



ADDIS ABABA UNIVERSITY
COLLEGE OF NATURAL SCIENCES
CENTER FOR FOOD SCIENCE AND NUTRITION

**Exploring the Relationship between Water, Sanitation, Hygiene and Animal
Keeping with Child Growth in four selected kebeles of Amhara region, Ethiopia**

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**Thesis Submitted to the school of Graduate Studies of Addis Ababa University in Partial
Fulfillment of the Requirements for Degree of Master of Science in Community Nutrition**

June 2018



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/ILRI/**



June 2018

DECLARATION

I, the undersigned, declare that this is original work and has never been presented in this or any other university and that all the source materials used for this thesis have been properly acknowledged.

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Date June 2018

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ABBREVIATIONS

ACGG	African Chicken Genetic Gain
ASF	Animal Source Food
ATONU	Agriculture to Nutrition
E.Coli	Escherichia coli
EED	Environmental Enteric Dysfunction
FAO	Food and Agriculture Organization
FBD	Food Born Disease
HAZ	Height for Age Z-Score
IFPRI	International Food Policy Research Institute
ILRI	International Livestock Research Institute
IRB	Institutional Research Board
LMICs	Low and Middle Income Countries
MFP	Meat, Fish and Poultry
NSI	Nutrition Sensitive Interventions
UNICEF	United Nations Children Fund
WASH	Water, Sanitation and Hygiene
WHO	World Health Organization

ABSTRACT

Stunting is a chronic condition reflecting poor nutrition and health. Despite significant reductions in stunting, it is still a major public health concern. Recently, it has been hypothesized that exposure to livestock can be a risk factor for diarrhea and environmental enteric disorder /EED/ in young children, which may significantly contribute to under nutrition. Thus, this study aimed to explore the relationship between Water, Sanitation and Hygiene and animal keeping with child growth.

A cross-sectional study was conducted in four selected kebeles of Amhara region. Selected households were interviewed. Household observations were conducted to check the presence of animals in the compound and inside the house, as well as spot-check animal feces in the compound. Anthropometric measurements were taken from 394 children aged 6-59 months. Height-for-Age Z (HAZ) score was calculated and classified according to the WHO guideline. The association between linear growth and animal keeping was analyzed using spearman correlation that adjusted for covariates.

Dietary diversity was low and mainly consisted of starchy staples. Child's stunting was highly prevalent (32%). HAZ was found to be negatively associated with the number of goats owned ($p < 0.05$); whereas child underweight and wasting was associated with number of horses in the household ($p < 0.05$). The distance between barn and the household was associated with child underweight.

Interventions that promote livestock ownership and consumption of animal products are needed in this setting, but this should be accompanied with improvements in animal handling to prevent children's exposure to animal feces.

Keywords; stunting, livestock, feces, goats, diet diversity, WASH.

1. INTRODUCTION

1.1 Background

Childhood malnutrition is a major public health problem in low-income countries; about 20% of childhood mortality is associated with stunting or underweight. Stunted children complete fewer years of schooling and as adults have reduced work capacity, earn less income and have poorer health (Black *et al.*, 2008).

According to UNICEF, WHO and the World Bank, 171 million children under the age of five were stunted (UNICEF, WHO, World Bank Group, 2015) in the year 2014. Loosely-speaking this means they were excessively short for their age or statistically it means their height -for- age z-score (HAZ, as it is known) was less than 2 standard deviations below the median of a healthy reference population (Galasso *et al.*, 2016).

The pathogenesis of stunting is poorly understood (Owino *et al.* 2016). Child under nutrition in poor countries has long been linked to disease burdens such as diarrhea and respiratory infections, but more recently to environmental enteric disorder (EED), a sub-clinical condition characterized by chronic damage to the gut, mal absorption of nutrients and low level immune system stimulation that diverts resources away from growth and development (Mbuya & Humphrey (2016); Korpe *et al.*, 2012). The realization that most stunting cannot be explained by poor diet or by diarrhea, nor completely reversed by optimized diet and reduced diarrhea has led researchers to reexamine papers published over the past several decades that have posited a linkage between unsanitary living environments leading to an acquired asymptomatic but chronic gut injury with systemic immune stimulation and poor growth (Humphrey 2009, Cairncross *et al* 2010., Fink *et al.*, 2011).

In most developing countries the majority of rural households own some form of livestock, as do many urban households (Heady and Hirvonen 2015). Recent evidence from rural India suggests that animal-sourced fecal matter is much more widespread than human-sourced fecal matter (Schriewer *et al.*, 2015). Also another meta-analysis showed linkage between diarrhea in young children and exposure to animals (Zambrano *et al.*, 2014). Some studies found significant positive associations between exposures to livestock and diarrhea. Thus there is some evidence

that exposure to livestock does increase the probability of diarrheal infection (Heady and Hirvonen 2016). It has also been hypothesized that high concentrations of any bacteria—even non-pathogenic bacteria—in the small intestine can cause EED and stunting (Mbuya and Humphrey *et al.* 2016). So while human feces may contain greater concentrations of the pathogenic bacteria that cause diarrhea the greater prevalence of animal feces in developing countries could potentially pose a greater risk for EED and stunting (Heady and Hirvonen, 2016).

To reduce the prevalence of stunting in the world especially in developing countries focus is given to nutrition specific and nutrition sensitive interventions (NSI). Nutrition-sensitive livestock interventions, which are increasingly popular in the developing world because of the important animal-sourced foods for child nutrition (Turner *et al.*, 2013), pay little attention to the health hazards associated with exposure to livestock feces (Heady and Hirvonen 2016). And analyses of the effects of improved dietary intake on child growth suggest that a nutritionally adequate diet is necessary but not sufficient for ensuring optimal linear growth (Martorell *et al.*, 2010).

According to the 2016 EDHS the prevalence of stunting in Ethiopia is 38%, which increases in rural areas. Many studies have shown that this is due to factors like poor child feeding, low dietary diversity, inadequate sanitation and hygienic practices. Major concerns were given to water, sanitation and hygienic interventions in relation to toilet constructions and related hygiene and water measures. In recent years, nutrition-sensitive agriculture interventions have promoted household animal rearing (e.g. poultry) to increase consumption of nutrient-dense foods like eggs. However, little emphasis was given to the potential environmental and household contamination with animal excreta. Very recently Headey D. and Hirvonen K. (2016) have identified associations between animal keeping and stunting. However, little is known about the type and density of animals and how they are associated with stunting. Therefore, this research will focus on animal keeping households to see if WASH practices influence children's linear growth.

1.2 .Statement of the Problem

Poor growth during infancy and early childhood remains an important risk factor for childhood morbidity and mortality and a major public health challenge in low- and middle-income countries. Childhood stunting is a risk factor for diminished survival, short adult height, impaired intellectual development, reduced economic productivity, and low off-spring birth weight (Ngure *et al.*, 2013).

Stunting rates among under- fives vary considerably around the world – from 57% in Burundi to less than 2% in Chile (Galasso *et al.*, 2016). The Global progress in improving childhood growth has been less impressive. While the prevalence of stunting (height-for-age z-score less than two standard deviations below the global median, as defined by the 2006 World Health Organization Child Growth Standards among children under 5year declined from 47% in 1985 to 30% in 2011 globally, only minor improvements have been achieved in some of the poorest regions of the world, like South Asia and sub-Saharan Africa (Stevens *et al.*, 2012). In recognition of the large disparities across the globe in the areas of early life nutrition and development, the World Health Assembly set a target to reduce by 40% the number of stunted children worldwide by 2025 (Danaei *et al.*2016). Although Ethiopia has made steady progress in reducing stunting (from 2000 – 2011 stunting declined from 58 % to 44 %) and 38% in 2016 (EDHS), the prevalence of stunting is still one of the highest in the world, and the issue is a national priority (Haile *et al.*, 2016).

In low income countries animal rearing is basically intended for income generating purpose and to meet the growing demand of ASF (Olawoye and Randolph n.d.). Livestock kept by the poor can produce a regular supply of nutrient-rich ASF that provide a critical supplement and diversity to staple plant-based diets (Murphy and Allen, 2003). This is particularly true for milk and eggs, which can help mitigate the effects of often large seasonal fluctuations in grain availability (Wilson *et al.*, 2005). Several observational studies show associations between intakes of ASF and better growth. In these studies the greatest deficits in linear growth were found in those with little or no ASF in their diet. On the basis of these, studies have widely promoted the strategy of increasing consumption of ASF, i.e. meat, fish, eggs and milk, for improving the amount and bioavailability of micronutrients available to children in the developing world (Millward, 2017).

Studies reported that there is a rapid fall in children's height-for-age Z-score from birth to 24 months, particularly during the time when children are being weaned off of exclusive breastfeeding and also becoming more mobile and crawling. These activities expose the child to contaminants in water and food, as well as soil and contaminants picked up on their hands that then go into their mouths (Haile *et al.*, 2016). In developing countries, young children crawl and play in areas where they may come into contact with soil that is contaminated with human and animal feces. Human or animal feet that tread in feces deposited in the open bring pathogens into the domestic environment-home and immediate vicinity to infants and young children (Ngure *et al.*, 2013).

Ethiopia has one of the highest livestock densities in the world, and significant qualitative evidence that Ethiopian children are highly exposed to poultry and their feces (Headey and Hirvonen 2016). Therefore, this study aimed to investigate the association between animal keeping and children's linear growth in relation to WASH practices in selected communities of Amhara region, as this region has the highest stunting rate (46%) in Ethiopia according to 2016 EDHS.

1.3. Significance of the Study

The significance of the study is to inform nutrition-sensitive agricultural programs particularly focusing on promotion of animal rearing to increase consumption of animal source foods for children while minimizing the adverse effects related to contamination.

1.4. Research Question

- What kinds of WASH practices are practiced in the area?
- Is there a relationship between WASH and child growth?
- Can the animal density and the type affect child growth?

1.5 Objectives of the study

1.5.1. General Objective

- ❖ To examine the association between Water, Sanitation, Hygiene and animal keeping practices and child growth.

1.5.2. Specific Objectives

- ❖ Characterize the WASH practices of the selected households.
- ❖ Investigate the relationship between WASH and child growth.
- ❖ Investigate relationship between animal density and types kept in households and child growth.

2. LITERATURE REVIEW

2.1. Stunting

Stunting reflects chronic under nutrition during the most critical periods of growth and development in early life. It is defined as the percentage of children, aged 0 to 59 months, whose height for age is below minus two standard deviations (moderate and severe stunting) and minus three standard deviations (severe stunting) from the median of the WHO Child Growth Standards. Worldwide, stunting affects nearly one-third of children under 5 years of age, with having high prevalence in low-resource countries in sub-Saharan Africa and South Asia. Globally, it is estimated that under nutrition is responsible, directly or indirectly, for at least 35% of deaths in children less than five years of age (Agedew and Chane 2015).

Poor linear growth, or stunting (low length- or height-for age), in young children is the result of multiple circumstances and determinants, including antenatal, intra-uterine and postnatal malnutrition (De Onis, Blössner and Borghi, 2012). Stunting also has far-reaching consequences. It is estimated that stunting is the cause of about one million child deaths annually. For the children who survive, stunting in infancy and early childhood causes lasting damage, including increased morbidity, poor cognition and educational performance in childhood, short stature in adulthood, increased risk of perinatal and neonatal death for women, lower productivity and reduced earnings in adults and—when accompanied by excessive weight gain later in childhood—increased risk of chronic diseases. Therefore, stunting hampers the development of entire societies (Black *et al.* 2013). The accumulative effects cost African and Asian countries up to 11% of their gross national product (Horton and Steckel, 2013).

The linear growth of healthy children from birth to five years of age is remarkably similar the world over (De Onis *et al.*, 2006). Yet, the latest global figures indicate that ~ 25% of children under age five (i.e. 159 million) have stunted growth because of chronic nutrition deprivation (Aguayo and Menon 2016). Stunting—a height- for- age below 2 standard deviations of the median height-for-age in the Child Growth Standards of the World Health Organization—happens early in life. Most stunting happens during the first thousand days (from conception through the first two years of life) although additional linear growth faltering may still happen after the first two years of life (Leroy *et al.* , 2014).

The factors influencing stunting among children 0±59 months are multiple. The WHO conceptual framework for stunting (2013) identified household and family factors, complementary feeding and breastfeeding practices and infections as the most plausible causes of stunting. Contextual factors at community and societal level such as beliefs, norms, and livelihoods influence the proximate causes of stunting. Many studies corroborated in reporting significant association with maternal education, household wealth, maternal age, dietary diversity, diseases and infections. Dietary diversity and recommended complementary feeding practices also reduce stunting in younger children. Infectious diseases arising from respiratory illnesses, malaria and diarrhea during the period of growth and development (6±59 months) are also important proximal determinants of growth faltering. The underlying factors for child under nutrition also include household and family related factors such as food security, child care, household environment (access to water and sanitation) and lack of basic health services (Hagos *et al.*, 2017).

2.2 Water, Sanitation and Hygiene (WASH)

WASH is the group term for Water, Sanitation and Hygiene. Due to their interdependent nature, these three core issues are grouped together. Water is essential for the survival and development of all children. Without water, children simply cannot stay alive or thrive in a healthy environment. Water resources, and the range of services they provide, strengthen poverty reduction, economic growth and environmental sustainability. Eight out of ten people without access to safe drinking water live in rural areas and nearly half of them live in sub-Saharan Africa (UNICEF 2016).

Sanitation is a comprehensive term and it means more than just toilets. It can be understood as interventions that reduce human exposure to diseases by providing a clean environment in which to live. It involves both behaviors and facilities, which work together to form a hygienic environment. Sanitation is essential for the survival and development of children. Currently, there are 2.4 billion people worldwide who do not use improved sanitation (a facility that safely separates human waste from human contact). Currently 1 in 7 people or 946 million people go in the open, known as “open defecation”. India, Indonesia, Nigeria, Ethiopia and Pakistan, account for 75% of open defecation. While progress has been made to improve access to sanitation in

some parts of the world, millions of children in poor and rural areas have been left behind (UNICEF 2016).

Good hygiene practices reduce the incidence of diseases such as pneumonia, trachoma, scabies, skin and eye infections and diarrhea-related diseases like cholera and dysentery. Something as simple as hand washing can save lives. Washing hands with soap at critical times, like after going to the toilet or before eating, can have a significant impact on children's health. The key to improving hygiene practices amongst children is to promote behavioral change within schools and communities. While each has a separate field of work, each is dependent on the presence of the other. All three areas in WASH support and strengthen one another. If one is missing, the others cannot progress (UNICEF 2016).

2.2.1 WASH coverage in Ethiopia

According to 2016 EDHS 97% of urban households had access to an improved water source of drinking water while 57% of rural households had access to improved drinking water source. Soap and water the essential hand washing agents were observed in 7% of rural households lowest being in Amhara region (5%). Essential hand washing agents were absent in 43% of urban households and 68% of rural households. Usage of improved toilet facilities was 6% in Ethiopia. And 39% of rural households had no toilet facility (EDHS 2016).

Ethiopia was praised in the global WASH JMP report of 2015 as having made the most remarkable progress in terms of sanitation coverage. From just 8% coverage in 1990, it had increased to 71% in 2015, 25 years later. "Open defecation was practiced by 44.3 million Ethiopians in 1990 and 28.3 million in 2015 – an average reduction of over 4 percentage points per year over 25 years" (JMP, 2015). The Ethiopian Demographic and Health Survey (DHS) in 2002 estimated that only 5% of households in Amhara had access to a sanitation facility. By 2006, a region-wide representative survey of trachoma revealed that 24.3% of households in Amhara had a pit latrine (Emerson et al. 2008).

2.3 Relationship between Stunting and WASH

Safe WASH is of paramount public health importance without considering the plausible impact on child hood stunting. Improved access to WASH can prevent a large infectious disease burden that includes diarrheal diseases but also other important infectious diseases. A sequence of

researches by a WHO-led group of experts estimated that approximately 500,000, 280,000 and 300,000 deaths are attributable to poor water, sanitation and hygiene, respectively (Prüss-Ustün *et al.*, 2014).

Chronic exposure to contaminated environments due to poor water quality, sanitation and hygiene are strongly associated with stunting (Fink *et al.*, 2011). Supported by proof of different studies, WASH is linked to a wide range of other infectious disease health outcomes, including helminthes infections, schistosomiasis, trachoma, respiratory infections and maternal and reproductive infections Soil-transmitted helminthic infections can be prevented with adequate sanitation and are strongly associated with childhood under nutrition. In particular, more severe cases of ascariasis and trichriasis are associated with growth faltering in children. Recent research suggests that infection, including subclinical conditions, such as chronic asymptomatic inflammation and other physiological responses to inflammation and other physiological responses to environmental ‘insults’ may account for a much larger share of stunting than previously thought (Onis *et al.*, 2013, Checkley *et al.*,2008). . A WHO analysis reported that approximately 10% of the total global burden of disease could be prevented with improved WASH (WHO 2008).

Pooled analysis of data from nine countries with longitudinal morbidity and anthropometry provided evidence that repeated bouts of diarrhea cumulatively increase the risk of stunting in children (Checkley *et al.*, 2008). Diarrheal disease, encompassing a broad range of bacterial, viral and protozoan enteric infections, is largely preventable with improved WASH. Diarrheal disease was fourth leading cause of disability globally in 2010, after ischemic heart disease, lower respiratory infections and strokes (Murray *et al.*, 2012).

Environmental factors (i.e., unimproved water, unimproved sanitation, and biomass fuel use) had the second largest global attributable burden to child growth. Particularly, 7.2million cases of stunting worldwide were attributable to unimproved sanitation. The burden of unimproved sanitation for stunting was larger than that of childhood diarrhea, as some of the effects of improved sanitation may be through prevention of other childhood infections and improvement of maternal health and nutrition in pregnancy. This further underscores the importance of ongoing WASH programs to increase access to, and use of, safe water and sanitation for children and families worldwide (Danaei *et al.*,2016).

There is growing evidence linking symptomatic and asymptomatic enteric infections to (Environmental enteric disorder) EED. EED is an asymptomatic syndrome causing chronic inflammation, reduced nutrient absorption of the intestine and a weakened barrier function of the small intestine. These abnormalities in gut function and structure may have profound consequences for affected children, including deficits in growth, early childhood development and immune function. It has been argued that EED, and not diarrhea, may be the primary causal mechanism linking WASH to child growth (Humphrey 2009). One observational study in Bangladesh has shown that children living in households with improved WASH were both less likely to have EED, and are less likely to be stunted (Lin *et al.* 2013).

Both EED and diarrhea are strongly associated with elevated exposure to fecal matter. But because humans appear to be the main reservoir for several of the most common pathogens that cause clinical diarrhea, the vast majority of water, sanitation and hygiene (WASH) interventions and strategies have placed primary emphasis on toilet construction and related hygiene and water measures, such as hand washing. Thus there is a little focus given to the contamination caused by animal excreta on child growth (Heady and Hirvonen, 2016).

2.4 WASH Intervention to Reduce Stunting

WASH interventions is one of the Nutrition - sensitive programs to address stunting, while nutrition- specific interventions target the direct causes of under nutrition, nutrition - sensitive interventions focus on the underlying determinants, influencing, for example, the price of food, the degree of diversity in agriculture, household incomes, access to and affordability of health care, the degree to which nutrition is integrated into health services, and water and sanitation infrastructure (Galasso *et al.*, 2016).

Poor sanitation and associated open defecation can lead to stunting through three channels: diarrheal diseases, environmental enteropathy and nematode infections. A recent study pooling Demographic and Health Surveys from a large number of countries (Fink *et al.*, 2011) found that access to improved water and especially sanitation was associated with significantly lower risks of child diarrhea, child mortality and stunting. However, interventions aimed at improving infrastructure (access and quality of water or sanitation facilities) and/or behavior (e.g. open defecation, hand-washing) have had limited impacts on stunting, although they have shown to be

effective at reducing child mortality or diarrhea incidence, a risk factor for both child mortality and stunting (Galasso *et al.*, 2016).

A public sanitation program in Mali showed that enhanced access to toilets did not reduce the prevalence of diarrhea but increased childhood growth, particularly in those <2 years of age. A possible explanation could be reduced chronic exposure to pathogenic bacteria, resulting in reduced severity or prevalence of EED. Because EED has its roots in the environment, the basis of preventing the condition is to “clean” the environment. This approach is challenging because water scarcity still afflicts 40% of the world’s population, and 13% of the population still defecates in the open. Furthermore, one-sixth of the world’s people lack access to safe drinking water. The provision of basic sanitation facilities, potable water, and improved hygiene practices cut the chain of transmission of pathogenic bacteria that can colonize the small intestine and cause EED. A study in Bangladesh found that ensuring a clean environment increased population height-for-age 0.54 SD compared with children living in default conditions. Increased access to clean water, and improved sanitation and hygiene, including reduction of exposure to feces and contact with animals; is one of the major potential interventions to tackle EED (Owino *et al.*, 2016).

A multi-country (including Ethiopia) analysis of DHS data concluded that the practice of open defecation significantly explains international variations in child height. In Ethiopia, two separate pooled analyses of DHS showed that reduced prevalence of open defecation is associated with a reduction in stunting (Headey 2014). In addition, a reduction of stunting was observed following the implementation of a water, sanitation and hygiene project in northern Ethiopia where hand washing was a key intervention (Wirth *et al.*, 2016). WASH interventions are generally focused on breaking the human fecal–oral route of disease. One under recognized source of fecal contamination, however, is animal feces, which are common contaminants in the environment of children living in poor communities of low and middle income countries (LMICs) (Kaur, Graham & Eisenberg 2017).

2.5 Reducing Stunting Through Improved Nutrition (Animal Source Foods)

Specific agricultural or livestock interventions that promote access to more nutritious and diversified diets could translate into improved nutrition directly by improving incomes and

indirectly by dietary diversity in home consumption. Major nutrition-sensitive approaches include home gardens enhanced with micro- nutrient rich fruits and vegetables. Given the critical importance of animal -source food for linear growth (Puentes *et al.*, 2016), there is also interest in targeting livestock and livelihood programs to be more nutrition-sensitive, with poultry rearing and dairy production promoting egg and milk consumption among children and women (Galasso *et al.*, 2016).

Animal source foods /ASFs/ are particularly appropriate for combating malnutrition and a range of nutritional deficiencies since they provide multiple benefits. First they are energy dense and good sources of protein and a large number of key micronutrients secondly high bioavailability of nutrients than plant source foods and with small amount of ASF consumption children can fulfill their high nutritional requirement (Randolph et al., 2007).

Stunting in early childhood has also been linked to poor dietary diversity especially low intake of animal source d foods (ASFs) which are rich in high quality protein and other growth stimulating nutrients (Headey, Derek and Hoddinot 2017). Because of its richness in energy and protein milk is considered to play a unique role in promoting to child growth among other animal source foods (Dror and Allen 2011). They also stated, intake of animal source food including milk, where diets were often nutrient deficient, has stimulated linear growth and weight gain in infancy, childhood and adolescence.

Ownership of livestock is highly predominant in rural sub- Saharan Africa. Additionally many development organizations provide livestock to households for poverty alleviation and nutrition improvement. In their study, Kaur and colleagues (2017) analyzed small scale livestock ownership as both a risk factor and a protective factor for child stunting and found livestock ownership to be associated both with an increased risk of infection and health benefits through improved nutrition and socioeconomic status. Furthermore, in other study consumption of animal source foods was found to be associated with a decreased risk of stunting and underweight (Darapheak *et al.*, 2013)

Two studies, in China and in India, have demonstrated the potential to reduce stunting via educational approaches emphasizing dietary diversity and consumption of animal-source foods, although in both cases, the impact on linear growth was quite small. A recent analysis in Ethiopia

shows that household ownership of cows in rural areas is associated with increased milk consumption and reduced prevalence of stunting, but the effects were weaker in communities with good access to markets. In addition, a study found that the provision of livestock support of pastoral communities in Ethiopia Somali Region prevented growth faltering in children <5 years old during the dry season (Wirth *et al.*, 2017).

2.6 Livestock Keeping As Risk for Stunting

According to the Food and Agricultural Organization (FAO), “domestic animals such as poultry, cattle, sheep, and pigs generate 85% of the world’s animal fecal waste, proportionally a far greater amount than the contribution by the human population”; the fecal production rate can total to 2.62×10^{13} kg/year. Inadequate separation of animal feces from human domestic environments, common in low-income countries, can lead to fecal-oral transmission of zoonotic pathogens through direct contact with humans and/or fecal contamination of fingers, food, and water sources. Several pathogens of zoonotic origin are associated with acute gastrointestinal symptoms that can arise from contact with animal feces. Children may experience long-term growth shortfalls after exposure to these pathogens (Penakalapati *et al.*, 2017)

Diet and infection impacts on nutritional status are well-known. Evidence indicates that poor WASH increase risk of infections, and infections influence growth .There is little indication that WASH or health and nutrition programs regularly include any significant emphasis on reducing exposure to animal feces (Dangour *et al.*, 2011).

Identifying dominant fecal –oral exposure pathways for young children when they are most vulnerable to the deleterious effects of contaminated environments is the first step in identifying those WASH interventions that are likely to be most efficacious. One recent study used structured observation of mother–child couples in Zimbabwe to assess fecal –oral exposure among young children and highlighted the risks associated with the consumption of soil – geophagia – and animal waste in per domestic areas (Ngure *et al.* 2013).

Livestock development efforts in lower-income countries are primarily intended to generate income and meet the growing demand for ASF. Livestock are ubiquitous in poor communities across the developing world. An estimated two-thirds of resource-poor rural households keep some type of live-stock. Similar information for poor urban households is scarce, but a survey in

two cities in Nigeria found that more than one-half of all urban households were keeping livestock; the highest rates were found in the most densely populated, lower-income areas (Olawoye and Randolph n.d.).

Livestock nourish the poor, but at the same time may expose the poor to zoonosis and food-borne disease (FBD). As highlighted in a recent World Health Organization (WHO) report, the poor “bear a disproportionately high share of the burden of (zoonotic) disease” because of their close contact with livestock in unsanitary conditions, the lower likelihood that they will get the needed healthcare, and the dual effects on both their health and their animals (WHO, 2006). Poor control of zoonosis and FBD can therefore undermine the effective use of livestock for reduction of poverty and stunting (Randolph *et al.*, 2014).

Livestock ownership in rural areas is believed to be an important precondition for increasing animal source food consumption, in case of poultry this would primarily refer to egg consumption Headey & Hirvonen (2015). In formative research done in Ethiopia, Peru and Zimbabwe children were observed consuming chicken feces which was found to contain extremely high concentrations of pathogenic bacteria, such as *Campylobacter jejuni* and *E. coli*. Using measurements of *Escherichia coli* as a marker, a study found that active exploratory ingestion of soil (2100 *E. coli* cfu) and chicken feces (10 000 000 *E. coli* cfu) posed greater risk of fecal bacteria exposure in terms of microbial load compared with fingers (no *E. coli* cfu estimated), food (no *E. coli* cfu estimated) and drinking water (800 *E. coli* cfu). Ingestion of chicken feces, which are highly concentrated with *E. coli* bacteria, can cause long term damage to the gut (EED) which consequently diverts the body’s resources into fighting infections at the cost of child growth and development. This is hypothesized to cause stunted growth patterns and reduced cognitive development (Headey & Hirvonen 2015).

Animal keeping has previously been identified as a risk factor for child mortality and morbidity. A research conducted in Guinea-Bissau where pigs usually roam in the close surroundings of the houses and often sleep in the same room with humans, found increased rates of persistent diarrhea in children. It demonstrated an increased risk of cryptosporidiosis in households with pigs and shown that *Cryptosporidium* is a major cause of persistent diarrhea and mortality in early childhood. Although the keeping of animals may be a proxy for overall poor hygiene, it is more likely that the association between pigs and persistent diarrhea is a reflection of the

significance of cryptosporidiosis and perhaps other zoonotic infections (Ngure *et al.*, 2013). Similar observations of fecal contamination of the play and feeding areas of infants and young children, and ingestion of chicken feces have been reported in Peruvian slums and Bangladeshi households. Other study done in Bangladesh linked EED and stunting with keeping poultry inside the house where children sleep (Headey *et al.*, 2017).

Another survey, conducted by IFPRI in Ethiopia under the Alive and Thrive program, checked if there were signs of animal feces in the homestead compound: 40 percent of households with small children had homesteads with visible signs of animal feces.. The study also tried to see the rates of child stunting by whether or not poultry are kept inside the main household dwelling overnight. Strikingly, stunting rates for children with this elevated risk are 50 percent, as compared to 44 percent for children from households where poultry are kept outside. This result implies that increased risk of exposure to feces might fully negate any nutritional benefits from owning poultry (Headey & Hirvonen 2015). Hence, while nutrient-rich foods from poultry could improve child growth, exposure to poultry feces could retard that growth.

2.7 Importance of WASH Intervention to Minimize Stunting Prevalence

It is becoming increasingly evident that nutrition interventions, by themselves, may not result in the desired impact if the target population suffers from frequent infection, both clinical and subclinical (i.e. asymptomatic). It is well known that infections can cause linear growth retardation, but subclinical conditions such as environmental enteric dysfunction, inflammation and other physiological responses to environmental insults are likely to be far more common than clinically obvious infections and may account for a large proportion of stunting (Smith *et al.* 2012).

According to a research finding, reducing the burden of stunting requires continuing the current efforts to diagnose and treat maternal and child infections, especially diarrhea, along with a new focus on clinical and public health interventions that focus on improving nutrition and sanitation among mothers and families. The Lancet's 2013 Maternal and Child Under nutrition Series identified 10 nutrition-specific interventions that could reduce stunting by 20% if they reached

90% of children in 34 countries. These included hand washing promotion, and access to safe water and sanitation (Sachdev *et al.*, 2013).

There is evidence that stunting incidence was 21 % lower in Sudanese children with access to water and sanitation facilities than in those children with no access. A study in Lesotho found evidence of an association between latrine ownership and attained height. These studies highlight that improved child growth is not only a food security issue but is also closely related to water, sanitation and hygiene. There is some evidence that environmental enteropathy is elevated in stunted children and is associated with chronic exposure to a variety of food- or water-borne micro-organisms, viruses, bacteria and protozoans. A letter published in the Lancet discusses the evidence of the effect of poor sanitation and hygiene on linear growth and suggests substantial under-reporting of under nutrition due to the fact that an important causal pathway to malnutrition from poor hygiene and sanitation may be caused by EED and not just diarrhea. This suggests that improving hygiene practices could be a key element to preventing malnutrition in chronically food-insecure areas (Fenn *et al.*, 2012).

It is becoming increasingly clear that all post-natal stunting cannot be completely reversed by improving children's diets if children live in highly unhygienic environments. Growing evidence suggests that there is a link between children's linear growth and the sanitation practices in the households where children live. The ingestion of high quantities of fecal bacteria by young children through mouthing soiled fingers and house-hold items leads to intestinal infections which affect children's nutritional status by diminishing appetite, reducing nutrient absorption, and increasing nutrient losses (Aguayo & Menon 2016). Therefore animal growing households and projects advocating animal keeping for a nutritious diet for child growth should also focus on the sanitation practices.

3. MATERIAL AND METHOD

3.1 Study Area

As this study was supported by Agriculture to Nutrition (ATONU) project the study areas were selected from the project implementing areas. The ATONU project works closely with the African Chicken Genetic Gains (ACGG) project—led by the International Livestock Research Institute—and the Ethiopian Institute of Agricultural Research, it operates in 20 villages in Ethiopia (in the regions of Amhara; Oromia; Southern Nations, Nationalities, and Peoples; and Tigray). The Amhara region was selected purposefully as it has the highest prevalence rate of stunting in Ethiopia (46%) (EDHS 2016). From this region four ATONU project implementing kebeles were selected.

The Amhara Region is located in the northwestern part of Ethiopia between 9°20' and 14°20' North latitude and 36° 20' and 40° 20' East longitude. Its land area is estimates at about 170000 square kilometers. Amhara borders Tigray Region in the North, Afar in the East, Oromia in the South, Benishangul-Gumuz in the Southwest and the country of Sudan in the west. The region is divided into 11 zones, 140 Weredas, and about 3429 kebeles (<http://www.ethiodemographyandhealth.org/Amhara.html>).

From the selected kebeles Surta and Gafera are found in Agew awi zone. Surta kebele found in Banja woreda has estimated distance 57 km from the woreda town Koso Ber and 500km away from the capital Addis Ababa. Whereas Gafera kebele in Fageta Lekoma woreda is located 5km from Koso Ber has estimated distance of 477km from Addis Ababa. The others Tsion teguaz and Dikuli kebeles are found in Gondar and West Gojam zone respectively. Tsion teguaz has an estimated distance of 10km from the district Gondar zuria and is 701km from Addis Ababa. Dikuli is also 12km and 500km from the district town Dur bete and Addis Ababa respectively.

3.2 Study Design and Period

A cross sectional study was conducted on 452 households from four selected kebeles in Amhara region from January to February 2018. But the study only focuses on 394 children who were available for anthropometric measurement.

3.3 Sample Size Determination

The sample size will be determined by single proportion sample calculation formula

$$n = \frac{Z_{\alpha/2}^2 P(1-P)}{d^2}$$

Where;

n - The minimum sample size required for very large source population ($\geq 10,000$)

Z - The critical value for a given confidence interval (95%)

P - Expected proportion of the event to be studied (0.5)

D - Margin of error (5%)

$$\rightarrow \frac{1.96^2 * 0.5(1 - 0.5)}{d^2} = \frac{384.16}{(0.05)^2} \simeq 384$$

$$n = 384 + 10\% = 422.2 \simeq 422$$

Therefore, the sample size was approximately 422 6- 59 month children.

3.4 Sampling Techniques

The four kebeles were selected purposively and all ATONU beneficiaries with child 6-59 months of age were included in each kebele. And the rest households with eligible child were listed by health extension and selected randomly until 105 houses were encompassed with in the kebele.

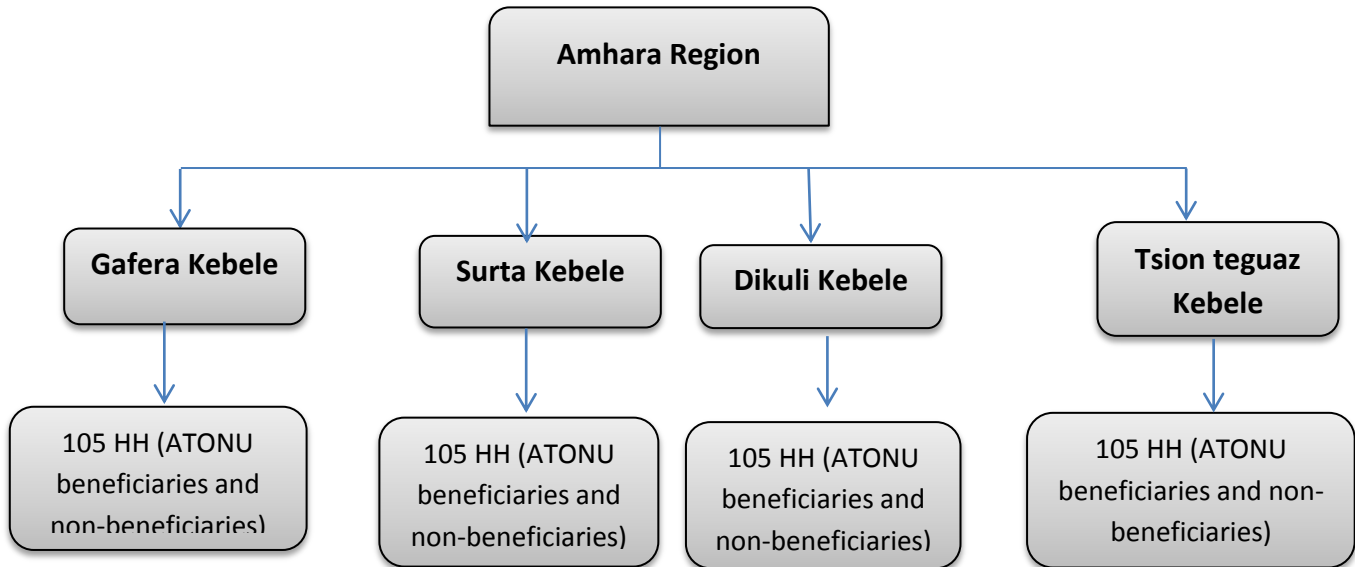


Figure 2 Schematic presentation of the sampling procedure

3.5. Study Population

The study population was children aged between 6-59 months in the four selected kebeles. They were included both from ATONU project beneficiaries and from households which were not project beneficiaries.

3.6. Inclusion and Exclusion Criteria

The inclusion criterion for the study was children aged 6-59 month at the time of the survey, while their mothers were usual residents of the kebele and who have given their consent to participate in the study. Children above five years or under 6 month were excluded from the study. In a household with more than one eligible child one was randomly selected.

3.7 Ethical Consideration

Ethical clearance was obtained from Addis Ababa University Institutional Review Board. Oral consent was obtained, from the child's mother/care giver/ father after providing her with an explanation of the study. The interview was continued after knowing their willingness to participate in the study. The formal letter was given and the purpose of the study was explained to woreda health offices for their permission and support during the study.

3.8. Data Collection

3.8.1. Questionnaire

The Data was collected using structured interviewer- administrated questionnaire which was adapted from Ethiopian Demographic health Survey (EDHS) and World Food Program (WFP) survey to obtain information on child's age, socio-demographic characteristics and economic status, animal type and density the household keep, and other variables. The WASH questions were developed from WHO/UNICEF Joint Monitoring Program for Water Supply and Sanitation (JMP) assesses the type of drinking water source, sanitation facility the household members use and also the hygiene practices with respect to the disposal of children's feces. The questionnaire was prepared in English and translated to local language, Amharic. The data was collected by ATONU/ACGG field assistances, health extension workers and development agents under the direction of a supervisor and the primary investigator.

3.8.2. Observation Checklist

Each household with an eligible child was observed to check compound and household cleanliness, animals staying place, presence of animal feces in the compound and inside the house and availability and type of latrine during the interview and results were recorded.

3.8.3. Anthropometric measurements

Anthropometric data, length (height) and weight, of the children in the study was measured. Recumbent length of children under the age two or ≤ 85 cm and height of children above the age two or >85 was measured using wooden height boards. The length/height of children was measured without shoes to the nearest 0.1cm. Weight of children was measured to the nearest 0.1kg using a calibrated suspended scale or pediatric scale with pan when it was available for under two years of age but when this materials were not accessible we measured the mother carrying her child and subtracted her weight from the result, for above two years children digital Seca scale or weight measuring scale was used, while wearing a minimum cloth and without shoes.

3.8.4. Dietary Pattern

To see the children's nutrient intake their dietary pattern was recorded by asking the mother or caregiver to recall the child's exact food intake in the previous 24 hour period or the preceding day before the assessment.

3.9 Variables

3.9.1 Dependent variable

Children were classified as stunted (dependent variable) based on their Z-scores for, height-for-age (HAZ). Children were considered stunted, wasted, or underweight if their Z-scores were less than -2 SD below the median values in reference to the United Nations World Health Organization.

3.9.2 Independent Variable

Factors that have been associated with child stunting in the literature were included as independent variables in the study: maternal education, working outside, dietary diversity of child, children's sex, access to sanitation facilities, and open defecation were included in the analysis.

3.10 Data Analyses

Data were entered and analyzed by using SPSS version 23.0 statistical software. The dependent variable "stunting" was created by taking the child's length/height and converting it to sex- and age-specific z scores relative to the World Health Organization (WHO) standards with the use of the ENA for SMART 2011 software. Stunting was defined as length/height-for-age less than -2 z scores. Children, whose z score were greater than or equal to -2 were considered to be not stunted.

4. RESULT

4.1 Socio-demographic characteristics

A total of 452 households were included in the survey from which 58 children were not available for the anthropometric measurement. Therefore the final analysis was based on 394 children. Majority of the households were male- headed and only 8% was female- headed. From the children parents 95.4% were married, 3.6% were divorced and 0.8% were widowers. More than 50% of the mothers (55%) were between 31- 50 years, whereas 44.7% were between 19-30years. The majority of the mother's (80.7%) had no formal education. More than 90% of were farming households and 81% ploughed their own land. Most households have a family size of 3-7. All of the study participants did not have electricity and 14.5% had a radio (Table 1).

Table 1 Socio demographic of household and parental characteristics of 394 children between 6-59 months of age in 4 selected kebeles of Amhara region

Characteristic	Value
<i>Mother/care giver's age</i>	<i>No. (% of children)</i>
19-30	176 (44.7)
31-50	217 (55)
>50	1 (.3)
<i>Household head</i>	
Father	357 (91)
Mother	31 (7.9)
<i>Marital status</i>	
Married	375 (95.4)
Divorced	14 (3.6)
Widowed	3 (.8)
<i>Educational status-mother</i>	
No formal education	317 (80.7)
Primary school	61 (15.5)
Secondary school	11 (2.8)
Above	4 (1)
<i>Occupation of father</i>	
Farmer	358 (93.0)
Merchant	19 (4.9)
Other	12 (2.2)
<i>Land ownership</i>	
Their own	316 (81.0)
Family's	32 (8.2)
Rented	28 (7.2)
No land	14 (3.6)
<i>Payment type</i>	
Cash	5 (1.3)
Cash and in kind	42 (10.9)
In kind	301 (77.8)
No payment	35 (9.0)
<i>Occupation of mother</i>	
Farmer	340 (86.5)
House work	32 (8.1)
Merchant	17 (4.3)
<i>Family size</i>	
3-7	307 (79)
>7	81 (21)
<i>Electricity</i>	
No	394 (100%)
<i>Radio</i>	
Yes	57 (14.5)

4.2 Children's characteristics

The female: male ratio was 52:48 more than 75% of the studied children were under three years of age. Consequently, only 5% of the children did not start consuming solid food (complementary foods) and 74% of the children were breast fed (Table 2). The mean HAZ-score for male children was -1.1, whereas as it was -1.01 for girls.

Table 2 Characteristics of 394 children aged between 6-59 months in four selected kebeles of Amhara region

Characteristic	No. (%)
Age (month)	
6-11	85 (22)
12-23	140 (35)
24-35	106 (27)
36-47	45 (11)
48-59	18 (5)
Gender	
Female	204 (52)
Male	190 (48)
Complementary feeding	
Not yet started	18 (5)
Breast - feeding	
Yes	290 (74)
Nutritional status	
HAZ	
Female	-1.02 (1.53)
Male	-1.11 (1.63)
Stunted (HAZ<-2)	126 (32)
Underweight (WAZ<-2)	92 (23.4)
Wasting (WHZ<-2)	67 (17)

4.3 Nutritional Status

From overall children 126 (32%) were stunted, 92(23.4%) were underweight and 67(17%) were wasted (table 2). As shown in figure 7 the prevalence of stunting, wasting and underweighting was higher in children aged 12 - 23 months.

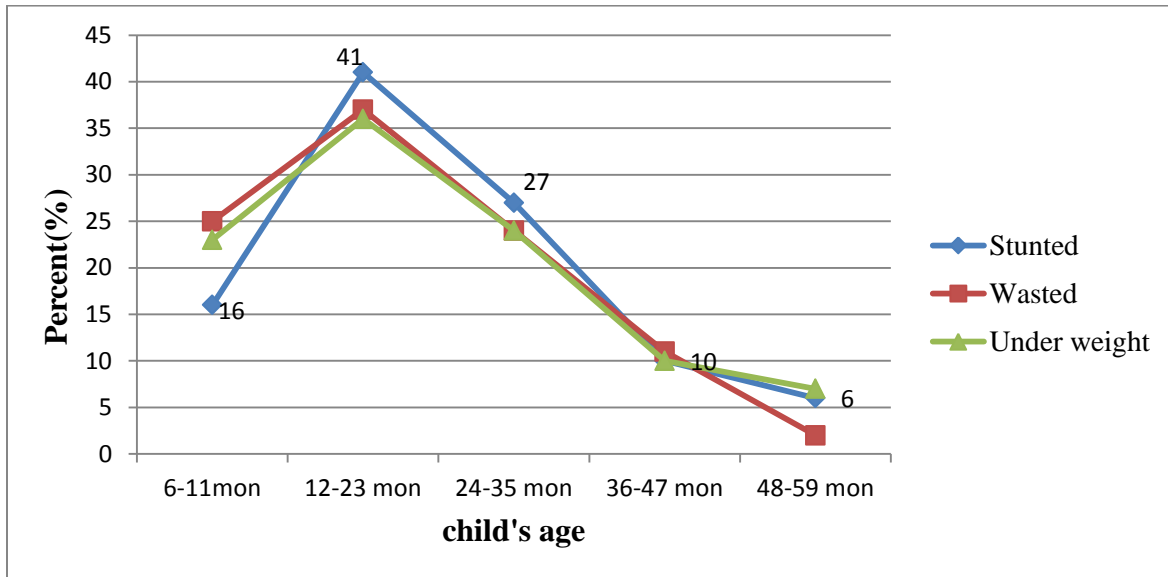


Figure 3 Nutritional status of 394 children aged between 6-59 months in four selected kebeles of Amhara region

4.4 Water, Sanitation and Hygiene Characteristics

Most households had access to improved water sources (71%), which was accessible to them in less than half an hour (Table 3). However, 90% of the households used unimproved toilet facilities like traditional toilets and practiced open defecation which increased the risk of individuals coming into direct contact with human excreta.

Table 3 WASH characteristics of 394 households in four selected kebeles of Amhara region according to the WHO/UNICEF Joint Monitoring Program for Water Supply and Sanitation (JMP)

Characteristics	No. (%)
Water source	
Improved	257 (71)
Unimproved	114 (29)
Time taken	
≤30min	363 (95)
>30min	19 (5)
Liters	
≥20lit	383 (98)
<20lit	7 (2)
Water treatment (chemical)	
Yes	20 (5)
Covered containers	
All are covered	341(87)
Some are covered	49 (13)
Toilet type	
Improved	39 (10)
Unimproved	354 (90)
Number of household sharing	
1 household	259 (95)
>2 households/ communal	14 (5)
Child excreta disposal (< 3years, n=330)	
Safe	212 (64)
Unsafe	118 (36)
* Improved water source: a piped water source into the home/yard/plot, public tap/stand pipe, a tube well/bore hole with pump, a protected dug well, a protected spring, captured rain water.	
* Unimproved water source: unprotected dug well, unprotected spring, surface water (river, lake, pond, stream, dam etc.)	
* Improved toilet type: flush or poured to piped sewer system/septic tank/pit, composting toilet, VIP latrine, pit latrine with slab.	
* Unimproved toilet type: flush/pour to anywhere other than the above mentioned, pit latrine without a closed slab or with an open pit	
* Safe child excreta disposal: child using toilet, put/rinsed into toilet, buried	
* Unsafe child excreta disposal: thrown into garbage, left in the open	
* WHO/UNICEF/JMP , 2010	

4.4.1 Awareness of households on hand washing

From the total households, 49%, had awareness about the importance of hand washing before preparing food, 83% before eating food, 10% before feeding a child, 59% after using a toilet and 8% after cleaning a child. Even though 87% of the participants claim to wash their hands after using toilet, only 48% of participants had hand washing facility near the toilet as seen during observation.

Table 4 Awareness of 394 households on hand washing in four selected kebeles of Amhara region

Characteristics	No. (%)
<i>Awareness about hand washing</i>	
Before preparing food	190 (49)
Before eating food	324 (83)
Before feeding a child	39 (10)
After using a toilet	228 (59)
After cleaning a child	31 (8)
<i>Wash after using toilet</i>	
Yes	344 (87.5)
No	49 (12.5)
<i>Hand washing facility near the toilet(OB)</i>	
Yes	189 (48)
No	201(52)
<i>Wash before eating or feeding</i>	
Yes	379 (97)
No	11 (3)
<i>Hand washing facility in the house (OB)</i>	
Yes	330 (85)
No	60 (15)

OB- Observation

4.4.2 Type of animals owned by households

The mean number of poultry, sheep and cows owned by the respondents was 2.7, 1.4 and 1.3, respectively. Some owned horses, donkeys and mules (Table5). Nearly 70% of the households did not have a separate barn.

Table 5 Characteristics of 394 households owning animals in four selected kebeles of Amhara region

Variables	No. (%)	Mean + SD
<i>Type of Animals</i>		
Cows	336(85)	1.34 ± 0.83
Oxen	263 (66)	1.16 ± 1.05
Goats	10 (2.5)	0.09 ± 0.6
Sheep	177 (45)	1.4 ± 1.82
Poultry	302 (76)	2.79 ± 2.6
Pack animals*	202 (51)	0.74 ± 0.87
<i>Animals place /at night</i>		
Inside the house	263 (69)	
Barn	119 (31)	
<i>House to barn estimated distance(m)</i>		
1-2 m	15 (12.6)	
3-4 m	55 (46.2)	
5-6 m	41 (34.3)	
>7m	8 (6.3)	

*Pack animals include horses, donkeys and mules.

4.4.3 Observation of Sanitation and Hygiene Practices

During observation, 85% of the children were playing on a relatively clean place; 86% were relatively clean with nails trimmed. Solid waste was visible in the compound of 46% of the households, and animals were observed in 60% of the compounds. About 15% of children were unclean as they were playing in an unclean place (Table 6). Chickens were the most widely observed animals in (51%) and outside (45%) the house.

Table 6 Sanitation observations on 394 households in four selected kebeles of Amhara region

Characteristics	No. (%)
<i>Cleanliness of the compound</i>	
Animal waste inside the compound	181(47)
Animals in the compound	229 (60)
Solid waste in the compound	179 (46)
<i>Households with animals in the compound</i>	
Cattle	127 (34)
Sheep /goat	44 (12)
Poultry	168 (45)
Horses /donkey/mule	37 (10)
<i>Cleanliness of the house</i>	
Animal inside the house	80 (20)
Animal waste inside the house	66 (18)
Clean household appearance	332 (87)
<i>Households with animals inside the house</i>	
Cattle	40 (43)
Sheep /goat	5 (5)
Poultry	47 (51)
<i>Cleanliness of child</i>	
<i>- Cleanliness of playing place</i>	
Not clean	54 (15)
<i>-Hygiene of the child</i>	
Not clean	52 (14)
<i>- Nail</i>	
Untrimmed	70 (18)

4.5 Dietary Diversity

More than 50% of children in all age groups consumed 1-2 food groups and consumption of 3-4 food groups was less than 40%. Higher dietary diversity was found in the 24-35month age group children.

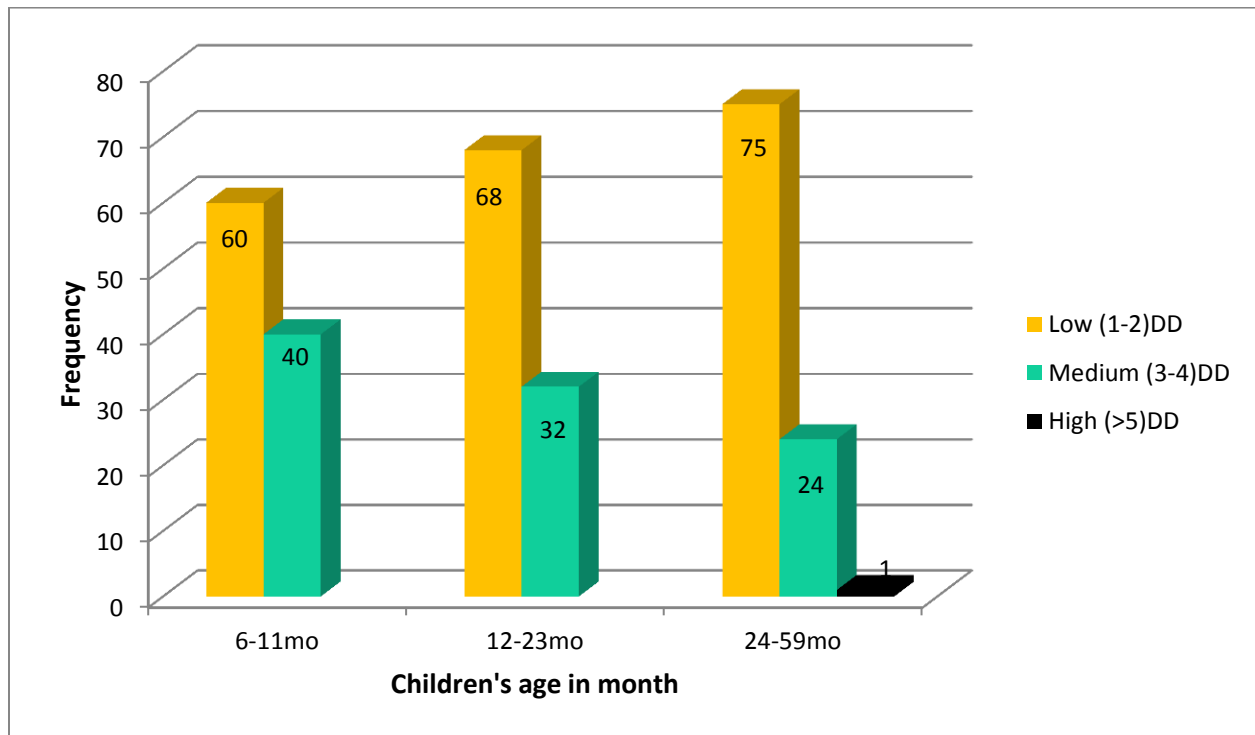


Figure 4 Dietary diversity of children aged 6-59months in the preceding 24hr in four selected kebeles of Amhara region

Cereals, roots and tubers were commonly consumed by all age groups (70%), and this was followed by legumes (Figure 10). Irrespective of the age of the child, consumption of nutrient-dense foods like eggs, meat, fish and poultry was less than 10%. The consumption of vitamin A-rich fruits and vegetables was almost nil and intake of other fruits and vegetables was also very low (<5%).

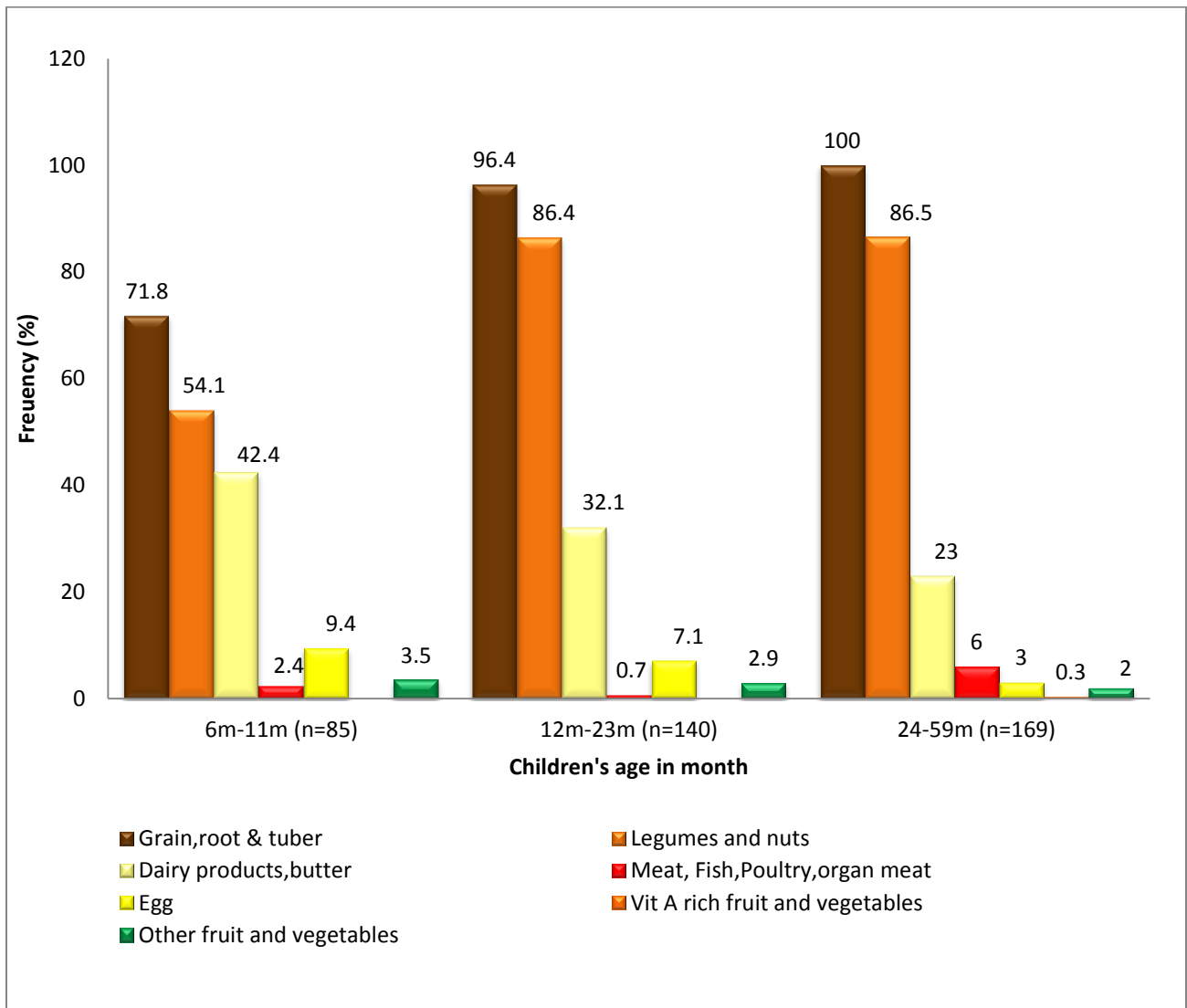


Figure 5 Food groups consumed by children aged 6-59 month in four selected kebeles of Amhara region

4.6 Factors Associated with Stunting

Results of the spearman correlation indicated that there was a significant positive association between number of oxen and child's weight for age and weight for height (Table 7). A negative association was also found between the number of goat a household keep and a child's height. Child's playing place, whether it was in the compound or outside the compound was positively associated with child's height. Keeping animals inside the house and having visible animal waste inside the house were negatively associated with HAZ as it was for cleanliness of child's nail.

Table 7 Association between child growth indicators (WAZ, HAZ & WHZ) and household characteristics

	HAZ		WAZ		WHZ	
	Spear man's rho	p-value	Spear man's rho	p-value	Spear man's rho	p-value
Food group consumed	-.016	.745	.036	.475	.034	.503
Still breast fed	-.109**	.031	-.105**	.038	-.055	.276
Birth rank	-.021	.679	-.041	.422	-.042	.403
Number of family	.005	.920	-.033	.521	-.047	.351
Childs age	-.051	.314	-.023	.651	-.002	.971
Mother's education level	-.014	.778	.027	.594	.066	.194
Mother's occupation	.002	.970	-.040	.424	-.060	.239
Number of chickens	-.010	.847	.041	.414	.053	.298
Number of cows	.051	.314	.014	.782	-.022	.663
Number of oxen	.034	.501	.127**	.011	.134***	.008
Number of goats	-.099**	.050	-.017	.734	.068	.177
Number of sheep	-.058	.253	-.004	.941	.017	.737
Number of horses	-.041	.422	-.205***	.000	-.229***	.000
Number donkeys	.014	.777	.106**	.035	.118**	.019
Number of mules	-.040	.430	-.065	.199	-.027	.590
Water source	-.070	.169	-.085*	.095	-.063	.217
Time to bring water	.091*	.075	.049	.343	-.040	.440
Liters of water	.041	.424	.099**	.050	.102**	.045
Type of toilet	.013	.802	.061	.230	.093*	.067
Child excreta disposal	.032	.530	.054	.289	.070	.167

Child playing inside the house	.039	.443	-.022	.661	-.034	.503
Child playing in the compound	.149***	.003	.133***	.009	.046	.361
Child playing outside the compound	.107**	.034	.061	.225	-.004	.942
Child general clean appearance	-.016	.748	.038	.457	.072	.160
Child's nail	-.110**	.030	-.058	.255	.031	.538
Animals overnight	-.029	.569	-.016	.756	.027	.595
Barn distance from main dwelling	-.022	.665	.005	.921	.050	.329
Cows in the compound	.022	.668	.081	.114	.102**	.046
Sheep /goat in the compound	-.089*	.080	.011	.830	.105	.040
Chickens in the compound	.013	.797	-.049	.334	-.041	.426
Horses in the compound	-.059	.245	-.099*	.052	-.047	.353
Clean compound	.087*	.087	.069	.177	.016	.762
Animal waste in the compound	.093*	.066	.107**	.036	.056	.270
Animals inside the house	-.099**	.050	-.076	.134	-.027	.589
Cows	.033	.521	.108**	.033	.111**	.028
Sheep /goat	-.060	.237	-.024	.633	.019	.703
Chickens	.096*	.058	.025	.629	-.036	.473
Household cleanliness	-.105*	.041	-.005	.925	.051	.324
Animal waste inside the house	-.105*	.042	.016	.755	.111**	.032

*p-value<0.1, **P<0.05, ***P<0.001

Controlling for different factors like mother's education level, mother's occupation, the diet diversity of a child, water source of the household, the type of toilet the household has and other covariates known to affect child growth, the negative association between number of goats and stunting remained significant (Table 8). There was also a significant negative association between number of horses and a child's weight and number of donkeys was positively associated with children weight for height Z-score. The total number of animals a household owned was negatively associated with stunting ($P < 0.05$). Both keeping animals inside the house and household cleanliness were negatively associated with stunting ($P < 0.05$).

Table 8 Association between HAZ and animal type, density and distance after controlling for confounders

Variables	HAZ	
		p-value
Number of chickens	-.091	.109
Number of cows	.040	.488
Number of oxen	-.021	.711
Number of goats	-.120**	.035
Number of sheep	-.081	.155
Number of horses	-.043	-.449
Number of donkeys	-.050	.381
Number of mules	-.068	.232
Total animals	-.127**	.026
Animals over night	-.019	.745
Barn distance from main dwelling	-.029	.613
Cows in compound	.073	.201
Sheep /goats in compound	-.074	.197
Chickens in the compound	-.008	.889
Horses in the compound	-.056	.326
Cleanliness of compound	.072	.209
Animal waste in the compound	.082	.150
Animals inside the house	-.134**	.018
Cattles in the compound	.063	.267
Sheep/goats in the compound	-.038	.510
Chickens in the compound	.074	.192
Household cleanliness	-.126**	.027
Animal waste inside the house	-.093	.103
Child general clean appearance	-.025	.663
Child's nail	-.081	.154

5. DISCUSSION

This study assessed the relationship between Water, Sanitation and Hygiene (WASH), animal keeping and child growth in Gafera, Surta, Dikuli and Tsion teguaz kebeles of Amhara region. The study showed that the prevalence of stunting, underweight and wasting was 32%, 23% and 17%, respectively. This result seems to be consistent with the 2016 Ethiopian Demographic and Health Survey (EDHS) report which showed the prevalence of stunting to be 38%, underweight 23%. In line with the report of Agedew and Chane (2015) in Kemba woreda, Southern Ethiopia, more boys than girls were stunted.

Several factors could be associated with the high stunting prevalence in this area. Among the key factors is WASH. Indeed, although 71% of respondents had access to improved water source, almost all (92%) did not treat their water prior to drinking it. In line with the 2016 EDHS report (95%), 90% of the respondents used unimproved toilet, which is defined based on the risk of human contact with feces and private use (but not shared or public) - (WHO/UNICEF/JMP, 2010). However, a more important indicator of risk of contamination is children's open defecation or unsafe disposal of child's excreta (WHO/UNICEF/JMP, 2010). Based on the indicator of open defecation/ unsafe disposal of child's excreta, 36% of the households in this study are at risk of contamination.

Another key factor consistently associated with stunting is dietary diversity. Indeed, diets of children in this study were predominantly plant-based with little or no consumption of nutrient-dense foods like eggs, MFP, and fruits. This finding is in line with the 2016 EDHS report that indicates that only 13.8% of children consume at least four food groups. The low dietary diversity is despite a significant proportion of households owning livestock. About 76% of households in this study owned poultry, 66% owned oxen, 85% owned cows, 46% owned goats and sheep and 51% owned pack animals.

The type, density, and number of livestock that the household owns can present a risk of poor WASH conditions that could have negative effects on stunting. Indeed the study by Headey *et al* (2017) showed that ownership of chicken and how close they roamed within the house was a significant predictor of stunting. In contrast to previous findings that have found poultry as a risk of child growth faltering, the number of goats owned was the only factor negatively associated

with child growth (-.099, $p=.05$). The magnitude of the association was even stronger when the model adjusted for covariates (-.066, $p=.035$).

Several limitations of the study need to be considered when interpreting our findings. First, the study is cross-sectional, hence not allowing causal inferences to be made. However, the study could still be indicative of potential factors associated with stunting. Second, although the study involved some household observation, this was only done once, which may not be enough to capture the habitual hygiene conditions of the households. Many of the indicators were non-normally distributed and auto-correlated; hence, we could not do regression analyses. However, the use of spearman correlation that adjusted for covariates presented a good alternative to investigate associations.

6. CONCLUSION AND RECOMMENDATION

The present study showed that the type and number of livestock rearing could present a risk for child stunting, particularly in settings where there is little consumption of the animal products. In this study, the number of goats households owned was negatively associated with HAZ. Ownership of other livestock like oxen and horses was in turn associated with WAZ and WLZ. In light of these findings, the following recommendation can be made:

While livestock ownership is often promoted, it does not always translate to consumption of animal source foods. A more aggressive behavioral change communication needs to be in place to promote the consumption of animal products in these settings.

To prevent growth faltering in children governmental and non-governmental organizations should work on educating the community about the risks of exposure to animal feces so that they may minimize their contacts.

Education on safe disposal of animal feces, encouraging and supporting households to have a separate place or barn for their animals, and keeping children's playing space clean and free from contamination is essential.

Composting animal waste and using it as a fertilizer for their home gardens.

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7 ANNEX I

7.1 Consent Form in English

Consent statement for participating in the survey and anthropometry measurement

This survey is done to explore the relationship between water, sanitation and hygiene (WASH) and animal keeping with child growth in your kebele. The findings of this research will be an input for nutrition, health and agricultural sectors. You are selected for this survey because you have an under five child. We kindly ask you and your child to be a part of this study. If you are willing to participate, you will be asked about your WASH practices in your house, it will take 15-20min. Your answers will not be disclosed to anyone except the primary investigator. If there is any question that you don't want to answer you can ask to skip or if you want to leave the survey, feel comfortable to do so at any time.

In addition to this we will measure the height and weight of your youngest child. It will help us to know the nutritional status of your child. It will be done twice. The measurement does not impose any harm to your child.

If you have any question about the survey and measurement you can ask me to clarify.

Are you willing to participate in the survey? Yes..... No

If mother/caregiver is willing to participate in the survey continue with the questions; if not you can leave.

7.2 QUESTIONNAIRE/ English/

Site number Site (village) name

House hold number..... Respondent's name

Mother/caregiver name Date/...../.....

Part 1.Socio demographic questions for child			
No	Questions	Answers	Skip
101	Name of the child		
102	Sex of the child	01 male 02 female	
103	Date of birth/...../..... dd/mm/yy	
104	How do you confirm the birth date	01 birth certificate 02 christening certificate 03 health center certificate 04 home registration 05 local calendar 06 mother or caregiver diary 07 from other people 08 other (specify)	
105	What is the birth rank of (NAME OF THE YOUNGEST CHILD)?		
106	Total number of household members		
107	How many under 5 children do you have?		
108	The relation of the respondent with the child	01 mother 02 caregiver 03 other (specify)	
109	Who is the head of the house	01 Mother 02 father / partner 03 fathers partner 04 mother's partner	

		05 other (specify)	
110	Religion	01 Orthodox Christian 02 protestant 03 catholic 04 Muslim 05 no religion 06 other specify	
111	Age of the mother/caregiver	Under 18 19-30 31-50 Above 50	
112	How old were you when you gave birth to your last child?	In years 88 don't know	
113	What is the marital status of the head of the household?	01 Single 02 Married 03 Widowed 04 Divorced	
114	Is your partner living with you or not	01 We're living together 02 He /she lives in other place	
115	What is the highest level of school the head of the household completed?	00 None 02 Primary 03 Secondary 04 Technical/vocational certificate 05 Higher/university/college 06 Others (specify) 88 Don't know	
116	What is the highest level of school the mother of the child completed?	00 None 01 Primary 02 Secondary 03 Technical/vocational certificate 04 Higher/university/college 05 Others (specify) 88 Don't know	
117	Occupation of the head	01 None 02 Farmer 03 Student 04 Fisher 05 Merchant 06 Government work 07 House work 08 Laborer 09 Other (specify).....	
118	If the heads occupation is farmer, whose	01 our own	

	land you plough?	02 family's 03 rented 04 unknown 05 other (specify)	
119	Payment type of the head	01 cash 02 cash and in kind 03 in kind 04 no payment	
120	What is the occupation of the mother/caregiver?	01 Farmer 02 Student 03 craft 04 Laborer 05 Merchant 06 Government work 07 House work 08 Other (specify).....	
121	Do you have electricity in your house?	01 No 02 Yes	
122	Do you have radio?	00 No 01 Yes	
123	Do you have TV?	00 No 01 Yes	
124	Does any member of this household own any agricultural land?	00 No 01 Yes	
125	Does this household own any livestock?	00 No 01 Yes	
126	If yes how many animals?	1. Milk cows 2. Oxen 3. Goats 4. Sheep 5. Poultry 6. Horse 7. Donkey 8. Mule 9. Others	

Part 2.ATONU beneficiaries

No	Questions	Answers	skip
201	Are you ATONU project beneficiary?	01 Yes 02 I was but I'm not now 03 No	Q>301 Q>301
If the response to question no 1 is YES continue with the next question if NO go to question no 301			
202	How does the project support you?	01 Giving poultry	

	<i>More than 1 answer is possible</i>	02 Giving seeds of vegetables for home 03 gardening 04 Giving education 05 Other (specify).....	
203	How many chickens have you had before the ATONU support?		
204	How many chickens were you given by ATONU?		
205	How many chickens are still alive from the poultry given to you?		Q>211
If all the chickens are dead skip to Q no211			
206	How important were the poultry for your household?	01 Very important 02 Important 03 Neutral 04 Unimportant 05 Very unimportant	
207	Have you eaten from the poultry given to you in the last six month?	01 Yes 00 No	
208	Have you taken any from your poultry to the market in the last six month?	01 Yes 00 No	
209	Have you consumed eggs from your poultry in the last six month?	01 Yes 00 No	
210	Have you sold any eggs in the past six month?	01 Yes 00 No	
211	How successful was your home garden in the past six month?	01 Very successful 02 Successful 03 Neutral 04 Unsuccessful 05 Very unsuccessful	Q>214 Q>214
If the answer is 04 or 05 skip to Q no 214			
212	Do you consume vegetables from your home garden?	01 Yes 00 No	
213	Have you ever taken vegetables from your garden to a market?	01 Yes 00 No	
214	Have you received any education from the project?	01 Yes 00 No	
215	Was the education given by the project necessary?	01 Yes 00 No	
216	What were the topics mentioned in the education? <i>There can be more than one answer</i>	01 Women empowerment 02 home gardening 03 food diversity 04 Other specify	
217	From the education you got which one	01 Women empowerment	

	have you practiced?	02 home gardening 03 food diversity 04 Other specify	
218	What have you benefited from the project?	
219	How do you rate the benefits you gained from the chickens?	01Very useful 02 Useful 03 Neutral 04Useless 05 Very useless	
220	How do you rate the benefits you gained from the home gardening?	01 Very useful 02 Useful 03 Neutral 04 Useless 05 Very useless	
221	How do you rate the benefits you gained from the education?	01 Very useful 02 Useful 03 Neutral 04 Useless 05 Very useless	
222	What do you want to be changed from the project?		

Part 3.WASH

No	Questions	Answers	skip
301	What is the main source of drinking water for the members of the household?	01 Piped water in to the household 02 Piped water into the compound 03 Public tap/stand pipe 04 Tube well/borehole(with pump) 05 Protected dug well 06Unprotected dug well 07 Protected spring 08 Unprotected spring 09 surface water (river, pond) 10 pond, lake 11 Other (specify)	
302	How many hours it takes you to bring water?	98.....min guessing 88 don't now	
303	How do you bring water to your house?	01 man power 02 donkey/horse	

		03 cart 04 other specify	
304	How much water do you bring daily?liters guess	
305	Observe if all water containers are covered	01 all are covered 02 some are covered 03 none are covered	
306	Do you treat your drinking water?	01 no 02 yes	
307	What do you use to clean/treat the water	01 Boiling 02 Treating chemicals 03 Clean cloth 04 Leaving until it settles 06 Other (specify)	
308	What kind of toilet facility do you have	01 VIP/simple pit latrine with flour/slab 02 Pit latrine without flour/slab 03 No facility, field, bush, plastic bag 04 Other (specify).....	
309	Observe if the house hold have (01 or 02)type latrine	01 yes they have 02 no	
310	How many households share this toilet	01 Not shared (1HH) 02 Shared family (2 HH) 03 Communal latrine (3 HH or more)	
311	The last time [NAME OF YOUNGEST CHILD] passed stools, what was done to dispose of the stools?	01 Child used toilet/latrine 02 Put/rinsed into toilet or latrine 03 Buried 04 Thrown into garbage 05 Put/rinsed into drain or ditch 06 Left in the open 07 Other (specify).....	
312	In your opinion when should we wash our hands	
313	Do you wash your hands after using a toilet or cleaning a child	00 No 01 yes	
314	Check if there is hand washing facility near the toilet (observation)	01 Yes there is 00 There is none	
315	Do you wash your hands before eating or feeding a child	00 No 01 Yes	
316	Check if there is hand washing facility inside the house(observation)	01 Yes there is 00 There is none	
317	Where does your child play? There can be more than one answer	01 Inside the house only 02 In the compound 03 Outside the compound	
318	Observe where the child was during the	01 Inside the house	

	visit?	02 In the compound 03 Outside the compound	
319	If the child is playing, check where she/he is playing?	01 on a clean place 02 on a dirt 03 near an animal	
320	Observe Child's hygiene	01 neat 02 not neat (soiled with dirt)	
321	Observe Child's clothing	01 fully dressed 02 partially /t-shirt only 03 other	
322	Observe Child's nails	01 Properly trimmed 02 Untrimmed	
323	Where do the animals stay at night?	01.In the house 02.In a barn	
324	Observe if there is a separate space/barn for the animals	01 Yes there is 00 There is none	
325	Observe How far the barn is from the main house	Guess in metermt	
326	Where do the animals stay at day	01. Inside the house 02. Outside the house/in the compound 03 outside the house compound	
327	Observe where the animals are at the time	01. Inside the house 02. Outside the house/in the compound 03 outside the house compound	
328	Observe if there are any animals in the compound	01 Yes 00 No	
329	If yes which type. there can be more than one answer	1. cows, Oxen 2. Sheep, Goats 3. Poultry 4. Horse, Donkey, Mule 5. Others /specify/.....	
330	Observe the House hold environment/compound cleanliness	01 No visible waste 02 Visible waste	Q>332
If the answer is 01 skip to Q 332			
331	Is there visible animal excreta	01 yes 02 no	
332	Were there any animals inside the house	01 Yes 00 No	
333	If yes which type. There can be more than one answer	1. cows, oxen 2. Sheep, Goats 3. Poultry 4. Others /specify/.....	
334	Household cleanliness	01 Clean	

		02 Not clean	
335	Is there any visible animal excreta inside the house?	01 Yes 00 No	

Part 4. Dietary pattern questions /24hr recall/

401. Tell me what your child ate and drank yesterday

Circle on the date:

01 Monday **02** Tuesday **03** Wednesday **04** Thursday **05** Friday **06** Saturday **07** Sunday

Time	Feeding place	Food/drink	Ingredients
402	Was the child breast fed yesterday?		No=0, Yes =1

Part 5. Anthropometry and 24hr recall form (only for children aged 6 to 59 months)

1. Child's code <input type="text"/>	2. date of interview/...../..... dd/mm/yy	3. location <input type="text"/>
Child's name First name middle name last name		
Mother/care giver name First name middle name last name		
4. child sex (1=M,2 =F) <input type="text"/>	5. age(months) <input type="text"/>	
6. child's weight in kilograms 1 st measurement 2 nd measurement Average	7. child's length in centimeters 1 st measurement 2 nd measurement Average	

We have finished the survey. Thank you very much for your participation and time.

7.3 Consent Form in Amharic

ትውውቅ እና ፍቃድ መጠየቅ

ስሜ..... ይባላል። የመጣሁት ከአዲስ አበባ ዩኒቨርሲቲ ሲሆን የመጣሁበት አላማም ከአለም አቀፍ የእንስሳት ምርምር ኢንስቲትዩት (ኢልሪ) በመተባበር በቀበሌያችሁ ያለውን የመቀንጨር ደረጃ ለማጥናት ነው። ከዚህ ጥናት የሚገኘው ጥቅል መረጃ ለጤና፣ ለስነ-ምግብ እንዲሁም ለግብርናው ዘርፍ እንደግብዓት ሆኖ ሊያገለግል ይችላል። እርስዎም የዚህ ቀበሌ ነዋሪ በመሆን እና ከአምስት ዓመት በታች የሆነ ህፃን ስላሉት በዚህ ጥናት ላይ እርሶ እና ልጅ እንዲሳተፉ በትህትና እንጠይቃለን። በጥናቱ ላይ ለመተባበር ፈቃደኛ ከሆኑ ቃለ-መጠይቁ ከ15-20ደቂቃ የሚወስድ ሲሆን የእርስዎም ሆነ የቤተሰብ የግል መረጃ በምስጢር የሚያዝ ይሆናል። ለመመለስ የማይፈልጉት ጥያቄ ቢኖር ለማለፍ ወይም ቃለ-መጠይቁን ለማቋረጥ ቢፈልጉ መብቶ የተጠበቀ ነው። ሆኖም የእርሶ ተሳትፎ አስፈላጊ ስለሆነ እንደሚሳተፉ ተስፋ እናደርጋለን።

በተጨማሪም በጥናቱ የተመለከተውን ልጅ ቁመትና ክብደት የሚለካ ይሆናል። የልኬቱን ትክክለኛነት ለማረጋገጥ ሁለቱ የሚካሄዱ ይሆናል። ልኬቱ በልጁ ላይ የሚያመጣው ምንም አይነት ችግር አይኖርም።

ቃለ-መጠይቁንም ወይም ልኬቱን የተመለከተ ጥያቄ ካሎት ወይም ከላይ ከጠቀስኩት ሀሳብ ግልፅ ያልሆነ ነገር ካለ ሊጠይቁኝ ይችላሉ። ጥያቄዎትን ለማብራራት ዝግጁ ነኝ።

በጥናቱ ላይ ለመሳተፍ ዝግጁ ኖት? አዎን የለም

እናት/ትንከባካቢ በጥናቱ ለመሳተፍ ፈቃደኛ ከሆኑ ጥቁዎን ይጀምሩ። ፈቃደኛ ካልሆኑ አመስግነው መጠይቁን ያቋርጡ።

7.4 Questionnaire in Amharic

ቃለ - መጠይቅ

ቃለ- መጠይቁ የተካሄደበት ቀን/...../2010ዓ.ም የመጠይቅ ቁጥር /...../...../...../...../...../...../.....

ክልል አማራ ወረዳ ቀበሌ የቤት መለያ

የተጠያቂው ስም

ክፍል 1. የህጻኑ ሁኔታ			
ተ.ቁ	ጥያቄዎች እና ማስታወሻዎች	አማራጮች/መልሶች	ዝለል
101	የህጻኑ ስም ማነው		
102	የህጻኑ ጾታ	01 ወንድ 02 ሴት	
103	የትውልድ ዘመን/...../.....ዓ.ም ቀን/ወር/ዓ.ም	
104	የትውልድ ዘመን መረጃ ምንጭ	01 የልደት ምስክር ወረቀት 02 የጥምቀት ምስክር ወረቀት 03 የህክምና ተቋም ማስረጃ 04 ከቤት ምዝገባ 05 ከአካባቢያዊ ቀን አቆጣጠር 06 እናት/ተንከባካቢ ማስታወሻ 07 ከሌላ ሰዎች መረጃ 08 ሌላ/ይገለጥ.....	
105	የህጻኑን ስም በመጥራት ስንተኛ ልጅ መሆኑን ጠይቅ		
106	የቤተሰብ አባላት ብዛት ስንት ነው		
107	ከ 5 ዓመት በታች የሆኑ የቤተሰቡ አባላት ስንት ናቸው		
ክፍል 2. የአቶኑ ተጠቃሚ			
ተ.ቁ	ጥያቄዎች እና ማስታወሻዎች	አማራጮች/መልሶች	ዝለል
201	የአቶኑ ተጠቃሚ ናት?	01 አዎን 02 ነበርኩ አሁን ግን አይደለሁም 03 አይደለሁም	301
ለጥያቄ 201 መልሱ 01 ከሆነ ወደ ቀጣዩ ጥያቄ ይቀጥሉ:: መልሱ ግን 02 ወይም 03 ከሆነ ወደ ጥያቄ 301 ይሻገሩ::			
202	ፕሮጀክቱ የሚያደርግለት ድጋፍ ምን ይመስላል? ከ1 በላይ መልስ ሊኖር ይችላል	01 ዶሮ በመስጠት 02 የአታክልት ዘር በመስጠት(በግቢ ውስጥ የሚዘራ) 03 ትምህርት በመስጠት 04 ሌላ ካለ ይገለጽ	

203	በፕሮጀክቱ ከተሰጡት ዶሮዎች ውስጥ በህይወት ያሉ ብዛት		
በህይወት ያለ ከሌለ ወደ ጥያቄ 209 ይዘለሉ			
204	ከዶሮዎቹ ያገኙትን ጥቅም እንዴት ይገልጹታል?	01 በጣም ጠቃሚ 02 ጠቃሚ 03 ምንም አይልም 04 ጠቃሚ አይደለም 05 ምንም አይጠቅምም	
205	ከተሰጡት ዶሮዎቹ ባለፈው 6 ወር ስጋ ተመግበው ያውቃሉ?	01 አዎን 00 አይ	
206	ከተሰጡት ዶሮዎች ውስጥ ባለፈው 6 ወር ወደ ገበያ ወስደው ያውቃሉ?	01 አዎን 00 አይ	
207	በተሰጡት ዶሮዎቹ የተጣለ እንቁላል ባለፈው 6 ወር ተመግበው ያውቃሉ?	01 አዎን 00 አይ	
208	በተሰጡት ዶሮዎቹ የተጣለ እንቁላል ባለፈው 6 ወር ወደ ገበያ ወስደው ያውቃሉ?	01 አዎን 00 አይ	
209	የጓሮ አትክልቱ ምን ያህል የተሳካ ነበር?	01 በጣም የተሳካ ነበር 02 የተሳካ ነበር 03 ምንም አይልም 04 ብዙም አልተሳካም 05 ምንም አልተሳካም	212
ለጥያቄ ቁጥር 209 መልሱ 04 ወይም 05 ከሆነ ወደ ጥያቄ ቁጥር 212 ይዘለሉ			
210	በፕሮጀክቱ ከተሰጡት ዘር ዘርተው ተመግበዋል?	01 አዎን 00 አይ	
211	ከጓሮ አትክልቱ የደረሰውን ለገበያ ወስደው ያውቃሉ?	01 አዎን 02 አይ	
212	በፕሮጀክቱ የሚሰጠው ትምህርት ገብቶት ያውቃል	01 አዎን 02 አይ	
213	በፕሮጀክቱ ትምህርት ምን ምን ተካቷል? ከ አንድ በላይ መልስ ሊኖረው ይችላል	01 ስለ ሴቶች ማብቃት 02 ስለየጓሮ አትክልት 03 ስለምግብ ማሰባጠር 04 ሌላ ካለ ይጥቀሱ	
214	ከተሰጠው ትምህርት የትኛውን ተግባራዊ አድርገዋል?	01 ስለ ሴቶች ማብቃት 02 ስለየጓሮ አትክልት 03 ስለምግብ ማሰባጠር 04 ሌላ ካለ ይጥቀሱ	

		
215	በፕሮጀክቱ የሚሰጠው ትምህርት ጠቃሚ ነው?	01 አዎን 02 አይ	
216	ከዶሮዎቹ ያገኙትን ጥቅም እንዴት ይገልጹታል?	01 በጣም ጠቃሚ 02 ጠቃሚ 03 ምንም አይልም 04 ብዙም ጠቃሚ አይደለም 05 ምንም አይጠቅምም	
217	ከጓሮ አትክልት ያገኙትን ጥቅም እንዴት ይገልጹታል?	01 በጣም ጠቃሚ 02 ጠቃሚ 03 ምንም አይልም 04 ብዙም ጠቃሚ አይደለም 05 ምንም አይጠቅምም	
218	በፕሮጀክቱ የሚሰጠውን ትምህርት እንዴት ይገልጹታል?	01 በጣም ጠቃሚ 02 ጠቃሚ 03 ምንም አይልም 04 ብዙም ጠቃሚ አይደለም 05 ምንም አይጠቅምም	
219	በፕሮጀክቱ ምን ቢሻሻል ጥሩ ነው ይላሉ?	
ክፍል 3. የቤተሰብ ብዛት			
ተ.ቁ	ጥያቄዎች እና ማስታወሻዎች	አማራጮች/መልሶች	ዝለል
301	መጠይቁን የሚሞላው ሰው ከህጻኑ ጋር ያለው ግንኙነት	01 እናት 02 ተንከባካቢ 03 ሌላ ከሆነ ይገለጽ.....	
302	የቤተሰቡ መሪ ማን ነው?	01 እናት 02 አባት/አጋር 03 ከባል ጋር የሆነ ሌላ ሰው 04 ከእናት ጋር የሆነ ሌላ ሰው 05 ሌላ ከሆነ ይገለጽ.....	
303	የየትኛው ሀይማኖት ተከታይ ናት?	01 ኦርቶዶክስ 02 ፕሮቴስታንት 03 ካቶሊክ	

		04 ሙሰሊም 05 የሀይማኖት ተከታይ ያልሆነ 06 ሌላ ከሆነ ይገለጽ.....	
304	የእናት/ተንከባካቢ እድሜ	01 ከ18 በታች 02 19-30 03 31-50 04 ከ50 በታች	
305	የመጨረሻውን ልጅዎን ሲወልዱ እድሜዎ ስንት ነበር?	እድሜ በአመታት 88 አላውቅም	
306	ያሉበት የጋብቻ ሁኔታ ምንድን ነው?	01 ያላገባ 02 ያገባ 03 የሞተበት 04 የፈታ	
307	የትዳር አጋሮ አብሮት ይኖራል ወይስ ሌላ ቦታ ነው ያለው?	01 አብሮት ነው የምንኖረው 02 ሌላ ቦታ ነው የሚኖረው	
309	የቤቱ መሪ ከፍተኛ የትምህርት ደረጃ ስንት ነው?	00 ምንም 01 አንደኛ ደረጃ 02 ሁለተኛ ደረጃ 03 ቴክኒክና ሞያ 04 ዩኒቨርሲቲ/ኮሌጅ በላይ 88 አላውቅም	
310	የልጁ እናት ከፍተኛ የትምህርት ደረጃ ስንት ነው?	00 ምንም 01 አንደኛ ደረጃ 02 ሁለተኛ ደረጃ 03 ቴክኒክና ሞያ 04 ዩኒቨርሲቲ/ኮሌጅ በላይ 88 አላውቅም	
311	የትዳር አጋሮ የስራ ዓይነት ምንድን ነው?	01 ምንም 02 አርሶ አደር 03 ተማሪ 04 አሳ አጥማጅ 05 ነጋዴ 06 የመንግስት ስራ 07 በቤት ውስጥ ስራ 08 የቀን ስራተኛ 09 ሌላ ካለ ይጥቀሱ	
312	አርሶ አደር ከሆነ የሚሰራበት መሬት የማነው?	01 የራሳችን ነው	

		02 የቤተሰብ 03 በኪራይ የተገኘ 04 የማይታወቅ ሰው ነው	
313	የትዳር አጋሮ በምን ዓይነት የክፍያ ሁኔታ ደግሞ ይከፈላል?	01 በጥሬ ገንዘብ 02 በጥሬ ገንዘብ እና በዓይነት 03 በዓይነት ብቻ 04 ክፍያ የለውም	
314	የእርስዎ የሥራ ዓይነት ምንድን ነው?	01 አርሶ አደር 02 ተማሪ 03 ባለሙያ 04 የጉልበት ሰራተኛ 05 ነጋዴ 06 የመንግስት ሰራተኛ 07 የቤት ውስጥ ሰራ 08 ሌላ ካለ ይጠቀስ	
315	በቤትዎ የኤሌክትሪክ መብራት አለ ወይ?	01 አለ 02 የለም	
316	ሬድዮ አለዎት ወይ?	01 አለ 02 የለም	
317	ቲቪ አለዎት ወይ?	01 አለ 02 የለም	
318	ከቤተሰቡ መካከል የራሱ የሆነ መሬት ያለው አለ ወይ?	01 አለ 02 የለም	
319	የርቢ እንስሳት /ኩባት/ አላችሁ ወይ?	01 አለ 02 የለም	
320	አዎ ካሉ ስንት?	1. የወተት ላም 2. በሬ 3. ፍየል 4. በግ 5. ዶሮ 6. ፈረስ 7. አህያ 8. በቅሎ 9. ሌላ ካለ ይጠቀስ	
ክፍል 4.ውሃ፣ ጽዳት እና ፍሳሽ			
ተ.ቁ	ጥያቄዎች እና ማስታወሻዎች	አማራጮች/መልሶች	ዝለል
401	ቤተሰቡ የመጠጥ ውሃ ከየት ያገኛል?	01 የቧንቧ ውሃ እስከ ቤት ድረስ ተዘርግቷል	

		<p>02 የቧንቧ ውሃ እስከ ግቢ ውስጥ ተዘርግተዋል</p> <p>03 የቧንቧ ውሃ ከግቢ ውጪ ተዘርግቷል/ቦኖ ውሃ/</p> <p>04 ፓምፕ ያለው የጉድጓድ ውሃ</p> <p>05 የታጠረ የጉድጓድ ውሃ</p> <p>06 ያልታጠረ የጉድጓድ ውሃ</p> <p>07 የታጠረ ምንጭ ውሃ</p> <p>08 ያልታጠረ የምንጭ ውሃ</p> <p>09 የገፀ ምድር ወንዝ</p> <p>10 ኩሬ/ሀይቅ/ግድብ</p> <p>11 ሌላ ካለ ይግለጹ</p>	
402	ውሃ ቀድቶ ለማምጣት ምን ያህል ሰዓት ይወስዳል?	<p>98 /...../...../...../ደቂቃ በግምት</p> <p>99 አላውቅም</p>	
403	ውሃ እንዴት ነው የምታመጡት?	<p>01 በሽክም</p> <p>02 በአህያ/በፈረስ ተጭኖ</p> <p>03 በጋሪ</p> <p>04 ሌላ ካለ ይግለጹ</p>	
404	በቀን ምን ያህል ውሃ ታመጣላችሁ?	<p>.....ጀሪካን 5ሊትር፤</p> <p>.....ጀሪካን 10 ሊትር፤</p> <p>.....ጀሪካን 20 ሊትር</p> <p>ሌላ ከሆነ ይግለጹ.....</p>	
405	(ምልክታ) በቤት ውስጥ ያሉ የውሃ ማጠራቀሚያዎች የተከደኑ መሆናቸውን ይመልከቱ	<p>01 ሁሉም ተከድነዋል</p> <p>02 አንዳንዱ ተከድኗል</p> <p>03 የተከደነ የለም</p>	
406	የመጠጥ ውሃውን ለማከም የምትጠቀሙት ዘዴ ምንድን ነው?	<p>01 ማፍላት</p> <p>02 በመድሃኒት/ኬሚካል በማከም</p> <p>03 በንጹህ ልብስ በማጣራት</p> <p>04 እስኪጠል መጠበቅ</p> <p>05 እንዲሁ ነው የምንጠቀመው</p> <p>06 ሌላ ካለ ይግለጹ</p>	
407	ቤተሰቡ የሚጠቀመው የመጻዳጃ ቤት ምን አይነት ነው?	<p>01 የጉድጓድ ሽንት ቤት ወለሉ በደንብ የተሰራ</p> <p>02 የጉድጓድ ሽንት ቤት ወለል ያልተሰራ/ ባህላዊ ሽንት ቤት</p> <p>03 ሽንት ቤት የለም /ቁጥቋጦ ውስጥ</p> <p>04 ሌላ ካለ ይግለጹ</p>	

408	(ምልክታ) ለጥያቄ 405 መልሱ(01:02) መልስ ከሆነ መጻዳኛ ቤት መኖሩን ያረጋግጡ	01 መጻዳኛ ቤት አለ 02 መጻዳኛ ቤት የለም	
409	ሽንት ቤቱን ስንት ቤተሰብ ይጋራዋል?	01 የዚህ ቤተሰብ ብቻ 02 ሁለት ቤተሰብ 03 የጋራ መጻዳኛ ነው /ከ 3 ቤተሰብ በላይ/	
410	/የልጁን ስም በመጥራት/ በመጨረሻ ሲጻጻፍ ሰገራው የት ነው የታጣለው?	01 ልጁ ሽንት ቤት ይጠቀማል 02 ወደ ሽንት ቤት ተጣለ 03 ተቀበረ 04 ወደ ቆሻሻ መጣያ ተጣለ 05 በውሃ ተለቅልቆ ወደ ጉድጓድ/ሜዳ ላይ ተደፋ 06 ሜዳ ላይ ነው 07 ሌላ ካለ ይግለጹ	
411	እጃችንን መታጠብ ያለብን መቼ መቼ ነው ብለው ያስባሉ?	01 02 03 04 05	
412	ልጅዎን ካጸዳዱ በኋላ ወይም ከመጻዳኛ ቤት ከተጠቀሙ በኋላ እጅን በአግባቡ ይታጠባሉ?	01 አይ 02 አዎ	
413	(ምልክታ) በመጻዳኛ ቤቱ አካባቢ የእጅ መታጠቢያ መኖሩን ያረጋግጡ	01 አዎን አለ 02 የለም	
414	ልጅዎን ወይም ራሱን ከመመገብ በፊት እጅን በአግባቡ ይታጠባሉ ?	01 አይ 02 አዎ	
415	(ምልክታ) በቤት ውስጥ የእጅ መታጠቢያ መኖሩን ያረጋግጡ	01 አዎን አለ 02 የለም	
416	ልጁ የት ነው የሚጫወተው? ከ 1 በላይ መልስ ሊኖረው ይችላል	01 በቤት ውስጥ 02 ግቢ ውስጥ 03 ከግቢ ውጪ	
417	(ምልክታ) በጉብኝቱ ወቅት ልጁ የት ነበር?	01 በቤት ውስጥ 02 ግቢ ውስጥ 03 ከግቢ ውጪ	
418	(ምልክታ) ልጁ እየተጫወተ ከሆነ የሚጫወትበት አካባቢ ምን ይመስላል?	01 በንጹህ ቦታ ላይ 02 በቆሻሻ ቦታ ላይ 03 በእንስሳት አካባቢ	
419	(ምልክታ) የልጁ የሰውነት ንጽህና ምን ይመስላል?	01 ንጹህ ነው 02 ቆሻሻ ይታይበታል	
420	(ምልክታ) የልጁ የልብስ አለባበስ ምን ይመስላል?	01 ሙሉ ልብስ ሲሰጥ	

		02 ከላይ ብቻ ለብሷል 03 ሌላ	
421	(ምልከታ) የልጁ ጥፍር ምን ይመስላል?	01 ተቆርጧል 02 ያልተቆረጠ /ቆሻሻ ያለበት/	
422	ያሏቸውን እንስሳት ማታ የት ነው የምታሳድሩት?	01 ቤት ውስጥ 02 በበረት ውስጥ	
423	(ምልከታ) ለእንስሳቱ በቤቱ ውስጥ የተለየ ወይም በረት የተዘጋጀ መሆኑን ያረግጡ?	01 አዎ አላቸው 02 የተለየ ቦታ የላቸውም	
424	(ምልከታ) የተለየ በረት ካለ ከዋናው ቤት ምን ያህል ይርቃል ? (በግምት)	በግምትሜትር	
425	እንስሳቱ ቀን ቀን የት ይውላሉ?	01 ቤት ውስጥ 02 በግቢ ውስጥ 03 ከግቢ ውጪ	
426	(ምልከታ) በጉብኝቱ ወቅት እንስሶቹ የት ነበሩ?	01 በቤት ውስጥ 02 በግቢ ውስጥ 03 ከግቢ ውጪ	
427	(ምልከታ) በግቢ ውስጥ እንስሳት አሉ?	01 አዎ አሉ 02 የሉም	
428	(ምልከታ) ግቢ ውስጥ እንስሳት ካሉ የትኞቹ ናቸው? ከ 1 በላይ መልስ ሊኖር ይችላል	01 ላም፣በሬ 02 በግ፣ፍየል 03 ዶሮዎች 04 ፈረስ፣አህያ፣በቅሎ 05 ሌላ ካለ ይግለጹ	
429	(ምልከታ) የግቢውን የንጽህና ሁኔታ ይመልከቱ	01 የሚታይ ቆሻሻ የለም 02 ቆሻሻ በግቢ ውስጥ ይታያል	
430	(ምልከታ) የሚታይ የከብት ቆሻሻ	01 አለ 02 የለም	
431	(ምልከታ) በቤት ውስጥ እንስሳቶች አሉ ወይ?	01 አዎ አሉ 02 የሉም	
432	ካሉ የትኞቹ ናቸው?	01 ላም፣በሬ 02 በግ፣ ፍየል 03 ዶሮዎች 04 ሌላ ካለ ይግለጹ	
433	የቤቱ ውስጥ ንጽህና ምን ይመስላል?	01 ንጹህ ነው 02 ንጹህ አይደለም	
434	በቤት ውስጥ የሚታይ የእንስሳት ቆሻሻ አለ?	01 አዎ አለ 02 የለም	

ክፍል 5. የ24 ሰዓት የህጻናት አመጋገብ ሁኔታ የተመለከተ

501.(የልጅ ስም) ትላንት ከአንቅልፍ አንደተነሳ ምን እንደበላ እና እንደጠጣ(ፈቃደኛ ከሆኑ) ይነገሩኝ

የሳምንቱ ቀናት (በቀኑ ላይ ያክብቡ) 01 ሰኞ 02 ማክሰኞ 03 ረቡዕ 04 ሀሙስ 05 አርብ 06 ቅዳሜ 07 እሁድ

ሰዓት	ምግብ	መጠጥ	የንጥረ ምግብ መግለጫ
502	ልጅ ትላንት ጡት ጠብቶ ነበር ወይ?	01 አዎ 02 አልጠባም	

መጠይቁ ተጠናቋል። ለተሳትፎዎና ለሰጡን ጊዜ በጣም እናመሰግናለን።

ክፍል 6. የቁመት እና የክብደት ልኬት

የልጅ ስም	የልጅ እድሜ	የልጅ ጾታ ወ..... ሴ
601	የልጅ ክብደት (በግራም)	1ኛ ልኬት 2ኛ ልኬት.....
602	የልጅ ቁመት በቁም የሚለካ	1ኛ ልኬት 2ኛ ልኬት.....
603	የልጅ ቁመት በጀርባው/ዋ ተኝቶ/ታ የሚለካ	1ኛ ልኬት 2ኛ ልኬት.....

8. ANNEX II

8.1 ATONU Beneficiaries

From 44 ATONU beneficiaries, who had a child aged 6-11 month, only 36 children completed the survey the others were not present for anthropometric measurement. Children less than the age 3 were 80% from the total and 57% of the children's were males. From the children 33% were stunted, 25% were wasted and 19% were underweight. 41 households had cows, 36 of them had chickens and none of them had mules.

Table 1 Nutritional status of 36 ATONU beneficiary children aged 6-59 month.

Child characteristics	Frequency (%)	mean (SD)
Gender (Male)	25 (57)	
6-11 month	5 (14)	
12-23 month	12 (33)	
24- 35 month	12 (33)	
36 – 47 month	3 (8)	
48 – 59 month	4 (11)	
Stunted (HAZ < -2)	12 (33)	-0.898 (1.60)
Wasted (WAZ < -2)	9 (25)	-1.31 (1.99)
Underweight (WHZ < -2)	7 (19)	-1.36 (1.63)
Number of Livestock		
Cow	41(93)	1.00 (.374)
Ox	25 (56.8)	0.70 (.701)
Goat	2 (4.6)	0.07 (.334)
Sheep	18(41)	0.64 (.838)
Chicken	36 (81.7)	1.80 (1,13)
Horse	20 (45.5)	0.57 (.728)
Donkey	8 (18)	0.18 (.390)
Mule	None	None

All the beneficiaries received chickens and education, only one household did not received vegetable seeds from the project. More than 70% of them had eaten and sold chicken and eggs from their home. 59% believed the chickens were very important and 4.5% believed the chickens were very unimportant. The home gardening was very successful for 25%, successful for 38% and unsuccessful for 23% of the beneficiaries.

Table 2 Support from the project the 44 beneficiaries received

Benefits	YES		NO	
	Frequency	%	Frequency	%
Received chickens	44	100		
Received vegetables seed	43	98	1	2
Received education once in 15 days	44	100		
Eaten poultry in the past 6 month	32	74.4	11	25.6
Sold chicken	32	76	10	24
Eaten eggs in past 6 month	37	88	5	12
Sold eggs in the past 6 month	35	83	7	17
Consumed vegetables from their garden	33	75	11	25
Sold vegetable to market	14	33	28	66
Received education once in 15 days	41	97	1	2
Education about women empowerment	41	93	3	7
Education about home gardening	43	98	1	2
Education about diversifying food	43	98	1	2
Practiced women empowerment	14	32	30	68
Practiced home gardening	35	79.5	9	20.5
Practiced diversifying food	39	87	5	11

For all beneficiaries chickens were given, before the project 14%, 25%, 52% and 9% had no chicken, 1-2 chickens, 3-5 chickens and more than 5 chickens respectively. There were no chickens in 17% of the households during the survey, in 58% of the households not more than 5 chickens were found, 7% had 6- 10 chickens and more than 10 chickens were found in 16% of the beneficiaries homes. Almost half of the respondents rated the benefit of receiving the chickens very useful and 5% rated it was useless, and 40% rated the benefit from the home gardening to be very useful and 13% said it was useless (figure 1). Home gardening was successful in only 25% of households and unsuccessful for 23% of beneficiaries.

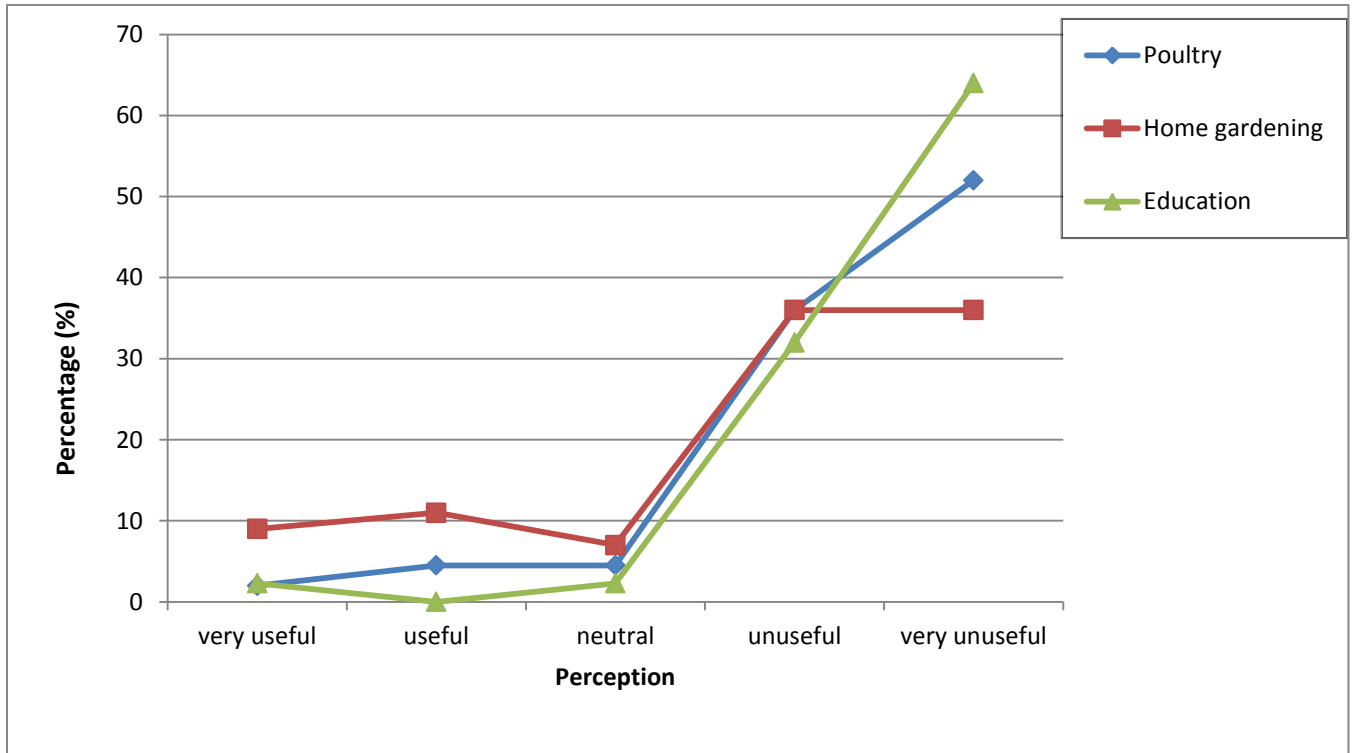


Figure 1 Perception of beneficiaries on the usefulness of the support

Public tap water usage was by 32% of the beneficiaries same percentage used water from tube well with pump. Only 7% had a pit latrine with floor while 16% had no facility. 38% of children used toilet and 16% of children's excreta was left in open. 82% of households claimed to wash their hands after using toilet but only in 70% of the households was found a hand washing facility near the toilet.

Table 3 WASH characteristics of 44 beneficiaries in 4 rural kebeles of Amhara region

Variables	Frequency	%
Water source		
Public tap	14	31.8
Tube well with pump	14	31.8
Protected spring	6	13.6
Other (unprotected)	10	22.8
Type of toilet		
VIP/pit latrine with floor	3	6.8
Pit latrine without floor/traditional	34	77.3
No facility, bush, field	7	15.9
Child's excreta disposal		
Child use toilet	17	38.6
Put in to toilet	18	40.9
Other (unsafe disposal)	9	20.4
Hand washing after using toilet		
Yes	36	81.1
Facility near the toilet (OBn.)	31	70.5
Hand washing before eating/feeding a child		
Yes	38	86.4
Facility inside the house (OBn.)	33	75

According to a previous day24hour dietary recall consumption of grain, root and tuber was 91%. Dairy product consumption was 32% and egg consumption was 9%. Other fruits and vegetables (7%) were consumed better than vitamin A rich fruits and vegetables (2%).

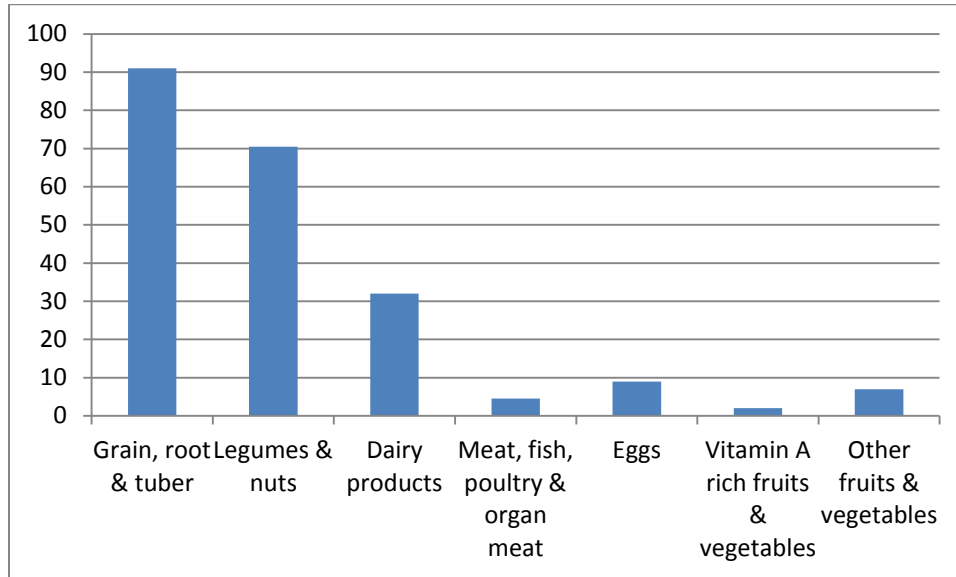


Figure 2 Consumption of food groups by ATONU beneficiary children

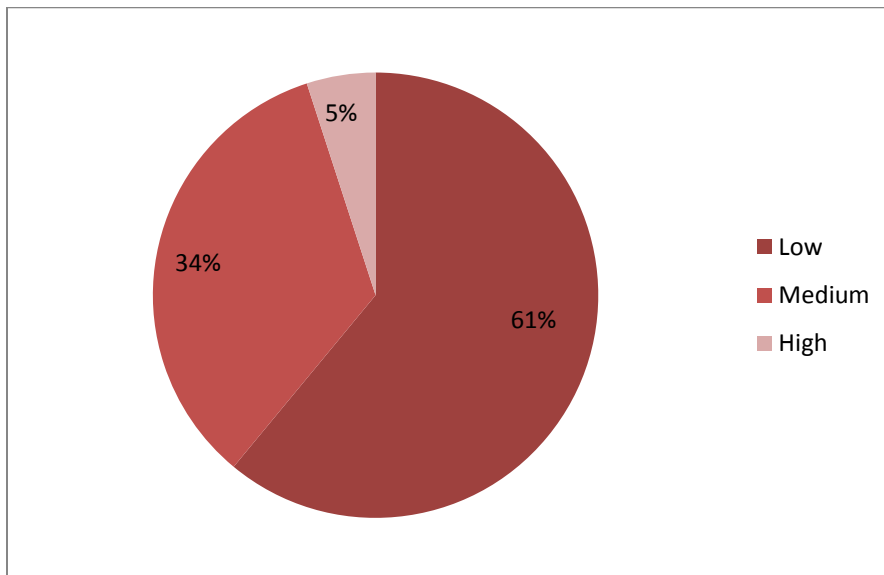


Figure 3 Dietary diversity of ATONU beneficiary children

8.2 Benefit from the project

Many beneficiaries said the benefit they gained from the projects was receiving chickens and seeds for home gardening. They said this has increased their consumption of egg and vegetables. Some said the project has helped them to increase their income by selling chickens and eggs and allowed them to buy what they don't have in the house. Few said the education given by the project was very useful and helped them to know about women and sharing responsibilities.

8.3 What to improve from the project

Most of the beneficiaries want the project to continue supporting them but they also mentioned what should be improved. Almost all beneficiaries said the project have to consider the season for giving poultry and seed mentioning the chickens they received during the rainy season died and the vegetables could not survive the dry season. They also stated the need for medication for the chickens. The red/brown colored chickens were more preferred by some of the beneficiaries and they want to get those for next phase. Some also said that it would be better if the giving of vegetable seeds consider what is most profitable with the type of land and weather. They also mentioned permanent crop will benefit them more.