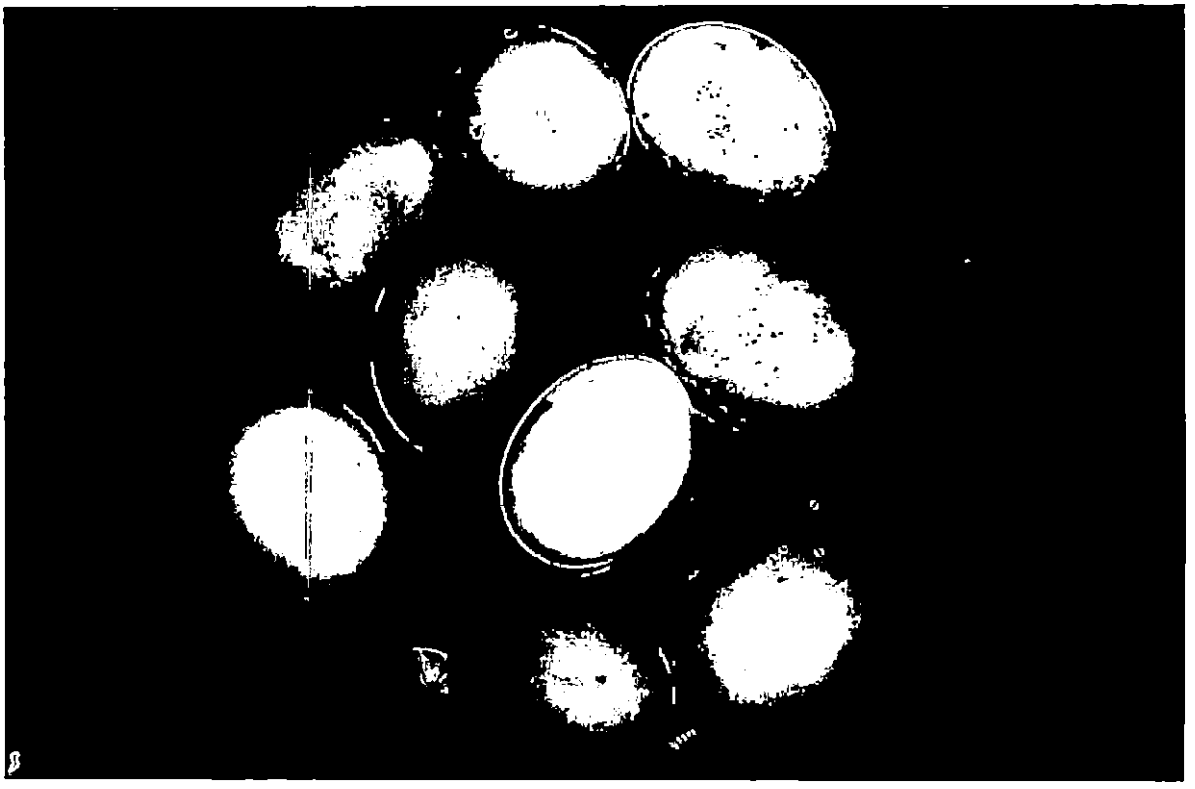


Plate 9. Flight height and perching behaviour were more in Gramalakshmi hens

Broody appearance of short duration was mostly seen in Gramasree hens

Gramalakshmi hens showed more perching behavior by perching to trees, compound walls, roof of coops and even of farmer's houses (Plate 9). Scratching ability in search of feed in backyards was more with Gramasree birds.

The details of the birds which showed broody appearance in both GL and GS hens are presented in Table 8. Even though no typical broodiness was shown by both groups of birds, broody appearance lasting for five to 12 days was shown by 22 hens (9.74 per cent) in GL and 36 hens (15.45 per cent) in GS group. The broody appearance was exhibited in 19 households in GL group and 24 households in GS group (Plate 8). The percentage of broody appearance days to total hen days in production period was 1.05 per cent in GL group and 1.35 per cent in GS group.

4.5 Production performance of Gramalakshmi and Gramasree hens

4.5.1 Body Weight (BW)

The household wise mean body weight of GL and GS hens at the age of 20^{th} week is presented in Table 9 and the graphical representation is done in Fig.1. The procedure is illustrated in Plate 10. The overall mean BW at 20 weeks of age (BW_{20}) for GL group was 1092 ± 6 g and that in GS group was 1250 ± 5 g. The BW_{20} in GS group was significantly higher than that in GL group ($P<0.05$). Individual body weights in GL group at 20^{th} week ranged from 880g (GL-2 and 5) to 1300g (GL 19) and that in GS group was 980g (GS 11) to 1520g (GS 3). The overall mean for GL group was 1092 ± 6 g and that in GS was 1250 ± 5 g. The mean body weight at 20^{th} week in the GL households ranged from 1000g to 1179g. The lowest mean was recorded in GL-5 and the highest in GL-19. In GS households the mean body weight ranged from 1131g to 1414 g with lowest mean in GS-11 and the highest in GS-3.

The household wise mean BW of GL and GS hens at the age of 40^{th} week (BW_{40}) is presented in Table 10 and the graphical representation is done in Fig. 2. Individual BW_{40} ranged from 1580 g (GL 1) to 1920 g (GL 11) and that in GS group ranged from 1640 g (GS 8) to 2160 g (GS 16).

Table 9. Mean body weight and its range (g) in Gramalakshmi and Gramasree hens under backyard system in GL-1 to 30 and GS-1 to 30 households at 20 weeks of age

Gramalakshmi (GL)			Gramasree (GS)		
Household Code no.	Body weight range (g)	Household mean body weight (g)	Household Code no.	Body weight range (g)	Household mean body weight (g)
GL-1	960 -1100	1014	GS-1	1160 -1360	1269
GL-2	880 -1100	1006	GS-2	1140 -1420	1304
GL-3	1000 -1240	1164	GS-3	1320 -1520	1414
GL-4	980 -1280	1128	GS-4	1280 -1460	1376
GL-5	880 -1080	1000	GS-5	1180 -1400	1308
GL-6	980 -1160	1087	GS-6	1120 -1280	1205
GL-7	960 -1100	1026	GS-7	1180 -1400	1275
GL-8	980 -1220	1099	GS-8	1180 -1340	1265
GL-9	1040 -1140	1090	GS-9	1180 -1280	1233
GL-10	1000 -1120	1071	GS-10	1220 -1300	1253
GL-11	1040 -1220	1141	GS-11	980 -1220	1131
GL-12	980 -1220	1128	GS-12	1220 -1300	1268
GL-13	1040 -1260	1125	GS-13	1140 -1280	1211
GL-14	960 -1220	1065	GS-14	1180 -1400	1311
GL-15	1040 -1220	1110	GS-15	1180 -1300	1240
GL-16	1000 -1220	1091	GS-16	1180 -1320	1248
GL-17	1080 -1280	1160	GS-17	1200 -1360	1285
GL-18	960 -1220	1067	GS-18	1180 -1320	1263
GL-19	980 -1300	1179	GS-19	1160 -1380	1270
GL-20	1080 -1220	1162	GS-20	1100 -1300	1211
GL-21	960 -1100	1033	GS-21	1160 -1260	1215
GL-22	960 -1100	1031	GS-22	1180 -1300	1220
GL-23	1020 -1200	1115	GS-23	1160 -1240	1203
GL-24	1080 -1220	1140	GS-24	1160 -1260	1218
GL-25	960 -1160	1047	GS-25	1160 -1240	1205
GL-26	960 -1200	1054	GS-26	1140 -1220	1171
GL-27	980 -1100	1046	GS-27	1180 -1320	1236
GL-28	1000 -1200	1085	GS-28	1180 -1260	1217
GL-29	1080 -1240	1146	GS-29	1200 -1300	1240
GL-30	960 -1100	1035	GS-30	1140 -1260	1211
Overall mean		1092 ±6 g [a]			1250 ± 5 g [b]

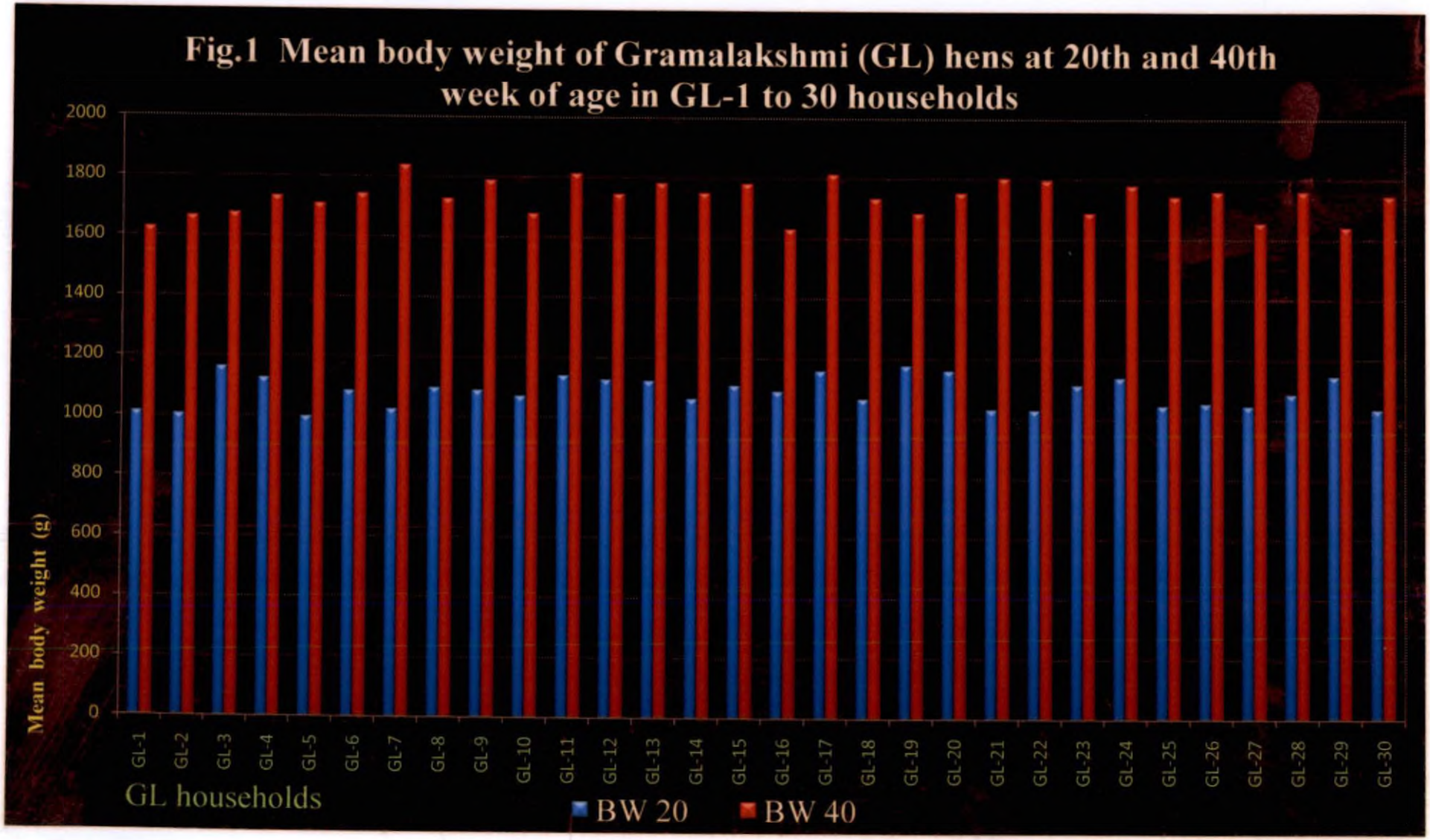
Mean values bearing different superscripts differed significantly ($P<0.05$)

Table 10. Mean body weight and its range (g) in Gramalakshmi and Gramasree hens under backyard system in GL-1 to 30 and GS-1 to 30 households at 40 weeks of age

Gramalakshmi (GL)			Gramasree (GS)		
Household Code no.	Body weight (g) range	Household mean body weight (g)	Household Code no.	Body weight (g) range	Household mean body weight (g)
GL-1	1580 -1700	1628	GS-1	1860 -2120	1953
GL-2	1580 -1740	1667	GS-2	1780 -1980	1898
GL-3	1640 -1720	1677	GS-3	1880 -2100	1983
GL-4	1680 -1800	1734	GS-4	1680 -1880	1800
GL-5	1660 -1740	1710	GS-5	1780 -2020	1894
GL-6	1680 -1800	1743	GS-6	1780 -1940	1874
GL-7	1820 -1860	1840	GS-7	1780 -1940	1860
GL-8	1680 -1780	1728	GS-8	1640 -1820	1720
GL-9	1760 -1820	1790	GS-9	1800 -2120	1969
GL-10	1640 -1720	1680	GS-10	1840 -1940	1872
GL-11	1680 -1920	1814	GS-11	1780 -1920	1863
GL-12	1680 -1800	1747	GS-12	1920 -2100	1977
GL-13	1680 -1840	1783	GS-13	1780 -1900	1832
GL-14	1680 -1820	1751	GS-14	1880 -2100	1989
GL-15	1760 -1820	1783	GS-15	1880 -2020	1948
GL-16	1580 -1680	1632	GS-16	1960 -2160	2020
GL-17	1780 -1860	1816	GS-17	1780 -1940	1863
GL-18	1680 -1800	1735	GS-18	1860 -2040	1957
GL-19	1580 -1780	1686	GS-19	1880 -2100	1989
GL-20	1680 -1800	1755	GS-20	1780 -2120	1906
GL-21	1760 -1860	1804	GS-21	1860 -2040	1969
GL-22	1720 -1880	1797	GS-22	1860 -2060	1969
GL-23	1640 -1760	1689	GS-23	1920 -2100	2011
GL-24	1740 -1840	1780	GS-24	1760 -1980	1843
GL-25	1680 -1820	1743	GS-25	1800 -2120	1983
GL-26	1680 -1840	1760	GS-26	1780 -1920	1845
GL-27	1580 -1720	1656	GS-27	1680 -1860	1780
GL-28	1680 -1840	1760	GS-28	1660 -1900	1774
GL-29	1580 -1780	1643	GS-29	1680 -1940	1803
GL-30	1640 -1840	1746	GS-30	1680 -1860	1774
Overall mean		1739 ± 5 g [a]			1900 ± 7 g [b]

Mean values bearing different superscripts differed significantly ($P<0.05$)

Fig.1 Mean body weight of Gramalakshmi (GL) hens at 20th and 40th week of age in GL-1 to 30 households



1-42997

Fig 2. Mean body weight (g) of Gramasree(GS) hens at 20th and 40th week of age n GS 1 to 30 households

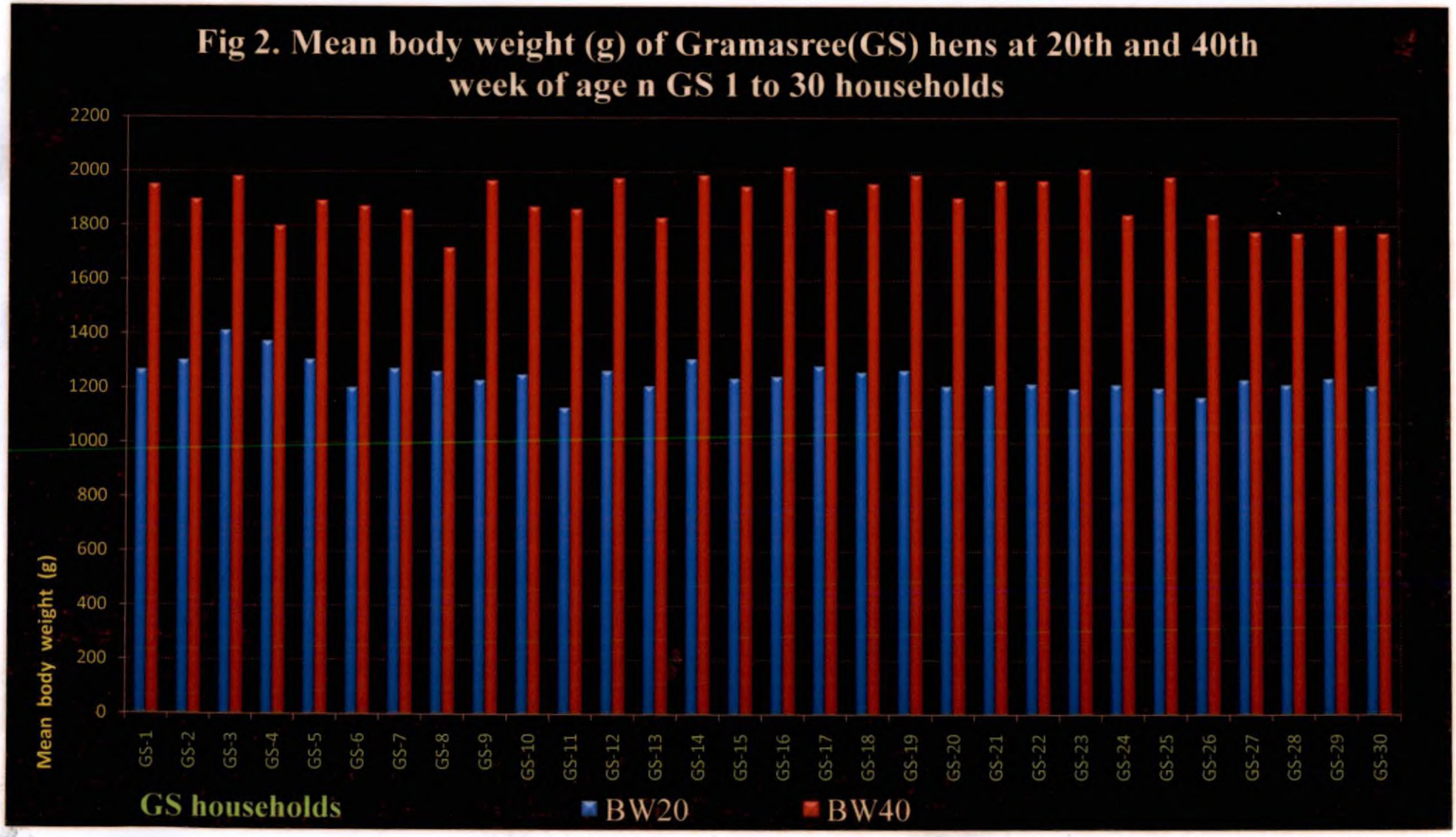


Plate 10. Body weight and Egg weight of GL and GS hens were recorded by visiting the households under study . Boold collection at 20th and 40th week was done for estimation of hematological and serum biochemical parameters.

The overall mean BW_{40} for GL group was 1739 ± 5 g and it was significantly lower than that in GS group with a value of 1900 ± 7 g ($P<0.05$). The mean BW_{40} in the GL households ranged from 1628g (GL-1) to 1840g (GL-7.) and that in GS group ranged from 1720g (GS-8) to 2020 g (GS-16).

The distribution of BW_{20} of GL and GS hens is presented in Table 11 and the graphical representation is given in Fig.3. Out of the total 226 pullets, the distribution of BW_{20} in GL hens revealed that there were 14.16 per cent (32) hens below 1000 g, 51.33 per cent (116) between 1001 to 1100 g, 23.01 per cent (52) between 1101 to 1200 g and 11.5 per cent (26) between 1201 to 1300 g. There were no hens having BW_{20} above 1300 g in GL group. In the GS group, out of the total 233 hens, the distribution of the hens in BW classes <1000g, 1001 to 1100 g, 1101 to 1200 g and 1201 to 1300 g were 0.43 per cent (1), 0.86 per cent (2), 29.61 per cent (69) and 48.93 per cent (114) respectively. There were 16.31 per cent (38) hens between 1301 to 1400 g and 3.86 per cent (9) hens having body weight above 1400 g.

Out of the total 189 hens, the distribution of BW_{40} in GL hens (Table 10 and Fig. 3) revealed that there were 4.76 per cent (9) hens having BW of <1600 g, 28.57 per cent (54) between 1601 to 1700 g, 49.74 per cent (94) between 1701 to 1800 g, 16.40 per cent (31) between 1801 to 1900 g and 0.53 per cent (1) between 1901 to 2000 g. There were no hens having body weight above 2000 g in GL group. In the case of GS hens, out of the total 204 hens none of them fall in the category of <1600 g at 40 weeks of age. There were 4.41 per cent (9) hens between 1601 to 1700 g, 16.18 per cent (33) between 1701 to 1800 g, 29.90 per cent (61) between 1801 to 1900 g, 31.86 per cent (65) between 1901 to 2000 g and 17.65 per cent (36) above 2000 g at 40 weeks of age in GS group.

4.5.2 Age at first egg (AFE)

The average AFE expressed in days and weeks in all the households is presented in Table 12 and is graphically represented in Fig.4. The AFE in days ranged from 162 to 207 days in GL and from 159 to 209 days in GS units.

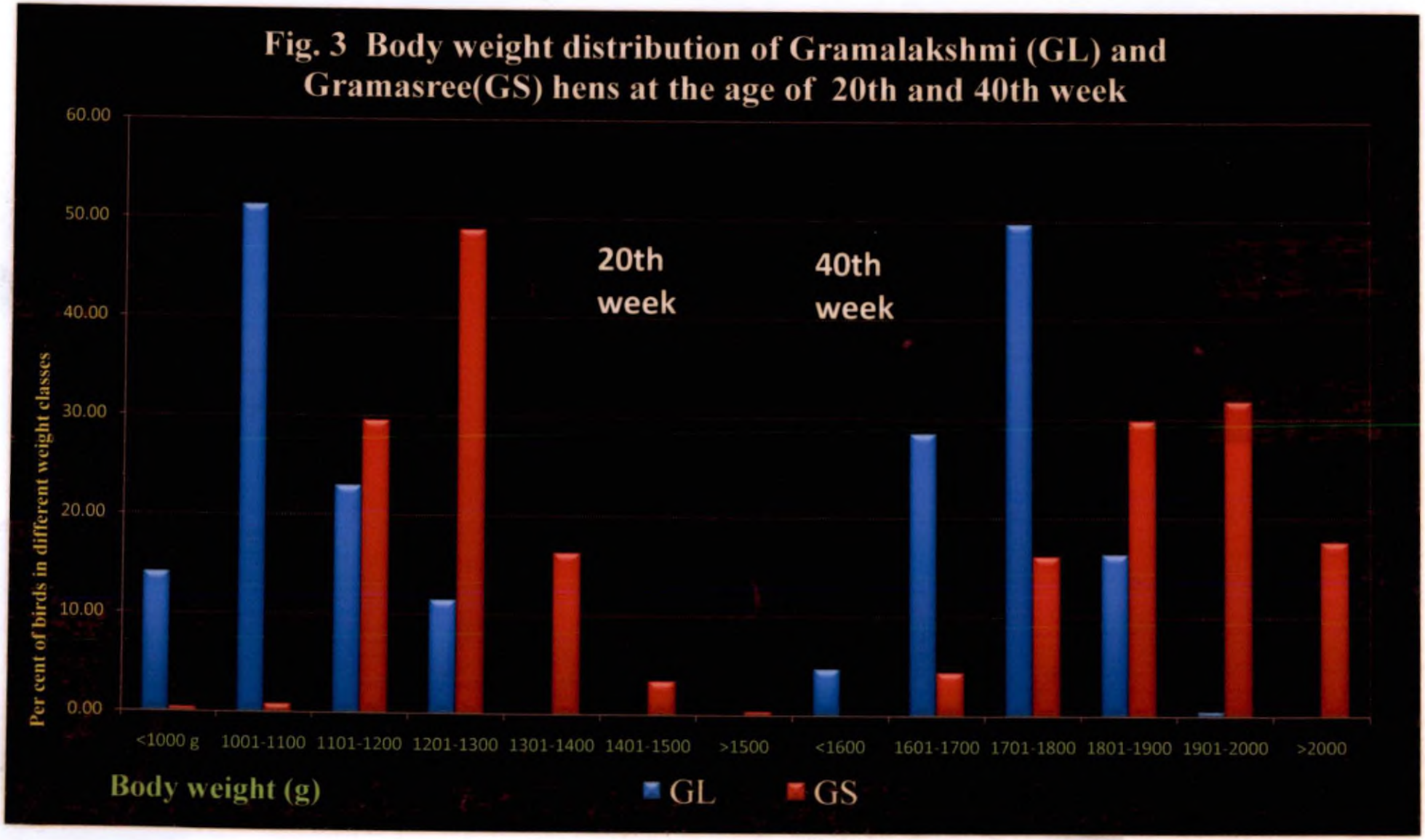
Table 11. Frequency distribution of body weight in Gramalakshmi and Gramasree hens under backyard system of rearing 20th and 40th week of age

20th week Body weight classes	Gramalakshmi (GL)		Gramasree (GS)	
	Number of hens	Per cent	Number of hens	Per cent
<1000 g	32	14.16	1	0.43
1001-1100	116	51.33	2	0.86
1101-1200	52	23.01	69	29.61
1201-1300	26	11.50	114	48.93
1301-1400	-	-	38	16.31
1401-1500	-	-	8	3.43
>1500	-	-	1	0.43
Total	226	100	233	100
40th week Body weight classes	Number of hens	Per cent	Number of hens	Per cent
<1600	9	4.76	-	-
1601-1700	54	28.57	9	4.41
1701-1800	94	49.74	33	16.18
1801-1900	31	16.40	61	29.90
1901-2000	1	0.53	65	31.86
>2000	-	-	36	17.65
Total	189	100	204	100

Table 12. Age at First Egg (days-weeks) recorded in Gramalakshmi and Gramasree hens under back yard system of rearing in GL-1 to 30 and GS-1 to 30 households

Gramalakshmi (GL)			Gramasree (GS)		
Code no.	AFE in days	AFE in weeks	Code no.	AFE in days	AFE in weeks
GL-1	168	24	GS-1	168	24
GL-2	169	25	GS-2	174	25
GL-3	167	24	GS-3	159	23
GL-4	197	29	GS-4	209	30
GL-5	191	28	GS-5	176	26
GL-6	188	27	GS-6	176	26
GL-7	185	27	GS-7	172	25
GL-8	169	25	GS-8	182	26
GL-9	171	25	GS-9	180	26
GL-10	207	30	GS-10	198	29
GL-11	171	25	GS-11	166	24
GL-12	169	25	GS-12	182	26
GL-13	194	28	GS-13	165	24
GL-14	183	27	GS-14	170	25
GL-15	164	24	GS-15	195	28
GL-16	165	24	GS-16	192	28
GL-17	170	25	GS-17	194	28
GL-18	180	26	GS-18	161	23
GL-19	169	25	GS-19	182	26
GL-20	180	26	GS-20	183	27
GL-21	170	25	GS-21	160	23
GL-22	184	27	GS-22	181	26
GL-23	186	27	GS-23	174	25
GL-24	172	25	GS-24	170	25
GL-25	170	25	GS-25	175	25
GL-26	164	24	GS-26	185	27
GL-27	162	24	GS-27	181	26
GL-28	163	24	GS-28	176	26
GL-29	195	28	GS-29	196	28
GL-30	191	28	GS-30	190	28
Overall mean	177.1±2.2				179.7± 2.2

Fig. 3 Body weight distribution of Gramalakshmi (GL) and Gramasree(GS) hens at the age of 20th and 40th week



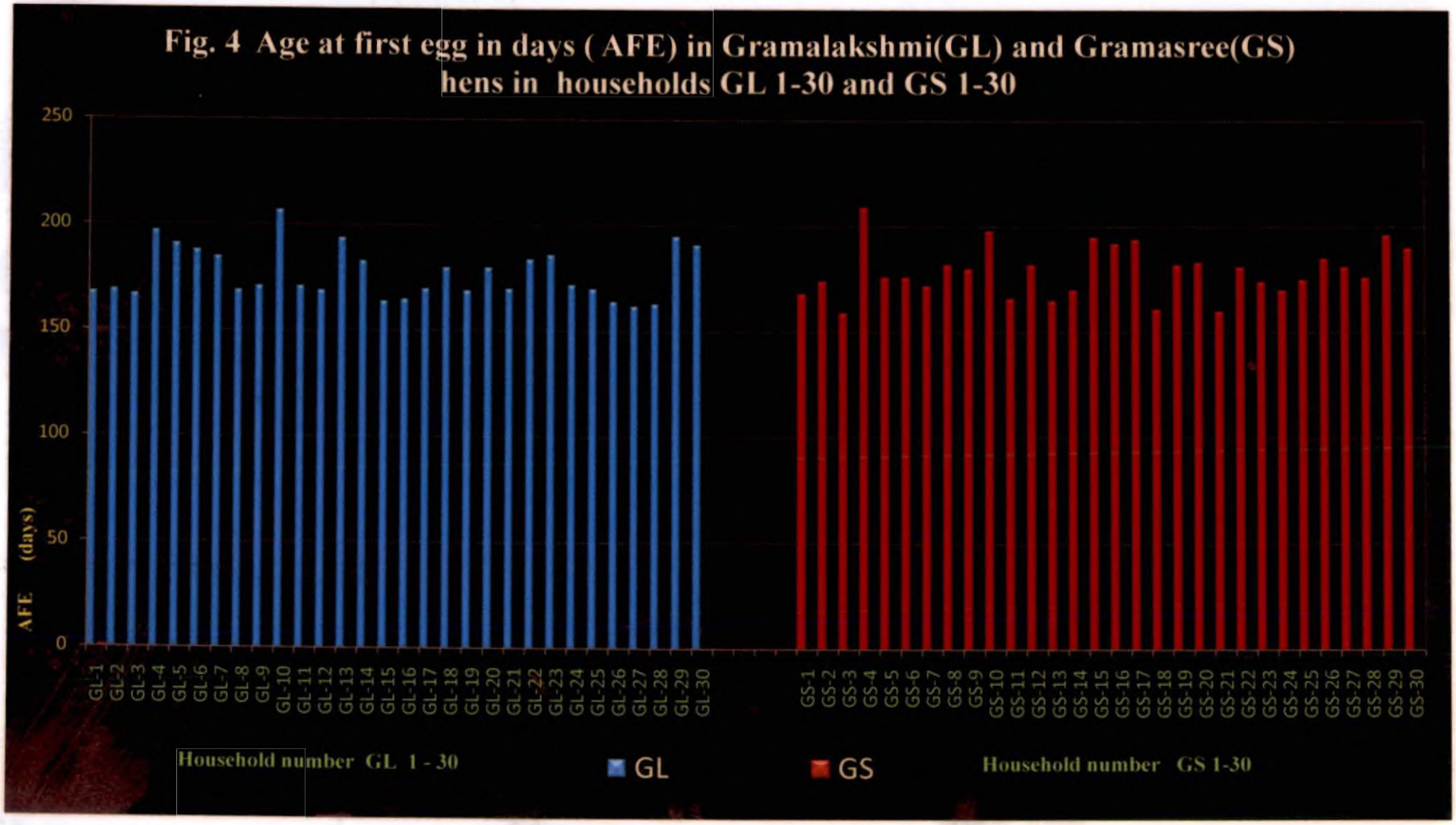


Fig. 4 Age at first egg in days (AFE) in Gramalakshmi(GL) and Gramasree(GS) hens in households GL 1-30 and GS 1-30
250
200
150
100
50
0
AFE (days)
GL-1 GL-2 GL-3 GL-4 GL-5 GL-6 GL-7 GL-8 GL-9 GL-10 GL-11 GL-12 GL-13 GL-14 GL-15 GL-16 GL-17 GL-18 GL-19 GL-20 GL-21 GL-22 GL-23 GL-24 GL-25 GL-26 GL-27 GL-28 GL-29 GL-30
GS-1 GS-2 GS-3 GS-4 GS-5 GS-6 GS-7 GS-8 GS-9 GS-10 GS-11 GS-12 GS-13 GS-14 GS-15 GS-16 GS-17 GS-18 GS-19 GS-20 GS-21 GS-22 GS-23 GS-24 GS-25 GS-26 GS-27 GS-28 GS-29 GS-30
Household number GL 1 - 30
GL
GS
Household number GS 1-30

The average AFE in GL and GS groups were 177.13 ± 2.21 and 179.07 ± 2.22. The earliest age at first egg recorded in group GL was in unit GL 27 and that in GS group was in GS 3. The high values of AFE at 207 and 209 days of age in GS 4 and GL 10 indicated late sexual maturity in these groups. In GL group the hens attained 10 per cent production at 169 days of age and that in GS group was 165 days. The hens in GL group attained 50 per cent production at 174 days of age and GS hens attained 50 per cent production in 173 days of age.

4.5.3 Egg production

4.5.3.1 Hen housed egg production

Weekly and cumulative mean hen housed egg number and per cent production from 24 to 40 weeks of age in GL and GS hens under backyard system of rearing in 30 households each were recorded from the daily egg production data collected from the farmers.

Weekly hen housed egg number and per cent production

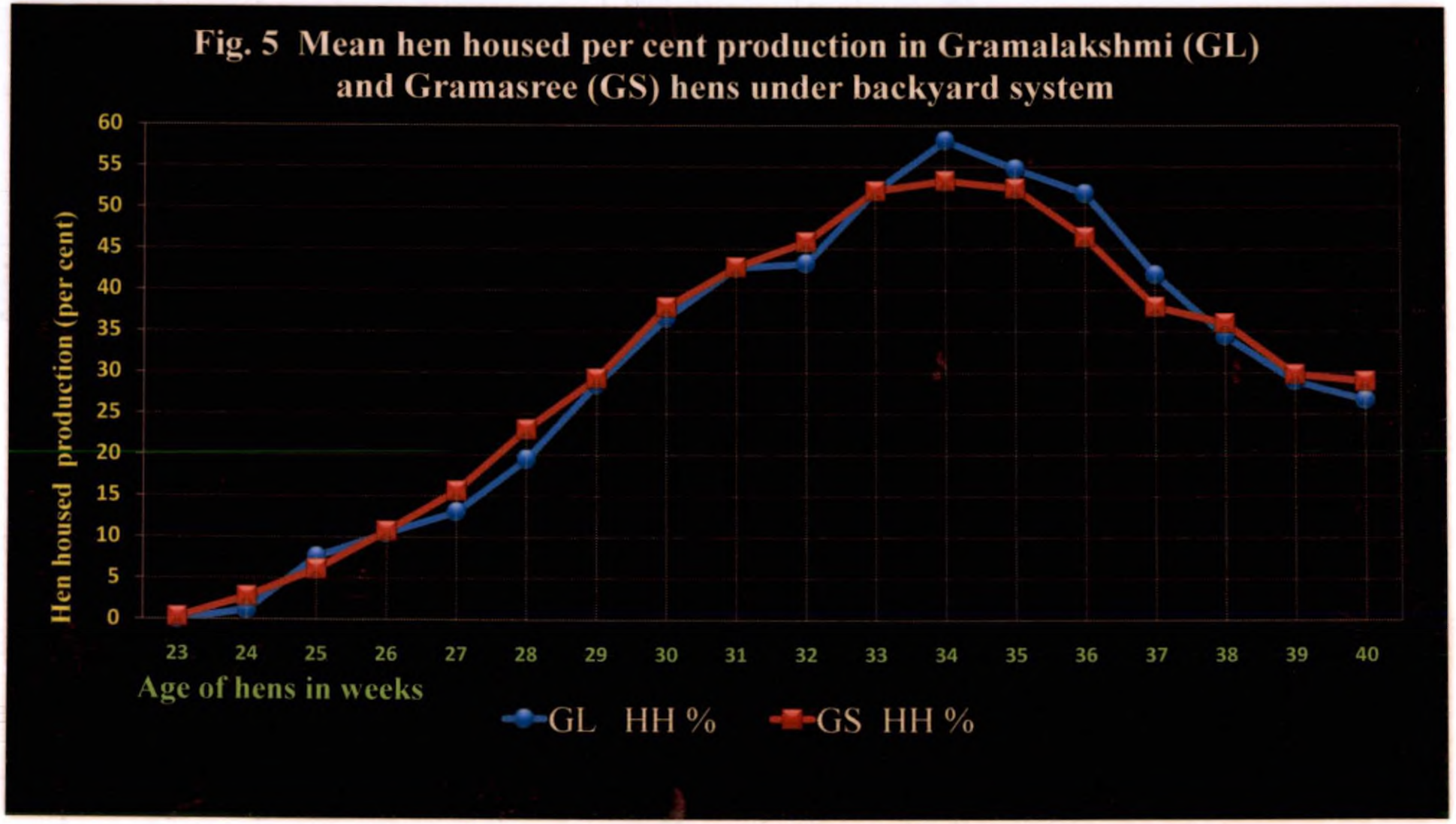
Weekly hen housed egg number (Table 13) in GL group during 24 week of age was 0.08 and at the end of the study at 40 weeks of age it was 1.87. The weekly egg number reached peak production at 34th week with weekly egg number of 4.07. The cumulative weekly egg number in GL group for the period from 24 to 40 week was 38.63. In the case of GS group, the peak production was attained at 34th week of age and the weekly egg number was 3.73. The cumulative hen housed egg number up to 40 weeks of age was 38.60 eggs per hen.

Weekly hen housed percent production in GL and GS hens are graphically represented in Fig.5. In GL group the egg production started in 24th week (1.2 per cent) and increased to 7.65, 10.49, 13.08 19.47, 28.57 and 36.66 per cent in 25, 26, 27 28, 29 and 30 weeks of age respectively. There after HH per cent was 42.73, 43.24 and 52.02 in 31, 32 and 33 weeks, respectively and the peak production in GL group was at 34 weeks of age (58.15 per cent).

Table 13. Week-wise egg number and per cent production on hen housed and hen day basis in Gramalakshmi and Gramasree hens under backyard system of rearing for the period from 23 to 40 weeks of age

Age of hens in weeks	Gramalakshmi (GL)				Gramasree (GS)			
	Hen housed egg production		Hen day egg production		Hen housed egg production		Hen day egg production	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
23	-	-	-	-	0.02	0.31	0.02	0.31
24	0.08	1.20	0.08	1.21	0.20	2.82	0.20	2.83
25	0.54	7.65	0.54	7.74	0.43	6.13	0.43	6.18
26	0.73	10.49	0.75	10.68	0.75	10.73	0.76	10.82
27	0.92	13.08	0.93	13.35	1.09	15.63	1.11	15.82
28	1.36	19.47	1.40	20.00	1.62	23.11	1.64	23.42
29	2.00	28.57	2.07	29.62	2.05	29.31	2.08	29.69
30	2.57	36.66	2.71	38.67	2.66	37.95	2.72	38.91
31	2.99	42.73	3.26	46.52	3.00	42.80	3.17	45.27
32	3.03	43.24	3.34	47.67	3.21	45.86	3.40	48.57
33	3.64	52.02	4.10	58.62	3.64	52.05	3.91	55.89
34	4.07	58.15	4.69	67.01	3.73	53.28	4.08	58.28
35	3.83	54.74	4.43	63.35	3.67	52.36	4.01	57.28
36	3.62	51.77	4.22	60.31	3.25	46.47	3.56	50.84
37	2.93	41.91	3.42	48.82	2.66	38.01	2.91	41.58
38	2.41	34.45	2.81	40.13	2.52	36.05	2.77	39.54
39	2.03	29.01	2.40	34.30	2.09	29.86	2.34	33.38
40	1.87	26.74	2.24	31.97	2.03	29.00	2.32	33.12
Mean 24-40 wk	38.63 ± 0.94	32.46 ± 0.79	42.28 ± 0.77	35.53 ± 0.68	38.60 ± 0.82	32.44 ± 0.69	40.82 ± 0.80	34.30 ± 0.67

Fig. 5 Mean hen housed per cent production in Gramalakshmi (GL) and Gramasree (GS) hens under backyard system



The HH production gradually declined to 54.74, 51.77, 41.91 and 34.45 per cent at 35, 36, 37 and 38 weeks of age. The production at 39 and 40th week of age was 29.01 and 26.74 per cent. The overall mean from 24 to 40 weeks of age in all households GL 1 to 30 put together was 32.46 per cent.

In GS group the egg production started at 23 weeks of age with HH percent of 0.31 and increased to 2.82, 6.13 and 10.73 per cent in 24, 25 and 26 weeks of age. The production was 15.63, 23.11, 29.31, 37.95, 42.80 and 45.86 per cent from 27 to 32 weeks of age. The production gradually increased to 52.05 per cent at 33 weeks of age and reached peak at 34 weeks (53.28 per cent). The production decreased to 52.36, 46.47, 38.09, and 36.05 in 35, 36, 37 and 38 weeks of age respectively. At the age of 39 and 40 weeks of age the per cent were 29.86 and 29.00. The overall mean from 24 to 40 weeks of age in all households GS-1 to 30 put together was 32.44 per cent.

Cumulative hen housed egg number and per cent production

Cumulative mean hen housed egg number (Table 14) among households ranged from 23.29 to 46.85 with an overall mean value of 38.63 eggs per hen in GL group. The lowest mean was recorded in GL-10 and highest in GL-22. In GS group the egg number ranged from 30.57 (GS- 4) to 52.57 (GS-18) with an overall mean of 38.60.

The household wise hen housed per cent production (Table 14) in GL group ranged from 19.57 per cent in GL-10 to 39.37 per cent in GL-22 with a mean of 32.46 per cent. In GS group the hen housed production ranged from 25.69 per cent in GS- 4 to 44.18 per cent in GS-18 households with a mean of 32.44 per cent.

4.5.3.2 Hen day egg production

Weekly hen day egg number and percent production

Weekly hen day egg number (Table 12) in GL group during 24 week of age was 0.08 and at the end of the study at 40 weeks of age it was 2.24.

Table 14. Household-wise egg number and per cent production on hen housed and hen day basis in Gramalakshmi and Gramasree hens in GL-1 to 30 and GS-1 to 30 households from 24 to 40 weeks

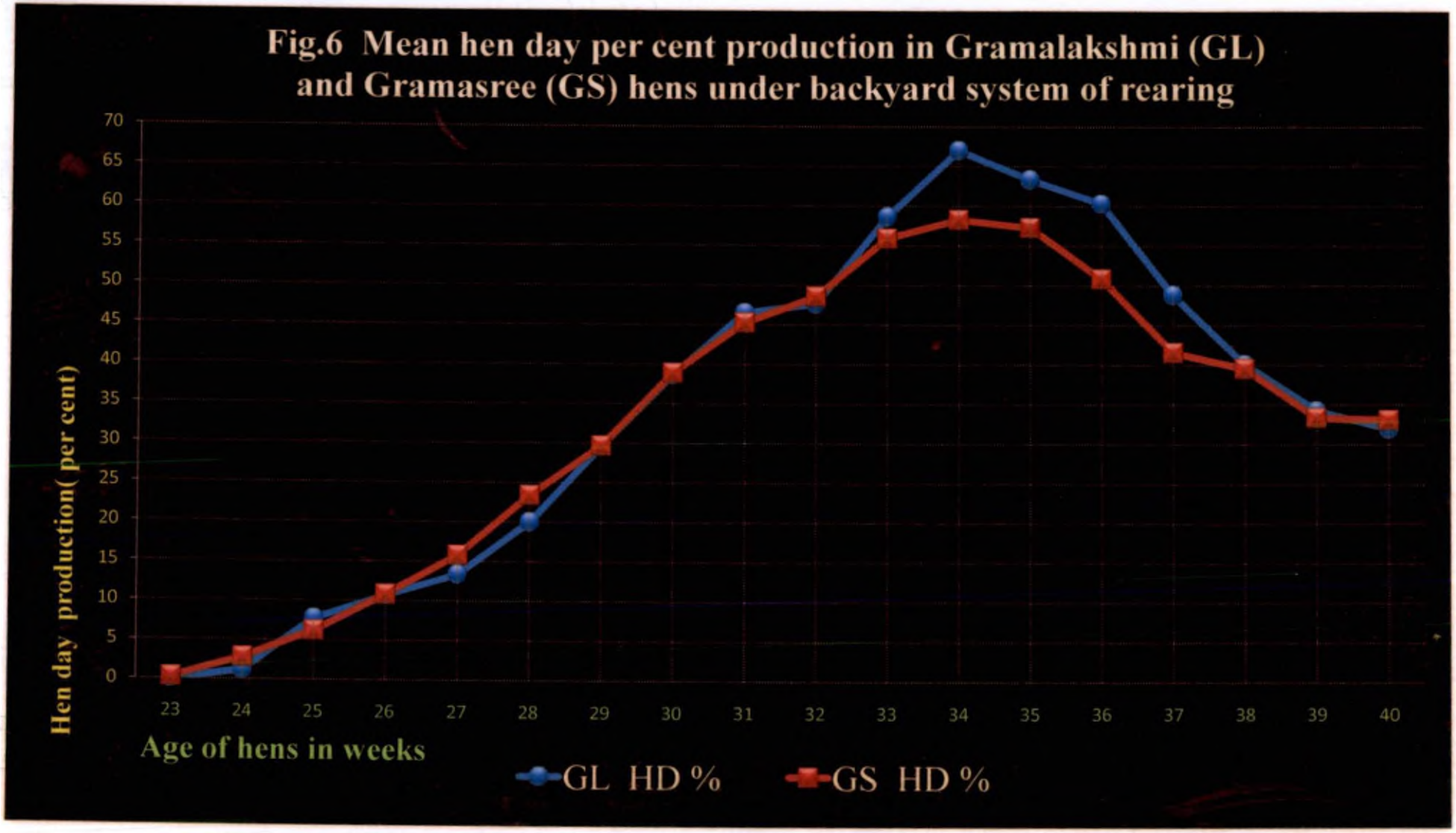
Gramalakshmi (GL)					Gramasree (GS)				
Code no.	Hen housed egg production		Hen day egg production		Code no.	Hen housed egg production		Hen day egg production	
	Number	Per cent	Number	Per cent		Number	Per cent	Number	Per cent
GL-1	39.29	33.02	49.54	41.63	GS-1	40.44	33.99	41.14	34.57
GL-2	44.14	37.09	47.20	39.67	GS-2	37.10	31.18	39.88	33.51
GL-3	39.33	33.05	43.52	36.57	GS-3	40.44	33.99	42.47	35.98
GL-4	37.87	31.82	38.36	32.23	GS-4	30.57	25.69	36.85	30.97
GL-5	30.83	25.91	39.31	33.04	GS-5	35.00	29.41	35.41	29.76
GL-6	44.83	37.68	44.83	37.68	GS-6	35.50	29.83	38.36	32.24
GL-7	43.60	36.64	43.60	36.64	GS-7	39.13	32.88	41.39	34.78
GL-8	33.57	28.21	43.02	36.15	GS-8	37.75	31.72	39.84	33.48
GL-9	39.13	32.88	47.45	39.87	GS-9	38.13	32.04	40.46	34.00
GL-10	23.29	19.57	31.64	26.59	GS-10	35.00	29.41	38.93	32.71
GL-11	40.63	34.14	42.83	35.99	GS-11	43.57	36.61	50.48	42.42
GL-12	36.13	30.36	43.26	36.35	GS-12	38.00	31.93	38.32	32.20
GL-13	32.13	27.00	37.94	31.89	GS-13	32.57	27.37	39.49	33.19
GL-14	38.50	32.35	40.91	34.38	GS-14	45.57	38.30	45.57	38.30
GL-15	37.67	31.65	40.14	33.73	GS-15	41.00	34.45	41.00	34.45
GL-16	32.71	27.49	40.13	33.73	GS-16	35.13	29.52	40.00	33.61
GL-17	39.43	33.13	46.59	39.15	GS-17	35.00	29.41	35.48	29.82
GL-18	42.00	35.29	42.44	35.29	GS-18	52.57	44.18	52.57	44.18
GL-19	35.50	29.83	40.86	34.34	GS-19	34.75	29.20	35.04	29.45
GL-20	36.33	30.53	36.33	30.53	GS-20	40.14	33.73	40.14	33.73
GL-21	40.66	34.17	40.66	34.17	GS-21	46.50	39.08	51.71	43.57
GL-22	46.85	39.37	46.85	39.38	GS-22	37.88	31.83	40.24	33.82
GL-23	38.00	31.93	38.40	32.27	GS-23	36.88	30.99	37.35	31.38
GL-24	37.37	31.40	48.28	40.57	GS-24	42.38	35.61	45.69	38.39
GL-25	46.17	38.80	46.17	38.80	GS-25	37.63	31.62	39.67	33.33
GL-26	43.28	36.37	45.24	38.02	GS-26	39.00	32.77	39.26	32.99
GL-27	40.28	33.85	45.23	38.01	GS-27	36.89	31.00	40.15	33.74
GL-28	46.75	39.29	46.75	39.29	GS-28	41.86	35.17	41.86	35.17
GL-29	40.28	33.85	40.28	33.85	GS-29	33.38	28.05	38.19	32.09
GL-30	34.87	29.30	35.28	29.65	GS-30	40.71	34.21	40.71	34.21
Mean	38.63	32.46	42.28	35.53	Mean	38.60	32.44	40.82	34.30

The peak production was at 34th week with weekly egg number of 4.69. The cumulative weekly egg number in GL group for the period from 24 to 40 week was 42.28. In GS group the egg number at 23rd week age was 0.02 and at 40th week it was 2.32. The peak production was at 34th week and the weekly egg number was 4.08. The cumulative hen housed egg number for the period from 23 to 40 weeks of age was less than that of GL group and was 40.82.

With respect to percent production (Table 12 and Fig.6), in GL group the egg production started in 24th week (1.21 per cent) and it increased to 7.74, 10.68,13.35, 20.00, 29.62 and 38.67 at 25, 26, 27, 28, 29 and 30 weeks of age respectively. There after HD per cent was 46.52, 47.67 and 58.62 per cent at 31, 32 and 33 weeks of age. The peak production in GL group was recorded at 34 weeks of age. (67.01 per cent). The HD production gradually declined to 63.35, 60.31, 48.82 and 40.13 per cent at 35, 36, 37 and 38 weeks of age. The egg production was above 55 per cent consecutively for four weeks from 33 to 36 weeks of age. The production at 39 and 40th week of age was less than 40 per cent. (34.30 and 31.97 per cent). The overall mean from 24 to 40 weeks of age in all households GL 1 to 30 put together was 35.53 ± 0.68 per cent.

In GS group (Table 12 and Fig.6), the egg production started at 23 weeks of age with HD percent of 0.31 and increased to 2.83, 6.18 and 10.82 per cent in 24, 25 and 26 weeks of age. The production was 15.82, 23.42, 29.69, 38.91, 45.27 and 48.57 per cent from 27 to 32 weeks of age. The production gradually increased to 55.89 per cent at 33 weeks of age and reached peak at 34 weeks (58.28 per cent) as in the case of GL group. The production was 57.28 per cent in 35th week. The high level production of more than 55 percent was maintained only for three weeks. (33, 34 and 35). The production decreased to 50.84, 41.58, and 39.54 in 36, 37 and 38 weeks of age respectively. At the age of 39 and 40 weeks of age the per cent was almost same. (33.38 and 33.12). The overall mean from 24 to 40 weeks of age in all households GS 1 to 30 put together was 34.30 ± 0.67 per cent.

Fig.6 Mean hen day per cent production in Gramalakshmi (GL) and Gramasree (GS) hens under backyard system of rearing



Cumulative hen day egg number and per cent production

The cumulative mean hen day egg number among households ranged from 31.64 to 49.54 with an overall mean value of 42.28 eggs per hen in GL group (Table 14). The lowest mean was recorded in GL-10 and highest in GL-1. In GS group, the egg number ranged from 35.04 (GS–19) to 52.57 (GS–18) with an overall mean of 40.82 per cent.

The household wise cumulative hen day production in GL group ranged from 26.59 per cent in GL-10 to 41.63 per cent in GL-1 with a mean of 35.53 per cent. In GS group, the hen day production ranged from 29.45 per cent in GS- 19 to 44.18 per cent in GS-18 household with a mean of 34.40 per cent. The overall mean household wise cumulative hen day production in Gramalakshmi and Gramasree groups were statistically comparable.

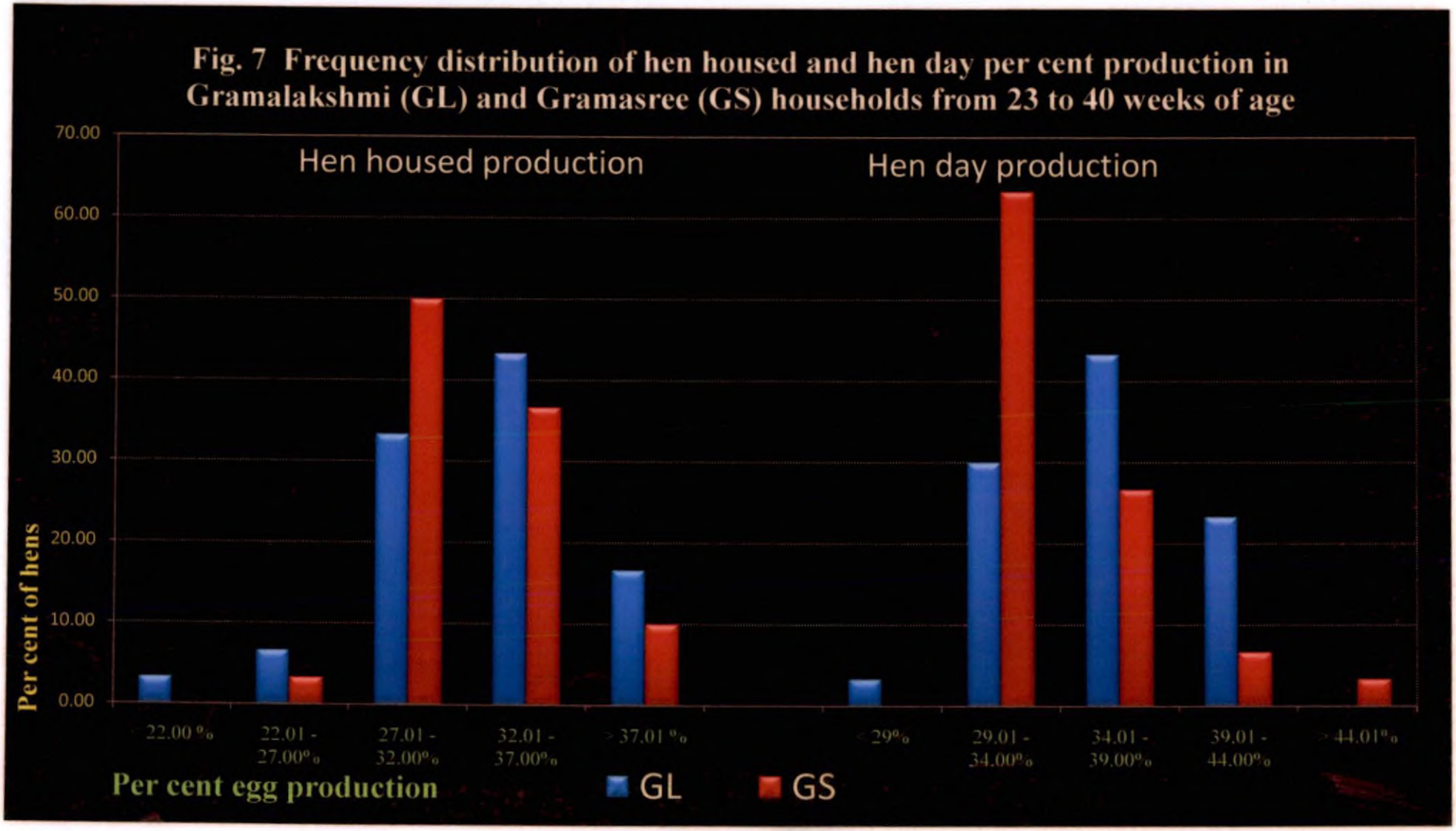
The classification of the households based on hen housed per cent production (Table 15 and Fig. 7) revealed that out of the 30 households, three households (10 per cent) in GL group showed poor egg production at the level of less than 27 per cent. In 10 households (33.33 per cent) the HH production per cent was average and was between 28 to 32 per cent and in 12 households (40.0 per cent) the production was good between 32.01 to 37 per cent and that in five households (16.7 per cent) HH per cent was high and above 37 per cent. In GS group, the hen housed production per cent was poor in one household (GS-4) with 25.69 per cent. In 15 households (50 per cent) the HH production was average in the class 27 to 32 per cent. 11 households (36.67 per cent) showed good production between 32.01 to 37 per cent. Three households (GS-18, GS-21 and GS-14) showed higher HH production in the class above 37 per cent.

The classification of the households based on hen day per cent production (Table 15 and Fig. 7) revealed that in nine households (30.0 per cent), the HD per cent production was average and was between 29.01 and 34 per cent. In 13 households (43.33 per cent) production was good and between 34.01 and 39 per cent.

Table 15. Frequency distribution of hen housed and hen day egg production per cent in Gramalakshmi and Gramasree households under backyard system of rearing

Hen housed per cent classes		Gramalakshmi (GL)		Gramasree (GS)	
		Number	Per cent	Number	Per cent
< 22.00	Poor	1	3.33	-	-
22.01 - 27.00		2	6.67	1	3.33
27.01 - 32.00	Average	10	33.33	15	50.00
32.01 - 37.00	Good	13	43.33	11	36.67
> 37.01	High	5	16.67	3	10.00
Hen housed per cent classes		Number	Per cent	Number	Per cent
< 29	Poor	1	3.33	-	-
29.01 - 34.00	Average	9	30.00	19	63.33
34.01 - 39.00	Good	13	43.33	8	26.67
39.01 - 44.00	High	7	23.33	2	6.67
> 44.01		-	-	1	3.33

Fig. 7 Frequency distribution of hen housed and hen day per cent production in Gramalakshmi (GL) and Gramasree (GS) households from 23 to 40 weeks of age



Higher productivity ranging from 39.01 to 44 per cent was observed in seven households (23.33 per cent). In GS group there were no poor producers. The hen day egg production per cent in 63.33 per cent of households (19) was average (29.01 to 34 per cent) and the number households in this category in GS group was double than that of GL group. But good egg production class between 34.01 to 39 per cent was low in GS group and the number of households in that group was eight. In three households the HD egg production per cent was higher.

4.5.4 Egg Weight (EW)

4.5.4.1 Pullet Egg Weight (PEW)

Overall mean weight of all the eggs collected from the GL and GS households at commencement of lay is presented in Table 16 and the graphical representation is shown in Figure 8 and 9. The procedure is illustrated in Plate 10. In GL group, the highest individual egg weight at commencement of lay was recorded in GL- 22 (38.2 g) and the lowest in GL 5 (29.5) with an overall mean of 34.0 ± 0.3 g in households GL-1to 30. The overall mean egg weight in GL households was highest in GL- 22 (37.1 g) and was lowest in GL-5 (31.0 g). In GS group, the highest individual egg weight at commencement of lay was recorded in GS- 28 (36.8 g) and the lowest in GS-3 (28.2 g) with an overall mean of 33.1±0.2 g in households GS-1to 30. The highest overall mean egg weight in GS households was 35.0 g recorded in GS-28 and GS-8 and the lowest mean was 30.2 g recorded in GS-3. The household -wise mean pullet egg weight recorded in GL group was significantly higher than that in GS group $P<0.05$). The highest and lowest individual pullet egg weights in both the groups were recorded in households with highest and lowest mean egg weights.

4.5.4.2 Egg weight at 30 weeks of age (EW_{30})

The mean EW_{30} is presented in Table 16 and the graphical representation is done in Fig 8 and 9. Out of the total 210 eggs from GL units, the highest individual egg weight at EW_{30} was recorded in GL- 12 (53.0 g) and the lowest in GL 10 (39.8 g) with an overall mean of 47.2g ± 0.2 g.

Table 16. Mean egg weight (g) at pullet age and at 30th and 40th week in Gramalakshmi and Gramasree hens under backyard system in GL-1 to 30 and GS-1 to 30 households

Gramalakshmi (GL)				Gramasree (GS)			
Code no.	Pullet egg weight (g)	30th week egg weight (g)	40th week egg weight (g)	Code no.	Pullet egg weight (g)	30th week egg weight (g)	40th week egg weight (g)
GL-1	34.9 ± 0.3	48.2 ± 0.4	53.6 ± 0.4	GS-1	31.3 ± 0.3	43.0 ± 0.2	48.5 ± 0.4
GL-2	36.2 ± 0.3	50.7 ± 0.5	56.2 ± 0.5	GS-2	32.6 ± 0.2	46.8 ± 0.2	53.2 ± 0.4
GL-3	35.2 ± 0.3	49.3 ± 0.3	53.8 ± 0.3	GS-3	30.2 ± 0.6	48.0 ± 0.6	53.3 ± 0.3
GL-4	32.6 ± 0.5	44.9 ± 0.6	50.6 ± 0.6	GS-4	31.3 ± 0.5	40.4 ± 0.5	47.4 ± 0.6
GL-5	31.0 ± 0.4	43.7 ± 0.4	48.3 ± 0.4	GS-5	33.2 ± 0.2	46.4 ± 0.4	53.4 ± 0.5
GL-6	32.9 ± 0.2	45.0 ± 0.4	52.8 ± 0.6	GS-6	32.2 ± 0.5	46.3 ± 0.4	52.9 ± 0.3
GL-7	31.4 ± 0.5	44.5 ± 0.5	52.7 ± 0.8	GS-7	33.4 ± 0.4	47.4 ± 0.4	54.6 ± 0.4
GL-8	35.2 ± 0.3	49.5 ± 0.4	54.2 ± 0.2	GS-8	35.0 ± 0.4	45.9 ± 0.5	52.9 ± 0.3
GL-9	34.6 ± 0.3	50.7 ± 0.4	59.6 ± 0.3	GS-9	33.4 ± 0.3	47.9 ± 0.3	53.4 ± 0.3
GL-10	35.2 ± 0.3	44.9 ± 1.0	49.6 ± 0.7	GS-10	32.8 ± 0.3	39.6 ± 0.6	48.5 ± 0.5
GL-11	31.7 ± 0.3	46.7 ± 0.5	51.8 ± 0.4	GS-11	31.0 ± 0.4	43.4 ± 0.3	49.1 ± 0.2
GL-12	32.6 ± 0.7	50.5 ± 0.6	54.0 ± 0.4	GS-12	33.7 ± 0.3	44.2 ± 0.5	48.5 ± 0.4
GL-13	35.8 ± 0.6	44.8 ± 0.6	50.9 ± 0.7	GS-13	32.8 ± 0.3	42.8 ± 0.5	47.2 ± 0.5
GL-14	32.7 ± 0.2	45.9 ± 0.4	53.4 ± 0.6	GS-14	33.2 ± 0.2	48.7 ± 0.5	53.7 ± 0.3
GL-15	34.1 ± 0.5	45.6 ± 0.3	52.1 ± 0.6	GS-15	34.0 ± 0.3	43.4 ± 0.4	48.9 ± 0.3
GL-16	35.7 ± 0.4	50.9 ± 0.3	58.0 ± 0.2	GS-16	33.1 ± 0.3	48.7 ± 0.8	53.2 ± 0.5
GL-17	33.5 ± 0.3	48.9 ± 0.4	56.2 ± 0.8	GS-17	33.5 ± 0.2	44.8 ± 0.3	51.6 ± 1.0
GL-18	33.5 ± 0.4	47.1 ± 0.9	55.2 ± 0.5	GS-18	33.3 ± 0.2	47.9 ± 0.4	52.4 ± 0.4
GL-19	33.1 ± 0.4	47.8 ± 0.7	54.6 ± 0.5	GS-19	32.9 ± 0.3	46.1 ± 0.6	52.0 ± 0.5
GL-20	35.7 ± 0.4	45.3 ± 0.8	55.0 ± 1.0	GS-20	33.2 ± 0.5	46.7 ± 0.3	52.7 ± 0.3
GL-21	34.3 ± 0.4	45.6 ± 0.2	55.2 ± 0.9	GS-21	33.7 ± 0.4	47.3 ± 0.4	51.9 ± 0.4
GL-22	37.1 ± 0.4	48.1 ± 0.3	55.2 ± 1.2	GS-22	34.0 ± 0.3	45.7 ± 0.5	52.2 ± 0.2
GL-23	35.3 ± 0.4	43.6 ± 0.5	54.7 ± 0.7	GS-23	32.8 ± 0.3	48.3 ± 0.4	53.1 ± 0.6
GL-24	32.2 ± 0.6	47.4 ± 0.6	56.6 ± 0.7	GS-24	32.4 ± 0.4	42.2 ± 0.4	46.4 ± 0.5
GL-25	34.7 ± 0.6	48.5 ± 0.4	57.3 ± 0.5	GS-25	32.0 ± 0.3	47.3 ± 0.3	52.2 ± 0.5
GL-26	36.4 ± 0.4	48.6 ± 0.3	56.3 ± 0.9	GS-26	34.3 ± 0.5	47.4 ± 0.4	50.8 ± 0.7
GL-27	31.5 ± 0.5	48.0 ± 0.5	57.3 ± 0.9	GS-27	33.3 ± 0.4	48.4 ± 0.5	53.9 ± 0.5
GL-28	32.9 ± 0.4	48.1 ± 0.6	56.2 ± 0.8	GS-28	35.0 ± 0.5	46.4 ± 0.3	51.3 ± 0.3
GL-29	34.0 ± 0.6	46.2 ± 0.3	51.4 ± 0.7	GS-29	34.5 ± 0.4	48.0 ± 0.5	52.0 ± 0.3
GL-30	35.1 ± 0.4	46.1 ± 0.6	54.9 ± 0.7	GS-30	34.6 ± 0.5	45.2 ± 0.8	50.5 ± 0.6
Mean*	34.0 ± 0.3	47.2 ± 0.2	54.3 ± 0.2	Mean	33.1 ± 0.2	45.8 ± 0.1	51.4 ± 0.2

* Mean values between GL and GS groups differed significantly at corresponding age groups ($P<0.05$)

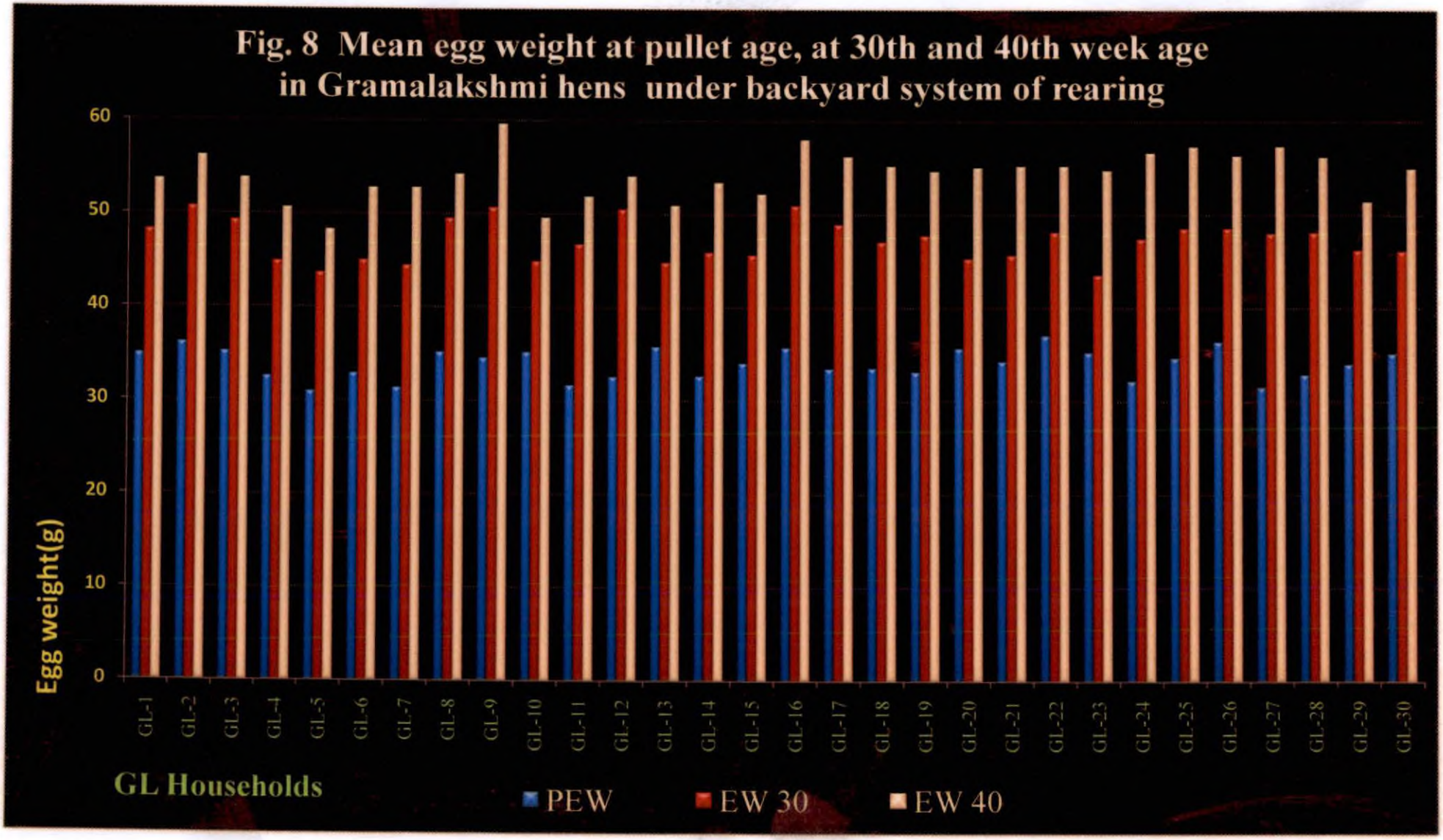
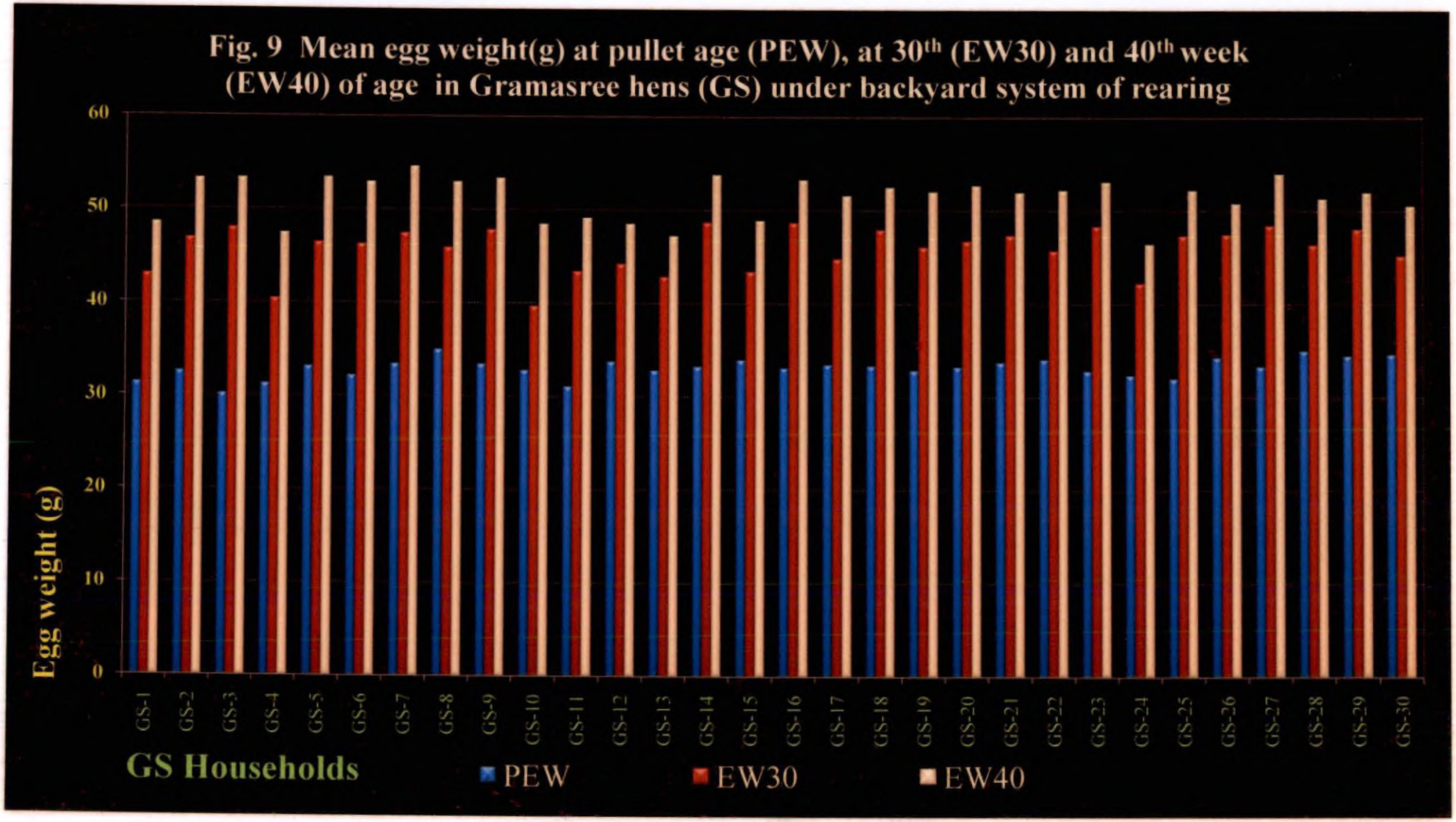


Fig. 8 Mean egg weight at pullet age, at 30th and 40th week age in Gramalakshmi hens under backyard system of rearing
60
50
40
30
20
10
0
Egg weight(g)
GL-1
GL-2
GL-3
GL-4
GL-5
GL-6
GL-7
GL-8
GL-9
GL-10
GL-11
GL-12
GL-13
GL-14
GL-15
GL-16
GL-17
GL-18
GL-19
GL-20
GL-21
GL-22
GL-23
GL-24
GL-25
GL-26
GL-27
GL-28
GL-29
GL-30
GL Households
PEW
EW 30
EW 40

Fig. 9 Mean egg weight(g) at pullet age (PEW), at 30th (EW30) and 40th week (EW40) of age in Gramasree hens (GS) under backyard system of rearing



The overall mean EW_{30} in GL households ranged from 43.6 g to 50.9 g and the lowest weight recorded in GL-23 and the highest in GL-16 households. In GS group, the highest individual EW_{30} was noticed in GS-16 (51.8 g) and the lowest in GS-10 (36.5 g) with overall mean of 45.8± 0.1 g. The highest household wise mean value was reported in GS-14 and GS-16 (48.7) and the lowest mean in GS-10 (39.6).

4.5.4.3 Egg weight at 40 weeks of age. (EW_{40})

The mean EW_{40} from all the GL households is presented in Table 16 and the graphical representation is shown in Fig. 8 and 9. In GL group, the highest individual EW_{40} was noticed in GL-9 (61.1 g) and the lowest in GL-10 (46.1 g) with overall mean of 54.3 ± 0.2 g. The highest household wise mean value was reported in GL-9 (59.6 g) and the lowest mean in GL-5 (48.3 g). In GS group, the highest individual EW_{40} was noticed in GS-7 and GS-27 (56.2 g) and the lowest in GS-24 (44.6 g) with overall mean of 51.4 ± 0.2 g. The highest household wise mean value was reported in GS-7 (54.6 g) and the lowest mean in GS-24 (46.4 g).

4.6 Livability and Mortality pattern

The mortality pattern and the causes of death in GL and GS hens for the period from 21 to 40 weeks of age are presented in Table 17. The overall mortality was 37 (16.37 per cent) out of 226 hens housed in GL and 29 (12.45 per cent) out of 233 hens housed in GS group. The overall mortality of in GL units was significantly higher than that reported in GS units ($P<0.05$). Mortality occurred in 22 households in GL and 24 households in GS group.

There was no mortality during the initial three weeks from 21 to 23 weeks of age in both units . Number of hens died during 24 to 30 weeks of age was 18 (7.96 per cent) in GL and 11 (4.72 per cent) in GS group. Out of these, seven hens in GL and three hens GS were died due to predators. Fig. 10 revealed that, week wise mortality was the highest at 30^{th} week recording 3.54 per cent (8 n) in GL and 3.43 per cent (8 n) in GS group.

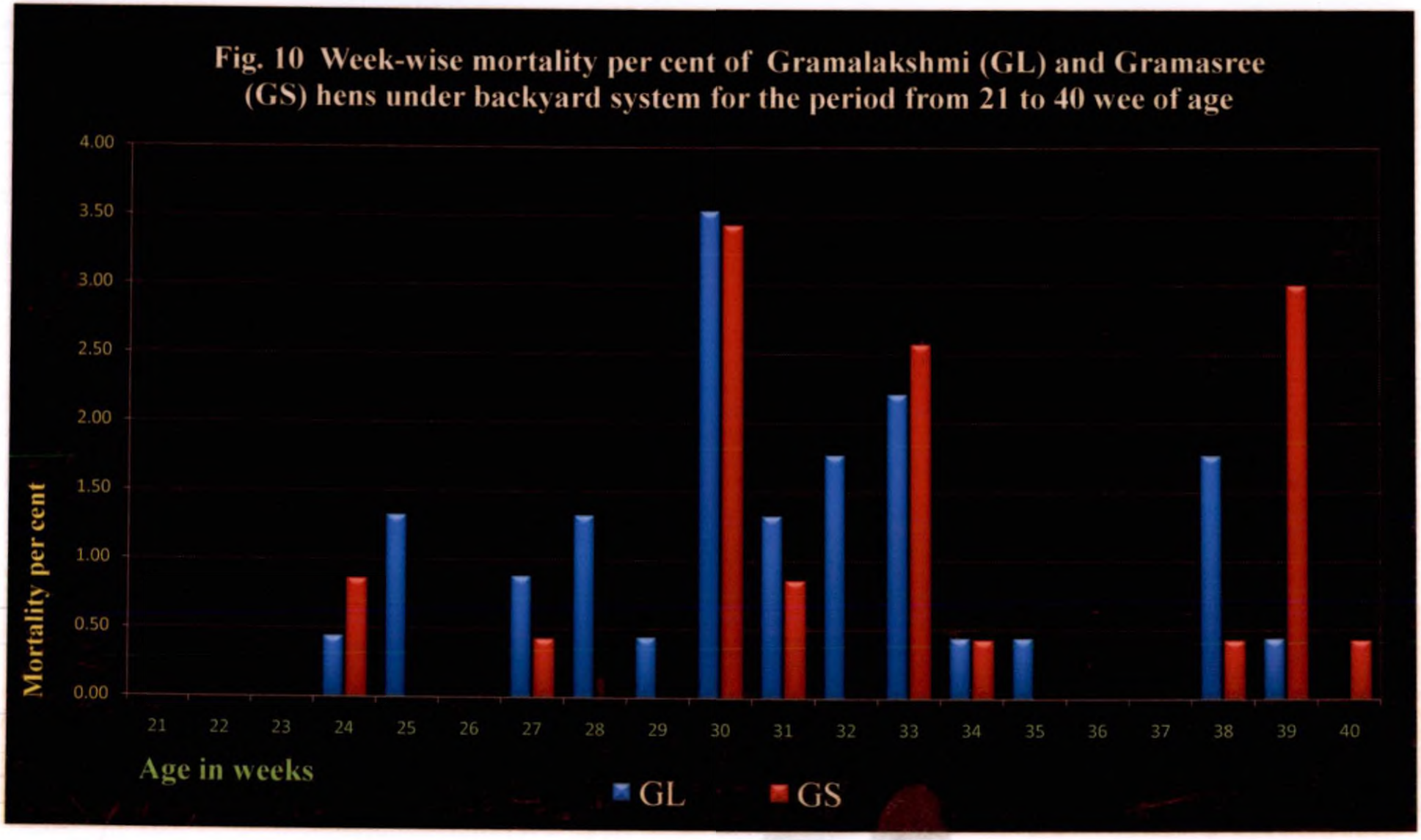
Table 17. Week wise mortality pattern with causes of death in Gramalakshmi and Gramasree hens under bcakyard system of rearing in house holds GL-1 to 30 and GS-1 to 30 for the period from 21 to 40 weeks of age

Gramalakshmi (GL)				Gramasree (GS)			
Code no.	24-30 week	31-40 week	Total	Code no.	24-30 week	31-40 week	Total
GL-1	1	1	2	GS-1	-	1	1
GL-2	-	1*	1	GS-2	1	1	2
GL-3	-	2#	2	GS-3	-	1#	1
GL-4	-	1	1	GS-4	1+1#	-	2
GL-5	1+1#	-	2	GS-5	-	1	1
GL-6	-	-		GS-6	1*	-	1
GL-7	-	-		GS-7	-	1#	1
GL-8	1+1*	-	2	GS-8	-	1	1
GL-9	1+1*	-	2	GS-9	-	1#	1
GL-10	2+1*	-	3	GS-10	1	-	1
GL-11	-	1	1	GS-11	1*	-	1
GL-12	1*	1*	2	GS-12	-	1	1
GL-13	2*	-	2	GS-13	1+1*	-	2
GL-14	-	1	1	GS-14	-	-	
GL-15	-	1+1#	2	GS-15	-	-	
GL-16	1+1*	-	2	GS-16	1#	-	1
GL-17	-	2*	2	GS-17	-	1	1
GL-18	-	1	1	GS-18	-	-	
GL-19	1	1*	2	GS-19	-	1	1
GL-20	-	-		GS-20	-	-	
GL-21	-	-		GS-21	1	-	1
GL-22	-	-		GS-22	-	1#	1
GL-23	-	1#	1	GS-23	-	1	1
GL-24	1+1#	-	2	GS-24	-	1*	1
GL-25	-	-		GS-25	-	1*	1
GL-26	-	1#	1	GS-26	-	1	1
GL-27	-	1+1#	2	GS-27	1	1#	2
GL-28	-	-		GS-28	-	-	
GL-29	-	-		GS-29	-	2	2
GL-30	-	1	1	GS-30	-	-	
Total	18	19	37	Total	11	18	29
Per cent	7.96	8.41	16.37	Per cent	4.72	7.73	12.45

* Death due to predators, 12 in GL group (5.31%) and 5 in GS group (2.15%)

Death due to accidents, 8 in GL group (3.54%) and 7 in GS group (3.00%

Fig. 10 Week-wise mortality per cent of Gramalakshmi (GL) and Gramasree (GS) hens under backyard system for the period from 21 to 40 wee of age



At this age, three hens in GL and two hens in GS were died due to predation. Number of hens died during 31 to 40 weeks of age was 19 (8.41 per cent) in GL and 18 (7.73 per cent) in GS group. Out of this five hens in GL and two hens in GS were died due to predation.

Regarding the causes of mortality, the death due to predators was high in GL group (12 numbers) than that in GS group (5 numbers). Out of the total hens housed 5. 31 per cent in GL and 2.15 per cent in GS were due to predation. The number of birds died due to accidents and inclement weather was eight (3.54 per cent) in GL group and seven (3.00 per cent) in GS group. Out of the total birds housed, the death due to ailments alone contributed 7.52 per cent in GL group and 7.30 per cent in GS group.

4.7 Hematological and serum biochemical parameters

Serum biochemical examinations for the *in vitro* quantitative estimation of Hemoglobin (Hb), Packed Cell Volume (PCV), Alkaline Phosphatase (ALP), Alanine Amino Transferase (ALT), Calcium (Ca) and Phosphorus (P) content of GL and GS hens were done at 30 and 40 weeks of age. The mean values observed are shown in Table 18. The graphical representation of the parameters is given in Figure 10, 11 and 12. The procedure for blood collection is illustrated in Plate 10.

4.7.1 Hemoglobin (Hb)

The mean Hb content in GL hens at 30^{th} and 40^{th} week was 11.38 and 10.92 g/dL. In GS hens the estimated mean values were 10.75 and 10.44 g/dL. Within the group the Hb per cent at 30 week in GL hens was significantly higher than that at 40 weeks ($P<0.05$). Among the groups the Hb per cent at 30^{th} week in GL hens was significantly higher than that in GS hens ($P<0.05$). At 40^{th} week also the Hb per cent in GL group was significantly higher than that in GS group ($P<0.05$).

Table 18. Mean values of hematological and serum bio chemical parameters of Gramalakshmi and Gramasree hens at 30 and 40 weeks of age under backyard system of rearing

Sl no.	Parameters	Gramalakshmi (GL)		Gramasree (GS)	
		30 week	40 week	30 week	40 week
1	Haemoglobin (g/dL)	11.38 [a]	10.92 [b]	10.75 [bc]	10.44 [c]
2	Packed cell volume per cent	33.86	33.65	33.27	33.49
3	Alkaline phosphatase (I.U./L)	245.44 [a]	197.6 [b]	242.76 [a]	191.96 [b]
4	Alanine amino transferase (I.U./L)	9.76 [a]	7.84 [b]	9.92 [a]	8.24 [b]
5	Calcium (mg/dL)	9.86 [b]	8.57 [c]	10.37 [a]	8.44 [c]
6	Phospharus (mg/dL)	4.80 [b]	4.55 [c]	5.14 [a]	4.59 [b]

Mean values bearing different superscripts differed significantly within the row ($P<0.05$)

Fig. 11 Mean values of Haemoglobin (Hb), Packed cell volume (PCV), Calcium (Ca) and Phosphorus (P) in Gramalaklhmi and Gramasree hens at 30th and 40th week

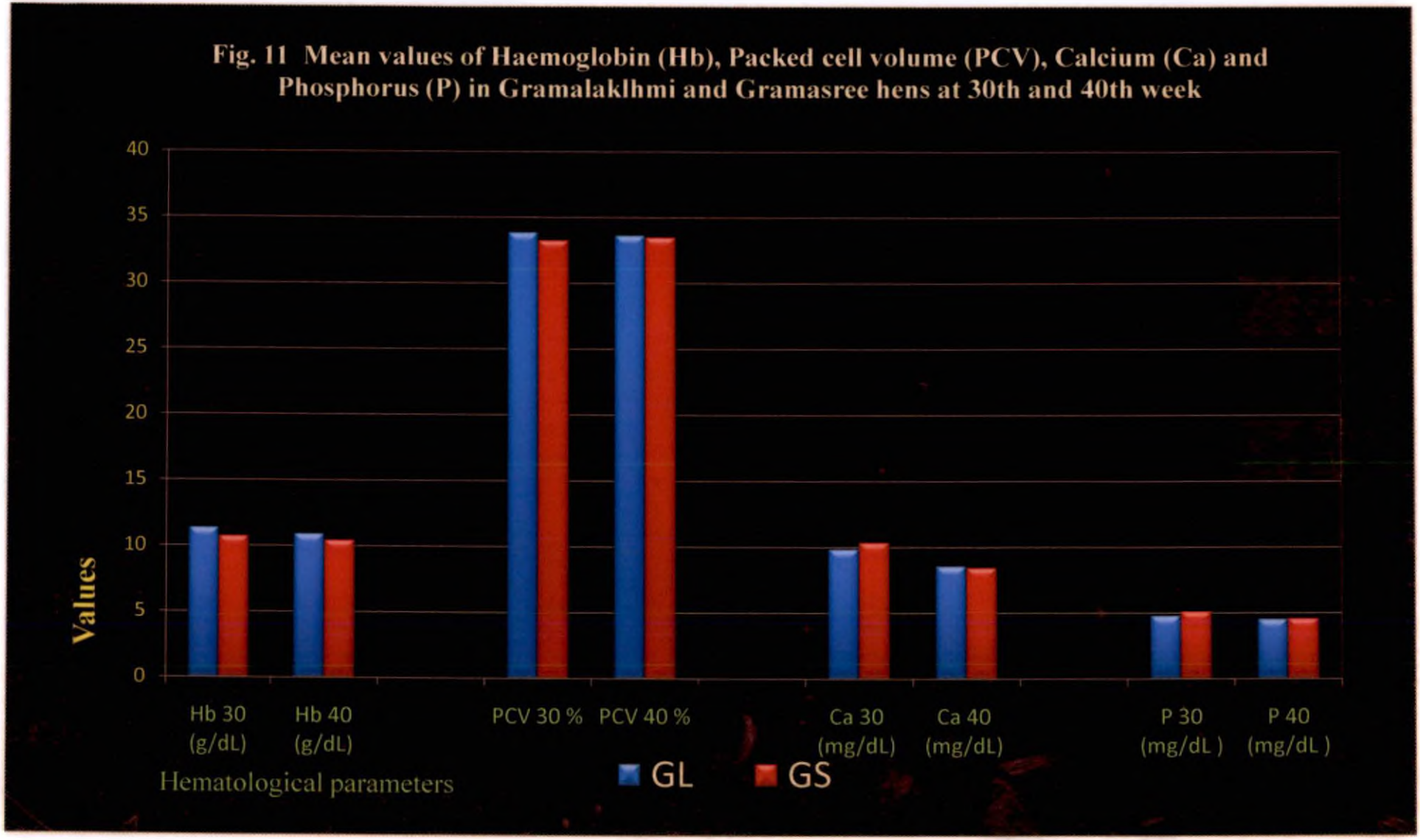


Fig. 12 Mean values of serum Alanine Amino Transferase (ALT in I.U.) content of Gramalakshmi (GL) and Gramasree (GS) hens at 30th and 40th week of age

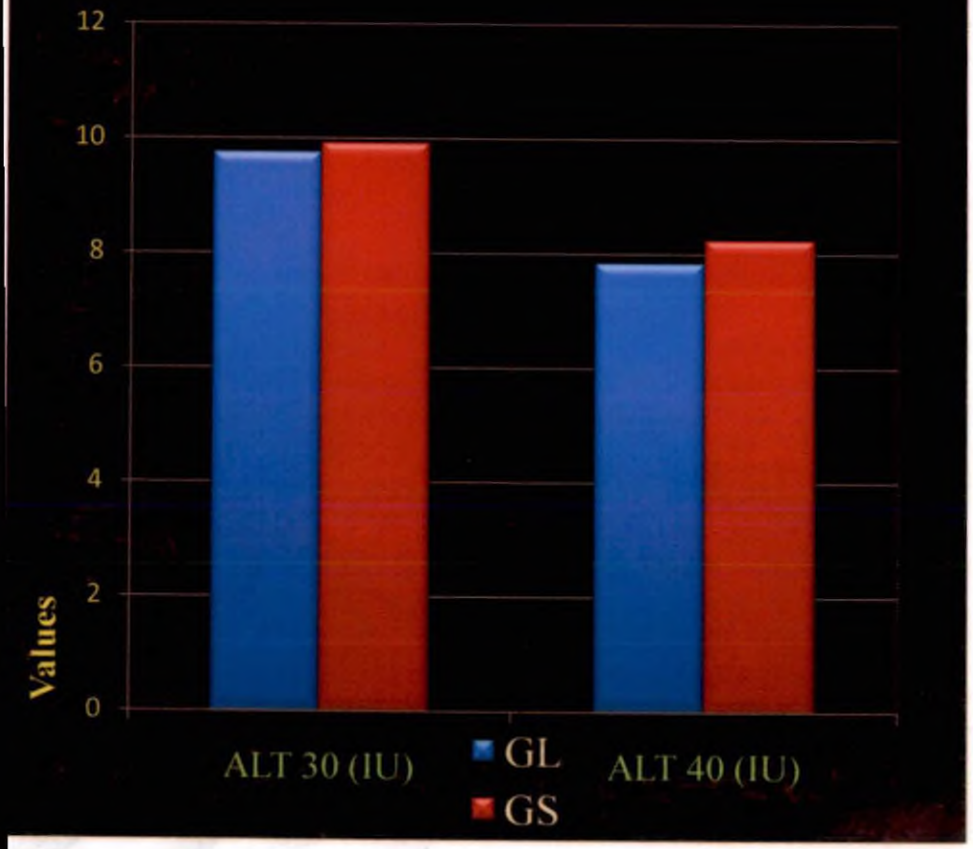
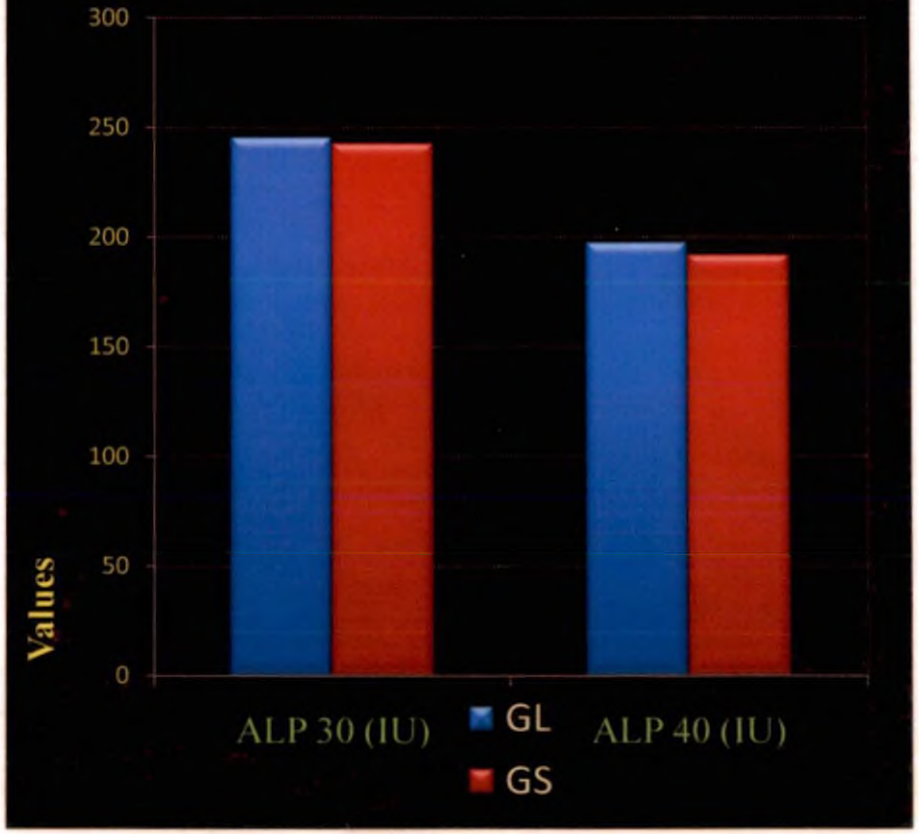


Fig. 13 Mean values of serum Alkaline Phpsphatase (ALP in I.U.) content of Gramalakshmi (GL) and Gramasree (GS) hens at 30th and 40th week of age



4.7.2 Packed Cell Volume (PCV)

The overall mean PCV per cent in GL hens in 30 and 40 weeks of age were 33.86 and 33.65 per cent and that in GS hens were 33.27 and 33.49 per cent. Within the group in both GL and GS hens, mean PCV values at 30th and 40th week were comparable.

4.7.3 Alkaline Phosphatase (ALP)

The mean serum ALP values at the age of 30 and 40 weeks of age in GL hens were 245.44 IU/L and 197.60 IU/L and that in GS hens were 242.76 IU/L and 191.96 IU/L. Within the group the mean ALP values at 30th week in GL hens was significantly higher than that at 40 weeks. In GS hens also the values at 30th week was significantly higher than that at 40th week ($P<0.05$).

4.7.4 Alanine Amino Transferase (ALT)

The mean serum ALT values estimated in GL hens at 30 and 40 weeks of age was 9.76 and 7.84 IU/L and that in GS hens was 9.92 and 8.24 IU/L. Within the group the ALT values at 30 week in GL hens was significantly higher than that at 40 weeks. In GS hens also the values at 30th was significantly higher than that at 40 weeks ($P<0.05$).

4.7.5 Calcium (Ca)

The mean blood Ca content in GL hens at 30th and 40th week were 9.86 and 8.57 mg/dL and that in GS hens were 10.37 and 8.44 mg/dL. Within the group in GL hens, the mean Ca per cent in 30th week was significantly higher than that in 40th week ($P<0.05$). In GS hens also the mean value in 30th week was significantly higher than that in 40th week. Among the groups at 30th week the mean Ca per cent in GS hens was significantly higher than that in GL hens.

4.7.6 Phosphorus (P)

The mean blood phosphorus content in GL hens at 30th and 40th week were 4.80 and 4.55 mg/dL and that in GS group were 5.14 and 4.59 mg/dL. Within the

group at 30th week, both in GL and GS groups, the mean P per cent was significantly higher than that in 40th week ($P<0.05$). Among the group at 30th week, the mean value was significantly higher in GS hens than in GL hens ($P<0.05$).

4.8 Costs and returns involved in backyard rearing

The Costs and returns of GL and GS hens under backyard system of rearing for the period from 21-40 weeks of age is calculated based on the information collected from field survey conducted among 30 farmers each from GL and GS households and the results are presented in Table 19 and 20. For calculating the margin of returns over cost incurred, the hand feed cost alone was considered.

The cost of feed per day per hen ranged from Rs. 0.14 to Rs. 0.33 with a mean of Rs. 0.21± 0.01 in GL group. It was Rs. 0.14 to Rs. 0.41 with a mean of Rs. 0.22 ± 0.01 in GS group.

The marketing of eggs is done by the farmers at their door steps or through the outlets of self help groups (Plate 11). Sale value of eggs produced in backyard system fetched a higher value of Rs. 4 per egg as reported by the farmers. The household wise returns through the sale of eggs ranged from Rs. 652 (GL- 10) to Rs. 1512 (GL -18) in GL households with an average value of Rs. 1164 (Table 19) and that in GS households ranged from Rs. 820 (GS- 15) to Rs. 1492 (GS- 21) with an average value of Rs. 1200 (Table 20).

The household wise margin of returns by sale of eggs over feed cost in GL group ranged from Rs. 546 to Rs: 1261, with an average value of Rs. 957.3. In GS households, it ranged from Rs. 644 to Rs. 1183 with an average value of Rs. 966.8. The margin per egg over feed cost ranged from Rs. 2.99 to Rs. 3.55 in GL households with an average value of Rs. 3.29 and that in GS households ranged from Rs. 2.87 to Rs. 3.45 with an average value of Rs. 3.23.

Table 19.Costs and returns of Gramalakshmi hens under backyard system of rearing in GL-1 to 30 households for the period from 21-40 weeks of age

Code no.	Feed cost /day/bird (Rs.)	21-40 wk feed cost (Rs.)	Sale value of eggs (Rs.)	Margin / house (Rs.)	Margin per egg (Rs.)	Cost /return ratio (Rs.)
GL-1	0.33	270	1104	835	3.02	3.10
GL-2	0.26	245	1236	991	3.21	4.04
GL-3	0.16	182	1416	1234	3.49	6.78
GL-4	0.20	217	1212	995	3.28	4.59
GL-5	0.18	126	740	614	3.32	4.87
GL-6	0.22	185	1076	891	3.31	4.82
GL-7	0.24	168	872	704	3.23	4.19
GL-8	0.21	168	940	772	3.29	4.60
GL-9	0.23	217	1252	1035	3.31	4.77
GL-10	0.14	106	652	546	3.35	5.13
GL-11	0.26	284	1300	1017	3.13	3.59
GL-12	0.20	196	1156	960	3.32	4.90
GL-13	0.18	175	1028	853	3.32	4.87
GL-14	0.26	280	1232	952	3.09	3.40
GL-15	0.15	182	1356	1174	3.46	6.45
GL-16	0.18	147	916	769	3.36	5.23
GL-17	0.18	157	1104	947	3.43	6.04
GL-18	0.25	308	1512	1204	3.19	3.91
GL-19	0.16	168	1136	968	3.41	5.76
GL-20	0.15	182	1308	1126	3.44	6.19
GL-21	0.16	203	1464	1261	3.45	6.21
GL-22	0.29	280	1312	1032	3.15	3.69
GL-23	0.16	176	1216	1040	3.42	5.89
GL-24	0.33	301	1196	895	2.99	2.97
GL-25	0.20	168	1108	940	3.39	5.60
GL-26	0.15	137	1212	1075	3.55	7.83
GL-27	0.24	214	1128	915	3.24	4.28
GL-28	0.33	374	1496	1122	3.00	3.00
GL-29	0.19	182	1128	946	3.35	5.20
GL-30	0.19	207	1116	909	3.26	4.39
Avg	0.21 ±0.01	206.8 ±11.1	1164.1 ±37	957.3 ±30.9	3.3 ±0.03	4.98 ±0.22

Table 20.Costs and returns of Gramasree hens under backyard system of rearing in GS-1 to 30 households for the period from 21-40 weeks of age

Code no.	Feed cost /day/bird (Rs.)	21-40 wk feed cost (Rs.)	Sale value of eggs (Rs.)	Margin / house (Rs.)	Margin per egg (Rs.)	Cost /return ratio (Rs.)
GS-1	0.26	322	1456	1134	3.12	3.52
GS-2	0.23	301	1484	1183	3.19	3.93
GS-3	0.31	371	1468	1097	2.99	2.96
GS-4	0.14	119	856	737	3.44	6.19
GS-5	0.16	182	1120	938	3.35	5.15
GS-6	0.17	175	1136	961	3.38	5.49
GS-7	0.27	284	1252	969	3.09	3.42
GS-8	0.25	266	1208	942	3.12	3.54
GS-9	0.20	217	1220	1003	3.29	4.62
GS-10	0.26	196	840	644	3.07	3.29
GS-11	0.30	259	1220	961	3.15	3.71
GS-12	0.15	168	1216	1048	3.45	6.24
GS-13	0.21	175	912	737	3.23	4.21
GS-14	0.25	246	1276	1030	3.23	4.18
GS-15	0.21	147	820	673	3.28	4.58
GS-16	0.17	168	1124	956	3.40	5.69
GS-17	0.16	182	1120	938	3.35	5.15
GS-18	0.34	336	1476	1140	3.09	3.39
GS-19	0.16	182	1112	930	3.35	5.11
GS-20	0.20	196	1124	928	3.30	4.73
GS-21	0.41	420	1492	1072	2.87	2.55
GS-22	0.21	224	1212	988	3.26	4.41
GS-23	0.16	175	1180	1005	3.41	5.74
GS-24	0.32	336	1356	1020	3.01	3.04
GS-25	0.20	210	1204	994	3.30	4.73
GS-26	0.23	287	1404	1117	3.18	3.89
GS-27	0.23	266	1328	1062	3.20	3.99
GS-28	0.23	224	1172	948	3.24	4.23
GS-29	0.18	176	1068	892	3.34	5.05
GS-30	0.19	182	1140	958	3.36	5.26
Avg	0.22 ±0.01	233.1 ±13.2	1199.9 ±34	966.8 ±23.7	3.2 ±0.03	4.40 ±0.19

Plate 11. Sale of eggs were done by the farmers directly at their door steps

Outlets were operated by the women self help groups for marketing of eggs

The ratio between feed cost and sale value of eggs among GL households ranged from 1:2.97 (GL-24) to 1:7.83 (GL-26) with an overall mean of 1:4.98 and that ranged from 1:2.55 (GS-21) to 1: 6.24 (GS-12) with an overall mean value of 1: 4.40 in GS group.

The relation between feed cost, and margin of feed cost over egg is studied and it is seen that as feed cost increased the hen day per cent also increased, but the margin from egg was reduced.

In households GL-1, 24 and 28 layer chicken feed was used for hand feeding (Table 4) and feed cost was highest in the group and was Rs.0.33 per bird per day. The hen day per cent production was high in these households with 41.63, 40.57 and 39.29 per cent respectively (Table 14) and the margin of return per egg was relatively low with values of Ts. 3.02, 2.99 and 3.00 respectively (Table 19) . On the other hand, in households GL 10, 19, 20 and 23, where layer feed chicken was not given, cost of feeding per day per bird were Rs. 0.14, 0.16, 0.15 and Rs. 0.16 and the hen day production percent cent were 26.59, 32.35, 32.06 and 32.27 respectively. The margin per egg in these household were high and was 3.35, 3.41, 3.44 and 3.42 respectively.

In GS household also the same trend was seen. In households GS 18, 21 and 24 higher feed cost of Rs.0.34, 0.41 and 0.32 (Table 5) and hen day per cent of 44.18, 43.57 and 38.39 (Table 20) was observed, but in these households the margin of return per egg was relatively low with values of Rs. 3.09, 2.87 and 3.01. Whereas, households GS 4, 12 and 23 recorded low feed cost of Rs. 0.14, 0.15 and Rs. 0.16 with low hen day per cent of 30.97, 32.20 and 31.38, but the margin per egg in these household was high and was 3.44, 3.45 and 3.41 respectively. These findings showed the influence of hand feeding on production and profit.

Salient findings pertaining to the production performance of GL and GS hens under back yard system of rearing obtained in the present study were summarized and presented in Table 21 for easy comparison of the groups. From the observations it is seen that the performance was similar in Gramalakshmi and Gramasree hens.

Table 21. Salient findings pertaining to the production performance of gramalakshni and Gramasree hens under back yard system of rearing

Sl. No	Mean values of production parameters	GL	GS
1	Body weight at 20th week (g)	1092 ± 6	1250 ± 5
2	Body weight at 40th week (g)	1739 ± 5	1900 ± 7
3	Average age at first egg (days)	177.1 ± 2.2	179.7 ± 2.2
4	Cumilative hen housed egg number (24-40 wk)	38.63 ± 0.94	38.60 ± 0.82
5	Cumilative hen housed egg per cent (24-40 wk)	32.46 ± 0.79	32.44 ± 0.69
6	Cumilative hen day egg number (24-40 wk)	42.28 ± 0.77	40.82 ± 0.80
7	Cumilative hen day egg per cent (24-40 wk)	35.53 ± 0.68	34.30 ± 0.67
8	Pullet egg weight(g)	34.0 ± 0.3	33.1 ± 0.2
9	Egg weight at 30th week	47.2 ± 0.2	45.8 ± 0.1
10	Egg weight at 40th week	54.3 ± 0.2	51.4 ± 0.2
11	Mortality per cent (21 to 40 weeks)	16.37	12.45
12	Average feed cost/ egg sale value ratio	1: 4.98	1: 4.40

5. DISCUSSION

The results obtained in the study on performance of Gramalakshmi and Gramasree hens under backyard system of rearing are discussed in this chapter. The farmers profile, the managemental practices adopted in rearing of Gramalakshmi and Gramasree hens, the data pertaining to production performance of GL and Gramasree hens and cost and returns of GL and GS hens under backyard system are discussed.

In Kerala State, Malappuram is having the highest poultry population (Anon, 2005) among all other districts and so a Panchayath in that district was selected for the study. For effectively assessing the production performance of the two groups, selection of the households was done such that the farmers are exclusively rearing either GL or GS hens.

5.1 Socio economic status of farmers

Among the 60 farmers rearing GL and GS hens, 48.30 per cent (29) were agricultural workers (Table1). The survey area is a rural village with vast area of fertile cultivable land and that was the reason for involvement of more number of agricultural workers among the farmers. It was also documented in the present study that the people from all walks of life rear poultry and this finding is in close agreement with finding of Yousef and Al-Yousef (2007) and Girishkumar (2009). The other occupations of the farmers included small scale business, coolie and abroad jobs.

It was observed in the present study that mostly the women (80.0 per cent) are engaged in the routine activities of back yard rearing of GL and GS hens. (Table1and Plate 2). The children in the household also helped in the activities. The men were involved in the off farm activities like purchase of feed and other inputs. The marketing of the eggs are also done by the women through the 'self help group' associations. Similar findings of women mostly engaged in poultry rearing activities were reported by Halima *et al.* (2007b) and Girishkumar (2009).

Out of the total 60 farmers rearing GL and GS hens, majority of the farmers (41.67 per cent) do not have any other animal husbandry activities other than rearing of back yard chicken (Table 1). Cattle rearing were practiced by 21.66 per cent, goat rearing by 18.33 per cent and cattle and goat together by 13.33 per cent of the farmers (Plate 3). In farmer's opinion, the efficient utilization of leftover food items and kitchen wastes in the household can be done by maintaining a small flock of poultry with a cattle or goat. The results observed in the study conducted by Girishkumar (2009) are in agreement with the findings of the present study. The practice of rearing GL and GS hens along with other poultry is seen in five percent of the household only. Das *et al.* (2008) reported that a household flock in Bangladesh is usually comprised of two or more varieties of poultry species.

The land holding of farmers presented in Table 1 revealed that the average land area was more in GL households. Das *et al.* (2008) classified the poultry farmers of Bangladesh based on the land holdings as landless, small, medium and large scale farmers. In the present study the individual land holding in households ranged from 6 cents to 1.75 acres with only two households having land area above one acre. The findings of Girishkumar (2009) in a study on native chicken of northern Kerala are in agreement with the present study.

Main agricultural activities of farmers were plantain, coconut farming and vegetable cultivation (Plate 3). Some practiced mixed farming. Out of the 60 farmers 26.67 per cent had no agricultural activities. The farmers allowed the hens to scavenge and scratch in the plantain farms as they were of the opinion that scavenging birds help in fertilizing and deweeding the farm. Mcainsh *et al.* (2004) and Girishkumar (2009) also reported similar results. But farmers practicing vegetable cultivation used to prevent the entry of hens with fencing the farm yard with locally available fencing materials like plaited coconut leaves. Out of the total 60 farmers 26.67 per cent who had no agricultural activity opined that scavenging poultry is destructive to cultivations.

5.2 Flock size of Gramalakshmi and Gramasree hens

The total number of birds available at the time of survey in all the 30 households together in GL group was 226 and that in GS was 233 (Table 2) . The mean flock size of hens per household in GL group was 7.5 and that in GS was 7.8 (Plate 4). Farmers were of the opinion that if the number of birds are more than ten, they have to hand fed them as the scavengeable food stuffs in the back yards will not be sufficient enough for the birds to thrive. These findings are in close agreement with the observations of Vij *et al.* (2006) and Kumar and Kumar (2007).

In both groups 16 households were selected from eastern wards and 14 households were selected from the western wards of the Panchayath (Plate 1). This similar distribution of the households provided the hens with uniform geographical conditions of scavenging for the birds under study.

5.3 Management practices adopted

5.3.1 Housing

All the farmers rearing GL and GS hens had provided night shelter for their birds (Plate 5). This might be due to the awareness of the owners regarding the nocturnal predators and to protect the birds from thieves. Halima *et al.* (2007) also documented similarly.

Measurement of distance of the coops from the farmer's house showed that 16.7 per cent of coops in GL and 20.0 per cent in GS groups were adjacent to the farmer's house (Table 2). In these households the coops were either on the sides of the walls outside the house or were attached with the kitchen or inside the covered work area of the house. Similar result was observed by Halima *et al.* (2007). Farmers opined that they can reduce cost of construction and can attend to the hens in night hours also in case of any emergency if the coops are adjacent. But some farmers opined that the problem of ecto parasites were more in adjacent coops. The average distance of the coops from farmers house in GL households was 5.2 m. and that in GS was 4.2 m. According to Girishkumar (2009) the mean

distance of the coop from the house was 6.44 and 4.42 m with an overall mean of 5.75±0.49 m in two districts of northern Kerala which is slightly higher than the values of present study might be due to the lower land holding of farmers in the present study.

Most of the farmers used wood for the construction of the night shelter. Wood was used in 50.0 per cent (15) of the GL and 56.7 per cent (17) of GS night shelters (Table 2). Wire mesh was used in 16.7 (GL) and 23.3 (GS) per cent and brick was used in 33.3 and 20.0 per cent of GL and GS coops. No separate ventilation was provided for these shelters as farmers were of the opinion that birds housed in wooden and wire mesh coops are getting enough air and light. 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). Girishkumar (2009) also reported similar observations. Wood is mainly used for construction of the coops because it is comparatively cheap and the low weight of the coop makes it a portable structure which can be transported from one place to other on transfer of residence or for cleaning purposes.

The popular roofing material used in construction of the coops (Table 2) was tiles with 60.0 per cent(18) in GL and 50.0 per cent(15) in GS groups followed by thatched roof (20.0 per cent in GL and 23.3 per cent in GS). Most of the farmers used tiles instead of coconut leaf thatching in order to avoid the annual recurring expenditure with respect to re-thatching of the coop. Farmers used to use slightly damaged tiles replaced from their own home to thatch the poultry coops. Findings of Mcainsh *et al.* (2004) and Girishkumar (2009) were in close agreement with the present study.

The study on floor area of night shelter showed that most of the coops were having area between 0.6 to 1 sq. m. (63.3 per cent of the coops in GL group and 50 per cent in GS group). The average floor area in GL households was 1.0 sq. m. and that in GS households was 0.9 sq.m (Table 2). There was no relation with the number of birds housed and the floor area provided as farmers were utilizing their existing coops for housing their hens. Floor area of the coops in the present study

was slightly higher than that reported by Girishkumar (2009) who reported an average area of 7.46 sq. ft in native chicken of northern Kerala.

5.3.2 Watering Practices

The study on the source of drinking water used to their chicken (Table 3 and Plate 6) revealed that in both the groups, well water was used by most of the farmers (73.33 per cent in GL and 80.0 per cent in Gramasree group) which is in close agreement with the finding of Kumar and Kumar (2007) who also reported similar observations.

5.3.3 Health care measures adopted

The study on the veterinary services that farmers availed revealed that 50.0 per cent farmers in GL and 56.7 per cent in Gramasree group were availing services from Government Veterinary Dispensary in the panchayath and 43.3 per cent in GL and 26.7 per cent in Gramasree were depending on indigenous herbal medications (Table 3). Since the birds were supplied as part of a government scheme most of the farmers were availing the service of the local veterinary Dispensary. Farmers were self treating the hens with herbal medicines based on the traditional knowledge and with the previous experiences. Girishkumar (2009) also found the similar reports.

The major ailments encountered in the 30 households of GL group were Ectoparasitism in 46.7 per cent of households followed by Respiratory affections in 26.7 per cent. In case of GS group also Ectoparasitism and Respiratory affections were the major ailments of concern. The corresponding percentages being 40.0 and 36.7. The inadequate housing facilities in these households play an important role in the occurrence of respiratory ailments. In both the groups ecto parasitism was a major problem of concern. All the farmers who housed their hens adjacent to the residence complained about the problem of ecto parasitism. 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. According to

Girishkumar (2009) the important disease conditions in scavenging native chicken were respiratory disease (25.0 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). In the present study none of the above referred contagious disease was a major problem.

5.3.4 Feeding Practices

All the hens in both groups were let out for scavenging in day time in the backyards (Plate 7). The birds forage on the green grass in the premises and scratch for the seeds, grains, vegetation and insects which ever available on the scavenging field. According to Tadelle et al. (2002) the crop contents of scavenging local hens of Ethiopia included seeds, plants, worms, insects and other items. Das *et al.*(2008) reported that the scavengeable feedstuffs consumed by native chicken of Bangladesh varied from 9 to 27 g per bird per day. In the present study the quantity of the scavenging feed items was not quantified. In addition to the feed resources available on the backyards, the birds were also fed with kitchen waste and left over house hold food items including cooked rice which were not quantified. Mcainsh *et al.* (2004) also opined similarly.

Hand feeding was practiced in all the households under study (Plate 7). Halima *et al.* (2007) documented that about 99 per cent of the respondents of north-west Ethiopia gave supplementary feeds to their chickens. The reasons for supplemental feeding as reported by farmers were to meet the nutritional and behavioural needs of the birds. The nutritional reason was to provide balanced diet to increase the egg production and to prevent nutritional deficiency disorders. This is in agreement with the report of Tadelle (1996). The behavioural reason was to prevent birds feeding on the cultivated vegetations in the household. Most of the farmers fed the hens twice daily and the time of hand feeding was in the morning and in the evening.

The farmers used paddy, rice, rice bran, wheat, wheat bran, maize bran, layer feed and cattle feed for hand feeding in varying amounts (Table 4 and 5).

references are available on the items hand fed to the backyard poultry. Mcainsh *et al.* (2004), Gupta *et al.* (2006), Kumar and Kumar (2007), Yousef and Al-Yousef (2007) and Girishkumar (2009) also reported on the hand feeding items and they found that the items hand fed will vary according to their local availability.

In the present study the most widely used feed item in both the group was rice bran, which was used in 22 households in GL (73.33%) and 21 households in GS group (70%). The other items fed were rice bran, wheat, wheat bran and maize bran. Farmers opted different cereal brans due to its low cost and easy availability. In both the groups, a total of 21 households each used either locally available poultry layer feed or commercial cattle feed for hand feeding. Even though the inclusion of commercial poultry or cattle fed increased the cost of hand feeding, farmers used to include these items in the daily feed as it increased the egg production (Table 22). This is in agreement with the finding of Tadelle (1996) who reported that non supplemented local birds in Ethiopia showed a hen day production of 14 per cent but the production increased to 30 per cent by supplementation of a combination of 15g maize and 15g Noug (Guzotia abssinica) cake.

The average quantity of feed per day in GS households was slightly higher than that in GL households. This quantity was considerably lower than the feed consumption of cross bed hens under deep litter system reported by Jayanthy (1992) as 106.61 and 104.95 g. and that by Sridharan (1998) as 113.2g and 113.66g. But the results in the present study was higher than that reported by Girishkumar (2009) who reported the feed supplementation quantity as 17.36±2.68 and 7.06±2.09g in Kozhikode and Kannur districts respectively. The lower quantity in the present study might be due to the fact that native birds of low productivity are not provided with enough supplemental feeding.in the present study, the quantity of the feed does not imply the quality, as the quality varies with the ingradients in the hand fed items. The overall quantity of hand feeding items for the period from 21-40 weeks of age in GL households was 660.1kg. and that in GS households was 743.4kg.

5.3.5 Bio security measures

The biosecurity measures adopted by the farmers rearing GL and GS hens are listed out in Table 6. Housing was provided for all the hens in both groups for biosecurity, in order to get rid of the threat of predators and to protect them from climatic variations. But this finding is against the observation of Guerne et al. (2009) who opined that housing of backyard poultry for biosecurity is seemed ignored in some villages of African countries. The coops used for housing the birds in the present study cannot be considered as ideal ones because these coops were not having enough ventilation and lighting facilities. Weekly disinfection of coop was done in 4 households (13.3 per cent) in GL group and 5 households (16.7 per cent) in GS group in order to reduce the off odour of the droppings, to avoid the problem of ecto parasites and to prevent diseases.

In the present study it is found that all the birds were vaccinated against Ranikhet disease by the Government veterinary services available in the Panchayath against the observation of Mcainsh *et al.* (2004) who reported that none of the farmers of Zimbabwe vaccinated their chicken. Regular deworming of the birds was done in 11 households (36.7 per cent) in GL group and 14 households (46.7 per cent) in GS group. The farmers used garlic juice for deworming the birds. Use of ecto prasiticides on birds and coops were practiced in 12 households (40.0 per cent) in GL group and 10 households (33.3 per cent) in GS group. This practice was mostly done in households where the coops were attached to the farmer's residence.

Isolation of affected birds was practiced in 17 households (56.7) in GL group and 14 households (46.7) in GS group. Scientific disposal of the carcass of the birds was practiced in 30.0 per cent households in GL group and 36.7 per cent households in GS group. Farmers opined that if the carcasses are not disposed properly crows and dogs will play a vital role to contaminate the water sources like wells and ponds and will spread the disease. Confinement of birds on

outbreaks in the neighbouring houses was practiced in 18 households (60.0 per cent) in GL and 16 households (53.3 per cent) in GS group.

5.4 Behavioural characters

The result of survey on behavioural characters of GL and GS hens under backyard system of rearing is presented in Table 7. The study on behavioural parameters was conducted to ascertain the adaptability of GL and GS crossbred hens under backyard system of rearing. Alders and Spradbrow (2001) reported that village chicken have more adaptability than commercial chicken due to their good flight skills, their ability to escape from predators and their ability to scavenge own food.

The Gramasree hens with multi coloured plumage and brown shelled eggs had more acceptability among local people and consumers (Plate 8). According to the farmers, the flight height and flight distance was more with Gramalakshmi than Gramasree birds. This may be because of the significantly lower weight of these hens both at 20^{th} and 40^{th} week. Gramalakshmi birds were more aggressive than Gramasree. Foraging on vegetation in the household premises were more with Gramalakshmi birds. These birds were reported to fly high in air and feed on banana leaves(Plate 9). In order to protect the cultivated vegetations farmers rearing GL hens used to fence the plantain farms. Gramalakshmi hens showed more perching behavior by perching to trees and roof of coops and even of farmer's houses. Kumar and Kumar (2007) also reported on the perching behavior of the hens. Scratching ability in search of feed in backyards was more with Gramasree birds. This may be due to the indigenous character of the birds due to the presence of desi blood in parent line.

The GL and GS hens are supposed to be non broody as they are cross breds. There are no reports of these hens showing broodiness in deep litter system of rearing. But in backyard system a small per cent showed broody appearance of short duration (Plate 9). Farmers tried to incubate hatching eggs with these hens, but the attempts were in vain due to the short period of broodiness. Due to this

short period of broody appearance, the hens were out of lay and thereby losing hendays in both groups. The loss of hendays was more in GS group.

It is the usual practice of farmers to interrupt broodiness for the resumption of next cycle and for that, the methods adopted were dipping of the birds in water frequently, disturbing the bird from settling in nest, keeping the bird tied in unfamiliar surroundings and even making the bird restless by inserting a quill feather into the nostrils. Similar observations were made by Iqbal and Pampori (2008) in indigenous chicken of Kashmir and by Girishkumar (2009) in his study on native chicken of northern Kerala.

Short period of broodiness was reported earlier also in study conducted by Iqbal and Pampori (2008). Similar findings were reported by Vijh *et al.* (2006) in which it is stated that under field condition, broodiness was found sometimes in Nicobari birds; whereas, in deep litter condition, the character was rarely expressed.

5.5 Body Weight

5.5.1 Body Weight at 20 weeks of age (BW_{20})

The individual BW_{20} ranged from 880 to 1300 g in GL group and 980 to 1520 g in GS group and this showed that the variation between the BW of pullets were narrow (420 g) in GL group and wide (540 g) in GS group. However, the overall mean BW_{20} in GS group was 158 g higher than that of GL group and this difference was significant. The significantly higher pullet body weight in GS group ($P<0.05$) clearly indicate that these are heavier than GL pullets in respect of BW_{20} (Table 9 and 10).

The body weight of 1142 g under backyard system and 1181.5 ± 9.15 g. in deep litter system in ALP x WL were reported by Radhakrishnan and Ramakrishnan (1982) and Sridharan (1998). These results are higher than the overall mean BW_{20} recorded in GL pullets in the present experiment, might be

due to differences in the system, location, season and management practices in the study.

The pullet with the lowest BW_{20} of 880 g is present in two households GL-5 and GL-2. Within the group, the lowest household-wise overall mean BW_{20} of 1000 g and 1006g also was recorded GL-5 and GL-2 (Fig.1) which indicated the poor management practices in these households. The pullet with the highest individual BW_{20} of 1300g was present in household GL-19 and the highest mean BW_{20} (1179 g) among the households was also observed in the same household which might be due to the better care and management in this household during growing periods.

The lowest and highest individual BW_{20} in GS households were 980 and 1520 g and these pullets were in GS-11 and GS-3 households. As in the case of GL group, the lowest (1131g) and highest (1414g) household mean BW_{20} were also observed in the same households (Fig. 2) which indicated the feeding and management in grower period influenced the BW in these households.

The range of mean BW_{20} among households observed in the present study is in agreement with the result observed by Radhakrishnan and Ramakrishnan (1982) in RIR x WL with 1134 g BW at 20 weeks of age and that by Khan and Krishna (1983) with 1450 g in the cross between RIR x WL in the same age group. Leo *et al.* (2006a and 2006b) found the average body weight of Gramasree hens at 20 weeks of age under deep litter system as 1500g and the higher value might be due to the difference in the system of rearing.

The frequency distribution of BW_{20} in different weight classes illustrated in Table 11 and Figure 3 revealed that 88.5 per cent of GL pullets come under the lower BW classes of less than 1200 g and 98 per cent of GS pullets falls into classes greater than 1200g thus making the hens in GS group heavier than that in GL group.

5.5.2 Body Weight at 40 weeks of age (BW_{40})

The individual BW_{40} of GL and GS hens showed wide range of variations from 1580 to 1920 g in GL group and 1640 to 2160 g in GS group (Table 10). The difference between the two households having the lowest (GL-1) and highest (GL-11) mean BW_{40} was 340 g in GL group and 520 g in GS group thereby showing higher and pronounced variation in GS group. At 40^{th} week also the GS hens were having significantly higher body weight than GL hens ($P<0.05$) and the difference between the groups was 161 g.

Radhakrishnan and Ramakrishnan (1982) recorded the mean body weight of ALP x WL as 1570g at 40 weeks of age under backyard system of rearing which is lower than the value obtained for GL group in the present study. The mean body weight at 40 weeks of age observed by Jayanthy (1992) for Desi x Austra White cross was 1445.36g which is also lower than the present study. The increase in the BW_{40} might be due to the increased level of nutrition during the laying period. Sridharan (1998) recorded the overall mean body weight in Rhode-white cross breds reared on deep litter system at 44 weeks age as 1539.79g which was lower than the mean value observed for the Gramasree hens in the present experiment. The reduced weight may be due to the high production stress on the birds reared on deep litter when compared with the backyard system.

As in the case of BW_{20}, in BW_{40} also the hens with lowest individual weight in both GL and GS groups wre in the household with lowest household-wise mean BW_{40} indicating the poor management in the respective households. With respect to the highest individual BW_{40} in GS group, the hen was housed in the household with highest mean BW_{40}, but in GL group this trend was not seen.

The increase in overall mean BW from 20 to 40 weeks of age was from 1092 to 1739 g in GL hens and from 1739 to 1900 g in GS hens with a mean increase of 647 and 650 g in over a period of 20 weeks registering an average increase of 32.35 and 32.5 g per week in GL and GS groups, respectively.

The frequency distribution of BW_{40} in different weight classes illustrated in Figure 3 revealed that 83 per cent of GL hens come under the BW classes of less than 1700g and 96 per cent of GS pullets falls into classes greater than 1700g thus making the GS hens heavier than the GL hens. Thus from the results on BW_{20} and BW_{40} it is evidently clear that the GS hens are heavier body weight lines.

5.6 Age at first egg (AFE)

The absolute value of age at first egg (AFE) in days and weeks in each of the households GL-1 to 30 and GS-1 to 30, presented in Table 12 and the graphical representation in figure 4, showed wide variation in AFE among the GL and GS groups. The earliest AFE in both the groups were in agreement with the finding of Leo *et al.* (2006a and 2006b) who found the average age at first egg of Gramalakshmi hens is 160 days and that of Gramasree hens is 159 days.

The overall mean value of AFE in present study was 177.13 ± 2.21 days in GL flock and that in GS group was 179.07 ± 2.22 days (Table 12). Both these mean values were statistically comparable each other. These findings are lower than the values recorded by Nair and Bhattacharyya (1984) who observed the age at first egg averaged 147.6 days in ALP x WL crossbred hens under backyard system and that recorded by Radhakrishnan and Ramakrishnan (1982) who observed the overall mean age at first egg of ALP x WL as 161days and that of RIRxWL as 161.2 days under backyard system of rearing. Sridharan (1998) reported that the age at first egg averaged 161.63 ± 1.20 days in Austra-white hens under deep litter system of rearing and the range of values were 157 to 166 days. Higher AFE values than the present study were observed by Khan and Krishna (1983) with 188 days in Rhode- White hens (RW) and Girishkumar (2009) in scavenging native chicken with 199.26±4.99 days. The differences in these results might be due to the differences in system of rearing and management practices.

The overall results among the GL and GS hens (Table 12) indicated vide variation in AFE among households. This might be due to the variation in

individual households in feeding and other management practices. The variation was seen both in GL and GS groups.

The birds in GL group attained 10 per cent production at 169 days and that in GS group was 165 days. Sridharan (1998) reported the mean age at 10 per cent production was 166.25 days in AW and 163 days in RW with the range of values from 161 to 169 days in AW and 158 to 169 days in RW. The results were almost in the same range.

The hens reached 50 per cent production at 174 days in GL group and at 173 days in GS group. Radhakrishnan and Ramakrishnan (1982) observed the age at 50 per cent production averaged 171 and 177.2 days for ALP x WL and RIR x WL respectively under backyard conditions. According to Sridharan (1998) the overall mean age at 50 per cent production was 179.13 days in AW and 176.75 days in RW with a variation from 172 to 184 days in AW and 175 to 180 days in RW. All these findings were in the same range.

5.7 Egg production

Weekly hen housed egg number and per cent production

The weekly egg number and per cent production of GL and GS hens for the period from 24 to 40 weeks of age is presented in Table 13. The graphical representation of weekly hen housed per cent production is done in Figure 5. The hen housed egg production per cent was statistically comparable among the group.

Gramalakshmi

The GL group started egg production at 24 weeks of age and reached peak production at 34th week with 4.07 eggs / hen per week equivalent to 58.15 per cent production . The GL hens attained 10, 25 and 50 per cent production at 26, 29 and 33 weeks of age respectively, under backyard system of rearing (Table 12). The peak production at 34th week observed in the present study is not in agreement with Sridharan (1998) who stated that the peak production in cross bred, AW hens was attained at 32nd week under deep litter system of rearing. The

higher value might be due to the difference in the rearing systems. In the present study it is also noted that the peak production was not maintained for a remarkable period but the production reduced immediately after of a period of seven days.

It is advantageous to note that the production potential in GL flock was maintained at higher rates of 51.77 and 58.15 per cent during the period of 33- 36 weeks of age. Thereafter the production per cent registered a sharp decline. One of the reasons for very poor production that exhibited in certain weekly periods was due to high mortality that occurred in GL group during the course of study. Since the study was conducted during the period from March to July, the hot humid season in the study period might have affected the rate of production in several months.

The cumulative mean egg production in GL group during the period from 24 to 40 weeks of age was 38.63 eggs per hen and it represented 32.46 per cent production on HH basis. These results are lower than that of 82.98 eggs and 49.39 per cent production reported by Sridharan (1998) in Austra-white hens in deep litter system of management under *adlib* feeding for the period from 20 to 44 weeks of age. The variation in the results might be due to the different rearing systems.

Gramasree

In GS group, even though the egg production started at 23 weeks of age, the peak production was attained only at 34 weeks of age similar to that reported in GL group but with lower rate of production (53.3 per cent) and the egg number (3.73 eggs per hen/week). As in the case of GL group here also the peak production was not maintained for a longer period.

The cumulative hen housed egg number for the period from 24 to 40 weeks of age was almost similar in GL and GS hens (38.63 vs 38. 60 eggs per hen) and it was statistically comparable with each other. The corresponding overall production averaged 32.46 per cent in GL and 32.44 per cent in GS

group.The result in the present study was lower than that reported by Jayanthy (1992) who found that the progenies from Austra-White hens on crossing with naked neck male desi males produced 47.81 eggs per bird during 21 to 40 weeks of age.

In spite of weekly variations in egg production, the overall mean hen housed egg production in GL and GS was similar. Week wise comparison of egg production between GL and GS households shown in Figure 5 indicated significantly higher production rate in GL group consecutively from 34 to 37 weeks of age. Whereas, in periods prior to peak production, the per cent HH production in GS flock was numerically higher than that of GL group leading to similar values of overall egg production in GL and GS group. The egg production performance up to peak production period (34^{th} week) was better with GS birds while after that there was significantly higher performance by the GL birds compensating the lower production in the early period.

Cumulative hen housed production in households

Cumulative mean hen housed egg number (HHN) and per cent production (HHP) up to 40 weeks of age in Gramalakshmi (GL) and Gramasree (GS) hens are presented (Table 14) separately for each of the households GL 1-30 and GS 1-30. Wide variations were noticed among households within and between groups.

In GS households, the lowest and the highest mean values recorded were greater than the lowest and highest mean values recorded in GL group. It is seen that in households where higher production was recorded, the hens were fed with layer feed.

Weekly hen day egg number and per cent production

The weekly hen day egg number and production per cent of GL and GS hens for the period from 24 to 40 weeks of age is presented in Table 13 and the graphical representation is done in Figure 6.

Gramalakshmi

In GL group, the weekly hen day egg number during 24 week of age was same as that in hen housed basis as there was no mortality at 24th week of age. The HD percentage increased to 67.01 per cent and registered the peak production at 34 weeks of age. After peak production, there was decline in HD production every week. The egg production even after decline was above 60 per cent at 35 and 36 weeks of age. The average weekly egg production during the period from 33 to 36 weeks was 62.32 per cent indicated relatively higher level of intensity of production during the period from 33 to 36 weeks of age.

The overall mean from 24 to 40 weeks of age in all households GL 1 to 30 put together was 35.53 ± 0.68 per cent on HD basis and 32.46 per cent on HH basis. The cumulative HDN was 42.28 eggs per hen on HD basis as against the average egg production of 38.63 eggs per hen on HH basis. These results showed a difference of +3.07 per cent production and +3.65 eggs on HD basis in GL group. The result in the present study was lower than the observation made by Sridharan (1998) who reported the overall hen day egg number in AW and RW as 85.72 and 101.21 eggs and per cent as 51.02 and 60.24.

Gramasree

In GS group, the egg production started by one pullet at 23rd week of age and reached peak at 34 weeks of age with 58.28 per cent production. The weekly egg number was 4.08 at peak production period (34th week). The level of production at 33, 34, 35 and 36 weeks of age was relatively lower than that registered by GL group at the corresponding age. The average weekly egg production during the period from 33 to 36 weeks was only 55.57 per cent as against the value of 62.32 per cent in GL group during the above period showing poor intensity of production in GS group.

The overall mean from 24 to 40 weeks of age in all households GS 1 to 30 put together was 34.30 per cent on HD basis and 32.44 per cent on HH basis.

The cumulative HDN was 40.82 eggs per hen on HD basis as against the average egg production of 38.60 eggs per hen on HH basis. These results showed a difference of +1.86 per cent production and +2.22 eggs on HD basis in GS group.

The week wise egg production comparison between GL and GS households shown in fig.5 indicated distinctly high production per cent in GL group consecutively at 33 to 39 weeks of age, whereas in all other weeks the per cent HD production in GS was higher than that of GL groups.

Cumulative HD production in households

Cumulative mean hen day egg number and per cent production from 24 to 40 weeks of age in Gramalakshmi (GL) and Gramasree (GS) hens under backyard system of rearing in 30 households each are shown in Table 13.

The cumulative mean hen day egg number among households ranged from 31.64 to 49.54 with an overall mean value of 42.28 ± 0.77 eggs per hen in GL group. This is in agreement with the finding of Jayanthy (1992) who reported that Austra-White crossbred hens produced 47.81 eggs per bird during 21 to 40 weeks of age. The household wise hen day per cent production in GL group ranged from 26.59 per cent in GL-10 to 41.63 per cent in GL-1 with a mean of 35.53 ± 0.68 per cent. The lowest egg number both on hen housed and hen day basis was recorded in the household GL-10, might be due to the poor management in that house hold.

In GS group the lowest mean recorded was greater than that in GL group and was 35.04 in GS-19 household. The higher mean value was also greater than the corresponding value in GL group and was 52.57 recorded in GS-18. But the mean cumulative egg number in GS group was lower than that in GL group and was 40.82 ± 0.80. In GS group household GS-18 recorded the highest egg number both on hen housed and hen day basis. In GS group the hen day production per cent ranged from 29.45per cent (GS-19) to 44.18 per cent (GS-18) with a mean of 34.40 ± 0.67 per cent.

Frequency Distribution

The frequency distribution of the production percentage of GL and GS hens under backyard system of rearing both in hen housed and hen day basis is presented in Table 15 and is graphically represented in Figure 7.

From the frequency distribution of egg production it is evident that under backyard system of rearing, the production per cent GL and GS hens varied widely among households in both hen housed and hen day basis. This may be due to the wide variation in the feeding and management practices adopted in these households. The number of households in poor and higher production classes was more in GL group. Good producers were also more in GL group. But the number of average producers were high in GS group there by making the overall mean values between the groups statistically comparable. When comparing the hen housed and hen day production per cents it is seen that in GL group the households with higher production in hen housed and hen day basis are different showing that the mortality in the high producing households adversely affected the overall production per cent. In GS households the top producers in hen housed and hen day basis were almost the same which revealed that the mortality had little influence in the overall mean production percent.

5.8 Egg Weight (EW)

Weight of eggs from 30 households each from Gramalakshmi and Gramasree units were recorded during the commencement of lay (Pullet egg weight), 30^{th} and at 40^{th} week of age and the mean egg weights are presented in Table 16. The graphical representation of the same is shown in Fig. 8 and 9.

5.8.1 Pullet egg weight

The mean pullet egg weight in GL group was significantly higher than that in GS group. In both the groups, the highest individual pullet egg weight was recorded in the same household which had the highest household mean pullet egg weight in the respective groups. In the case of lowest individual pullet egg weight

also the same trend was seen and the lowest pullet egg weight in both the groups was recorded in the same households which had the lowest mean. This showed that the feeding and management in those households influenced the pullet egg weight. There was no relation seen between AFE and pullet egg weight.

5.8.2 Egg weight at 30 weeks of age (EW_{30})

The results pertaining to the egg weights revealed that the individual weight of 210 eggs ranged between 39.8 g to 53.0 g with an overall mean of 47.2g ± 0.2 g at 30 weeks of age in GL group. The overall mean is slightly lower than the value recorded by Sridharan (1998) who reported that the mean egg weight of Austra-white hens at 32 weeks of age was 49.22 ±0.50g. The variation may be due to the difference in the age of the birds. The Table 15 and Figure 8 indicated that the household mean EW_{30} ranged from 43.6 to 50.9 g and the mean EW in 26 households were less than 50 g . In GS group, the highest individual EW_{30} ranged from 36.5 g to 51.8 g with overall mean of 45.8± 0.1 g. The mean EW_{30} in GS households ranged from 39.6 to 48.7 g at 30 weeks of age (Table15 and Figure 8). The mean EW_{30} in the present study was slightly lower than the value observed by Sharma et al. (1992) stated the egg weight at 32 week as 48.57g in RIR x WI cross. EW_{30} in GL group was significantly higher than that in GS group.

5.8.3 Egg weight at 40 weeks of age (EW_{40})

The mean EW_{40} presented in Table 16 indicated that the overall mean in GL group was 54.3 ± 0.2 g and the mean household-wise EW_{40} ranged from 48.3 to 59.6g. Mean individual EW_{40} values ranged from 46.1 to 61.1 g. Sridharan (1998) reported mean egg weight of 49.59 g in Austra-white hens at 40 weeks of age, Leo *et al.* (2006a and 2006b) recorded an egg weight of 50 g and Yadev *et al.,* (2009) recorded a value of 52.95 g which were lower than the present results. In GS group overall mean EW_{40} was 51.4 ± 0.2 g. This finding was in agreement with egg weight of 50 g in RIR x WL cross named Kalinga Brown by Mishra (1996) and 50 g in GS hens reported by Leo *et al.* (2006a and 2006b). The EW_{40} in GL group was significantly higher than that in GS group.

5.9 Livability and mortality pattern

Table 17 showed the week wise mortality pattern and the causes of death in GL and GS hens for the period from 21 to 40 weeks of age in each of the 30 households in both groups. The graphical representation of week wise mortality per cent is shown in Fig. 10.

5.9.1 Week wise mortality pattern

The livability was 100 per cent till the end of 23 weeks of age. Number of hens died during the period from 24 to 30 weeks of age was more in GL group than in GS group. The reason for the high mortality in GL group during the initial period was due to high rate of predator mortality. In both units, week wise mortality was the highest at 30^{th} week and this might be due to the environmental stress due to the hot humid weather during that period. Out of the total hens housed, 8.41 per cent in GL and 7.73 per cent in GS group was died during the period from 31 to 40 weeks of age. During this period mortality due to accidents and inclement weather was more in both the groups. This might be due to the drastic change in weather due to the heavy summer rains during that period.

The overall mortality in GL unit was significantly higher than that of GS unit ($P<0.05$). It is seen that the livability per cent in the present study in GL hens (83.63 per cent) was lower than that in GS hens (87.55 per cent). Radhakrishnan (1981) found that the livability per cent up to 40 weeks of age was 96 per cent in ALP x WL hens and that in RIR x WL cross was 92 per cent under backyard system. The livability per cent in the present study was lower than that obtained in the study of Sridharan (1998) who observed the livability per cent in Austra-white and Rhode-white hens for the period from 21 to 44 weeks of age under deep litter system of rearing as 89.17 and 95.83 per cent. In the present study it is seen that 8.85 per cent of deaths in GL and 5.15 per cent in GS group was due to predators and accidents which could be minimized by better management. Excluding the mortality due these reasons, the livability per cent in both groups will be in close agreement with the findings in deep litter system.

5.9.2 Causes of mortality

Results regarding the causes of mortality (Table 17) revealed that in both groups most of the deaths occurred due to various ailments which included respiratory affections, enteritis and fowl pox. It is seen that farmers usually ignore the ailments of back yard poultry as these hens are not the primary source of income for them and this might be the reason for the increased mortality due to ailments. The death due to predators was more with GL group. GL birds are seemed to scavenge to distant places from the farmers houses in search of food and this might be the reason for increased mortality due to predation. In both group the death due to predators was more in the early period of study (24-30 weeks). The main predators reported by the farmers were dogs, mongoose and wolves. Reasons for other deaths in both the groups were attributed to accidents and deaths due to inclement weather which were mostly reported during the period from 31 to 40 weeks. The findings on the reasons for mortality were in close agreement with that of Girishkumar (2009) who found that in scavenging native chicken the mortality due to disease, out of total mortality, was 52.17 per cent and due to predation was 47.83.

The mortality pattern in both group showed a relation with the distance of the hen's coop from the farmer's house. Five coops in GL and six coops in Gramasree groups were attached to the farmers house (Table 2). There was zero or minimum mortality in the hens housed in these coops. This may be because of the fact that the farmers can easily attend to the birds in attached coops. Also hens housed adjacent to the farmer's house will usually scavenge in the household vicinity which will reduce the mortality due to predators in these birds.

5.10 Hematological and serum biochemical parameters

Hematological parameters pertaining Hemoglobin (Hb) and Packed cell volume (PCV) estimated in whole blood collected from GL and GS hens both at 30 and 40 weeks of age is presented in Table 18. The graphical representation of the estimated values are shown in Fig. 11, 12 and 13.

5.10.1 Hemoglobin (Hb)

In GL group, the mean Hb value of 11.38 g/dL at 30 weeks of age showed significant reduction to 10.92 g/dL at 40 weeks of age. This might be due to the production stress imparted in GL hens between 30 and 40 weeks of age. Whereas, in GS hens, the estimated mean values were 10.75 and 10.44 g/dL and was comparable statically since stress due to egg production was comparatively low in GS hens during the above period.

The comparison between GL and GS hens showed that at 30 weeks of age, the Hb percent was significantly higher in GL group and indicated higher health status due to better nutritional status. At 40 weeks of age the same trend was observed with higher Hb g/dL in GL hens. This might be due to the optimum body weight at 40 weeks of age in GL hens.

Durotoye *et al.* (2000) reported Hb value of 11.33 g/dL in local chicken of Nigeria which is in close agreement with the present study. Sethu (2003) reported higher Hb value of 12.75 ±0.19 and 12.37 ±0.22 g% in egg type male chicken at the age of 7^{th} and 8^{th} month. Darsana (2008) and Girishkumar (2009) reported Hb values of 8.53 ±0.12 and 9.91 which were lower than the values in the present study.

5.10.2 Packed cell volume (PCV)

The mean PCV per cent in GL and GS groups at 30 and 40 weeks of age was 33.86, 33.65, 33.27 and 33.49 per cent respectively and were comparable among each other and was in close agreement with PCV per cent of 33.30 reported by Durotoye *et al.* (2000) in local chicken of Nigeria and 34.07 ± 0.67 reported by Darsana (2008) in broiler chicken at the age of 7th week. However, Girishkumar (2009) stated higher value of Packed Cell Volume (36.88 per cent) in native chicken. The production stress or nutritional stress did not affect the PCV per cent in either of the groups. Lower PCV values were reported by Sethu (2003) in egg

type male chicken at the age of 7th and 8th month and the values were 31.06 ± 0.49 and 32.68 ±0.58 per cent.

5.10.3 Serum Biochemical Parameters

Estimation of liver enzymes Serum Alkaline Phosphatase (ALP), and Serum Alanine Amino Transferase (ALT) was carried out in GL and GS hens at 30 and 40 weeks of age in order to assess the impact of stress on hens in lay under backyard system of rearing (Table 17). There are only few literatures on studies in serum biochemical parameters of GL and GS hens.

5.10.4 Alkaline Phosphatase (ALP)

In GL hens, the mean serum ALP value of 245.44 IU/L at the age of 30 week significantly reduced to 197.60 IU/L at 40 weeks of age. Similar trend was observed in GS group, wherein the value of 242.76 IU/L was reduced to 191.96 IU/L. In the present study, the 30th week falls in May 2009, the peak summer with hot-humid weather in Kerala, and the birds were subjected to high environmental stress which resulted in high values of ALP. Moreover, the rate of increase in egg production during the fortnight 28-30 weeks of age was 18.67 per cent in GL hens and 15.49 per cent in GS hens which led to production stress also. The nutritional availability of hens through scavenging was less. The ALP values recorded at 40 weeks of age is higher than that stated by Durotoye *et al.* (2000) in local chicken of Nigeria (168.5 IU/L). Kalitha et al. (1993) and Kansal and Gangwar (1984) also reported decrease in ALP values due to age and egg production. Singh et al. (1983) observed more plasma ALP activity in high producing pullets.

5.10.5 Alanine Amino Transferase (ALT)

The mean serum ALT values estimated in GL hens at 30 and 40 weeks of age was 9.76 and 7.84I U/L and that in GS hens was 9.92 and 8.24 IU/L respectively. The trend of results in ALP was exactly similar to that discussed under ALP. The ALT values recorded in both the age groups were lower than that recorded by Durotoye *et al.* (2000) who reported a value of 23.1±1.7 IU/L in local chicken of Nigeria

and that recorded by Darsana (2008) who reported a value of 19.07 ±0.73 (IU/L) in broiler chicken at the age of 7th week. Very high values were observed by Karthiayini (2007) who recorded values of 44.83±2.32 during summer and 44.92 ±2.57 during rainy season in broiler chicken at the age of 8th week.

5.10.6 Calcium (Ca) and Phosphorus (P)

The blood Calcium and Phosphorous value in GL and GS hens showed significant reduction at 40 weeks of age The reason for significant reduction in Ca and P in both groups at 40 weeks of age might be due to the progression in production during the period from 30 to 40 weeks of age.

Significantly lower Ca and P mg/dL in GL hens in comparison with that of GS hens at 30th week might be due to heavy drain of these minerals consequent to the significantly higher egg weight (Table 18) recorded at 30 week of age in GL hens. Even though, significantly higher egg weight was noticed in GL group at 40 weeks of age, because of the lower rate of egg production and better nutrition at this age, the Ca mg/dL in GL group was comparable with that in GS group and P level in GL group also was comparable with that in GS group. The Ca and P values recorded at 40th week of age in both groups in the present study were in close agreement with the values observed by Durotoye *et al.* (2000) who reported values of 8.70±1.00 Mmol/L of Ca and 4.30±0.60 Mmol/L of P in local chicken of Nigeria. Very low value of Ca (1.97 ±0.05 Mmol/L) was observed by Darsana (2008) in broiler chicken at the age of 7th week.

5.11 Costs and returns involved in backyard rearing

All the farmers utilized their existing coops for providing night shelter and so the housing expenses are not taken into account under the cost items. The cost of the pullets is estimated to be equal to the returns expected from the sale value of spent hens. So the cost pertaining to hand feeding cost alone is calculated as the cost of rearing the hens under back yard system. Table 19 and 20 revealed that the feed cost per bird per day in GL and GS groups were almost same. (Rs. 0.21 ±

0.01 in GL group and Rs 0.22 ± 0.01 in GS group). The cost of hand feeding was calculated based on the ingredients in the feed.

In the present study, it is advantageous to note that eggs produced in backyard system of rearing fetched a higher value of Rs. 4.0 per egg locally and due to this factor backyard system of rearing can be thought of as a subsidiary income source for the rural households. Similar observation was reported by Das *et al.* (2008) who reported that the traditional free range scavenging poultry of rural Bangladesh played an important role in generating family income in addition to improving the nutritive value of family's diet with eggs and meat. According to Kugonza *et al.* (2008), chickens and eggs are being mainly used to generate household income and for home consumption.

The household wise returns arrived by the sale value of eggs ranged from Rs. 652 to 1512 in GL households with an average value of Rs. 1164 and that in GS households ranged from Rs. 820 to 1492 with an average value of Rs. 1200. 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 was Rs. 2667 for small farms having average flock size of 5. Alders and Pym (2009) observed that output of village poultry in terms of weight gain and number of eggs per hen per year is often low, but there is minimal input in terms of housing, disease control, management and supplemental feeding.

There is high demand for the backyard eggs and so the marketing was not at all a matter of concern in these households. Most of the sales of the GL and GS eggs were done in the door steps of the farmer's house. A marketing network headed by the self help group of women of the village namely *kudumbasree* also was there to sell these eggs through their outlet in the panchayath and also through stalls in various exhibitions conducted by Government departments.

The margin per egg over feed cost was numerically higher in GL Group than GS group. The margin ranged from Rs. 2.99 to Rs 3.55 in GL households

with an average value of Rs 3.29 and that in GS households ranged from Rs 2.87 to 3.45 with an average value of Rs 3.23. In GL group, the minimum margin was noticed in GL 24 and the maximum in GL 26. In GS group, the minimum margin was in GS 21 and the maximum in GS 12.

Ratio between feed cost and return from sale value of eggs was calculated for assessing the influence of hand feeding expenditure on egg yield. The ratio ranged from 1:2.97 to 1:7.83 in GL group with a mean of 1:4.98 and from 1:2.55 to 1: 6.24 with a mean value of 1: 4.40 in GS group. It is seen that the ratio in GL group was higher by Rs 0.58 than the GS group. Thus profitability is more with Gramalakshmi hens under back yard system of rearing.

It should be noted that higher margin per egg and higher ratio of feed cost to egg sale value in back yard poultry rearing not genuinely implied the magnitude of egg yield and the efficient exploitation of productivity. Similar opinion was made by Bell (2009) who reported that the profitability per unit of money invested or the benefit/ cost ratio is important and not the profitability per farm or per bird. The households with minimum investment on hand feeding recorded better margin but their production per cent was low and the volume of gross profit was not remarkable. But in the households with higher feeding cost, even though the margin per egg was less, the production per cent as well as the total profit was more. So regarding the exploitation of productivity of cross bred hens under backyard system, performance in these households should be considered as better.

Relation of feed cost to production per cent and margin per egg

The relation between feed cost, hen day per cent production and margin per egg is studied for assessing the influence of hand feeding on the egg production. From the results it is seen that as feed cost increased, the per cent hen day production was also increased. There is a positive influence on egg production by hand feeding with chicken layer feed. So apart from scavenging, hand feeding with chicken layer feeding also should be practiced in cross bred

hens reared under back yard system to exploit their productivity and to ensure the margin of returns.

From the above observations it can be concluded that the performance of Gramalakshmi and Gramasree hens under back yard system of rearing is almost in the same manner. Gramalakshmi hens are having good behavioural adaptability for foraging in the back yards and were having significantly higher egg weight at pullet age, 30^{th} and 40^{th} week. Gramalakshmi hens showed significantly higher egg production during the peak period but the overall egg production per cent was comparable. The overall egg production per cent in GL hens was adversely affected by the higher mortality rate due to predators. In the case of Gramasree group, the birds showed significantly higher body weight at 20^{th} and 40^{th} week. For this reason these hens can be considered as a dual purpose bird as their multi coloured plumage enable them to fetch higher price and acceptability among the consumers. Even though the egg weight is less in GS hens, its brown shelled small eggs are considered as 'superior back yard eggs' and are having high demand in the market. Considering the above findings it can be observed that both GL and GS hens are having positive attributes in tapping the natural resources in the rural back yards of Kerala.

SUMMARY

The production performance of Gramalakshmi (GL) and Gramasree (GS) hens from 20 to 40 weeks of age was studied under backyard system of rearing in Vattamkulam Panchayath of Malappuram District in Kerala. Performance of 226 pullets in GL group and 233 pullets in GS group in 30 households each were studied during the period from March to July 2009.

The salient results obtained in the present study are furnished below.

1. The socio-economic status of farmers indicated that majority of the farmers who reared GL and GS hens were agricultural workers. The land holding of the farmers ranged from 6 to 175 cents in GL group and 7 to 71 cents in GS group. In more than 75 per cent of the households, the chicken rearing was managed by women. The farmers were having agricultural activities like plantain cultivation, coconut farming and animal husbandry activities like cattle and goat rearing.

2. The flock size at start of the experiment ranged from 5 to 9 pullets among GL households and 5 to 10 pullets among GS group. All the 60 households have provided coops for shelter made up of wood, wire mesh or brick with cement with roofing mainly of tiles followed by thatched roof.

3. Farmers depended on Government Veterinary services and indigenous herbal medications for treating the ailing hens. All hens were hand fed and the average quantity of feed items hand fed in GL group ranged from 16.3 to 30.2 g and that in GS group ranged from 15.8 to 36.4 g/hen/ day. Well water was the main source of drinking water for experimental birds.

4. The biosecurity measures adopted by the farmers included housing of ailing birds in separate coops, scientific disposal of the carcass of dead birds, confinement of the hens in coops when diseases occur in the neighboring houses, regular deworming and the use of parasiticides on birds and coops for the control and prevention of ectoparasites.

5. Aggressiveness, height and distance of flight and foraging ability were more with GL hens. Whereas, scratching ability in search of feed in backyards and broody appearance was more with GS birds. Broody appearance lasted for 5 to 12 days in 22 hens in GL group (9.74 per cent) and 36 hens in GS group (15.45 per cent).

6. The overall mean body weight (BW) at 20 weeks of age in GL group was 1092 g and that in GS group was 1250 g, indicated significantly higher pullet body weight in GS group ($P<0.05$). The overall mean BW at 40 weeks of age was 1739 g in GL group and 1900 g in GS group and was significantly higher in GS group ($P<0.05$).

7. The overall mean age at first egg in GL the flock was 177.13 days and that in GS group was 179.07 days. The pullets in GL group attained 10 per cent production at 169 days of age and that in GS group at 165 days of age. The GL birds reached 50 per cent production at 174 days of age in GL group and at 173 days of age in GS group.

8. The peak production recorded at 34 weeks of age in GL and GS hens was 4.07 eggs/hen/week in GL group and 3.73 eggs/hen/week in GS group on HH basis with 58.15 and 53.3 per cent production respectively. The corresponding production on hen-day basis at 34 weeks of age was 67.01 per cent in GL group and 58.28 per cent in GS group.

9. The cumulative mean hen housed egg number from 24 to 40 weeks of age in GL group was 38.63 eggs/hen and that in GS group was 38.60 eggs/hen representing 32.46 and 32.44 per cent production respectively.

10. The cumulative hen-day egg production from 24 to 40 weeks of age was 35.53 per cent in GL group and 34.30 per cent in GS group. Cumulative hen-day production among households in GL group ranged from 31.64 to 49.54 eggs/hen and that in GS group ranged from 35.04 to 52.57 eggs/hen.

11. The overall mean egg weight (EW) in pullets and EW at 30 and 40 weeks of age in GL group were 34.0, 47.2 and 54.3 g and that in GS group were

33.1, 45.8, and 51.4 g respectively and the mean values in GL group were significantly higher than the corresponding EW in GS group ($P<0.05$).

12. The overall mortality was significantly higher ($P<0.05$) in GL group (16.37 per cent) than that of GS group (12.45 per cent). The death due to predation was high in GL and GS groups.

13. In GL group, the mean Hemoglobin (Hb) value of 11.38 per cent at 30 weeks of age showed significant reduction to 10.92 per cent at 40 weeks of age ($P<0.05$). The Packed cell volume (PCV) per cent in GL and GS groups at 30 and 40 weeks of age were comparable among each other.

14. In both GL and GS groups, the mean serum Alkaline Phosphatase (ALP) value at the age of 30^{th} week showed significant reduction at 40^{th} week. The mean serum Alanine Amino Transferase (ALT) values also showed significant reduction in 40^{th} week ($P<0.05$).

15. The blood Calcium and Phosphorous per cent in GL and GS hens showed significant reduction at 40 weeks of age in comparison with that observed at 30 weeks of age ($P<0.05$).

16. Ratio between feed cost and return from sale of eggs averaged Rs.4.98 in GL group and Rs.4.40 in GS group. The margin per egg over feed cost was numerically higher in GL group in comparison with that of GS group (Rs.3.29 and Rs. 3.23).

The results obtained in the present study revealed that the egg production in GL and GS hens was similar on hen housed and hen day basis in spite of higher mortality in GL group. However, the egg weight was significantly higher in GL group and the body weight was significantly higher in GS group. Both GL and GS eggs fetched higher price in the market. Based on the above findings, it can be concluded that the performance of Gramalakshmi and Gramasree hens under back yard system of rearing is almost in the same manner.

REFERENCES

Acharya, R.M. and Bhat, P.N. 1984. *Livestock and poultry genetic resources in India.* Research Bulletin No 1, IVRI, Izatnagar, Uttar Pradesh, India.

Aklilu,H.A., Udo,H.M.J., Almekinders,C.J.M and Zijpp, A. J.,2008. How resource poor households value and access village poultry keeping in Tigray, *Agricultural Systems,***96** : p 175-183

Alders,R.G.and Pym, R.A.E., 2009. Village poultry: still important to millions, eight thousand years after domestication. *World's Poult. Sci. J.,* **65**: 181-190.

Alders, R. and Spradbrow, P., 2001. Controlling New Castle Disease in Village Chicken: *A Field Manual. ACIAR monograph* N° 82, 112 p.

Alemu, Y. and Tadelle, D., 1997. Status of poultry research and development in Ethiopia. *Research Bulletin No.4.* Debre Zeit Agriculural research Center, Alemaya University of Agriculture.63pp.

Anon. 2005. Report on Seventeenth Quinquennial Livestock Census 2003 of Kerala State, Directorate of Animal Husbandry, Thiruvananthapuram.77p.

Beena, C. J., 1995. Evaluation of production performance in 'F'strain of White Leghorn. M.V.Sc.Thesis. Submitted to Kerala Agricultural University, Mannuthy, Thrissur.

Bell, J.G.,2009.Factors limiting production efficiency and profitability from small holder poultry production .*Worlds Poult. Sci. J.***65**: 207-210.

Biswas, P.K., Uddin, G.M.N., Barua, H., Roy, K., Biswas, D., Ahad, A. and Debnath, N.C. 2008. Survivability and causes of loss of broody-hen chicks on smallholder households in Bangladesh. *Prev. Vet. Med.,* **83**:260–271.

Crawford, R.D. 1990. Origin and history of poultry species. In: Crawford, R.D. (ed.), *Poultry Breeding and Genetics.* Elsevier, Tokyo, pp. 1-40.

Darsana, M.G. (2008). Physio biochemical evaluation of broiler chicken fed with processed fish wastes. M.V.Sc.Thesis. Submitted to Kerala Agricultural University, Mannuthy, Thrissur.

Das, S.C., Chowdhury, S.D., Khatun, M.A., Nishibori, M., Isobe, N. and Yoshimura, Y. 2008. Poultry production profile and expected future projection in Bangladesh. *World's Poult. Sci. J.,* **64**: 99-118.

Doley,S., Barua,N., Kalita,N. and Gupta,J.J.2009.Performance of indigenous chicken of North-Eastern region of India under different rearing systems. *Indian J. Poult.Sci.* 44(2):249-252

Durotoye,L.A.,Fadairo,M.O. and Avwemorue, A.K., 2000.Diurnal variation in blood parameters in the chicken in the hot tropical climate. *Afr.J.Biomed. Res.*, **3**:143-147.

DZARC, 1984. Debre Zeit Agricultural research Center. Debre Zeit Agricultural Research Center, *Annual Report.*

Fiks-vanNiekerk, T.G.C.M, 2001. Organic poultry farming: a small but growing concept. *In Proceedings of the 6th European Symposium on Poultry Welfare, Zollikofen,Switzerland,* pp. 35-37. Swiss Branch of the WPSA, Zollikofen,Switzerland.

Girishkumar, P., 2009. Evaluation of native chicken of northern Kerala, M.V.Sc.Thesis. Submitted to Kerala Agricultural University, Mannuthy, Thrissur.

Gueye, E. 1998. Village egg and fowl meat production in Africa. *World's Poult. Sci. J.*, **54**: 73-85.

Guerne, B.E., Paganiand, P.and , Honhold, N., 2009. Progress towards practical options for improving bio security of small scale poultry production. *World's Poult. Sci. J.*, **65**: 211-215.

Gupta, J.J., Doley, S., and Yadav, B.P.S. 2006. Study on rural poultry production in Meghalaya. *Indian J. Poult. Sci.*, **41**:108-110.

Halima, H., Neser, F.W.C., Marle-Koster, E. and Kock, A., 2007. Village-based indigenous chicken production system in north-west Ethiopia. *Tropical Anim. Hlth. and Production,* **39**: 189-197.

Halima, H., Neser, F.W.C., Tadelle Dessie, Kock, A. and Van Marle-Koster, E. 2006. Studies on the growth performance of native chicken ecotypes and RIR chicken under improved management system in northwest Ethiopia. *Liv. Res. Rural Dev.*, **18**: 6.

Haunshi, S.,Saxena,S.C., Biswajit,D. and Bujarbaruah,K.M. 2006. Comparative study of certain egg quality traits of Vanaraja and White leghorn chicken. *Indian J. Poult. Sci.* 41(3):323-324

Iqbal, S. and Pampori, Z.A. 2008. Production potential and qualitative traits of indigenous chicken of Kashmir. *Liv. Res. Rural Dev.*, **20**:11.

Jayanthy, M.V., 1992.Performance of Desi x Exotic Crossbred Layers, M.V.Sc.Thesis. Submitted to Kerala Agricultural University, Mannuthy, Thrissur.

Kalita,N., Lokanath, G.R. and Ramappa,B.S. (1993). Biochemical variants in relation to economic traits in poultry. *Poult. Guide, 30* (5): 63.

Kalita,N.,Gawande,S.S. and Barua,N.2009.Production and reproduction performance of indigenous chicken of Assam under rural conditions . *Indian J. Poult.Sci.*44(2):253-255

Kansal, M.L. and Gangwar, P.C. (1984) cyclic changes of oviducal tissue and blood plasma alkaline and acid phosphatases in layer (Gallus domesticus) during spring and summer seasons. *Indian J. Poult.Sci.* **19** (2): 94-99.

Karthiayini, K., (2007). Effect of season and antistress agents on physiological and biochemical parameters of of broiler chicken under sress. PhD.Thesis. Submitted to Kerala Agricultural University, Mannuthy, Thrissur.

Khan, A.G. 2008. Indigenous breeds, crossbreds and synthetic hybrids with modified genetic and economic profiles for rural family and small scale poultry farming in india. *World's Poult.Sci.J.* **64** (3):405-415.

Khan, A.G. and Krishna, J., 1983. Replica of Desi Fowl.*Indian. Poult. Review*, 14(24) :15-21.

Kugonza, D. R., Kyarisiima, C. C. and Iisa A. 2008. Indigenous chicken flocks of eastern Uganda: I. Productivity, management and strategies for better performance. *Liv. Res. Rural Dev.*, **20**:9.

Kumar, S. and Kumar, D. 2007. *Local Hill Fowl of Uttarakhand State.* Department of Genetics and Animal Breeding, College of Veterinary and Animal Sciences, G.B. Pant University of Agriculture and Technology, Pant Nagar, Uttarakhand State, 5p.

Leo, J., Jalaludeen A.and Peethambaran P.A., 2006a. *Gramalakshmi- A potential Bird for the Backyard.* Leaflet, Centre for Advanced Studies in Poultry Science, Kerala Agricultural University, Mannuthy.P.O, Kerala, 680 651.

Leo, J., Jalaludeen A.and Peethambaran P.A., 2006b. *Gramasree- Coloured Bird for the Backyard.* Leaflet, Centre for Advanced Studies in Poultry Science, Kerala Agricultural University, Mannuthy.P.O, Kerala, 680 651.

Lucas, A.M. and Jamroz, C. 1961. *Atlas of avian haematology*. U.S. Department of Agriculture, Monograph 25.

Mack, S., Hoffmann, D. and Otte, J. 2005. The contribution of poultry to rural development. *World's Poult. Sci. J.*, **61**: 7-13.

Mcainsh, C.V., Kusina, T., Madsen, J. and Nyonji, O. 2004. Traditional chicken production in Zimbabwe. *World's Poult. Sci. J.*, **60**:233-245.

Mehta, R. and Nambiar, R.G.2007. The Poultry Industry in India, 61 p. (http://www.fao.org/ag/AGA Info/home/events/bangkok2007/docs/part 1/ 1-5.pdf.)

Mengesha, M., Tamir, B. and Tadelle, D. 2008. Socio-economical contribution and labor allocation of village chicken production of Jamma District, South Wollo, Ethiopia. *Liv. Res. Rural Dev.*, **20**:10.

Mishra,S.C.,1996. Poultry production in eastern and north eastern India. *Indian. Farming*, p.83.

Mohan,J., Sastry, K.V.H., Moudgal, R.P. and Tyagi, J.S. 2008a. Production and other characteristics of Aseel peela desi hens under normal rearing system. *Indian J. Poult.Sci.*43(2):217-219

Mohan, J., Sastry, K.V.H., Mougal,R.P. and Tyagi,J.S. 2008b. Performance profile of Kadakanath desi hens under normal rearing system. *Indian J. Poult.Sci.*43(3):379-381

Muchenje, V. and Sibanda, S., 1997. *Informal survey report on poultry production systems in Chivhu and Sanyati farming areas.* Crop-livestock farming systems research methodologies training workshop. Danida project report, pp 23-42.

Nair, N.S. and Bhattacharyya, A.R., 1984. Studies on the Performance of White Leghorn x Austrolorp cross under backyard system . *Poult. Adviser*.**17**(12):53-54.

Ngo, T.K.C., Thi Kim Cuc, Muchadeyi, F.C., Baulain, U., Eding, H., Weigend S. and Wollny C.B.A. 2006. An Assessment of Genetic Diversity of Vietnamese H'mong Chickens, *Int. J. Poult. Sci.*, **5**: 912-920.

Padhi, M.K., Panda., B.K. Sahoo, S..K. Mahapatra, C..M. and Giri, S.C. 2003. Evaluation of different hybrids under free range system of poultry keeping in coastal Orissa. *Indian J. Poult. Sci.* **38** (2) 121-125.123.

Panda, B. and Mohapatra, S.C. 1989. *Poultry production*, Publications and information division, Indian Council of Agriculture Research, Krishi Anusandhan Bhavan, New Delhi – 110 012, India, 190p.

Rai, R. B. and Ahlawat, S.P.S. 1995. Evaluation of disease resistance characteristics of Nicobari fowl. *Indian Vet. J., 72:354*-357.

Radhakrishnan, P.M., 1981. Evaluation of pure bred and cross bred chicken under backyard conditions. M.V.Sc.Thesis. Submitted to Kerala Agricultural University, Mannuthy, Thrissur.

Radhakrishnan, P.M. and Ramakrishnan, A., 1982. Evaluation of pure bred White Leghorn, Rhode Island Red, Australorp and their reciprocal crosses under backyard conditions, *Kerala J. Vet. Sci.*, 13(2):193-198.

Sethu, C.N., 2003. Effect of blue green alga (*Spirulina platensis*) on haematological , biochemical and fertility parameters of egg type male chicken. M.V.Sc.Thesis. Submitted to Kerala Agricultural University, Mannuthy, Thrissur.

Sharma,D.,Johari,D.C.,Kataria,M.C. and Singh, D.P.,1992.Combining ability analysis for egg production traits of light and heavy breed crosses of egg type chicken. *Indian J.Poult. Sci.*, **27**(4):183-187.

Selvam,S. 2004. An economic analysis of free range poultry rearing by rural women. *Indian J. Poult. Sci.*, **39**:75-77.

Semmaran,M., Sasidhar,P. V. K., Majumdar, S., Chander,M. and Tripathi, H. 2008. Adoption behaviour of Giriraja backyard poultry by farmers in Karnataka. *.Indian J. Poult.Sci.*,43(3):343-345.

Singh, B. P.,Taparia,A.L.,Tailor and Jain, L.S. 2003. Factors affecting mortality pattern in chicken. *Indian J. Poult. Sci.*, **38**(2): 173-177.

Singh,C.B. and Kumar,D.2008.Gene tic parameters of production traits of native fowl of Garhwal Himalayas.*Indian J. Poult.Sci.*,43(3): 361-362.

Singh, R.P., Jithendrakumar, Dwarakanath, P.K. and Balaine,D.S. (1983). Association of plasma 5'- nucleotidase and alkaline phosphatase with production traits in chicken . Genetic and Phenotypic variability. *British Poult.Sci.* 24: 483-488.

Singh,V.K, Manimohan. Verma, S.B. Mandal, K.G. and Singh, D.P. 1999. Analysis of body weight at different ages in pure and cross bred chickens. *Indian J. Poult.Sci* . **34**(2) : 155-1601-125.

Snedecor, G. W. and Cochran, W. G. 1994. *Statistical Methods* (8th ed.). Oxford and IBH Pub. Co., Kolkata, India.p313.

Sonaiya, E.B., 2007. Family poultry, food security and the impact of HPAI. *Worlds Poult. Sci. J.*, **63**(1): 132-138.

Sonaiya, E.B., 2009. Some technical and socio economic factors affecting productivity and profitability of small holder family poultry . *Worlds Poult. Sci. J.*, **65**: 201-205.

Sridharan, E., (1998). Production performance of Austra – White and Rhode – White layers on litter floor.M.V.Sc. Thesis. Submitted to Kerala Agricultural University, Mannuthy, Thrissur.

Sturkie, P.D. and Griminger, P. 1986. Body fluids-blood. In: Sturkie, P.D. (ed), *Avian physiology* (4^{th} ed.). Springer Verlag, New York, pp 102-129.

Tadelle, D., 1996. Studies on village poultry production systems in the central highlands of Ethiopia as assessed by analysis of crop contents. *Ethiopian J. Agric. Sci.* **17**:47-57.

Tadelle, D.,Nigusie, D., Alemu,Y. and Peters, T.J., 2002. The feed resource base and its potentials for increased poultry production in Ethiopia. *World's poult. Sci. J.* **58**(1):77-87.

Talha, A.F.S.M., Hossain, M.M., Chowdhury, E.H., Bari, A.S.M., Islam, M.R. and Das, P.M. 2001. Poultry diseases occurring in Mymensingh District of Bangladesh. *Bangladesh Vet. J.*, **18**: 20–23.

Tauson, R.,2005.Management and housing systems for layers-effects on welfare and production . Worlds Poult. Sci. J.**61** (3):477-487.

Vande,W.H.A. and Elson, A. 2006, Rearing factors that influence the propensity for injurious feather pecking in laying hens, *World's Poult. Sci.J.* **62** (4):654-664.

Vij, P.K., Tantia, M.S. and Vijh, R.K. 2006. Characterization of Punjab brown chicken. *Animal Genetic Resources Information,* **39**: 65 – 76.

Vij, P.K., Tantia, M.S., Anil Kumar, K., Vijh, R.K. and Ahlawat S.P.S. 2007. *Chicken Breeds of India-Tellichery.* Leaflet 42, National Bureau of Animal Genetic Resources, P.O. Box 129, Karnal, 132 001.

Vijh, R.K., Chatterjee, R.N., Vij, P.K., Tantia, M.S. and Ahlawat, S.P.S. 2006. *Chicken Breeds of India-Nicobari.* Leaflet 36, National Bureau of Animal Genetic Resources, P.O. Box 129, Karnal, 132 00.

Vijh, R.K., Roy,T.C., Vij, P.K., Tantia, M.S. and Ahlawat S.P.S. 2005. *Chicken Breeds of India-Miri.* Leaflet 2, National Bureau of Animal Genetic Resources, P.O. Box 129, Karnal, 132 001.

Yadev,S.N., Kumar,Y., Singh,B., Ghosh,A.K. and Kaur,N.2009. Evaluation of egg quality traits of chicken reared under backyard system in Western Uttar Pradesh. *Indian J. Poult.Sci.* 44(2):261-262.

Yousef and Al-Yousef, 2007. A survey study on the distribution of Saudi baladi chickens and their characteristics. *Int. J. Poult. Sci.* **6**: 289-292.

PERFORMANCE OF 'GRAMALAKSHMI' AND 'GRAMASREE' CHICKEN LAYERS UNDER BACKYARD SYSTEM

B. AJITH BABU

Abstract of the thesis submitted in partial fulfilment of the requirement for the degree of

Master of Veterinary Science

Faculty of Veterinary and Animal Sciences
Kerala Agricultural University, Thrissur

2010

Department of Poultry Science
COLLEGE OF VETERINARY AND ANIMAL SCIENCES
MANNUTHY, THRISSUR-680651
KERALA, INDIA

ABSTRACT

The present study was conducted to assess the production performance of Gramalakshmi (GL) and Gramasree (GS) hens under backyard system of rearing. The period of study was from 20 to 40 weeks of age in 226 GL and 233 GS hens which were reared in 30 households each. The study area was in Vattamkulam Panchayath of Malappuram District in Kerala.

Most of the farmers were agricultural workers and the women in the households managed the chicken flock under backyard system. Farmers used wooden coops, mainly with tiled roof placed either adjacent or far away from the house for providing night shelter to the birds. Apart from scavenging, hand feeding was practiced in all households with a variety of feed items with varying quantity. The average quantity of feed items ranged from 15.8 to 36.4 g/bird/day. Out of the 60 households, the source of drinking water in 46 households was from wells. The farmers availed veterinary services from government agencies and also depended on indigenous herbal medications. Biosecurity measures were also adopted. Aggressiveness, foraging and flight behavior was evident in GL hens while scratching ability was exhibited more in GS hens and both flocks showed broody appearance of short duration occasionally.

The results obtained in the present study indicated that the overall mean Body weight at 20 and 40 weeks of age was significantly higher in GS group than that of GL group ($P<0.05$). The age at first egg varied widely among households (159 to 209 days). Both flocks attained peak production at 34 weeks of age with significantly higher egg production of 67.01 per cent in GL group in comparison with 58.28 per cent in GS group, on HD basis ($P<0.05$). The cumulative mean egg production from 24 to 40 weeks of age was comparable between GL and GS flocks on HH basis (32.46 and 32.44 per cent) and HD basis (35.53 and 34.30 per cent). The overall egg production showed narrow variation between GL and GS flocks (42.28 and 40.82 eggs/hen) but with wide variation among households, ranging from 31.64 to 52.57 eggs/hen. The egg weight of pullets and the mean

EW at 30 and 40 weeks of age was significantly higher in GL group (34.0, 47.2 and 54.3 g) in comparison with those of GS group (33.1, 45.8 and 51.4 g) ($P<0.05$).

The overall mortality in GL units (16.37 per cent) was significantly higher than that of GS units (12.45 per cent) and death due to predators was high in both flocks. In the present study, in GL group, the mean Hemoglobin value at 40 weeks of age showed significant reduction. Serum biochemical parameters, Alkaline Phosphatase, Alanine Amino Transferase , blood Calcium and blood Phosphorous values were reduced significantly at 40 weeks of age both in GL and GS hens in comparison with the mean values recorded at 30 weeks of age.

From the above observations it can be concluded that the performance of Gramalakshmi and Gramasree hens under back yard system of rearing is almost in the same manner and both these hens are having positive attributes in tapping the natural resources in the rural back yards of Kerala.