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The Contribution of Livestock in Meeting Food Production and Nutrition in Ethiopia

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Abstract
Good health depends on good nutrition. Good nutrition, in turn, depends on agriculture to provide the foods. Most livestock in developing countries, especially ruminants, convert human-non-edible feeds, including crop residues, household wastes and forage, into high value meat, milk, and eggs. In large parts of the developing world urbanization, population and income growth are leading to increasing overall food consumption and changes in dietary composition, particularly food of livestock origin with considerable implications for food production, processing and retail systems. Among others, there is lack of interdisciplinary approach and knowledge/skill on food system and productivity. The aim of this paper; therefore, was to synthesize knowledge on sustainable livestock derived food production and utilization through case study approach including document analysis and interviews. In addition, it also serves as a spring-board for research/intervention to define areas of attention that enhance the role livestock in food production and nutrition. Interviews and extensive current literatures on livestock and food/nutrition situation in Ethiopian scenario were made and it also captured experiences of collaboration across disciplines elsewhere and finally highlights future prospects. All of the respondents reported consuming livestock products with 34.7% consume greater than four types of products (meat, milk, eggs, butter, etc.) and 32.7% consume once a day. 71.4% reported that there is supply problem and the main reasons they claimed include lack of urban agriculture and unscientific husbandry practices. Among the strategies to enhance livestock role in food system challenges/ security and nutritional benefits, it is essential that livestock/crop agriculture, and nutrition sciences and their related research/intervention activities need to work together in an integrated manner. Narrowing the nutrition gap also requires "nutrition-sensitive" food and agriculture systems that explicitly incorporate nutrition objectives. A growing market demand has significant opportunity for improving productivity even though there are challenges in the increasing urbanization and limited livestock support services.
Keywords: Livestock-origin food; Human nutrition; Interdisciplinary approach; Ethiopia

1. Introduction

Food production and availability is a function of the natural resource base, production technology and production policy. Agriculture plays an essential role in every culture throughout the world. Everyone has to eat. The global food systems are complex but they rely on agriculture, i.e. the production of crops and animals from the land, and aquaculture and fisheries. In quantitative terms, agriculture is hugely dominant in food supply. It provides some 90% of human calorie intake (Makkar and Beever, 2013). While much of the world is still stuck in subsistence agriculture, barely eking out a living and able to feed their families; another sizeable proportion of humanity is enjoying the fruits of modernity. Our modern world is engaged in global commerce with nearly ubiquitous, instant communications. We are awash in information, but most know very little about what is in their food or how it is produced. Establishing an organized system to share information about agriculture can be a matter of life and death (Joseph, 2007). In addition, the main objective of agricultural research is generating technologies to ensure food security, enhance income generation, and promote foreign exchange earnings through sustainable natural resources management (Ethiopian Academy of sciences, 2013).

Our population trajectory means that from now to 2030, the world will need to build the equivalent of a city of one million people in developing countries, every five days! There is widespread consensus that, going forward, farmers must produce more food per unit of land, water, and agrochemicals. To do so, however, they simply cannot continue producing in the same way. They will have to do this while facing climate change, volatility, shifting nutrition needs, and the increasing scarcity of most of the physical factors of production. Agriculture is at the threshold of a necessary paradigm shift (Daniele et al.,2012).

Global health depends on good nutrition. Good nutrition, in turn, depends on agriculture to provide the foods (FAO, 2012). Further, improved nutrition has a potential impact on GDP through improvement of productivity and indirectly through prolonged life expectancy (Speedy, 2003). Individuals must consume sufficient amounts of not only calories, but also protein, fats, vitamins, and minerals to support growth and development throughout their life cycle. Although tremendous progress has been made in meeting the world's food demand, many parts of the developing world continue to suffer from under-nutrition—that is, deficiencies in energy, protein, and essential vitamins and minerals (Shenggen and Joanna, 2011). Livestock source foods of

a wide variety provide rich sources of complete protein, energy, and an array of micronutrients that are often limiting in the diet (Neumann et al.,2002). Since the 1960s, estimates for animal sources for low-income countries have risen from around 160 to 340 kcal/day (670 to 1400 kJ/day) (World cancer research fund, 2007).

Livestock production is of major socio-economic importance in ACP countries while playing a key role in food security and rural development, often with a critical socio-cultural dimension (SPORE, 2014). Without livestock the millions of hectares of the grasslands in the world could not be used to cultivate crops for human consumption (FAO, 2006). Most livestock in developing countries, especially ruminants, convert human-non-edible feeds, including crop residues, household wastes and forage, into high value meat, milk, and eggs. These livestock-source foods provide high quality, readily absorbed protein and micronutrients (CAST, 1999).

Livestock production is undergoing rapid change, and this change manifests itself in the growing contribution that livestock makes to satisfying increasing global demands for high-value food products, and in continuous adjustments at the level of resource-use intensity, size of operations, product orientation and marketing channels (Steinfeld et al.,2006).

Today's food animal production systems, regardless of size or scale, are faced with many challenges to meet the demands of an ever growing human population. Today's consumers expect high-quality, safe, affordable and nutritious food. At the same time, the consumer demand for quality animal care standards and environmental compliance are constantly evolving and increasing (Campbell et al.,2003). As the future generation of food animal industry professionals, students learn how to meet these challenges through a comprehensive, science-based education (Campbell et al.,2003) and interdisciplinary approach to expand our communication across fields (Collins, J. 2002; Buller, H. 2008; Winowiecki et al.,2011;Helene et al.,2012).

In this paper, we preferred to use term 'livestock' instead of 'animal' because the former mean 'any creature kept for the production of food, wool, skins/hide, or for the purpose of its use in the farming of the land' (Dictionary of Agriculture, 1996) which are mainly vertebrates while the latter form the largest kingdom (of living organism) in terms of the numbers of species, of which 96% are invertebrates (Encyclopedia of Life sciences, 2004). Livestock is an important and integral component of the Ethiopian agricultural system and plays a significant in the provision of food, power and income generation both at the household and at national levels (Alemu and Zinash, 2002). The livestock population in Ethiopia is estimated to be 53.9 million cattle, 25.4 million sheep, 24.0 million goat, 915,518 camels, 50.4 million chickens, and 5.2 beehives (CSA, 2013).

Ethiopia's livestock, fisheries and apiculture resources have vast untapped investment opportunities, and can play pivotal role in bringing transformation in Agriculture. Ethiopia offers one of the largest domestic markets in Africa. Its proximity to the Middle Eastern Markets provides good opportunities for investments in the production of exportable livestock products (Daniel, 2014). Moreover, Ethiopia's steady economic growth and urbanization will continue to increase the demand for livestock products become a major source of protein (Delgado et al. 1999; Hall et al. 2004; Seré et al. 2008). In addition, the projection of human population in Ethiopia shows an increasing trend with alarming rate which in turn increases the demand for food especially of livestock origin (Hadera, 2002). The emerging commercially oriented livestock sector is constrained by lack of feed, improved breeds, and adequate support services such as veterinary, extension, credit, information, land, etc. (Azage et al.,2003; Asfaw et al.,2011).

In addition, livestock science and food science are fragmented in our education system. Further, professionals in agriculture, nutrition, and health speak different "languages," and efforts will be needed to overcome this barrier (IFPRI, 2012). In fact, there is also a fertile ground in Ethiopia that facilitates synergetic linkage of nutrition into agriculture. There were some efforts to design strategies to promote nutrition among sectors including the Ministries of agriculture, and that of health sector which is evidenced by the national nutrition program (2013-2015). Moreover, the sensitization on nutrition by the Ministry of health (MOH) extension workers and that of Ministry of agriculture (MOA) extension workers (rural women affair) is also a good start even though weak communications between the two ministries regardless of their clear roles and responsibilities.

In this regard, a collation of information pertaining to livestock-derived food production and consumption and its linkage with human nutrition remains limited. In addition, there have been little or no efforts exerted to study the interdisciplinary perspectives of livestock science. Among others, there is lack of interdisciplinary approach and knowledge/skill on food system and productivity to feed growing population. The aim of the paper, therefore, was to address knowledge on sustainable livestock derived food production and utilization through case study approach including interviews and document analysis. Through brief questionnaire survey of fifty people in Bishoftu town (Annex Table 4) and extensive literature search (mainly 1995-2014), it critically synthesized knowledge on livestock and food/nutrition in Ethiopian context/scenario and also captured experiences working across disciplines elsewhere and finally to highlight future prospects and interventions. It is also meant to encourage further research in the area in addition to informing policy and practice.

2. Linkages between agriculture and nutrition

How does agriculture/food interface look-like? How can agriculture ensure food and nutrition security? The fundamental purpose of agriculture is to produce food and raw materials, and to grow healthy, well-nourished people (IFPRI, 2012). Livestock is a significant source of nutrition and even non-food uses for a substantial number of people globally. It has considerable and growing importance in most cultures and in many diets (Daniele et al.,2012). One of the sector's most important tasks then is to provide food of sufficient quantity and quality to feed and nourish the world's population sustainably so that all people can lead healthy, productive lives. Achieving this goal will require closer collaboration across the sectors of agriculture, nutrition, and health, which have long operated in separate spheres with little recognition of how their actions affect each other. It is time for agriculture, nutrition, and health to join forces in pursuit of the common goal of improving human well-being (IFPRI, 2012).

The linkages between agriculture, nutrition, and health seem obvious: adequate levels and qualities of food produced and consumed promote good nutrition and robust health. The reality, however, is that patterns of food production and consumption vary widely around the world and the positive linkages between agriculture, nutrition, and health are not realized. Despite the large role that agriculture has played in the past, a number of pressing problems in the areas of agriculture, nutrition, and health are evident including poor nutrition, poverty and climate change, among others (IFPRI, 2012).

Addressing these problems will require solutions to be developed at the intersection of the agriculture, health, and nutrition sectors. Many policymakers and practitioners in the agriculture, nutrition, and health sectors continue to work in isolation despite the potentially strong synergies among initiatives to improve nutrition and health through agriculture. Faster progress must be made in the drive for adequate food, good nutrition, good health, and sustainable agricultural growth, but the three sectors must work together to minimize the negative links among them and maximize the positive synergies (IFPRI, 2012).

The report by the Ethiopian Academy of sciences (2013) further underlined that to attain the highest possible food security and nutritional benefits for the people of Ethiopia, it is essential that agriculture, nutrition, and health sciences and their related research activities work together in an integrated manner. This study also emphasizes that agriculture, nutrition, and health are mutually interdependent with evidence based conclusion that there is a fertile ground in Ethiopia that facilitates synergetic linkage of nutrition into agriculture and health.

However, a number of weaknesses which do hamper progress were also noted by Ethiopian Academy of sciences (2013). Key amongst these are:

• Nutrition is not well reflected in the Plan of Action for Sustainable Development to Eradicate Poverty (PASDEP), Growth and Transformation Plan (GTP) and Agriculture development-led Industrialization (ADLI);
• There is lack of functional and accountable multi-sectoral coordination;
• There is limited agro-industrial and private sector participation in addressing malnutrition.

The specific objective of the GTP that is relevant to nutrition refers to expanding and ensuring quality of education and health services, and achieving the MDGs. It clearly sets out to ensure the implementation of the nutrition strategy with a target to reduce the prevalence rate of stunting to 37 percent by 2015. The fact that the Plan advocates for a pro poor economic growth and gives due emphasis to social protection contributes to improved nutrition. However, it doesn't specify how nutrition is to be addressed in the agriculture and other sectors though the National Nutrition Strategy /NNS/ (Program) recognizes the importance of establishing a multi-sectoral coordination mechanism and a comprehensive monitoring and evaluation system. NNS has also opened an opportunity for a policy and programatic dialogue to integrate nutrition into different sectors, including agriculture (Ethiopian Academy of sciences, 2013Among the five strategic objectives and initiatives of national nutrition program, strategic objective four focuses on strengthen implementation of nutrition sensitive interventions across sectors, the first result being in the agriculture sector. In this regard, the initiatives include promoting urban and school gardening; improve access to and utilization of animal source foods (FDRE, 2013)
In a country where high prevalence of malnutrition is associated with high incidence of poverty, agriculture is probably the only viable sector to deal with the twin challenges of malnutrition and poverty. Nutrition should be integrated into agriculture using the potential entry points in the existing agriculture mandated policies, programs, researches, and pre-service (training) institutions taking into consideration their strengths and opportunities. The major agricultural and food security programs have indirect reference to nutrition in the process of attaining their objectives. The multisectoral coordination body has to make sure that new programs or projects in the agriculture sector incorporate appropriate nutrition objectives and indicators. At the initial stage, donors should allocate resources for nutrition sensitive activities of the agricultural sector. In the long run, the federal Ministry of Agriculture (MoA) should include nutrition in its sectoral plan, focusing on its mandated task of improving food quality and the 'utilization pillar' of the Food Security Program, and request for government budgetary allocation (The Ethiopian Academy of sciences, 2013).

Consumer awareness campaigns, such as nutrition literacy programs in villages, can increase poor people's knowledge of and demand for nutritious food. More consumption of nutritious foods can not only

improve health, but also open new markets for agricultural producers (IFPRI, 2012). For instance, promotional work to create awareness of the nutritional value of milk is critical to overcome some of the cultural factors affecting the consumption of dairy products in Ethiopia (Asfaw et al.,2011). In this regard, the activity of Ethiopian health extension workers at grassroots community-based health care delivery system for local residents is a good job. The program has created increased access to essential preventive and curative health services to the people at the grassroots level through the implementation of 16 health packages, including nutrition. However, the national agricultural research system's linkages with the extension system and the health system are weak at present (Ethiopian Academy of science, 2013).

Broadly speaking, reshaping agriculture for better nutrition and health will require steps in four main areas: filling knowledge gaps, ensuring that the three sectors do not work at cross-purposes, seeking out and scaling up innovations and successes, and creating an environment for cooperation (IFPRI, 2012). Improved nutrition results not only from greater volumes of food production on farms, but also from the way food commodities are handled in the post farm segments of value chains. Transport and storage improvements can reduce postharvest losses and deterioration of the nutritional quality of foods. Efficient post-farm handling can reduce costs and retail prices, thus increasing access for poor consumers (IFPRI, 2012).

FAO (2012) further noted the need to strengthen links between the agriculture, nutrition and health sectors**.** Interventions aimed at improving diets and raising levels of nutrition should combine public health, nutrition education and dietary strategies. Agriculturalists need to work with nutritionists to identify deficits in local diets and micronutrient intakes. Food-based interventions will be more effective when accompanied by community health programmes. Interventions should include a strong programme of nutrition education and behaviour change, targeted principally towards women, in order to ensure that increases in food supply and income lead to improved household nutrition.

As there is little effort to integrate agriculture and nutrition in Ethiopian universities, experiences of other countries (universities) incorporated food sciences in Agriculture department needs to be adapted as an important lesson (Table 1,Annex).

3. Nutrition trends in Ethiopia

Malnutrition usually encompasses a combination of an inadequate intake of total energy and micronutrients and to a lesser extent, protein. Moreover, the high burden of infection and parasites has a negative impact on nutritional status (UNICEF, 1998). Malnutrition not only has deleterious effects on physical growth, resistance to infection, and work capacity but also on cognitive development, school performance, and physical activity in adults and children (Layrisse et al.,1990; Scrimshaw, 1994).

Ethiopia has shown some progress in reducing malnutrition in recent years towards improved food and nutrition security over the past decade. Consistent and comparable data of DHS since 2000 have shown that malnutrition, as measured by stunting and underweight rate of prevalence, have decreased by more than 10 percentage points between 2000 and 2010. The decrease has been steady, with both falling by 1.34 percentage points per year over the 10 year period. Wasting, which measures the more immediate effect of malnutrition, seems to have fallen only slightly from around 12 percent in 2000 and 2005, to 9 percent in 2011. However, stunting of children under five years of age is above the Sub-Saharan African (SSA) average prevalence rate of 42%, but still a public health problem and an overarching development concern. Chronic malnutrition as measured by stunting and underweight, anaemia, and deficiencies of Iodine, zinc and Vitamin A indicate major nutritional problems in Ethiopia. The 2011 DHS (Anthropometric trends) data indicate that, nationally, 44 percent of children under the age of five are found to be stunted, 33 percent are underweight, and 12 percent are wasted. WHO (1979) considers stunting and underweight prevalence rate of over 40 percent and 30 percent respectively as very high and a major public health problem. This indicates that malnutrition remains a public health problem in Ethiopia (Ethiopian Academy of science, 2013).

In general, prevalence of malnutrition varies with age, gender, location (rural/urban), and regions. It is interesting to note that adequate food producing regions of the country such as Amhara and Oromia are reported to have high prevalence rate of stunting as compared to less productive regions, thus indicating that while household food security is necessary, it is not the only determining factor for ensuring nutrition security (Ethiopian Academy of science, 2013). As a result, the government, in collaboration with the donor community, is planning on starting local production and utilization of complementary food (Asfaw et al., 2011).

Under-nutrition, including inadequate levels of consumption of food of animal origin, remains a huge and persistent problem in the developing world. Dairy and other livestock products can make an important contribution to household food security and are especially important in meeting the micronutrient requirements of women and young children. Adding a small amount of animal-based foods to a plant-base diet can yield large improvements in maternal health and child development. Inadequate diets also hamper the mental and physical development of children and result in increased morbidity and mortality from infectious diseases (Gerosa and Skoet, 2012).

4. Livestock source food (LSF)

What are the links between livestock and food sciences and some misconceptions and dietary knowledge gaps on livestock-derived foods? Global food consumption patterns are undergoing change, especially in large parts of the developing world, where income growth and urbanization are leading both to increasing levels of overall food intake as well as changing composition of food consumption, with growing shares of high-value products and of food of animal origin in particular (Gerosa and Skoet, 2012).

The biggest differences between LSF and plant source foods are the density of the micronutrients and their bioavailability, and the source of high-quality and readily digestible proteins. Diets without LSF can be particularly low in vitamin A and B12, riboflavin, calcium, iron, and zinc (Murphy & Allen, 2003).

Animal products are good sources of the minerals iron, calcium and zinc. Animal products are also good sources of other vitamins, especially vitaminA, thiamin, riboflavin and niacin (Garrow et al.,2000). Energy and protein values of common livestock products in Ethiopian foods, per 100 g are mentioned at Annex Table 5.

The iron in meat and fish consists of 10 to 70% heme iron (Carpenter & Clark, 1995). The estimated content of heme iron in cooked meats is for instance 60% for beef, 40% for pork, 30% for chicken, and 25% for fish (Lombardi-Boccia et al., 2002; Purchas et al., 2003). Heme iron is highly bioavailable (15-35%) and little affected by dietary absorption inhibitors (Monsen et al., 1978). Red meat is the best source of easily absorbed iron. Meat and fish products offer considerable amount of zinc being highly bioavailable (Krebs et al., 2006a). Furthermore, the type of protein will also affect the bioavailability of zinc, with animal proteins being better enhancers than plant proteins. It is suggested that the effect is based on the amino acids keeping the zinc in solution (Lonnerdal, 2000). A good-quality plant protein such as that of the soya bean has a lysine/protein ratio of 6.4, but animal proteins in milk and beef have even more favourable ratios of 8.2 and 9.1, respectively (Garrow et al.,2000).

Vitamin B12 is naturally found in meat (especially liver and shellfish), milk and eggs. Animals, in turn, must obtain the vitamin from bacterias producing it. As animal products are the only source of this vitamin, population groups who do not consume LSF are at risk of developing a corresponding deficiency (Villamor et al., 2008). It has been shown that the presence of vitamin B12 in the maternal plasma of lactating women and its intake from complementary foods are strongly and positively associated with its concentration in the infant's plasma (Jones et al., 2007). Observational studies provide evidence that vitamin B12 deficiency is linked to poorer cognitive performance and delayed motor and language development (Black, 2003).

Vitamin A is found in the form of retinol in high amounts in liver, and in considerable amounts in milk and egg yolk. In contrast, muscle tissue is a poor source of retinol. Pre-formed retinol is better absorbed and used more efficiently from LSF than the provitamin A carotenoids from plant source foods (Stephensen, 2001).

Some characteristics of food products from different livestock species

Meats

The significantly high micronutrients (zinc, iron, protein, and vitamin B12, and the essential amino acids) are important for physical growth, cognitive function and performance. These micronutrients also prevent such health problems as anemia (iron and Vitamin B12 deficiencies) and immune function diseases, which can result in or be intensified by iron, zinc, and Vitamin B12 deficiencies in addition to Protein-Energy Malnutrition (Neumann et al., 2002). . In Ethiopia, the protein and fat contents of Chevon and mutton are 20% protein and 5.3% fat and 19% protein and 6.4% respectively from the samples collected from market (Tsegaye, 2012).

Long-chain omega-3 fatty acids have an essential role in brain development in newborns and are vital to the healthy by maintenance and function of the body. They also can help maintain long-term good health by reducing the risk of a number of diseases such as heart diseases, cancer, autoimmune disease, inflammatory diseases, and depression (Whetsell et al.,2003).

The association between animal fats and cardiovascular disease had been studied and recommendations range from excluding fats altogether, to a moderate consumption of fats due to their essential role in the body, and recently the emphasis has shifted away from fat quantity to fat quality (Laaksonen et al.,2005; Ohlund et al.,2007). Blood cholesterol level ranks only about fourth or fifth in the risk factors for coronary heart disease. Smoking, excessive bodyweight, lack of exercise, hypertension and stress are other important factors. Dietary factors may account for only 25 percent of all causes of elevated blood cholesterol (Narahari, 2003).

Monounsaturated and polyunsaturated fatty acids are more important compared to total fat ingestion in terms of reducing the risk of cardiovascular heart disease in middle aged men (Webb and O'Neill, 2008; Laaksonen et al.,2005). According to Williams (2000), the very long chain omega 3 fatty acids (eicosapentaenoic acid and docosahexaenic acid) have beneficial cardiovascular and anti-inflammatory properties.). As they cannot be synthesized in the body, the omega-3 and omega-6 fatty acids are required in the diets of humans as well as other mono-gastric mammals (Whetsel et al., 2003). These fatty acids function as carriers of the fat-soluble vitamins (vitamin A,D,E, and E) and play a crucial role in the immune response of both man and animal (Webb and O'Neill, 2008). The meat and milk of grazing animals has been reported to contain significantly more

omega-3 fatty acids (Dhiman, 1999).

The place of animal fats – and particularly the fats of ruminants – in the diet of man has been given a new dimension by the discovery that one particular fatty acid, known popularly as conjugated linoleic acid (CLA) or more precisely as *cis*-9, *trans*-11 octadecadienoic acid, has a beneficial role in the body. This acid has been shown to be antiatherogenic and anticarcinogenic, and also to limit obesity and stimulate immune function (Garrow eta al.,2000; Rainer and Heiss, 2004). CLA reduces the risk for cancer, atherosclerosis and diabetes (Daley et al.,2010). Because plants do not synthesize CLA, ruminant fats in milk or meat are the primary dietary CLA sources for humans (Herbein et al.,2000).

Reducing the fat content in meat may adversely affect the eating satisfaction. The degree of saturation of fat is one of the most important characteristics that influence the quality parameters (palatability and flavor of meat) (Webb and O'Neill, 2008). Meat from mature animals contains more intramuscular fat, which has a diluting (juiciness and flavor) and consequently tenderizing effect on meat (Riley et al.,1986).

Lean red meats and fish are also major sources of eicosapentaenoic acid, and docosahexaenic acid, which may provide a protective effect against platelet aggregation reducing the risk of heart attack (Wood et al., 2003; Li et al.,2005). Moreover, lean red meat (beef) and lean white meat (fish, poultry) show similar effect on the good and total cholesterol serum levels (Saadoun, 2014). Goat meat has also Sulubrious fatty acid profile and is good for health (Mohgoub et al.,2002).

The protective effects of omega-3 fatty acids on arthrosclerosis development are attributed to changes in plasma lipids, for instance the reduction of triglycerides. Furthermore, omega-3 fatty acids may stimulate endothelial relaxation, which leads to cardioprotective and antiarrhythmetic effects on the heart. Positive effects of omega-3 fatty acids on glucose metabolism have also been reported (Sirtori and Galli, 2002).

Although there are genetic, age related and gender differences among the various meat producing species with respect to lipid profiles and raitios, the effect of animal nutrition is quite significant (DeSmet et al.,2004). Ruminants tend to deposit saturated fat because the unsaturated lipids of their plant diet are hydrogenated in the rumen (Garrow eta al.,2000). It is possible to increase the proportions of the long-chain polyunsaturated fatty acids (PUFA), specifically eicosopentaenoic acid (EPA) and docosohexaenoic (DHA) acid, which are considered to have special benefits to human health. It can be achieved by increasing the proportion in dietary lipids of alpha linolenic acid (LNA), which is the precursor of EPA and DHA. Changing the diet of ruminants from conserved forages and concentrates to fresh forages (e.g. grazed grasses and clovers) increases the intake of LNA and, despite rumen hydrogenation of PUFA, this increases the proportion of long-chain PUFA in meat and milk fats, and also lowers the *n*-6 : *n*-3 ratio (Garrow eta al.,2000). Meat of forage-raised animals contains significantly more omega-3-fatty acids, conjugated linoleic acid, and unsaturated fatty acids, compared to meat of animals finished with stored forages or grain (Whetsell et al.,2003).

Ethiopia's lowland cattle, sheep, goat, and camel breeds are also highly demanded in the Middle East due to their better taste and the organic nature of their production (Belachew and Jemberu,2003). There is also a possibility for organic grass-fed and produced meat for niches in the European Union (EU) markets (Asfaw et al.,2011).

Addis Ababa butcheries sell an average of 313.5 kg of raw beef per week. Supermarkets sell an average of 498kg beef, 197kg sheep meat, 18.5kg goat meat, and 268kg poultry meat per week.

ELFORA /a leading livestock company in Ethiopia/ runs a wealthy business of selling live animals, whole carcasses, meat cuts, processed meat, and canned meat products. Compared to the cost at butcheries or supermarkets, ELFORA offers by far the best price (Abbey, 2004).

Mince meat which is finely divided by chopping (knife) or passing through a mincing machine; known as ground meat in the USA. In Ethiopia, it is said to be *Kitifo* (minced beef served raw or half cooked). Succus is any juice or secretion of animal or plant origin. Succus entericus is the intestinal juice (Bender, 2006). Succus is said to be '*manta*' in Wolaita- is mixed with a paste ('*daata*') (made by grinding ripped pepper, salt and garlic) and happily eaten with 'raw beef'. It is believed by the consumers that the meat is inspected in abattoir and disease outbreaks are not common expect the chance of getting tape worm. However, foods most often involved in disease outbreaks are raw or insufficiently cooked meat, milk, poultry and eggs (Carhan et al.,2004).

Milk

Milk has been known as nature 's most complete Food. Intake of cow's milk and milk products contributes to health throughout life. Experimental studies indicate that cow's milk protein may help to increase bone strength, enhance immune function, reduce blood pressure and risk of some cancers, and protect against dental caries. Milk fat is also a source of energy, essential fatty acids, fat-soluble vitamins, and several health-promoting components such as conjugated linoleic acid, sphingomyelin, and butyric acid. For example, emerging scientific findings reveal that CLA may protect against certain cancers and cardiovascular disease, enhance immune function, and reduce body fatness/increase lean body tissue. Milk and other dairy foods are an important source of many vitamins and minerals. Calcium helps to reduce the risk of osteoporosis, hypertension, some cancers,

and some types of kidney stones, and may have a beneficial role in weight management (Jarvis et al.,2007). Milk lipids also contribute to the palatability of the diet (Taylor and MacGibbon, 2002). Bovine milk analysis in Ethiopia by Alganesh et al. (2007) discloses that it contains 6.05% fat and 3.31% protein).

Among the many valuable constituents in milk, the high levels of calcium play an important role in the development, strength, and density of bones in children and in the prevention of osteoporosis in elderly people. Calcium also has been shown to be beneficial in reducing cholesterol absorption, and in controlling body weight and blood pressure (Gobbetti et al., 2007).

Lactase is the enzyme (β-galactosidase, EC 3.2.1.23) that hydrolyses lactose to glucose and galactose; present in the brush border of the intestinal mucosal cells. Deficiency of lactase (alactasia) is common in most ethnic groups after adolescence, leading to lactose intolerance. Lactose-free milk may also be prepared by physical removal of lactose by ultrafiltration. Fungal lactase is also used to produce lactose-free milk for people suffering from alactasia (Bender, 2006). Similarly, disaccharide intolerance is impaired ability to digest lactose, maltose or sucrose, owing to lack of lactase, maltase or sucrose in the small intestinal mucosa. The undigested sugars remain in the intestinal contents, and are fermented by bacteria in the large intestine, resulting in painful, explosive, watery diarrhea (Bender, 2006).

Lactose is milk sugar, the carbohydrate of milk; a disaccharide, β- 1,4-glucosyl-galactose. Used pharmaceutically as a tablet filler and as a medium for growth of micro-organisms. The fermentation of lactose to lactic acid by bacteria is responsible for the souring of milk. Ordinary lactose is α-lactose, which is 16% as sweet as sucrose; if crystallised above 93°C, it is isomerised to the β-form which is more soluble and sweeter. Lactic acid is responsible for the flavour of fermented milk and for the precipitation of the casein curd in cottage cheese. Lactobacillus genus of bacteria is capable of growth in acidic medium, and producing lactic acid by fermentation of carbohydrates. It responsible for souring of milk, and production of flavour in yogurt and other fermented milk products (Bender, 2006).

Butter is made from separated cream (fatty part of milk,4%) by churning (sweet cream butter); legally not less than 80% fat (and not more than 16% water). Lactic butter is made by first ripening the cream with a bacterial culture to produce lactic acid and increase the flavor (due to diacetyl). This is normally unsalted or up to 0.5% salt added. Sweet cream butter may be salted up to 2%. Clarified butter is butter fat, prepared by heating butter and separating the fat from the water. It does not become rancid as rapidly as butter. Also known as ghee or ghrt (India);samna (Egypt) (Bender, 2006) and *nitir kibe* in Ethiopia.

A few cultures use butter for cosmetics, e.g. Ethiopia (butter) (FAO,2013). Buttermilk is the residue left after churning butter, 0.1–2% fat, with the other constituents of milk increased proportionally. Slightly acidic, with a distinctive flavour due to the presence of iacetyl and other substances. Usually made by adding lactic bacteria to skim milk; 90–92% water, 4% lactose with acidic flavour from lactic acid (Bender, 2006).

Traditional Ethiopian butter is always made from soured milk. Small quantities of milk are collected in a clay pot over a period of a few days and allowed to sour naturally. When sufficient milk has been collected the milk is churned by shaking the pot until butter granules are formed. The churn is shaken to and fro either on the lap or on the ground. The traditional method of churning is time-consuming and may take on average two hours to complete. The butter milk is then used for preparation of a cottage-type cheese, called *ayib* in Ethiopia. ILCA dairy technology personnel set about developing which, when fitted to the traditional clay pot, would give rapid and consistent agitation to the milk. The results indicated that the efficiency of churning was considerably improved when using the internal agitator, which gave 76 % fat recovery against 67% by the traditional method, and which reduced the churning time by more than half (O'Conner, 1992).

Yogurt

Milk (from a variety of animals but usually cows) coagulated and fermented with two types of bacteria, *Streptococcus thermophilus* and *Lactobacillus bulgaricus*. The two organisms are symbiotic; each produces compounds that promote the growth of the other. Both act to precipitate and gel proteins; main flavour development is from the slower formation of dlactic acid by *L. bulgaricus*, although *S. thermophilus* has a greater capacity to metabolise lactose to l-lactate (Bender, 2006).

Milk, fermented in various countries (*'Ergo'* in Ethiopia, naturally fermented cow milk) using starter culture of bacteria. The acidity (and alcohol) prevent the growth of potentially hazardous microorganisms, and the fermentation thus acts to preserve the milk for a time. In a study by Gonfa *et al.* (2001) in Ethiopia, the relatively low pH of *Ergo*, ranging from 4.3 to 4.5 retards the growth of undesirable microorganisms, such as pathogens and spoilage bacteria, and enables its further storage.

Cheese is prepared from the curd precipitated from milk by rennet, purified chymosin or lactic acid. There is a very wide variety of different types of cheese. The strength of flavour of cheese increases as it ages; mild or mellow cheeses are younger, and less strongly flavoured, than mature or extra mature cheeses. The flavour that

develops on ripening is due to the activity of proteinases and lipases, with further metabolism of free fatty acids to a variety of products. Cheeses differ in their water and fat content and hence their nutrient and energy content, ranging from 50 to 80% water in soft cheeses (mozzarella, Quark, Boursin, cottage) to less than 20% in hard cheese (parmesan, Emmental, Gruyère, cheddar) with semi-hard cheeses around 40% water (Caerphilly, Gouda, Edam, Stilton). They contain much of the calcium of the milk and many contain a relatively large amount of sodium from the added salt (Bender, 2006).

ayib is a soft curd type cheese made in many parts of Ethiopia. It is made from the buttermilk resulting from the churning of sour milk. The fluid remained is said to be *aguwt* (Whey) and the protein in the milk has been removed during the *ayib* making process. At farm level whey can be fed to animals or consumed by humans. The composition of *ayib* which varies considerably from smallholder to smallholder is about 76% water, 14% proteins, 7% fat and 2% ash (O'Connor, 1993).

Whey *i*s the fluid left when curd (clotted protein) formed when milk is treated with rennet. It is the residue from milk after removal of the casein and most of the fat (as in cheese-making); also known as lactoserum. It contains about 1% protein (lactalbumin and lactoglobulin) together with all the lactose, water-soluble vitamins and minerals, and therefore has some food value, although it is 92% water. Whey cheese (e.g. ricotta) is made by heat coagulation of the protein and whey butter from the small amount of fat (0.25%). Dried whey is added to processed cheese; much whey is fed in liquid form to pigs, and it is also used to produce nutritional supplements and beverages (Bender, 2006).

Honey

Honey is syrupy liquid made by bees (the honey bee is *Apis mellifera*) from the nectar of flowers (which is essentially sucrose).The flavour and colour depend on the flowers from which the nectar was obtained and the composition varies with the source. If the ratio of fructose: glucose is high, there is a tendency for the honey to crystallise. Comb honey is stored by bees in cells of freshly built broodless combs and sold in the comb; drained honey is drained from decapped combs. Fructose is found as the free sugar in fruits and honey, and as a constituent of the disaccharide sucrose. 1.7-times sweeter than sucrose. Beeswax is wax from the honeycomb of the bee, used to glaze confectionery, in chewing gum, and as a flavouring agent (Bender, 2006).

Whereas nectar from the many floral sources generally contains just the sugars fructose, glucose, and sucrose, honey contains these and many other more complex sugars. The additional sugars arise largely as a result of honeybees adding several enzymes during the nectar-to-honey ripening process. The presence of active enzymes and the acidity of honey result in its composition being in a constant state of change (Doner, 2003).

Comprehensive surveys of average honey composition have established that the major components are fructose (38.4%), glucose (30.3%), and water (17.2%). In addition to the two major sugars are an array of more than 20 higher sugars, which are formed by linking the fructose and glucose in various combinations. The principal physical characteristics of honey are due to its sugars, but subtle differences in minor constituents from nectar are responsible for the flavor differences of honey from different floral sources (Doner, 2003).

The honey (high-energy carbohydrate) sugars are largely the easily digestible simple sugars, similar to those in many fruits. Honey is also included in many over-the-counter pharmaceutical preparations, providing flavor and textural properties valued by consumers (Doner, 2003).

Honey can be a lifesaver for people and animals in critical health. The simple sugars and especially the fructose content play an important role. Honey is absorbed very quickly into the tissues. It contains small amounts of other bee products such as pollen, bee milk, propolis and bee venom. These products together have a healing effect on the throat, the gastrointestinal tract, the skin and body tissues. Honey is thinned for use as a cough syrup or it is added to improve the syrup's effectiveness. For example, honey mixed with hot water, lemon juice or hot milk is a well known remedy for coughs and sore throats. Honey is also used for burns and other wounds because of the osmotic cleansing effect and its healing properties. The hydrogen peroxide released when honey is thinned disinfects wounds and stings a bit. The honey of stingless bees is used for the same ailments as the honey from bees. In South America it is also used in pure form as eye drops to treat cataracts. Other bee products including pollen, bee bread, royal jelly and propolis have health values (Agromisa Foundation, 2005).

Ethiopia is the largest honey-producing country in Africa and the fourth largest beeswax-producing country in the world. Apiculture provides not only honey and beeswax, but also other valuable products such as propolis, pollen, bee venom, and royal jelly from which the farmers can obtain additional cash income. Ethiopian honey processors currently market honey, beeswax, and to a lesser extent propolis. The majority of processors process table honey, for both domestic and international markets. Beeswax is also exported. Exports of honey to countries, such as Sudan, Yemen, United Arab Emirates, United Kingdom, Norway, and Saudi Arabia, have progressively increased over the last decade, reaching 629 tons in 2010, worth $1,889,000 (The World Bank,2012). The chemical composition of Ethiopian honey sampled from Tigray region showed that 0.18% mineral content, 71% reducing sugar, 2.71% sucrose and 74% other sugars (Gebreegziabher et al.,2013).

Egg

Eggs are an important part of the human diet in most countries around the world (Belyavin and Belyavin, 2003). Most nutrients in the egg are present in variable amounts depending on breeding, feeding, and management of the hens. The only vitamin not found in eggs is vitamin C. The amino acids in the proteins of the egg are relatively uniform among eggs so that egg proteins are often used as the standard against which other protein food sources are evaluated in biological value studies (Stadelman, 2003). Egg protein is a mixture of proteins, including ovalbumin, ovomucoid, ovoglobulin, conalbumin, vitellin and vitellenin. egg white contains 11% protein, mostly ovalbumin; yolk contains 16% protein, mainly two phosphoproteins, vitellin and vitellenin (Bender, 2006). In this regard, little information is available in Ethiopia except physical egg quality traits. But is egg is commonly consumed as boiled and fried.

If the eggs are maintained at a temperature of 8–10 _C and a relative humidity of 85%, the quality deterioration and weight loss are slow. Providing the initial egg quality is good and that only intact and naturally clean eggs are stored, they can be held under these permitted controlled conditions for 6–8 weeks and still remain acceptable. Refrigeration is the only means by which eggs can be stored for long periods of time (several months). A temperature of 0 _C and a relative humidity of 85% close to the eggs is essential (Belyavin and Belyavin, 2003).

Fish

In discussing food uses of fish, the term 'fish' refers to edible species of finfish, molluscs, and crustaceans coming from the marine or freshwater bodies of the world, either by capture fisheries or by aquaculture. Fish muscle contains 18% protein and 1–2% ash; the percentage of lipids varies from less than 1% to more than 20% in high-fat finfish. Overall, fish provides about 16% of the animal proteins in the world and is a source of vitamins, minerals, and essential fatty acids Food and nutritional professionals and consumers have known for years that fish is a high-protein food that is low in energy, total fat, and saturated fat when compared with other protein-rich animal foods. In addition, a large proportion of the fat in fish is polyunsaturated, the o-3 (n-3) fatty acids (Arin et al.,2003**).**

Because of increased evidence for the cardiovascular benefits of fish (particularly fatty fish), consumption of at least two fish servings per week is recommended to maintain health. The predominant beneficial effects include a reduction in sudden death, decreased risk of arrhythmia, lower plasma triacylglycerol levels, and a reduced blood-clotting tendency (Arin et al.,2003**).**

Fish as food, myotomal muscular tissue is the chief food source; other nonmuscular tissues, such as fins, gonads, and livers, may be important foods (of economic, if not always of much nutritional, importance, e.g., shark fins). In some instances where the bones are eaten (e.g., sardines and whitebait, and, in Japan, the roasted vertebral columns of certain larger species), these are important sources of dietary calcium and phosphorus. Fish are also a valuable source of the vitamins nicotinic acid, riboflavin, and vitamin B12. Above all, however, fish are important as an excellent protein source (Bone, 2003).

Fish oils contain long-chain polyunsaturated fatty acids which offer some protection against heart disease. The two main ones are eicosapentaenoic acid (EPA C20:5 ω3) and docosohexaenoic acid (DHA C22:6 ω3). Fish oil concentrates containing these fatty acids are sold as pharmaceutical preparations (Bender, 2006).

Some problems in using Fish as Food- As fish have become more popular, there have been increasing reports of foodborne diseases attributed to these foods. Foodborne diseases following exposure to fish can result from the food itself (toxic species, allergies), but also bacterial or viral contamination of the fish, naturally occurring seafood toxins, or the presence of additives and chemical residues due to environmental contamination (Arin et al.,2003).

Diphyllobothriasis is intestinal infestation with the broad tapeworm *Diphyllobothrium latum* (fish tapeworm). Infection is from eating uncooked fish containing the larval stage. It may cause vitamin b12 deficiency by impairing absorption. Scombroid poisoning Apparently caused by bacterial spoilage of fish including many of the Scombridae (tuna, bonito, mackerel) but also non-scombroid fish and other foods. Symptoms (including skin rash, nausea, tingling) resemble histamine poisoning and were previously thought to be due to bacterial formation of histamine, now doubted (Bender, 2006). Therefore, precautions need to be taken as raw fish (*filet*) is also consumed by some persons.

Fish is extremely perishable as it has high moisture content. It has been estimated that in the high ambient temperatures of the tropics, fish spoils within 12-20 hours of being caught depending on species and size (Geoff Ames *et.al.*, 1996). Smoking is a good method of drying and preserving fish where there is no cold facility for fresh fish handling (Clucas and Ward, 1996).

In a study by Assefa (2013) revealed that there are 180 different species of fish in Ethiopia and 30 of those are native to the country. The demand for fish products is higher in fasting season of Orthodox Christianity. It further described that smoked, filleted and dried was preferred successively but gutted and whole fish was not

preferred. At present, the country Ethiopia has an estimated annual total exploitable fish potential of 51,481ton, which can meet only 79 percent of the current actual demand, 55 percent of the projected demand in 2010, and 44 percent of the projected demand in 2015, based solely on population size (FAO, 2003).

Fish is harvested mainly from inland rich resources of water body like lakes, rivers and reservoirs. There is a potential for fish farming in artificial ponds (aquaculture) in Ethiopia (Lemma and Zenebe, 2009). Protein content of fresh tilapia fish in Ethiopian condition is 18.04 % (Abera and Yared, 2009).

Pork

It is meat from pig (Swine, hog), eaten fresh, as opposed to bacon and ham, which are cured. In composition, it has water, protein, fat, minerals and vitamins in various percentages (Bender, 2006). Consumption of pig meat is forbidden by religions -Orthodox Christianity and Muslim. However, it is found in supermarkets and restaurants/hotels around Addis Ababa for use by foreigners (esp. Chinese) and some Ethiopians. According to FAO (2011) estimates, 1.5 (in thousands metric tonnes) was consumed in Ethiopia in 2000, which is projected to increase by 3.1 in 2030. Therefore, information needs to be generated to explain the contribution of pork in the diet and economy, which is scant in Ethiopia.

5. Nutrition targeted Livestock projects

What is contribution of the livestock sector (both rural and urban) and nutrition-sensitive livestock programs to Ethiopia food security (food utilization and food system stability)? The Dairy Technology Project in Ethiopia, a collaborative project between the Ethiopian Agricultural Research Organization (EARO) and the International Livestock Research Institute (ILRI) introduced cross-bred cows and improved feeding and dairy management technologies. Data collected by EARO and ILRI from 1995–1996 was analysed to assess whether there were any improvements in income, patterns of food and non-food expenditures and calorie intakes (Ahmed et al., 2000). A cross-sectional study was carried out comparing wealth-matched groups of participating households with cross-bred cows and nonparticipating households using traditional practices. Using econometric modeling and a thorough accounting for important confounding variables such as seasonality and wealth, the authors found that ownership of cross-bred cows and adoption of new dairy technologies were associated with higher income, household food expenditures and energy intakes. The increase in income was found to translate directly into increased per capita energy intakes. Intra-household allocation of food was not considered, and no milk-specific findings were identified (Ahmed et al., 2000).

The Dairy Goat Development Project (DGDP) in Ethiopia, implemented by FARM-Africa (Ayalew et al., 1999; Ayele and Peacock, 2003) is a widely-cited small livestock programme designed to improve nutrition. The project was introduced in 1988 when goats were recognized as being an important part of mixed farming systems in the country. The DGDP was developed to “improve family welfare through generating increased income and milk consumption” (Ayele and Peacock, 2003). This project uniquely included an explicit nutrition objective: “increase the consumption of milk by children, thereby improving their intake of vital micronutrients, such as vitamin A and zinc”. It also targeted female-headed households and sought to empower women through “development of leadership skills and improved technical knowledge”. FARM-Africa evaluated this project using a pre- and post-intervention design to look at programme outcomes related to income and milk consumption. Only adequacy inference is possible from this design. Some process-evaluation data were also collected to look at goat production (Ayele and Peacock, 2003). Using the Helen Keller International (HKI) food frequency questionnaire, they determined that children in the 39 households surveyed in Gorogutu District consumed milk more frequently following the intervention. In Gursum District, FARM-Africa found that more than 85 percent of the intervention households, especially young children, consumed the goat milk they produced (Ayele and Peacock, 2003).

In another interventions, participatory research carried out in Liben and Shinile, Ethiopia, prior to developing interventions to promote milk consumption (Sadler and Catley, 2009) demonstrated that Somali pastoralists’ have a strong appreciation for milk (Randolph *et al.*, 2007). Milk supplied two-thirds of energy and 100 percent of protein for young children around one year of age. Children’s milk consumption varied between seasons and fell during droughts. The communities identified interventions to improve animal health (fodder production, increased water supply and veterinary care) as a means to ensuring adequate supply of milk for consumption (Sadler and Catley, 2009). The same source discloses that there is positive impact of livestock production on household income, assets, and food security.

Due to the important nutritional value of milk, increasing consumption of milk either directly or through fortified foods is often a priority of national health and nutrition programs. Ethiopia’s National Nutrition Program (NNP) includes provision of Ready to Use Thereputic Food (RUTF),

Corn-Soy-Milk blend (CSMB) to health centers serving mothers and infants, children, and HIV affected Ethiopians. The NNP Implementation Guide recommends local procurement of these fortified foods, specifically citing Hilina Enriched Food Processing Center located in Addis Ababa (Land O’Lakes inc., 2010).

Food-based strategies to combat nutrient deficiencies include activities to increase the production and consumption of foods rich in specific nutrients. Food-based strategies are believed to be more sustainable and culturally acceptable than supplementation or fortification. An additional advantage is that several micronutrient deficiencies can be alleviated simultaneously without the risk of antagonistic interactions or nutrient overload (Ruel, 2001). The potential of livestock-source foods (LSF) to alleviate micronutrient deficiencies as part of a food-based strategy is well recognized (Smitasiri, 2000; Gittelsohn and Vastine, 2003).

According to Ethiopian Academy of sciences (2013), the main weakness identified in nutrition intervention projects is the lack of direct budget allocation by the government for nutrition as most of the nutrition funding for implementing the intervention programs comes mainly from donors.

Guided by the Feed the Future (FtF) Initiative's dual focus of agriculture and nutrition, USAID/Ethiopia's Health and Agriculture teams are joining forces to address nutrition challenges in Ethiopia. Through value chain programs, funding will assist agriculture extension workers to deliver behavior change communication messages focused on proper utilization, preparation and storage of food to improve household nutrition to farmers, a segment of the population not traditionally reached by nutrition programming (USAID, 2011). FAO (2013) further stressed incorporation of nutrition education into agriculture projects was to improve consumption and also to improve the nutrition impact of consumption.

According to Bender (2006), basic foods plan is a grouping of foods used for public health education with a recommendation to eat some food from each group every day; foods may be divided into four, five or seven groups. For the seven group plan, the groups are: (1) green and yellow vegetables; (2) oranges, grapefruit, tomatoes and raw salads; (3) potatoes and other vegetables and fruits; (4) milk and cheese; (5) meat, poultry, fish and eggs; (6) bread, pasta, flour and other cereal products; (7) butter, margarine, oils and fats.

FAO's nutrition Section has guidance and support for the implementation of a nutrition-sensitive food and agriculture systems programme. It provides improved tools for assessing the nutrition situation in a given area and identifying the major causes of nutrition problems and specific nutrient deficiencies; by designing policies and programmes to overcome the challenges identified; and by monitoring their progress and evaluating their effectiveness (FAO, 2012).

6. Livestock products consumption

What factors constrained consumption of livestock products? How does sustainable supply of livestock source food can be produced following the growing demand in Ethiopian diet? Animals, including man, consume food to obtain the nutrients they need depending on socioeconomic conditions, food supply, and culture (Carolyn et al.,2014). Our food is derived from plants, animals, and single-cell organisms. They are composed largely of water, fats, carbohydrates, proteins, minerals, and vitamins. Inadequate intake of one or more of these nutrients leads to nutrient deficiencies. The type and composition of the food we consume is dictated by both physiological and psychological needs (Jeyakumar, 2013).

Foods containing all the essential amino acids in quantities adequate to meet growth and repair are termed complete protein foods and are exclusively of animal origin. Animal proteins have a more balanced amino acid profile and contain notable amounts of both essential and nonessential amino acids (Jeor et al., 2001). Global demand for animal protein will double by 2040 under the combined effect of population growth, urbanization and changing consumption patterns, according to the FAO report The state of Food and Agriculture (2009) with considerable implications for food production, processing, and retail systems (Daniele et al.,2012). The strictest vegetarians are vegans, who consume no products of animal origin at all. Those who consume milk and milk products are termed lacto-vegetarians; those who also eat eggs, ovolacto- vegetarians. Some vegetarians (pescetarians) will eat fish, but not meat; demi-vegetarians eat little or no meat, or eat poultry but not red meat. Vitamin B12 is found only in animal foods so strict vegetarians are at risk (Bender, 2006).

World population is growing, particularly developing countries. For food, we need agriculture. The value of global agricultural output has been growing at an average rate of 2.3% per year since 1961, outpacing the average population growth during the same period which was 1.7% per year (FAO, 2007). This is attributable to substantial increases in developing countries, but also to a shift towards higher value commodities such as livestock and horticulture. A study estimates that between 2000 and 2025 consumption of meat in India will increase by 176% and by 70% in the case of milk and vegetables, but only 26% for grains (von Braun, 2007). Similar trends can be seen in other large, developing countries such as China, Brazil and Nigeria (FAO, 2007). As a result of these changes, the per capita consumption of food around the world has increased by more than 20% in five decades, from an average of 2280 kcal/person/day in the early 1960s to 2800 kcal/ person/day (FAO, 2007).

Growing populations and incomes, along with changing food preferences, are rapidly increasing the demand for livestock products. The global production of meat is projected to more than double from 229 million tons in 1999/01 to 465 million tons in 2050, and that of milk to grow from 580 to 1043 million tons (FAO, 2006). There will be increasing consumption of animal products per capita in less developed countries (FAO, 2011a).

Within 30 years, developing countries will account for more than 50% of the growth in the demand for milk, meat and eggs. Average per capita meat consumption in China has increased by more than four-fold in 30 years, a trend that is expected to carry over to Africa, with FAO predicting a doubling of per capita meat consumption on this continent by 2050 (SPORE, 2014).

The population growth, urbanization and income growth that fueled the increase in meat and milk consumption are expected to continue well into the new millennium, creating a veritable Livestock Revolution. China and Brazil play a dominant role in the meat part of the Livestock Revolution and milk consumption as food in India. The Livestock Revolution in developing countries will continue at least to 2020 and will increasingly drive world markets for meat, milk and feed grains. Increased consumption of meat and milk under the Livestock Revolution can improve the incomes of poor farmers and food processors in developing countries (Delgado, 2003).

Ethiopia's steady economic growth and urbanization will continue to increase the demand for livestock products become a major source of protein (Delgado et al. 1999; Hall et al. 2004; Seré et al. 2008). In addition, the projection of human population in Ethiopia shows an increasing trend with alarming rate which in turn increases the demand for food especially of livestock origin (Hadera, 2002). According to livestock report by the CSA (2014), livestock derived food products also constitute an important proportion of the value of total food products in the country (Table 4). According to CSA (2013) sampled households in Ethiopia, the estimates of total cow milk, camel milk production, total honey production, eggs produced, are about 3.80 billion liters, 165.12 million liters, 45.91 million kilograms of which the greater portion is harvested from traditional hives, and 93.13 million respectively (Table 3). The surplus dairy and cross bull calves which are under utilized for beef presently and can be an excellent source of high quality beef to enter into the vacuum-packed(de-boned) meat (dairy beef) export market (USAID and MOARD,2008). In a study by Mekonen et al., (2014), crosses of Boar goats and Dorper sheep with local showed potential for greater meat yield with carcass weights of 50% boar goat (12.8kg) and 25% Dorper sheep (16.6kg). In general, with the largest livestock population in Africa, Ethiopia may find a future in food animals (FAOSTAT, 2004).

According to CSA (2014), it is commonly accepted that livestock products are often used for household consumption and/or sold to finance the purchase of basic household commodities such as coffee, salt, cooking oil, sugar, etc. The products are sometimes used as payments and gifts to others (table 2,Annex). The composition of food of livestock origin is not included here though there are various data generated from both livestock and nutrition researches.

The importance of milk in the diet of Ethiopians differs according to the farming systems and the socio-cultural setups. In the lowlands, especially where livestock keeping is the main occupation, milk is consumed by all groups of the society. In the highlands, the rural people are sedentary farmers raising both livestock and crops, with their diet consisting mainly of cereals and legumes. Generally, milk consumption in rural areas can be considered as a function of wealth or availability to a given household, while in urban areas it can be determined by the purchasing power of the household, the level of awareness on its nutritive value and availability (Yilma et al.,2011).

With growing urbanization, there has been a rapidly developing food service sector (fast food outlets, restaurants, and hotels) in Ethiopia, particularly in Addis Ababa. This will increase the demand for high quality processed dairy products and dairy ingredients. Additionally, the food manufacturing sector, which utilizes dairy ingredients, has been expanding in Ethiopia. There are several bakeries and confectionary factories which require dairy products as their main ingredients; these represent another area of growing market opportunities for dairy producers and dairy product processors and suppliers (Asfaw et al.,2011).

The emergence of supermarkets in developing countries reflects a structural change in the way that meat, dairy products and eggs are collected, inspected, processed, packaged and supplied to consumers. It is a change that has deep impacts on livestock producers, particularly in determining who can and who cannot participate in the mainstream supply chains (Steinfeld et al.,2006). The commercialization of processed dairy products through supermarkets is expanding and is expected to keep doing so in the foreseeable future. Increasing urbanization and corresponding changes in consumer preferences, behaviour and purchasing power are the identified causes for the rise of supermarket-processor dairy chains (Francesconi et al.,2010). The period from 2005–10 has been a time of subtle transition for the Ethiopian dairy sector. There has been an increase in processing capacity, accompanied by an increase in dairy product lines. In 2000, the Ethiopian dairy product line consisted of pasteurized milk and butter. In 2010, consumers could find a wider variety of domestic dairy products (The World Bank,2012). In Addis Ababa, surveys of the different supermarkets reveal a variety of locally processed as well as imported milk products (pasteurized milk, UHT milk, cream, butter-cook, butter-table, Gouda cheese, cottage cheese, mozzarella cheese, provolone cheese, cream cheese, fermented milk, and natural and flavoured yoghurt) (Yilma et al.,2011).In addition, eggs, meat, bottled honey, fish and pork are observed in the supermarkets around Addis Ababa.

MAMA Dairy offered 32 dairy products to its customers in 2010 compared to 12 products in 2006. This

reflects a dairy sector that can adjust to consumer and market demands. Fasting periods are a challenge as processors report a decline in processing output of 25 percent during the August and March/April fasting periods. However, some processors are managing fasting periods by producing inventories of UHT milk and cheese, although this can create cash flow problems. Nonetheless a younger generation that consumes more milk is emerging, complementing traditional consumption by children and the sick (The World Bank,2012). Fasting also involves abstaining from eating meat, eggs, and butter (Akililu et al.,2007). The reverse happens in fish demand, i.e. it is higher in the fasting season.

7. Food safety

Food safety is an important principle for building healthy eating patterns. Foods that pose high risk of food-borne illness and, thus, should be avoided include raw or partially cooked eggs or foods containing raw eggs; raw (unpasteurized) milk and products made from unpasteurized milk; unpasteurized juice; raw or undercooked seafood, meat, poultry, fish, or shellfish; and raw sprouts (Cerhan et al., 2004).

Although the most important food safety problem is microbial food-borne illness from bacteria and viruses, there are also food safety risks from parasites, toxins, and chemical and physical contaminants in foods. The food safety recommendations in the 2010 Dietary Guidelines are based on the FightBAC principles of safe food-handling practices (clean, separate, cook, and chill) (USDHH and USDA, 2010).

Different organizations have been working in different countries to establish quality standards to ensure the health of the consumer. Microbial criteria stipulate that specific microorganisms or toxins produced by a microorganism must not be present at all, are allowed in a limited number of samples, or be present at less than a specified number or amount in a given quantity of a food ingredient (NRC, 1985).

While risk-based approaches have proven very successful in assuring safety of animal-source foods in developed countries, they have yet to be applied to the informal markets which predominate in developing countries, and where most of the poor buy and sell (Grace et al.,2007).

First, the incorporation of nutrition/health education in curricula, and sensitization of food safety issues in the community and actors of the livestock value chain (consumers, livestock producers, processors, retailers, abattoir/butchery service, etc.) will help in correcting the food safety problems in Ethiopia. Later, gradually, bringing the legal enforcement of the quality and standard in Ethiopian context will be an option. In addition, quality of imported products need more caution. In this regard, institutions like the Quality and standards Authority of Ethiopia, the food and drug authority and the MOA Animal and plant health regulation directorate have made a good start in preparing guidelines and proclamations.

ILRI Safe Food, Fair Food project is also working on capacity building to improve the safety of animal-source foods and ensure continued market access for poor farmers in sub Saharan Africa (Herrero et al.,2011), which is a good lesson to make hygienic production and handling of livestock products. In a recent study by Makita et al. (2012) in Ethiopia showed that the traditional milk fermentation reduced the risk by 93.7% and thus traditional food preparation method is important in risk mitigation. The same source disclosed that improving the safety of milk and dairy products could be achieved through supporting appropriate traditional food preparation and consumption where an industrial risk mitigation system is not feasible.

8. Urban food production and nutrition/food security

Urban agriculture: worthy, but not trendy! During the past 15 years, studies have shown that urban agriculture should be recognized as an integral and permanent element of the urban socio-economic and ecological system (Mougeot, 2006; Van Veenhuizen and Danso, 2007). It forms an important part of the livelihood strategies of large numbers of urban poor. In many countries, rapid urbanization is accompanied by increasing urban poverty, food insecurity, and mal-nutrition. As a result, in many cities the number of people involved in urban agriculture tends to increase with ongoing urbanization, rather than decreasing, as had been previously assumed. Another factor is the growing urban demand for perishable products, including vegetables, meat, and eggs, coupled with the comparative advantages of production close to the markets, and the availability of productive resources, including urban organic wastes, wastewater, and vacant public land (Practical action,2009).

More than 75 percent of the total population growth is located in urban areas, and between 1990 and 2010 the world urban population has topped rural population, rising from 42 percent to 51 percent. It is estimated that, by 2030, urban populations will be at least twice that of rural populations. Urbanization growth is occurring faster in developing countries. The urban population has doubled in low-income food deficit countries, in Africa and China, compared to a 20 percent increase in Europe and a 30 percent increase in North America. Urbanization and urban agglomeration have seen a shift of poverty from rural to urban areas, often concentrated in squatter and slum areas (Popkin et al., 2008). There is price differentials compared to rural areas among other causes of dietary shift (Drewnowski et al., 2010). Urbanization is important in the development of modern food systems and the impact of this on diets. Urban people adopt new eating habits, consuming higher amounts of animal protein, and eating a higher proportion of their food away from home (Steinfeld et al.,2006).

Populations around the world are growing and becoming predominately urban, fueling the need to re-examine how urban spaces are developed and urban inhabitants are fed. One remedy that is increasingly being considered as a solution to inadequate food access in cities, is urban agriculture. As a practice, urban agriculture is beneficial in both post-industrial and developing cities because it touches on the three pillars of sustainability: economics, society, and the environment. Historically, as well as currently, economic and food security are two of the most common reasons for participation in urban agriculture. Urban agriculture not only provides a source of healthful sustenance that might otherwise be lacking, it can also contribute to a household's income, offset food expenditures, and create jobs. Social facets are another reason for populations to engage in urban agriculture (Ackerman et al.,2014).

Urban agriculture plays a significant role in both food and nutrition security for African urban households, and land availability and urban livestock are critical factors in enabling it to sustain that role. The nutritional benefits of urban livestock-keeping outweigh any health risks involved, which can be managed (Grace et al.,2008). It is established that urban agriculture is a good way to alleviate hunger. Small, mixed crop–livestock backyard farms appear to be the backbone of cities' urban farming systems, ensuring food and nutrition security for those households and, to an extent, the city itself. They also recycle nutrients in the city ecosystem, reducing waste and pollution, thus contributing to sustainability (Lee-Smith, 2010).

The growth of urbanisation causes serious losses in the availability of productive agricultural land. However, hundreds of millions of urban dwellers rely on urban agriculture (UA) for part of their food consumption or income as they sell high-value crops or non-food crops or raise livestock for sale (Redwood, 2009). A range of studies in urban centres in East Africa during the 1990s showed 17–36% of the population growing crops and/or keeping livestock (Lee-Smith, 2010). Studies in Ethiopia by Lee (1997) and Mpofu (2013) in Addis Ababa; Messay (2010) in Adma; Dereje et al. (2007) in Mekele and Haile et al, (2012) in Hawasa also showed the great contribution of UA to food security, job creation and environmental greening. This is an important benefit as percentage of urban population in Ethiopia is measured at 24% in 2014 according to the estimate of the World Bank which increased from the previous years' estimate. Even though urban agriculture is a viable activity to complement food supplies from rural areas to towns and is a means of income for many urban poor, its contribution has been underestimated (Mougeut, 2000). Urban and peri-urban agriculture has a significant role in food and nutrition security in most low-income nations, although in many cities it is more difficult for the urban poor to get access to the land needed for agriculture (Lee-Smith, 2010). In this regard, there is a need to incorporate urban and periurban agriculture in National Land Policy by taking the experience of such countries as Kenya (Lee-Smith, 2010), Latin America and Caribbean (FAO,2014) . This will restrict the loss of agricultural land to urban expansion and promote more intensive production for land that remains in agriculture. In short, societies that are better able to manage their resources now will be better able to capture this food and agro related market growth and promote its development in the future (Marcos and Scare, 2013).

In many cities of developing countries, sheep, goats and sometimes even cattle, can quite happily produce significant milk and meat from a feed resource base of banana peels thrown from buses at stops, supplemented with various other household and commercial vegetable wastes and the occasional ''vacation'' to common roadside grazing near town. In most cases when ruminant animals produce enough to support a family and provide surplus product for sale, more land is needed (Brown, 2003). Recent analyses suggest that Ethiopia's steady economic growth and urbanization will continue to increase the demand for livestock derived food products become a major source of protein (Delgado et al. 1999; Hall et al. 2004; Seré et al. 2008).

Like many developing countries, Ethiopia has a high rate of urbanization, averaging about 4.3% per annum (Ministry of Works and Urban Development) (MWUD, 2006). About 30% of this population is concentrated in the capital and primate city, Addis-Ababa. This population growth rate is also accompanied by growing numbers of the urban poor and malnourished, due primarily to the high rate of unemployment (Mpofu, 2013).

Addis-Ababa Master Plan (ORAAMP), recognized that urban farming was making a positive contribution to food security and nutrition in Addis-Ababa (Mpofu, 2013). The Addis-Ababa City Government has recognized urban agriculture as one of the important tools to end poverty. To this effect, the City Government has taken the following measures to encourage this sector (Mpofu, 2013):

1. Recognized the existence and continuation of urban farming within and around the City;
2. Accepted urban agriculture as an integral component of the City's development Master Plan; and,
3. Established the Department of Urban Agriculture at both city and sub-city levels.

However, the study was able to identify the following factors that constrained the sustained growth and development of urban agriculture (Mpofu, 2013):

a) Lack of institutional supportive in urban agriculture;
b) Lack of integration of urban agriculture into City land use and zoning plans; and,
c) Lack of coordination among the public agencies.

When livestock are intensively produced under confined conditions, accumulations of manure require

appropriate management which includes collection from the production site, storage, treatment processes, or may only include storage prior to application on land or processing in another environmentally- responsible way (Hristov et al.,2013) and interdisciplinary approach. Urban dwellers, the urban poor and other livestock entrepreneurs could obtain considerable benefits, including nutrition security, employment creation and recycling of waste through urban agriculture.

9. Concluding remarks

In Ethiopia, among others, there is lack of interdisciplinary approach and knowledge/skill on food system and livestock productivity to feed the growing population. This paper was aimed to synthesize knowledge on sustainable livestock derived food production and utilization through case study approach including interviews and document analysis. In addition, it also serves as a spring-board for research/intervention to define areas of attention that enhance the role livestock in food production and nutrition. Brief questionnaire survey and extensive current literatures on livestock and food/nutrition situation in Ethiopian scenario were made and it also captured experiences of collaboration across disciplines elsewhere and finally highlights future prospects. All of the respondents reported consuming livestock products with 34.7% consume more than four types of products (meat, milk, eggs, butter, etc.) and 32.7% consume once a day. 71.4% reported that there is supply problem and the main reasons they claimed include lack of urban agriculture and unscientific husbandry practices. Among the strategies to enhance livestock role in food system challenges/ security and nutritional benefits, it is essential that livestock/crop agriculture, and nutrition sciences and their related research/intervention activities need to work together in an integrated manner. Narrowing the nutrition gap also requires "nutrition-sensitive" food and agriculture systems that explicitly incorporate nutrition objectives. A growing market demand has significant opportunity for improving productivity even though there are challenges in the increasing urbanization and limited livestock support services.

Diets are common in both dietary fibre and starchy staple foods in rural Ethiopia. In urban areas, there is a need to use livestock source foods in appropriate amounts esp. with age and physical activity, which are valuable sources of complete, high-quality, easily digestible protein and many essential micronutrients such as iron, zinc, calcium, vitamin A and vitamin B12. The overconsumption of certain foods, particularly those high in saturated fat and cholesterol, salt (sodium) and total energy, has been linked to overweight, obesity and subsequent diseases of lifestyle (WHO, 2007). Appropriate nutrition education is essential to promote the use of livestock source foods (Neumann et al.,2002).

Modification of livestock diets can easily increase the proportion of unsaturated fatty acids in meat, milk and eggs (Woods and Fearon, 2009). For instance, beef from pasture-fed cattle had higher proportions of linolenic acid and over all, higher proportions of (poly) unsaturated fatty acids than beef from grain-fed animals (Descalzo et al.,2005; Dannenberger et al.,2006). The fat from grass-finished beef may have a yellowish appearance from the elevated carotenoid content (precursor to vitamin A) (Daley et al.,2010). The typical fattening/finishing adult oxen at the end of working life/ after plowing season ends is common practice in certain areas of Ethiopia including Wolaita (Takele and Habtamu, 2009) and Harrer highland livestock farmers (Fekadu and Alemu, 2000). In addition to nutrition modification, fattening young bulls by private sector can be an option to supply different meat quality for consumers.

Though there is a fertile ground that facilitates synergetic linkage of nutrition into agriculture, livestock science and food science are fragmented in education system. It is time to restore the bridge between agriculture and nutrition. Narrowing the nutrition gap requires "nutrition-sensitive" food and agriculture systems that explicitly incorporate nutrition objectives (FAO,2012). These efforts will have to start at the time of professional training, through, for example, interdisciplinary problem-based learning approaches. National government, farmers, healthcare workers, nutritionists, environmental groups, civil society organizations, educators, researchers, and the private sector all have important roles to play in leveraging agriculture for improved nutrition and health and should work together to achieve common goals (IFPRI, 2012).

The linkage of nutrition and agriculture should be started at the district and village levels, with technical support given to professionals from the research institutes and higher learning institutions. Nutrition education and training should be part of the agricultural education program and produce qualified manpower for expanded nutrition interventions in the country (Ethiopian Academy of Sciences, 2013).

It is important to remember that agricultural growth alone will not eradicate under-nutrition and ill health—specific interventions such as nutrition programs targeted at children under age two and improved healthcare services for underserved populations are still needed. Moreover, these kinds of safety net programs, as well as education and health services, infrastructure, trade policies, and other factors, make up the larger context within which advances in agriculture, nutrition, and health will take place. Changes in these factors will also make a difference to how well the linkages among agriculture, nutrition, and health operate (IFPRI, 2012).

Promoting nutrition-sensitive homestead gardening and livestock production; reducing post-harvest loss; and incorporating nutritional outcomes in agricultural policies and programs; involving private sector

agribusinesses in processing of perishable and seasonal foods are other intervention areas. The multi-sectoral nutrition programs and interventions also need a strong coordinating body that brings on board all the relevant stakeholders/in order to realize food and nutrition security at national and household levels, institutionalized coordination through a multi-sectoral approach is the key for integration of nutrition into health, agriculture and other sectors. The Agriculture (DAs) and health extension workers play a role in delivering information supportive of several programs in agriculture, health and nutrition at grassroots levels. Thus, more attention and support should be given to the agricultural sector to enable it to contribute to the enhancement of the nutritional status of vulnerable groups (Ethiopian Academy of Sciences, 2013).

Investment in research for example describing livestock source food consumption, health properties, and nutrient composition is essential to address consumer concerns towards a healthy, sustainable livestock source diet (Schönfeldt et al.,2013). Moreover, McDermott, J.J., et al (2010) argues that an increase in public and private investments in smallholder livestock systems would help nearly one billion people use their livestock enterprises as pathways out of poverty. Such investments would help people with few alternative livelihoods meet the growing demand in developing countries for livestock products and do so in ways that are sustainable over the longer term.

For this very reason, Africa in general and Ethiopia in particular, needs to have a Livestock Revolution (Berhe, 2014). Livestock Revolution is all about including and engaging the poor and the smallholders with a special attention to gender issues; multi-disciplinary integration; developing human and institutional capacities; adopting right based approaches; investing in innovative technology; reducing wastes and losses; increasing resilience and early warning systems (Berhe, 2014). In this regard, the opening of Livestock sector office as a separate ministry is encouraging but much remains to be done in working with different sectors in addressing the constraints of small holder livestock farmers.

With the above concluding remarks, the following recommendations were drawn:

- The emerging commercially oriented livestock sector is constrained by lack of feed, improved breeds, and adequate support services such as veterinary, extension, credit, information, land, etc. (Azage et al.,2003; Asfaw et al.,2011) which is an entry point for business opportunity. In addition, locally manufactured processing equipment and support services need in place for smallholder livestock producers (including women) demanding appropriate, affordable and easily accessible package of production technology (FAO 2007). In this regard, we need to look options in rural technology centers in addition to private sector in supplying quality inputs and services. The agriculture and food trade fair/exhibition organized by the Ethiopian chamber of commerce is also very important effort to connect livestock producers and input suppliers.

-Promoting increasing milk consumption grows sales/market and encourages supply through building awareness of nutritional benefits USAID (2013). Rapidly increasing demand for livestock-source food products exerts pressures on the livestock sector, which needs to adapt fast in order to cope with such demand (Steinfeld et al.,2006). More attention and support should be given to the livestock sector to enable it to contribute to the enhancement of its roles in sustainable ways.

-Recent joint FAO/WHO expert consultation on fats and fatty acids in human nutrition notes that there is no probable or convincing evidence for significant effects of total dietary fats on coronary heart disease or cancer (FAO, 2010). The problem of saturated fats in animal products can be reduced by advice to consumers and by modifying the concentration and constitution of fats in animal products (Garrow eta al.,2000).

-The need of practical knowledge (training) and skills to be employed or self-employed in the sector needs to be considered by new universities. Training and preparing young livestock science graduates in enterprise skills in specific career in the value chain would be key issue in Ethiopia.

-Agricultural education should be incorporated in primary education as before. The experience of developed countries show that starting from KG, kids are learned how food is produced both in class and rural area visit. Thus, agriculture and nutrition courses need to be incorporated into curricula at all levels. Moreover, it is essential that agriculture and nutrition sciences need to work together in academics, research and development in an integrated manner as they are mutually interdependent. Further, the roles and responsibilities of relevant stakeholders (ministries –education, agriculture, health and NGOs, etc.) should be clearly put. The experiences of other countries (universities) that incorporated food science in agricultural department need to be adapted as an important example.

-There exist urban agricultural practices in both western such as New York (Ackerman et al.,2014) and London (FADC, 2000) and developing countries (Kenya, Brazil, Botswana, China, Cuba, Uganda, etc) (FADC, 2000; Hovorka and Keboneilwe, 2004; Brazil Government, 2008; Lee-Smith, 2010). In Ethiopia, government recognition of urban agriculture for food, income and employment generation and opening of urban agriculture offices in the town administration are good start but incorporation in the urban master plan /urban planning/national land policy and technical and legal support in relation with land access/security at grass root remains consideration.

-Food and drink waste including fruit juice and vegetable house/pastry, university students cafeteria, etc can be a good sources of livestock feed in urban areas if food waste management strategy and appropriate technology is in place.

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Annex

Table 1- Examples of nutrition and agriculture education in other countries

SNo.	University	Department/college name	Country
1	Agriculture university of Norway	Food science	Norway
2	Tuft university	Agriculture /human nutrition research	USA
3	Nippon veterinary & Animal science university	Food science and technology	Japan
4	Swedish university of agricultural sciences	Food science	Sweden
5	Royal veterinary and agriculture university	Dairy and food sciences	Denmark
6	College of Food systems	Arid-land agriculture	United Arab Emirates
7	University of Alberta	Agricultural, food and nutritional sciences	Canada
8	University of Guelph/Ontario Agricultural College	Department of Food Science	Canada
9	University of Kentucky	College of Agriculture/ Department of Animal and Food Sciences	USA
10	University of Queensland	School of land and food science	Australia
11	Michigan State University	Department of Agricultural, Food, and Resource Economics	USA
12	Bogor Agricultural University	Department of Food Science & Technology	Indonesia

Table 2 -Patterns of smallholder farm livestock producer's utilization of homemade Livestock products in Ethiopia, 2013/14

Product	Utilization (%)			
	Household consumption	Sale	Used for wage Payments in kind	Other
Milk	42.27	5.64	0.27	51.82 /production of butter, Cheese, and the likes/
Butter	61.11	34.71	0.25	3.92
Cheese	82.33	12.72	0.25	4.71
Honey	40.4	56.25	0.59	2.76
Eggs	26.85	36.6	0.22	36.32/hatching/
Beef	44.37	37.89	1.02	16.72
Goats meat/mutton	89.75	3.52	0.31	6.42

Source: CSA (2014).

Table 3. Livestock source food availability in Ethiopia

Livestock source food	Total production	Yield/head	
		Indigenous	Improved
Meat	34 mill cattle 13mill. Sheep 12mill. goat	108 kg 10 kg 8.5 kg	- 16.6kg 12.8kg
Milk	3.80 billion liters	2.15liters	Crossbred=1655 liters and exotic=2707liters
Honey	45.91 mill. kg	5-6kg	18-30kg
Egg	93.13mill.	50-80	150-250
Fish	51,481 ton	Average table size of Tilapia=250gm; Cat fish=500gm	-
Pork	1.5 thousands metric ton (consumed)	-	-

Source: Demeke et al.,2004; FAOSTAT,2004; Dessie and Ogle, 2007; Lemlem and Tesfay (2010);CSA (2013); FAO, 2003;Mekonen et al.,2014.

Table 4. Survey respondents profile

Factors	Descriptions
Occupation	46.9% government-employed and 44.9% private
Education level	55.1% university graduates and 38.8% high school
Age	57.1% are 25-34 years; 34.7% are 35-54 years
Gender	61% are male; 38.8% are female
Religion	51% are Orthodox; 32.7% protestant; 12.2% Muslim; 2% Catholic
Marital status	63.3% Married
Family size	63.3% have 1-5; 20.4% have >5
Income/month	4.1% get 500-1000 birr; 53.1% get 1001-5000; 12.2% get >5000; 30.6% unknown*

*Traders did not want to give information on their monthly income

Table 5. Energy value of common livestock products in Ethiopian foods, per 100 g

Food	Local name	Energy (kcal)	Protein (g)
Beef, raw	Yebere siga,tire	115	19.8
Mutton, raw	Yebeg siga,tire	91	19.7
Goat meat, raw	Yefiyel siga,tire	99	19.9
Chicken, whole, raw	Doro, mulu, tire	93	16.4
Milk, cow, fresh	Yelam wetet, yaltefela	74	3.4
Egg, whole, raw	Inqulal, difin, tire	153	12.1
Lake fish, raw	Yehaiq asa, tire	107	17.6
River fish, raw	Yewenz asa, tire	137	18.9
Butter, unspiced, raw	Qbe, qimem yelelew, tire	735	1.3

Source: FDRE Ministry of Health (2008). National Guidelines for HIV/AIDS and Nutrition. Addis Ababa, Ethiopia.

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