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ASSESSMENT OF FEED FORMULATION AND FEEDING PRACTICES FOR URBAN AND PERIURBAN DAIRY COWS AROUND HOLETTA, ETHIOPIA

MSc Thesis

By

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College of Veterinary Medicine and Agriculture

Department of Animal Production Studies

June, 2014

Bishoftu, Ethiopia

ASSESSMENT OF FEED FORMULATION AND FEEDING PRACTICES FOR URBAN AND PERIURBAN DAIRY COWS AROUND HOLETTA, ETHIOPIA

A Thesis submitted to the College of Veterinary Medicine and Agriculture, Addis Ababa University in partial fulfillment of the requirements for the degree of Master of Science in Tropical Animal Production and Health

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As the members of the Examining Board of the final MSc open defense, we certify that we have read and evaluated the thesis prepared by **Assaminew Shewangizaw** Entitled: **Assessment of feed formulation and feeding practices for urban and periurban dairy cows around Holetta, Ethiopia** and recommended that it be accepted as fulfilling the thesis requirement for the degree of**: Masters of Science in Tropical Animal Production and Health.**

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DEDICATION

This thesis is especially dedicated to my brothers Melese Tefera who fulfilled my desire and supported to my success.

STATEMENT OF THE AUTHOR

First, I declare that this thesis/dissertation is my *bonafide* work and that all sources of material used for this thesis have been duly acknowledged. This thesis has been submitted in partial fulfillment of the requirements for an advanced (MSc) degree at Addis Ababa University, College of Veterinary Medicine and Agriculture and is deposited at the University/College library to be made available to borrowers under rules of the Library. I solemnly declare that this thesis is not submitted to any other institution anywhere for the award of any academic degree, diploma, or certificate.

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ACKNOWLEDGEMENTS

Had it not been with the assistance of several people, this study would havenot been possible. First and for most, the author would like to express his sincere gratitude to his research advisor, Dr Ashenafi Mengistu, for his invaluable comment, professional guidance and dedication in this study ever since the write up of the proposal.

The author would like to thank the Holetta ATVET College Management Committee forallowing him to participate in this study program and NICHE PROJECT/ETH/146for the financial support to this thesis research.

He would like to express his sincere gratitude to Ato Zewdei Wondatir, dairy cattle researcher at Holetta Agricultural Research Center, for his guidance during the proposal preparation. He also thanks him for the support in data handling and analysis, and unforgettable brotherly approach, which allowed him to successfully complete his postgraduate program. He would like to express also his sincere gratitude to Dr Zelalem Yilma, for his guidance during the write up of the proposal.

His particular regards are due to Ato Mesfin Niguse, Manager of Biftu-Berga Dairy Union at Holetta, for his invaluable help in allowing himtotravel with Union's milk collectors and made easy to collect the data from the dairy producers in and around Holetta.He alsoappreciates the help of Ato Lemma Worku for his timely assistance in the collection of the survey data.

He pays special tribute to the staff of Animal Nutrition and Soil Laboratory at Holetta Agricultural Research Center: Ato Geremew Taye, Ato Alemayehu, W/r Seble Wengeland others, for collaboration in timelylaboratory analysis offeed samples.

ABBREVIATIONS

AOAC	Association of Official Analytical Chemists
ARC	Agricultural Research Councilof United Kingdom
CP	Crude protein
CSA	Central Statistics Authority of Ethiopia
DM	Dry matter
FAO	Food and Agricultural Organisation of the United Nations
GLM	General Linear Model
ILRI	International Livestock Research Institute
IVOMD	*In vitro* organic matter digestibility
ME	Metabolizable energy
MJ	Mega Joule
SAS	Statistical Analytical Software
SDDP	Smallholder Dairy Development Project in Ethiopia

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

There was a concern that farmers mix feed rations using locally available feed ingredients in any proportions and are often not aware of their quality, cost and impact of nutrient imbalances to performances of animals.This study was conducted on private urban and periurban dairy production systems around Holetta to assess the existing feed formulation and feeding practices for crossbred dairy cows in terms of nutrient supply, identify the gap in relation to the recommended nutrients required, assess performances of crossbred dairy cows and evaluate the economic viability of concentrate feeds. Structured questionnaire and laboratory analysis for home-mixed concentrate were employed to generate data from a total of 60 dairy farms. Based on laboratory analysis, the overall mean of home-mixed concentrates nutrient contents, were216.58±20.86 g/kg DM of crude protein,10.99±0.59 MJ/kg DM Metabolizable energy, 4.55±1.23 g/kg DM calcium and 10.16±1.16 g/kg DM of phosphorusand were differed significantly (P<0.05) between urban and periurban production systems. The overall mean crude proteinsupply per kg of milk yieldthrough home-mixed concentrates was93.06±15.81g anddid not vary (P>0.05)across the production subsystems.The overall mean nutrient supply per kg of milk yield through home-mixed concentrates4.73±0.70 MJ metabolizable energy, 1.98±0.62 g calcium and 4.36±0.73 g phosphorus and varied significantly (P<0.05)across production subsystems. The overall estimated mean daily milk yield per cow,calving intervaland days open was 10.20±2.63 kg,14.83±1.52 months and 163.83±36.90 days, respectively, and varied significantly (P<0.05) across the production subsystems of the study.The milk price/concentrate price ratio was 5.42 per cow/day varied significantly (P<0.05) across the production subsystems of the studyThus,it is concluded that big variation in nutrient supply and imbalances resulting in an apparently low performance of dairy animals in terms of milk yield, calving interval and days open as compared to what were expected and variation in economic viability of the dairy farms.

***Key words**: Feed formulation, Urban,Periurban, cows, nutrient supply*

1. INTRODUCTION

The livestock sector has been contributing a considerable portion to the economy of the Ethiopia, and still promising to rally round the economic development of the country. The total cattle population for the country is estimated to be about 53.99 million heads of cattle. Out of this total cattle population, the female cattle about 55.48% and the remaining 44.52% are male cattle (CSA, 2013).The estimated total cow milk produced in Ethiopia during the year 2012/13 is about 3.80 billion liters(CSA, 2013).Dairy farming is expanding with crossbred high yielding cows in urban andperiurban areas.

Urban and periurban dairy production system is becoming an important supplier of milk products to urban centers, where the demand for milk and milk products is remarkably high. As a result of this, urban and periurb dairying is being intensified through the use of crossbred dairy cows, purchased and conserved feed and stall-feeding. These production systems are favored due to the proximity of the production sites to centers of high fresh milk demand, easy access to agro-industrial by- products, veterinary services and supplies (Azage *et al*., 2013).Urban and periurban dairying is contributing immensely towards filling the large demand-supply gap for milk and milk products in urban centers, where consumption of dairy products is remarkably high and they are the main suppliers of raw milk to processors of different scales (Zelalem *et al*., 2011).

Urban dairy systems in general are located in cities and/or towns on production and sale of fluid milk, with little or no land resources, using the available human and capital resources mostly for specialized dairy production under stall feeding conditions. As compared to other systems, they have relatively better access to inputs and services provided by the public and private sectors, and use intensive management (Azage *et al*., 2013). By virtue of their location, urban producers are not expected to have access to agricultural or pastureland, as the operation takes place within cities and as a result, they are forced to buy their feed (Zegeye, 2003).Periurban dairy systems are located in rural areas or at the periphery of the urban which have relatively better access to urban centers in which dairy products are highly demanded(Azage *et al*., 2013). Periurban dairy producers are mainly found around big cities like Addis Ababa and smaller towns. They may or may not have access to cultivable or pastureland(Zegeye, 2003).

In general, urban and periurban dairying is being intensified through the use of crossbred dairy cows, purchased and conserved feed and stall-feeding (Azage *et al*., 2013). This dairying is constrained by feed scarcity (both in terms of quantity and quality), lack of access to land, disease prevalence, low level of management, lack of proper breeding management such as lack of accurate heat detection and timely insemination which may considerably contribute to long days open (postpartum anestrous), late age at first service and calving, long calving interval and low milk production (Belay *et al*. 2012b). Studies have shown that breed improvement will lead to an improvement in milk productivity of cattle ranging from 60 to 300% if accompanied by better feeding regimes (McDermott *et al.,* 2010). Besides, feed is the major input cost in animal agriculture, accounting for 65–70% of the total rearing cost (FAO, 2012).Feed shortage is posed by both quantity and quality of feeds produced on the farm; insufficient inputs for commercial feeds; lack of standard feed formulation systems; and the absence of feed testing for quality in Ethiopia (Land O'Lakes, 2010).As dairying is a routine venture which requires continuous and adequate supply of the required nutrients, no improvement in dairy production is possible without adequate understanding and concomitant improvement in feed quantity and quality.

In the periurban and urban systems, the success of dairy production in general and crossbreeding programs in particular needs to be monitored regularly by assessing the productive and reproductive performance under the existing management and feeding practices.Use of agro-industrial products as supplements to dairy animals is limited to urban and periurban dairy production systems due to its accessibility andkeeping of improved genotypes(Azage *et al*., 2013).Concentrate mixtures are blended using locally available feed ingredients in any proportions with no awareness of their quality, cost and impact of nutrient imbalances to productive and reproductive performances. The usual practice by dairy producers to judge quality is mainly based on visual perceptions of mixed rations without laboratory based compositional confirmation (Land O'Lakes, 2010).Nutrient concentrations in feeds vary considerably, and not all nutrients in feeds are equally available to the animal (Adugna, 2008).

In order to improve dairy cattle productivity, proper ration formulation and feeding practices are important not only to produce high-quality and quantity food products, but also to economic efficiency. To design relevant crossbred dairy cow feeding strategies and implement context specific interventions for future feeding strategy of the urban and periurban crossbred cows,evaluation of existing practices of feed formulation and feeding is important. Thus, this study was initiated with the following objectives:

- To characterize the existing feed formulation and feeding practices of dairy cows in terms of nutrient supply; and
- To identify the gap of nutrient supply of the existing feed formulation practices in relation to the recommended nutrient requirement
- To assess the performance of crossbred cows in the study site
- To evaluate the economic viability of concentrate feeding for crossbred cows.

2. LITERATURE REVIEW

2.1. Urban and Periurban Dairy Production Systems

2.1.1. Urban dairy production system

Urban dairy production system includes from smallholder to highly specialized, state or businessmen owned farms, which are mainly concentrated in major cities of the country (Azage *et al.,*2000). Urban farmers owned larger herds but farmed less land, and sold a greater proportion of liquid milk than periurban farmers, who processed more milk. Purchased feed played a more important role for the feed supply of urban than periurban farms (Yitay *et al*., 2009).By the virtue of their location urban producers are not expected to have access to agricultural or pastureland, as the operation takes place within cities and as a result, they are forced to buy their feed (Zegeye, 2003). The dairy production in urban system is relatively intensive and mainly based on stall-feeding using purchased roughages and concentrates (Fekede *et al.*, 2013).

2.1.2. Periurban dairy production system

Periurban dairy production system is developed in areas where the population density is high and agricultural land is shrinking due to urbanization around big cities like Addis Ababa. In genotype possesses animal types ranging from 50% crosses to high grade Friesian in small to medium-sized farms. The periurban milk system includes smallholder and commercial dairy farmers in the proximity of Addis Ababa and other regional towns(Azage *at al*., 2000). Periurban dairy production systems have been emerged around cities and towns, which heavily rely on purchased fodder. The term periurban refers to the linkage and interaction between rural and urban areas and characterized by the production, processing and marketing of milk and milk products that are channeled to consumers in urban centers (Rey *et al*., 1993). Based on the number of animals possessed and status of farmstead structure and facilities available on farm, the periurban dairy farms classified into two subsystems(Diriba *et al.,* 2014)small-scale and medium sized periurban dairy farms.Periurban dairy production system where crop and livestockproduction are closely integrated and agriculturalactivities other than milk production form additional source of income(Fekede *et al.*, 2013).Periurban dairy farms in the Hawassa, Shashemenne and Dilla, for instance, operate at different scale of production ranging from small to medium scale. They have access to landand usually practice mixed crop–livestock farming, which produces part of the feed in the formof crop residues and grazing (Azage*et al.*, 2013).

2.2. Dairy Farming Characteristics ofUrban and PeriurbanAreas ofEthiopia

2.2.1. Gender and off-dairy farm activities

Studies have shown that female headed dairy farmers are increasing in urban dairy production systems.For instance female headed dairy farms are higher in urban based dairy production than in the periurban crop-livestock mixed farms in the greater Addis milkshed, central highlands of Ethiopia (Fekede *et al*., 2013). This implies the role of gender in dairying increases and varies based on production system and market orientation (Azage *et al.*, 2013).Therefore, dairyingis supporting the livelihoods of female headed households inurban areas(Fekede *et al*., 2013).

In previous studies many authors were reported dairy producers engaged in other income generation activities in addition to dairy operation.A report fromCentral Zone of Tigray, Northern Ethiopia, revealed that business persons, farmers and government employee took the leading in their proportion in the urban areas whereas, farmers (65.8%) followed by business persons took the rank one to three, respectively, in the periurban areas (Gebrekidan *et al.,* 2012b).Another report form North Western Ethiopian highlands were shown, the contribution of off-dairy agricultural and off-farm activities to the household income is higher in urban farms (Yitaye *et al*., 2009).Employment and income from the dairy sector will vary between and within production systems because of differences in feed sources, management, herd sizes, form of milk and disposal patterns, amongst others (Staal *et al.,* 2008).

2.2.2. Education level and labour usedin dairy farms

The level of education of dairy farmers is an important factor determining the managerial capacity, adoption of new technologies and the overall intensification of smallholder dairy production(Fekade *et al*., 2013). For instance, Azage *et al.* (2013) reported to educational status of the dairy producers is higher in the urban dairy system than in the periurban system.Farmers with high education levels adopt usually new technologies more rapidly than lower educated farmers (Ofukou *etal*., 2009).Dairy cows require farm labour to perform various activities in the farm. In order to achieve this, both hired and family labours are employed in dairy activities and their intensities and types of the farm labour differ between cities. For instance, in urban dairy units of Jimma town (Belay*et al.,* 2012a) and Makelle (Dayanandan, 2011) hired labour is used intensively in 33.3 and 73% of households respectively. The owners of dairy cattle in those cities can afford to pay labour wages. Meanwhile, family members in Bishoftu town (54 %) family members carried out most of the management activities(Mulisa *et al.,* 2011). This is an indication that dairy cattle management requires the attention of family members since they have big benefit.Division of family labour in dairying varies based on production system and market orientation (Azage *et al.,* 2013).The authors also reported thatthe dominant source of labour for dairy production was family labour while the contribution of hired labor is minimal in Ethiopia.The use of hired labour in performing dairy activities is common in urban cities of East Africa (Gillah *et al*., 2012).

2.2.3. Age and family size of dairy producers

The average age of household head of the dairy farmer in Ethiopia where reported forJimma town by Belay *et al*. (2012a)51.26 years,Hawassa City by Haile *et al*.(2012)45.17 yearsand for Bako and Nekemet by Diriba *et al.* (2014) 48 and 46 years, respectively.The large family size is an advantage for the dairy producers toengage the labour force in different activities of dairying (Azage*et al*., 2013)and considered as an asset and a factor which guarantees social security within the household in agriculture based livelihoods (Fekade *et al*., 2013).The average family size reported for the whole Ethiopia was (5.15 persons) (CSA 2005).The mean value of family size also reportedby (Solomon *et al*. 2009; Belay *et al*. 2012a; Haile *et al*., 2012; Abdi *et al*. 2013)was 5.7, 6.02, 7.1 and 5.42 persons/household in North-eastern Amhara region,Jimma town,Hawassa City andWest Hararghe,respectivelyin Ethiopia.Fekade *et al*. (2013) reported for the comparatively higher average family size per household in Ejere (7.08) and Sululta(7.21) Woredas (periurban production system) than the urban (6.19 persons/household)based dairy production in Girar-Jarso the greater Addis milkshed, Central Highlands of Ethiopia.

2.2.4. Cows ownership

Cattle holding vary depending on the type of production system, wealth status and the overall farm production objectives. Report indicated for Hawassa City by Haile *et al*. (2012) medium and small farms were possessed on average 7.3 and 1.99 cows, respectively. The overall average number of crossbred cows owned per household 2.7 heads was reported for the greater Addis milkshed (Fekede *et al.,* 2013).According to Diriba *et al*. (2014) report, the mean number of crossbred cattle per household was 2.67 and 7.29 for Bako and Nekemite, respectively,westernEthiopia. Dairy farmers in the periurban and urban areas are specifically targeting consumer in the nearby town and city. These producers have better genetics, they preferred to crossbred cows having 50 to 62.5 % improved genetics (Land O'Lakes, 2010).

2.2.5. Improved forages development and grazing land holding

Availability of grazing land for ruminant animals has become restricted, as a result of the increasing human population, urbanization, industrialization and increasing demand for utilization of agricultural land for crop production. The production of improved pasture and forages is insignificant and the contribution of agro-industrial by-products is restricted to some urban and Periurban farms (Alemayehu, 2005). Households allocate portion (0.51 ha) of their land for pasture productionwhere reported fromBahir Dar Zuria and Mecha Woredas, North Western Ethiopia(Asaminew and Eyassu, 2009).In Bako, western Ethiopia, 93.8% of dairy farmers allocated land for improved forages development, with an average area of 0.4 hectares.In general, land allocated for pasture/grazing is either small or is degraded with low biomass production, which cannot meet the nutritional requirements (Azage *et al.,* 2013).

2.2.6. Dairy cattle housing conditions

Dairy animal's type of housing provided varied depending upon the classes of dairy animals, agro-ecology, production system, physiological stage of dairy animals (Azage *et al.,* 2013). A good shed for dairy cattle provides comfort to the animal, decreases wastage of feedstuff and ensures better environmental control. For instance, 42% of farms (Mulisa *et al.,* 2011) in Bishoftu town had earthen floors. Cattle designs such as kraals and traditional free stalls are very common in Dare-Dawa town (Embet and Zeleke, 2008). Of the dairy farms, most of the farms in all scales of production kept their dairy cows under cow shed roofed with corrugated sheets of materials in Bishoftu town (Mulisa *et al.*, 2011). The authors also reported for the dairy shed floor structure in which the majority of small and medium dairy cattle holder has concrete floor. Zemenu *et al.* (2014) reported that in urban areas of Debre-markos, the majority of the farms are used the separate enclosure houses and stone slab floor. A good shed for dairy cattle provides comfort to the animal, decreases wastage of feedstuff and ensures better environmental control. If these basic needs cannot be met in the animal shed, then health, welfare and production of the cattle will be compromised(Mulisa *et al.,* 2011).

2.2.7. Water sources and frequency of watering dairy cattle

Report has shown in the periurbandairy system river followed by pipe water are themajor source of water for dairy animals, however, the majority of the urban dairy farming system (Hawassa, Shashemene, Yirgalem, Dilla), southern Ethiopia rely on pipe water (Azage *et al.,* 2013).The major water resources for livestock are wells and rivers for market-orientation in Fogera Woreda, Amhara region, Ethiopia(Belete *et al.,* 2010).Report as shown for watering frequency of dairy cattle are depends on access to water sources, the age structure of the herd, physiological stage of animals and season.For instance, in the urban and periurban system (Shashemene-Dilla milkshed), about 36% of the households water their cattle once a day(Azage *et al.,* 2013).

2.2.8. Nutrition related dairy cows diseases

In Dire Dawa, mediumscale dairy production, had encountered reproductive health disorders followed by emaciation or poor body condition (Emebet and Zeleke, 2008). Postpartum anestrus, as well as infertility, is magnified by losses of body condition during the early postpartum period (Walsh *et al.,* 2011). Negative energy balance resulted in loss of body condition as the cow mobilized body fat reserves to support milk production. Much emphasis has been placed on the strong association between negative energy balance in early lactation and length of the postpartum anovulatory period (Garnsworthy *et al.,* 2008). Energy status (negative energy balance)was reported that affect fertility by altering oocyte function in cows with low body condition (Hansen,2011). Concerning prophylactic measure most of the farms has been practiced against blackleg, anthrax, pasteurellosis and foot and mouth disease whenever an outbreak is suspected in Dire Dawa (Emebet and Zeleke, 2008). Application of acaricides, deworming and vaccination, had wide application in “Dejen Districts” (Mekonnen *et a*l., 2010).

2.3. Feeds andFeeding of Crossbred Dairy Cows

2.3.1. Basal feed resources

The urban and periurban dairy feedlots operations depend on the hay produced in pasturelands as a source of roughage feed in the Centeral Highlands of Ethiopia, the greater Addis milkshed(Fekede *et al.,* 2013). The major roughage feed resources for dairy animals across all the different production systems included natural pasture/grasslands, grass hays,crop residues non-conventional feed resources (Asaminew and Eyassu, 2009;Yitay *et al.,* 2009; Azage *et al*., 2013). The crude protein content of pastures is lower than the forage crude protein content of 7% which would cover the maintenance requirements of ruminants (McDonald *et al*., 2002). Good grass and legume hays are adequate for maintaining most classes of livestock, particularly those in a non-productive state (Streeter*et al.,* 2006).Therefore, dairy cows depending on poor qualitybasal feeds will not express their full genetic potential.

2.3.2. Concentrate ingredients

According to Azage *et al*. (2013), agro-industrial by-products such as bran, middling, oil seed cakes and molasses are fed as supplement to crossbred dairy cows in urban and periurban areas. The feed ingredients used (agro-industrial byproducts, hays or crop residues) are low in calcium (Zewdie *et al*., 2011). The agro-industrial byproducts contain more phosphorus than calcium, a condition that is very likely to cause calcium deficiency (Adugna, 2008). Concentrate mix is formulated to supplement a basal diet and thus it is not a balanced feed (Lukuyu *et al*., 2012).Dairy animals are feed variety of feed materials, the mix depending largely on availability (Staal and Shapiro, 1996). The heavy use of feed materials by dairy producers rather than nutritionally-balanced commercial concentrates may contribute to the low productivity (Staal and Shapiro, 1996).

2.3.3. Composition of concentrate mixtures

Several authors in Ethiopia who conducted research on crossbred cows feedingare used concentrate mixture for control group feeding contains greater than 220g/kg of crude protein (CP) in the dry matter (DM). For instance, (Rehrahie*et al*. (2003); Mesfin *et al*. (2009; 2013); Tekeba *et al*. (2013) used 236.8243 and225g/kgDM of CPat the Holetta Agricultural Research Center, central Ethiopia andAndassa Livestock Research Center, respectively.The same authors also reported for metabolizable energy (ME) contents of the same concentrate mixture fed to crossbreed cows control group for similar research and time was contained 12.3,12 and11.7 MJ/kg DM.

A research conducted by Nega *et al*. (2006) in the urban and periurban centers of Central Rift Valley, Ethiopia (Arsi Negelle, Ziway, Wonji Kuriftu and Lume districts) farms home-mixed concentrate for lactating crossbred dairy cows, was contained 213 g/kg DM of CP,10.6 MJ/kg DM of ME, 3.4 g/kg DM of calcium (Ca) and 12 g/kg DM phosphorus (P). Mesfin *et al*. (2013) investigated that dairy farmers home-mixed concentrate for lactating crossbred dairy cowsin periurban dairy production system of Central Ethiopia, contained260g/kg DM of CP and 10.8 MJ/kg DM of ME.

2.3.4. Concentrate feeding levelto crossbred dairy cows

In earlier study at the Holetta Agricultural Research Center, where 2, 4, 6, 8, and 10 kg of the same type of concentrate mixture fed to lactating crossbred dairy cows per day and, 6 kg/cow/day were recommended (Tadesse *et al.*, 1991). Crossbred cows produced lower rates of increase in the marginal yield response, and economic benefit from the marginal level increased above 0.5 kg of concentrates per kg of milk yield,this level are taken the point of biological and economic optima (Mohammed, 1991). Othersalso (SDDP, 1999; Pandey andVoskuil, 2011)recommended that feeding concentrate at the rate of 0.5 kg perkg of milk yield with *ad libtum* roughages feeding.

2.3.5. Nutrient required to crossbred dairy cows

Nutrition has a profound influence on productive and reproductive performance of dairy cattle. Because of high metabolic rate and requirement for milk secretion, lactating cows have special demand for nutrient supplement(Indetie, 2009). In practice milk yield and composition are influenced mainly by the dietary supplies of energy and protein (Tadesse *et al*., 2003).Energy and protein, of feeds are central in determining nutritional adequacy and feeding levels for different classes of stock (Streeter, 2006). Rations should be formulated to ensure that the animal consumes the desired amount of nutrients in a day

(Adugna, 2008).Well balanced diets should prevent severe negative energy balance and an excess intake of specific dietary components (Leroy *et al*., 2010).

2.3.5.1. Protein

Protein is an expensive component and overfeeding should be avoided to minimize the cost. In addition, extra energy, which would otherwise be used for milk production, is used to remove the extra protein (nitrogen) from the body in the form of urea in the urine (Lukuyu *et al*., 2012).For instance, on average 10 kg daily milk produced is required860 g/dayof CP for a standard 500 kg body weight cow and 40 g butterfat concentration in the milk (ARC, 1994).Yan *et al.* (2006) reported that nitrogen excretion in manure is highly correlated withdietary nitrogen intake, and hence a key mitigationstrategy to reduce manure nitrogen output is to reducedietary nitrogen concentrations.Any protein not required by the cow is excreted in the urine as urinary urea, a consequence of urea nitrogen recycling and the removal by the kidney of any urea not recognized by the animal as necessary for rumen function (Lock and Van Amburgh, 2012).

2.3.5.2. Energy

Quantitatively, energy is the most important nutrient considered during the formulation of dairy cow rations usually needed to produce milk (Lukuyu *et al*., 2012). The most important nutritional requirement of the animal is energy for maintenance and demand for energy depends on breed, live-weight, sex and physiological state (pregnancy, lactation) of the animal (Streeter, 2006). Formaintenance the cow needs 45 to 60 MJ of ME per day(Brännäng and Persson,1990; SDDP, 1999). A basal diet from native grass hay, pasture grass provided *ad libitum* can fulfil maintenance needs of crossbred dairy cows (SDDP, 1999). Crossbred dairy cows (400 kg body weight and 40 g butterfat content) require 5 MJ of ME for each kg of milk produced (Brännäng and Persson**,** 1990).Energy deficiency causes extension of the interval from parturition to recovery of ovarian cyclicity and activity of *corpus-luteum* (Patton *et al.,* 2007).Further, state of negative energy balance lower the fertility of growing follicles leading to lower the conception rate(Diskin *et al*., 2003).As reviewed by Remppis *et al.* (2011),continuing negative energy balance causes decreasing milk yield, fertility problems, and incidence of metabolic diseases.

2.3.5.3. Calcium and phosphorus

Calcium (Ca) and phosphorus (P) are closely correlated for building the skeletal structure. The dietary P concentration needed to meet dietary requirements varies widely with feed intake, breed, body weight, growth rate and physiological state (Chantiratikul *et al*., 2009). Feeding a calcium-deficient diet may delay uterine involution and depress fertility (Funston,2007). A lactating cowproducing 10 kg of milk per day is required 30 gCa/day as recommended by ARC (1994). Regarding P requirement cows producing 10 kg milk per day is required 28 g P/day and 1.65 g pis recommended per kg of milk yield (ARC1994). The Ca: P ratio is also recommended 1:1 to 2:1(ARC 1994).

2.4. Productive and Reproductive Performance of CrossbredDairy Cows

2.4.1. Average daily milk yield

The average daily milk yield of crossbred cows is reported in Ethiopia by Belay *et al*. (2012b) 8.52 kg/day/cowfrom Jimma town, Fikrineh *et al*. (2012) 8.9 kg/day/cow inmid rift valley andNigusu and Yoseph (2014) 14.1kg /day/cow in urban and secondary town dairy production systems in Adama milkshed. The average daily milk production for crossbred dairy cows was summarized and reported in Ethiopia for urban (10.21 to 15.9 kg/day/cow) and periurban (9.5 kg/day/cow) systems (Azage *et al*., 2013).Study has shown in Holetta Agricultural Research Center, crossbred cows fed formulated concentrate mix (0.5 kg/kg of milk) and*ad lib* native pasture hay the mean daily milk yield was 10.2 kg/cow/day (Getu*et al*., 2013b).

2.4.2. Calving interval

Calving intervalis a function of calving-to-conception interval or days open, which is considered to be the most important component determining the length of calving interval, and gestation length, which is more or less constant.Theestimated average calving interval for crossbred dairy cowsreported in Ethiopia (Zewdei *et al*. (2011);Belay *et al*. (2012b);Gebrekidan *et al.,*(2012a); Hunduma(2012); Nigusu and Yoseph (2014); Niraj*et al*. (2014); Zemenu *et al*. (2014)ranged from 12.6to 18 months.The average estimated calving interval also reported 441.6 days (14.7 months) of the Friesian x Sanga cows from the Accra plains of Ghana (Obese *et al.*, 2013). Relatively longer calving interval might be indicative of poor nutritional status, poor breeding management, lack of own bull and artificial insemination service, longer days open, diseases and poor management practices (Belay *et al*., 2012b).

2.4.3. Days open

Days open, the number of days between calving to conception, influences profitability of the dairy industry. The averagelength of days open recentlyreported for crossbred dairy cows in Ethiopia was 85.6 to 197 days (Zewdei *et al*., 2011; Belay*et al*., 2012b; Hunduma,2012; Niraj *et al*., 2014).The major nutritional factor decreasing reproductive efficiency of milking dairy cows resulted by negative energy balance that induces a delay in first ovulation after calving (or a low oocytes quality) and increase in embryo mortality incidence with interval from calving to conception that increases over 120-130 days(Rossi *et al*., 2008).Leroy *et al*. (2010) reviewed and concluded that the lack of estrus events during the early postpartum period in dairycows attributed to negative energy balance.Report also indicatesthe magnitude and duration of the prepartum energy status (i.e., negative energy balance) has a detrimental effect on subsequent reproductive and productive performances in high producing dairy cows (Nishany *et al*., 2013). The degree and duration of energy deficit during this early postpartum period is positively correlated with the number of days to first estrus(Leroy and Bols, 2009).

2.5. Feeds and Milk Marketing

2.5.1. Feed marketing

Feed has become a marketable commodity in different parts of the country, particularly around towns and cities. The types of feeds marketed in different places are very diverse and in most cases include both concentrates and roughages (Adugna, 2007; Azage *et al.,* 2013). Feed marketing is common in urban areas where dairy farmers have limited or no access to land for feed production. Thus, purchased feed is themajor source of feed in this system (Azage *et al.,* 2013). The different agro-industrial byproducts could be purchased either directly from the processing plants or from traders who buy the byproducts in large quantities from the factories and resale them to livestock producers(Adugna, 2007:Berhanu*et al.,* 2009).The ultimate buyers of concentrate feeds (agro-industrial byproducts and grain) are mostlycommercial livestock producers and small scale urban or periurban livestock producers. Feed marketing system in Ethiopia is not well developed it becomes a crucial constraint to the expansion and development of the dairy sector(Azage *et al.,* 2013).

2.5.2. Milk marketing and processing

Liquid milk is marketed directly to consumers, through farmers groups (cooperatives), through private collectors, and directly to processors (milk collections centers) hence,liquid milk is marketed through both formal and informal channels (Wouters and van der Lee, 2010).In market-oriented urban and periurban system, fluid milk marketing is dominant being higher in urban than periurban system. Although both formal and informal milk marketing systems do exist, the latter is the dominant system across all the production systems (Azage*et al*., 2013).Both urban and periurban systems where located around Addis Ababa and regional towns and take the advantage of the urban markets (Zelalem *et al.*, 2011).The primary selling outlet of milk is direct sell to consumers and price of dairy commodities are determined by different factors such as season, access to market/distance from towns, fasting and non-fasting days, festivals and holidays, level of supply vs. purchasing ability of the urban dwellers, and quality and sources of dairy products (Sintayehu *et al.,* 2008). The same authors also reported that the major constraints for dairy development in the Southern Ethiopia included availability and costs of feeds, shortage of farm land, discouraging marketing systems, waste disposal problems, lack of improved dairy animals, poor extension and animal health services, and knowledge gap on improved dairy production, processing and marketing.

2.3.3. Economic viability of concentrate feeding

The economic prospects for milk production are very closely related to developments in feed costs, which are rising due to pressures on access to land and the competition between feed and food production (Wouters and van der Lee, 2010). However, adequate level of concentrate supplementation to crossbred cows is required to increase feed intake and milk production (Tadesse *et al.,* 2003). Urban and periurban dairy producers depend substantially on concentrate feeds to supplement crossbred cows (Staal and Shapiro, 1996).Costs of milk production largely depend on feed costs. The cost of milk and milk products that are found in the market today is a reflection of the high cost of feed supplements used by the majority of dairy farms that are engaged in market-oriented milk production (Zelalem *et al.,* 2011). Feed quantity and quality are major factors limiting milk production (Wouters and van der Lee, 2010). In milk production systems which do not rely heavily on pasture grazing and fodder crops to provide cow nutrition, the milk price/concentrate price ratiois an important indicator of the economic viability of the dairying (Staal and shapiro 1996). The milk price/concentrate price ratios are well above 3; this indicates feed price is not beyond the range of profitability (Staal and shapiro 1996).

3. MATERIALS AND METHODS

3.1. Description of the Study Site

The study was conducted on private urban and periurban dairy farms around Holetta. The site is located at 9^{o} 3’ N latitude and 38^{o} 30’ E longitudes, about 30 km West of Addis Ababa along the main road to Ambo(Figure 1). The study area has an altitude of 2400 meters above sea level and receives an average annual rainfall of about 1000 mm. The mean minimum and maximum temperatures are 6 and 22^{o}C, respectively. In this study, urban system constitutes those dairy farms, which are located within the boundary of Holetta town, whereas peri-urban system dairy farms are located outside of the town’s boundary (5 to 10 kilometers), produce milk and deliver to the towns milk collectors.

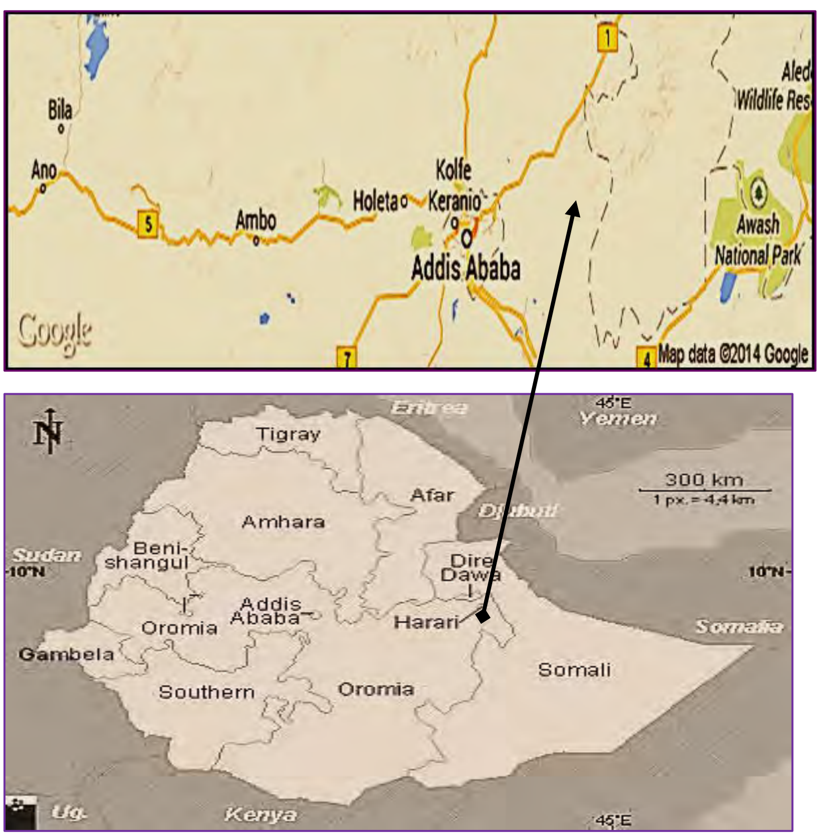

Figure 1.Map of the study site

Source:Adapted from map data (2014)Google

3.2. Study Population and Sampling Techniques

Two production systems, urban and periurban, around Holetta area were considered for this study. These production systems were later stratified into small- and medium-sized dairy farms based on the number of crossbred cows they possess (ILRI, 1996). Accordingly,dairy farms owning less than 3 cows were considered as small- and 3 to 10 as medium-sized farms. Large scale commercial dairy farms (own more than 10 crossbred dairy cows) were not considered in this study since they have a capacity to purchase commercial concentrate mix.Crossbred cows with any exotic blood level inheritance were used for the urban and periurban dairy system of the Holetta town. A reconnaissance survey was conducted in order to select specific dairy farmers and to get general picture of the study sites. Based on the record available from the Dairy Union there were about 295 and 301 dairy farmers keeping crossbred cowsin urban and periurban sites of Holetta. Based on the sample size to proportion technique 10% of the farms from site, thus a total of 60 dairy farms (30 from each urban and periurban) were considered for questionnaire survey and home-mixed concentrate feed samples.Fifteenmedium and smallsizeddairy farms that mix two or more feed ingredientswere selected randomly from each urban and periurban production system.

3.3. Data Collection Procedures

Structured questionnaire were developed and pre-tested for the survey work. Cross-sectional survey was conducted across the dairy farms from November, 2013 to February, 2014. Information were gathered on the general dairy farm characteristics (gender, off-dairy farm activities, education level, labour used, age, family size, cattle holding, forage and grazing land holding cattle housing, water resource and watering frequency, nutrition related health problems and prophylactic measures to diseases),feeds and feeding (feed resources, available concentrates and mixtures, concentrate feeding practices and levels) productive and reproductive performances (average daily milk yield, calving interval and days open), and milk and milk product marketing.

3.4. Chemical Analysis of Home-Mixed Concentrate

Home-mixed concentrates samples were collected from each farm and sealed in the plastic bag for chemical analysis. Chemical analyses of the samples were performed at Holetta Agricultural Research Center's Laboratory. DM and ash contents of feed samples were determined by oven drying at 105ºC overnight and by igniting in a muffle furnace at 600ºC for 6 hour, respectively (AOAC, 1990). Nitrogen (N) content was determined by the Kjeldahl method and Crude Protein (CP) was calculated as N*6.25 (McDonald *et al.*, 2002). The two stage *in vitro* technique developed by Tilley and Terry (1963) was used to determine *in vitro* organic matter digestibility (IVOMD) of the feeds. Metabolizable energy (ME) was estimated from the IVOMD: ME (MJ/kg of DM)=0.016(g/kg of IVOMD) according to McDonald *et al.* (2002). Calcium (Ca) content of the feeds was analyzed using atomic absorption spectrophotometers according to Perkins (1982), and phosphorus (P) content was determined according to AOAC (1990).Nutrientssupplied per milk yield through concentrate mixture were estimated from the total amount of concentrate offered per day/cow and dividing to the milk produced from respective cow/day and multiplying with their respective DM and nutrient concentration according to McDonald *et al.*(2002).

3.5. Milkand Feed Price Assessment

Data on price of milk and feed were collected from each farm at the time of the survey period from the farmer/producer and retailers. To come to the final conclusion of economic viability, calculation of partial budget analysis was employed. The technique includes calculation of total cost of concentrates/cow/day, average milk yield/cow/day, price of milk/kg, return/cow/day, net return/cow/day andmilk price to concentrate price ratio. The cost of concentrate was estimated from the proportion of each ingredients blended and their corresponding price obtained from the retailer and the respondents. Return was calculated as the product of mean milk yield/cow/day and price of milk per kg sold. Net return was calculated as the difference of return/cow/day and the cost of concentrates/cow/day. Milk price: concentrates price ratio was found as the quiescent of return/cow/day to total cost of concentrates offered per cow/day according to Staal and Shapiro (1996).

3.6. Statistical Analysis

The collected data were stratified into production systems and farm sizes and analyzed using Statistical Analysis System software (SAS, 2004).Descriptive statistics were employed to describe qualitative variables. General Linear Model (GLM) procedure of SAS was employed to analyze the effect of classification variables. Mean comparisons was done using the Tukey adjustment for variables whose F-values showing a significant difference at 5% level. The model used to analyze the effects of production subsystems and farm sizes on variables was:

$$Yijk = \mu + H_i + P_j + (HP)_{ij} + e_{ijk}$$

Where,

y_{ijk} =Variables (nutrients content, concentrates intake, milk yield, calving interval and days open of crossbred dairy cows)
μ = overall mean
H_i = the effect of i^{th} herd size (i = small and medium sized dairy farms)
P_j = the effect of j^{th} study production system (j= urban and periurban farms)
$(HP)_{ij}$ = is the effect of interaction between i^{th} herd size and j^{th} production systems
e_{ijk} = random error

4. RESULTS

4.1. Dairy Farm Characteristics in Urban and Periurban Areasof Holetta

4.1.1. Gender and off-dairy farm activities

From the overall respondents, the proportion of males was about 58.3 %. The largest proportion for female ownership dairy farms (60%) was observed in urban smallfarm sizefollowed by 40% in periurban small farm size (Table 1).The respondents in the study area were engaged in other income generation activities in addition to dairy operation. From the off-dairy farm activities of dairy farmers, crop production (50%) and pity business (40%) were the leading in the study site as a whole. Pity business (60%) was the highest proportion in the urban small farm size whereas; crop production took the highest proportion (66.7%) in the periurban medium farm size.

Table1.Gender of respondents and off-dairy farm activities around Holetta

Variables (% farms)	Production system by farm size						
	Urban			Periurban			
	Small (n=15)	Medium (n=15)	Total (n=30)	Small (n=15)	Medium (n=15)	Total (n=30)	Overall (n=60)
Sex of the farm owner							
Male	40.0	66.7	53.3	60.0	66.7	63.3	58.3
Female	60.0	33.3	46.7	40.0	33.3	36.7	41.7
Off-dairy farm activities							
Civil servant	13.3	20.0	16.7	6.7	0. 00	3.3	10.0
Petty business	60.0	26.7	43.3	40.0	33.3	36.7	40.0
Crop farming	26.7	53.3	40.0	53.3	66.7	60.0	50.0

4.1.2. Education level and labour used

The farm owners who attended secondary education were higher than thoseeducation levels (Table 2). About 38.3% were with an attendance of secondary education followed by those with elementary education (25%). The proportion of those who can read only was 20%. The highest (53.3%) secondary education level farm owners were observed in urban small farm size.

Both hired and family labors were used in the study area in dairy farming activities (Table 2). The highest proportions (70%) of the dairy farm owners use family labor and the rest use hired. Majority of dairy farms owners (86.7%) in the urban system with small farm size and 93.3% in the periurban with small farm size used family labour. With medium farm sizes, 53.3% and 46.7% in the urban and in the periurban systems, respectively, dairy farm owners use hired labour.

Table 2.Dairy farmers' education level and labor use around Holetta

Variables (% farms)	Production systems by farm sizes						
	Urban			Periurban			Overall
	Small (n=15)	Medium (n=15)	Total (n=30)	Small (n=15)	Medium (n=15)	Total (n=30)	Total (n=60)
Education level							
Illiterate	6.7	6.7	6.7	6.7	6.7	6.7	6.7
Read and write	20.0	20.0	20.0	26.7	13.3	20.0	20.0
Elementary (1-6 grade)	6.7	26.7	16.7	20.0	46.7	33.3	25.0
Secondary (7-12 grade)	53.3	33.3	43.3	40.0	26.7	33.3	38.3
Above secondary	13.3	13.3	13.3	6.7	6.7	6.7	10.0
Labor used							
Family	86.7	46.7	66.7	93.3	53.3	73.3	70.0
Hired	13.3	53.3	33.3	6.7	46.7	26.7	30.0

4.1.3. Age and family size

The distribution of age with production sub systemsis similar (P>0.05) (Table 3). The overall mean family size of the sampled households was 5.83±1.85 persons/household. Family size of sample households significantly (P<0.05) varied across production systems in this study (Table 3). The largest (P<0.05) mean family sizes 6.73±0.47 persons/household was observed in periurban small farm sizes.The family size in the urban was significantly (P<0.05) lower than the periurban production system.

Table 3.Age and household family sizes of dairy farmers around Holetta

Production system	Farm size	Age	Family size		
			Male	Female	Total
Urban	Small (n=15)	41.60±2.82	2.33 ± 0.30^{b}	2.07±0.31	4.40 ± 0.48^{b}
	Medium (n=15)	44.93±2.82	3.27 ± 0.30^{a}	2.53±0.31	5.80 ± 0.48^{a}
	Mean(n=30)	43.26±1.61	2.80±0.21	2.30±0.22	5.10±0.33
Periurban	Small (n=15)	42.07±2.82	3.80 ± 0.30^{a}	2.93±0.31	6.73 ± 0.47^{a}
	Medium (n=15)	43.73±2.82	4.00 ± 0.30^{a}	2.40±0.31	6.40 ± 0.47^{a}
	Mean (n=30)	42.90±1.61	3.90 ± 0.21^{a}	2.67±0.22	6.57±0.33
Overall mean (n= 60)		43.08±8.84	3.35±1.17	2.48±1.20	5.83±1.85

$^{a-b}$means between production system and farm size followed by different superscript letter are significantly different (P< 0.05)

4.1.4. Dairy cow ownership

Average crossbred cows ownership was similar(P>0.05) over production systems of the study site (Table 4).The overall mean number of cattle holding in the study sitewas 10.00±3.82 heads of cattle. The mean number of cattle herd size in the production systems were smaller significantly (P<0.05) in urban than in the periurban dairy production system. The smallest mean number of cattle (5.00±0.99 heads) were observed in the urban small farm size followed by (9.80±0.99heads)in the urban medium farm size.

Table 4.Cow ownership and average herd size (cattle) over dairy production systems around Holetta

Cattle	Number	Production system		Mean
		Urban	Periurban	
Crossbred cows	Small (n=15)	1.53±0.35	1.60±0.35	1.57±0.24
	Medium (n=15)	4.27±0.35	4.00±0.35	4.13±0.24
	Mean (n=30)	2.90±0.24	2.80±0.24	2.85±1.34
Total cattle	Small (n=15)	5.00±0.99^{cy}	11.53±0.99^{a}	8.26±0.70^{y}
	Medium (n=15)	9.80±0.99^{bx}	13.67±0.99^{a}	11.73±0.70^{x}
	Mean (n=30)	7.40±0.70^{b}	12.60±0.70^{a}	10.00±3.82

$^{a-c}$ means in the same row between production system category and $^{x-y}$ means in the same column between herd size category followed by different superscript letter are significantly different (P< 0.05).

4.1.5. Improved forages development and grazing land holding

Forty three percent of the respondents were found to growimproved forages (Table 5). Regarding the production systems, higher proportions of the periurban farms and but few of the urban farms have planted improved forages (70% of the periurban and 16.7% the urban) such as Napier grass and oats. All urban small farm sizes were not planting improved forages. Those respondents, who did not grow improved forages, they are hindered by limited access of land (over 85%) to grow improved forages.

Table 5.Proportions of dairy farmers who grow improved forages and reasons for not

Variables (% farms)	Production system by farm size						
	Urban			Periurban			Overall
	Small	Medium	Total	Small	Medium	Total	
Grow improved forages	n=15	n=15	n=30	n=15	n=15	n=30	n=60
Yes	-	33.3	16.7	66.7	73.3	70.0	43.3
No	100	66.7	83.3	33.3	26.7	30.0	56.7
Reason fornot	n=15	n=10	n=25	n=5	n=4	n=9	n=34
Lack of awareness	6.7	10.0	8.0	40.0	-	33.3	14.7
Limited access	93.3	90.0	92.0	60.0	100.0	66.7	85.3

Even those having improved forages allotted very small plot (0.04 ha) as in indicated in Table 6. Land allocated for growing improved forages was significantly ($p < 0.05$) lower in urban (0.01 ha) as compared to periurban (0.07 ha). The urban small farm size had no any grazing land. The average grazing land holding in the study area was 0.67 ha per household.

Table 6.Improved forages developmentand grazing land holding of dairy farmers around Holetta

Variables	Farm size	Production system		Mean
		Urban	Periurban	
Land allocated for forages(ha)	Small (n=15)	-	0.06	0.02
	Medium (n=15)	0.02^{b}	0.08^{a}	0.06
	Mean (n=30)	0.01^{b}	0.07^{a}	0.04
Grazing land holding(ha)	Small (n=15)	-	0.53	0.27
	Medium (n=15)	0.89	1.27	1.07
	Mean (n=30)	0.45	0.9	0.67

$^{a-b}$ means in the same row of category followed by different superscript letters are significantly different ($P < 0.05$)

4.1.6. Dairy cattle housing conditions

The dairy cattle housing conditions (barn type, floor, roof, drainage and hygienic conditions) of the study site based on observations during the survey are presented in Table 7. The dairy cattle were managed in a modern barn (40%) but had no individual cattle pens followed by traditional barn (33.3%) and modern barn with individual cattle pens (26.7%). The floor for housing crossbred cattle was concrete (41.7%), stone paved (40%) and ground (18.3%) types in the study area. The highest concrete floor proportions (56.7 %) of the cow barn were observed in the urban-medium production sub-system. The majority (93.3%) of roofs of the barns were rain proof. The roofs in 96.7 % and 90 % of farms from urban and periurban, respectively, were rain proof (corrugated iron sheet cover). About 52% of the barns were with poor drainage whereas, 38% had satisfactory drainage. The general farm hygiene condition of farms in the study site was generally poor.

Table 7.Percentages of farms dairy cattle housing conditions around Holetta

Variables (% farms)	Production system		Total
	Urban n=30	Periurban n=30	n=60
Type of housing			
Traditional barn (free stall)	46.7	20.0	33.3
Modern barn with individual cattle pen	36.7	16.7	26.7
Modern barn without individual cattle pen	16.7	63.3	40.0
Type of floor			
Concrete	56.7	26.7	41.7
Stone slab	26.7	53.3	40.0
Ground compact	16.7	20.0	18.3
Type of roof			
Rain proof	96.7	90.0	93.3
Not rain proof	3.3	10.0	6.7
Drainage			
Good	20.0	0.0	10.0
Satisfactory	43.3	33.3	38.3
Poor	36.7	66.7	51.7
Farm hygiene			
Good	20.0	0.0	10.0
Satisfactory	33.3	23.3	28.3
Poor	46.7	76.7	61.7

4.1.7. Water resources and frequency of watering

Respondents had three different water sources for their dairy animals which included: well, river and tap water (Table 8). About 50% of the dairy farms in this study use tap water. Main sources of water in urban production system 76.7% of the farmsis tap water.

In periurban production system, 43.3% of the farmssource of water for cattle is well followed by river for the 33.3% of the farms.

Table 8.Water sources for dairy cows around Holetta

Variables (% farms)	Production system		Total
	Urban (n=30)	Periurban (n=30)	(n=60)
Water resources			
River	13.3	33.3	23.3
Well	10.0	43.3	26.7
Tap water	76.7	23.3	50.0

Frequency of watering in the urban production system twice a day (56.7%) was taken the highest proportion (Figure 2) followed by *ad libtum* (30%) a day. In the periurban production system, dairy farmers provide water twice (60%) followed by once (30%) a day.

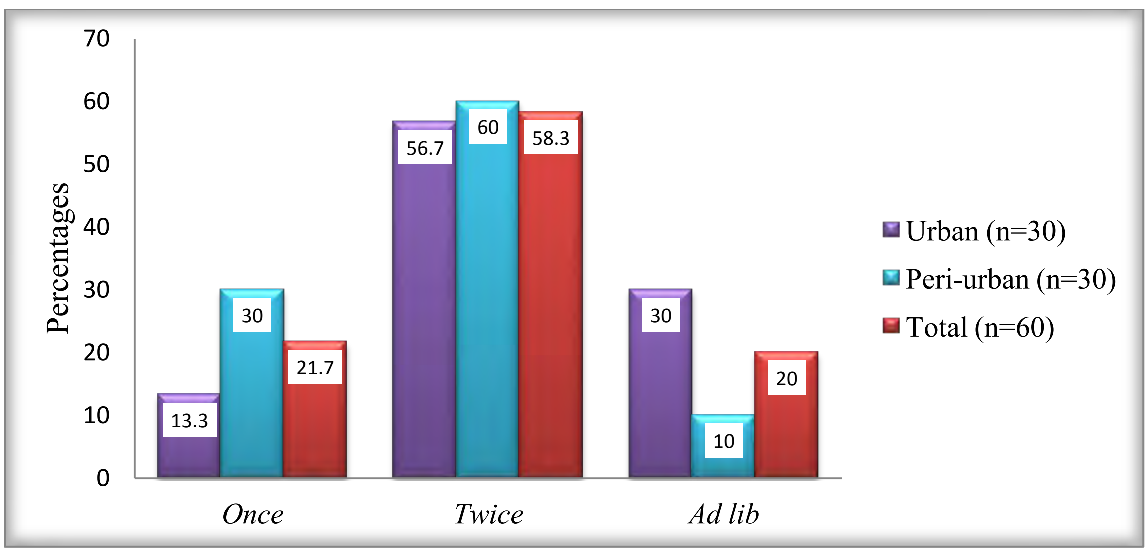

Figure 2.Frequency of watering dairy cows across the visited farms at Holetta

4.1.8. Nutrition relateddairy cows diseases

As the results in Table 9 show, emaciation or poor body condition and bloating were major nutrition health problems around Holetta.

Table 9.Percentages offarms common nutrition related health problems of dairy cowsaround Holetta

Health problems (% farms)	Production system by farm size						
	Urban			Periurban			Overall
	Small (n=15)	Medium (n=15)	Total n=30)	Small (n=15)	Medium (n=15)	Total (n=30)	Total n=60)
Emaciation							
Present	100.0	73.3	86.7	86.7	100.0	93.3	90.0
Absent	-	26.7	13.3	13.3	-	6.7	10.0
Bloating							
Present	100.0	80.0	90.0	93.3	93.3	93.3	91.7
Absent	-	20.0	10.0	6.7	6.7	6.7	8.3

The prophylactic measures which were performed in the study site included vaccination, deworming and spraying (Table 10). Majority (95%) of the farms reported that they annually vaccinate their cattle against anthrax and blackleg. All farms were practicing deworming against internal parasites. Highest proportions (80%) of the dairy farms were also performing spraying against external parasites.

Table 10.Prophylactic measures to diseases undertaken around Holetta

Prophylactic measure (%Farms)	Production system		Total
	Urban (n=30)	Periurban (n=30)	(n=60)
Vaccination	93.3	96.7	95.0
Deworming	100.0	100.0	100.0
Spraying	76.7	83.3	80.0

The highest proportions of the farms in the study site were applied deworm two times per year against internal parasites figure 3. Three times per year was also reported next and followed by once a year.

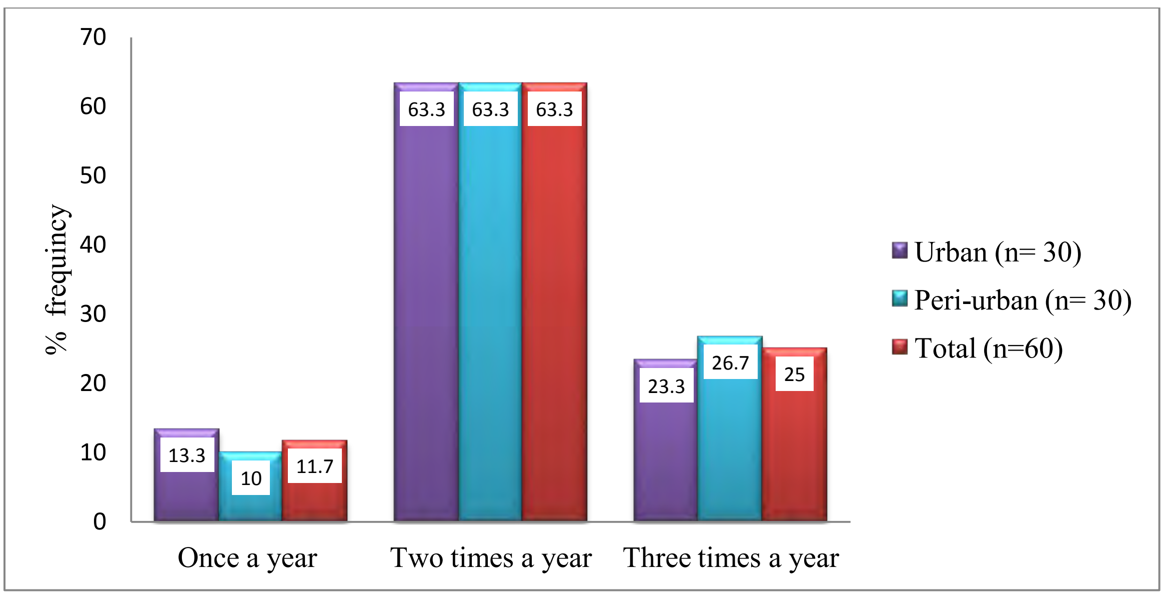

Figure 3:Frequency of deworming dairy cattle around Holetta

About 50% of the farms in the study site were applied spraying two times per year against external parasites (Figure 4). Farmers were practicing spraying acaricide two times per year against external parasites in periurban higher than fromthe urban production systems.

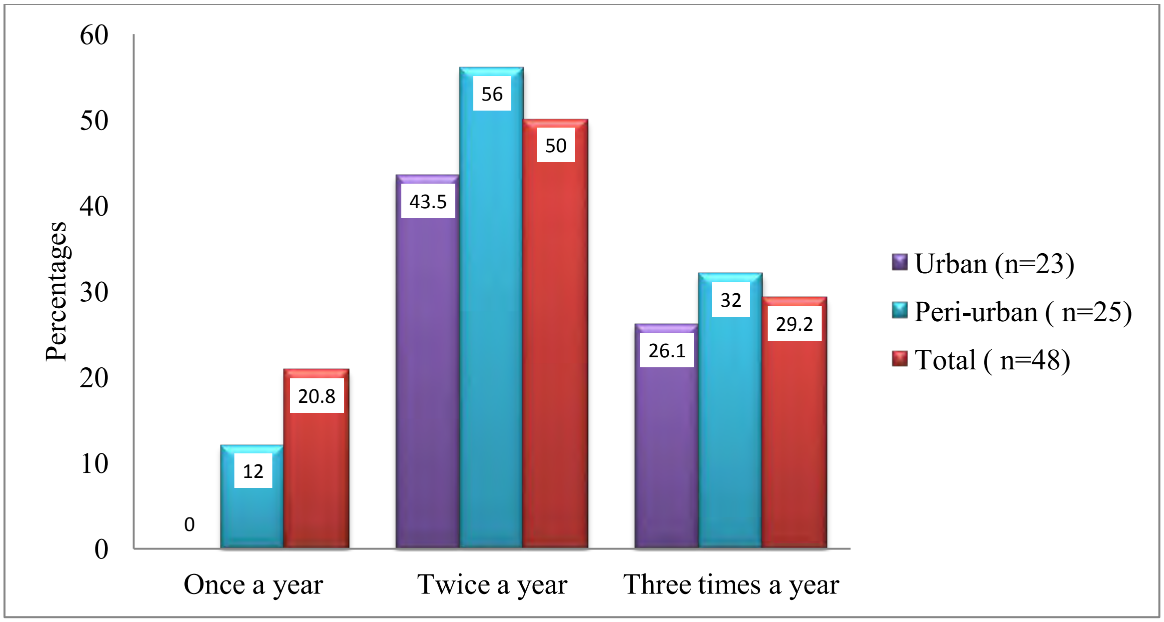

Figure 4.Frequency of spraying measures taken against external parasite across visited farms at Holetta

4.2. Feeds and Feeding of Crossbred Dairy Cows

4.2.1. Basal feed resources

About 51.7% of the dairy farms basal feed sources to cattle were found grass hay, straws and grazing (Table 11). Of all, 36.7% in the urban were reported to use only grass hay as a sole basal diet; however, there were no farms use only grass hay in the periurban production systems as a sole basal diet. In urban and periurban 33.3% and 26.7% of the dairy farms, respectively, use both grass hay and straw as a basal feed when available. Over 73.3% periurban farms use all types of basal diets, available in the site (grass hay, straw and grazing). About 47% dairy farm owners in the site use wheat, barley, teff and pulse straw commonly as basal dietwhen available abundantly.

Table 11.Percentages dairy farms' basal feedtypesaround Holetta

Farms (%)	Production systems		
	Urban	Periurban	Total
Basal diet	(n=30)	(n=30)	(n=60)
Grass hay	36.7	0.0	18.3
Grass hay and straw	33.3	26.7	30.0
Grass hay, straw and grazing	30.0	73.3	51.7
Straw types	n=19	n=30	n=49
Wheat and barley	42.1	13.3	24.5
Wheat, barley and teff	47.3	46.7	47.0
Wheat, barley, teff and pulse	5.3	26.7	16.3
Wheat, barley and pulse	10.3	13.3	12.2

4.2.2. Available concentrates feed ingredients

The common types of concentrates feed ingredients used were identified (Table 12) includes: wheat bran, noug seed cake, wheat middling, linseed cake, bean hulls and salt. Among the different ingredients used, noug seed cake and salt are the sole concentrates feed ingredients for home-mixed concentrate mixture in the study site. Wheat bran is frequently used in concentrate mixture. The dairy farmerswere blend the concentrate mixture for crossbred dairy cows from wheat bran(42.60%), noug seed cake (34.20%), wheat middling(10.27%)and the remaining proportions from linseed cakes bean hulls and common salts in this study site. The smallest($P<0.05$) proportions of wheat bran (26.73%) was used in periurban medium size farms. The highest($P<0.05$) proportions of noug seed cake(42.34%) was used in the concentrate mixture by periurban small size subsystem.Highest-cost($P<0.05$) of concentrates (Birr 3.74 per kg of mix) were blended in periurban medium size subsystem as compared to other subsystem.

Table 12.Available concentrate ingredients, proportionsand their corresponding prices in the study site

Production system	Farm size	Feed ingredients (%)						Price/kgof mix
		Wheat bran	Wheat Middling	Noug cake	Linseed cake	Bean hulls	Salt	
Urban	Small (n=15)	47.57[a]	14.50[a]	29.26[b]	1.30	5.29	2.08	3.29b
	Medium (n=15)	53.26[a]	17.14[a]	25.65[b]	-	1.63	2.33	3.23b
	Mean (n=30)	50.42	15.82[a]	27.45[b]	0.65	3.46	2.21	3.26b
Periurban	Small (n=15)	42.82[a]	4.77[b]	42.34[a]	1.63	5.98	2.46	3.28b
	Medium (n=15)	26.73[b]	4.69[b]	39.55[a]	13.84	12.74	2.47	3.74a
	Mean (n=30)	34.78	4.73[b]	40.94[a]	7.73	9.36	2.46	3.52[a]
Overall mean (n=60)		**42.60**	**10.27**	**34.20**	**4.19**	**6.41**	**2.33**	**3.40**
Average price of ingredient		2.74	3.52	3.78	6.40	3.00	5.00	
Price of ingredient in kg of overall mean mix		1.17	0.36	1.29	0.27	0.19	0.12	**3.40**

[a-b] means in the same column category followed by different superscript letter are significantly different (P< 0.05)

The major reasons of the dairy producers were not purchase commercial concentrate mix by unavailability in feed retailer shops (60.9% of the farms) followed by high prices23.9%of the farms) (Figure 5). Farmers had also indicated concern regarding the lack of information and poor quality (low milk production)were hindered them to purchase commercial concentrate mixtures.

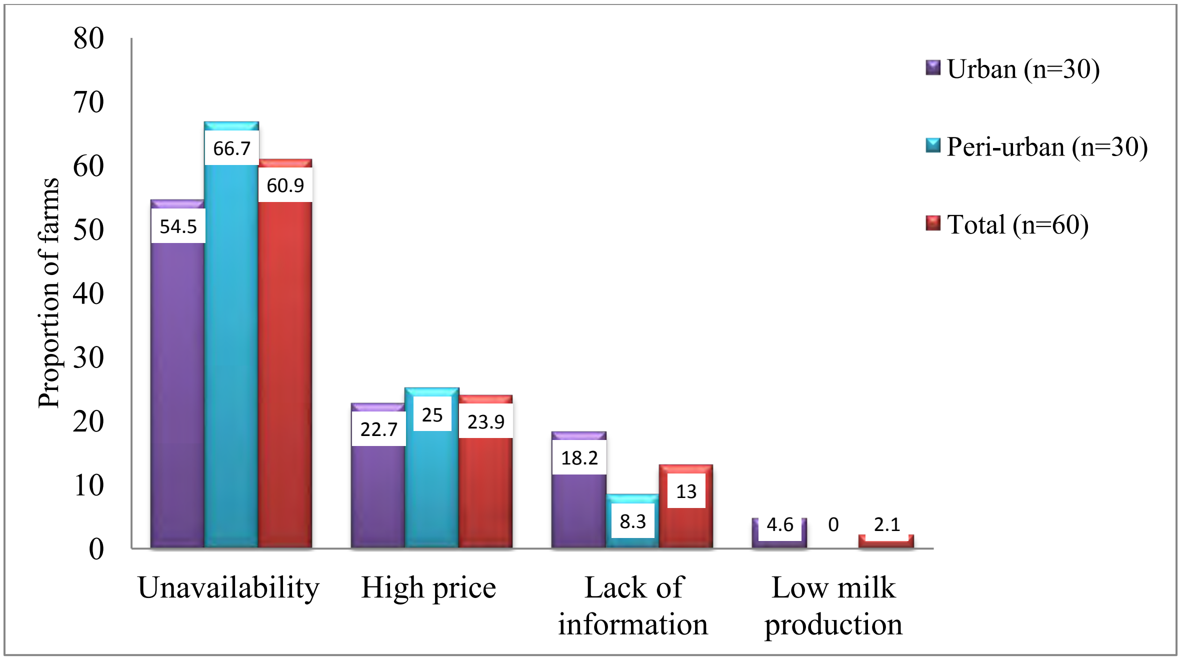

Figure 5.Major reasons hindered dairy farms to purchase commercialconcentrate mixtures around Holetta

Concentrate feed ingredients (agro-industrial by-products) commonly were blended to feed all lactating crossbredcows similar mixtures regardless of milk yields (Table 13). Famers (95%) did not mix and feed concentrate mixture for different classes of cattle.Price and availability of ingredients were considered as the bases of mixing (formulating) concentrate mixtures for crossbred dairy cows by 80% dairy farmers. Cow's milk productivity, price and availability together were considered also as bases of formulating diets for dairy cows by 20% of farms.

Table 13.Farmers concentrate blending practices around Holetta

Variables (% farms)	Production system		
	Urban (n=30)	Periurban (n=30)	Total n=60)
Mix feed ingredients for different classes of dairy cattle			
Yes	3.3	6.7	5.0
No	96.7	93.3	95.0
Bases of blending concentrate mixtures			
Price and availability	73.3	87.7	80.0
Cow's milk productivity , price and availability	26.7	13.3	20.0

Sixty percent of the farmers use feed ingredients proportions for concentrate mixture by their own estimation (Figure 6). The other respondents were also reported as they obtained information to mix feed ingredients from Woredas Agriculture Extension Service and Agricultural Research Center.

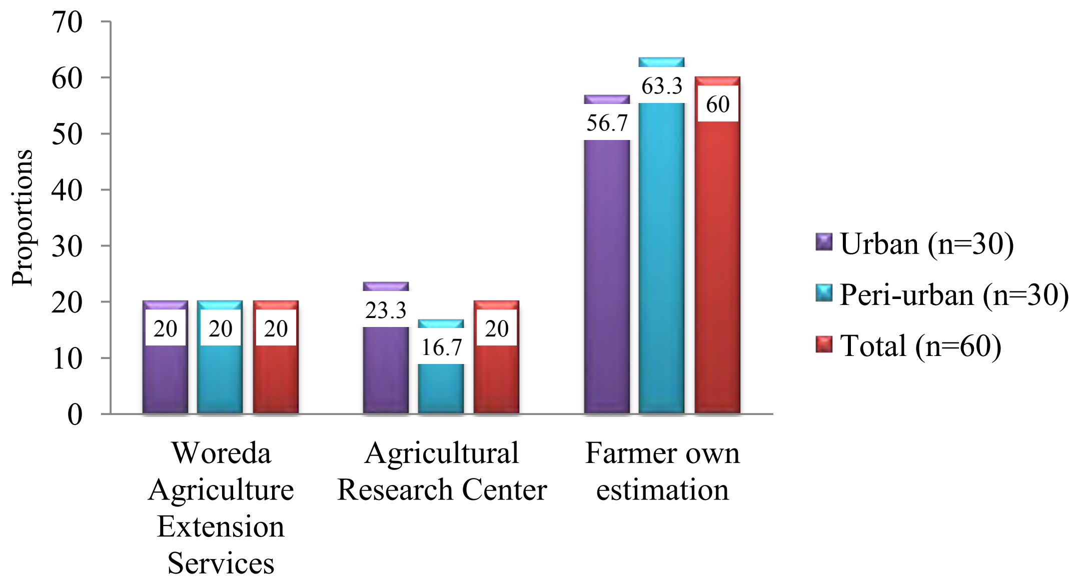

Figure 6.Farms proportions in obtaining the information to blend feed ingredients

4.2.3. Chemical composition of concentrate mixtures

The mean chemical compositions of the home-mixed concentrate mixtures based on laboratory results are presented in Table 14. The mean DM content of home-mixed concentrate mixtures in the site was 906.20±7.71g/kg. The mean dry matter (DM) content of home-mixed concentrate mixtures in urban farms was significantly ($p<0.05$) lower than periurban farms. The highest DM content was observed in periurban medium farm size. The ash contents of the farms concentrate mixtures were not much different ($p>0.05$) across the production subsystems in this study. The mean CP content of home-mixed concentrate mixtures was 216.58±20.86g/kg of DM.The mean CP content was significantly ($p<0.05$) lower in urban medium farm sizes than periurban medium farm size. The mean ME value of the home-mixed concentrate of farms where blended to feed crossbred lactating dairy cows was 10.99±0.59MJ/kg of DM.The mean ME value wassignificantly ($p<0.05$) reduced from urban farms to per urban production systems. The smallest ($p<0.05$) mean ME values was found in periurban medium farm size.

The mean Ca concentration of the home-mixed concentrate was4.55±1.23g/kg of DM. The Ca concentrations were significantly ($p<0.05$) increased in urban to periurban farms. On contrary, phosphorous (P) concentrations in urban farms were significantly ($p<0.05$) reduced from urban to periurban farms. The highest (10.60±0.30 g/kg of DM) P concentration was observed in urban small farm size. The lowest P concentration (9.36±0.30 g/kg of DM) was found in periurban medium farm size.

Table 14.Chemical composition of home-mixed concentrate mixtures in dairy farms around Holetta

Nutritive values	Farm size	Production systems		Overall mean
		Urban	Periurban	
DM (g/kg)	Small (n=15)	901.61±20[b]	909.04±20[a]	905.33±1.41
	Medium (n=15)	902.95±20[b]	911.23±20[a]	907.09±1.41
	Mean (n=30)	902.28±1.41[b]	910.13±1.41[a]	906.20±7.71
Ash (g/kg DM)	Small (n=15)	92.15±3.49	100.30±3.49	96.22±2.47
	Medium (n=15)	97.59±3.49	99.02±3.49	98.30±2.47
	Mean (n=30)	94.87±2.47	99.66±2.47	97.26±13.52
CP (g/kg DM)	Small (n=15)	208.93±5.39	218.32±5.39	213.62±3.81
	Medium (n=15)	208.67±5.39[b]	230.42±5.39[a]	219.54±3.81
	Mean (n=30)	208.80±3.81[b]	224.37±3.81[a]	216.58±20.86
ME (MJ/kg DM)	Small (n=15)	11.30±0.15[a]	10.95±0.15	11.12±0.11
	Medium (n=15)	11.25±0.15[a]	10.47±0.15[b]	10.86±0.11
	Mean (n=30)	11.28±0.11[a]	10.71±0.11[b]	10.99±0.59
Ca (g/kg DM)	Small (n=15)	3.93±0.32[b]	4.92±0.32[a]	4.42±0.25
	Medium (n=15)	3.77±0.32[b]	5.61±0.32[a]	4.69±0.25
	Mean (n=30)	3.85±0.25[b]	5.26±0.25[a]	4.55±1.23
P (g/kg DM)	Small (n=15)	10.60±0.30[a]	10.13±0.30	10.36±0.21
	Medium (n=15)	10.55±0.30[a]	9.36±0.30[b]	9.95±0.21
	Mean (n=30)	10.57±0.21[a]	9.74±0.21[b]	10.16±1.16

[a-b] means in the same row of category followed by different superscript letter are significantly different ($P < 0.05$)

4.2.4. Concentrate mixture feeding practices and levels

Home-mixed concentrate supplementation was mainly lactating dairy cows in this study site. The act of feeding concentrate to non-lactating animals was not common. According to the respondents, lactating cows and non-dairy herd fed individually and the quantity of concentrate mixtures offering is based the lactating cow's milk yield.The overall estimated mean quantity of concentrate mixtures supplement percow/daywas 4.87±1.53 kg (Table 15). Significantly different ($P<0.05$) in amount of concentrate mixtures supplementation per cow/day was observed across the farming system. The smallest (3.74±0.39 kg/day) mean quantity of home-mixed concentrate supplementto crossbred dairy lactating cows was found in periurban small farm size.The overall mean quantity of concentrate mixtures supplement per kg/kg of milkwas 0.47±0.06 kg.Significantly ($P<0.05$) different in amount of concentrate mixtures supplementation per kg of milk yield was observed in the study site between urban and periurban production systems. The smallest mean (0.45±0.02 kg/kg of milk yield) quantity of home-mixed concentrate supplementation to crossbred dairy cows was practiced in perurban small farm size.

Table 15.Concentrate feeding levels per day and milk yield to cowsaround Holetta

Amount	Farm size	Production system		Mean
		Urban	Periurban	
kg/day	Small (n=15)	5.48 ± 0.39^{a}	3.74 ± 0.39^{b}	4.61±0.28
	Medium (n=15)	5.49±0.39	4.79±0.39	5.14±0.28
	Mean (n=30)	5.49 ± 0.28^{a}	4.26 ± 0.28^{b}	4.87±1.53
kg/kg of milk yield	Small (n=15)	0.49 ± 0.02^{a}	0.45 ± 0.02^{b}	0.47±0.01
	Medium (n=15)	0.49±0.02	0.47±0.02	0.48±0.01
	Mean (n=30)	0.49 ± 0.01^{a}	0.46 ± 0.01^{b}	0.47±0.06

$^{a\text{-}b}$means in the same row of category followed by different superscript letter are significantly different($P< 0.05$)

4.2.5. Nutrient supplyfor milk yield

The mean estimated nutrients supply through home-mixed concentrate mixture per kg of milk based on the laboratory result and quantity provided per cow/day for lactating crossbred cows are given in Table 16. Assuming the maintenance requirement obtained from *ad lib* feeding of roughages, the overall estimated mean CP supply was93.06±15.81g/kg of milk yield. The mean CP supply through concentratesacross the study site production subsystemswas similar (P>0.05). The overall estimated ME supply through concentrate was 4.73±0.70MJ/kg of milk yield. Differences significantly (P<0.05) across the production systems in energy supply per kg of milk yield was existed,which is, higher in urban farms. The smallestamount of ME supply (4.43±0.18 MJ/kg of milk yield)was observed in periurban small farm size, whereas the largestamount 5.01±0.18MJ/kg of milk yield supply was found in urban medium farm size. Regarding, Ca supply g/kg milk yield through home-mixed concentrate mixture, variation significantly (P<0.05) was existed in the production systems. The lower Ca level (1.68±0.16g/kg milk yield)was fed in the urban medium farm sizes whereas the highest (2.40±0.16g/kg milk yield)Ca supplyingwas observed in periurban medium farm size. Similarly, P supply g/kg milk yield significantvariation (P<0.05) was observed.The highest amount (4.72±0.13g/kg milk yield)P supplywas found in urban medium farm size.

Table16.Nutrient supply to milk yield through concentrate mixture around Holetta

Amount	Farm size	Production system		Mean
		Urban	Periurban	
CP (g/kg MY)	Small(n=15)	91.86±4.08	88.78±4.08	90.30±2.89
	Medium (n=15)	93.43±4.08	98.19±4.08	95.81±2.89
	Mean (n=30)	92.64±2.89	93.47±2.89	93.06±15.81
ME (MJ/kg MY)	Small (n=15)	4.96±0.18^{a}	4.43±0.18^{b}	4.70±0.13
	Medium (n=15)	5.01±0.18^{a}	4.50±0.18^{b}	4.76±0.13
	Mean (n=30)	4.99±0.13^{a}	4.47±0.13^{b}	4.73±0.70
Ca (g/kg MY)	Small(n=15)	1.71±0.16	2.03±0.16	1.87±0.11
	Medium (n=15)	1.68±0.16^{b}	2.40±0.16^{a}	2.04±0.11
	Mean (n=30)	1.70±0.11^{b}	2.21±0.11^{a}	1.98±0.62
P (g/kg MY)	Small (n=15)	4.66±0.19^{a}	4.10±0.19^{b}	4.37±0.13
	Medium (n=15)	4.72±0.19^{a}	3.98±0.19^{b}	4.35±0.13
	Mean (n=30)	4.69±0.13^{a}	4.04±0.13^{b}	4.36±0.73

[a-b]means in the same row of category followed by different superscript letter are significantly different (P< 0.05), MY = Milk Yield,

4.3. Productive and Reproductive Performance of Cows around Holetta

4.3.1. Average daily milk yield

The estimated average daily milk yield,calving intervals and days openare presented in Table 17. The estimated overall mean daily milk yield based on the farmer's response and observation during the survey was 10.20±2.63 kg/cow/day at the study site. Significant different (P<0.05) average daily milk yield was observed across the study production systems.The small amount (8.48±0.68 kg/ cow/day) averagedaily milk yield wasmilkingfrom periurban small farm sizesand large amount (11.18±0.68kg/ cow/day)was milking from urban small farm sizes.

4.3.2. Calving interval

The overall estimated mean calving interval was 14.83±1.52 months around Holetta.Marked difference (P<0.05) was existed in calving interval across the production systems of the study site. Longer calving interval was observed in periurban areas than in the urban farms. The longest (15.47±0.39 months) calving interval was reported from periurban small farm sizes.

4.3.3. Days open

The overall estimated mean days open in the study site was 163.83±36.90 days.Significantlylonger (P<0.05) mean days open was reporting from periurban dairy farms.The longest days open (179.07±10.04 days) was reporting from periurban medium farm size.

Table 17.Average dailymilk yield, calving interval and days open ofcrossbred cows around Holetta

Traits	Farm size	Production system		Mean
		Urban	Periurban	
	Small (n=15)	11.18±0.68^{a}	8.48±0.68^{b}	9.83±0.48
ADMY	Medium (n=15)	11.06±0.68	10.08±0.68	10.57±0.48
kg/cow/day	Mean (n=30)	11.12±0.48^{a}	9.28 ±0.48^{b}	10.20±2.63
	Small (n=15)	14.60±0.61	15.47±0.39^{a}	15.03±0.28
CI	Medium (n=15)	13.93±0.39^{b}	15.33±0.39^{a}	14.63±0.28
(months)	Mean (n=30)	14.27±0.28^{b}	15.40±0.28^{a}	14.83±1.52
	Small(n=15)	161.53±10.04	173.06±10.04	167.30±7.10
DO	Medium (n=15)	141.67±10.04^{b}	179.07±10.04^{a}	160.36±7.10
(days)	Mean (n=30)	151.60±7.10^{b}	176.06±7.10^{a}	163.83±36.90

$^{a-b}$ means in the same row for the same trait followed by different superscript letter in the same row for the same trait are significantly different (P<0.05), ADMY = Average Daily Milk Yield, CI = Calving Interval, DO = Days Open.

4.4. Feed and Milk Marketing around Holetta

4.4.1. Feed marketing

The major feed resource marketed at this study site includesgrass hay, crop residues as basal feed source. Besides basal diets, agro-industrial by-products (noug seed cakes, wheat bran, wheat middling linseed cake, bean hulls) and few farms maize as well are marketed commonly. The agro industrial by-products, maize and salt are shown with their corresponding prices in Table 18. Linseed cake and maize are the most expensive feed ingredients available in the market, however only few farms purchase and incorporate in the crossbred dairy cows concentrate mixtures.

Table 18.Available feed ingredients and their corresponding price at Holetta

Type feed ingredient	Average price/kg (Birr)
Noug seed cake	3.80
Salt	5.00
Wheat bran	2.70
Wheat middling	3.60
Bean hull	3.15
Linseed cake	6.50
Maize	7.00

4.4.2. Milk marketing and processing

The highest proportions (76.7%) of the respondents were agreed that they get market to their fluid milk at the price of Birr 8.50/kg (Table 19). The small proportions (15%)of the farmers are selling the fluid milk to the nearby hotels with a price range of Birr 7.5 to 8 per kg fluid milk and the restareselling fluid milk to private milk processors with a price range of Birr 9 to10per kg of milk.Over 93% of the dairy farmers around Holetta are not involved in processing of fluid milk into dairy products.

Table 19.Proportions of dairy farms milk marketing and processing around Holetta

Collectors	Production system		Total	
	Urban n=30	Periurban n=30	n=60	Price/kg
Hotels	16.7	13.3	15.0	Birr 7.5-8.0
Dairy Union and cooperatives	70.0	83.3	76.7	Birr 8.5
Private processors	13.3	3.3	8.3	Birr 9-10
Do you process milk				
Yes	3.3	10.0	6.7	
No	96.7	90.0	93.3	

4.4.3. Economic viability of concentrates

Total concentrate cost, calculated return, net returns, and milk price: concentrate ratio are given in Table 23. The overall mean estimated mean price of home-mixed concentrates was Birr 3.38per kg. The highest(P>0.05) priceBirr 3.74 per kg was found in periurbanmedium farm size. Total concentrate cost offered per cow/day was Birr 16.45. The gross and net return obtained from milk sold was Birr 86.99 and 70.54per cow/day. Significance differences (P<0.05) were observed in return and net return obtained per cow per day in the production subsystems. Smallest return and net return obtaining Birr 71.21 and 58.96per cow/day was earnedby periurban small farm size.The overall mean milk price/concentrate price ratio for the study site dairy farms was 5.42 per cow/day. The milk price/concentrate ratio was significantly different (P>0.05) across the production systems.The highest (P>0.05)milk price/concentrate price ratio (5.85 per cow/day) was foundfromperiurban small farm size.

Table 20.Milk price: concentrate price ratio analysis per cow/day around Holetta

Production system	Farm size	Particulars						
		Price of concentrate Per kg	Cost of concentrate (Birr)	Milk yield /cow/day (kg)	Price of milk/kg (Birr)	Returns (Birr)	Net returns (Birr)	Milk price: Concentrate price ratio
Urban	Small (n=15)	3.29±0.08[b]	18.01±1.34[a]	11.18±0.68[a]	8.53±0.12[a]	96.01±6.43[a]	77.99±5.33[a]	5.40±0.20[a]
	Medium (n=15)	3.23±0.08[b]	17.74±1.34[a]	11.06±0.68[a]	8.53±0.12[a]	94.81±6.43[a]	77.07±5.33[a]	5.44±0.20[a]
	Mean (n=30)	3.26±0.06[b]	17.88±0.95	11.12±0.48	8.53±0.09[a]	95.41±4.54[a]	77.53±3.77[a]	5.42±0.14
Periurban	Small (n=15)	3.28±0.08[b]	12.25±1.34[b]	8.48±0.68[b]	8.40±0.12[a]	71.21±6.43[b]	58.96±5.33[b]	5.85±0.20[a]
	Medium (n=15)	3.74±0.08[a]	17.80±1.34[a]	10.08±0.68	8.50±0.12[a]	85.95±6.43	68.14±5.33[ab]	5.00±0.20[b]
	Mean (n=30)	3.52±0.06[a]	15.03±0.95	9.28±0.48	8.45±0.09[a]	78.58±4.54[b]	63.55±3.77[b]	5.42±0.14
Over all mean (n=60)		**3.38**	**16.45**	**10.20**	**8.49**	**86.99**	**70.54**	**5.42**

[a-b]means in the same column of category followed by different superscript letter are significantly different (P<0.05)

5. DISCUSSION

5.1. Dairy Farming Characteristics around Holetta

5.1.1. Gender and off-dairy farm activities of the dairy farmers

The proportion of female headed dairy farms in this study is higher as compared to the reported values for Jimma town (Belay *et al*., 2012a) in which the proportion of female and male owners is 24% and 76% respectively. The proportion of female headed dairy farmsare comparable with the reported values female and male owners is 47.7% and 52.3%, respectively for Hawassa City (Haile *et al*., 2012).The proportion of female households was higher in urban (46.7%) based dairy production than in the periurban(36.7%) in this study is consistent with the report indicated similar trends (Fekede *et al.,* 2013) who shown the proportion of female householdswas higher in Girar-Jarso(urban based dairy production) than Ejere and Sululta (periurbanbased dairy production) in the greater Addis milk shed central highlands of Ethiopia.The higher proportion (60%) of female in urban production system with small herd size category in this study involved in dairying indicates supporting livelihoods of female headed households in urban areas. As the survey indicates, most dairy farmers do not take dairying as sole career and have supplemented their life earning by crop production, pity business and civil servants. Therefore, dairy farming is not taken as an exclusive means of earning income by the total respondents. Crop production (50%) and (60%) took the leading on the non-dairy income generation activity in urban and periurban, respectively of the present study site.

5.1.2. Education level and labor used of the dairy farmers

In Holetta, the respondents (43.3%), had attended secondary school in the urban is slightly comparable to the figure (41%) and 38.3%reported (Fekede*et al*., 2013; Gillah *et al.,* 2013) for urbanin thegreater Addis milkshed, central highlands of Ethiopia, and Morogoro and Dare es Selaam in Tanzania, respectively.The secondary education level of dairy farmersin urban area higher than the periurban areais in line with trends observed in the AddisAbaba milkshed(Fekede*et al*., 2013). This might be due to better basic educational infrastructure and hence have access in urban than periurban. Farmers with high education levels adopt usually new technologies more rapidly than lower educated farmers (Ofukou *etal*., 2009). Better education level means better cattle management practices as education level enhances societies to be aware of efficient utilization of natural resources and adopt new technology in improving livestock productivity. The level of education of dairy farmers is an important factor determining the managerial capacity, adoption of new technologies and the overall intensification of dairy production Technology adoption rates increased with increased education level (Mekonnen *et al*., 2010).

Thirty percent of dairy farmers used hired labours in this study was comparable to the report of33% in Jimma town (Belay *et al.,* 2012a). However, lower than that reported for dairy farmers depend largely on hired labour (52.0%) in Dar es Salaam city and Morogoro town in Tanzania (Gillah *et al.,* 2013). Majority of dairy farm owners (86.7%) in urban system with small herd size and (93.3%) in the periurban with small farm size group were used family labour. This indicates small farm size managed by family labour.Dairy farm owners (53.3%) in urban system with medium farm size and 46.7% in the periurban with medium farm size group used hiredlabour. This indicates as crossbred cows increased additional labour required for the dairy management.

5.1.3. Age and family size of dairy producers around Holetta

The overall mean age of 43.08±8.84 years in the present study was in line with Azage *et al*. (2013) who reportedthe average age of the household heads ranged from 39.7 in Mieso to 51.9 years in Shashemene, and it is within the range of the productive age. The currentfinding was alsocomparable with the Hawassa City between 40.5 and 45.9 years (Haile *et al*., 2012) and Metekel zone, northwestern Ethiopia 43.20±1.00 years(Solomon *et al.,* 2014).The mean ages of the respondents in this study and all of the respondents were within the range of productive age (20-60 years).

The overall mean family size in this study5.83 persons/household wascomparable tothe report of (Solomon *et al*. 2009; Mekonnen *et al*. 2010; Belay *et al*. 2012a; Abdi *et al*. 2013)) 5.7, 5.38,6.02 and 5.42 persons/household northeastern Amhara region, Dejen District, Jimma town and west Hararghe, respectively. There was increasing trend in family size from 5.10 to 6.57persons per household in urban to periurban dairy farms possessing households. The smallest average family sizes (4.40 persons per household) in urban small farm sized were observed. This might be attributed to the meancrossbred cows holding, most of the management activities in the small farm size are found to be carried out by family members, and hence hired labour may raise the family sizes.

5.1.4. Cows ownership

The overall average number of crossbred cows owned per household was 2.85 heads in the study site is in line with the figure reported by Fekede*et al*. (2013) 2.7 heads of cows per household for greater Addis milk shed, central Ethiopia. The mean number of cows per household in this study was greater than thefigure reported for smallholder dairy farmers(1.29 cows), but lower than the figure reported formedium farms (6.43 cows) in Bishoftu, Ethiopia (Mulisa*et al*., 2011).

Out of the mean number of cattle holding per householdcrossbred cows were shared 2.9 and2.8from7.4 and 12.6 heads of cattle in the urban and periurban farms, respectively. The variations could be attributed to differences in production objectives between urban and periurban farmers, and also the lack of sufficient space to accommodate large herd size in urban centers.Crossbred cows possessed per household indicate the increased tendency of market-orientation by the producers as crossbred cows are primarily reared to generate income from sale of milk.

5.1.5. Improved forage development and grazing land holding

The respondents (85.3%) in the study site were hindered bylimited access of land to grow improved forages. This is in line with (Azage *et al.,* 2013) who shown the shortage ofland reported in urban production system underlines the limitation of land to expand dairy production in urban centers.Diriba *et al*. (2014) who reported inclination of slighting improved forages andrelying more on poor quality roughages and bought-in concentrate ingredients is common in periurban of Bako and Nekemite, western Ethiopia.

Larger grazing land holding in the farming area was reduced from the periurban farmers as compared to the urban dwellers. This study result is in line with (Ahmed *et al*., 2010; Belete *et al*. , 2010) who reportedthe average size of private grazing land per household was 0.46 ha in the high altitude zone ofCentral Highlands of Ethiopia and 0.1 to 0.5 hain Fogera woreda, Amhara region, Ethiopia, respectively.The present result was larger than the findings of the figure 0.1and 0.077 ha of private grazing land forUmbulo Wacho Watershed in Southern Ethiopiaand West Hararghe (Funte *et al*., 2010; Abdi *et al*., 2013) respectively.Urban small sizehas no any grazing land in the study areais consistent with the previous study characterization, urban dairy system is with little or no land resources mostly for specialized dairy production under stall-feeding conditions (Azage *et al.,* 2013).

5.1.6. Housing conditions of dairy cattle

The purpose of housing dairy cattle like other farm animals is to reduce climatic stress on the animals that hinder production, reproduction and proper growth and development (Yibrah*et al*., 2005). The proportion traditional barn (33.3%) in Holetta was lower than finding of Embet and Zeleke (2008)traditional free stalls proportion which was common in Dare-Dawa town (87.9 %). The highest concrete floor proportions (56.7 %) of the cow barn were observed in the urban production system of this study sitewas lower than the finding of Mulisa *et al.* (2011) in Bushoftu town for the majority of medium dairy holders (71.4%).The roofs of the barn (93.3%) were rain proof which is higher than most of the farms in all scales of production 78.8% kept their dairy cows under cow shed roofed with corrugated sheets of materials (Mulisa *et al.*, 2011) in Bisheftu town. The general farm hygiene conditionsin this study site were more poorly hygienic than Asela town where 39% dairy farmsare poorly hygienic (Hunduma,2013).The current result is in line with similar observations were made in several urban and periurban dairy units of East Africa (Gillah *et al*., 2012).

5.1.7. Water resources and frequency of watering

Main source of water in urban production system in the site is tap water for 76.7% of dairy farmswhich is comparable to the report of Azage *et al.*(2013) who reported the majority (71.8%) of the urban dairy farming system (Hawassa, Shashemene, Yirgalem, Dilla), southern Ethiopia rely on tap water (Azage *et al.,* 2013). However, in periurban production system, the source of water for cattle is river (33.3%) which is lower than the report shown river (46%) in the periurban dairy system of Shashemene–Dilla milkshed (Azage *et al.,* 2013).Regarding frequency of watering, most of dairy farmers water their cattle twice a day in this studyis agreed Lemma *et al*., (2005) who reported that almost all the respondents watered their cattle twice in a day. Actuallyfor watering frequency of dairy cattle isdepends on access to water sources, the age structure of the herd, physiological stage of animals and season(Azage *et al.,* 2013).

5.1.8. Nutrition relateddairy cowsdiseases

Emaciation or poor body condition was major health problem in the site crossbred dairy cows, which might be associated with negative energy balance during lactations.Bloating wasalso reported as major health problem around Holetta which might be caused by abrupt change in feeding roughage to concentrate supplementation for milk production.Majority of the farmowner'sundertaken vaccination, deworming and spraying in this study site was consistent withMekonnen *et al*. (2010) who reportedapplication of acaricide, deworming, vaccination, had wide application in “Dejen District”.

5.2. Feeds and Feeding of Crossbred Dairy Cows

5.2.1. Feed resources

In the study site production systems the major basal feed sources for animals were grass hay, straws and grazing. Generally, straws from wheat, barley, teff and pulse were used as basal diets. Natural pasture (grazing/hay) and crop residues are the major feed resources used as a basal diet for dairy production in rural and periurban dairy systems (Azage et al., 2013). Most of the respondents commonly feed their animals hay and flour and oil industry byproducts such as wheat bran, wheat middling and noug seed cake mixtures. Livestock feed resources in Ethiopia are mainly natural grazing lands and browses, crop residues, pasture, forage crop and agro-industrial by-products as reported by Alemayehu(2005), Sintayehu*et al*. (2008) in Shashemene area,and Yisehak*et al.* (2013) in Jimma Zone.

5.2.2. Concentratefeed ingredients

Dairy farmers in this study siteare commonly used wheat bran and noug seed cake in their concentrate mix for their crossbred dairy cows. This is consistent with the report ofYoseph *et al.* (2000) who observed that noug cake and wheat bran blend are invariably in Addis Ababa milkshed. Some dairy producers use wheat middling, maize, linseed cakes and bean hulls in the concentrate mixture. Noug seed cake was the sole protein source in the concentrate mixturewhich is consistent to the report of Diriba *et al*., (2014) who indicatednoug cake is the major concentrateingredient used as protein supplement in Bako and Nekemite, western Ethiopia.

Dairy farmerspracticed concentrate feed mixing at home in this studyis consistent with report of Yoseph *et al.* (2000) home-mixed concentrates were blended from flourmill byproducts and oilseed cakes dominates the urban and periurban system of Addis Ababa milk shed. Farmers use feed ingredients proportions in the concentrate mixture by their own estimation. This implies somewhat the extension services in ration formulation and feeding system of crossbred cows is weak.

5.2.3. Chemical composition of concentrate mixture

The present studyoverall mean CP value(216.58±20.86 g/kg DM)was considerably higher than the values 150g/kg DMof concentrate mixture recommended byDelgado and Randel (1989) for cowsgrazing tropical grass swards. In this study the mean CP contentwas lower than the report of Rehrahie*et al*. (2003) who found concentrate mixes purchased as a mix (236.8 g/kg DM) at Holetta Agricultural Research Center, Mesfin *et al*. (2009, 2013) central Ethiopia (243g/kg DM) and Tekeba *et al* at Andassa Agricultural Research center (225g/kg DM). The mean CP content was comparable with research conducted by Nega *et al*. (2006) in the urban and periurban centers of Central Rift Valley, Ethiopia and who found 213 g/kg DM of CPin the farmers' home-mixed concentrate for lactating crossbred dairy cows. However, the mean CP content in this studywas lower than Mesfin *et al*. (2013) who investigated 260 g/kg DM of CP fromfarmers' home-mixed concentrate for lactating crossbred dairy cows in periurban dairy production system of central Ethiopia.The mean CP content home-mixed concentrates increased in the study area from urban to periurban farms. These indicate the farmers home-mixed concentrate mixture for lactating crossbred cows is considerably variable and unbalanced for the CP contents;the ingredients were blended in the concentrate mixture without any standards.

The mean MEcontent 10.99±0.59 MJ/kg DMin the sitewas lower than the report of Rehrahie*et al*. (2003); Mesfin *et al*. (2013); Tekeba *et al*., (2013) who shown closer to 12 MJ/kg DM of ME. The present resultwas comparable to and 10.6 MJ/kg DM of ME content of the finding of Nega *et al*. (2006) and 10.8 MJ/kg DM of ME with finding of Mesfin *et al*. (2013) in farmers' home-mixed concentrate to dairy cows of Central Rift Valley and central Ethiopia, respectively. The smallest ME content obtained in periurban medium farm size of in this study might be due to small proportions of energy source feed ingredients were blended in the concentrate mixtures and with no standards.

The overall mean Ca concentrations of the concentrate mixtures 4.55±1.23g/kg of DM washigher than the mean figure findings of Nega *et al*. (2006) 3.4 g/kg DM of Cahome-mixed concentrate to lactating crossbred dairy cows. The low concentrations (3.77±0.32 g/kg of DM of Ca) found in urban medium farm sizes in this study might be due to low proportions of oil seed cakes which relatively contains higher Ca than flour mill byproducts (Adugna, 2008).This shows farmers did not use any Ca source in their home-mixed concentrates. The overall mean P concentrations of the concentrate mixtures10.16±1.16g/kg DM Pwas slightly comparable the mean figure finding of Nega *et al*. (2006) 12 g/kgDM of P.

Differences foundthe mean nutrientcontent in the concentrate mixtures across the production subsystem, might be attributed to the variation in the level ingredients proportions and types used for mixing.Besides farmers have no any standards to blend ingredients in the mixtures. This is consistent with Mesfin *et al*.(2013) who concluded that the quantities of individual feed ingredients included in the concentrate mixtures was seemed to depend on their relative availability rather than on the farmers' conscious desire to supply better quality and balanced concentrate mixture to their cows. This implies somewhat weak intervention for improving the rations through extension services.

5.2.4. Concentrate feeding practices and levels

Concentrate mixturesfeedingto lactating crossbred dairy cows farmers followed individual feeding practices in this study site. This is in line with supplementation of dairy animals depends on the level of production in the case of urban and periurban system (Azage et al., 2013). Ahmed *et al*. (2010) reported that those farmers around the periurban areas utilize by-products of grain for lactating crossbred cows. Supplementation of dairy animals depends on the level of production in the case of urban and periurban system is mainly given to lactating cows only (Azage *et al*., 2013).

Concentrate mixtures supplementations per day were higher for urban (5.49 kg/ cow/day) than periurban production (4.26 kg/cow/day). Thesequantities were lower than the recommended 6 kg/cow/day to lactating crossbred dairy cows (Tadesse *et al.*, 1991). The concentrate mixture feeding to lactating crossbred dairy cows based on milk yield in this studywasbelow the recommended 0.5 kg/kg of milk (Mohammed, 1991; SDDP, 1999 andPandey and Voskuil 2011).

5.2.5. Nutrient supplyfor milk yield

5.2.5.1. protein

The mean CP supply 93.06 g/kg of milk supplywhich is equivalent to 949 g for the average daily milk yield produced in this study which is 10.20 kg of milk per day. Thus the supply of CP per day through concentrate mixture regardless of CP supply from the basal feed in this studysite was considerably higherthan the recommended 860 g/day for a standard cow 500 kg weight and 40 g butterfat producing 10 kg of milk per day (ARC, 1994). A dairy cow producing 10.95 kg milk per day required 928.5 g/day of CP(ARC, 1990 as cited by Getu *et al.,* 2013a).This implies that the protein supply through the concentrate mixture could be fulfilled and even over the cow's protein requirement regardless of the basal diet. Overfeeding CP reduces profit margins because of the relatively high cost of proteinsupplements and the poor efficiency of N use bydairy cows fed high protein diets (Broderick, 2003).Feeding diets containing large amount of CP is often associated with increase days open which is attributed to increase in tissue urea and ammonia concentrations leading to impaired reproductive physiology and modified endocrine function or exacerbated postpartum negative energy balance (Shangfield *et al.,* 1999). Any protein not required by the cow is excreted in the urine as urinary urea, a consequence of urea nitrogen recycling and the removal by the kidney of any urea not recognized by the animal as necessary for rumen function (Lock and Van Amburgh, 2012).High dietary protein levels are positively associated with the degradation of protein in the rumen (increased ammonia concentrations) and have been shown to decrease the efficiency of nitrogen utilization for milk production (Broderick, 2003; Hristov *et al.*, 2004; Law *et al.*, 2009). Increasing dietary protein concentration above the requirement reduced the daily and cumulative energy balance(Law *et al.*, 2009).Due to detrimental effects of excess protein feeding on re-establishment of ovarian cycles postpartum, as well as adverse alterations in theoviductal and uterine environment of the developing embryo, it is recommended that lactating dairy cows should not be fed in excess of their needs for maintenance, growth and lactation (Thatcher*et al.,* 2008)

5.2.5.2. Energy

The overall estimated ME supply was 4.73 MJ per kg of milk provided was lower than the recommended 5.1 MJ per kg of milk (SDDP, 1999; Moran, 2005). The difference observed in this study site production subsystem in ME supply per kg of milk through concentrate mixture might be the supplementation level was below the recommended (0.5 kg/kg of milk and 6 kg/cow/day).This might be lead tonegative energy balance and loss of body conditions resulting low milk yield and long calving interval and day open as reported in this study.As reviewed and concluded by Rossi *et al.* (2008), negative energy balance is the major nutritional factor decreasing reproductive efficiency, that induces a delay in first ovulationafter calving (or a low oocytes quality), an increase in embryo mortality incidenceand an increased incidence of uterine diseases with interval from calving toconception that increases over 120-130 days, reduction on conception rate.

5.2.5.3. Calcium and phosphorous

Calcium(Ca supply) g/kg of milk yield 1.95 g through concentrate mixture was lower than the recommended 2.6 g/kg of milk (Brännäng and Persson**,** 1990). For 10 kg milk /day and 40 g butterfat per kg of producing 500 kgweight standard cow requires 30 g Ca per day (ARC, 1994).However, 10.2 kg milk producing cow per day in this study was supplied closer to 20 g per day through concentrate mixtures. Phosphorus (P) supply per g/kg milk yield attributed to relatively low proportion of wheat bran incorporated in periurban farms particularly in medium farm size. Wheat bran is high in P concentration (Adugna, 2007).Phosphorus supply per g/kg milk 4.36 is higher than the recommended

1.8 and 1.65 g/kg of milk (Brännäng and Persson**,** 1990; ARC, 1994), respectively. This implies a 10.2 kg milk producing cow in this study might be supplied 44 g per day which is higher than the recommended 28 g/day for cows producing 10 kg/day (ARC, 1994).

Regarding, the Ca: P ratios were low in the concentrate mixture supplement per day which is 20:44 (0.45:1). For instance,if the basal diet is native hay which contain 2.4 g Ca and 0.1 g p per kg of DM (Adugna, 2007) and a cow may eat 7.5 kg DM of native hay per day will get 18 g Ca and 0.75 g p. Thus, Ca: P ratiowill be closer to 38:45(0.84:1)which is out of the recommended range from 1:1 to 2:1(ARC, 1994). The majority of the dairy farmers in this study were used agro-industrial byproducts for their home-mixed concentrates to feed lactating dairy cows.The agro-industrial byproducts, hays or crop residues are low in calcium. On the other hand, the agro-industrial byproducts contain more phosphorus than calcium (Adugna, 2008). This implies cows might lead to calcium-deficiency. Feeding a calcium-deficient diet may delay uterine involution. High phosphorus intakes along with low calcium intakes also depress fertility (Funston, 2007).

5.3. Productive and Reproductive Performance of Crossbred Dairy Cows

5.3.1. Average daily milk yield

The estimated mean daily milk yield10.20±2.63 kg/cow/day of this study iscomparableto the finding from Hawassa City, 10.32±1.5 kg/cow/day (Haile *et al*., 2012) and Dar es Salaam, Tanzania 10.4±0.7 kg/cow/day (Gillah *et al*., 2013). Higher mean daily milk yieldobtained in this study as compared to Zewdei*et al*., (2011) 6.1, 7.1 and 9.7 kg/day/cow in periurban areas of Debre-berhan, Jimma and Sebeta area respectively, Belay *et al*. (2012b) 8.52 kg/cow/dayin Jimmatown and Fikrineh *et al*., (2012) 8.9 liters inmid rift valley. However, it is lower than the report of Nigusu and Yoseph (2014) 14.1kg /day/cow in urban and secondary town dairy production systems in Adama milkshed. Lowermean daily milk yieldin this study as compared to the Adama milkshed in particular the difference could be attributed to differences in management conditions and the level of exotic gene inheritance in the crossbred animals and/or the availability and level of energy in the ration.In urban, the estimated mean daily milk yield (11.12±0.48 kg/cow/day) higher than the periurban system (9.28 ±0.48 kg/cow/day) is comparable to Azage *et al*. (2013) who reported the mean daily milk yield for crossbred dairy cows in urban (10.21-15.9 kg/cow/day) and periurban (9.5kg/cow/day) systems.

The smallest mean daily milk yield (8.48±0.68 kg/cow/day) obtained from periurban small farm sizescategory in this study. This difference could be attributed to small amountenergy supply throughconcentrate intake (3.74±0.39 kg/cow/day)as compared to therest farms. The energy supply per kg of milk yield (4.43MJ) was very low as compared to the recommended (5.1MJ).In urban farms, cows were feed an average of 5.49 kg home-mixed concentrates, 0.49 kg per kg of milk and 4.99 MJ/ kg of milk yield had shown better mean daily milk yield 11.12 kg of milk. This implies mean daily milk yield is a function of concentrate feeding level and its energy content.

5.3.2. Calving interval

The overall estimated mean calving interval in this study about 14.83±1.52 months (445 days) wascomparable to (Kiwuwa *et al*. (1983); Enyew *et al.* (2000); Obese *et al*. (2013); Niraj *et al*., (2014)reported about 459 days for crossbred cattle in Arsi region Ethiopia, 463.1 days for crossbred dairy cattle with different level of European inheritance in Ethiopia, 441.6 days (14.7 months) of the Friesian x Sanga cows from the Accra plains of Ghana and 428.11 days in Gondar. Shorter calving interval (Hunduma (2012); Nigusu and Yoseph (2014)) reported,372.8 days in Asella town, 13.6 months in Adama milk shed, respectively than the present work. However, longercalving interval Zewdei*et al*., (2011) 477, 463.5 and 474days in periurban areas of Debre-berhan, Jimma and Sebeta, respectively and Belay *et al*. (2012b) 21.3 months in Jimma town as compared to the current finding. A long calving interval implies that farmer's income suffers because cows spend a greater portion of their lactation at low production levels (Swai *et al.,* 2007)**.**

The marked increment in length of mean calving intervalform urban (14.27 months) to periurban (15.40 months) in present workis in line withreport of Gebrekidan *et al.* (2012a) who found the similar trend on the average figure of calving interval ofcrossbred cows, increased from 1.31 years (15.94 months)in urban to 1.62 years(19.71 months) in periurban from Central Zone of Tigray. Similar trend and comparable figure to the current study arereported fromGondar,420.22 days (14 months)in urban and 458.77 days (15.29 months) in periurban(Niraj *et al*., 2014). If at all possible, calving interval should be in the range of 12 to 13 months for cattle (Kiwuwa *et al*., 1983) in order to maximize reproductive efficiency and profitability in a dairy herd. The average value 15.47±0.39 months of calving interval in the periurban small farm size observed in this study was prolonged as compared to the 12 to13 months period considered acceptable for crossbred dairy cows (Kiwuwa *et al*., 1983). The longer calving interval in this study particularly the periurban area could be due to poor feeding practices. Thus, poor feeding practices, adversely, affected the synthesis and secretion of hormones responsible for ovarian follicular development and function leading to extended calving intervals in these cows (Thatcher*et al*., 2008).

5.3.3. Days open

The overall mean days open 163.83±36.90 days obtained in this study was lower than the average 200 days reported for crossbred dairy cattle with different level of European inheritance in Ethiopia (Enyew *et al*.,2000). Similar long day open wasreported by Zewdei *et al*., (2011) 197 and 194days from Debre-berhan and Sebeta, respectively as compared to the present figure.The average days openvalue in this study was slightly comparableto the report of Lemma and Kebede (2011) 176.8days from Addis Ababa and 171.18days ofAlphonsus*et al*. (2014) from Nigeria. Differences in length of days open between the production systems existed which was increased from urban (151.60±7.10 days) to periurban (176.06±7.10 days) dairy farms. This study days open figure (151.60±7.10 days) for urban is agreed to the report 5.19 months from Jimma (Belay *et al*., 2012b). The present valueof daysopen was longer than the reported value of Hunduma (2012) 85.6 daysfrom Asella town and Niraj *et al*. (2014) 93.11 days in Gondar town.The longest days open indicated in periurban medium farm sized category in current values attributed to inadequate nutrition particularly energy supply through the concentrates.The major nutritional factor decreasing reproductive efficiency of high yielding dairy cows resulted by negative energy balance that induces a delay in first ovulation after calving (or a low oocytes quality) and increase in embryo mortality incidence with interval from calving to conception that increases over 120-130 days (Rossi *et al*., 2008). The reproductive performance of cattle, particularly the probability of conception, may be negatively associated with the magnitude and duration of negative energy balance in early lactation (Walsh *et al*., 2011).

5.4. Feeds and Milk Marketing

5.4.1. Feed marketing

To overcome feed scarcity from own production, dairy producers in different dairy farming systems purchase feeds from outside in both the urban and periurban areas of Holetta town. According to Azage *et al*. (2013) report, among the roughages, grass hay and crop residues of wheat, barley, teff and pulse straw are marketed in small quantities in different dairy production systems in Ethiopia. Consistently in Holetta also major roughages were marketed include grass hay, crop residues as basal feed source.Agro-industrials are the main supplementary feed source commonly found in the feed retailer shops. Feed marketing is common around Holetta areas where dairy farmers have limited or no access to land for feed production. Thus, purchased feed is the major source of feed in the site dairy production.

5.4.2. Milk marketing and processing

More than 76% of the respondents were agreed that they get market to their fluid milk at the price of Birr 8.5/kg.These producers were organized in cooperativeand supply their milk to their cooperatives. Thus, the role of intermediaries to deliver the product to the end users is minimal in this market chain (Zekarias *et al.,* 2012). About 93% of dairy f warms are not processing fluid milk into products which is in line with urbanization's negative effect on butter sales could be related to a positive impact of this variable on sales ofliquid milk and hence indirectlyreducing sales of processed products(Staal *et al*., 2008). Raw fluid milk was the most marketable dairy product in Holetta which is consistent to Staal *et al*.(2008) that liquid milk sales would be higher where higher population densities reduce transport and transaction costs and facilitate development of local markets.As the survey indicated in this study, most of the producers were selling the fluid milk to formal milk collectors (cooperatives and/or unions). These dairy production and marketing unions/cooperatives collect fresh milk from their members in the area and resell it to processors, cafeterias, hotels, or final consumers. The development of market infrastructure and market institution is very important for inducing efficiency and incentives for market participants on the value chain (Azage *et al*., 2010). However, over 24% of respondents produced fluid milk was selling to large and small scale private milk processors prevail in Addis Ababa and Holetta. Milk processing in Holetta by producers is not common and hence raw milk was the main output from dairy cattle and sold directly to collectors for processing, hotels, cafeterias and directly to consumers.*Ergo*, butter, cottage cheese *(Aybe)* and milk (in its natural form or with coffee) are available in small coffee and tea houses and catering places. This is consistent with the report of Azage *et al.* (2013) who indicated major dairy products commonly marketed are fresh milk, butter, ergo (fermented whole milk), cottage cheese (*ayib*), and buttermilk.

5.4.3. Economic viability concentratesmixtures

The economic viability based on calculations of the total cost of supplemental concentrate feed only and assuming the basal diet met the maintenance requirement of crossbred cows.The highest priceBirr 3.74 per kg found in periurbanmedium farm size might be attributed to the use of relatively higher proportions of oil seed cakes in concentrate mixtures of the respective farm sizes. On average urban farms earned a net return higher than periurban farms per cow/day is might be attributed to better energy supply through the concentrate mixture to produce 1 kg milk. Concentrate mixture supplements in perurban small farm size category in this study seemed the most cost effective since it has a favorably higher milk price to concentrate price ratio.Greater than 3 is the minimum acceptable economic viability (Staal and shapiro, 1996). All the farmswhich had got greater than 5milk prices to concentrate price ratio can be said a relatively optimum feeding approach.As shown in this study result about 90% of the farms were faced emaciation or loss of body conditions and imbalancesin nutrient supply per kg of milk produced. Farmers tried to reduce the cost of milk production and appeared profitable with failed in a manner to furnish the cow with nutrients in a balanced proportion and they provide concentrate below the recommended concentrate level per kg of milk yield and per day.

6. CONCLUSIONS AND RECOMMENDATIONS

In this study an attempt was been made to evaluate the efficiency of feed formulation and feeding practices of home-mixed concentrates in terms nutrient supply to crossbred dairy cows. The amount of crude protein and phosphorous consumed through concentrates were above the requirement for the observed milk output while the amounts of metabolizable energy and calcium consumed were below the requirement.Negative energy and calcium balances can be concluded checking the amount of metabolizable energy and calcium suppliesagainst the required per kilogram of milk yield.Concentrate feeding level is the most important factor, particularly energy and calcium supplies,that determine the productive and reproductive performances of dairy cattle seriously affecting the fertility and breeding efficiency of cows. Hence, in this study, negative energy balance is the major nutritional factor decreasing productive and reproductive performance of crossbred dairy cows that induces low milk yield, long calving interval and delay days open particularly in periurban dairy farms.

From the present study, it is concluded that big variation in nutrient supply and imbalances in the home-mixed concentrates resulting in an apparently variation in economic viabilities across the production subsystems

On the basis of the findings, the following recommendations are forwarded to achieve the production and feeding efficiency of dairy sector in the study area.

- There is a need to encourageprivate investors to be involved in commercial feed manufacturingto supplybalanced rationswith fair price targeting to meet the minimum quality requirements and aimed to correct the imbalances of nutrients for a particular class and grade of livestock.

- Female headed dairy farms are emerging in the urban,provision of strong extension services with targetingwomen and training them in basic principles of feed collection, storing, strategic least-cost ration balancing, and feeding systemis crucialand could increase adoption rate of technologies.

- Dairy producers mix feed ingredients with their own estimation however, in order to make crossbred dairy cowsto produce up to their maximum genetic potentials much emphasisshould be given with respect to balancing the nutrient supply with the nutrient required of the animal’s and cost of feed stuffs, special attentionshould be given to the limiting nutrients in major feed stuffs.

- Detailed further studies callon nutrients and concentrate feedinglevel to improve the productive and reproductive efficiency and economic viability of crossbred cows through nutritional manipulation.

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APPENDICES

Appendix I. Questionnaire Used in the Study

Enumerator……………………………………

A) Personal Information of the Respondent

1. Name…………………………………….
2. Address
   1) Urban
   2) Periurban
3. Sex
   1) Male
   2) Female
4. Age of the respondent…………years
5. Family size………………..persons Male……….Female…………

B) General Farm Characteristics

6. Off-dairy farm activities
   1) Civil servant
   2) Petty business
   3) Any others specify…………….
7. Education of the farm owner
   1) Illiterate
   2) Elementary (1-6 grade)
   3) Secondary(1-12)
   4) Above secondary
8. Who is the labor of the farm?
   1) Family
   2) Hired
9. Cattle and cows ownership

a. Number of crossbred cows………………
b. Total number of cattle……………………

10. Do you have experience in growing improved forage species to feed your animals?
    1) Yes
    2) No

11. If yes, please specify the type of forage crops you grow and area allocated to it

Type of forage crops grown	Area allocated
1.	
2.	
3.	
4.	

12. If no, please specify your reason not growing improved forage-
    1) Lack of awareness
    2) Limited access
    3) High price
    4) Any other specify………………
13. Do you have private grazing land?
    1) Yes
    2) No
14. If yes, specify the area of your grazing land………………hectare(s)
15. What is the sources of water for the animal
    1) River
    2) Well
    3) Tap water
16. Any other specify…………………………
17. How many times do you water the dairy cattle per day
    1) Once
    2) Twice
    3) Adlib

18. Common dairy cows nutrition related diseases:
    1) Emaciation
    2) Milk fever
    3) Bloat
19. Do you vaccinate your animal?
    1) Yes
    2) No
20. If your answer for Q No. 19 is yes, how often and against which disease?
    1) FMD
    2) CBPP
    3) Anthrax
    4) Black leg
    5) Pasteurellosis
    6) Others specify…………………………………………..
21. Do you deworm your animal?
    1) Yes
    2) No
22. How many times do you deworm your animal per year? ……………
23. Do you spray your animal?
    1) Yes
    2) No
24. How many times you spray your animal per year? ……………
25. What type of housing do you use?
    1) Traditional barn (free stall)
    2) Modern barn with individual cattle pen
    3) Modern barn without individual cattle pen
    4) Open barn (only fence)
26. Type of floor?
    1) Ground
    2) Concrete
    3) Others specify…………………………….

27. Ventilation in building:
    1) Excellent
    2) Satisfactory
    3) Poor
28. Type of roof
    1) Rain proof
    2) Not rain proof
29. Do you have maternity (Calving) pen:
    1) Yes
    2) No
30. The type of drainage system used is:
    1) Excellent
    2) Satisfactory
    3) Poor
31. The general farm hygiene practiced in the farm is:
    1) Excellent
    2) Satisfactory
    3) Poor (Washing animals, frequency of cleaning the barn …etc.

C) Feeds and Feeding Practices

32. What are available feed ingredients and their current price?

Herd available feed ingredient	Current price/kg
1)	
2)	
3)	
4)	
Total	

33. How much proportion do you add from each ingredient in a concentrate mixture?

Herd available feed ingredient	Proportions
1)	
2)	
3)	
4)	
5)	

34. Do you ever mix feed ingredients for different classes of dairy cattle (cow, heifers, and calves)?
    1) Yes
    2) No
35. What is your basis of formulation diet?
    1) Cow's milk productivity
    2) Nutritive value of available feed ingredients
    3) Price of ingredients
    4) Availability of feed ingredients on market
    5) palatability
    6) Any others specify …………………………
36. Where do you obtain the information to mix feed ingredients
    1) Woreda Agriculture Extension Services
    2) Agricultural Research Center
    3) Own estimation
    4) Any others specify…………………………
37. Have you ever purchase and feed commercialmanufactured concentrate mixtures?
    1) Yes
    2) No
38. If you don't purchase commercial formulated feed, what is your reason to be hindered to purchase
    1) High price
    2) Low milk production

3) Unavailability on the nearby market
4) Lack of information

39. What is the basal diet for your cows?
    1) Grass hay
    2) Straw
    3) Grazing
    4) Any other specify…………………………
40. If your answer is straw, specify the types…………………
41. Do you feed your dairy herd and non-dairy herd separately?
    1) Yes
    2) No
42. Is there any separate feeding practices based on milk yield
    1) Yes
    2) No
43. If yes, please specify the amount……………………………

D) Milk Production and Reproduction Performances

44. Average milk yield per cow per day (liter),

Average Daily milk yield kg/cow/day (kilogram)
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
Aérage per cow/day

45. Average calving interval (in months)…………………………

46. Average time calving to conception (Days open) in months…

E) Milk and milk product marketing

47. What are the major milk marketing places or collectors? ……

48. What is the current price of milk per kilogram? …………………

49. Do you ever process milk?

    1) Yes

    2) No

50. If yes what are the major milk products that you often sell market place and current price?

Type of milk product	Market place or collector	Current price/Kg
1)		
2)		
3)		