

**ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
REGIONAL AND LOCAL DEVELOPMENT STUDIES
(RLDS)**

**HOUSEHOLD WATER SUPPLY AND FACTORS
AFFECTING CONSUMPTION LEVEL: THE CASE OF
MEKELLE TOWN, TIGRAY.**

**BY
BIHON KASSA**

**ADDIS ABABA
JUNE 2006**

**Household Water Supply and Factors Affecting
Consumption Level: The Case of
Mekelle Town, Tigray**

**A Thesis Presented to:
The School of Graduate Studies
Addis Ababa University**

**In Partial Fulfillment of the Requirement for the Degree of
Master of Arts in Regional and
Local Development Studies**

**By
Bihon Kassa**

June 2006

**ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES**

**Household Water Supply and Factors Affecting Consumption
Level: The Case of Mekelle Town, Tigray**

**By
Bihon Kassa**

Approved by Board of Examiners

Chairperson, Department of
Graduate committee

Signature

Advisor

Signature

Examiner

Signature

Examiner

Signature

DECLARATION

I declare that this Thesis is my original work and has not been presented for a degree in any other university and that all source materials used for the Thesis have been duly acknowledged.

Student's name, signature and Date

This Thesis has been submitted for examination with my approval as a university advisor.

Name, Signature and Date

ACKNOWLEDGMENTS

I am indebted to some individuals and institutions in conducting this study. Firstly, I want to express my heartfelt gratitude and special appreciation to my adviser Dr. Woldeamlak Bewket for his devoted intellectual guidance and considerate encouragement. Without his genuine and valuable comments, this research paper could not have such a final shape.

I would like to express my special thanks and appreciation to my wife Sr. Mulu Meles. Her wholeheartedly encouragement and support helped me a lot.

I would like to extend my thanks to my friends and colleagues Ato Gebregziabher Haylesilasie, Ato Berhe Mekonen, Ato Yemane Zeray, Ato Kidane Gebregziabher and Ato Tewelde Mezgebo for their unreserved support.

I would also like to extend my thanks to Ato Mekonen Alemu and Ato Birhanu G/ Michael who helped me in most of the editorial works in this thesis works.

Thanks also go to the staff of Institution of Regional and Local Development Studies (RLDS) of Addis Ababa University for facilitating my study and shaping my career.

My sincere and gratitude goes to w/o Atsede Chirkos, Mekelle University department of Management, who untiringly typed the manuscript.

I would like to extend my thanks to Mekelle University Faculty of Business and Economics students as well as friends for their contribution to the successful completion of the fieldwork.

Mekelle Water Supply Service Office, Mekelle Master Plan Project Office, Tigray Water Resource Development Bureau, Ministry of Water Resources and Mekelle Tabia Administrators deserve my special thanks for the relevant documents that they provided me.

TABLE OF CONTENTS

	Page
Acknowledgement -----	i
Table of Contents-----	ii
List of Tables-----	v
Acronyms -----	viii
Abstract -----	IX

CHAPTER ONE

INTRODUCTION -----	1
1.1. Problem Statement -----	3
1.2. Justifications and Rationale for the Study -----	5
1.3. Objectives of the Study-----	6
1.3.1. General Objective-----	6
1.3.2. Specific Objectives -----	6
1.4. Research Questions -----	6
1.5. Research Hypotheses -----	7
1.6. Methodology -----	7
1.6.1 Data Sources -----	7
1.6.2 Sampling and Survey Design -----	8
1.6.3. Explanatory Variables used in the Study -----	10
1.6.4. Methods of Data Processing and Analysis -----	14
1.6.5. Limitations of the Study -----	16
1.6.6. Organization of the Paper-----	16

CHAPTER TWO

LITERATURE REVIEW-----	17
2.1. Water Supply Issues -----	17
2.2. Water Resource Development and Management-----	18
2.2.1. Supply-oriented Management Techniques -----	18
2.2.1.1. Rainwater Harvesting -----	18
2.2.1.2. Groundwater Resources Development -----	19
2.2.1.3. Surface Water Resources Development-----	20

2.2.2. Demand-oriented Management Techniques -----	20
2.2.2.1. Water Conservation -----	20
2.2.2.2. Water Tariffs -----	20
2.2.2.3. Reducing Unaccounted-for Water -----	23
2.2.2.4. Pollution Control -----	23
2.2.2.5. Recycling of Water and Waste Treatment -----	24
2.3. Water and Poverty -----	24
2.4. Explanatory Variables for Household Water Consumption Levels-----	27
2.4.1. Physical Factors -----	28
2.4.1.1. Rainfall -----	29
2.4.1.2. Yield of Boreholes -----	29
2.4.1.3. Seasonal Variation and Temperature -----	30
2.4.1.4. Pressure Maintained in Pipelines-----	31
2.4.1.5. Accessibility of Water -----	32
2.5. Socio-economic Factors -----	33
2.5.1. Household Income-----	33
2.5.2. Household Sizes -----	34
2.5.3. Educational Level of Household Heads -----	35
2.5.4. Occupation of Household Heads -----	36
2.5.5. Private (Metered) Connection-----	37
2.5.6. Water Using Appliances (Fixtures) -----	38
2.5.7. Possession of Garden Plots and Domestic Animals -----	38

CHAPTER THREE

BACKGROUND OF THE STUDY AREA----- 40

3.1 A Brief History of Mekelle -----	40
3.2 Geology -----	40
3.3 Physical Setting -----	42
3.3.1 Topography-----	42
3.3.2 Climate -----	43
3.4 Groundwater Sources-----	44

CHAPTER FOUR

THE EXISTING WATER SUPPLY SYSTEM-----	46
4.1. Sources-----	46
4.2. Production-----	47
4.3. Distribution-----	51
4.3.1. Pipeline Network -----	51
4.3.2. Reservoirs -----	52
4.3.3. Connection Type-----	53
4.3.4. Public Standpipes-----	53

CHAPTER FIVE

DETERMINANTS OF HOUSEHOLD WATER CONSUMPTION LEVELS-----	55
5.1. Occupation of Household Heads (OCHH) -----	56
5.2. Accessibility of Water Tap (ACCESS) -----	58
5.3. Frequency of Body Washing or Bathing (FRWA) -----	60
5.4. Presence of Domestic Animals (PREDO) and Garden Plots (PGAR) -----	61
5.5. Seasonal Pattern of Water Consumption by In-house and Yard Connected Households-----	62
5.6. Pressure Maintained in the Pipelines-----	64
5.7. Household Size (SIHH) and Water Consumption-----	64
5.8. Household Income (INHH) and Water Consumption -----	69
5.9. Educational Level of Household Heads (EDHH) -----	71
5.10. Presence of Private Meter Connection (PREM) -----	74
5.11. Presence of Water Using Appliances (WATAP) -----	75

CHAPTER SIX

<u>CONCLUSIONS AND RECOMMENDATIONS -----</u>	<u>78</u>
6.1 Conclusions-----	80
6.2 Recommendations -----	82

References

Appendices

LIST OF TABLES

	Page
Table 1: Population, household size and number of private meter connections by 'Tabia'	9
Table 2: Number of sampled households from each 'Tabia'.....	10
Table 3: Per capita Consumption Figures, Iringa Town, Tanzania.....	28
Table 4: Geological log of some of the boreholes	42
Table 5: water production, consumption and loss	47
Table 6: Actual monthly and daily production of water, expected production per month, number of wells on service and their yield (2005/06)	48
Table 7: Actual and expected production capacity of each well.....	50
Table 8: Mean daily per capita water consumption by occupation, total sample (water vendors excluded)	57
Table 9: Mean daily water consumption per capita and round trip time taken to fetch water of households without private meter connection (public stand pipe users).....	59
Table 10: Mean daily water consumption per capita (MDWCPC) by frequency of body washing	60
Table 11: Mean daily water consumption per capita (MDWCPC) of households with or without, domestic animals and garden	61
Table 12: Seasonal Patterns of Monthly and daily per household	

and per capita water consumption in the town (from March 2005 to February 2006) -----	63
Table 13: Mean daily water consumption per household (MDWCPHH) by size of households (households without private meter connection) -----	65
Table 14: Mean daily water consumption per capita of households without private meter connections -----	66
Table 15: Mean daily water consumption per household (MDWCPHH) and mean daily water consumption per capita (MDWCPC) of households with private connection and non-vendors -----	67
Table 16: Mean daily household and per capita water consumption by income and total sample (excluding water vendors) -----	70
Table 17: Mean daily water consumption per household and per capita by educational level of household heads and with private meter connection (water vendors excluded)-----	72
Table 18: Mean daily water consumption per household and per capita by educational level of household heads (without private meter connection) -----	73
Table 19: Mean daily water consumption per household and per capita by type of water supply service: privately connected	

households (Group – 1), without private connection (Group – 2)
and privately connected and vendors (Group – 3)-----74

Table 20: Mean daily water consumption per capita of households

with and without flush toilet and shower -----76

ACRONYMS

CSA	Central Statistical Authority
MDGs	Millennium Development Goals
MDWCPHH	Mean Daily Water Consumption per Household
MDWCPC	Mean Daily Water Consumption per Capita
MWCPHH	Monthly Water Consumption per Household
NGOs	Non-Governmental Organizations
MWR	Ministry of Water Resources
UNICEF	United Nation Children's Fund
WHO	World Health Organization
WSSA	Water Supply and Sanitation Authority
WSP	Water and Sanitation Program

ABSTRACT

This research tries to assess household water supply and factors affecting consumption levels in Mekelle town. It is with the main objective of assessing the water supply problems and major factors that affect household per capita water consumption in the town. To achieve this, relevant data were gathered from both primary and secondary sources. The major primary instrument of data for the study was household questionnaire survey. A sample of 200 households was selected using systematic random sampling method from four 'Tabias' and responses of the questionnaire survey were entered into SPSS and STATA Software for analysis.

As found out, mean daily per capita water consumption of sample households with private connection (group 1), households with out private connection (group 2), and households with private connection and water vendors (group 3) is 49.5 l/c/d, 11.9 l/c/d and 83.9 l/c/d respectively. Daily per capita water consumption of those households who do not have their own private connection is 11.9 liters. This is lower than the amount specified by Ministry of Water Resource (1996) which was 20 liters of water per person per day and far lower than the WHO standard (45 l/c/d).

The result of regression analysis indicated that average income of household heads, household size, presence of meter connection, and flush toilet are statistically significant to explain the variation in daily per capita water consumption among households in the town.

Hence, income, presence of meter connection and flush toilet are positively related to mean daily water consumption per capita (Y). On the other hand, household size is negatively related to mean daily water consumption per capita (Y). Therefore for appropriate water supply projection, a detail study on the physical and socio-economic factors affecting per capita water consumption are desirable.

Key words: *Supply, Physical, Socio-economic, Household, Per capita, Consumption, Daily.*

CHAPTER I : Background and Justification

1.1 Tuberculosis

Tuberculosis (TB) is an infectious disease that is thought to have existed at least as long as mankind, but still remains a major global public health problem (Evans, 1998). TB is the most frequent cause of death from a single infectious disease in persons aged 15 - 49 years (Van Soolingen, 2001). It is the world's second commonest cause of death from infectious disease, after human immunodeficiency virus (HIV) / acquired immuno - deficiency syndrome (AIDS) (Frieden *et al.*, 2003)

1.2 Global epidemiology of tuberculosis

The recent report of World Health Organization (WHO) revealed that one third of the world population is thought to be infected with tubercle bacilli, eight to ten million people develop new active TB and two to three million deaths occur annually (WHO, 2005). Due to accelerating human immunodeficiency virus (HIV) pandemics and development of drug resistant strains, TB was declared as a global emergency in 1993 by WHO (WHO, 2004). Sub -Saharan Africa has the highest prevalence of TB. From sub - Saharan countries, Nigeria, Ethiopia, South Africa, Tanzania, Kenya, Democratic Republic of Congo, and Zimbabwe are among the 22 high TB burden countries worldwide (WHO, 2005). Twenty-two high TB burden countries in the developing world account for 6.9 million new TB cases, comprising over 80 % of the total global caseload. Of these, nine countries in sub - Saharan Africa account for 1.5 million of the cases with the incidence rates ranging between 305 and 525 per 100, 000 population (WHO, 2004).

A substantial rise in the number of TB cases reported from sub - Saharan Africa has been observed following an alarming increase in the HIV infection (Frieden *et al.*, 2003). It is believed that the clinical pattern of TB has demonstrated a dramatic change due to co-