IMPACTS OF WASH ON COMMUNITY-MANAGED ACUTE CHILD MALNUTRITION IN ETHIOPIA

By

BIZUNEH ASSEFA

A research project report submitted in partial fulfilment of the requirements for the award of the degree of
Master of Science
Of Loughborough University

DECEMBER 2010

Supervisor: A. Godfrey (Dr.)

Water, Engineering and Development Centre
Department of Civil and Building Engineering

Acknowledgements

I am gratefully acknowledges the inputs of thought, words, and time of numerous people during the study of this dissertation. I would like to extend my sincere gratitude to my family (Martha, Michael, Natnael and Fikreab) and Concern Ethiopia that made possible this study with financial and moral supports.

While many individuals contributed to this document; special recognition is given to the following individuals and organizations:

- Dr. Amoka Godfrey of WEDC, Loughbrough University of UK, and my supervisor of the study, for providing me with valuable advice, guidance and critical editing needed to complete my study.
- Aine Fay, former Concern Ethiopia Country director, for her intelligent leadership, support and follow-up of every steps of my study in WEDC.
- Endalmaw Belay, Concern Ethiopia North-Ethiopia Coordinator; my guarantor for the study, for his passion, tolerance and commitment of support during the study.
- Asnaku Hassen, human resource Manager of Concern Ethiopia, for her exceptional support and advice during my study in WEDC.
- Yizengaw Yimene, senior Nutritionist in Concern Wollo, for his coach and sharing his wealth of experience during the study.
- Dessie Zuria Zone Water office, for providing water test kits and experts during field experiment.
- And the six data collectors(Mebrat, Bayoush,Toyeba, Ansha, Mulu and Zewde)

At last, I would like to extend my honorable thanks for Concern-Wollo livelihood, Emergency Nutrition and Logistic programs staffs for advice and support in many conditions while I am doing the research.

Certificate of Authorship

I certify that:

(i) I am responsible for the work submitted, and that the original work is my own

(ii) I have not submitted this work to any other institution for the award of a degree;

(iii) all *laboratory work, *field work and *computer programming has been carried out by me with no outside assistance *except as noted below;

- Water quality test kits and assistant water quality experts work with the researcher.
- Six data collectors work with the researcher

and

(iv) all information (including diagrams and tables) or other information that is copied from, or based on, the work of others has its source clearly acknowledged in the text at the place where it appears.

Signed: _____

Name: _____

Date: _____

Individual Research Project Access Form

Location: WEDC Resources Centre, Loughborough University

Author: Bizuneh Assefa Wassie

Title: IMPACTS OF WASH ON COMMUNITY-MANAGED ACUTE CHILD MALNUTRITION IN ETHIOPIA

Status of accesses: Open

Author's declaration:

I agreed to the following conditions:

This project report shall be made available within the WEDC Resources Centre, both as a hard copy and electronically, and may be borrowed by WEDC staff and students. Sections may be used for teaching purposes, and pages copied, subject to copyright regulations. It may also be copied by the British Library for supply to requesting libraries and individuals, subject to a written assurance that it will not be published in part or in full.

Author's signature: _____ Date: _____

Conditions of access approved by: _____

(Project Supervisor's name)

Supervisor's signature: _____

Abstracts

Child malnutrition in Ethiopia claims children death counted in hundred-thousands every year. Despite considerable efforts are exerted by the national and regional state governments; it is now a serious concern of the country and international humanitarian aid agencies. Many humanitarian aid agencies links chid malnutrition from nutrient rich food deficit alone and intervening more in curing than prevention. However the study recognises child malnutrition as a complex and multidimensional issues; but mainly deep rooted in inadequate and inefficient public health issues at household level. Adequate and wholesome water supply, proper sanitation and hygiene promotion and socio-economic improvement at poor household level contribute to the reduction of child malnutrition in Ethiopia. The study identifies micro level determinants of household wealth status, family sizes, birth spacing, safe and accessible water, have and use of latrine, washing hands with soap as key determinants of acute child malnutrition in Ethiopia. Empirical results of the study seriously condemn institutionalising community based management of acute child malnutrition (CMAM) with one sector which is Ministry of Health and urges the importance of linking WASH, Gender, and pro-poor household economy empowerment with the existing CMAM approach to reduce child death; to improve recovery rate and to discourage re-admission rates of children in any child oriented emergency interventions.

Executive Summary

Purpose

Ethiopia, mainly punctuated by recurrent drought and famine, has the highest child malnutrition rates in the world. Hundred thousands of children died each year before celebrating their fifth birthday due to malnutrition related causes. The socio-economic and intergenerational adverse impacts of child malnutrition are also enormous in Ethiopia. Despite, international humanitarian agencies, bilateral and multilateral donors and the hosting government exert lots of effort to mitigate child malnutrition in Ethiopia; it is steel a pressing problem across all regions of the country. The study entitled 'evaluate the impacts of WASH on community managed acute child malnutrition in Ethiopia' emanate from the prevailing problems observed in an emergency intervention programs held by Concern Ethiopia in a district of Ethiopia.

The main purpose of the study is to contribute to the improvement of child malnutrition intervention approaches through investigating the impact of WASH on moderate and severe acutely malnourished rural children aged between 6-59 months. The study has taken place in one of emergency prone district of Ethiopia where Concern-Worldwide has implementing CTC/CMAM emergency intervention programs since 2008.

The study has set two objectives. Each objective has two specific hypothetical questions as follows:

1. To assess the potential impact of socio-economic determinants of family size and relative wealth status of a household on acutely malnourished children aged between 6 to 59 months in Dessie Zuria Woreda of Ethiopia.
    a. How do fertility rate/family sizes of a household living in rural areas affect child malnutrition?
    b. How does relative wealth disparity among the rural people impacts on child malnutrition? Does child malnutrition reduce when the wealth status of the poor reaches to the middle and better-off?
2. To evaluate the potential impact of water supply, sanitation and hygiene facilities on severe and moderate acute child malnutrition aged between 6 to 59 months in Dessie Zuria Woreda of Ethiopia.
    a. Does an improved water supply sources improve child malnutrition? Are there any malnutrition index differences between children using protected and unprotected water sources?
    b. How does sanitation and hygiene improvement at household affect child malnutrition? Are there any malnutrition index differences between children below

five years whose households have and have-not basic sanitation and hygiene facilities?

Methodology

A cross-sectional descriptive case control study approach was used to asses the prevailing disparity of anthropometric index differences (wasting and underweight) among three distinct groups: moderately acutely malnourished children (MAM), severely acutely malnourished children (SAM) and controlled group children (CGs). The researcher used interviews, observation and field experimental methods to harness primary data. Secondary data sources, particularly livelihood and emergency nutrition surveys and reports held by the agency were well reviewed to triangulate the reliability and validity of primary source data.

In addition, went to every individual houses of MAM, SAM and CG children, a total of 217 children below five years of age anthropometric data of height, weight, age, sex and MUAC are assessed from June 25 to July 20/2010. To get better insight on the existing water, sanitation and hygiene condition of the family; all mothers'/caretakers of these children are interviewed and observed during field work. Moreover; thirty-seven water samples from household storages and six from protected communal water sources were examined to crosscheck the prevailing water quality at household and communal level respectively. The views of six-key informant interviewees were also considered during data analysis.

Statistical and nutritional assessments of key WASH and anthropometric variables are analysed using statistical packages for social science (SPSS) and emergency nutrition assessment (ENA) software respectively. Variables whose P-values are below 0.05 are analysed.

Principal findings

Key findings 0f the studies are:

- ✓ Child malnutrition surprisingly reduced as one goes from poor to better-off households. Relative wealth disparity among the rural people is an aggravating cause of child malnutrition in Ethiopia. Very poor and poor segments are the prime victim takers of child malnutrition below five years.
- ✓ The effect of high number of family sizes (five and more persons per household) has nothing to do with wasting. It is not the high number of family size that significantly determines child malnutrition below five years of age, rather the number of under-five year children per household is a critical determinant of aggravating wasting and underweight of children. Analysis revealed that the effect of severe wasting which is the cause of many child deaths; mainly manifested in households having two and more children below age five. High number of family size and the presence of two and more

children below five years of age in a family is the worst scenario to aggravate acute child malnutrition.

- ✓ Bacteriological safe water at home significantly reduces child wasting and underweight. Public health issues, particularly related to protected/safe water plays great role on reducing child malnutrition in rural areas. Children wasting and underweight significantly reduced in households used protected water sources than unprotected water source users. There is a negative correlation between protected water and child malnutrition indexes of wasting and underweight.
- ✓ Mothers' energy and time spent on water collection aggravate child malnutrition. There is no direct relationship between child malnutrition and topographical challenges; rather indirectly elongate time to collect water and demands high calories of mothers. Cross comparison was held in-between better-off families who used cattle power and mothers' power for water collection. The result revealed that children whose mothers used cattle power to fetch water showed improvement in nutritional status than mothers used their own power.
- ✓ Sanitation facilities particularly having and using latrine at household level significantly reduces child malnutrition. Safe disposal of excreta, particularly proper disposal of child excreta is vital to improve child malnutrition at household level. Empirical results of the study show that children nutritional indexes of wasting and underweight are lower in households having traditional pit latrine than have-not.
- ✓ Handwashing with soap is critically important to reduce acute child malnutrition from Ethiopia. Family members, particularly mothers and caretakers handwashing with soap plays significant role to reduce acute child malnutrition in rural areas. The study remarked that children of mothers/caretakers who used soap to demonstrate handwashing and wash at critical time show nutritional improvement than the counterparts that not used soap. Moreover; handwashing with soap is critically important to speed up recovery rates of moderately and severely malnourished children below five years of age.
- ✓ Improvement in hygiene promotion at household level contributes lots for child malnutrition reduction. The empirical results of interview and observation at the study areas showed that the level of hygiene awareness is very low. Most of them not recognize the detrimental impacts of open defecation and improper child faeces disposal on child health. Proper storage and handling of water at home, handwashing with soap at critical time and proper disposal of household solid and liquid wastes contribute to ill health and child malnutrition in Ethiopia.

Conclusions

Based on the summarized findings of the study, the researcher set the following conclusions and recommendations.

- Child malnutrition affects every economic and social classes of the society. However the magnitude is harsher to children born from poor and very poor households. The combined effect of household poverty and deprive of basic necessities of water, sanitation and hygiene facilities make child malnutrition more complicated.
- High numbers of family size seriously impede child malnutrition. Its adverse effect is mainly prevailing on underweight than wasting of children. But, high number of family size combined with two and more U'5 children in a family seriously aggravate both wasting and underweight. Hence; the main concerns of nutritionists, working on acute child malnutrition; has to be high family size and the existence of two and more under-five years' children in a family.
- Unprotected or unsafe water sources seriously aggravate acute child malnutrition. Child born and live in households who used protected water sources is less vulnerable to acute child malnutrition than the counterpart that used unprotected water sources. By enhancing susceptibility to diarrheal infections, unprotected/unsafe water pushed the moderate malnourished children to be more severely malnourished
- Inaccessible water supply projects that demand high calorie and time expenses of mother's impacts child malnutrition. Any advancement of rural water supply technologies that reduce time and energy of mother's can bring positive deviance on child malnutrition.
- Have and use of traditional pit latrine improve child malnutrition. The more advancement of appropriate household sanitation technologies in rural setting more reduces child malnutrition. Proper child faeces disposal to pits and creating open defecation free environment in the rural villages positively contribute to the reduction of child malnutrition.
- Improvement in the level of sanitation and hygiene awareness at every household is found critical to minimize child deaths due to malnutrition. Severe child malnutrition mainly the issue of ill health due to infections comes along with poor sanitation and hygiene at household level.
- Mothers/caretakers handwashing with soap, particularly at critical times is more important hygiene promotion works to reduce child malnutrition. By promoting key hygiene messages in the rural setting, it is possible to reduce child suffrage due to severe wasting and underweight.

Recommendations

- Pro-poor development policy and strategy, that strives to reduce wealth disparity among the poor and better-off, either through agricultural productivity or from non-agricultural sectors is indispensible to minimize child suffrage due to acute child malnutrition.
- Enhance reproductive health and family planning in every rural household. Not only need the provision of contraceptives but also social works equal emphasis.

- Protect every communal water sources! To ensure faecal pollution as minimum as possible. Proper design, sitting, construction, monitoring and evaluation are required.
- Introduce appropriate water treatment technologies and supplies to treat water at household level are vital. Government has to monitor every communal water pollution incidences and immediately react and correct the problem.
- Every rural household who depend on unsafe water sources has to get the required water disinfectants (*aqua-tabs*) during rainy season.
- Considering the pro and cons of provision of supplying more cattle on the existing natural and public resources; introducing hauling cattle with long-term subsidized repayment.
- Set proper and regular sanitary surveillance, disinfection and maintenance system to ensure safe and reliable drinking water supply.
- Effectively and efficiently implement the existing National Sanitation and Hygiene Strategy of Ethiopia.
- Increase the level of awareness of the people through appropriate hygiene promotion tools and approaches.
- Link water, sanitation and hygiene programs with CTC and CMAM approaches not only in case of emergency but also in long-term development.
- Mainstream nutrition and gender equality in every development and emergency context.
- Institutionalize CMAM approaches to multi ministry levels: Particularly to Ministry of Health(MoH), Water(MoWR) , Agriculture(MoA) and Economic and Finance (MoFED)

Table of Contents

Lists of Figures

Lists of Tables

Lists of Pictures

Acronyms

ACF:	Action Contre la FAIM (Action against Hunger, an international NGO)
ARSE	Amhara Regional State of Ethiopia
CMAM:	Community based Management of Acute Malnutrition
CNS:	Concern Nutrition Survey
CTC:	Community-Based Therapeutic Care
DFID:	Department for International Development
DHS:	Demographic Health Statistics
DZ:	Dessie-Zuria
DZW:	Dessie Zuria Woreda
DZWHO:	Dessie Zuria Woreda Health Office
EFMoH:	Ethiopia Federal Ministry of Health
EHP:	Environmental Health Project
ENA:	Emergency Nutrition Assessment
ENCU:	Emergency Nutrition Coordination unit
FDREMoH:	Federal Democratic Republic Ethiopia Ministry of Health
HAZ:	Height age Z-score
HH:	Household
IFPRI:	International Food Policy Research Institute
INGO:	International Non-Governmental Organisation
IRC	International Water and Sanitation Center
JAMA:	Journal of American Medical Association
MDG:	Millennium Development Goal
MoFED:	Ministry of Finance and Economic Development
MoH:	Ministry of Health
MUAC:	Mid Upper Arm Circumference
NCHS:	National Centre for Health Statistics
NRHSE:	National Reproductive Health Strategy of Ethiopia
NSCSE	National Strategy for Child Survival in Ethiopia
NGO:	Non Governmental Organisation
OTP:	Outpatient Therapeutic Program
P-Values:	Probability values (observed significance level)
RUTF:	Ready-to-Use Therapeutic Food
SD:	Standard deviation
SFP:	Supplementary Feeding program
SPSS:	Statistical Package for Social Science
TFC:	Therapeutic Feeding Centre

TPL:	Traditional pit Latrine
UNCHR	United Nations High Commissioner for Refugees
US-AID:	United States Agency for International Development
U’5:	under five years
WASH:	Water Sanitation and Hygiene
WAZ:	Weight Age Z-square
WEDC:	Water Engineering Development Centre
WFP:	World Food Program
WHO:	World Health Organisation
UNICF:	United Nations Children’s Fund
WHZ:	Weight for Height Z-square
WSP	Water and Sanitation Program

Definition of Terms

Amhara region: One of the second largest population federal state of Ethiopia

Community Therapeutic Care (CTC): It is an approach designed to provide care for the majority of acutely malnourished children at home over inpatient care over a few extreme cases.

Concern Worldwide: It is a non-governmental, international, humanitarian organisation dedicated to reduction of suffering and working towards the ultimate elimination of extreme poverty in the world's poorest countries.

Dessie Zuria Woreda (DZW): It is the second lowest administrative units of the government, comprising Thirty-one Kebeles. It is one of the drought prone and emergency areas of the Amhara Region.

E-coli: Escherichia coli, is an ideal indicator that indicate existence of faecal-pollution. In most cases used in routine assessment of faecal-contamination of water resources, however not show protozoa and viruses.

Gott: Equivalent meaning to small village. It is the *smallest* group or sub-division of Kebele that has specific name locally with defined geographic boundaries that are known to the local people.

Kebele: The lowest government administrative unit

Mid-upper Arm circumference (MUAC) meter: is a measuring instrument, usually plastic tape used to screen and admit children only by measuring the Mid-upper Arm circumference. Children whose mid arm circumference less than 110mm refer and admitted to Outpatient Therapeutic Program(OTP), whereas; >/=110mm and <125mm are admitted to Supplementary Feeding Program(SFP)

Moderate acute malnutrition (MAM): Moderate acute malnutrition is defined, if the wasting is less severe (W/H between 70% and 80% the National Centre for Health Statistics (NCHS) of the median). Or a mid-upper-arm circumference (MUAC) of ≥11.0 cm but <12.5 cm. Or(low weight-for-height between -3 and -2 z-scores)

Outpatient Therapeutic Program (OTP): It is a home based treatment and rehabilitation with a special formulated readily available therapeutic food(RUTF) provided on a weekly or bi-weekly basis, medical treatment using simplified medical protocols, and regular follow up for children with severely acutely malnourished without health complication.(Tanner and Collin 2004)

Ready to Use Therapeutic Foods (RUTF): RUTF is an energy-dense mineral/vitamin-enriched food, specifically designed to treat severe acute malnutrition.

Severe acute malnutrition (SAM): Severe acute malnutrition is defined as a W/H < 70%NCHS median or MUAC of < 11.0 cm in children age 1–5 years and/or the presence of bilateral pitting oedema of nutritional origin.

Stunting (low height for age): is an indicator of chronic under nutrition, especially protein-energy malnutrition, the result of prolonged food deprivation and/or disease or illness.

Supplementary Feeding program (SFP): It is a dry take home ration for children with moderately acutely malnourished children without health complication (Collins and Tanner 2004) treatment of severe acute malnutrition.

Underweight (low weight for age): is used as a composite indicator to reflect both acute and chronic under nutrition.

WAZ (Weight-by-age z-score) and WHZ (Weight-by-height z-score): are defined as $(m_i - m_r)/\sigma_{rm}$ where, m_i is the observed weight (height) of children below five years of age and gender, m_r is the median weight (Height), and σ_{rm} is the standard deviation of the corresponding measurement for the corresponding measurement of the reference population of children bellow age five and gender group (Gupta et al. 2005).

Wasting (low weight for height): is an indicator of acute under nutrition, the result of more recent food deprivation or illness.

Chapter-1 Introduction and Background of the Study

1. 1 Introduction

Child malnutrition is a pressing problem throughout the developing world. In developing countries, approximately 60 million children are suffer from moderate acute malnutrition and 13 million suffer from severe acute malnutrition at anyone time (Collins et al. 2006). The shocking fact about child malnutrition is that its prevalence has actually increased in Sub-Saharan African countries (Deolalikar 2008).

The unhygienic and unsafe potable water sources are a challenging environment for malnourished children below five years of age. An infant born to a mother that is undernourished will likely to be born stunted in height and low in weight even at full term (Haddad et al. 2004).Its degree of vulnerability for various infectious diseases during his life is very high and his/her productive role in the socio-economic sector is also marginal.

Ethiopia mainly punctuated by recurrent drought and famine; has the highest child malnutrition rate in the world (Silva 2005). Despite; the country setting an objective to reduce under-five mortality from 140/1000 to 67/1,000 by 2015 (EFMoH 2007); one in two Ethiopian children under five years of age is stunted, eleven percent wasted and forty-seven percent underweight (CSA 2001). Malnutrition accounts for 57% of child death in Ethiopia (FMoH 2005). It affects most parts of Ethiopia mainly due to erratic rainfall. In many respect water is the most crucial element in the lives of Ethiopian people. It means health, food and survival, and the lack of it-diseases, starvation and death (Rami 2003).

The cause of child malnutrition is very complex. Rural people by tradition consider child malnutrition, particularly “oedematous malnutrition” as a curse from God or links with other superstitious beliefs. Likewise, many earlier scholars hypothesized different causes for child malnutrition differently. However; progress has been made during few decades in search for improved understanding of the causes of child malnutrition. In this decade; it is recognized that child malnutrition arises from complex web of multidimensional and interrelated determinants (Smith et al. 2000) or caused by failure in many sectors (Haddad et al. 2005) and complex interaction of economic, social, political, nutritional, and public health factors (Collins et al. 2006).

Previous studies have concentrated on the impact of underlying determinants; particularly maternal education and access to health care, on malnutrition (Silva 2005). However; a number of important research questions still remain. Impacts of relative wealth, protected water sources, basic sanitation and hygiene facilities on child malnutrition, at rural setting; are

not yet investigated by researchers. This research seeks to shed light on such questions by identifying the principal links and impacts between relative wealth and child malnutrition, safe water and child malnutrition, accesses to sanitation and hygiene with child malnutrition.

1.2 Background of the study

Ethiopia situated in the Horn of Africa; is the third most populous country of the continent. It has 79 million inhabitants and nearly 84% live in desperate rural areas (FDRMOH 2008). Ethiopia is an ancient country with a reach diversity of people and cultures and a unique alphabet that has existed for more than 3000 years. The country has maintained its independence, even during the colonial era of Africa (CSA 2001). Regardless of these marvellous historical, natural and cultural heritages; the country is punctuated by famine and high rate of child malnutrition.

Among the nine administrative regions of the country, the Amhara region particularly south-Wollo zone; nationally acknowledged as drought prone and large scale emergency intervention area of the country. International relief agencies have been intervening in this particular area for decades, targeting children, pregnant and lactating mothers. The international humanitarian agency, 'Concern Worldwide' has been based at south-Wollo for twenty-seven years. During these years, the agency has responded to various humanitarian crises and saved many children, pregnant and lactating mothers from the verge of death. Concern worldwide and 'Valid international' are targeting acutely malnourished children in Dessie Zuria Woreda (DZW) for relief aid and for research purpose respectively.

The Community Therapeutic Care (CTC) approach invented by Steve Collins from 'Valid international'; was initially studied, piloted and implemented in this particular area since 2000.The approach, regardless of some limitation and drawbacks; get recognition from the national government and now is adopted all over the country as the best nutrition approach. Accordingly, Concern Ethiopia has been advocating, implementing and institutionalising this approach within its emergency and development programs as well as in government ministries.

The four independent nutrition-emergency programs (one that follows on failure of the preceding program) are designed and implemented based on the principle of CTC approach and run by 'Concern Ethiopia' for the past two consecutive years failed without meeting the minimum sphere standards. Regardless of identifying the reasons for past program failure, the agency is continuing the fifth-nutrition program in the area.

The agency has used Mid-Upper Arm Circumference (MUAC) and 15% weight gain as admission and discharge criteria respectively and provided Readily Available Therapeutic Food (RUTFs), Famix and Plumpy nut for targeted children, pregnant and lactating women at no cost. During July 2008 to June 2010 programs reached a total of 14,699 moderately malnourished children (MAM), 1,882 severely malnourished children (SAM) and 7,335 pregnant and lactating women.

1.3 Statement of the problem

Dessie Zuria Woreda (DZW) where this study has taken place; is one of the highest child malnutrition and recurrent emergency areas of the Amhara Regional State of Ethiopia (ARSE). It encompasses 31 administrative Kebeles with a total population of 172,428. Children less than five years of age account for 12.1% of the total population (CNS 2009).

Despite the district water offices disclosed potable water coverage in the area reached 68.2%; the recent Concern Ethiopia Nutrition Survey (CNS 2009) report revealed as if it were not go beyond 34.6 %. This is by far below the national average and contravenes with the districts data. The yearly disease surveillance reports of Dessie Zuria Woreda Health Office (DZWHO) put diarrheal, skin and respiratory tract infections at the highest level on top-ten diseases of the Woreda this highlighted low sanitation and hygiene coverage of the area.

Child malnutrition is pervasive in the area. In the emergency nutrition program of Concern Ethiopia alone; an average of 32 children are admitted every working days.Of the 14,699 MAM children admitted in two consecutive years of emergency program; only 40% get cured, 25% not-cured and 31% are readmitted to the program.

Similarly; of the 1882 SAM children admitted were 68.3% cured, 19.7% not-cured and the remainder percentages are either defaulted or died. The outputs of the intervention were far below the Humanitarian Character and Minimum Standards that demands greater than 75% recovered/cured in both moderate and severe acute malnutrition cases(Sphere 2003: 134-153).

Poor coverage and access to safe water supply, sanitation and hygiene facilities and socio-economic issues like relative wealth disparity among the poor and the better-off; and high fertility rate/family sizes per household are bottlenecks for child nutrition improvement in the area. The researcher has tried to answer the above mentioned key problems; setting the following aim, objective and research questions.

1.4 Aim and objective of the study

1.4.1 Aim of the study

The aim of the study is to contribute to the improvement of child malnutrition intervention approaches investigating the impact of water, sanitation and hygiene on acutely malnourished rural children of Ethiopia aged between 6-59 months. This will be realised on the premises that the following two specific objective and the corresponding underling hypothetical questions are systematically answered by the researcher.

1.4.2 Objective of the study

1. To assess the potential impact of socio-economic determinants of family size and relative wealth status of a household on acutely malnourished children aged between 6 to 59 months in Dessie Zuria Woreda of Ethiopia.

    a. How do fertility rate/family sizes of a household living in rural areas affect child malnutrition?

    b. How does relative wealth disparity among the rural people impacts on child malnutrition? Does child malnutrition reduce when the wealth status of the poor reaches to the middle and better-off?

2. To evaluate the potential impact of water supply, sanitation and hygiene facilities on severe and moderate acute child malnutrition aged between 6 to 59 months in Dessie Zuria Woreda of Ethiopia.

    a. Does an improved water supply sources improve child malnutrition? Are there any malnutrition index differences between children using protected and unprotected water sources?

    b. How does sanitation and hygiene improvement at household affect child malnutrition? Are there any malnutrition index differences between children below five years whose households have and have-not basic sanitation and hygiene facilities?

1.5 Significance of the study

Apart from the requirement of fulfilling MSc in Loughborough University; the study was carried out to improve the existing nutrition intervention approach in Ethiopia because of the following rationales.

I. The study highlights the importance of considering WASH along with nutrition interventions

II. It also highlights key WASH entry points along with the existing Readily Available Therapeutic Food RUTF and antibiotics treatment approach.
III. The study recommends the importance of institutionalising WASH in many development sectors; particularly in nutrition programs.
IV. The study contribute to the existing literature as it will emphasize the links of wash with child malnutrition in Ethiopia

1.6 Limitation of the study

The main concern of the study was to show the impact of wash on child malnutrition in Ethiopia. Since, the study had done in high and higher highlands of Ethiopia ranges from 2500-4500a.s.l. Findings of the research have implication for all agencies intervene in development, relief and emergencies, particularly working on the improvement of child malnutrition status in Ethiopia and other least-developed and developing countries with similar socio-economic and agro-ecology status.

To analyse the impact of WASH and socio-economic variables on child malnutrition, the researcher has used descriptive cross-sectional studies and assumed '*other confounding variables remain constant*'. Hence; many variables that impact child malnutrition through long time could not be considered in this particular study. Moreover; the combined impacts/effects of more than two variables are also not analysed in this particular research.

The study considered the two prominent child malnutrition indexes of '*wasting*' and '*underweight*' to view the impacts of WASH and socio-economic variables on child malnutrition. However, child malnutrition index of '*stunting*' is not considered as it is more shows chronic impacts of child malnutrition than acute child malnutrition.

1.7 Report outline

This dissertation is divided into five chapters. The firs chapter is about general introduction which includes background of the study; statement of the problem; research aim and objectives; significance of the study; scope and limitation.

Chapter two covers the literature review and the definition of key concepts; child malnutrition in Ethiopia; water supply and child malnutrition; and sanitation, hygiene and child malnutrition.

Chapter three is the research methodology, which describes study sites, study designs, research methods, data collection methods and research analysis.

Chapter four is data presentation and analysis and includes outline introduction, socio-economic variables and child malnutrition, protected water sources and child malnutrition, sanitation and hygiene at household level and child malnutrition.

Chapter five is the research conclusion and recommendation including evaluation the aim and objectives; summary of findings and recommendation for the study.

Chapter-2 Literature Review

2.1 Preparing for the review

The main purpose of reviewing literatures is to collect and present recent publications on child malnutrition, water supply, sanitation and hygiene found in reliable resource centres. It allows the researcher and readers to have background information about the essence of the study. Throughout the review processes, attempt was given to examine and present literatures that give emphasis for the links of wash with child malnutrition.

Lists of relevant topics for review were outlined from the research objective and hypothetical questions. This helped the researcher to identify resource centres and sources of information. Key topic areas like child malnutrition in developing countries, water supply and health, water supply and infections, Infections & malnutrition, malnutrition in Ethiopia, Child malnutrition intervention approaches are reviewed in different publications.

To find more recent information and publications from organisations involved in these key topic areas, potential resource centres and organisations are identified: IRC, WEDC, WSP, WHO, UNICEF, USAIDS, JAMA, IFPRI and INGO's are some of the sources of publication listed in the literature review.

Accessing internet in the program area was the utmost challenge of the researcher. Dial-up internet connection was the only internet access available by the agency. This restrained the researcher not to review many on-line recent publications. However; the existing hardcopy publications collected by the researcher and the sponsoring agency were well examined

2.2 Definition of key concepts

Different scholars, in different era; define malnutrition differently. In earlier time (Gomez 1995) define malnutrition as a pathological condition of varying degree of severity, and diverse clinical manifestation, resulting from the deficient assimilation of the components of the nutritional complexes. Similarly; Concern's Supplementary Feeding Program (SFP) training manual (SFP 2009) define malnutrition as a nutritional disorder or condition resulting from inadequate nutrition/diet. Compare and contrasting different views and definitions, the researcher used (EFMOH 2007) definition "a long term year round phenomenon due to chronic inadequacies in food instance combined with high levels of illness" for this particular study.

2.3 Overview of Child Malnutrition

Severe acute malnutrition (SAM) remains a major killer of children under five years of age. It affects approximately 20 million children under five years of age and contributes to more than 1 million child deaths in the world in each year (WHO 2007). Developing countries are the major victim taker of the incidence due to severe and moderate malnutrition. In these countries alone; an estimated sum of 60 million children suffering from moderate acute malnutrition and 13 million suffers from severe acute malnutrition at any one time (Collins et al. 2006).

2.3.1 Types of Malnutrition

The two major types of malnutrition are Chronic and Acute malnutrition. Chronic malnutrition, or stunting, is defined by a height-for-age (HAZ) < -2 Z scores. Stunting of a child's growth may be the result of failure to receive adequate nutrition over a long period, or sustained improper feeding practices, or of the effect of repeated episodes of illness (CSA 2001: P: 153). It is associated with a number of long-term factors including frequent infection, sustained inappropriate feeding practices and poverty (Concern's SFP training manual 2009).

Depending on the degree of wasting and the presence of oedema; acute Malnutrition further classified into moderate and severe acute malnutrition. Moderate acute malnutrition is defined, if the wasting (low weight-for-height) is less severe (W/H between 70% and 80% the National Centre for health Statistics (NCHS)of the median) or a mid-upper-arm circumference (MUAC) of ≥11.0 cm but <12.5 cm. In many cases moderate malnutrition contributes more to the overall disease burden than severe malnutrition.

Severe acute malnutrition is defined as a W/H < 70% NCHS median or MUAC of < 11.0 cm in children age 1–5 years and/or the presence of bilateral pitting oedema of nutritional origin, (which is called "oedematous malnutrition"). Severe malnutrition in children is commonly found in conjunction with gastroenteritis, pneumonia, and other infections (Ashworth 2006)

2.3.2 Causes of malnutrition

The causes of malnutrition are subtle and complex; various researchers proposed different determinants in different occasions. (UNICEF1990) as referred by (Collins et al. 2006); the causes of primary acute malnutrition are essentially poverty, social exclusion, and loss of entitlement. Silva (2005:8) highlights insufficient food intake and repeated infectious diseases are the most important determinants of malnutrition. Similarly; ACF (2007) also emphasise infection as a cause and consequence of malnutrition.

The IFPRI-led team (Haddad et al.2004) recognized malnutrition can be caused by failures in many sectors or some combination of deprivations in food, psycho-social care, water, sanitation, and health services. However; the most rigorous determinants of malnutrition is provided by conceptual frameworks of UNICEF as shown in fig: 1 below amended by (Haddad et al. 2005).

The figure depicted that child malnutrition incorporate causes of biological and socio-economic elements at micro and macro level. The *immediate causes* (infection and poor diet) for this particular framework are a micro level issue perceived at individual level. This is directly influenced by the *underlying causes* (household food security, poor child care, poor health, water and sanitation) mainly manifested at the household level. The *Basic causes* (natural resource endowment, political system, economic performance, and power relationships) are macro-level determinants deep rooted in poverty (IFPRI 2000).

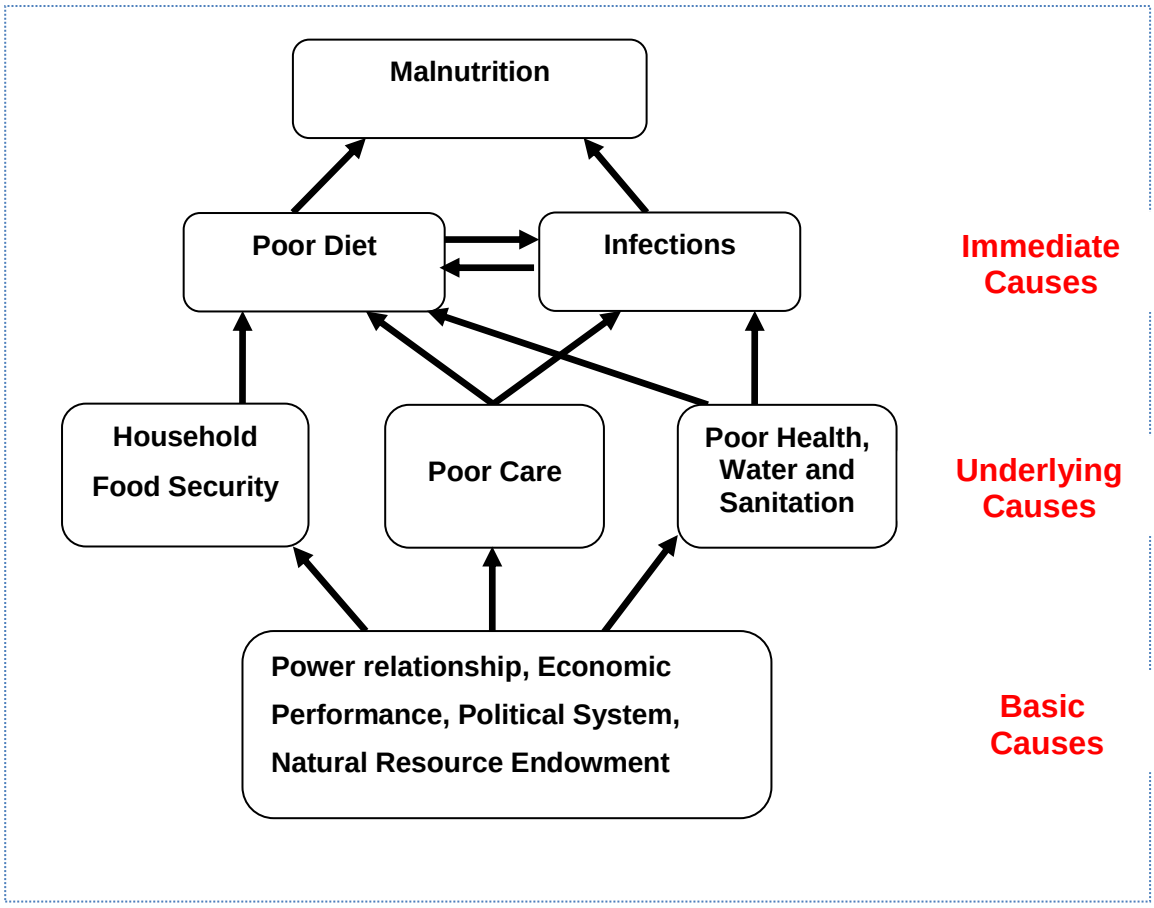


FIGURE 2.1 Determinants of Malnutrition

Source: adapted from (Haddad et al. 2004).

2.3.3 Indicators of Child Malnutrition

CSA (2001:154-158) used child malnutrition indexes of stunting, wasting and underweight to measure child malnourishment. The percentage values of these indexes determine the how much a child is moderately or severely malnourished. The three commonly used indicators are height-for-age (HAZ), weight-for age (WAZ) and weight- for-height (WHZ). The technocratic names of these indicators are stunting, underweight and wasting respectively.

International references: U.S. National Centre of health statistics (NCHS) as recommended by WHO assigned the following criteria to differentiate degree and types of malnutrition.

TABLE 2.1 Child malnutrition indexes using Z-score as measurement

Degree of Malnutrition	Stunting	Wasting	underweight
Moderately stunting, wasting, underweight	HAZ<-2SD from the median of the reference population	WHZ<-2SD from the median of the reference population	WAZ<-2SD from the median of the reference population
Severely stunting, wasting, underweight	HAZ <-3SD from the median of the reference population	WHZ <-3SD from the median of the reference population	WAZ<-3SD from the median of the reference population

In case of community-managed acute malnutrition; mid-upper arm circumference (MUAC) is applied to differentiate the degree of severity of acute malnutrition. There are some disparities between the national and international cut-off points to measure the degree of acute malnutrition. The table below shows the international and national cut-off points in case of Ethiopia. The researcher, for this study purposes; used the international cut-off indicators!

TABLE 2.2 Child malnutrition indexes using MUAC as a measurement

Degree of Severity	National/Ethiopian MUAC cut-offs	International MUAC cut-offs
Severely malnourished	MUAC<110mm	MUAC<110mm
Moderately malnourished	MUAC≥110 &<120mm	MUAC≥110 &<125mm
Mildly malnourished	MUAC≥120 &<135mm	MUAC≥125 &<135mm

Source: Concern 2009 survey reports

2.3.4 Impacts of Child Malnutrition

Childhood underweight causes about 35% of all deaths of children under the age of five years worldwide (WHO 2008). Malnutrition, particularly child malnutrition has detrimental impacts on

the current and future socio-economic and environmental development of a country. An infant born to a mother that is undernourished will likely to be born stunted in height, low in weight and more susceptible to infectious diseases and non communicable diseases in latter life (Haddad et al. 2004).The continuation of this accelerate the vicious cycle of intergenerational poverty, ill health and death in the hosting country.

Recent studies has shown that under nutrition has a whole range of effects that impede not only children nutrition and development in the short term, but also their cognitive ability and productivity in adulthood, with measurable impacts (Ruel and Hoddinott 2008). Therefore; holistic intervention on child malnutrition has positive externalities in many sectors.UNCHR/WFP (2006) cited (SCN, 2004) remarked that good nutrition underpins progress towards each of the first six MDGs. Similarly;(Mekonen et al. 2005) acknowledged that the inability to reduce the prevalence of malnutrition in children under five will lead to non-achievement of one of the key targets of the first Millennium Development Goal, eradication of extreme poverty and hunger.

TABLE 2.3 Nutrition's contributions to the attainment of the MDGs

MDGs	Nutrition's contributions to the attainment of the Millennium Development Goals (MDGs)
Goal 1:Eradicate extreme poverty and hunger	Malnutrition erodes human capital, reduces resilience to shocks and reduces productivity (impaired physical and mental capacity).
Goal 2:Achieve universal primary education	Malnutrition reduces mental capacity. Malnourished children are less likely to enrol in school, or more likely to enrol later. Current hunger and malnutrition reduces school performance.
Goal 3: Promote gender equality and empower women	Better-nourished girls are more likely to stay in school and to have more control over future choices.
Goal 4: Reduce child mortality	Malnutrition is directly or indirectly associated with more than 50% of all child mortality. Malnutrition is the main contributor to the burden of disease in the developing world.
Goal 5:Improve maternal health	Maternal health is compromised by an anti-female bias in allocations of food, health and care. Malnutrition is associated with most major risk factors for maternal mortality
Goal 6:Combat HIV/AIDS, malaria, and other disease	Malnutrition hastens onset of AIDS among HIV-positive. Malnutrition weakens resistance to infections and reduces malarial survival rates.

Source: adapted from (Silva, 2005)

2.4. Child Malnutrition in Ethiopia

Despite the fact that Ethiopia relatively shows remarkable improvement in economic development, political stability and democracy on the past two decades; the country is still ranks sixth among the countries of world in terms of absolute number of child deaths. Ethiopia has one of the highest infant and child mortality rates in the world. One-tenth babies born in Ethiopia do not survive to their 1st birthday and one-sixth children dies before their 5th birthday (CSA 2001; Silva 2005). About 472,000 Ethiopian children die each year before celebrating their fifth birthday (MoH 2005:6). Malnutrition is extremely prevalent on children's of this age group and accounts for the 57% of child deaths in Ethiopia (MoH 2005).

The Ethiopian Ministry of Finance and Economic development (MoFED 2002) referred in (Mekonen et al.2005) indicated that in recent years, Ethiopia has only had limited success in reducing the prevalence of child malnutrition. In the case of wasting, the rate increased slightly from 9.2 percent to 9.6 percent between 1995 and 2000. However, the proportion of severely wasted children declined by 47.1 percent (i.e. from 3.4 percent to 1.8 percent) over the same period.

2.4.1 Overview of Child Malnutrition Interventions Approaches in Ethiopia

Until 2001, Emergency response to high levels of acute malnutrition was predominantly through therapeutic feeding centres (TFCs). TFCs are large inpatient centers where patients are admitted for 21 days or longer. According to Gatchell et al (2006) the centers are resource-intense and are often very far from those affected with acute malnutrition. Carers of malnourished children must often travel long distances to access the services, and coverage is low. Additionally, congregation of sick and malnourished children in centers can enhance the spread of infection and increase morbidity and mortality. Similarly, Khara and Collins (2004) condemn TFCs as high risk environments; the patients are immune-suppressed and often infected; the conditions are cramped, and water and sanitation are often difficult. To address some of the challenges of traditional TFCs, Valid International developed the concept of community based therapeutic feeding centre (CTC). It is an innovative concept that mobilizes communities and supports local health services to rapidly and effectively treat those with acute malnutrition in their homes. According to CTC field manual (Collins et al. 2006:3), the first pilot CTC program was implemented during famine in Ethiopia in 2000. The local government had prohibited TFCs and malnourished people had to be treated as outpatients.

Collins et al (2006) remarked that CTC is based upon the fundamental principle that all people whose lives are at risk from malnutrition should receive appropriate care and assistance. The provision of care should be impartial, targeted solely on the basis of need. It should be delivered without discriminating between or within affected populations and should not favour

any particular side in conflicts or disputes. A typical emergency-response CTC program is composed of four elements: community mobilization, an outpatient therapeutic program (OTP) for cases of severe acute malnutrition without medical complications, inpatient care for those with medical complications, and supplementary feeding for those with moderate malnutrition to prevent them from becoming severely malnourished**.** Since 2001, evidence for the effectiveness of CTC as an approach to the treatment of severe acute malnutrition in emergencies has been building through nongovernmental organization and government responses in Ethiopia.

CTC programs aims to start case findings and treatment before the prevalence of malnutrition escalates in an area; it still require much work to be done before CTC is fully scaled up and integrated into the government health system alone (Cotes 2009). Since, malnutrition is complex web of determinants; working with one sector alone may isolate many potential actors not to work on potential determinants of child malnutrition (Haddad et al. 2005). Interventions outside the nutrition sector – indeed, even outside the health sector–can have profound effects on reducing child malnutrition (Deolalikar, 2008).

Ferron et al. (2000) recommend the importance of integrating participatory sanitation and hygiene promotion in emergency and rehabilitation programs; however many emergency programs still fail to recognize this as an important objective. Deolalikar (2008) also share the views of (Hadded et al.2005 and Ferron et al. 2000) remarking on the importance of recognizing the non-nutritional interventions, such as improved water, sanitation, transport and power infrastructure, as well as policies that enhance agricultural productivity and dietary diversification, might have larger effects on reducing malnutrition than nutritional interventions.

Increased recognition of the high prevalence of acute malnutrition in non-emergency settings has led many to ask whether the need to more effectively address this burden in development settings. Several international humanitarian organisation working in Ethiopia, have begun looking at the feasibility of addressing acute malnutrition more effectively in development contexts. In different wings, INGO's are now mainstreaming community-based management of Acute malnutrition (CMAM) which is based on the principle of CTC approach. However it seems very early to scale-up CMAM approach in poor countries by the international agencies.

The existence of enabling environment, adequacy and availability of human and financial resources, the issue of supply and demand of RUTT/RUSF in the long-run and other socio-economic issues that determine child malnutrition will have been a bottle neck in scaling up processes. Despite; Ethiopia is now in track of institutionalizing CMAM at national level; particularly in one sector i.e. the Ministry of Health (MoH).

2.5 Water supply and Child Malnutrition

2.5.1 Water and Health

The human right to water entitles everyone to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic use (WHO 2003:12). Despite, in 2004 an estimated 1.1 billion people were without access to safe water (WHO/UNICEF 2006). Rampant competition to fresh water among big economic sectors, population bursts and the associated increment of freshwater demand, and widespread water resource pollution and depletion may cause freshwater scarcity and ecological imbalance for today and future generation. Economically weak, politically instable under developed and developing countries will hit more in the future.

The persistence of these situations may exacerbate the future safe water demand and exposed many for infections & illness. Poor families without accesses to safe water frequently find themselves ever poor as result of ill-health caused by lack of fresh water (WHO 2003).

> "Access to safe water is a fundamental human need and, therefore, a basic human right. Contaminated water jeopardizes both the physical and social health of all people. It is an affront to human dignity"
>
> *Kofi Annan (n.d), Former United nation Secretary-General*

The links between water and health has long been understood (UNICEF 1999). Water affects health mainly through helping or hindering the transmission of communicable diseases (DFID 1998). Üstün et al.(2008) in a book entitled "*Safer Water, Better Health'* highlighted the importance of WASH by stating that almost one-tenth of the global disease burden could be prevented by improving water supply, sanitation, hygiene and management of water resources.

2.5.2 Quantity of Water, Diseases and Child malnutrition

Where water is scarce, it is very difficult to maintain hygiene and sanitation essential to control many other routes of faecal-oral transmission (DFID 1998). In many emergency situations; much of water-related disease transmission is due to insufficient water for personal and domestic hygiene as to contaminated water supplies.

Despite, difficulties of determining the average quantity of water necessary to keep somebody in good health, provision of sufficient quantity of water has retained health benefit (Howard, 2002). Diseases like Intestinal tract infection, skin and eye infections, and some non fecal-oral diarrheal diseases (mainly transmitted by body lice) are water-washed diseases and mainly reduced by the availability of sufficient quantity of water (Cairncross & Feachem 2005:6-7).

Likewise; Hoddinott (1997) as referred by (ACF 2007) poor access to water greatly affect height and weight gain of children.

TABLE 2.4 Health benefits from greater quantity of water

	Health Benefits from greater water quantity
Greater water quantity	➢ 20% reduction in incidence of diarrheas from improved water quantity; ➢ 50% reduction in 24 hours incidence of diarrheas when water collection roundtrip is reduced from +60 to 0-5 minutes ➢ 5% reduction of children with stunted growth when the household has water on the premises;

Source: (Esrey 1994) cited in (IRC 2005)

2.5.3 Quality of water and Diseases

Sphere standard two stated that water is palatable, and of sufficient quality to be drunk and used for personal and domestic hygiene without causing significant risk to health. It seems a bit hard to maintain this standard in all circumstances. In many rural water supply projects, water may be contaminated at sources due to poor design, sitting, construction or operation and maintenances; similarly can be contaminated as people collect it from the sources and take it to the home.

The microbiological quality of water need high priority as it links with infectious diarrhoeal diseases (Howard 2002). According to WHO drinking water guideline, water intended for drinking should not contain any detectable E-coli or thermo-tolerant bacteria in 100ml sample (Smet and Wijk 2002:67). It is also difficult to get E-coli free water in rural settings. The following table shows risk classification of E-coli for rural water supply. The following table shows Risk classification of E-coli for rural water supply.

TABLE 2.5 Level of risks of E-coli per 100ml of water samples

Count per 100ml	Risk category
0	conformity with WHO guideline
1-10	Low risk
11-100	Intermediate risk
101-1000	High risk
>1000	Very high risk

Source: Smet and Wijk (eds.) 2002:69

Howard (2002) added that most pathogens in rural areas are derived from faeces, testing Escherichia Coli (E-coli) which provides the closest mach to the criteria of ideal indicator bacteria and testing critical parameters like turbidity and PH and conducting sanitary surveillance is vital for water quality management. Management of drinking water at household level is crucial to safeguard water from contamination. According to (Kleinau and Pyle 2004: 55) safe water management at the rural setting applies only to those households meeting the following preconditions:

- ✓ Use an improved water source that is within reach 30 minutes or less in rural areas and accessible daily
- ✓ Cover containers and use narrow-neck containers
- ✓ Limit access of children to the drinking water by raising the water containers above ground (prevent children from putting hands in water)
- ✓ Use a different vessel to transfer water than the one used for drinking or pouring from the container
- ✓ Treat water to remove pathogens from the water (e.g., chlorination, filtration, boiling, or solar disinfection)
- ✓ Keep container clean

2.5.4 Accessibility, Convenience and Child Malnutrition

Women who walk long distances to collect water can burn as much as 600 calories of energy or more per day, which may be one third of their nutritional intake (UNICEF 1999). Accessible and convenience drinking-water save time, energy and improve the nutritional status of women and children (UNICEF 1999; Rottir and Ince 2003; WHO 2003). Improvement on accessibility and convenience help to avoid potentially risky methods of water storage and gathering that expose children to infectious diseases.

2.5.5 Infections and Child Malnutrition

Childhood underweight causes about 35% of all deaths of children under the age of five years worldwide. An estimated 50% of this underweight or malnutrition is associated with repeated diarrhoea or intestinal nematode infections as a result of unsafe water, inadequate sanitation or insufficient hygiene (Üstün et al. 2008).

Sources and transmission routes of infections in a household and public environment could be arisen due to water related, excreta related, refuse related and house related infections (Cairncross and Feachem 1993:1-27). Infections in the public domain is relatively widespread and indiscriminate, whereas, infection in the domestic domain characterised by clustering around those households where sanitation and hygiene are poor (DFID 1998).

The links between infection and malnutrition is still debatable. DFID (1998:64) acknowledged soil transmitted Heliminths contribute to malnutrition. Recent studies on malnutrition revealed that Heliminths consume nutrients from the children infected, cause abdominal pain, diarrhea, intestinal obstruction, anaemia and various health complications that contribute to poor appetite and decreased food intake, which contributes to severe child malnutrition.

A study in Nepal by (Malla et al. 2004) had shown high linkage of child malnutrition with intestinal parasite. Similarly; Humphrey (2009) as quoted by (Zhang n.d) shows the links between water-related diseases, such as tropical enteropathy cause malnutrition. (Malla et al.(2004) also added that parasitic infections in children under 5- years of age are especially problematic because they have negative life long health consequences. These infections can contribute to malnutrition, which in turn can result in delayed growth and malnutrition as well as impaired cognitive growth.

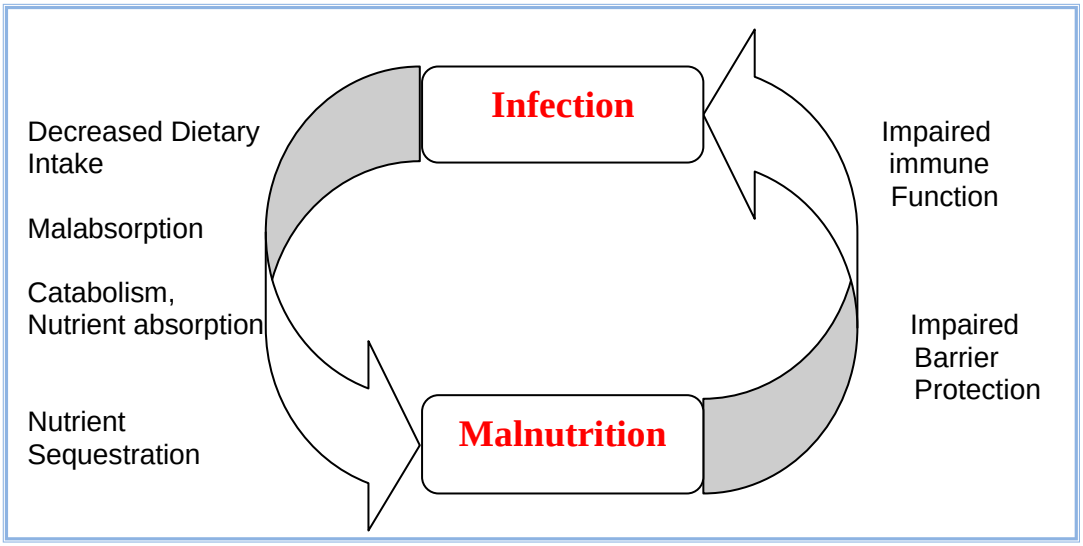


FIGURE 2.2 Relationships between Infection and Malnutrition

Source (Brown, 2003) cited in (ACF 2007)

2.6 Sanitation, Hygiene and Child Malnutrition

2.6.1 Overview of sanitation and hygiene in Ethiopia

Before the onset of national health prevention policy in 2005, the situation of sanitation and hygiene in Ethiopia was devastating. CSA (2001:134-135) revealed that only 4% of children's stool is disposed of in the toilet or latrine in rural areas of Ethiopia.

Despite; absence of tangible sanitation and hygiene coverage data in the country; different study reports mentioned the poor coverage of sanitation and hygiene across the country.

FDREMoH (2005:15) reported that up to 60 percent of the current disease burden in Ethiopia is attributable to poor sanitation where 15 percent of total deaths are from diarrhoea, mainly among the large population of children under five years of age. As well as diarrhoea, there is a high prevalence of worm infestations (causing anaemia) which have a synergistic effect on the high levels of child malnutrition (FDREMoH 2005:15).

The five year (2005-2010) health prevention strategic plan of the country had given strong emphasis for public health improvements; focussing on prevention aspects. Now days; 16-package for health services extension programme are implemented at the grass root level. The package mainly encompasses aspects of excreta, solid and liquid waste disposal; water quality control; food hygiene; proper housing; vector control (*arthropods and rodents*); personal hygiene health education and promotion. To implement the policy into practice; two health extension workers are appointed at the lowest government administrative structure or Kebeles level.

Except some modification and improvements; the country sanitation and hygiene framework is more or less the replica of the Environmental Health Program (EHP) hygiene improvement framework.

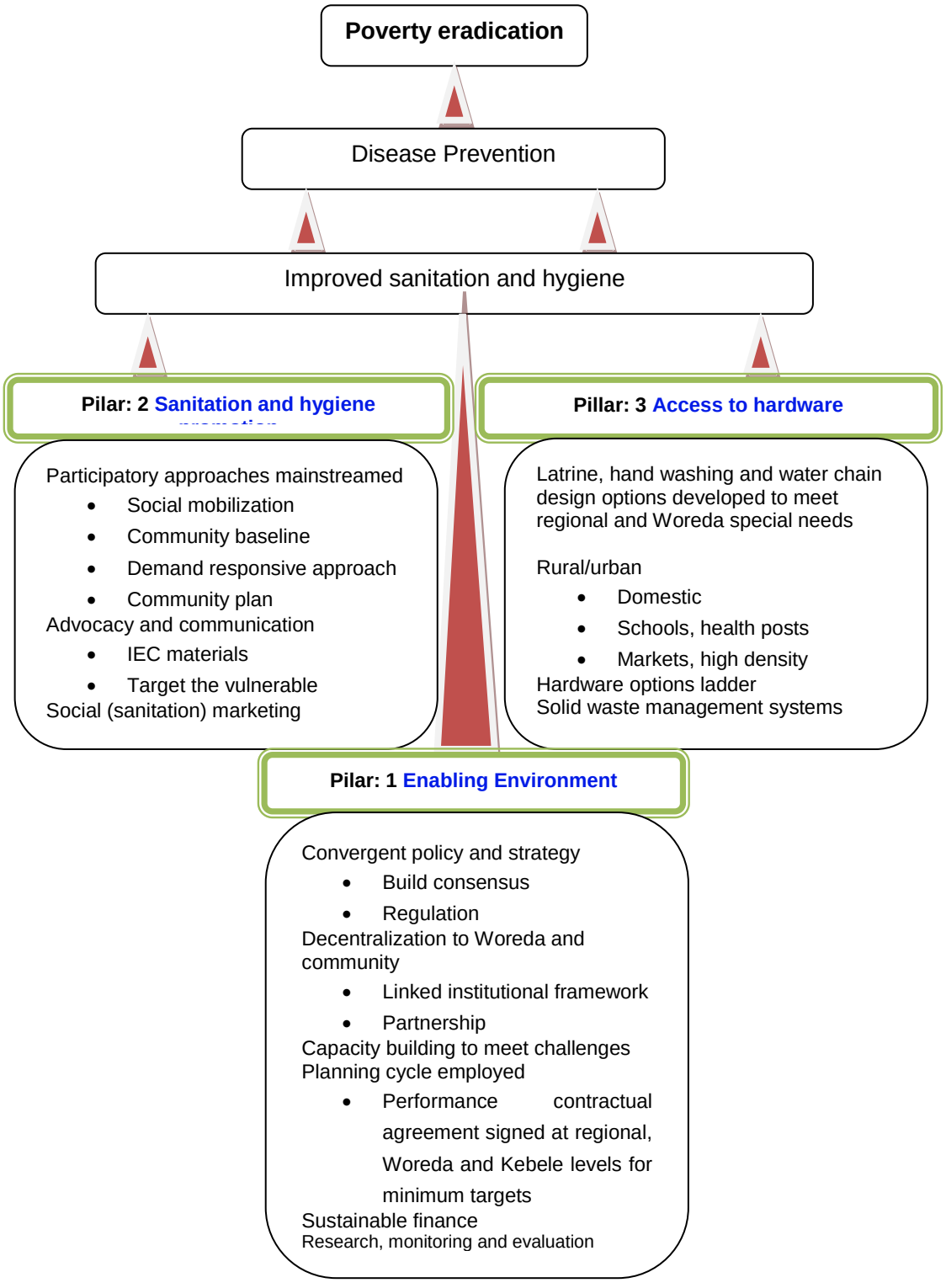


FIGURE 2.3 Ethiopian National Sanitation and Hygiene Improvement Framework

Source: Federal Democratic Republic of Ethiopia National Hygiene and Sanitation Strategy Ministry of Health (2005)

2.6.2 Sanitation, Disease and Child malnutrition

Diarrheal diseases continue to be an important public health problem in developing countries, with high morbidity and still significant levels of mortality among children (EHP 2004). Globally, 1.6 million of children die from diarrhoea per year and some 4,500 child deaths every single day. The largest single cause of these deaths is an unsafe and unhygienic environment: over 90 per cent of diarrheal deaths are attributed to poor hygiene, sanitation, and unsafe drinking water (UNICEF 2006) Water Aid cited (WHO 2008) agreed o the figure remarked that children deaths due to diarrhea alone surpass the combined child death due to malaria, measles and HIV/AIDS.1.4 millions of these deaths are caused by poor sanitation and drinking water.

A primary benefit of sanitation is improved human health, achieved by breaking the transmission of photogenes to humans by the containment of faeces. When excreta are deposited near peoples home, or on land where people often congregate, the risk of contamination will be higher. IRC (2005) cited sanicon.net; emphasized the pollution incidence of one gram of faeces stating: *a gram of faces can contain: 10,000,000 viruses, 1,000,000 bacteria, 1,000 parasite cysts, 100 parasite eggs*.

TABLE 2.6 Health Benefits from improved Sanitation

Health Benefits from improved Sanitation	
Improved sanitation	➢ 36% reduction in incidence of diarrhea from improved excreta disposal; ➢ 30% reduction in incidence of diarrhea in children (3-36 months) in households with flush toilets ➢ 15% in incidence of diarrhea in children (3-36 months) in households with pit latrines; ➢ 40% reduction of children with stunted growth in households with flush toilets; ➢ 26% reduction of children with stunted growth in households with pit latrines

Source: (Esrey 1994) referred to (IRC 2005)

2.6.3 Hygiene and Child Malnutrition

The loss of young life around the world due to diarrhea is devastating, and it is even more tragic for being almost entirely preventable (Kleinau and Pyle 2004). Diarrhea directly and adversely affects children's nutritional status. The CTC research and development program also realized diarrhea is associated with the malabsorption of macronutrients and

micronutrients, resulting in weight loss and a deteriorating condition. They are exploring the addition of symbiotic (a combination of high-dose, acid-resistant probiotics with several types of prebiotic) to Readily Usable Therapeutic Food (RUTF) (CTC field manual, 2006) to manage diarrheal disease on malnourished children.

Managing the disease, improving resistance and preventing the diseases are the three common types of intervention used to fight under-five diarrheal infections (Kleinau and Pyle 2004).To prevent the prevalence of diarrheal disease the paths has to be blocked. Disposing all faeces safely through improved sanitation, improving water quality, providing sufficient water quantity and hand washing with soap is crucial. The F-diagram shows the role of WASH as a primary barrier for diarrheal diseases.

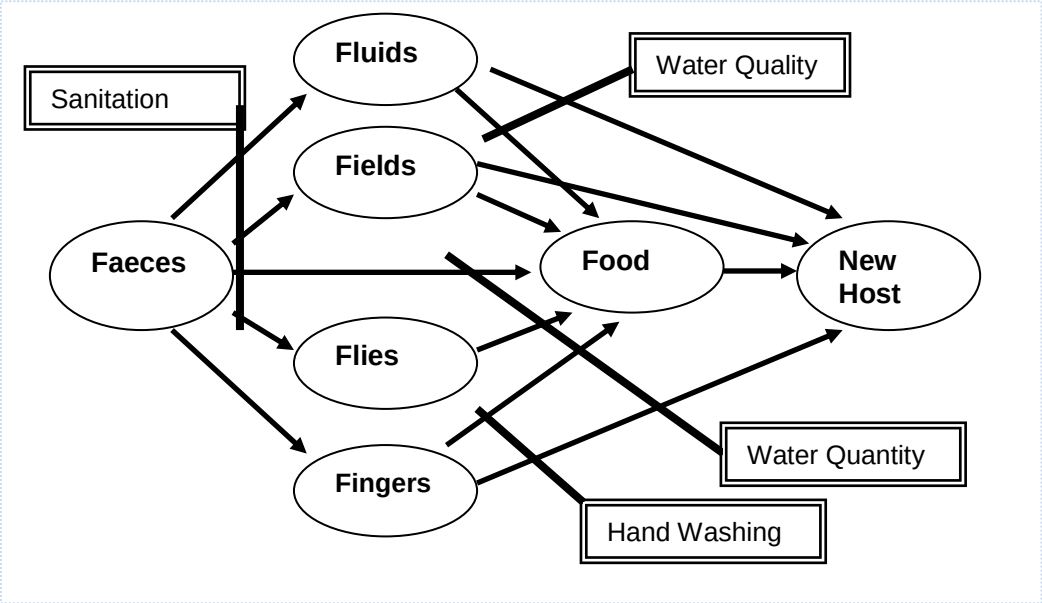


Figure 2.4 F-Diagram - Primary prevention

Source: (Wagner and Lenois 1998) referred by (Kleinau and Pyle 2004)

EHP in various strategic reports advocates the importance of using 'hygiene improvement framework' to deter diarrhoeal diseases. The three core components of hygiene improvement framework, has the following linkages with child malnutrition:

Accesses to hardware: accesses to *water supply system:* **-** increase water quantity and quality improve personal and domestic hygiene, reduce women workload and improve child care and reduce child malnourishment. Similarly; having accesses to *toilet facilities* safeguard the environment and public health and hence reduce faecal contamination and infection. This ultimately brings positive impact on child malnutrition improvement. *Household technologies and supplies* like Usage of soap, chlorine, filters, narrow necked water containers, and potties for small children reduce faecal-oral disease and infection hence improves child malnutrition.

Hygiene promotion: **-** advocating for, teaching, and supporting behaviors that are known to reduce diarrheal disease, namely: proper hand washing, proper disposal of feces, and storing and using safe water, at least for drinking and preparing food reduces faecal infections and hence improve child nutrition. The five strategies of communication, social mobilisation, community participation, social marketing and advocacy primarily targets children and caretakers to raise awareness, to enhance participation and involvement, to develop public private partnership about usage of sanitation and hygiene facilities. All induce improvement on child malnutrition.

The enabling environment (Policy improvement, institutional strengthening, community involvement, financing and cost recovery activities, cross sectors and public private partnership) plays significant role in the proper implementation of sanitation and hygiene policy in both micro and macro scale. These directly or indirectly improve nutritional status of children less than five years of age.

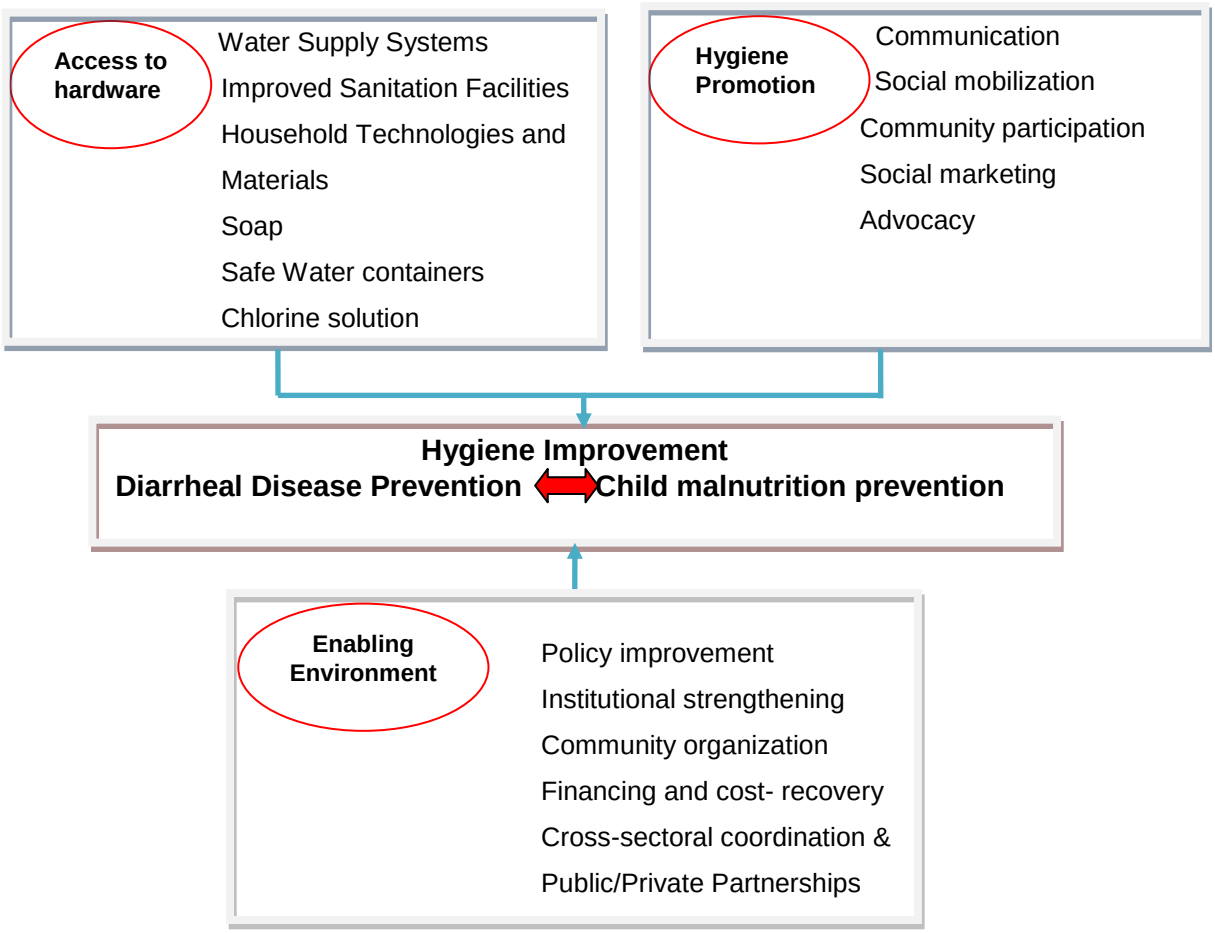


FIGURE 2.5 Hygiene Improvement Framework

Source; adapted from (EHP, 2004*)*

2.6.4 Handwashing and Child Malnutrition

Faecal-oral infections can largely be prevented if hands are washed after defecation or after contact with anything that could be contaminated with faeces (Rottir and Ince 2003). All faecal-oral infections can be transmitted by both water born and water washed routes (Cairncross and Feachem 1993:1-27) Despite the overall quantity of water available is limited ;washing hands at critical time leads to very significant improvements in health (WHO 2003).

Pluby et al (2005) on the article entitled '*Effective of Handwashing on Child Health'* as published by (Lancet 2005: 225–33) remarked that regular handwashing with soap is very effective in preventing diarrhoea and respiratory disease, two of the leading causes of global childhood death. Moreover; handwashing with soap was effective against pneumonia in well-nourished and malnourished children.

In stringent ways, Kleinau and Pyle (2004) describe appropriate hand washing**,** involves three elements: hand washing supplies, hand washing technique, and hand washing at critical moments. These authors also categorized the three elements as follows:

TABLE 2.7 Appropriate handwashing practices, supplies and techniques

✓ HANDWASHING SUPPLIES	1) Water — from tap or container 2) Soap, ash, or other detergent 3) A device that facilitates unassisted hand washing such as a basin, sink, bucket, or tippy tap 4) Clean towel or cloth, although this is optional because air drying is an acceptable alternative
✓ HANDWASHING TECHNIQUES	1) Uses water 2) Uses soap, ash, or other detergent 3) Washes both hands 4) Rubs hands together at least tree times 5) Dries hands hygienically — by air or with a clean cloth
✓ HANDWASHING AT CRITICAL MOMENT	1) After defecation 2) After handling child's feces or cleaning a child's bottom 3) Before preparing food 4) Before feeding a child 5) Before eating

Adapted from (EHP, 2004)

Shordt and Cairncross (2004) cited (Curtis and Cairncross 2003:275-81) remarked the importance of handwashing with soap to save millions of lives each year. Knowledge of handwashing with soap at critical times; skills to wash hands correctly; existence of enabling environment or existence of soap and water at convenient places and the actual practices of the people determine to prevent the diseases(Shordt and Cairncross 2004: 1-19)

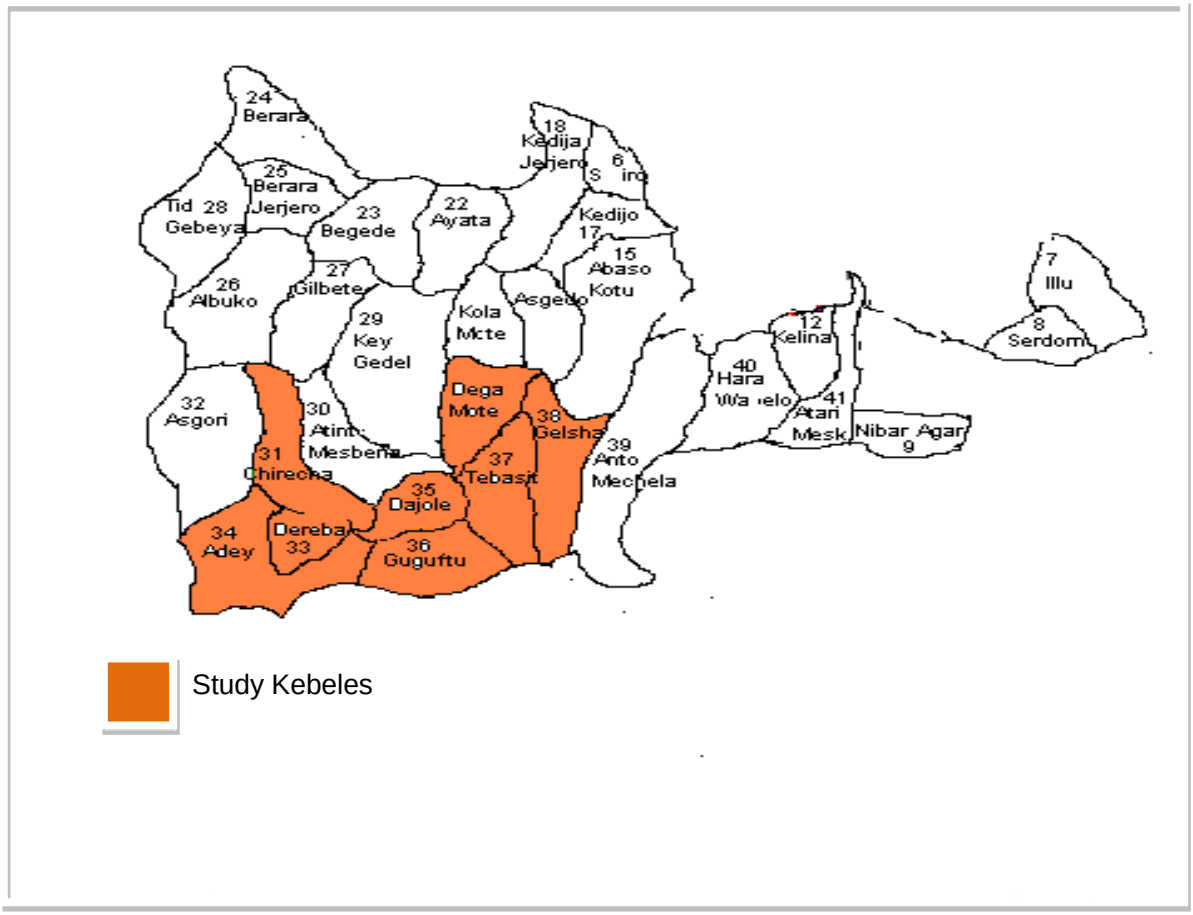
Chapter- 3 Methodology

3.1 Chapter Introduction

This chapter presents the different methods and ethical considerations that the researcher used during data collection, analysis, presentation and discussion of findings of the study. This includes details on the study sites, study design, research methods, data collection, and analysis.

3.2 Study sites

Amhara region, particularly Dessie Zuria Woreda (DZW) is known by high child malnutrition rates and big scale emergency intervention area of Ethiopia. This research is done in the most and recurrently affected districts (*Woreda*) of the region. The study sites are located in South-Wollo Zone of the Amhara regional state of Ethiopia; in the mid, high and higher highland villages (*Kebele*) of the region. The following figure shows the specific study Kebeles selected for this particular study.



MAPS 3.1 Dessie Zuria Woreda (DZW) and the research data collection sites

Source: Source: Concern Ethiopia (n.d)

3.3 Study designs

From thirty-one administrative villages of Dessie-Zuria Woreda (DZW; the researcher purposely selected eight of the most affected Kebeles. The inclusion criteria that the researcher used are high prevalence rate of child malnutrition and its representation of at least three agro-ecological zones of the district (*Woreda*).

From the purposely selected eight-Kebeles, small-villages (*gotts*) having more number of moderately and severely malnourished children; are identified. Names and status of affected children living in these particular small-villages and targeted in the 4th nutrition and emergency program of Concern Ethiopia; are systematically collected from the existing database.

Regardless of relative wealth, social and child malnutrition status, names and villages of households using protected water sources and showing relative improvement in household sanitation and hygiene management; are identified from each health posts located in the purposely selected eight Kebeles. This allows the researcher to look at different cases of child malnutrition in the specific area.

The researcher has outlined appropriate interview questionnaires, observation checklists and field experiments formats used to record interviewees opinions, facts, water quality tests and sanitary surveillance data of a particular water sources. To assess hypothetical questions stated in chapter-one; six qualified female data enumerators and experienced water quality analyst are appointed by the agency to upon the request and desire of the researcher.

The researcher gave one day training for all data enumerators. The training mainly focused on data collection, management and ethical considerations considered during field works. The researcher has involved on data collection with enumerators and confirms their competency for the intended purposes.

3.4 Research methods

There are various types of research methodologies depending on the nature of the field of study. For this particular study; the researcher used cross-sectional descriptive research method and case study approach to assess the impact of WASH on child malnutrition aged between 6-59 months in Ethiopia.

These method and approach allows the researcher to use both quantitative and qualitative data to asses the complex variables of child malnutrition and also allows him to triangulate findings of one method with the other.

3.4.1 Reference population

Naturally, Impacts of wash on child malnutrition are easily measured on those less than five years of age. This is because of the fact that children of this age group have the highest risks taker and vulnerability to infectious diseases due to unsafe drinking water and faecal contamination. Therefore; the sampling framework of this particular study is all children aged between 6-59months old live in the area. The total population number in the proposed study sites are 49,263 and children under five years of age accounts for the 12.1% of the total population (CNS 2009). Hence, the sampling framework is 5961 children living in that particular area.

Moreover; all moderate and severely malnourished children who were targeted on the 4th supplementary feeding program (SFP) and Outpatient Therapeutic feeding program (OTP) of DZW emergency program are the initial reference population for this particular study.

3.4.2 Sample Size

Taking into account time and budgetary constraints; the researcher has used composite of purposive and random sampling methods. From the purposely selected eight Kebeles, a total of 79 small villages (*Gotts)* which have high prevalence of MAM and SAM children and having CG's are selected.

The researcher used Emergency Nutrition Assessment (ENA) software to determine sample sizes. Since, the prevalence of child malnutrition is reaches up to 10-12% (CNS 2009) in the study area, the researcher used design effects of 1.5 at the desired precision of 5% (0.05significance level) to determine the required sample size. However, the number of SAM children living in that particular area is scant; the researcher used 10% significant/precision number to determine the sample size.

TABLE 3.1 Sample size determinations using ENA software

Moderately Malnourished Children (MAM)	Severely Malnourished children (SAM)	Children in protected water source areas (CGs)
Total population=49,263 Children<5 yr=5961 Prevalence =10% Precision 6% Design effect=1 Sample sizes =95	Total population=49,263 Children<5 yr=5961 Prevalence =10% Precision 10% Design effect=1 Sample sizes =34	Total population=49,263 Children<5 yr=5961 Prevalence =10% Precision 6.4% Design effect=1 Sample sizes =83

The researcher also crosschecked the validity of the sample size determined by the ENA software with the standard sample size formula used by statisticians. Bartlett et al. (n.d:58) in the journal entitled *organisational research: determining appropriate sample size in survey research;* recommend 118 and 83 samples sizes to collect continuous data for 6000-10,000 population sizes with the significant level of 5% and 10% respectively. Therefore; the sample size determined by the ENA software is not contravene with the conventional sample size determination approaches. Hence; the data collected by the researcher is sufficient enough to generalise findings up to 10% significant level.

The following flowcharts identify samples households of moderately malnourished children (MAM), severely malnourished Children (SAM) and controlled group children (CGs).

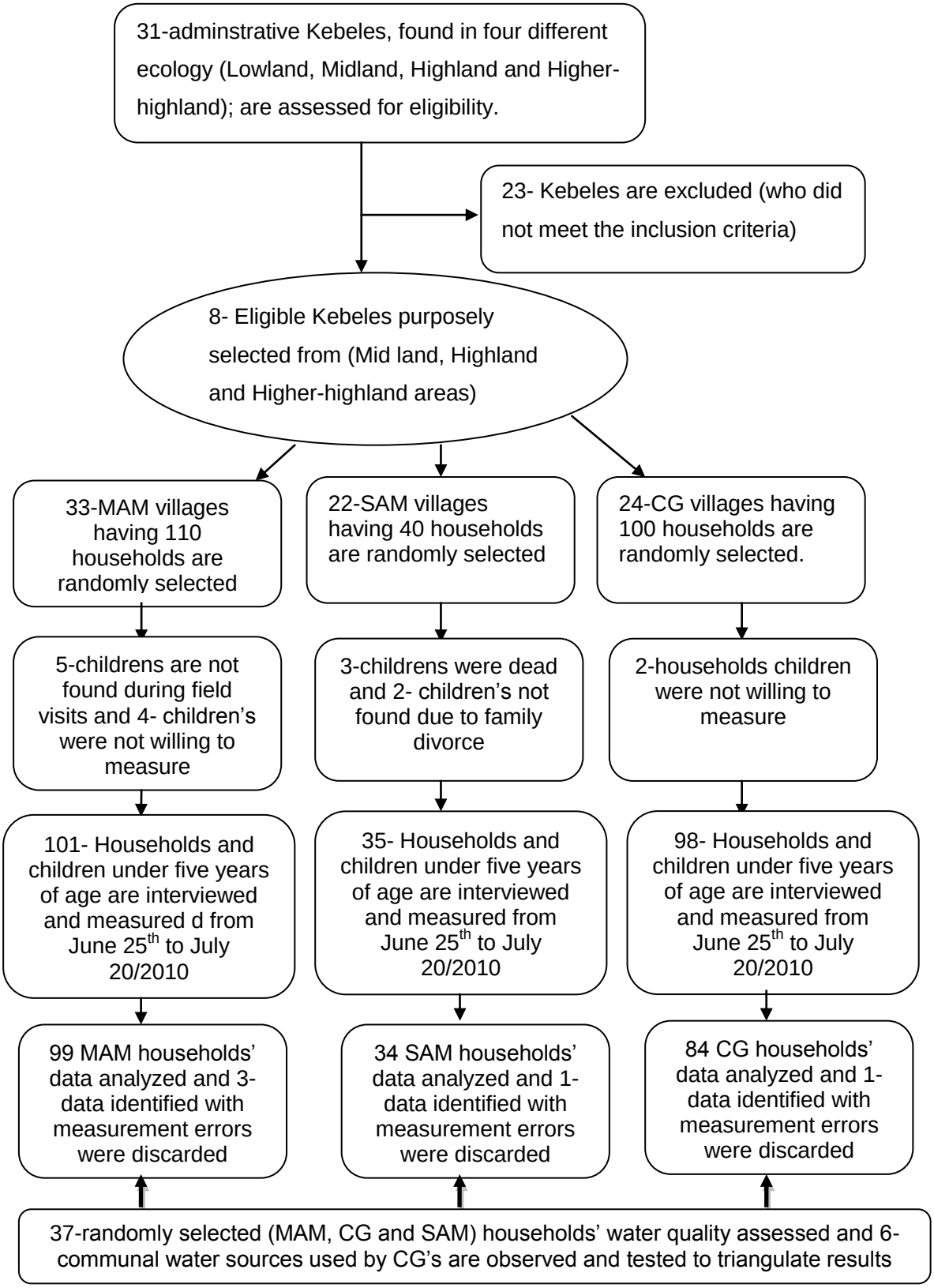


FIGURE 3.1 flowcharts used by the researcher to interview and observe study groups

3.5 Data collection methods

The researcher had collected both primary and secondary data from the 79 small-villages. Primary data were gathered directly from respondents of MAM, SAM and CG's and key informants. Secondary data were collected from reviewing literatures, government and INGO progress and survey reports done in the study area.

Target Kebeles as explained earlier, were purposely selected based on the eligibility criteria set at the beginning. The eligibility criteria were outlined considering various constraints of the researcher: including villages having high number of MAM and SAM children, geographically adjacent Kebeles, representing a minimum of three-agro ecological zones and accessible to collect the required data within the constraints of time and money.

The researcher used both quantitative and qualitative data upon the requirement. Both types of data are simultaneously collected from June 25 to July 20/2010. A total of 268 data (217 interviewed data of households of MAM, SAM and CG children; 37- water quality test data at households of MAM, SAM and CGs, 8- key informant interviewees' data and 6- communal water sources bacteriological and physical data) were collected on the specified date.

Selection of households within each village was done by using random sampling approaches. The researcher had taken names of children, specific villages', and nutritional statuses from the existing database. Then, simple random sampling (lottery method) was used to include at least 60% for children and their mothers for anthropometric measurement and interview respectively.

The researcher appointed six- data collectors, two female per Kebeles; to collect both quantitative and qualitative data together with the researcher. Quantitative data collection include: weighing children, measuring their height and mid-upper circumference and recording ages of children either using birth certificate or from direct interview. Similarly; quantitative WASH and socio-economic data are collected using field tests, interviews and observation.

3.5.1 Measuring Instruments

The researcher used UNICEF SALTER weight scale graduated to 0.100 kg, aluminium height boards and plastic mid-upper arm circumference meter (MUAC meter) to measure weight, height and mid-upper arm circumference of children respectively.

The data enumerators are well skilled on measuring children using height board, weight scale and MUAC meter. The researcher together with his assistant used DelAgua water test kit to

examine E-coli, PH, turbidity and residual chlorine from samples taken from households and communal water sources.

3.6 Approaches used

Different researchers used different approaches to minimise biases and ensure reliability and validity of the research outputs. For this specific study, the researcher used individual Interview, Key informant interview, systematic observation, participant observation, and field experiments. This allows the researcher to triangulate data.

3.6.1 Individual Interview

Interview as a data collection method is better exploited when applied to the exploitation of more complex and subtle phenomena (Denscombe 2007:174). The researcher used structured and semi structured interviews to harness appropriate data for the study.

Structured interview is applied to get primary data from MAM, SAM and CG children households. This method allows the researcher to get insight on water supply, sanitation and hygiene aspects of a particular household. Type of water sources, daily water consumption, accessibility, convenience and household treatment and other pertinent data are collected using this method of data collection. Similarly; data on sanitation and hygiene like: types and availability of latrine, child faces disposal system, understanding of key hygiene messages, how, where and when mothers/caretakers wash their hands. Likewise, semi-structured interview is conducted with key informant interviewees to grasp many silent issues of child malnutrition in the area.

3.6.2 Key Informant Interview

The researcher individually interviewed six-key Concern and local government staffs who are working in the study area. North-area coordinator of Concern Ethiopia, 1-nutrition emergency manager, 1-nutrition & emergency senior expert, 1- OTP nurse from the agency staff, Manager of Woreda MoH, 1-health extension worker. The above mentioned experts identified in advance and used semi-structured interview questionnaires that do not consume more than twenty minute.

3.6.3 Observation

The researcher used both systematic and participatory observation to collect data from the real life situation of the area. These methods allow the researcher to collect consistent data and preserving the naturalness of the setting (Denscombe 2007:207-225). The researcher has trained data collectors on how to observe household sanitation and hygiene issues systematically and participatory manner.

Spot observation is done in all target households during the interview session to document the sanitation and hygiene situation. The presence of latrine, type of latrine, super and substructure condition, sign of open defecation in the compound, the type of water containers used, the place where it is located, the presence of lid etc are observed on spot.

Accordingly, structured participatory observation is held to document when and where mothers' wash hands, child faeces disposal system, frequency of cleaning water container, using of soap or ash during hand washing how dispose liquid and solid wastes are disposed are recorded. The usage of structured observation allows the researcher to collect almost uniform data.

3.6.4 Field experiment

The researcher used 'quasi experimental' approach to look at the existing household water quality of MAM, SAM and CG's. Drinking water from 37 households were analysed using Delagua test kit. The researcher also undertakes household sanitary surveillance along with field experiment. Moreover; anthropometric data of height, weight, and MUAC of MAM, SAM and CG children are measured using standard measuring instruments.

3.7 Data Analysis

In recent years, researchers have been promoting the use of the case control study method as more statistically reliable and ethical approach to measuring the impact of an intervention than the with-and-without approach (Ferron et al. 2000:91). This research was done on the premises of case control approaches; considering that controlled group (CGs) children has fully similar in many socio-economic aspects with the target (MAM and SAM children) except using protected water sources. This allowed the researcher to have a look at their chid malnutrition index similarities and differences. Comparing have and have-not of key WASH facilities; the researcher has determined child malnutrition index disparities within the study group.

To analyse the data; the researcher used statistical packages of Emergency Nutrition Assessment (ENA/SMART) and statistical packages for social science (SPSS) to analyse child malnutrition indexes and WASH data respectively.

The researcher used descriptive statistics such as mean values and percentages. Bivariate analysis and chi-square tests were applied to look at correlation of different variables. The researcher calculated the correlation coefficient to examine whether there is a linear association/correlation between the different indicators (WAZ and WHZ) of child nutritional

status on the one hand, and the WASH variables they are expected to be associated with on the other. Moreover; to investigate whether the differences are due to chance or truly or statistically significant and to view their association; the researcher used chi-square test and determined 'P'-values. P-values less than 0.05 means, there is significant chance that the difference is not random. As the researcher used two categories (or one degree of freedom), the number of cases expected to fall in these categories should be at least five before this test can be applied. Hence; the researcher fully maintained this restriction while doing the analysis.

The analysis of qualitative data was basically based on the transcript of key informant interviews, participatory observation, responses of malnourished children households and informal debriefing with experts. Common ideas of respondents are valued for analysis. Moreover, data presentation and analysis were done only for WASH and socio-economic variables that show P- values are below 0.05 or probability of obtaining result by chance is very low (at least 5 out of 1000 times),

.

Chapter-4 Data Presentation and Analysis

4.1 Introduction

The results and discussion presented in this section were obtained by using statistical methods of data analysis presented in section 3.7 of above. Findings are presented in series of heading and sub-headings so as to make for smooth reading and understanding. Analyses were done using ENA/SMART (emergency nutrition assessment) and SPSS (statistical package for social science) software so as to analyze malnutrition indexes (Z-score of wasting and underweight) and key quantifiable WASH variables respectively. The researcher also summarized findings of the study using simple descriptive statistics, bivariate analysis and Chi-square tests. In most cases, table and graphical presentation are used to depict visual summary of findings.

Significant socio-economic parameters like family sizes, number of children under five years within a household (HH), relative wealth and its impact on child malnutrition are presented in section 4.2. The impacts of protected water supply sources on child malnutrition are presented in section 4.3. Findings of impacts of sanitation and hygiene on child malnutrition are presented in section 4.4. All findings and discussions are summarized only for variables whose P- values are below 0.05 (probability of obtaining result by chance is very low).

4.2 Socio-Economic variables and child malnutrition

To asses the degree of vulnerability of acute child malnutrition at rural settings, the researcher has used key socio-economic variables that determine child malnutrition at household level. Significant socio-economic variables of family sizes; number of children below five years and relative wealth status of a household are considered and compared with child malnutrition indexes of wasting and underweight.

4.2.1 Family size and child malnutrition

In many contexts women difficulties are compounded by large family sizes. WEDC community and management additional resource booklet citing Caroline and Moser (1993:27-36) noted that women's social roles are reflected in three distinct but over-lapping of productive, reproductive and community management works. Mother's reproductive and productive activities, to maintain and increase household income and resources increases as family sizes of a household go beyond five and above. This is because of the fact that these activities demand the hard physical labour of mothers.

The research output revealed that 71% of the interviewed mothers of severely acutely malnourished children (SAM) and moderately acute malnourished children (MAM) have family

sizes of five and more. Poor and very poor, who take the lion share of having more family sizes; exposed to excessive productive and reproductive works. These ultimately demand energy and time expenses of mothers.

The study remarked an inverse correlation of family sizes and child malnutrition indexes at 0.05 significant levels. It rectified 'family sizes per household' is a critical determinant of acute child malnutrition, not in 'wasting' but 'underweight' of children in Ethiopia.

TABLE 4.1 Family size and Child malnutrition

Study Groups	Prevalence of GAM (<-2 z-score) (WHZ)		Prevalence of GAM (<-2 z-score) (WAZ)	
	Households having five and more family	Households having four and less family	Households having five and more family	Households having four and less family
MAM Children	**12.7%**	**18.5%**	**73.2%**	**59.3%**
CG Children	**5.2%**	**19.2%**	**25.9%**	**15.4%**

The proportion of female headed households is mainly observed in households of SAM children. Findings revealed that 83% of mother's of SAM, 91% of MAM and 93% of CG children are living together with their husband. These demonstrate severity of child malnutrition perceived more in female headed household. The severity of acute child malnutrition further increased in poor widows with more family size.

4.2.2 Under five children per household and child malnutrition

Analysis revealed that 49.5% of households of SAM children, 25% (24/99) of households of MAM children at least had two under five-year children. It deduced that birth spacing is one of the critical determinants of child malnutrition.

The prevalence rate of child malnutrition significantly reduced on households having one child than having two. The degree of severity i.e. severely wasted and undernourished children prevail more on those households having two under five children than one. Unequal attention and nutritional shortfalls due to increased division of available resources in the household are main causes observed during the study.

Mothers' who have two and more children below five years of age and living in desperate poverty situation may not properly take care of their children. The household sanitation and

hygiene condition could be neglected while involved in income generating and reproductive works.

It is imperative that high fertility rate with low birth spacing demands mother's energy and compromise mothers and family member health. Two children under five years of age might not get proper care and support of mothers. The research findings deduced that birth spacing below five years by double increase the risk of acute child malnutrition. Ffindings of WHZ and WAZ z-score also revealed prevalence of wasting and underweight increased in household's having two children than one.

TABLE 4.2 proportions of children under five years of age in households (HH) of SAM and MAM

Study Groups	**Percentage of children under five years of age**		**Remarks**
	Two children <5 yrs of age per HH	One child <5 yrs of age per HH	
HH's of moderately acutely malnourished (**MAM**) children	25%	75%	*Anthropometric indicators of WHZ revealed that the number and prevalence of SAM children increased in households having two under five children than one.*
HH's of severely acutely malnourished **(SAM**)children	49.5%	50.5%	

Statistical Bivariate analysis confirmed that households having two children below five years of age are more susceptible and vulnerable to severe child malnutrition than households having one child. Severe-wasting or low weight for-height (WHZ <-3 of the National Center for Health Statistics [NCHS] reference median is predominantly observed on those having two under five years children per household. This depicted that severe acute child malnutrition, which is mainly determined by the degree of wasting and considered as the main causes of child mortality; is prevalently observed on poor households and female headed households having two children below age five.

Similarly; comparison of the degree of child malnutrition (wasting and underweight) in households having one and two children below five years of age revealed that the prevalence of child malnutrition, particularly 'wasting' by double reduce in households having one child below age five than households having two children. However; the prevalence rate of 'underweight' is not significantly influenced by the number of children under five per

household. Hence; acute child malnutrition is the results of high fertility rate combined with low birth spacing.

TABLE 4.3 Survey results of WHZ among HH's having one and two children per household

Study Groups	Prevalence of GAM (<-2 z-score) (WHZ)	
	Two children under five 5yrs old per HH	One child under five years old per HH
Household's of (**MAM**) children	**26.9%**	**11%**
Households of **(CG**) children	**15.4%**	**8.5%**

TABLE 4.4 Survey results of WAZ among HH's having one and two children per household

Study Groups	Prevalence of GAM (<-2 z-score (WAZ)	
	Two children under five 5yrs old per HH	One child under five 5yrs old per HH
Household's of (**MAM**) children	**73.1%**	**65.5%**
Households of **(CG**) children	**30.8%**	**30.9%**

4.2.3 Relative wealth and child malnutrition

Given the complexity of poverty, the best way of addressing the issue of poverty seems to be through utilising forms of PRA. This technique generally involve wealth ranking, whereby people are asked to rank each local household in terms of its wealth, according to whatsoever criteria they agree to be appropriate (WEDC, 2007 community and management additional resource module citing Chambers (n.d).

The neighbourhood community, who well knows each other; better differentiate who is the very poor and the better-off than any econometrics measurement researchers are currently using in the rural settings. The wealth ranking database, done by the agency in 2007/2008 livelihood baseline survey; still used by the agency for targeting poor and very poor in different development interventions.

Considering that there were no major policy changes done within the past two years that brings spontaneous and discontinuous stride of improvement at household level; the relative wealth data is considered as reliable source data by the researcher. The researcher took the relative wealth status of each interviewed household from the existing database of Concern Ethiopia and used for analysis.

Literatures reviewed in Concern Ethiopia revealed that the main differences among the poor and the better-offs are mainly differentiated because of accesses to arable land, standard of housing, sources of additional income and households copping strategy. Poor and very poor households are mainly confronted with food gap and only cover one third of the yearly consumable food demand from the small plot they have. The remaining two-third food gap is filled by either food aid (safety-net) program of the government or work as daily labourer in the area. In due absence of relief aid, house head of the family (mostly male) migrates to town in search of jobs; whereas mothers and children are involved in selling labour force for better-off farmers. The situation substantially burdened mothers of children less than five years of age.

Income-poverty increases nutritional needs because of the income-poor expend more physical labour, are isolated from markets and services and therefore expend more time and energy to access them (World Bank 2002). Many researchers agreed on the strong effect of wealth with child malnutrition. The findings of this study also reinforce the strong association and correlation between relative wealth and prevalence rate of child malnutrition.

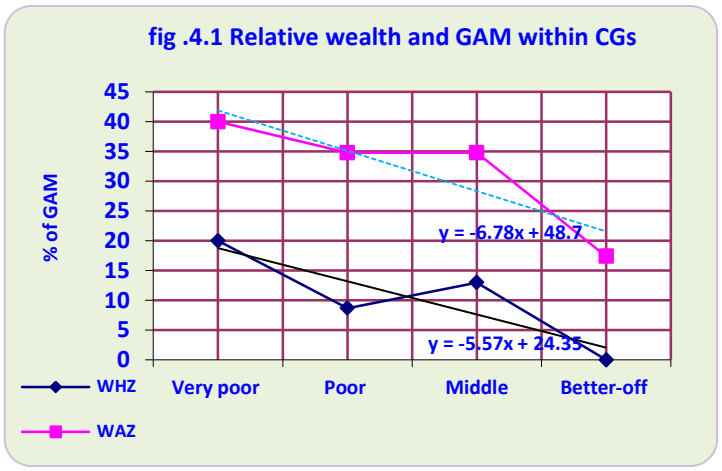
Analysis of the study remarked that underweight and wasting of children below five years of age rapidly diminishes as we go from poor household home to that of better-off. Because of wealth differences, the prevalence rate of wasting and underweight of children born and live in the poor and very poor by double higher than the better-off strata. Other determinants remain constant; the prevailing gap between better-off and poor classes by itself is a good ground of causes of acute child malnutrition in Ethiopia.

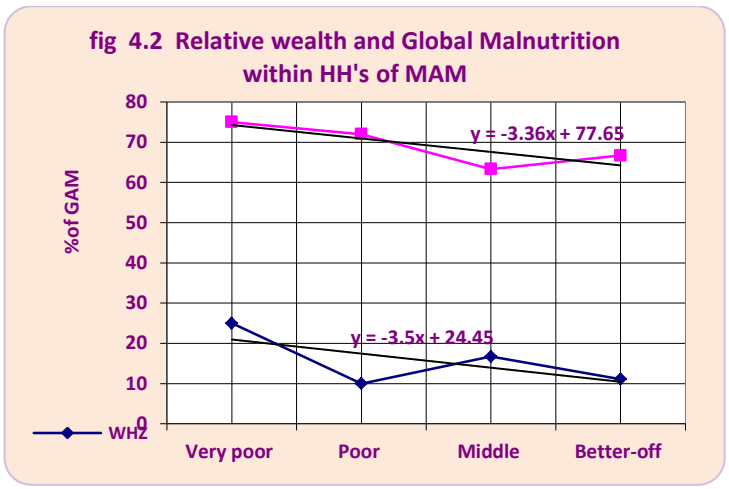
The study depicted that 53% of households of SAM and 63% of households of MAM are categorised under poor households. Table-12 remarked that child malnutrition affects every economic classes of the society, however; its degree of severity prevail more on the poor and very poor segment of the society. It implies the degree of vulnerability of child malnutrition reduces as rural households economy grows.

TABLE 4.5 Proportion of poverty across SAM and MAM households

Interviewed households	Very-poor HH	Poor HH	Middle HH	Better-off HH
Households of Severely acutely malnourished Children(SAM)	21%	32%	35%	12%
Households of Moderately acutely malnourished Children (MAM)	20%	41%	30%	9%

Separate analysis done on households of MAM and CG children revealed that the prevalence rate of global acute malnutrition (GAM) of wasting (WHZ<-2 z-score) and underweight (WAZ<-2 z-score) reduces as one goes from the biter-off household to the very-poor household. Even though the trend line is different among MAM and CG children, child malnutrition indexes reduces at an alarming rate as one goes from the very poor to the better-off family.





Z-scores of wasting and underweight (WHZ and WAZ) revealed that child malnutrition reduces as income at household level improves. Moreover, bivariate correlation analysis revealed that there is a negative correlation in between relative wealth and child malnutrition indexes of HH's of CG and MAM children.

The above trend line-graph of CGs depicted that children's nutritional status grow sharply worst amongst lower wealth status of a household. Looking at differences *by wealth status of a household*, the share of underweight children amongst very poor mothers was 40 percent, compared with 17.4 percent among the economically better-off mothers. The corresponding shares of wasting of children were 20 percent and approaches to zero percent, respectively.

Likewise, the strong effect of relative wealth is also perceived in the case of moderately malnourished children (MAM). The share of underweight children amongst very poor mothers was 75 percent, compared with 66.7 percent among the economically better-off mothers. The

corresponding shares of wasting of children were 25 percent and 11.1 percent, respectively. These highlighted the strong effect of rural poverty disparity on acute child malnutrition.

4.3 Protected water sources and Child malnutrition

Child malnutrition in Ethiopia, as in other low-income countries, results from a series of interconnected factors basically deep-rooted in poverty, including lack of access to food, health care, safe and accessible water, sanitation and hygiene services, and appropriate child feeding and caring practices. The role of accesses to adequate, safe and reliable drinking water worthily contributes to the reduction of acute child malnutrition rates in lots of ways. The analysis and discussion parts of the sub-titles listed herewith presented the impact of safe, adequate, accessible and convenience water sources on child malnutrition below five years of age.

4.3.1 Impact of protected water source

The principal aim of protecting water source, particularly at rural settings; are to supply adequate and wholesome water to the community. Well protected water sources can reduce the risks of diarrheal disease that diminish nutrient absorption and increase the risk of malnutrition among children aged below five years. Results of the study revealed that the degree of child malnutrition (severe and moderate wasting and underweight) are observed on households used unsafe (unprotected springs, river or stream) water sources.

Table 4.6 HHs of MAM & SAM children used protected and unprotected water sources

Households of SAM children used:		**Households of MAM children used:**	
Protected water sources	unprotected water sources	Protected water sources	unprotected water sources
37%	**63%**	43%	**57%**

Research findings revealed that severe acute malnutrition (SAM) which is the major killer of children below five years of age is predominantly observed in households who used unprotected water sources. Observation of Outpatient Therapeutic Program (OTP) examination cards revealed that 52.5% of SAM children are diagnosed with diarrhoeal diseases. Moreover; significant numbers of these children are also identified with WASH related skin and eye infection.

Though, the debate ‘diarrheal infection cause child malnutrition or the vice versa’ is not yet resolved, the results of the study is strengthened the usual saying of “diarrhea prevents children from achieving normal growth, while malnutrition increases the frequency and the duration of diarrheic events thereby creating a vicious circle” (ACF 2009).Moreover; the

study emphasize WASH related diseases, particularly diarrheal diseases; can pushdown the moderately malnourished children to be more severely malnourished and then ultimately to death.

Similarly; child malnutrition indexes of wasting and underweight are higher in the case of children used unprotected water sources. The prevalence rate of global acute malnutrition of wasting (WHZ<-2 z-score) and underweight (WAZ<-2 z-score) in the case of moderately malnourished children are reduced by 40-percent and 30-percent respectively. Likewise, severely malnourished (SAM) children used unprotected water sources are more vulnerable for severe wasting than SAM children used protected water.

The usage of protected water or treated water in every household having children below five years of age is found important to minimize child death due to severe wasting.

TABLE 4.7 Prevalence of wasting and underweight on children used protected and unprotected water sources

Study groups	Children used protected water sources		Children used unprotected water sources	
	GAM(<-2z score) (WHZ)	GAM(<-2z-score)(WAZ)	GAM(<-2z-score) (WHZ)	GAM(<-2 z-score) (WAZ)
(MAM) Children	13%	60.9%	18.2%	78.2%
(SAM) children	30.80	92.3%	38.10	85.7%

Statistical analysis also deduced that there is a negative correlation between improved water sources and child malnutrition indexes. This implies that improvement in water sources reduce the incidence of acute child malnutrition. Hence; a child who used protected water sources is less vulnerable to diarrheal infections; and hence easily developed high recovery rate compared with child used unprotected water sources.

The control group (CG), representing under-five years of age children in protected water source areas; less vigorously hit by child malnutrition. The prevalence rate of ‘wasting’ and ‘underweight’ in this particular study group showed that prevalence of global acute child malnutrition of wasting (WHZ) and underweight (WAZ) is 9.5% and31%[respectively. This is by far below the recent nutrition survey results of the Woreda (district) done even after end of fifth-emergency intervention program; which is 10.1 %and 47.5% respectively. The comparative results deduced that improvements in water supply alone significantly contribute to the reduction of acute child malnutrition in Ethiopia.

4.3.2. Water quantity and child malnutrition

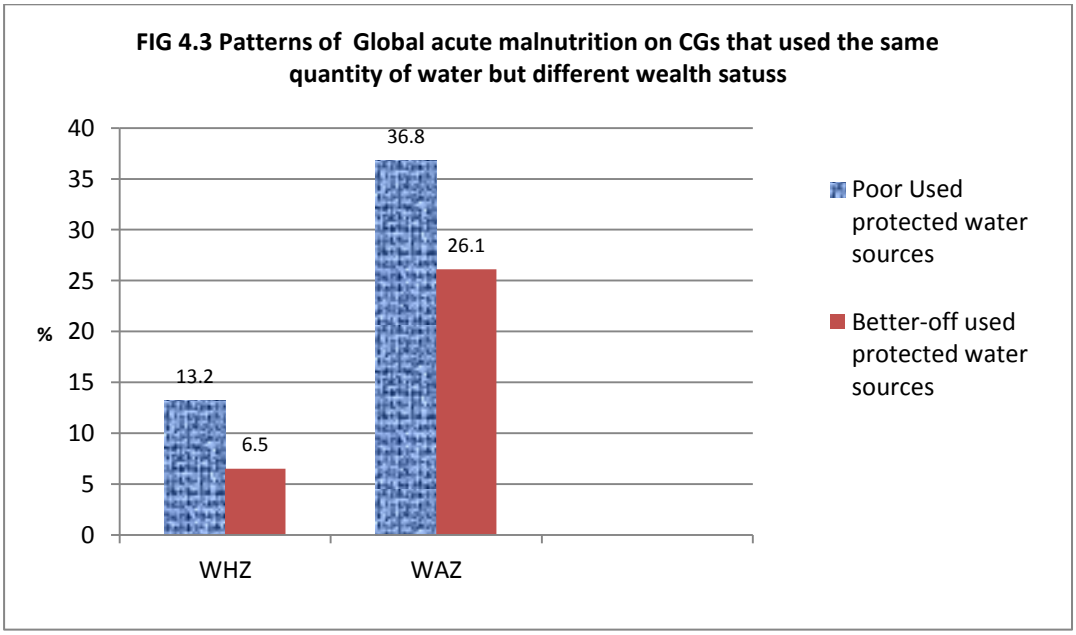
DIFID (1998) cited (Cairncross and Feachem, 1993) developed water consumption vs. travel time graph. The literal implication of the graph is: *Despite the availability of sufficient water at source or tap points, moving the residents 'along the plateau' of the graph will not increase water consumption at the household level.* Data analysis held on this study revealed that most of the people (70-80%) are moving on '*along the plateau'* an average return tri to fetch water elapse 40-45 minute.

Due to the fact that interviewed households used standardized plastic jerry-can to collect water; the average water consumption, whatsoever the time elapsed and the topography challenges; is within the range of 8-10liter/capita/day; which is very minimal to maintain sanitation and hygiene at household level.

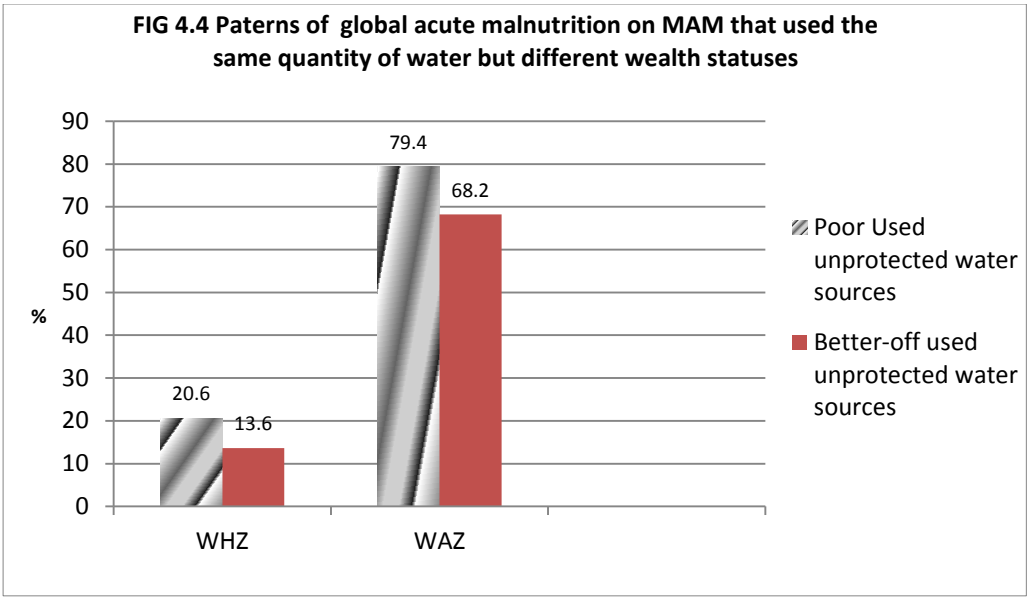
Though, difficult to compare child malnutrition indexes of wasting and underweight due to similarity of water consumption per day per household; the quantity of water used by a household compromise household sanitation and hygiene and hence child malnutrition.

However; comparative analysis between children of poor and better-off families who used the 8-10lit/capita/day of protected water showed remarkable variation on malnutrition indexes. This remarked that, within the existing context; wealth/income at HH level and the quality of domestic water sources is more determined than the quantity of water used at HH level.

FIG 4.3 Patterns of Global acute malnutrition on CGs that used the same quantity of water but different wealth satuss



Similar analysis was conducted within households of MAM children that used unprotected water sources as follows:



From fig 4.3 and 4.4 depicted the massive variation of WHZ and WAZ among poor and rich. Moreover; poor households depend on unprotected water source are more vulnerable to child malnutrition that the better–off households. This emphasise that wealth disparity between the poor and the better-off significantly impacts on child malnutrition. However, wealth improvement at household level alone not gives guarantee for child nutritional improvement unless coupled with improvement in quality and quantity of water at household level.

4.3.3 Accessibility and Convenience of water sources

Accessible and convenience water supply contribute to the reduction of burden of mothers' and enhance childcare and wellbeing. Women who walk long distances to collect water can burn as much as 600 calories of energy or more per day, which may be one third of their nutritional intake (UNICEF 1999). Moreover; inaccessible and inconvenience water supply detain proper child care and feeding of infants. The researcher has looked at accessibility and convenience from time spent on collection and topographical challenges perspective alone.

4.3.3.1 Time spent on water collection

Findings revealed that the contribution of mothers, from other members of the family; to fetch water is very high. 74.3% of mothers of SAM and 88% of mothers of MAM walk at least an hour to fetch water to the family every single day.

Given value of '1' and '0' for households spent less and more than 30-minute to collect water respectively; bivariate correlation analysis depicted that there is a positive correlation between

wasting (*measured based on MUAC<125mm*) with time of collection at 0.05 significant level. This showed that the more mothers' spent time to collect water aggravate acute child malnutrition.

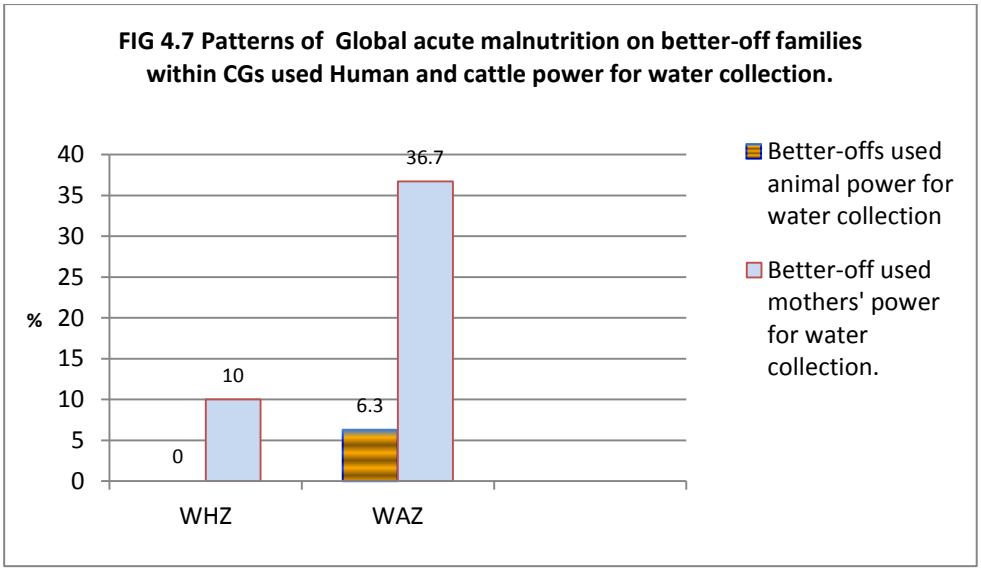
4.3.3.2 Topographical Challenges and child malnutrition

Using Likert scale; the researcher has assessed topographical challenges to collect water from sources to home. An average 43% of mothers of SAM children climbed over a steep slop carried an average estimated weight of 25 kilogram of water. All Households of SAM children used human labor to transport water from sources to home. This demands the high energy outlay of mothers.

Similarly; 42% of mothers of MAM children climbed over a hill (steep slope) at least two times per day carried an average of 25Kg of water. Only 4% of the interviewed households of MAM children used cattle power to transport water whereas the remaining 96% is fully dependent on human power, particularly mother's power.

In case of CGs, an average 49% (41/84) respondents daily carried 20-25kg of water and climbing over a hill to fetch water from source to home. Findings also revealed that 21% of the households used cattle power to collect water, whereas the majority i.e. 79% used human labor.

There is no direct relationship between child malnutrition and topographical challenges; rather indirectly elongate collection time and demands high calories of mothers. Cross comparison was held between better-off families who used cattle power and mothers' power for water collection. The result revealed that children whose mothers used cattle power to collect water showed improvement in nutritional status than mothers used their own power. This remarked that regardless of relative wealth similarities between households; mothers who used cattle power save time and energy used for child care and feeding.



4.3.4 Water Quality and child malnutrition

Howard (2002) remarked the importance of giving priority for microbiological quality of water as it links with infectious diarrhoeal diseases. In line with source protection, management of drinking water at household level is crucial to safeguard water from contamination. According to (Kleinau and Pyle 2004: 55) safe water management at the rural setting implies households have cover containers, use narrow-neck containers, limit accesses of children by raising the water container above the ground, keep container clean and used household treatment facilities. Similarly DFID (1998:70-75) cited the early study of B.C. Deb et al. (1986) remarked water storage containers with small diameter of inlet and outlet lower the prevalence of cholera transmission than the conventional water storage and dipping.

In this particular study, most of the interviewed households of MAM and SAM children are used unprotected water sources and more than ninety-percent of them had not practiced any methods of water treatment at household level even in the worst season of the year. Moreover; 23% of HH's of SAM children 16% of mothers of MAM children used clay pots to store water and dipping to pour. The use of clay jars and dipping increases the risks of water pollution and children below five years easily affected by infections come along with unsafe water.

The field experimental data conducted on randomly selected households of MAM and SAM children during rainy season revealed that ten-of twenty four samples (42%) taken from MAM and SAM households are identified with low to intermediate risks of E-colie. However, only three-of thirteen (23%) randomly collected samples of CGs are identified with E-coli. The degree of risk or high number of E-coli/100ml was identified on water samples taken from households of SAM children and low in CG's. The field experiment and observation informed

that households of severely and moderately malnourished children water storage and handling system had exposed their children for water born and related infections.

Similarly, water quality test conducted on six protected water sources revealed that two of the six protected water sources are identified with an average of 4E-coli/100ml and one with 15E-coli/100ml; according to (Smet and Wijk 2002) it is categorized under low and intermediate risk respectively. Whereas the other three protected water sources are found free from E-coli. Water quality surveillance surveys conducted on these water sources also showed that highly risky protected springs show high number of E-coli. What is observed in the field test is that: both protected and unprotected water sources are unreliable during rainy season. Protected water sources, particularly located in the waterways are more susceptible for faecal pollution.

The researcher observation also revealed that E-coli are found mainly on households used turbid water. Descriptive analysis deduced that 75% (18/24) of households of SAM and MAM children and 46.2 %(6/13) of CGs used turbid (>5NTU) water. Since; risks of faecal-pollution and turbidity are high during rainy season; households who depend its water source from unprotected water sources are easily affected by faecal-contamination. As turbidity accentuate bacterial attachment growths; SAM and MAM children depend on unprotected water sources; easily affected by faecal contamination and reverse to severe malnutrition and illness during rainy season.

Protected water sources reduced turbidity at rainy season and hence contribute to the reduction of bacterial attachment growth. However; springs developed at gullies or runoff routes; didn't guarantee turbidity and faecal pollution. Physical and bacteriological parameter testes conducted in six protected communal springs revealed that five out of six springs have turbidity <5NTU).

In general the physical and bacteriological quality of water at household level is a critical determinant of child malnutrition in the area. Therefore; study results on subsection 4.3.1, that stated children used protected water sources is less vulnerable for severe wasting and underweight is valid result.

Along with bacteriological tests, physical tests of PH and temperature are also measured at communal and household level. The researcher observed that PH and temperature of water at HH level varies with the type of container and length of stay at home *(this require further investigation).* Field experiment result revealed that all the three study groups PH and temperature range between (6.8 - 8.1) and (10.1 ^{o}C -21 ^{o}C) respectively.

4.4 Sanitation and hygiene improvement at household level and child malnutrition

In many respect, children are more susceptible to faecal contamination. The researcher assessed sanitation and hygiene at household level considering the presence of latrine, sanitation facilities, handwashing with soap and solid and liquid waste disposal.

4.4.1 Latrine Usage and child malnutrition index

DFID (1988) remarked that children are the prime victims of faecal-oral diseases; they are consequently the main reservoir of infection. Since; child faeces are more likely to contain the disease causing organisms; it is more infectious than those of adults. Hence; proper disposal of faeces, particularly children faeces is imperative to enhance public health and to create healthy environment for children. Study and analysis held on the study area revealed that most of households of malnourished children practice open defecation.

TABLE 4.8 Latrine coverage among SAM, MAM and CGs

Study groups	Households having latrine (TPL)	Households without latrine (TPL)
Households of SAM children	**37%**	**63%**
Households of MAM children	**48.5%**	**51.5%**
Households of CG children	**66%**	**34%**

Table 4.8 depicted that most family member of households of severely wasted and underweight children (SAM children) practice open defecation than households of MAM and CGs. Therefore; severe child malnutrition, mostly diagnosed by diarrheal infections and other health complications; are linked with poor accesses of sanitation facilities at household level.

Sanitation improvement, particularly household focused intervention; retain health benefit for that particular household. A number of studies in the field of sanitation have shown that health benefit accrue to families who have latrine, even where neighbourhood do not (DFID 1998:75).

Knowledge and awareness of interviewed households of SAM and MAM children, regarding the serious adverse health impacts of improper child faeces disposal; is very low in the area. There is a misconception within the community that child faeces are not hazardous to health. Even, households having toile is not properly dispose child faeces in the toilet. Table 4.9 show the proportion of households have toilet and dispose child faces in the field.

TABLE 4.9 Children excreta disposal by households of SAM, MAM and CGs

Study groups	Households having latrine (TPL)	Households without latrine (TPL)	Households disposed child faces in the field
Households of SAM children	**37%**	**63%**	**75%**
Households of MAM children	**48.5%**	**51.5%**	**70%**
Households of CG children	**66%**	**34%**	**49.4%**

Despite low coverage of latrine in the area, 35% to 40% of households of malnourished children that have toilet did not dispose his/her child faeces in the latrine. The persistence of improper disposal of child faeces in the area, assure the continuation of infection- malnutrition cycle in the area.

Comparative analysis held within CGs revealed that the prevalence rate of global acute malnutrition is by far lower on households having traditional pit latrine than have-not. Moreover, the probability of being severely wasted and underweight is higher on children living in household's without latrine.

TABLE 4.10 Prevalence of wasting and underweight of children have and have not latrine

Study groups	Prevalence of wasting (<-2 z-score) (WHZ)			Prevalence of Underweight (<-2 z-score) (WAZ)		
	GAM (<-2 z-score)	**MAM (<-2 z-score and >=-3 z-score)**	**SAM (<-3 z-score)**	**GAM (<-2 z-score)**	**MAM (<-2 z-score and >=-3 z-score)**	**SAM (<-3 z-score)**
Households of CG have toilet	**4.7%**	**4.7%**	**0**	**28.1%**	**21.9%**	**6.3%%**
Households of CG haven't toilet	**25%**	**20%**	**5%**	**40%**	**20%**	**20%**

A similar assessment was held within households of MAM children those having toilet and used protected water sources vs. those have-not toilet and used unprotected water sources. The result revealed that those HH's used protected water sources and have toilet show improvement on z-scores seen on table 4.11.

The result deduced that malnourished children living in households deprived of the primary and basic access of sanitation and drinking water facilities are not easily recover and get the desired weight gain even after an intensive supplementary feeding intervention. Hence; the cumulative impact of having potable water and latrine by far surpasses the individual contribution on child malnutrition reduction.

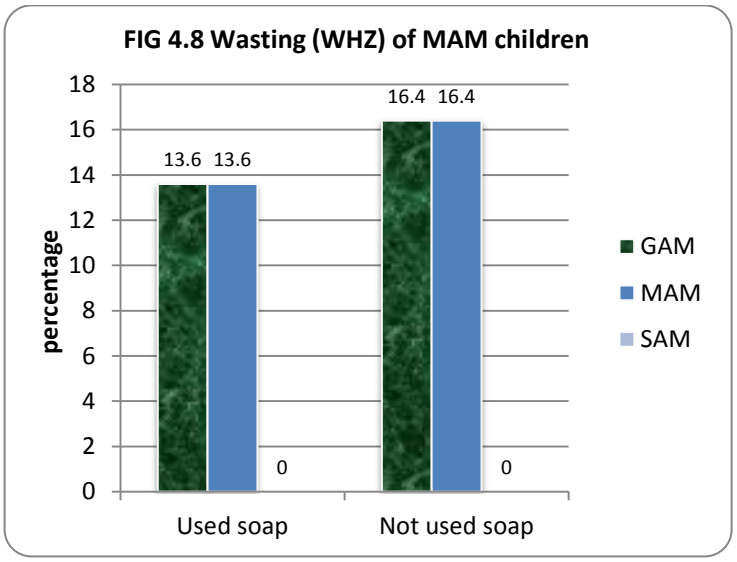
TABLE 4.11 Cumulative effect of have latrine and protected water source on reducing child malnutrition.

Study groups	Prevalence of children wasting (<-2 z-score) (WHZ)			Prevalence of children Underweight (<-2 z-score) (WAZ)		
	GAM (<-2 z-score)	**MAM (<-2 z-score and >=-3 z-score)**	**SAM (<-3 z-score)**	**GAM (<-2 z-score)**	**MAM (<-2 z-score and >=-3 z-score)**	**SAM (<-3 z-score)**
Households of MAM children have toilet & used protected water	**20%**	**20%**	**0**	**60%**	**45%**	**15%**
Households of MAM children haven't toilet & not used protected water	**21.4%**	**21.4%**	**0**	**75%**	**50%**	**25%**

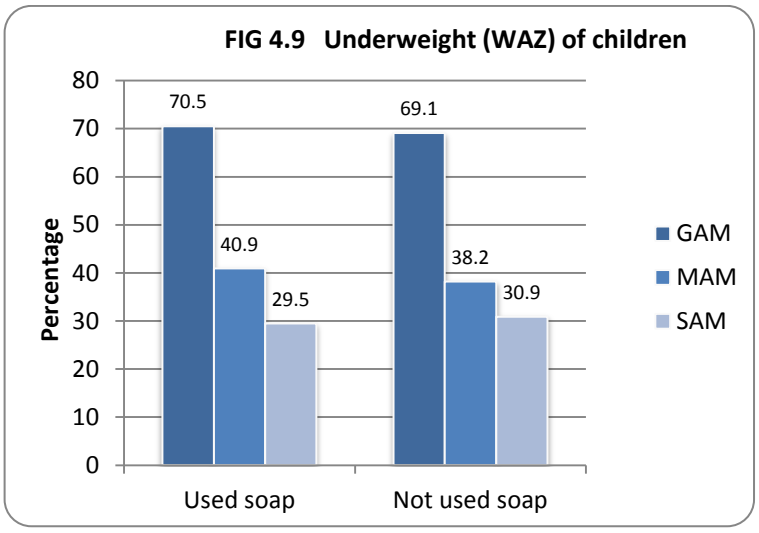
The statistical analysis held within CG and MAM group revealed that there is a negative correlation between child malnutrition indexes and access to latrine. Therefore, it is possible to say that improvement in coverage of latrine in the area significantly contribute to the reduction of child malnutrition. Along with improvement on hardware, emphasis on software to improve household level of awareness on proper child excreta disposal and usage of latrine positively deviate the current trend of acute child malnutrition.

4.4.2 Hand washing with soap and child malnutrition

Building sanitation facilities by itself can not improve health very much, what matters is the way in which it is used, and the way in which it may promote changes in sanitation and hygiene-related behaviour (DFID 1998:70). During field observation and interview, 55.6 %(56/99) respondents of mothers of MAM children did not used soap while demonstrating handwashing.



This figure revealed that households used soap for handwashing significantly influence wasting of children below 5-years of age.

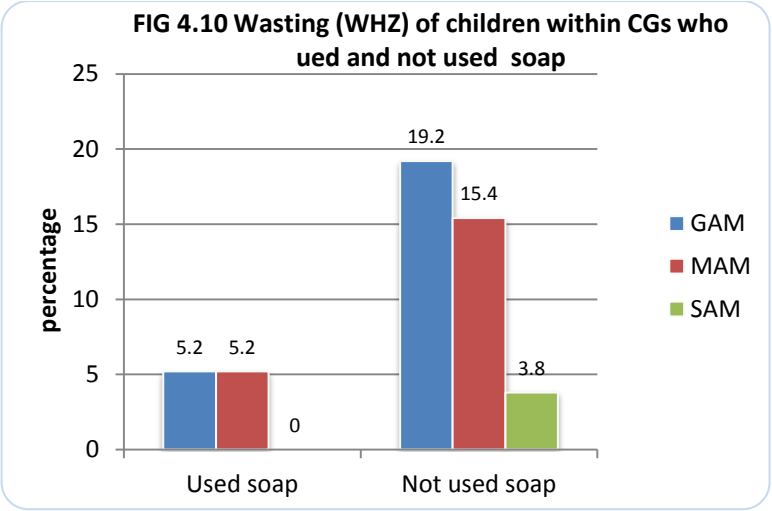


This figure revealed that households used soap for handwashing significantly influence wasting than underweight of children below 5-years of age.

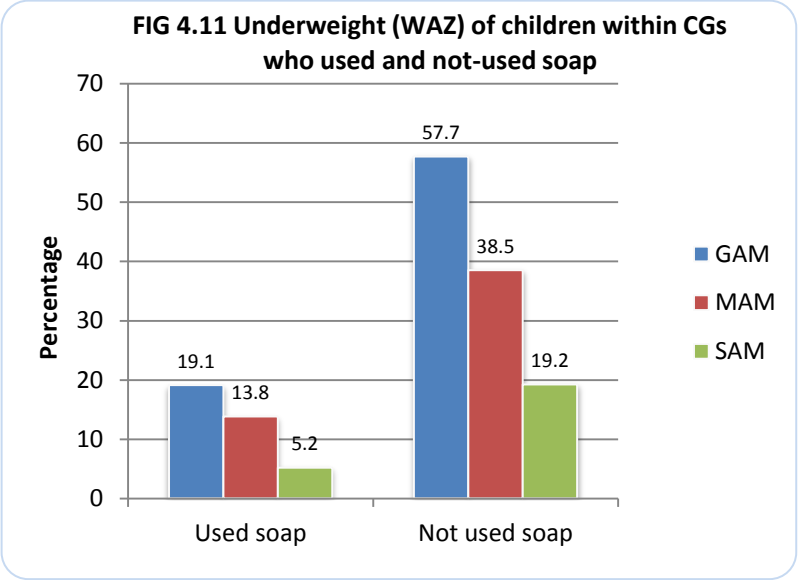
The researcher also used both interview and observation methods to assess knowledge and skills of handwashing of mothers/caretakers of children. From the randomly selected CGs, approximately 70% (58/84) used soap to demonstrate handwashing during field observation. Children of mothers who used soap to demonstrate handwashing during observation has less vulnerable than mothers who didn't use soap. Findings also revealed that 79.32 % (46/58) of children living in households using soap for handwashing did not affected by acute child malnutrition in the past two emergency years in the area. However, 38.5 %(10/26) of children whose mothers' not used soap for handwashing were sick and get food aid from Concern.

The researcher also compared malnutrition indexes of children whose mothers used and not used soap for demonstrating handwashing. Findings revealed that children whose mothers used soap are less vulnerable than counterparts not used soap while demonstrating

handwashing. Figure 4.10 and 4.11 depicted that washing hands with soap contribute to the reduction of acute child malnutrition in rural settings of Ethiopia.



It is observed that wasting of children significantly reduced as mothers/caretakers used soap for handwashing.



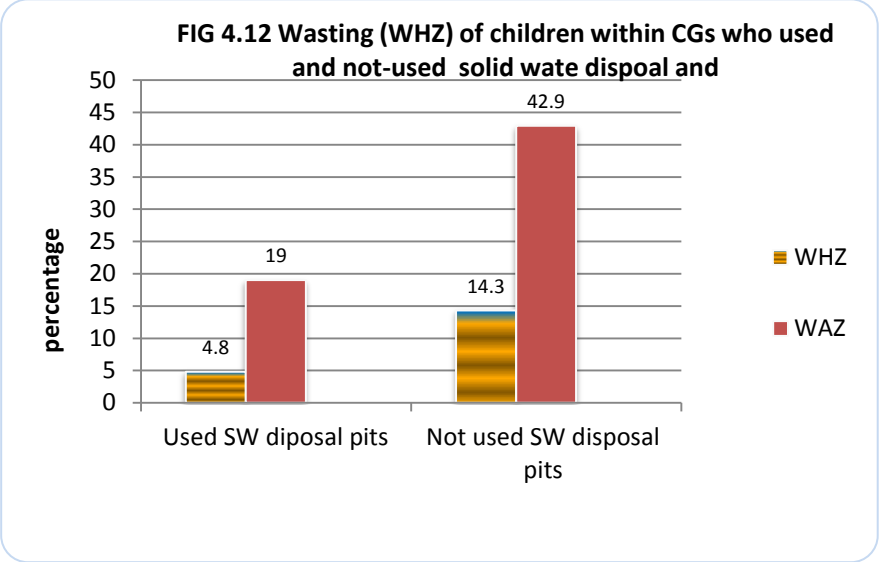
It is observed that underweight of children significantly reduced as mothers/caretakers used soap for handwashing.

Considering that handwashing after defecation, before preparing food and before feeding children is critical to improve child health. Interview analysis revealed that 62% (61/99) of households of MAM children did not practice all the three critical handwashing practices Moreover; 71.8% of mother's of CGs and 68% of mothers of SAM not washed at these critical times.

4.4.3 Solid and liquid waste disposal and child malnutrition

The research findings revealed that 50.6% (43/84) of CGs and 32.31% (32/99) of Households of MAM have solid waste disposal pits. Similarly; 44.7 %(38/84) of CGs and 22% of MAM have solid waste disposal pits. Within the randomly selected CGs, solid waste disposal pits

and child malnutrition has negatively correlated. Bivariate analysis held in these specific groups revealed that children living in HH's of CG's used solid waste disposal pit shows improvement in nutritional status than their opposites.



4.5 Bivariate correlation analysis and Pearson's CHI-square test of association.

The Pearson chi-square test of association is used to screen an influential variables that were significantly associated with child malnutrition indexes. Table 4.12 & 4.13 show the list of variables associated with child wasting and underweight at 0.05 significant levels. Chi-square, p-values, standard deviation and Pearson coefficient of correlation are presented as follows.

TABLE 4.12 Bivariate Correlation Coefficients

Critical Variables	underweight	Wasting	MUAC Malnutrion
Underweight	1		
Wasting	0.465	1	
MUAC Malnutrition	0.428	0.282	1
Protected Water	-0.216	-0.198	-0.310
Five and more Family Size/HH	-0.185	-0.262	-0.295
Under five children	0.093	0.065	0.03
Using Cattle power	-0.208	-0.087	-0.119
Collection Time>30min	0.108	0.129	0.234
Being poor and very poor	0.171	0.072	0.137
Having Latrine	-0.116	-0.316	-0.218
Handwashing with soap	-0.316	-0.163	-0.147
Using solid waste disposal pit	-0.217	-0.201	-0.219

Table 4.13 Chi-square ad P-values

Descriptions	Chi-Square values	P-values	Standard deviation SD
Wasting (WHZ) *[1-WHZ<-2-z-scores] [0-WHZ >/=-2-z-scores]*	51.857	0.000	0.311
Underweight WHZ *[1-WAZ <-2-z-scores] [0-WAZ >/=-2-z-scores]*	6.857	0.000	0.482
Family sizes *[1- five and more] [0-lessthan five]*	10.383	0.001	0.469
Under five year children *[1- have two and more] [0-only one]*	40.04	0.000	0.364
Water sources *[1- protected water used] [0-unprotected water used] adj**	76.190	0.000	0.153
Water transport *[1- used human power] [0- used cattle power]*	27.429	0.000	0.413
Time for water collection *[1- less or equal 30min] [0- greater than 30min]*	3.048	0.081	0.494
Relative wealth *[1- poor and very poor] [0- middle and better-off*	0.762	0.021	0.488
Having Latrine [*1- have latrine] [0- not-have latrine]*	135.714	0.000	0.984
Wash hands with soap [*1- wash with soap] [0- not-wash with soap]*	9.333	0.002	0.667

Chapter-5 Conclusion and Recommendation

5.1 Conclusion

The researcher realised malnutrition in Ethiopia is deep rooted in extreme poverty and mainly arise due to failures of many socio-economic sectors both at macro and micro level. Furthermore; it is more complicated by seasonal shocks and disaster. However; the issue of child malnutrition below five years of age at rural setting of Ethiopia is mainly prevail on failure of household sanitation and hygiene and unsafe drinking water sources.

In this particular study of impacts of WASH on community managed acute child malnutrition; the researcher found that family sizes, number of children under five years of age per household, household economy, protected water sources, accessibility and convenience of water supply sources, household latrine, handwashing with soap and solid waste disposal are the most important determinants of child malnutrition. The following important conclusion emerges from the study.

- There was a statistical significance relation between family sizes and child malnutrition. Poor and very poor have high fertility rate and more family size than economically better-off families. Moreover; severe and moderately malnourished children prevail in households of with high family size.

- Family size of household impact under-five (U'5) child malnutrition. A child born and lives in households with more family size is highly prone to underweight than wasting. Whereas, the presence of two and more under-five children in a household impacts more on wasting than underweight. Regardless of many constraints; the researcher extracts the following four scenarios:
  I. High family size combined with one U'5 child: In this scenario, a child is more prone to underweight than wasting.
  II. Low family size combined with two and more U'5 children: In this scenario, a child is more prone to wasting than underweight.
  III. Low family size combined with one U'5 child: In this case the probable risks of acute child malnutrition i.e. wasting and underweight of child is very low.
  IV. High family size combined with two and more U'5 children: This is the worst scenario when a child is more susceptible to acute malnutrition of wasting and underweight.

  Hence, rampant population growth at rural setting seriously impact acute child malnutrition.

- High prevalence rate of child malnutrition; particularly severe wasting and underweight are compounded by having two and more under five children per household. Poor households with high fertility rate and short birth spacing are easily exposed for child malnutrition. Either one or two of children below five years of age of the family are affected by varying degree malnutrition.

- High fertility rate and low birth spacing is significantly observed in households of MAM and SAM children. Most of SAM children have at least two under five year's children. Hence; the magnitude of child malnutrition, particularly severely wasting and underweight; is significantly associated with the presence of two or more under five children per household.

- There is a direct association between number of children below five years of age per household and child malnutrition indexes. The more the number of children below five years per household doubles the risks of child malnutrition.

- Child malnutrition affects every economic classes of the rural society. However; the vulnerability and susceptibility of children born from poor households are higher.

- There is an indirect association/correlation between household economy and child malnutrition. The aggregate prevalence rate of child malnutrition; underweight and wasting of children below five years of age rapidly diminishes as we go from poor household to that of the better-off.

- Protecting rural water supply sources from contamination improve child malnutrition. Severe wasting and underweight of children which is the major killer of children below five years is more prevalent on children used unprotected water sources.

- Children from poor household and used unprotected water sources severely affected by child malnutrition. Hence; the combined effects of unimproved water sources and income poverty at household level increase the prevalence of child malnutrition.

- Water supply projects that reduce time spent to collect water, close to the beneficiaries, bacteriological safe to drink are important determinant to reduce severe acute child malnutrition. Moreover; children whose mother mostly used cattle power to collect water is less vigorously hit by child malnutrition.

- Children from households have and used latrine, is less hit by child malnutrition. Prevalence rate of global acute malnutrition (children wasting and underweight) is by far lower on households having traditional pit latrine than have-not. Moreover, the probability of being severely wasted and underweight is higher on children living in household's have-not latrine.

- Children from households used soap for handwashing is less hit by child malnutrition. Malnutrition indexes of wasting and underweight reduces on children whose mothers used soap for handwashing that not used soap.

5.2 Recommendations

Malnutrition, in a broader context; results from failure of social, human, financial, natural, institutional, and political capital both at macro and micro level. This study realized that child malnutrition below five years of age is mainly arise due to the immediate and underlying determinants of access to basic water supply, sanitation and hygiene facilities and wealth/economic status at household level. The proliferation of new young families without reliable capitals; further complicate child malnutrition in the area. Hence the following recommendation is forwarded:

1. **Set pro-poor rural development policy and strategy**. Politicians and policy makers commitment is indispensible to promulgate pro-poor economic development policy and strategy to ensure economic growth and provision of basic health services including water, sanitation and hygiene for households vulnerable to childe malnutrition.

   Arable land which is the mainstay of rural livelihood is the nucleus for wealth disparity among the poor and the better-off. The rural youngster (the future prospectus of building family) or the newly married couple has little opportunity to get sufficient land for agriculture. Policy makers have to think over the issue of arable land for the poor landless or create other sources of income generating activities beyond the agricultural sector.

2. **Improve reproductive health service for poor families.** The issue of high fertility rate and family size peculiarly observed in poor and very poor households. Family sizes of five and above are determined as a critical parameter that aggravates child malnutrition, particularly underweight below five years of age.

   In-depth social works to break traditional values and believes: the desire to have large family size, early marriage, values of children as a labour force and sources of support in

the old age need through attention. Inline with poverty alleviation, women economic and educational empowerment to limit birth spacing and to give care for the newly born child is crucial.

3. **Improve household economy of the poor.** Despite, poor and very poor has unable to harvest the yearly food requirements, introducing appropriate agricultural technologies that enhances productivity per square meter is required. Water harvesting for backyard gardening, make and use of composts, breading and fattening, poultry and other context specific appropriate backyard agricultural production has to be sought. Sustainable income generating activities within and out of the conventional agriculture sector is vital.

4. **Improve access to water supply facilities.** Access to water supply is a crucial element for child malnutrition prevention. Since; the quality of water at the point of abstraction and storage is important; protecting every single communal water sources is found imperative to minimize faecal contamination of water sources.

   At national or regional level, massive involvement is required to access safe water at rural settings. Proper sitting, construction and management of water sources on catchment basis are required. Similarly; introducing household level treatment technologies, safe water collection and handling, regular sanitary inspection and surveillance, regular disinfection, and dissemination of chlorine tablets '*aqua-tab'* during rainy season is important to minimize the probable incidence of water contamination.

   Moreover; to minimize time spent on collection, high expenditure of energy and workloads on mothers (who often collect water for the household); all water supply projects has to give emphasis to minimize these burdens. If capital and topography constrained the issue of accessibility and convenience; at least it is advisable to provide donkey or mule to ease mothers' burden.

5. **Improve access to sanitation facilities.** Sanitation facilities, particularly accessing at least the basic sanitation facilities of TPL, significantly reduce faecal pollution of communal water sources. Effective implementation of the national sanitation and hygiene policy brings positive deviance on health improvement and hence child nutritional improvement. Efforts have to be exerted to create demand for improved sanitation facilities in rural settings. Enhance latrine coverage in the area; support the poor to have basic pit latrine; and one step stride to the next sanitation ladders has to be thought to consolidate public health and hence to reduce acute child malnutrition in the area.

6. **Improve sanitation and hygiene promotion.** Sanitation and hygiene promotion reduces the incidences of diarrheal infection on children below five years of age. This directly or indirectly contribute to the reduction of child malnutrition. Key hygiene practices of drink safe water; safe disposal of excreta; washing hands with soap; safely disposing of solid and liquid domestic wastes improves hygiene at household level. In order to implement key hygiene practices; communication, social mobilization, social marketing and community participation is vital. Moreover; simultaneously targeting mothers and caretakers of children below five years of age for both nutrition and WASH programs particularly for household water treatment, improved sanitation and improved hygiene practices enhances child weight gain and minimizes opportunistic infections come along with sanitation and hygiene.

   Linking/ working sanitation and hygiene promotion with emergency nutrition intervention not only improves the nutritional status and health of children but also reduces high outlay of cost per children by reducing readmission rate. Hence; joint implementation of nutrition and sanitation and hygiene promotion in any emergency context makes either of the programs more effective and efficient.

7. **Mainstream nutrition across development programs.**
   The death of hundred thousands of Ethiopian children is due to preventable communicable diseases. The contribution of child malnutrition reaches up to fifty-seven percent; which is by far surpasses the contribution of HIV/AIDS. Moreover; the intergenerational influences or its contribution to the continuation of poverty cycle is very immense. However; very little attention is given by international and national development actors working in Ethiopia. This study urges the requirement of strong emphasis to mainstream 'Child malnutrition below age five' within all development agenda as what they have done for HIV/AIDS, gender, equality, environment, disability and other cross cutting issues.

   This is because of the fact that child malnutrition is more hidden on the social dimensions of poor awareness and accesses to water, sanitation and hygiene facilities and the household economy dimensions of poor income sources and management at household level.

8. **Integrating CMAM with WASH.** CMAM which is recently institutionalized in MoH is a good start to reduce child morbidity and mortality due to severe and moderate wasting and underweight. It is difficult to categorieze the works of CMAM either in prevention or curing works. The work of CMAM, in this particular study; was recognized as a bridge to

link children identified with malnutrition to treatment or stabilization centers (health posts, health centers and hospitals). The approaches, apart from reducing child mortality due to malnutrition; has not involved to eliminate the prime causes of child malnutrition. In general; it serves as an intermediary between prevention and curing.

The research investigated that the prime causes or possible to say 'the external imposed forces that push either moderately malnourished or non-malnourished children to severe malnutrition is primarily due to confounding infections come along with unsafe water sources and inadequate household sanitation and hygiene at household level. Without merging CMAM with primary public health preventions, particularly with improvement of WASH; is impossible to minimize child malnutrition cases identified at rural settings. Unless and otherwise CMAM approaches link with other ministries, within the existing country economic, human and institutional set up; the full institutionalizing of CMAM to MoH alone can bring many case identified children to the limited health centers/hospitals and would be a challenging assignment to the national government. Otherwise, CMAM more serve on promoting marketing for national and international RUTF industries than curing the affected poor children.

To minimize severe child malnutrition at rural settings, linking CMAM with WASH at national, regional and local level is indispensible.

9. **Set holistic development approaches.** The good start of linking CMAM/CTC with long-term development is appreciable. However; linking all the issue of child malnutrition with the ministry of health alone will not be fruitful. In contrary, make partnership with local NGO's and civil societies working to alleviate extreme poverty and working in collaboration with other government ministries like ministry of agriculture, ministry of water resources, ministry of economic finance and economic development is crucial

5.3 Further Research

This research proposed the following points for further study:

- Effects of standardized containers on sanitation and hygiene improvement in rural areas.
- Effects of premix (oil with famix) on malnourished children

References

ACF (2007) *Interactions of Malnutrition, Water Sanitation and Hygiene, Infections*. Action Contre la FAIM, Paris, France.

Appleton,B. and Sijbesma,C.(2005) *Hygiene Promotion*. Technical overview paper, Curtis,V. and Jong,D.(editors),IRC International Water and Sanitation Centre: Delft, the Netherlands.

Ashworth,A.(2006) *Efficacy and Effectiveness of Community Based Treatment of Severe Malnutrition*. Food and Nutrition Bulletin, Vol 27, No 3, United Nation University.

Bruijne,J.,Geurts,M. and Appleton,B. (ed.)(2007) *Sanitation for All*. Thematic overview paper 20, IRC International Water and Sanitation Centre: Delft, the Netherlands.

Cairncross,S. and Feachem, R. (1993) *Environmental Health Engineering in the Tropics: An introductory text,* second edition, Joh Wiley and Sons: Chichester, UK.

CNS (Concern Nutrition Survey), (2009) *Nutritional Survey Preliminary Report of Dessie Zuria Woreda.* Amhara Region, southwollo zone, Ethiopia.

Coats,G.H. (2009) *Humanitarian Response Index: Summary Report*. Emergency Nutrition Networks (March 2009), field exchange –issue No 35, pp. 17-18, oxford, UK. (Available at www.ennonline.net)

Collins,S., Bahwere,P.,Binns,P., Dent,N., Guerrero,S., Hallam,A., Khara,T.,Lee,J.,Mollison,S., Myatt,M.,Saboya,M., Sadler,K., Walsh,A. (2006) *Community-Based Therapeutic Care: A Field Manual.* Valid International, Nairobi, Kenya.

Collins,S., Sadler,K.,Dent,N.,Khara,T.,Guerrero,S., Myatt,M.,Saboya,M., and Walsh,A.(2006) *Key issues in the successes of community based management of severe malnutrition*. Food and Nutrition Bulletin, Vol 27, No 3, United Nation University.

CSA (2001) *Ethiopian Demographic and Health Survey 2000*.Central Statistical Authority, Addis Ababa, Ethiopia.

Denscombe, M. (2007) *The good research guide for small scale social research project*. Third edition, Open University Press: Buckingham, UK.

Deolalikar,A.B. (2008) *Copenhagen Consensus 2008 Perspective Paper: Malnutrition and Hunger.* Population Reference Bureau, Washington DC, USA.

DFID(1998) *Guide Manual on Water Supply and Sanitation Program.* Department for International Development, Water and Environmental Health, Loughborough, London,

EFMoH (2007) *Protocol for the management of Severe Acute Malnutrition*. Ethiopian Federal Ministry of Health Sector Strategic plan (2005-2009), Addis Ababa, Ethiopia.

EFMoH(2007) Protocol for the Management of severe Acute Malnutrition. Federal Ministry of Health. Addis Ababa, Ethiopia.

EHP (2004) *Assessing Hygiene Improvement: Guidelines for Household and Community level*. Environmental Health Project Strategic Report 8. Washington DC, USA.

EHP (2004) Assessing Hygiene Improvement: Guidelines for Household and /community level. Strategic Report-No 8, Environmental Health Project, Washington DC, USA.

ENCU (2004) *Emergency Nutrition Intervention Guideline*. Emergency Nutrition Coordination Unit, Addis Ababa, Ethiopia.

FDREMoH(2005) *National Hygiene and Sanitation Strategy: To enable 100% Adoption of Improved Sanitation and Hygiene*. Federal Democratic Republic of Ethiopia ministry of Health, Addis Ababa, Ethiopia.

FDREMoH(2005) *National Reproductive Health Strategy 2006-2015:* Federal Democratic Republic of Ethiopia Ministry of Health, Addis Ababa, Ethiopia.

FDRMOH (2008) *Health and Health Related Indicators*. Federal Democratic Republic of Ethiopia Ministry of Health, Planning and programming department, , Addis Ababa, Ethiopia.

Ferron,S., Morgan,J. and O'Reilley,M. (2000) Hygiene Promotion: A Practical manual for relief and development, ITDG Publishing, UK.

Fewtrell,L. and Colford,J.M (2004) *Water Sanitation and Hygiene: Interventions and Diarrhoea*. A systematic review and Meta-analysis, World Bank, Washington DC, USA.

Gatchell, V. Forsythe, V. and Thomas,P.R.(2006) *The Sustainability of CTC in non-Emergency Context.* Food and Nutrition Bulletin, Vol 27, No 3, United Nation University.

Gil,A., Lanata,C.,Kleinau,E.and Penny (2004) *Children's Faeces Disposal Practices in Developing Countries and Interventions to Prevent Diarrheal Diseases*. Strategic report-No 11, Environmental Health Project, Washington DC, USA.

Gómez, F.,Galvan,R.R., Frenk,S.,Munoz,J.C.,Chavez,R. and Vazquez,J.(n.d.) *Mortality in Second and Third Degree malnutrition*. Mexico city, Mexico.

Gupta,M.D., Lokshin, M., Gragnolati, M. and Ivaschenko,O. (2005) *Improving Child Malnutrition Outcomes in India*: Can The Intigrated Child Development Services Program be effective? World bank policy paper-No 3647, (available at *http://econ.worldbank.org*)

Haddad,L,Wiggins,S.,Garrett,J.and Ahmed,A.(2004)*Accelerating Malnutrition Reduction in Bangladesh: The Potential role of DFID.* Report of an International Food policy research Institute-lead team, Washington DC, USA.

Howard,G. (2002) Water Quality Surveillance: a Practical Guide. WEDC, Loughborough University :UK.

Kleinau,E. and Pyle,D.F. (2004) Assessing Hygiene Improvement: Guidelines for Household and Community Level. Environmental Health Project, Strategic Report 8, Washington DC, USA.

Luby, Agboatwalla, Feikin, Painter, Billhimer, Altaf, Hoekstra (2005) *Effect of Handwashing on Child Health: A Randomised Control trial*. Lancet, 366, pp. 225-63, Atlanta, USA.

Malla, Sherchand, Ghimire, Kumar, Gauchan (2004) *Prevalence of Intestinal Parasite Infections and Malnutrition among Children in a Rural Community of Sarlahi,Nepal*.Journal of Nepal health research Council vol.2, No 1 April 2006.

Mekonen,A., Jones,N. and Tefera,B. (2005) *Tackling child Malnutrition in Ethiopia: Do the Sustainable Development Poverty Reductions program's Underlying Policy assumptions Reflect local realities? Working paper No-19, Published by Young lives Save The Children UK.*

MoH(2005) National Strategy for Child Survival in Ethiopia. Family health department, Federal Ministry of Health, Addis Ababa, Ethiopia.

Pluby,S., Agboatwalla,M.,Fekin,D.R., Painter,J., Billhimer,W., Altaf,A.and Hoekstra,R.M.(2005) *Effect of handwashing on child health: a randomised controlled trial . Lancet (*2005; 366: 225–33), Atlanta, USA.

PRB (2004) *Improving the Health of the World poorest people*. Population Reference Bureau. Policy brief(April 2004) Washington DC, USA.

Ram, P. (2010) *Practical Guideline for measuring Handwashing Behaviour*. Water and Sanitation Program. University at Buffalo, the State University of New York

Rottier,E. and Ince,M.(2003) *Controlling and Preventing Diseases: The Role of Water and Environmental Sanitation Intervention*. WEDC, Loughborough University: UK.

Ruel,M. and Hoddinott,J.(2008) Investing in Early Childhood Nutrition. International Food Policy Research Institute (IFPRI) Policy brief –No 8,Washington DC USA.

SFP (2009) Concern Supplementary feeding Program.

Shordt,K.and Cairncross,S.(2004) *Sustainability of Hygiene Behaviour and the Effectiveness of Change interventions: Findings and implications for water and sanitation programmes from a multi-country research study.* Booklet 2,IRC international Water and Sanitation Centre: Delft, the Netherlands.

Silva,P.(2005) *Environmental Factors and Children's Malnutrition in Ethiopia*. Policy research paper-No3489, World Bank. (*Available at http:// econ.worldbank.org*.)

Smet,J. and van Wijk,C.(2002) *Small Community Water Supplies: Technology, people and Partnership.* IRC International Water and Sanitation Centre: Delft, the Netherlands.

Smith,L.C. and Haddad,L. (2000) *Explaining Child Malnutrition in Developing Countries: A Cross-Country Analysis.* Food consumption and nutrition division discussion paper, International Food policy research Institute , Washington DC, USA.

SPHERE(2003) 'Minimum Standards in Water supply, Sanitation and Hygiene promotion in Water Supply'. Chapter 2 in the Sphere project-Humanitarian Character and Minimum Standards in Disaster Response. The Sphere-Project: Geneva, Switzerland.

Tanner,C.G. and Collins,S.(2004) *Community Therapeutic Care (CTC):A new approach to managing acute malnutrition in emergencies and beyond.* Food and Nutrition Technical assistance, Technical note –No 8, Washington DC, USA.

UNCHR/WFP (2006) *Acute Malnutrition in protected Refugee Situations: A Global strategy*. Report of UN high commissioner for refugees and World food program 2006.

UNICEF (1999) Water, Environment *and Sanitation Technical Guidelines: Towards better Programming.* United Nations Children's Fund. New York, USA.

UNICEF/UNDP (2006) *Children and Water, Sanitation and Hygiene: The Evidence*. Human Development report-No 50, Occasional paper, United Nation Children's Fund.

UNICEF/WSP (n.d) *Are your hands* clean *enough: Study Findings on Handwashing with Soap Behaviour in Kenya.*A joint report by United Nation Children fund, Water and Sanitation Program.Nairobi, Kenya.

Üstün,A.P.,Bos,R.,Gore,F.and Bartram,J.(2008) *Safe Water Better Health: Costs, benefits and Sustainability of Interventions to Protect and Promote Health*. World Health organisation: Geneva, Switzerland.

Water Aid (2008) *Tackling the Silent killer: The Case for Sanitation*. Report on July 2008.London,UK.

Webb,P., von Braun,J. and Yohanenes (1992) *Famine in Ethiopia: Policy Implication of Copping Failure at national and Household level.* Research report 92, International Food policy research Institute, Washington DC, USA.

WEDC (2007) *Community and Management additional resources*. Water Engineering development Centre, Loughbrough university, UK.

WHO (2006) *Guideline for Drinking-water Quality*, volume 1: Third edition, World health organisation. Geneva, Switzerland.

WHO (2007) *Community Based Management of Severe Acute Malnutrition: A joint statement by the World Health Organisation, the World Food Program, the United Nations System standing committee on Nutrition and the United Nation children fund*. Geneva, Switzerland.

WHO (2008) *Safe Water Better Health: Costs, benefits and Sustainability of Interventions to Protect and Promote Health*. World Health organisation: Geneva, Switzerland.

Zhang,J.(n.d) *The Impact of Water Quality on Health: Evidence from the Drinking Water Infrastructure Program in China*. University of Maryland.USA

.

Appendix: 1 Interview Questionnaire for Mothers of Children aged from 6 to 59months

Interview No----------	**Research on Acute Malnutrition in Dessie Zuria Woreda MONTH: 6-59months**	**Tick on Child Category:** SAM MAM CG

Interview Date

Name of headed of Household.....				
1. Relative wealth status (fill at office)	**V. poor**	**Poor**	**Middle**	**Better-off**
2. Interviewers Name				
3. ZONE: _____	5. KEBELE/admin No/_____			
4. WOREDA/district/_____	1. Gott /village/Name._____			

INTRODUCTION (This interview questionnaire should be administered only for mother of MAM, SAM and NAM child)

Hello, my name is _____ and my colleague name is ----------We have been working in Concern Ethiopia Dessie Zuria Nutrition intervention program. We are conducting this survey to learn more about current health and nutrition status of your children. To do this, we will measure your children height and weight as usual and we would like to ask you some questions about water, sanitation, hygiene and other socio-economic issues that considered important for the study. This might take about 20 minutes and all answers provided will be kept confidential.

Would you permit us to ask you some questions about your family?

CONSENT GRANTED	1	INTERVIEW DECLINED	0 ➔STOP

Appendix: 1 Interview Questionnaire for Mothers of Children aged from 6 to 59months

*GENERAL INFORMATION **ABOUT** RESPONDENT*

7. What is your name? _____		
8. What is your marital status?	Married…….....1 Widow……..…….....2 Divorced/Separated…..…...3 Other(specify)…….……..	→10 →10
9. Is your husband living with you?	Yes ……...…… 1 No ……...…… 0	
10. what is the number of people living in this house (family size)	Two ……...…….... 1 Three ……..... 2 Four ……...……... 3 Five and above ……..…4	
11. How many children less than five years of age do you have?	One ……..... 1 Two ……..….. 2 Three.……..... 3 Four……..... 4 Five and above ……..……5	
12. What is the name of the children that receive food aid from Concern Ethiopia in the past eight months? (***Write the name and sex of the child in the space provided)***	Name..... Sex..... M F	
13. Can you remember the date, month and year when **NAME?** Born? ***(If she can't remember request her the vaccination card and fill in the space provided)***	Date | Month | Year | | | | | |	
14. What positive deviance did you see after the child get food aid from Concern?	---------- ---------- ---------- ---------- ---------- ---------- ---------- ----------	
15. Can we measure his weight, height and arm circumference?	No ……..……0 Yes ……..…… 1	Stop

Appendix: 1 Interview Questionnaire for Mothers of Children aged from 6 to 59months

Weight of ‘’Name’’ ……Kg
Height of ‘’Name’’ ……CM
MUAC of “Name”.....CM

Now, let’s have some discussion about your water sources and other related issues.

16. . From which sources do you collect your drinking water? *Multiple responses accepted* *Read out all responses* **’’Protected’’ means that the well has an enclosure with lid or a spring has a spring box and outflow.*	1. Protected* well 2. Unprotected well 3. Protected* spring 4. Unprotected spring 5. Borehole or tube well 6. Public stand pipe 7. Surface water (river, stream, lake, pond) 8. other sources ***(if only one source is sited then)***	→18
17. Which of these sources do you use most often? ***Enter one response only***	1. Protected* well 2. Unprotected well 3. Protected* spring 4. Unprotected spring 5. Borehole or tube well 6. Public stand pipe 7. Surface water (river, stream, lake, pond) 8. other sources	
18. Who generally collect the water from this source? *Multiple responses accepted* *Read out all responses*	1. Mother 2. Father 3. Adult male of HH (age >15) 4. Adult female of HH (age >15 5. Children of Households 6. Other_____	
19. How is the water brought to the house?	1. Using human power 2. Using Cattles 3. Already on premises 4. Other (specify).....	

20. In what type of Container is the water carried?	5. Plastic Jerry can 6. Clay pots 7. Using '*Kell*" 8. Other_____ ____	
21. What is the approximate volume in litter of the container? ***(If she don't know the exact volume, you can estimate comparing with the standard jerry can)***	----------Litter	
22. How many of these containers are carried per day at normal day?	----------in No	
23. Do you use this water source all year round?	1. Yes _____ 2. No	→25
24. How many months of the year do you use this water source?	For ----------Months	
25. How long does it take to fetch water from the water source? ***(if the respondent knows the time exactly register his response. if not as the range and tick the number appropriately correspond to his answer)***	1. Over 1 minute, not more than 5min. 2. Over 5min, not more than 10min 3. Over 10min, not more than 20min 4. Over 20min, not more than 30min 5. Over 30min, not more than 40min 6. Over 40min, not more than 60min 7. Over an hour (If she knows state here the exact hour).....	
26. How do you rate the topographical situation of the area to bring water filled container to house? ***One response only*** ***(Read out all responses and makes the question very clear)***	1. Extremely steep slop 2. Very steep 3. Steep 4. Flat 5. Down gradient	
27. Do you usually have to wait in line before you can fill your container?	1. Yes 2. No_____	→30
28. Approximately how long do you usually have to wait? *One response only* ***(if the respondent knows the time exactly register his response. if not, ask the range and tick the number appropriately correspond to his answer)***	1. 5 minutes or less 2. 20 minute or less 3. 30 minute or less 4. 40 minute or less 5. One hour or less (If she knows state here the exact hour).....	

29. How long it does usually takes to fill a load of water from the source?	1. 5 minutes or less 2. 20 minute or less 3. 30 minute or less 4. 40 minute or less 5. One hour or less (If she knows state here the exact hour).....	
30. Do you perceive that our water sources are free from contaminants?	1. Yes ---------- 2. No	→32
31. In your understanding, what are the probable causes of pollution?	---------- ---------- ---------- ----------	
32. Do you make some sort of household treatments to make the water clear and palatable?	1. Yes 2. No	
33. What kind/type of household water treatment mechanism do you use?	---------- ---------- ---------- ---------- ----------	
34. Do you use chlorine tablets '*Wuha-agar*' to treat water at household level?	2. Yes 3. No	
35. Can you explain me how do you use the chlorine tablet 'whua-agar'?	---------- ---------- ---------- ---------- ---------- ----------	
36. How often do you use the chlorine tablet?	1. Daily 2. Weekly 3. Monthly Other (specify).....	
37. Do government staffs treat the water sources?	1. Yes 2. No	
38. How often government staff treat your communal water sources?	1. Daily 2. Weekly 3. Monthly Other (specoify).....	
Now I would like to look at and ask a few questions about your drinking water. (OBSERVATION)		

39. Is drinking water kept in a separate container?	1. Yes 2. No	
40. Is drinking water kept above floor level?	1. Yes 2. No	
41. Is drinking water kept away from contamination?	1. Yes 2. No	
42. Do containers have narrow mouth/openings?	1. Yes 2. No	
43. Do containers have lid/cover?	1. Yes 2. No	
44. Is this in place at time of visit?	1. Yes 2. No	
45. How is water taken from the container?	1. Poured 2. Using cup Other(specify).....	
46. Who usually hands out drinking water from the container	1. Children 2. Mother 3. Maid 4. Anyone	
47. Is utensils used to draw water from the container clean?	1. Yes 2. No	
48. Is utensil used to draw water the container kept away from surfaces and stored in a hygienic container?	1. Yes 2. No	
49. How often is the container cleaned?	1. Every day 2. Every week 3. Every month 4. Rarely 5. Never	
50. Is the inside of water container looks clean?	1. Yes 2. No	
51. Is the outside of water container clean?	1. Yes 2. No	
Now I would like to ask you few questions about household Sanitation and Hygiene. (Interview)		
52. Do you have latrine?	1. Yes 2. No	→54

53. Where do people in the household defecate?	1. In the bush 2. Neighbours latrine Other(specify).....	→55 →55 →55
54. How many people use this latrine?	Male..... Female..... Children.....	
55. How do you dispose of the faeces of infants/young children?	1. Al children use latrine 2. Put faces in latrine 3. Do not dispose of them 4. Don't know Other(specify).....	
56. Do the children wash their hands after using the latrine?	1. Yes 2. No	
Now I would like to see and ask you few questions about your latrine. (Participatory Observation)		
57. Can we look at the latrine?	1. Yes 2. No	***Only for those having latrine***
58. Type of latrine?	1. Traditional pit latrine 2. TPL with san plat 3. Ventilated improved pit latrine Other (specify) … ……..	
59. How far the toilet from the household residence house? ***(estimate using pacing)***	1. <5meter 2. 5 to 10M 3. 10 to 30M 4. 30 to 50M More than 50M	
60. When it built?	1. 0 to 6Months before 2. 6month to 1year 3. 1year to 2year 4. More than 2years	
61. Physical appearance you observe during the visit?	1. Has door 2. Has roof 3. Has wall 4. Child friendly Other(specify).....	
62. Lid present and in place?	1. Yes 2. No	

63. Does cleaning materials present? (Brush, Cleaning water, ash, soap, etc)	1. Yes 2. No	
64. State your overall observation using the following competencies. 1, Has offensive smel, 2., Lot of flies, 3, Full of spider webs, 4, faeces are seen in the squat hole,	....	
65. Is the compound free of excreta?	1. Yes 2. No	
Now I would like to ask you few questions about hygine . **(Participatory Observation**		
66. When do you wash your hands? *Multiple responses accepted* ***(Reading the stated answers is not allowed!)***	1. After defecation 2. After cleaning babies' 3. Before food preparation 4. before eating 5. Before feeding children Other(specify)…….....	
67. Would you explain and show me what you do when you wash your hands? *Tick on Multiple responses!!*	1. Uses water 2. Uses soap 3. Use ash 4. Washes both hands 5. Rubs hands together at least three times 6. Dries hands hygienically—by aid drying or using a clean cloth Other (specify).....	
68. Where does she wash hands?	1. In the house floor 2. In the waste container 3. In the compound land Other(specify).....	
69. Do you have liquid waste disposal pit?	1. Yes 2. No	→71

70. What you observe in the liquid waste disposal pit? Please mark and specify things you observe!	1. Far from the residence house 2. Has lid 3. Properly Infiltrate liquid wastes 4. Has no flies Other(specify).....	
71. How do you dispose liquid wastes?	....	
72. Do you have solid waste disposal pit?	1. Yes 2. No	→74
73. What you observe in the solid waste disposal pit? Please mark and specify things you observe!	1. Far from the residence house 2. Has sufficient depth (1M) 3. Not yet filled 4. Has no flies Other(specify).....	
74. How do you dispose liquid wastes?	....	
Dou you give us consent to come and check the water quality that you used for drinking purposes.	**1. Yes** **2. No**	

APPENDIX 2 Water Quality Surveillance formats

COMMUNAL WATER SOURCE QUALITY TEST

I. Types of facility **PIPED WATER**

1. General Information

   Name of Kebelle _____

   Name of Gotte _____

2. Code Number _____

3. Date of Visit

Date		Month		Year	
				20	**10**

4. Water sample taken? _____; Sample No_____

II. Specific Diagnostic Information for Assessment

(Please Indicate at which sample sites the risks were identified)

1. Do any tap stands leak? ……..……..... Y/N _____
2. Does surface water collect around any tap stands? ……..... Y/N _____
3. Is the area up hill of any tap stand eroded? …….... .Y/N _____
4. Are pipes exposed close to any tap stand? ……... Y/N _____
5. Is human excreta in the ground within 10M of any tap stand……... Y/N _____
6. Is there a sewer within 30M of any tap stand? .....…… Y/N _____
7. Has there been discontinuity I the last 10 days at any tap stands? ... Y/N _____
8. Are there sign of leaks in the main pipes of the village? …….. Y/N _____
9. Do the community reports any pipe breaks in the last week? …….. Y/N _____
10. Is the main pipe exposed anywhere in the village? …….. Y/N _____

Total Number of 'Y' _____

III. Results and Recommendation

The following important points of risks were noted!

_____

_____

__

Signature of Inspector

_____

COMMUNAL WATER SOURCE QUALITY TEST

I. Types of facility **PIPED WATER WITH SERVICE RESERVOIR**

1. General Information

   Name of Kebelle _____

   Name of Gotte _____

2. Code Number _____

3. Date of Visit

Date		Month		Year	
				20	**10**

4. Water sample taken? _____; Sample No_____

II. Specific Diagnostic Information for Assessment

(Please Indicate at which sample sites the risks were identified)

1. Do any tap stands leak at sample site... Y/N _____
2. Does water collects around any sample site? ……..…….... Y/N _____
3. Is the area up hill eroded at any sample site? ……..…….... Y/N _____
4. Are pipes exposed close to any sample site? ….……... Y/N _____
5. Is human excreta in the ground within 10M of any tap stand……... Y/N _____
6. Is there a sewer or latrine within 30M of any sample site?…...…… Y/N _____
7. Has there been discontinuity within the last 10days at sample site? Y/N _____
8. Are there sign of leaks in sample area? ……... Y/N _____
9. Do users reports any pipe breaks in the last week? …….. Y/N _____
10. Is the supply main exposed in the sample area? ……..…….. Y/N _____
11. Is the service reservoir cracked or leaking? ……..... Y/N _____
12. Are the air vents or inspection covers are insanitary? ……..…….... Y/N _____

Total Number of 'Y' _____

III. Results and Recommendation

The following important points of risks were noted!

Signature of Inspector

COMMUNAL WATER SOURCE QUALITY TEST

I. Types of facility **PROTECTED SPRING**

1. General Information

   Name of Kebelle _____

   Name of Gotte _____

2. Code Number _____

3. Date of Visit

Date		Month		Year	
				20	**10**

4. Water sample taken? _____; Sample No_____; TTC/100ml_____

II. Specific Diagnostic Information for Assessment

(Please Indicate at which sample sites the risks were identified)

1. Is the spring unprotected? ....…….....…….... Y/N _____
2. Is the masonry protected the spring faulty? ……..…….…….... Y/N _____
3. Is the backfill area behind the retaining wall eroded? …….. Y/N _____
4. Does spilt water flood the collection area? ……... Y/N _____
5. Is the fence absent or faulty?…….…….... Y/N _____
6. Can animals has accesses within 10M of the spring? ……....…... Y/N _____
7. Is there a latrine uphill and or within 30M of the spring?.....…….... Y/N _____
8. Does surface water uphill collect uphill of the spring?...……..... Y/N _____
9. Is the diversion ditch above the spring absent or non- functional?... Y/N _____
10. Are there any other sources of pollution uphill of the spring?..... Y/N _____

    (E.g. solid waste, liquid wastes etc)

Total Number of 'Y' _____

III. Results and Recommendation

The following important points of risks were noted!

_____

_

Signature of Inspector

Appendix 3: Wealth & Well-being Status Indicators

The Better-offs	***The Middle-level***	***The Poor***	**The Very Poor**
Have land >1.5 hectare); Have 2 oxen, 1-2 cows, 1 mule, 1 donkey, 10-20 sheep; Have 1 house with corrugated iron sheet with additional hut; Have additional income from petty trading; Are able to cover food consumption throughout the year; Are able to cultivate their own land properly; Share land from others; Are able to send their children up to high school; Have cash deposit; Are respected & honoured; Are mostly targeted for government extension packages	Have 1-1.5 hectare of land Have 1or a pair of oxen, one cow, one mule, up to 10 sheep; Cover food consumption for 8-10 months;; Have access to agricultural inputs and technologies; Are able to send their children to school; Engage in trading activity.	Have up to 0.5 hectare of land; May rent out their small land to better farmers May have 1 ox or 1 cow, 1donkey and up to 3 sheep; Sell the labour of their children; Cover food consumption for 3-4 months' of the year Additional income based on daily labour and safety net; Poor housing condition.	Have no livestock & farm land; Live in poor tukuls; Some of them go begging; Are mainly dependant on relief aid and safety net. Sell the labour of their children, wife and their own labour to betters-off farmers; Seasonally migrate; Are mainly women who can't express their idea properly; Are excluded from social activities; Have very limited access to credit.

Source: Concern Livelihood wealth ranking study report

APPENDIX 4 Names of Gotts and number off MAM children measured during data collection

No	Names of Gott (Kebele)	Number of MAM children	No	Names of Gott (Kebele)	Number of MAM children
1	Abagoshu Ager	3	17	Guguftu	5
2	Abajal Ager(033)	3	18	Jagola	6
3	Abajali Ager (031)	2	19	Jaloye Ager	1
4	Abajegar	3	20	Jebene (031)	5
5	Abalima	2	21	Jeha Ager(038)	3
6	Abatarik (031)	2	22	Kolbo(21)	3
7	Abeche	4	23	Kurkur	2
8	Adangur	4	24	Medero	3
9	Adisketema (031)	3	25	Mehal Gott(033)	5
10	Bireye Ager	1	26	Mendibo	3
11	Chore (033)	3	27	Mentola	3
12	Dego (034)	4	28	Shemeto	1
13	Derka(033)	3	29	Tebasit	4
14	Enduluti (034)	3	30	Tucha (034)	3
15	Fetto(038)	2	31	Washa (034)	4
16	Gelsha	1	32	Wayou ager(035)	5

Appendix 5 Names of Gotts and number of SAM children measured during data collection

No	Names of Gott (Kebele)	Number of SAM children	No	Names of Gott (Kebele)	Number of SAM children
1	Wayou ager (035)	3	12	Kurkur(037)	3
2	Laykelad(035)	2	13	Tebasit(037)	1
3	Derka (033)	3	14	Medero	1
4	Adem Ager(031)	1	15	Abajegar Ager(037)	1
5	Jebene (031)	1	16	Wayena (021)	1
6	Kedir Ager(031)	1	17	Enduluti(034)	1
7	Abatarik(03)	1	18	Yimer ager(034)	4
8	Bireye Ager(037)	1	19	Washa(034)	1
9	Sheto Ager(036)	2	20	Dego(036)	2
10	Kolbo(021)	1	21	Abalima (036)	1
11	Damott(037)	2	22	Kutaye (038)	1

APPENDIX 6 Names of Gotts and number of CG children measured during data collection

No	Names of Gott (Kebele)	Number of CG children	No	Names of Gott (Kebele)	Number ofCG children
1	Haroya (031)	6	13	Wayou Ager(035)	3
2	Temsas(031)	5	14	Abajale Ager(033)	2
3	Kesho Wenze(038)	4	15	Gadena(033)	4
4	Addis ketema (031)	6	16	Shebute (033)	3
5	Gelsha(038)	3	17	Tebasit(037)	3
6	Siwedu (038)	1	18	Bilido(037)	3
7	Asho(038)	2	19	Jagola(037)	1
8	Amedo Mender(036)	4	20	Kurkur(037)	3
9	Sheto ager(036)	4	21	Washa (034)	3
10	Abagure (036)	6	22	Wateya	1
11	Abeche (036)	4	23	Adey(034)	1
12	Laykelad (035)	5	24	Dego(034)	7

Appendix 7: Health diagnosis reports of Severely Acutely malnourished (SAM) children admitted in health posts/centres during the Fourth- Emergency program of Concern Ethiopia (December -April 2010).

APPENDIX 7: Health diagnosis reports of Severely Acutely malnourished (SAM) children admitted in health posts/centres during the Fourth- Emergency program of Concern Ethiopia (December -April 2010).

Health centres /posts	**No of SAM children**	**No of SAM children Children diagnosed with WASH related diseases**	**Percentage**
Guguftu (036)	19	4	21%
Degamote (021)	5	2	40%
Cherecha (031)	14	8	57%
Dajole (035)	17	10	59%
Adey (034)	24	13	54%

Sources: Dessie Zuria health Centers (2010)

APPENDIX 8 Total population in the study areas

Name of the kebele	House holds			Total		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**
Gelsha (38)	1048	279	1327	3232	3112	6344
Tebasit(37)	827	380	1207	3802	3822	7624
Degamote(21)	734	165	899	2162	2160	4322
Dajolie(35)	1190	220	1410	3146	3410	6556
Guguftu(36)				3200	4365	7565
Chirecha(31)	1079	313	1392	2879	2950	5828
Adey(34)	630	831	1461	3200	4365	7565
Dereba(33)	599	294	893	1785	1674	3459
Total Population						**49,263**

Sources: Concern Ethiopia Livelihood Baseline Report (2007)