ATTITUDE OF FARMERS TOWARDS HAY BOX BROODER AND ON STATION EVALUATION USING BROILER CHICKS AT JIMMA

M.Sc. Thesis

By

Getenet Abate Alemu

July, 2011

Jimma University

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M.Sc. Thesis Submitted to the
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In partial Fulfillment of the Requirements for the Degree of Master of Science in Agriculture (Animal Production)

By

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APPROVAL SHEET

SCHOOL OF GRADUATE STUDIES
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As Advisors of Mr. Getnet we hereby we have red and evaluated his MSc thesis entitled "**The Attitude of Farmers Towards Hay Box Brooder and On Station Evaluation Using Broiler Chicks at Jimma**". We recommend that it can be accepted as fulfilling the thesis requirement for the degree of Master of Science in Agriculture (Animal Production).

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As members of Board of Examiners of the M.Sc. thesis open defense examination, we certify that we have read and evaluated the thesis prepared by Getenet Abate and examined the candidate. We recommended that the thesis be accepted as fulfilling the thesis requirement for the Degree of Master of Science in Agriculture (Animal Production).

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DEDICATION

This thesis work is dedicated to the Almighty God, who gave me all the strength and courage.

STATEMENT OF THE AUTHOR

I declare that this thesis is my original work and all sources of materials used for this thesis have been duly acknowledged. This thesis has been submitted in partial fulfillment of the requirements for M.Sc. degree in Agriculture (Animal Production) at Jimma University, College of Agriculture and Veterinary Medicine and put in the University Library to be made available to borrowers under the rules of the library.

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BIOGRAPHICAL SKECH

The author was born in Ghimbo Wereda of the former Keffa Province on May 1, 1973. He completed his elementary and secondary education at Ghimbo Elementary and Bonga Secondary school in 1986 and1990 respectively. The author Joined Jimma University; College of Agriculture in 1990/91 and graduated with Diploma in General Agriculture on July 3/1993.

After his graduation, the Author was assigned as head of the Menjiwo Wereda office of the Kaffa Zone natural resource development and environmental protection under Bureau of natural resource development and environmental protection of The Southern Nations and Nationalities Peoples Regional State. In 1999 he joined Awassa College of Agriculture as an "Advance Standing" student and graduated with BSc Degree in Animal Production and Range Land Management on July 2001.

Soon after graduation, the author was employed by the Ministry of Planning and Economic Development Department and assigned to Keffa Zone as an expert of NGO'S and Development Cooperation and Acting Head of Administration and Finance.

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LIST OF ABBREVIATIONS

BPEDORS	Bureau of planning and Economic Development of Oromiya Regional state
CACC	Central Agricultural Census Commission
CRD	Completely Randomized Design
EARO	Ethiopian Agricultural Research Organization
FAO	Food and Agricultural Organization
IPMS	Improving Productivity and Market Success
JUCAVM	Jimma University College of Agriculture and Veterinary Medicine
MASL	Meter above Sea level
MOARD	Ministry of Agriculture and Rural Development
SNNPRS	Southern Nations, Nationalities and peoples Regional state
SPSS	Statistical Package for social sciences

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ABSTRACT

Field surveywas conducted to assess the attitude of farmers towards the hay- box brooding technology and and on-station trial were conducted to evaluate the brooding performance of the technology in and in the vicinity of Jimma (JUCAVM). The farmers who received the hay-box chick brooders were interviewed using a semi-structured questionnaire. A total of 270 Cobb500 broiler chicks were used to evaluate the brooding performance of the existing and modified hay-box brooders of 30 chick's capacity, replicated in completely randomized design using electric brooders as positive treatments. Carcass yield and weight of internal organs were determined by slaughtering 6 chicks randomly taken from each treatment and a dressing percentage of 78.1, 76.21 and 73.44% was recorded from T1,T2and T3 respectively. Finally all the data collected were subjected to statistical analysis. About 98% of the respondents have said the hay-box chick brooder is very easy for construction and management. The respondents reported to have attained mean survival rate of 30-59% and 76 -90% to an age of 8 weeks and 4 weeks with the use of natural brooding and hay box brooder respectively. All the respondents (100%) reported to have a very strong interest in adopting the hay-box technology in their locality with some modifications. The results of the on-station trial, showed that there was no significance difference ($p>0.05$) between the treatment groups assigned to electric and modified hay box brooder in mean daily body weight gain, feed consumption and mortality (2.2%)) to an age of 56 days; whereas the treatment groups assigned to the existing hay box brooder had significantly ($P<0.05$) lower daily gain and survival rate (54%) than the others to an age of 56 days. The treatment groups assigned to the electric and modified hay box brooders attained body weight of 2.3 and 2.1kg/head respectively at an age of 56 days with survival rate of 98%.The internal organs weight data on the carcass evaluation shows that there is no significance difference ($p>0.05$)between all the treatment groups except liver, bursa of fabricius and Adrenal gland. About Birr 74 and 71 was invested to raise day old broiler chicks to an age of 56 days with the use of electric and modified hay box brooder resulting in net profit of Birr 51/head and birr 37/head respectively indicating that electric and modified hay box brooder could safely and economically be used to raise broilers as business at urban and rural household level in Ethiopia respectively. Refining the constructional design and specifications of the technology seems to be the future direction of research.

***Key words**: Broilers, brooding performance, survival rate, electric brooder, Hay box brooder*

1. INTRODUCTION

In Ethiopia, it is the Ministry of Agriculture and Rural Development (MoARD) that was given the mandate for national poultry extension work and the ministry established poultry multiplication centers in different parts of the country to be used as source of breeding stocks and management information. The poultry extension activities of MoARD have been concentrated on breed improvement through the distribution of 3-month's old pullets and cockerels. In 1980s MoARD has started strengthening the multiplication centers to attain their full operational capacities and establishing of 57 satellite brooder houses that get day old chicks from the multiplication centers, and rear them to 3 months and supply pullets and cockerels to farmers in their respective zones (Alemu and Tadelle , 1997).

It was reported that MoARD was operating with a total of 14 modern poultry breeding and rearing centers prior to 2007 all of which were involved in the distribution of fertile eggs, pullets/cockerels, culled layers and management information of Rhode Island Red breeds of chickens to the rural farming population. The centers were characterized by lack of financial resource, aged genetic materials, shortage of qualified personnel's, inadequate pharmaceuticals, which resulted in high mortality . With the exception of two (Bedelle and Bonga) all the other centers were totally or partially devastated by disease outbreak in the year 2006 (Solomon, 2007). Thus the supply of layers, pullets and cockerels from the government poultry breeding centers has not been commensurate with the demand and hence, MoARD cannot claim to have had sustainable and measurable impacts on the rural communities.Thus it is difficult to expect rapid and positive change through the supply of 3-months old pullets and cockerels from the government poultry multiplication and rearing centers (Solomon, 2007).

The poultry extension services of MoARD will face a considerable challenge if the breeding and rearing centers are expected to rear chicks up to three months or older before distributing to farmers. The Centers cannot meet this demand due to the huge requirements in terms of breeding facilities even though they are having adequate

hatching capacity (Nigussie *et al*., 2003). This situation warrants exploring possibilities of fabricating an artificial brooder which the farmers would be able to use to rear their chicks in the rural environment.

The hay-box chick brooding technology, developed at Jimma University College of Agriculture and Veterinary Medicine (JUCAVM) is an appropriate and simple techniques that could be used at village level. The technology utilizes simple and locally available materials. The major principles of this simple technique involve brooding chicks by conserving the metabolic heat produced by the chicks to keep them warm. Under village conditions using the hay-box brooder also have the advantages of providing protection against predator attack and reduce risk of exposure to disease through confinement (Nigussie *et al,*. 2003).

The Hay- box chick brooding technology was comprehensively studied using layer type day old chicks in Ethiopia. The brooder was tested in urban and rural areas of Jimma Zone and produced promising results (Solomon, 2001). The results of a series of on-station and on-farm trials conducted to evaluate the brooding performance of the hay-box brooder using layer type chicks clearly showed that locally constructed portable hay-box brooders in which no artificial heat is employed seems to be the brooders of choice for promotion of baby chick's poultry extension package under the Ethiopian household farming conditions. According to the results of a series of trials conducted in Jimma, mean survival rate of 80% to an age of 2 months was recorded from layer type White Leghorn day old chicks raised using the hay-box brooding technology (Solomon, 1999).

Several on-station and on-farm trials were also conducted to evaluate the performance of hay- box brooder with layer type exotic chicken using different insulation materials at Debre Ziet Agricultural research Center and Denbi village of Adaa Woreda. The results obtained from those trials indicated that mean mortality level of 18.7% and 19.6% were recorded from groups of layer type day-old chicks assigned to the electric brooder and hay-box brooders respectively, indicating that the use of hay-box brooders insulated with any type of cereal residues to replace artificial electric heating could be considered as simple and suitable techniques of brooding chicks without electricity. The on-farm

performance of layer type chicks brooded using the hay-box brooders was rated excellent. The results of the on station experiment also indicated that there was no significant difference (P>0.05) between the hay-box and electric groups in rate of maturity as measured by the age at first egg. Both the hay-box and electric groups were equally active, vigorous and comparable in the rate of feathering as evaluated by visual appraisal. (Nigussie *et al.,* 2003).

Solomon (2001) reported mortality rates as high as 24% using hay-box brooders under village conditions around Jimma. Chick mortality recorded from natural brooding as practiced under village condition in the central highlands of Ethiopia was reported to be about 61% in the first 8 weeks (Tadelle, 1996). Based on the results of the survey conducted in Wolayta, Southern highlands, Hoyle (1992) reported mean mortality rate of scavenging chicken (natural brooding) ranging from 47 to 73% to an age of 3 months. It is a promising success to reduce such a huge rate of mortality to as low as 7-10% to an age of 3 months with the use of hay box chick brooding technology (Nigussie *et al., 2003*).

A comprehensive verification trials aimed at field testing of hay box brooder in Ethiopia, Kenya and Tanzania were jointly conducted by JUCAVM and the Food and Agriculture Organization of the United Nation (FAO). About 82% of all the experimental chicks placed in the hay box brooder and distributed to the test farmers through FAO funded field testing project in Ethiopia survived to an age of 8 weeks, the value of which is comparatively very high under the Ethiopian circumstances as reported by Tadelle(1996) and Hoyle(1992). The results of the field testing trial conducted under Machakos condition located about 70 Km Southeast of Nairobi was found to be surprisingly high. About 96% of the hay-box groups distributed to farmers in Machakos survived to an age of 8 weeks whereas, about 83 % of all the chicks distributed to the test farmers in Makao Mapya and Msongole Kibaha Rural District in the Coastal Region of Tanzania survived to an age of 8 weeks (Solomon, Personal communication). The overall results of the field testing in Kenya and Tanzania indicated that the Hay Box Chick Brooder, now being made available in Kenya and Tanzania is helping poultry farmers solve the problem of high chick mortality rates within the first weeks of life through

disease, predation, harsh weather and physical injury. Unlike other brooders, this device does not require coal, oil, or electricity for heat. The brooder costs just Ksh100 (€1) to make (Solomon, 2010).

According to Improving Productivity and Market Success (IPMS) framers project, (personal communication) there are a number of farmers who have taken up or adopted improved exotic chicken with the use of hay-box brooder particularly in the Goma and Dale areas of the Oromia and SNNP (Southern Nations Nationalities and People) regional state, respectively. Being closely supervised by development agents with the provision of veterinary services, mean survival rate of 88.6% (to an age of 8 weeks) was recorded from the groups of day old exotic chicks adopted by the farmers in Gamma Woreda with the use of the hay-box brooder under the IPMS farmers' project**.** It is stated that smallholder farmers are successful in raising layer type day old chicks as a result of which IPMS is interested in researching in the area of setting up of proper input supply system(feed, vaccination, animal health issues and market linkage) for improved poultry production to work for smallholder farmers.

In the year 2005, CHF International Ethiopia planed to distribute 18 600 Rhode Island Red day old chicks with the use of the hay-box brooder. A total of 6854 Rhode Island Red, day-old chicks were distributed to 227 women headed households of Meskan and Alaba special Woredas along with the hay-box brooders during the first phase of the project. Unfortunately the expected threat of avian flu reaching Ethiopia via neighboring countries resulted in a project halt in poultry distribution to protect against possible flu transmission to human populations. CHF international Ethiopia was instructed by the donor to halt the distribution of chicks and the activity was changed in to sheep and goat provision. A series of follow up of the chicks distributed reported that 1078 day-old chicks died indicating survival rate of 84.3 %(CHF International Ethiopia, 2005).

It seems to be difficult to suggest an upper and lower limit on the number of baby chicks or adult birds that could conveniently be kept with the use of the hay-box brooding technology by rural farmers from housing and feeding point of views. According to Solomon (1999), farming community members were reluctant to accept the offer of hay-

box brooder of 10 chick's capacity. All the rural farmers who were offered batch's of more than 30 day old chicks either sold or released larger proportion of their chicks (at an age of 2 months) to other households in sharing arrangements. All the observations made tend to indicate that hay-box brooder of 30 chicks capacity seems to be the most appropriate both for urban and rural household poultry producers in Ethiopia. More-over the results of the verification trails aimed at field testing of hay box brooder in Ethiopia, Kenya and Tanzania clearly indicated that the hay box brooder of 30 chick's capacity is the most appropriate one compared to the others (Solomon,1999; 2007).

In summary the results of the field testing of the hay box brooder in Ethiopia clearly showed that locally constructed and portable hay-box brooders in which no artificial heat is employed seems to be the brooders of choice for rural household poultry producers under the present Ethiopian conditions. Unfortunately however, there is no research conducted to evaluate the suitability of hay-box brooder in raising broiler type day old chicks. Experience of IPMS and JUCAVM tends to indicate that smallholder farmers are successful in raising egg type day old chicks and IPMS seems to anticipate that it should be easier for the farmers to get involved into improved broiler production since it only takes about 8 weeks to market the product. This being the case, the major objective of this research proposal is to study the attitude of farmers towards the hay-box brooder and the feasibility of initiating household improved broiler production with the use of hay box brooder at JUCAVM with the following specific objectives.

- To conduct a survey and study the attitude of farmers towards the hay box brooder in and in the vicinity of Agaro, Seka, Serbo and Jimma towns.
- To evaluate the comparative on-station brooding performance of the existing and modified hay-box brooders of 30 chicks capacity using day-old chicks of modern broilers(Cobb500 breeds) at JUCAVM
- To study the comparative carcass yield and weight of internal organs of the experimental chicks raised with the use of the hay-box brooding technology
- To perform economic analysis on the use of hay-box brooder in rearing modern broilers as a business at household level.

2. LITERATURE REVIEW

2.1 Ethiopian Poultry Population and Distribution

The word poultry includes all domestic birds kept for the purpose of human food production (meat and eggs) such as chickens, turkeys, ducks, geese, ostrich, guinea fowl and doves and pigeons. In Ethiopia ostrich, ducks, guinea fowls, doves and pigeons are found in their natural habitat (wild) whereas, geese and turkey are exceptionally not common in the country. Thus the word poultry production is synonymous with chicken production under the present Ethiopian conditions (EARO, 1999).

According to Halima (2007) a substantial phenotypic diversity is expected within the Ethiopian indigenous chicken genetic resources attributed to the presence of diverse agro-ecological and socio-economic considerations. Ethiopia is one of the few African countries said to be accountable for significantly larger chicken population. (Fikre, 2001). There is no accurate figure representing the Ethiopian poultry population. CACC (2003) and FAO (2005) estimated the Ethiopian poultry population at 42.9 and 39 million, respectively while the Central Statistical Authority (2004-2005) reported 31 millions. According to CACC (2003) about 41.7%, 18.5%, and 39.7% of the national poultry population are chicks to an age of 8 weeks, growers aged from 9 to 20 weeks and adult birds of more than 20 weeks respectively. According to the Central Statistical Authority (2004-2005) about 97.82% of the total national poultry population consists of the indigenous chickens, whereas, the remaining 2.18% consists of the introduced exotic breeds of chickens.

The four major Regional States, in terms of land area and human population (Oromiya, Amhara, SNNP, and Tigray) collectively account for about 96% of the total national poultry population. Chicken rearing is not common in the lowlands of Ethiopia and the lowlands of Ethiopia i.e. Somali, Gambella, Afar and Benishangul-Gumze Regional States collectively own 3.24% of the total national chicken population of which 2.2 % is owned by Benishangul- Gumuze Regional State. Oromia region has about 34.4% of the

total national chicken population and contributes 36% of the total annual national egg and poultry meat production. Moreover, almost all the available commercial poultry farms of the country are located in Oromia region specifically in and in the vicinity of Debre Zeit. At the time of organizing this experimental study, the Regional State owns a total of seven poultry breeding and rearing centers (Solomon, 2007).

The Amhara region has about 31.3 % of the total national poultry population and contributes about 28% of the total annual national egg and poultry meat production. The Regional State has two breeding and multiplication centers (Kombolcha and Andassa). The Southern Nation and Nationality People (SNNP) Regional State owns about 18.8% of the total national chicken population and contributes about 18% of the total annual national egg and poultry meat production. The Regional State Bureaus of Agriculture operates 4- poultry breeding and multiplication centers. The Tigry Regional State owns about 11.65% of the total national poultry population and contributes about 15% of the total annual national egg and poultry meat production. At the time of initiating this experimental study, the Regional States operates one poultry breeding and multiplication center located in Mekelle (Solomon, 2008).

2.2 Poultry Production Systems in Ethiopia

In Ethiopia, poultry production systems show a clear distinction between the traditional, low input system on the one hand and modern production systems using relatively advanced technology on the other hand (Alemu, 1995). There is a third emerging "small scale" intensive poultry production system in urban and peri-urban areas as a business. On the top of these, there are government owned poultry breeding and rearing centers involved in the national poultry extension system which deals with the distribution of fertile eggs, baby chicks, pullets/cockerels, culled layers and management information of Rhode Island Red breeds of chickens to the rural farming population.

2.2.1 Traditional Poultry Production System

The traditional poultry production system comprises of the indigenous chickens and is characterized by small flock sizes, low input and output and periodic devastation of the flock by disease. There is no separate poultry house and the chickens live in family dwellings together with human population. There is no purposeful feeding of chickens, scavenging is almost the only source of diet. There is no planned breeding. It is by natural incubation and brooding that chicks are hatched and raised all over rural Ethiopia where traditional poultry production system is practiced. A broody hen hatching, rearing and protecting few number of chicks (6-8) ceases egg laying during the entire incubation and brooding periods of 81 days. Yet the successes of the hatching and brooding process depends on the maternal instinct of the broody hen and prevalence of predators in the area, such as birds of prey, pets and some wild animals, all of which are listed as the major causes of premature death of chicks in Ethiopia (Solomon, 2007). Mean survival rate to an age 3-months of baby chicks reared under the traditional production system of Ethiopia is about 40% (Sub Sector Review 1984; Hoyle 1992; Ethiopian Statistical Authority 1985-1996).

In the traditional poultry production sector, women are the primary owners and managers of chickens. Rural women raises poultry for income generation aimed at purchasing of basic commodities such as salt, cooking oil, sugars etc. (Aklilu**,** 2007). Newcastle disease (ND) is the most important cause of economic loss in the traditional poultry production system of the country (Nasser *et al.,* 2000). Vaccination against ND occurs in rural areas only in response to an outbreak. The four major Regional States (Oromia, Amhara, SNNP and Tigray) collectively accounts for about 94% of the national chicken population vaccinated and/or, treated, over any one year. The bio-security of the traditional poultry production system is very poor and risky, since scavenging birds live together with people and other species of livestock. Poultry movement and droppings are very difficult to control and chickens freely roam in the compounds used by households and children. There is no practices (even means) of isolating sick birds from the household flocks and dead birds could sometimes be offered or left for either domestic or wild predators.

Chickens and eggs are sold on open markets along with other food items. The current live bird marketing system widely exercised in the traditional poultry production system displays significant and potential hazard to people (including buyers) that comes to such places indicating that the implementation of bio-security and hygienic practices in such a system is generally difficult. (Feseha, 1995).

2.2.2 Small Scale Intensive System

This production system is newly emerging in urban and peri-urban areas, where small number of exotic breeds of chickens (50-1000) is produced along commercial lines using relatively modern management methods. This activity is being undertaken as a source of income in and around major cities and towns such as Debre Zeit. Most of the small scale intensive poultry farms obtain their feeds and foundation stocks from large scale commercial poultry farms and occasionally from nearby government owned breeding and rearing centers. They are involved in the production and supply of table eggs to various supermarkets, kiosks and small roadside restaurants through middlemen. The small scale modern poultry farms located in Debre Zeit and Addis Ababa enjoy the privilege of being advised and assisted by health professionals and Faculty of Veterinary Medicine. They are also at the reach of information, vaccination and treatment drugs. The small scale modern poultry production systems located outside of these locations has limited access to such service.

2.2.3 Breeding and Rearing Centers

At the time of planning this experimental study, the Ministry of Agriculture and Rural Development operate a total of 14 modern poultry breeding and rearing centers located in different parts of the country. Some of these centers had hatchery units, brooder and layers houses, and veterinary clinic and feed processing units. The centers used to directly import fertile eggs and day-old chicks of dual propose chickens (commonly RIR). In the recent years the centers were reported to badly suffer from shortage of

financial resources, lack of replacement breeding stocks and periodic disease outbreak. With the exception of Bonga and Bedelle all the centers were devastated by the outbreak of Infectious Bursal Disease i.e. Gumboro disease (Yilma, 2007).

2.2.4 Large Scale Commercial System

At the time of planning this experiment, there were more than 20 large scale commercial poultry farms in and around Addis Ababa, the majority of which are located in Debre Zeit. ELFORA, Alema and Genesis are the top 3 largest commercial poultry farms with modern production and processing facilities. ELFORA annually delivers around 420,000 chickens and over 34 million eggs to the market of Addis Ababa. Alema poultry farms is the 2nd largest commercial poultry farms in the country. The farm has its own broilers parent stock, feed processing plants, hatchery, slaughter houses, cold storage and transportation facilities. Formal marketing operations are practiced by the large scale commercial poultry farms. Few of the large commercial poultry farms have agreements with clients such as the Ethiopian Airlines and the larger hotels to supply poultry meat and eggs. Most poultry meat is sold frozen. The large scale commercial poultry sub sector is currently undergoing structural change. There are new export production units under construction. Modern broiler production is showing improvements with the involvement of ELFORA, Genesis and Alema farms. ELFORA has the capacity of producing 1,000,000 Kgs of Broilers each year whereas; Alema farm delivers nearly half a million broilers to Addis Ababa market annually (Alemu and Tadelle, 1997).

2.3 Poultry Consumption, Ownership and Marketing

Poultry meat and eggs are relatively cheap and affordable sources of protein for most consumers compared to other animal products. Consumption of poultry products is more common in urban than in rural areas. Poultry consumption is also commonly higher during holidays. In the early 1980's, the mean total national poultry meat and eggs production of Ethiopia was estimated to be 77,000 and 69,000 tones respectively (ILRI, 2000). In the mid 1990s, the per capita egg and poultry meat consumption in Ethiopia

was estimated to be about 57 eggs and 2.85 kg, respectively (Alemu and Tadelle, 1997). This figure is very low by the international standards. Nevertheless poultry are used for strengthening marriage partnership and social relationships in some parts of Ethiopia. In Northern Ethiopia (Tigray and Amhara regions), women who provide food like a chicken dish (Doro wot) are considered to be contributing to a stable marriage. Serving *Doro Wot* is also a demonstration of respect to guests. Poultry and poultry products are affordable and special meal of low income households during religious festivities like New Year, Christmas and Easter. Church leaders and attendants are also served with chicken dishes (Aklilu, 2007). On the contrary poultry and poultry products are not widely consumed by the inhabitants of Afar, Somali, Gambela and, Harari, Regional States as compared to the inhabitants of Northern highlands. According to Hoyle (1992) eggs have never been among the top ten animal products (milk, butter, cheese, honey, beef, mutton and goat meat etc) consumed at the household level in rural areas of SNNP Regional State.

In Ethiopia, men make the major decisions regarding production strategies, purchase and sale of many of the livestock resources indicating that women do not have control over such livestock activities. However, women are capable of selling chickens and eggs as these are under their control. Poultry keeping in most of the developing countries is the responsibility of women. In a study conducted by Tadelle and Ogle (1996), to characterize poultry production systems in the highlands of Ethiopia, it was learnt that women look after the birds, and the earnings from the sale of eggs and chicken are often their only source of cash income. Female-headed households are more involved in poultry keeping as means of earning income since they have fewer other opportunities than the male-headed ones.

There is no adequate literature on poultry marketing system in Ethiopia. The available limited information tends to indicate that a large number of marketing agents are involved along the poultry marketing chain. A study conducted on five selected poultry markets in East Shoa Zone revealed that the poultry marketing system is primarily characterized by direct sell of live birds either to consumers or retailers. It was found that about 42% of all transactions involves direct sell of producers to consumers whereas,

39.4% of the transactions involved local farmers selling their chickens to traders (Kenea *et. al*. 2003). The general indication is that a large number of middlemen are involved in the marketing chain between producers and consumers (Goutard and Magalhaes,2006).

The marketing channel of the breeding and rearing centers consists of the distribution of fertile eggs, baby chicks, pullets/cockerels and culled layers to the rural farming communities at a very subsidized price. Formal marketing operations exist in urban and peri-urban areas practicing large scale commercial poultry production where most of poultry meats are sold frozen. The majority of the products sold within the formal sector come from the commercial industry but a small number of frozen indigenous chickens are supplied through supermarkets in Addis Ababa. The small scale modern poultry production system is being undertaken as a source of income in and around major cities and towns such as Debre Zeit, are involved in the production and supply of table eggs to various supermarkets, kiosks and hotels through middlemen (solomon,2007).

2.4 Socio-economic Role of Poultry in Ethiopia

Village poultry of indigenous chickens play important economic, nutritional and socio-cultural roles in the livelihoods of the rural households and constitutes a significant contribution to food security of poor households (Gondwe, 2004; Abdelqader, 2007). According to Alam (1997) family chicken meat & eggs were estimated to contribute 20–30% of the total animal protein supply in low-income and food-deficit countries. Both chicken meat and eggs are affordable sources of protein and contribute to a well balanced diet to satisfy human needs. It is widely accepted that village chickens are important in breaking the vicious cycle of poverty, malnutrition and disease (Roberts, 1992). This is true in northern Ethiopia particularly in Tigray, Amhara other domestic animals due to its short generation interval. It is widely accepted that village chickens are important in breaking the vicious cycle of poverty, malnutrition and and Northern Oromia Regional States which collectively own about 43% of the total national poultry population. . According to Aklilu (2007), village poultry is the first step on the ladder for poor

households to climb out of poverty. It is also the only capital that households have left when declining into poverty because of varies reasons such as drought.

Poultry is a source of self-reliance for women, since poultry and egg sales are decided by women (Aklilu *et al*., 2007), both of which provide women with an immediate income to meet household expenses such as food. For poor families, poultry are often one of their few sources of petty cash and so the birds are kept for sale rather than home consumption (Bush 2006). In the SNNP Regional State, yearly income ranges from ETB 50 to over ETB 300 and is largely under the control of women. This income is significant and represents about 25% of the typical annual income of poor families in SNNPR (Bush 2006).

The small scale modern poultry production is newly emerging system in urban and peri-urban areas, where small number of exotic breeds of chickens (50-1000) is produced along commercial lines using relatively modern management methods. Most of these farms are involved in the production and supply of table eggs to various supermarkets, kiosks and small roadside restaurants through middlemen. The large scale commercial poultry are kept as full time business and highly dependent on market for inputs. Unfortunately however, reliable economic data concerning the value of small and large scale commercial poultry products sold in any one year is not available. The general indications are that the intensive poultry industry plays a key role in supplying poultry meat and eggs to urban markets at a competitive price. The industry also provides employment for a range of workers.

2.5 Breeds and Productivity

According to the Central Statistical Authority (2004-2005) about 98% of the total national poultry population consists of indigenous chickens and the remaining 2% consists of the introduced exotic breeds of chickens. All the available evidences indicated that all the imported breeds of chickens performed well under the intensive management system (Alemu and Tadelle, 1997).

The Ethiopian indigenous chickens are none descriptive breeds closely related to the Jungle fowl and vary in color, comb type, body conformation and weight. They are characterized by slow growth, late maturity and low production performance (Alemu and Tadelle, 1997). The mean annual egg production of indigenous chickens is estimated at about 60 small eggs with thick shell and deep yellow yolk color (Alemu and Tadelle, 1997). According to Teketel, (1986), the carcass weight of local chicken at 6 months of age was reported to be 559 g, the value of which was significantly lower than that of the 875 g recorded from Leghorn. The low productivity of the indigenous stock could partially be attributed to the low management standard of the traditional production system since it has been seen that the provision of vaccination, improved feeding, clean water and night time enclosure improves the production performance of the indigenous chickens to some extent (Hassen, 1992 and Teketel, 1986).

Local chickens are considered to be disease resistance and adapted to their scavenging environmental conditions. Unfortunately however, local chicken kept under intensive system of management (in confinement) are inferior to exotic stock in health status and characterized by lack of interest in their environment, wing droppings, huddling at the corner, leg weakness and cannibalism. They are also slow in rate of feathering (as evaluated by visual appraisal) and exhibit recurrent outbreak of diseases conditions (Solomon, 2004). The reason for the high mortality of local birds under intensive management system is not clear. The major reason for the high mortality rate of local birds could be due to the fact that they are not used to confinement and poultry diseases, which are important under confinement, such as coccidiosis, may have a greater effect in local stock than on exotic stock (Alemu and Tadelle, 1997).

The productivity of local scavenging hens is low, not only because of low egg production potential, but also due to high chick mortality. About 40-60% of the chicks hatched die during the first 8 weeks of age (Hoyle, 1992, Tadelle 1996 and CACC, 2003) mainly due to disease and predators attack. About half of the eggs produced have to be hatched to replace chicken that have died (Tadelle,1996), and the brooding time of the laying bird is

longer, with many brooding cycles required in order to compensate for its unsuccessful brooding. It is estimated that, under scavenging conditions, the reproductive cycle consists of 20-days of lying phase, 21-days of incubation phase and finally 56-days of chick brooding phase (Alemu and Tadelle**,** 1997). This implies that the number of clutches per hen per year is probably 2-3. Assuming 3 clutches per hen per year, the hen would have to stay for about 168 days out of production every year, entirely engaged in brooding activities.

It is by natural incubation and brooding that chicks are hatched and raised all over rural Ethiopia. A broody hen hatching, rearing and protecting few number of chicks (6-8) ceases egg laying during the entire incubation and brooding periods of 81 days. Yet the successes of the hatching and brooding process depends on the maternal instinct of the broody hen and prevalence of predators in the area, such as birds of prey, pets and some wild animals, all of which are listed as the major causes of premature death of chicks in Ethiopia (Solomon, 2007). Mean survival rate to an age 3-months of baby chicks reared under natural brooding condition in Ethiopia is about 40% (Sub Sector Review 1984; Hoyle 1992; Ethiopian Statistical Authority 1985-1996), indicating that the broody hen ceases egg laying for 2.7 months for the purpose of rearing 2.8 chicks to an age of 3 months. Artificial chick brooding should be adopted to initiate improvement in poultry production in Ethiopia. Unfortunately however, electricity is not available in rural Ethiopia. Hay-box chick brooding technology (developed at JUCAVM) in which no artificial heat is employed seems to be a brooder of choice by small scale poultry producers in Ethiopia (Solomon, 2007).

2.6 Broiler production

The term broiler is applied to chicks (Gallus *domestics)* that have been especially bred for rapid growth. Modern broilers are expected to reach average slaughter live weight of 2 kg/head at an age of eight weeks and feed conversion efficiency of about 50% (Smith, 1990). Broiler strains of birds are different from White leghorn based types used for egg production. The common modern broiler strains are based on crosses between Cornish

white, New Hampshire and White Plymouth Rock. The main guiding principle of broiler raring is the ‘‘all- in/all-out’’ principle so that only birds of the same age are kept on the same site. A batch of broilers could reach slaughter weight in eight weeks and with resting interval of 2 weeks 5 batches can be reared in each house each year. Modern broilers could safely and economically be kept t in a single and automated houses holding between 10,000 and 20,000 birds with minimum human labor requirement (Smith, 1990).

Cobb 500 strain of broiler chicken is the most common type kept in large scale commercial poultry farms in Ethiopia. Cobb 500 strain of broiler is developed by crossing of Cornish and barred Plymouth Rock. It is developed for large scale intensive production system and known for its fast growth. Cobb 500 strain of broiler chicken has proven ability to perform well in a wide range of environments and possess an excellent feed conversion ratio.(Kassa *et.al*, 2010) . Cobb 500 strain of broiler chicken purchased from Alema farm located in Debre Ziet was used in conducting this experiment.

2.7 Hay Box Chick Brooding Technology

Unlike most small animals, young chicks are unable to live for any length of time without an additional source of heat other than their own bodies. Chick brooding refers to the early period of growth (0-8 weeks), when young chicks are unable to maintain their normal body temperature without the aid of supplementary heat. There is no agreement among poultry men as to the exact brooding temperature of baby chicks just transferred from the incubator. According to Williamson and Payne (1984) the initial brooding temperature below the hover should be 35degree centigrade at 5 cm from the floor and this initial brooding temperature should be reduced in the tropics by 2.8 degree centigrade each week until it equals the mean daily ambient temperature. Under natural condition the broody hen provides the required warmth and protects against predators. Artificial chick brooding should be adopted to initiate improvement in poultry production in Ethiopia (Solomon, 2007).

There are several artificial chick brooders of every conceivable type and size, heated by oil, coal, wood, gas or electricity. Unfortunately however, it is difficult to adopt such brooders by rural poultry keepers due to the cost and unavailability of fuel and the small number of chicks to be raised. It was because of this that the national poultry extension package of Ethiopia was initiated in the early 1950s whereby, chicks of exotic breeds are reared for up to 3months of age on the government poultry multiplication centers before being distributed to the farming communities. Even though the government poultry multiplication centers have adequate hatching capacity, they do not however have enough rearing capacity to meet the ever rising demand of pullets and cockerels. There was need therefore to explore possibilities of fabricating an artificial brooder which the farmers would be able to use to rear their chicks in the rural environment. Therefore a hay-box chick brooding technology in which no artificial heat is employed was found to be the best option (Solomon, 2007).

The hay- box chick brooding technology was comprehensively studied using layer type day old chicks in Ethiopia. The brooder was tested in urban and rural areas of the western highlands around Jimma and produced successful results (Solomon, 2001). The results of a series of on-station and on-farm trials conducted to evaluate the brooding performance of the hay-box brooder using layer type chicks clearly showed that locally constructed portable hay-box brooders in which no artificial heat is employed seems to be the brooders of choice for promotion of baby chick's poultry extension package under the Ethiopian household farming conditions. A series of on-station and on-farm trials conducted to evaluate the performance of hay- box brooder with layer type chicken using different insulation materials at Debre Ziet Agricultural research Center and Denbi village of Adaa Woreda also indicated that the use of hay-box brooders insulated with any type of cereal residues to replace artificial electric heating could be considered as simple and suitable techniques of brooding chicks without electricity (Nigussie *et al* 2003). According to Improving Productivity and Market Success (IPMS) framers project, (personal communication) there are a number of farmers who have taken up or adopted improved exotic chicken with the use of hay-box brooder particularly in the Goma and Dale areas of the Oromia and SNNP (Southern Nations Nationalities and

People) regional state, respectively. In summary the results of the field testing of the hay box brooder in Ethiopia clearly showed that locally constructed and portable hay-box brooders in which no artificial heat is employed seems to be the brooders of choice for rural household poultry producers under the present Ethiopian conditions.

3.0 MATERIALS AND METHODS

3.1 Field Survey Study

The survey part of this study, concerned with the attitude of farmers towards hay-box brooder was conducted in and in the vicinity of Jimma, Agaro, Serbo, and Seka towns. Jimma is located at 342 Km southwest of Addis Ababa. Agaro, Serbo and Seka are located within 45, 17 and 19 Km radius of Jimma town respectively. All the three towns share more or less similar climatic condition. The farmers who received the hay-box chick brooding technology were identified on the basis of information provided by Jimma University College of Agriculture and Veterinary Medicine (JUCAVM) and Woreda (country) level Agricultural Bureaus. All the farmers who received the hay-box chick brooding technology (total of 50 farmers) were earmarked and communicated .A total of 35, 6, 4 and 5 farmers were identified from Jimma, Agaro, Serbo and Seka town respectively. The communicated farmers were interviewed using a semi-structured questionnaire, developed to collect data on the attitude of the farmers towards the hay-box brooder (Annex 1).

3.2 On Station Experimental Site Description

The on-station trial was conducted at JUCAVM located in Jimma town at an altitude of 1710 m.a.s.l. and characterized by two major (dry and rainy) seasons. The rainy season has two segments; the first one (small rainy season) occurring between February and April is characterized by insufficient and erratic rains which is usually land preparation and planting time. The second i.e. big rainy season starts in June and extends over mid September, during which time about 80% of the annual rainfall is received. The big rainy season is planting and growing seasons for the major crops grown in the area. The mean annual rainfall of the study area is reported to be about 1500 mm with minimum and maximum, relative humidity of 37.92 % and 91.4 % respectively (BPEDORS, 2000).

3.3 Construction of the Hay Box Brooders

A total of six hay-box brooders of 30 day-old chick's capacity were constructed according to the constructional design provided by Solomon (1999). Three of the hay-box brooders were constructed to have dimensional design of 30cm x 45cm x 45cm with day time running area of 30cm x 98cm x 98cm. The remaining three hay-box brooders were modified on the basis of space requirement of modern broilers day old chicks and constructed to have dimensions of 32cm x 49cm x 49cm with day time running area of 32cm x 115cm x115cm. All the 6 hay-box brooders constructed consisted of 4-outer framing boards, each of which is 2 cm thick (figure1). Four small ventilation holes of 2.5 cm diameter were drilled at the upper side of each frame board (total of 16 holes for the four sides of each box) and a door of appropriate dimension were fitted at the center of one of the four frame boards.

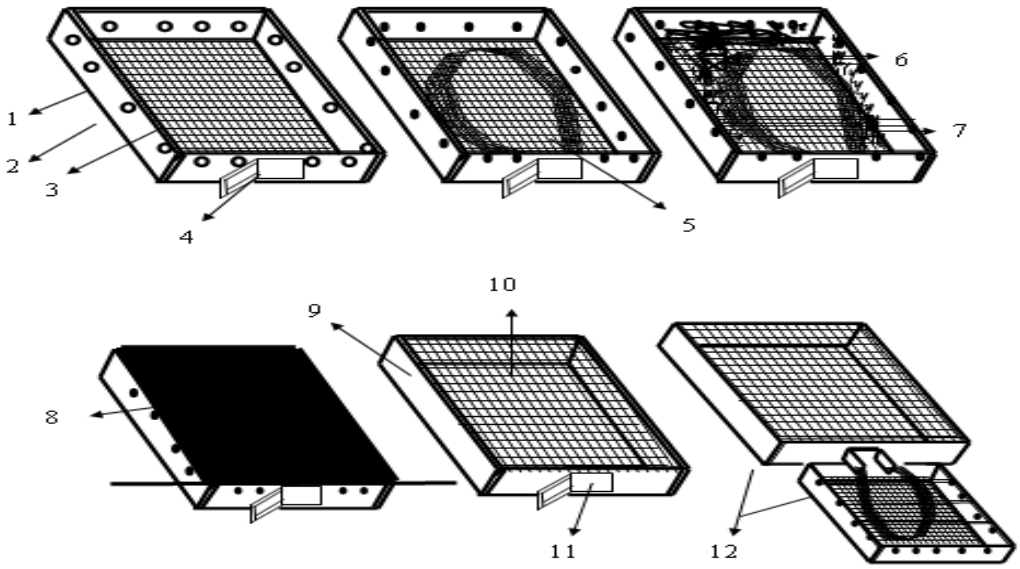

Figure 1. Constructional design of the hay-box brooders used in conducting the on-station experiment 1=frame board, 2 = Ventilation hole, 3 = mesh-wire floor, 4 = door, 5 = central nest, 6 = stuffed hay, 7 = stick, 8 = sack filled with hay, 9 =run frame board, 10 = mesh-wire, 11 = run door, 12 = box and run arrangement.

The floor of the hay-box brooder was made up of half inch wire-mesh nettings tightly stretched to prevent sagging. A central nest was fitted to each of the hay-box constructed. The central nest was made up of a central circle of wire-mesh netting with an opening at the door and is arranged to lead directly into the run, leaving no open space between the nest and door. Hay was stuffed very loosely between the sides of the boxes-and the central nest and the tops of the boxes were covered with sacks. Finally mesh-wire enclosed run of appropriate dimension was fitted to each box.

3.4 Management of the Experimental Chicks

The electric brooder house of JUCAM was cleaned, disinfected and well prepared in advance of the arrival of the experimental chicks. A total of 300 day old chicks of modern breeds of broilers (cobb 500) were purchased from Alema commercial poultry farm located in Debre Ziet. The chicks were transported to JUCAVM and placed on commercial broilers ration purchased from Alema farm for two consecutive days. At the end of the two days, a total of 270 chicks were randomly selected from the total of the 300 and divided into nine groups of 30 chicks each. Each group was randomly assigned to the existing hay- box brooders, the modified hay-box brooders and electric brooders in completely randomized design with 3 replicates for a study period of 2 months (Table 1.).

The electric brooder treatment groups were fed to appetite with commercial broilers starters ration and clean water was made available all the times. In contrast the hay box treatment groups were fed to appetite with the same broilers starters ration and offered clean water during day times in the run and closed into the box during night time. At the end of the first month of brooding all the treatment groups were switched over to commercial broilers finishers ration purchased from Alema commercial poultry farm. All the hay box treatment groups were gently pushed out of the box for several times for feeding and watering in the run, in day times during the first week of brooding. They were closed into the boxes only at night times after the first week of brooding. After the first week of brooding, the chicks have known their way about and run in and out of the box at will, when the doors of the box and the run were left open during day time as

shown in Figure 1. Data on body weight gain, feed intake and survival rate were collected throughout the entire study period. Weight gain was measured every week whereas; feed intake was measured daily. Mortality and disease conditions were recorded as occurred. Economic feasibility was calculated using feed consumption, body weight gain and market price. Biological efficiency were calculated as feed consumption per unite body weight gain of the experimental chicks.

Table 1. Treatment Allocation to the Experimental Chicks in Completely Randomized Design

S.N	Treatments	Rep./ Treatment	Chicks/ Rep	Dimensions	
				Night time box(cm)	Day time box(cm)
1	Electric brooder of JUCAVM, Positive Control(T_1)	3	30	-	-
2	Modified Hay-box Brooders(T_2)	3	30	30x49x49	32x115x115
3	Existing Hay-Box Brooder(T_3)	3	30	3x45x45	30x98x98

3.5 Carcass Yield and Weight of Internal Organs

At the end of the study period of 2 months, 6 chicks were randomly taken from each treatment, weighed and slaughtered for the purpose of measuring carcass yield and weight of internal organs. The dressing percentage was determined after de-feathered by hand plucking and re-weighing. The carcass was eviscerated by removing the viscera, head, shank, trachea, and lungs excluding the giblets (heart, liver and gizzard) in order to calculate the eviscerated carcass weight. The crop, liver, gizzard, proventriculus, duodenum, jejunum and ileum, combined caecum and large intestine, adrenal gland and bursa of Fabricus were weighed with and without contents using sensitive balance. Finally the relative weights of each organ were calculated as a proportion of weight of GIT parts to body weight.

3.6 Statistical Analysis

The survey data were analyzed using (SPSS)version 16 (SPSS Inc., Chicago, Illinois, USA, 2007). and the on station data was analyzed using SAS Computer package and the replication-wise mean values of different entries were subjected to analysis of variance techniques according to completely randomized design (CRD). Appropriate mean separation procedures (least significant difference LSD) were used to determine differences between treatment means whenever the treatment effects were found to be significant.

Model for On station experiment

$Y_{ij} = \mu + \tau_{ij} + \varepsilon_{ij}$

Where

Y *ij* = the value of the respective variable mentioned above

μ = overall mean of the respective variable

τ *i* = the effect of i^{th} *Brooder* (i= 1---3, Electric brooder, modified HB and Existing HB) on the respective variable

ε*ij* = random error term

4. RESULTS AND DISCUSIONS

4.1 Results of the Survey Conducted

4.1.1 Characteristics of the respondents

This survey work was conducted to assess the attitude of the farming population towards the hay-box chick brooding technology in and in the vicinity of Jimma, Agaro, Seka and Serbo towns. The results of the survey showed that the mean family size of the respondents were 7.4 persons/household. The mean family size of the respondents were greater than the national (5 persons/household) and Oromia Regional State averages (4.8) persons/household) as reported by CSA (2007). About 62% of the respondents reported to have mean landholding of < 0.16 hectares/household, the value of which is a typical characteristic of urban and peri-urban land holding under the present Ethiopian condition. Maize, coffee and enset (*Ensete ventricosom*) are the major garden crops cultivated. About 86.14% of the respondents reported to have cattle, sheep and equines. The majority (59.3%) of the cattle population kept by the respondents is reported to comprise of different levels of Holstein Frisian blood. Milk is said to be the major financial income of about 33% of the respondents.

Table 2. Family size and Land and Livestock Holding of the Respondents

Variables	Quantity	No. of Respondents	Percentage
No. Family size /hh	1-5	16	32
	6-10	26	52
	11-15	6	12
	>15	2	4
Total		50	100
Land holding /hh in ha.	<0.16	31	62
	0.16-1	8	16
	1-2	7	14
	>2	4	8
Total		50	100
No. Livestock/hh.			
Cattle	396	34	86.14
Sheep	24	13	5.2
Goat	7	3	1.52
Equines	33	19	7.14
Total	462	-	100

The results of the survey expressed in terms of the socio economic characteristics of the respondents are shown in Table 4. According to Table 4, about 82% of the recipients of the hay-box brooding technology were married urban dwellers whereas about 92% of the total respondents were married. About 62% of the respondents were female and 38% of the respondents were male headed families. This figure indicates that poultry is a source of self-reliance for women and provide women with an immediate income to meet household expenses in the study area. Poultry keeping in most of the developing countries including Ethiopia are the responsibility of women (Tadelle and Ogle, (1996) Guye,(1998). The recipients of hay box based poultry extension package of Ethiopia are not exceptional to this condition, since priority is given to women during distribution of poultry technical packages.

Table 3. Socio economic characteristics of the respondents

Variables	Parameter	Percentage
Residence	Rural	18
	Urban	82
Marital status	Married	92
	Un married	6
	Divorced	2
Religion	Orthodox	60
	Muslim	26
	Protestant	12
	Catholic	2
Sex	Male	38
	Female	62

The results of the survey also showed that 74% of the recipients of the hay-box chick brooding technology were Christians in religion of which about 60% are Orthodox Christians who keeps poultry both as food and income sources. The result of this study is in agreement with that of Aklilu (2007) who reported that poultry play important economic, nutritional and socio-cultural roles in the livelihoods of the rural households of the Orthodox Christian population. The educational level of the respondents ranged from

grade one to M.Sc holders, while the educational level of the majority (70%) is reported to range between grade 5 and 12. About 6 and 2% of the recipients are first and second degree holders respectively indicating the availability of interest in the hay box brooder and poultry technical packages regardless of educational levels and economic status of the farming population of the study area. This result agrees with that of Solomon (2007) who reported that the demand for the technology by individual farmers, governmental and nongovernmental organizations is very high.

Table 4. Educational level of the respondents

Level of Education	No. of Respondents	Percentage
1-4	6	12
5-12	35	70
Diploma	5	10
1st Degree	3	6
2nd Degree	1	2
Total	50	100

The total population and flock structure of chickens reported to be owned by the respondents are shown in Table 5 the mean flock size /house hold of the respondents is calculated to be 17.44 chickens, the value of which is higher than the mean flock size/household (6.23 chickens) of the Gomma Wereda as reported by Meseret (2010). The mean flock size/household recorded from the respondents (17.44) is also higher than the national (4.1), Oromia (3.6), Tigray (7.2), Gambella (7.5) and Benshangul-Gumuz (7.6) Regional State averages as reported by CACC (2003). The higher flock size/household of the respondents compared to the mean flock size of all the Ethiopian regional states seems to be attributed to the fact that some of the respondents (recipients of hay-box brooder) keep chickens as a business with the use of the hay-box brooder.

The majority of the chickens owned by the respondents (50%) are hens (> 5 months of age) followed by chicks (25%) of 0-8 weeks of age. This result agrees with that of Meseret (2010) who reported that the indigenous chicken population of Gomma *Wereda* is dominated by hens and chicks. On the contrary, the flock composition obtained from

both the indigenous chicken population of the respondents and Gomma *Wereda* did not concur with the findings of Tadelle and Ogle (1996) who reported that chicks' (0-8 weeks of age) account for the largest segments (53%) of the indigenous chicken population of the central highlands of Ethiopia. The relatively large proportion of hens per household in the study area might purposively done by the respondents to increase egg production and securing the sources of replacement flocks. It might as well be attributed to lack of selection and culling against the hens and build up of old and unproductive hens in the flocks. The comparatively larger number of pullets per household compared to the proportions of cockerels and cocks within the flock structure of the chicken population of the respondents (Table 5) could be a copping mechanism to replace the number of chicken reduced by selling, consumption and loss due to different reasons. The mean mature hen (> 5 months of age) to mature cock (>5 months of age) ratio owned by the respondents was calculated to be 4:1. This female to male ratio is comparable to the results obtained by Fisaha, (2009) who reported female to male ratio of 3.7:1 from central Ethiopia. The majority of the respondents (87%) reported to have 1- 4 mature cock.

Table 5. Population and composition of chickens owned by the respondents

Type of poultry	Type of chickens (No)	Type of chickens (%)	Urban holding (No)	Urban holding (%)	Rural holding (No)	Rural holding (%)
Hens(>5month)	439	50.34	379	86.3	60	13.67
Cocks(>5 month)	110	12.61	93	84.54	17	15.46
Pullets(2-5)months	66	7.56	48	72.72	18	27.3
Cockerels(2-5)months	37	4.24	22	59.46	15	40.54
Chicks (0-2) months	220	25.23	167	75.91	53	24.09
Total	872	100	709	81.31	163	18.69

4.1.2. Attitude of Farmers towards Hay Box Brooder

According to the results of this survey, all the respondents reported to have used natural incubation and brooding with the help of indigenous broody hen before being introduced to the use of hay box chick brooding technology. About 22% of the respondents said to have attained chick survival rate of 60-89% to an age of 8 weeks under natural brooding conditions. However, the majority of the respondents (70%) said to have attained chick survival rate of 30-59% whereas, about 8% of the respondents said to have attained less than 30% chick survival rate to an age of 8 weeks under natural brooding conditions as currently practiced all over rural Ethiopia (Table 6). This result seems to be in agreement with the results obtained elsewhere in Ethiopia. The survival rates of the Ethiopian indigenous chicks kept under natural brooding conditions is considered to be low (Sub-Sector review 1984). Chick survival under village conditions (with the use of natural brooding) in the central highlands of Ethiopia is about 39% during the first 8 weeks of brooding (Tadelle and Ogle 2001). Hoyle (1992) reported a mean survival rate to an age of 3 months ranging between 27% and 53% from a survey conducted on small scale poultry keeping in Welaita, former North Omo Region. All the other regions of Ethiopia are not exception to these conditions, since several years national poultry population data of the Ethiopian Statistical Authority (1985-1996) tends to indicate 36-41% survival rate to an age of 3 months.

Table 6. Survival rate of chicks raised with the use of hay box (as reported by the respondents)

Survival rate of chicks to an age of 8 weeks (%)	No. of Respondents	Percentage of Respondents
60-89	11	22
30-59	34	68
<30	5	10
Total	50	100
Survival rate of chicks to an age of 4 weeks (%)		
76-100	33	66
51-75	9	18
0-50	8	16
Total	50	100

All the respondents agree that about 75% of mortality reported from chicks kept under natural brooding conditions with the use of the mother hen is attributed to predation. Wild bird and domestic cats are said to be responsible for 71% of mortality of chicks up to an age of 8 weeks. About 16 % of the total mortality is said to be attributed to disease condition, while about 7% and 6% was reported to be attributed to ants attack and poor management respectively. It is by natural brooding that day old chicks are raised all over rural Ethiopia. A broody hen rears her chicks, providing the needed warmth and protects against predators such as birds of prey, pets and some wild animals, all of which are listed as the major causes of premature death of chicks when natural brooding method of chick rearing is employed Solomon (2007).

None of the respondents reported to have information concerning the existence of a possibility of artificial chick brooding under their specific objective and local conditions before the year 2003. The majority of (34.7) the respondents reported to have heard the existence of the hay box brooder starting from the agricultural year of 2007. The majority of the respondents (92%) have received the hay-box brooder distributed for research purpose in the same year. About 2% of the respondents said to have constructed their own hay-box brooders using locally available materials and constructional design and specifications provided by JUCAVM, whereas, 6% of the respondents reported to have purchased from carpenters who constructed the hay box brooder for market purpose.

About 56% of the respondents reported to have used the hay-box brooder in rearing day-old Fayoumi breed of chicks, while 36% of the respondents reported to have used the hay-box brooder in rearing day-old Rhode Island Red breed of chicks. The remaining 8% of the respondents reported to have used the hay-box brooders in rearing day-old chicks of either Isa Brown or White Leghorn breeds of chickens. The results of this study indicated that about 90% of the day –old chicks reared by the respondents with the use of hay–box brooders were obtained from JUCAVM. The remaining day-old chicks (10%) reared by the respondents with the use of the hay-box brooders were purchased from Genesis commercial poultry farm located in Debre Ziet town, 45 Km east of the capital, Addis Ababa.

The recipients of the hay-box brooders were asked for how long they kept their chicks in the hay box brooders. About 18% of the respondents reported to have kept their chicks in the hay-box brooder for a period of 4-6 weeks. About 48% of the respondents reported to have kept their chicks in the hay-box brooder for about 8 weeks. This result is in agreement with that of Yeshambel (2006), who reported that the majority of farmers in Mecha Wereda of Amhara Regional State reported to have used the hay box brooder in raising young chicks to an age of 8 weeks. The rest 10, 22 and 2 % said they kept for 10, 12 & 16 weeks respectively. Keeping of the chicks for more than 8 weeks of age within the hay box brooder might need adjustment in the height and floor space of the hay box brooder. According to Solomon (2007), 15cm high hay box brooder and chick run failed to be comfortable to chicks older than 4 weeks and several chicks (10% of total mortality) died as a result of being neck-trapped in the mesh wire nettings used to cover the top of the run. The roofs of both the hay-box brooder and the runs distributed to users was doubled (30 cm high) and found to accommodate chickens older than 8 weeks if the hay stuffed between the central circle and the wall of the box is removed and the number of chicks assigned to the box is adjusted.

The performance of the hay box brooder as reported by the respondents is shown in Table 6. About 66% of the respondents reported to have attained 76-100% survival rate to an age of 4 weeks with the use of hay-box brooder. About 18% of the respondents' reported to have attained 51-75% survival rate of the chicks to an age of 4 weeks of brooding with the use of hay-box brooder. The remaining 16% of the respondents reported to have recorded chick survival rate of 0-50% particularly during the first 2 weeks of chick brooding with the use of hay –box brooders. The chick survival rate reported by the respondents seems to be lower than those reported by Solomon (2007), who reported 80% mean survival rate to an age of 2 months, the value of which is high by the Ethiopian standard as reported by Sub-Sector review (1984), Tadelle and Ogle (2001), Hoyle (1992) and the Ethiopia Statistical Authority (1985-1996) with the use of natural brooding.

The respondents were also asked if they used the hay-box brooder repeatedly in rearing day-old chicks. Almost all of the respondents (98%) have said the hay-box chick brooder is very easy for management and about (94%) of them would like to keep it all the times. Moreover, the majority of the respondents (89%) said to have used the hay-box brooder repeatedly for several time. About 88% of the respondents reported to have used hay-box brooders in rearing day-old indigenous chicks for 1-4 consecutive rounds. The remaining 12% of the respondents reported to have used hay-box brooders in rearing day-old indigenous chicks for 5-7 consecutive rounds.

The recipients of the hay-box brooding technology were requested to state the advantages of the hay-box brooding technology compared to the use of natural brooding. Protection from predation and infectious disease, release of the hen to lay eggs, rearing larger numbers of chicks at a time and significant increase in rate of survival are the major issues addressed by the respondents. All the respondents (100%) reported to have a very strong interest in adopting the hay-box brooding technology in their locality. This result agree with that of Solomon, (2007) and Nugussie *et al* (2003) who reported that batches of 10 -70 day-old chicks could successfully be reared with the use of locally constructed hay-box brooders. However, it seems to be difficult to suggest upper limits on the number of chicks or adult birds that could conveniently be kept by rural farmers from housing and feeding point of views. Both urban dwellers and rural farmers were reluctant to accept the offer of hay-box groups of 10 baby chicks. About 62% of the respondents preferred and received hay-box brooders of 20 chicks capacity whereas, 28% of the respondents preferred and received hay-box brooders of 30-50 chicks' capacity and the rest 10% of the respondents preferred and received hay-box brooders of 10 chick capacity.

The recipients of the hay-box brooding technology were requested to suggest the short coming of the technology. About, 23.4 % of respondents said the hay-box brooding technology has no significant short coming to be mentioned. About 21.6% of respondents indicated gradual sagging of the day time run, top covering mesh wire and about 5% of the respondents reported heavy weight of the day time run as short coming of the

technology. According to the result of this survey, about 8% of the respondents pinpointed the weight and the existing dimension of the run as shortcoming of the technology. These results agree with that of Solomon (2007) who reported that sagging of the run top- covering mesh-wire could result in mortality due to the chicks being neck-trapped in the mesh wire nettings in the run during day times. Sagging of the run top-covering mesh-wire in combination to relatively short height (15 cm) of the run failed to be comfortable to chicks older than 4 weeks and several chicks (10% of total mortality) died as a result of being neck-trapped in the mesh wire nettings used to cover the top of the run. Such a mortality could totally be prevented through thoroughly stretching the mesh-wire netting and raising the height of both the box and the run to 30 cm (Solomon 2007).

About 51% of the respondents said to have experienced suffocation and smothering problems attributed to lack of adequate ventilation and floor space within the hay-box brooders during night times. This result seems to be in agreement with that of Solomon (2007), who reported that the intensity of ventilation of the hay-box brooder depends on the climatic conditions and chick density. There are 16 small ventilation holes drilled on the top of the outer frame boards of the hay box-brooder. The omission or blockage of these ventilation holes results in high brooding temperature, suffocation and chick mortality. The floor of the hay-box may also provide considerable additional air circulation depending on the type of constructional materials used. Thus, the use of wire-mesh floor could provide better ventilation than the use of other solid materials in the construction of the floor (Solomon 2007).

The majority of the respondents (66%) said to have no serious disease conditions with the use of hay-box brooder. About 13% of the respondents reported the occurrence of diarrhea, coccidiosis, and/or pneumonia. Few respondents (5%) reported to have encountered the problem of infestation with external parasite and ants. This result agree with that of Solomon (2007) who reported that the Hay-box brooding technology involves the use of any fibrous and bulky dry organic substance (hay and straw) as insulation materials for the conservation of the metabolic heat of the chicks.

Unfortunately however, these insulation materials and the top covering sack may harbor external parasites such as lice, mites, and bed bugs. Heavy infestation by these blood sucking parasites could be encountered under rural household conditions resulting in stunted and retarded growth of chicks. It is important therefore to change and renew the insulation materials and to clean the hay-box and the run with boiling water on a regular basis. Solomon (2007) also indicated that the technology offer safety against predators such as birds of prey, pets and wild animals. Unfortunately however, it could easily be attacked by ants which could result in total loss. Close attention (supervision) and fast reaction to sound signals are required in areas where there is high prevalence of ants such as south, west and southwestern of Ethiopia (Solomon 2007).

The recipients of the hay-box brooding technology were requested to identify the major components of the technology that require improvement. The respondents were also requested to suggest improvement methods of the technology. The majority of the respondents (56.6%) expressed the need of adjusting the night time box (the hay box brooder), whereas 23.8% of the respondents expressed the need of adjusting the day time run and the rest 19.6% of the respondents reported to have said there is no need to improve the existing hay-box chick brooding technology.

In summary the respondents of the hay box disclosed that a requirement for a slight modification on the size of night time box, day time run and a special mechanism of adjustment on day time run to offer feed and water in a better way.

4.2 Results of the On-Station Trial

4.2.1 Chick Mortality

The rate of mortality of the experimental chicks assigned to the different treatments is shown in Table 7.

Table 7. Body weight gain, fed efficiency and mortality rate of the experimental chicks

Parameters	T1	T2	T3	SE	Cv (%)
Initial B. weight(gm/head)	50.42 [a]	50.43 [a]	48.35 [a]	0.76	4.5
Body weight gain at an age of 28 days(g/head)	833.72[a]	705.64[b]	528.9[c]	46	5.12
B. weight gain at an age of 56 days(g/head)	2347.81[a]	2130.05[a]	1627.61[b]	114.1	6.69
Daily B. weight gain during the 1st 28 days(g/head)	29.8[a]	25.2[b]	18.9[c]	0.37	1.57
Daily B. weight gain during the 2nd 28 days (g/head	54.0[a]	51.0[a]	39.3[b]	3.40	2.27
Daily B.weight gain during the entire rearing(g/head)	41.92[a]	38.03[ab]	29.06[b]	2.04	6.7
Daily feed consumption during the 1st 28 days(g/h)	61.85[a]	52.18[b]	42.13[c]	8.46	3.04
Daily feed consumption during the 2nd 28 days(g/h)	145.01[a]	154.46[b]	132.74[c]	0.57	3.20
Daily feed consumption during the entire period(g/h)	103.43[a]	101.71[b]	87.44[c]	2.53	1.45
Feed conversion efficiency during the 1st 28 days	0.48	0.48	0.44	Ns	5.49
Feed conversion efficiency during the 2nd 28 days	0.37	0.36	0.29	Ns	8.41
Feed conversion efficiency during the entire period	0.40[a]	0.37[ab]	0.33[b]	0.015	6.46
Mortality during the 1st 28 days (%)	2.22[a]	2.22[a]	44.44[b]	0.56	75
Mortality during the 2nd 28 days (%)	0	0	2.22	Ns	252
Mortality during the entire period of 56 days (%)	2.22[a]	2.22[a]	46.66[b]	0.54	62

a, b, c Means letters in a raw having different superscript are statistically different at $p<0.05$

Mean mortality rate of 2.2% was recorded from each of the treatment group's assigned to the electric and modified hay box brooder during the first 28 days of the trail showing

that the electric and modified hay box brooders are equally productive in broilers rearing as measured by the percentage mortality of the experimental chicks. There has been no mortality recorded from each of the treatment groups assigned to electric and modified hay box brooder during the second month of the experiment. It is generally agreed that the first two weeks comprise the most critical phase of artificial chick brooding (Nesheim *et al*., 1979). According to Tadelle (1996), chick mortality recorded from natural brooding under village conditions in the central highlands of Ethiopia was about 60% during the first 8 weeks of age. The results of a survey conducted by Hoyle (1992) on small scale poultry keeping in Wolayta, North Omo region also indicated that the most challenging period for indigenous baby chicks kept under natural brooding condition in Ethiopia is from 2 to 4 weeks after hatching. The results of this study showed that about 98% of each of the treatment groups assigned to electric and modified hay box brooder survived to an age of 56 days, the value of which is very high by the Ethiopian standard as reported elsewhere from egg type chicks subjected to natural brooding.

As shown in Table 7, comparatively high rate of mortality (46.7%) was recorded from groups of broiler chicks assigned to the existing hay box brooder to an age of 56 days, the value of which is significantly($P<0.05$) higher than the groups assigned to the electric and modified hay box brooders. The mean rate of mortality recorded from the groups reared with the use of the existing hay box brooder in this study seems to be higher than the results reported elsewhere from the egg type chicks reared with the use of the existing hay box brooder and comparable to that obtained from natural brooding by Hoyle (1992) who reported a mean mortality rate of baby chicks ranging from 47 to 73% under rural condition of Wolayta, North Omo region. Solomon (1999) reported mortality rate of 12% from egg type chick's assigned to the existing hay box brooder to an age of one month. Solomon (1999) also reported mean survival rate of 80% (to an age of 2 months) from all the layer type groups of chick's assigned to the existing hay box brooders. During on-station trails conducted at Debre Ziet Agricultural Research Center mean mortality level of 19.6% was recorded from the layer type groups of chicks assigned to the existing hay box brooder to an age of two months (Nigussie *et al* 2003). The higher rate of mortality obtained from the treatment groups assigned to the existing hay-box

brooder in this study could be attributed to the more stressive brooding conditions. Furthermore the treatment groups assigned to the existing hay box brooders, experienced wetting and soiling with droppings accompanied by overcrowding and smothering. One of the treatment groups (replicate) assigned to the existing hay box brooder was also attacked by ants during night time which intern confounded the result of this study.

In summary the overall results of this study clearly showed that the existing hay box brooder could not be used to rear broiler type chicks as measured by rate of mortality to an age of 56 days.

4.2.2 Body Weight Gain

The production performance of the experimental chicks assigned to the electric and hay-box brooders are shown in Table 7. As shown in Table 7, there was statistically significant difference ($P<0.05$) between the treatment groups in body weight attained during the first month of the study period. The mean body weight attained by the group assigned to the existing hay-box brooders at an age of one month was significantly lower ($P<0.05$) than the mean body weight attained by the groups assigned to the electric and modified hay box brooders at an age of one month. The highest mean body weight at an age of one month was recorded from the treatment groups assigned to the electric brooder house, the value of which is significantly higher than the mean body weight attained by the groups assigned to modified hay box brooders at an age of one month. The better performance of the group's assigned to electric brooder could be attributed to the fact that the box groups were fed to appetite during day times only and closed behind in the box at night as compared to the electric groups, which were fed to appetite both day and night. The results of this study agree to that of Solomon (2007) who reported a mean body weight of 120 g per chick from layer type groups of chicks assigned to the existing hay-box and electric brooders at an age 6 and 4 weeks respectively indicating that the growth performance of the hay-box groups was significantly slower ($P<0.05$) than the electric groups during the first four weeks of brooding. The better performance of the groups assigned to the modified hay box brooder at an age of one month as compared to the

groups assigned to the existing hay box brooder seems to be attributed to the availability of relatively adequate floor space within the modified hay box brooders. Significantly lower rate of growth ($P<0.05$) were recorded from the groups assigned to the existing hay-box brooder both during the first and second month of the trial indicating that there is strong need to modify the existing hay box brooder if it is aimed at raising broiler type chicken of cobb500 breeds.

According to the data presented in Table 7 the mean daily body weight gain of the groups assigned to the electric, modified hay box and existing hay box brooder during the first 28 days of rearing was 29.8, 25.2 and 18.9 g//chick respectively indicating that the mean daily gain recorded from the electric groups was significantly higher than the others followed by the groups assigned to the modified hay box brooder ($P<0.05$). On the other side the mean daily body weight gain of the groups assigned to electric, modified and existing hay box brooder during the second 28 days of rearing was 54.0, 51.0 and 39.3 g/chick respectively, indicating that comparatively faster growth rate was obtained from the groups assigned to the modified hay box brooders during the finishing phase as compared to the starters phase (the first 28 days).

As shown in Table 7, there was no statistically significant difference ($p<0.05$) between the groups assigned to the electric and modified hay-box brooder in mean daily body weight gain during the overall feeding period of 56 days. On the contrary, the treatment groups assigned to the existing hay box brooder were found to be significantly ($P<0.05$) lower than the other two treatment groups in mean daily body weight gain during the overall feeding period of 56 days. The treatment groups assigned to the electric and modified hay box brooder attained body weight of 2.3 and 2.1kg/head respectively at an age of 56 days indicating that there was no statistically significant ($P<0.05$) difference between the electric and modified hay box groups in body weight gain at an age of 56 days. Thus the result of this study clearly showed that modified hay box brooder is equally productive as an electric brooder in raising broiler type chicks to an age of 2 months.

As shown in Table 7, the mean daily body weight gain of the groups assigned to the existing hay box brooder was significantly lower than the others($P<0.05$) in mean daily body weight gain during the overall feeding period of 56 days. Moreover the treatment groups assigned to the existing hay box brooders attained body weight of 1.6 kg at an age of 56 days, the value of which is significantly($P<0.05$) lower than the others. The result of this study clearly showed that the existing hay box brooder is inferior to modified hay box brooder in raising broiler type chicks as measured by mean daily weight gain of the experimental chicks.

4.2.3. Feed consumption

The feed consumption of the experimental chicks is shown in Table 7. The mean daily feed consumed/head was significantly higher ($P<0.05$) for the treatment groups assigned to the electric brooder during the first 28 days of the experiment. The higher feed consumption recorded from the electric groups during the starters phase could be attributed to the fact that the hay box groups were fed to appetite during day times only and closed behind into the box at night as compared to the electric groups, which were fed to appetite both during day and night times. The hay box groups were left in the run both during day and night times (instead of being enclosed into the boxes during night time) starting from the 16^{th} day of brooding and there was significant increase in feed consumption of all the hay box groups thereafter. There was no statistically significant difference ($P<0.05$) between the groups assigned to electric and modified hay box brooder in mean daily feed consumption (Table 7) during the entire experimental period of 56 days. The mean daily feed consumption of the treatment groups assigned to the existing hay box brooder during the entire experimental period of 56 days was significantly ($P<0.05$) lower than the others, which might be attributed to the comparatively insufficient floor and feeding space of the run as the chicks increase in size. On the contrary the groups assigned to the modified hay box brooder exhibited increased (compensatory) feed consumption after being left in the run during night times. These groups were found to be active and free of being soiled with droppings in the run.

4.2.4 Biological and economic efficiencies

The feed conversion efficiency of the experimental chicks is shown in Table 7. As shown in Table 7, there was no statistically significant difference ($P>0.05$) between the treatment groups assigned to electric and modified hay box brooders on one side and between the treatment groups assigned to the modified and existing hay box brooders on the other side in feed conversion efficiency expressed as mean body weight gain (gram) of the experimental chicks per unit feed consumed. The results of this study showed that the feed conversion efficiency of the treatment groups assigned to the existing hay box brooder was significantly lower ($P<0.05$) than the feed conversion efficiency of the treatment groups assigned to electric brooder.

Attempts were made to consider input-output analysis aimed at evaluating the economic feasibility of raising broilers type chicks with the use of hay-box chick brooding technology. The expected life of the hay box brooding technology was based on the information provided by Solomon (1999) who reported that the technology could be reused with minor repair and cleaning. The input used to raise the treatment chicks to an age of 56 days and the selling price of the chicks at the end of the 56 days are given in Table 8. About Birr 74 and 71 was invested to raise day old broiler chicks to an age of 56 days with the use of electric and modified hay box brooder respectively. Mean final body weight of 2.3 and 2.1 kg/head was attained at an age of 56 days by the treatment groups raised with the use of electric and modified hay-box brooder respectively (Table 7). A total of 89 chicks (98%) survived to an age of 56 days from each of the electric and modified hay box treatment groups (Table 7& 8). Market selling price of Birr 124.8 and 107.9/chick was calculated (based on their body weight at an age of 56 days) for the treatment group's assigned to electric and modified hay box brooder respectively. Thus a net profit of Birr 51/head and birr 37/head was calculated for the electric and modified hay-box treatment groups respectively over a rearing period of 56 days indicating that electric and modified hay box brooder could safely and economically be used to raise broiler type chicks as a business at urban and rural household level in Ethiopia respectively compared to the use of existing hay-box chick brooding technology.

There are several artificial chick brooders of every conceivable type and size, heated by oil, coal, wood, water gas and electricity. Unfortunately however, it is difficult to adopt these brooders by rural household poultry producers owing to unavailability of fuel, numbers of chicks to be raised and remote locations of the farm sites (Solomon 2007). The results of this study clearly showed that modified hay-box brooder in which no supplementary artificial heat is employed seems to be brooder of choice of small scale broiler production under the present Ethiopian objective rural condition. Moreover the modified hay-box brooder seems to better fits market oriented production system, since batches of up to 30 broiler type chicks could safely and economically be raised at a time compared to natural brooding.

As shown in Table 8, From the above result It can be concluded that the problems of (ant,) encountered in the existing hay-box cannot be tackled by modifying hay box brooders. about Birr 96 was invested to raise day old broiler chicks to an age of 56 days with the use of the existing hay box brooder. These groups attained mean body weight of 1.6 Kg/head at an age of 56 days and a total of 48 chicks (53.3%) survived to an age of 56 days. Such a low survival rate of the group assigned to the existing hay-box brooder is largely attributed to the losses of 30 chicks (the entire replicate) to ant attack on the 6^{th} day of brooding, the coincidence of which confounded the results. Market selling price of Birr 98.15/chick and net profit of Birr 2.15/head/56 day was calculated for the treatment groups assigned to the existing hay box brooder indicating that there is no economic justification for rearing broilers type chicks with the use of the existing hay box brooder.

Table 8. Economic evaluations of the experimental chicks raised with the use of electric and hay box brooders.

Items	T_1	T_2	T_3
Cost of electricity (birr)	772.56	-	-
Hay box brooder and run-box together(Dep.cost)30%	-	525	504
Labor cost (birr)	400	400	400
Feed cost(birr)	3,274.72	3,204.50	1,519.61
Feed and chicks transportation cost (birr).	833.33	833.33	833.33
Vaccination cost (birr)	71.30	71.30	71.30
Cost of experimental chicks (birr)	1,260.00	1,260.00	1,260.00
Total production cost to an age of 56 days (birr)	6,611.91	6,294.13	4,588.24
No of chicken survived	89	89	48
Production cost per chick (birr)	74	71	96
Market price of 1 kg of edible meat (birr)	65	65	65
Edible carcass weight(kg)	1.92	1.66	1.51
Estimated market price /chicks (birr)	124.8	107.9	98.15
Net profit /Chick to an age of 56 days (birr)	50.51	37.18	2.56

4.2.5 Carcass and internal organs

The carcass yield and weight of the internal organs of the experimental chicks are shown in Table 9. The results of the carcass yield showed that there was no significant difference between the treatment groups assigned to the electric and modified hay box brooders in dressing percentage ($P<0.05$), whereas the dressing percentage of the treatment groups assigned to the existing hay-box brooder is significantly lower than the others. The dressing percentage of all the treatment groups of this study ranged between 74 and 78% and found to be higher than the results reported by Kassa *et al* (2010) from cobb 500 breeds of broiler placed on meat and bone and soya bean meal based ration at Debre Zeit research station.

As shown in Table 9, there was no significant difference between all the treatment groups in weight of the internal organs (Crop, Proventriculus, and Gizzard, Duodenal loop, Jejunum, Ileum, Ceca and Large intestine). There have been neither gross morphological changes nor histopathological manifestation in the internal organs of all the treatment groups.

Table 9. Carcass and internal organs characteristics of the experimental chicks

Parameter	Electric brooder	Modified hay box	Existing hay box	SE	CV (%)
Crop	7.3[a]	7.33[a]	7.00[a]	0.08	2.71
Proventriculus	8.9[a]	8.3[a]	8.5[a]	0.18	6.22
Liver	44.83[b]	48.83[a]	50.50[a]	0.99	3.08
Gizzard	40.3[a]	39.5[a]	38.6[a]	0.44	2.44
Doudonal loop	10.3a	10.5[a]	11.25[a]	0.18	3.74
Jejunum	19.3[a]	19.00[a]	19[a]	0.38	6.30
Ileum	19.00a	21.00a	23.00a	1.07	15.23
Ceca	2.63[a]	2.61[a]	2.62[a]	0.007	0.88
Large intestine	12.8[a]	13.33[a]	13.5[a]	0.16	3.33
Adrenal gland	0.49[a]	0.49[a]	0.67[b]	0.03	1.52
Bursa of fabricus	1.17b	1.23[b]	1.50[a]	0.05	1.49
Life weight data	2.46[a]	2.18[b]	2.06[c]	0.062	0.90
Carcass weight	1.92[a]	1.66b	1.51b	0.062	0.84
Dressing percentage	$(8.84)^{a}_{78.1}$	$(8.73)^{b}_{76.21}$	$(8.57)^{c}_{73.44}$	0.046	0.34

N.B Data in brackets indicate square root transformed dressing percentages.

There was no significant difference between the treatment groups assigned to electric and modified hay box brooder in the weight of adrenal gland and bursa fabricu($P<0.05$). The mean weight of Adrenal gland and Bursa of fabricus recorded from the treatment groups assigned to the existing hay box brooder was significantly ($p < 0.05$) higher is higher than the others. It is reported that increased stress load, usually stimulates the Hyperplasia and hypertrophy of adrenal gland (Etches, 1995), which in turn leads to increase weight of adrenal gland. Larger the size of adrenal gland more synthesis of corticosterone hormone which might have suppressed the immune system of the chicks as measured by the weight of Bursa Fabricus. The result of this study tends to indicate that the treatment groups assigned to the electric and modified hay box brooder were more comfortable than the treatment groups assigned to the existing hay box brooder. Similarly mean liver weight of the treatment groups assigned to the existing hay box brooder was higher than the mean liver weight of the other treatment groups($P<0.05$). The higher

mean liver weight of the existing hay box groups might be attributed to stressive brooding zone (environment) of the existing hay box and shortage of sufficient heat during the first four weeks of brooding. This result seems to agree with that of Plavnik and Yahav (1998) who reported lower weight of liver in chickens raised at 35^0C as compared to those raised at 20-25^0C**.** Shinder *et al* (2002) and Yahar (2002) reported increased weight of liver from broiler chickens and turkeys exposed to low environmental temperature.

5. SUMMARY AND CONCLUSIONS

A field survey was conducted assess the attitude of farmers and on-station trails were made to evaluate the comparative brooding performance of the existing and modified hay box brooder of 30 chicks capacity using broiler type day old chicks at JUCAVM. The results of the field survey showed that the mean flock size /house hold of the respondents is 17.44 chickens, the value of which is higher than the mean flock size/household reported from different parts of the country, indicating that some of the respondents keep chickens as a business with the use of the hay-box brooder. About 66% of the respondents reported to have attained 76-90% survival rate to an age of 4 weeks of egg type chicks, with the use of hay-box brooder and all the respondents reported to have strong interest in adopting the hay-box brooding technology in their locality with some minor modifications such as increasing floor area of the night time box by few centimeters..

The results of the on-station trials indicated that the electric and modified hay box brooders are equally productive as measured by survival rate and growth performance of broiler type experimental chicks. Mean body weight of 2.3 and 2.1 kg/head was attained by the treatment groups assigned to electric and modified hay box brooder respectively over a rearing period of 56 days with survival rate of 98%. The results of this study clearly showed that there is no economic justification for rearing broilers type chicks with the use of the existing hay box brooder. Refining of the constructional design and specifications of the technology seems to be the future direction of research.

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7. APPENDESIS

Figures in the Appendix

Plate 1. Layer chicks grown by hay box brooder at Agaro town

Plate 2. Three day old Broiler chicks feeding in hay box running area

Plate 3. Three day old broiler chicks feeding in an electric brooder

Plate 4. Six weeks old broiler chicks raised in an electric brooder

Plate **5**. Destruction of six day old chicks by sudden ant attack

ANNEX 1

SURVAY

STRUCTURE OF QUESTIONAIRE ON ATTITUDE OF FARMERS TOWARDS HAY BOX CHICK BROODER

A. General information

1.1. Name of respondents ----------

1.2 .location Rural Peri- urban Urban

1.3. Peasant Association --------- Kebele ----------

1.4. Sex ---------- Religion ---------- Age --------Educational level ----------

1.5 Marital status ----------Occupation ----------Family size ----------

1.6 Agro ecology ---------- (Dega/ W/dega / Kolla) Altitude ----------masl

1.7. Name of Enumerator---------- -------Signature ----------Date----------

1.8 Division of labor within the household ----------

1.9. Total land holding ----------ha and Source of income ----------

2.0 Major food crop grown in order of importance

2.1 Household Size

Household Head		Children under 15years of age		Youth between 16 and 30 years of age		Adult between 31 and 45 years of age		Adult above 46 years of age		Family size
husband	wife	male	Female	male	female	male	female	male	female	

2.2 Livestock holding

Type	**Number**	**Purpose of keeping**	**Breed (local/ cross/exotic)**		
Cattle					
Cows					
Oxen					
heifers					
calf					
total					
sheep					
Goats					
Equines º Mules º horses º donkeys					

2.3 Poultry Population

Type	**Number**	**Breed (local, cross and exotic)**		
Chicken(total)				
Hens (> 5months)				
Cocks (> 5 months)				
Pullets(2-5months)				
Cockerels(2-5months)				
Chicks (0-2months)				

2.4. How long have you been keeping poultry? ----------

2.5. Who is responsible for poultry keeping within the household? ----------

2.6. Indicate annual income from poultry (Birr/year) ----------

2.7. Do you construct separate poultry house? Yes No

2.8 If your answer to question 2.7 is "No", where do you keep your chickens at night?

2.9 If your answer to question 2.7 is "Yes", do you practice cleaning of the poultry house? Yes No

3.0. How often do you clean poultry house? ----------

3.1 What is the problem of constructing separate poultry house? State in terms of importance

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3.2. Do you believe it is advantageous to construct separate poultry house? Yes No

---

B. General attitude of farmers towards using of hay box

1. How did you brood (raise) day old chick to an age of 8 weeks?

(a) With the use of broody hen (natural brooding)

(b) Without the use of broody hen (artificial brooding)

(c) Others, specify----------

2. If your answer is "a", the survival rate of your chicks kept under natural brooding (under broody hen).

(a) 90 to 100%

(b) 60 to 89%

(c) 30 to 59%

(d) Less than 30%

3. What is the major cause of mortality of chicks kept under natural Brooding (write in terms of importance)

(a) ----------

(b) ----------

(c) ----------

(d) ----------

(e) ----------

4. Do you know the existence of a possibility of chick brooding with out the use of broody hen under your objective condition? Yes No

5. Did you know about "hay-box chick brooder? Yes No

6. When did you hear about "hay-box chick brooder (indicate year or time)

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7. How did you hear about 'hay-box brooder"?

(a) From Development Agents

(b) From district agric. dev office

(c) From kebele chairman

(d) Through mass media

(e) From friends or neighbors

(f) Others, specify ----------

8. Did you use the hay box brooder" in raising chicks? Yes No

9. If your answer to question 8 is "Yes" indicate

(a) Type of chicks used ----------

(b) Source of chicks used ----------

(c) Season of the year you used ----------

(d) How many time did you use ----------

10. If your answer to question 8 is "Yes", how did you get the "hay box brooder

(a) Distributed for the purpose of research

(b) Constructed for myself

(c) Purchased fro others

(d) Others, specify ----------

11. If your answer to question 10 is "a", how many hay box brooders were distributed

(a) in your vicinity or the Wereda? ----------

(b) in the kebele or (PA)? ----------

12. What was the capacity of the "hay-box brooder you used?

(a) 10 chicks capacity (e) 50 chicks capacity

(a) 20 chicks capacity (f) 60 chicks capacity

(b) 30 chicks capacity (g) 70 chicks capacity

(c) 40 chicks capacity (h) others, specify ----------

13. Which of the following capacities of the hay box brooder could conveniently be recommended at the rural household level in your areas.

(a) 10 chicks capacity (e) 50 chicks capacity

(d) 20 chicks capacity (f) 60 chicks capacity

(e) 30 chicks capacity (g) 70 chicks capacity

(f) 40 chicks capacity (h) others, specify ----------

14. How long did you keep the chicks in the hay –box brooder?

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15. Indicate the survival rate of your chicks (kept in the hay box) to an age of

(a) The first week of brooding ----------

(b) The first month of brooding ----------

(c) The entire 2 months of brooding ----------

16. Do you like to adopt the hay box brooder in your locality? Yes No

17. If your answer to question 6 is "Yes", indicate some of the advantages of the use of hay-box brooder over natural brooding in order of importance

(a) ----------

(b) ----------

(c) ----------

(d) ----------

(e) ----------

18. If your answer to question 6 is "No", indicate some of the disadvantages of the use of hay-box brooder over natural brooding in order of importance

(a) ----------

(b) ----------

(c) ----------

(d) ----------

(e) ----------

19. Please indicate some of the short coming of the existing hay-box brooder in order of importance

(a) ----------

(b) ----------

(c) ----------

(d) ----------

(e) ----------

20. Indicate improvement methods to the existing hay-box brooder in order of importance

(a) ----------

(b) ----------

(c) ----------

(d) ----------

(e) ----------

21. Please indicate disease conditions associated with the use of hay box brooders

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22. Where do you keep your hay-box containing the chicks during night time

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23. Is the management of hay-box difficult? Yes No

24. Do you like the hay-box brooder? Yes No

25. Which of the following components of the hay-box brooder need improvements or Adjustments

(a) The day time run

(b) Night time box

(c) Others, specify ---