YANGON UNIVERSITY OF ECONOMICS
DEPARTMENT OF APPLIED ECONOMICS
MASTER OF PUBLIC ADMINISTRATION PROGRAMME

A STUDY ON IMPROVING WATER SUPPLY IN CHAUK TOWNSHIP, MAGWAY REGION

MANN THUYA HTUN
MPA – 18 (20th BATCH)

MARCH, 2023

YANGON UNIVERSITY OF ECONOMICS
DEPARTMENT OF APPLIED ECONOMICS
MASTER OF PUBLIC ADMINISTRATION PROGRAMME

A STUDY ON IMPROVING WATER SUPPLY IN CHAUK TOWNSHIP, MAGWAY REGION

A thesis submitted in partial fulfillment towards the requirements for the degree of Master of Public Administration (MPA)

Supervised by:

U Than Htun Lay
Associate Professor
Department of Applied Economics
Yangon University of Economics

Submitted by:

Mann Thura Htun
MPA II – 18
20th Batch

March, 2023

YANGON UNIVERSITY OF ECONOMICS
DEPARTMENT OF APPLIED ECONOMICS
MASTER OF PUBLIC ADMINISTRATION PROGRAMME

This is to certify that this thesis entitled "**A Study on Improving Water Supply in Chauk Township, Magway Region**", submitted in partial fulfilment towards the requirements for the degree of Master of Public Administration has been accepted by the Board of Examiners.

BOARD OF EXAMINERS

……

Dr. Khin Thida Nyein
(Chairperson)
Pro-Rector
Yangon University of Economics

……

Professor Dr. Kyaw Min Htun
(External Examiner)
Pro-Rector (Retd.)
Yangon University of Economics

……

Dr. Su Su Myat
(Examiner)
Professor / Head
Department of Applied Economics
Yangon University of Economics

……

Daw N Khum Ja Ra
(Examiner)
Associate Professor
Department of Applied Economics
Yangon University of Economics

……

U Than Htun Lay
(Supervisor)
Associate Professor
Department of Applied Economics
Yangon University of Economics

March, 2023

ABSTRACT

Every region and township's socio economic condition depends on how easy it is to get water. The purposes of this study are to identify the situation of water supply and to examine the improving water supply in Chauk Township in Magway Region. To achieve these objectives secondary data was used. The study found that every ward has access to water, but half of the population still needs more. According to the study, paying water costs was fair if they accepted the electricity fees to operate the tube wells. Moreover, Chauk Township's water supply system is a crucial component of the public service that the regional government supports. Subsequently, social and health conditions can be improved by receiving water resources in Chauk Township.

ACKNOWLEDGEMENTS

First and foremost, I would like to gratefully thank Professor Dr. Tin Tin Htwe, Rector of Yangon University of Economics, and Dr. Khin Thida Nyein, Pro-Rector of Yangon University of Economics, who helped me accomplish my study both directly and indirectly.

I am heartily grateful for their valuable support in conceptualizing this thesis.
I would like to express my special thanks to Professor Dr. Su Su Myat, Program Director and Head of Department, Department of Applied Economics, and all the teachers from the Department of Applied Economics at Yangon University of Economics for their support, suggestions, and advice on my thesis and my education life as a master of public administration.

In addition, I am very grateful and want to express my thanks to my supervisor, U Than Htun Lay, Associate Professor of Yangon University of Economics, for his good advice, enthusiastic support, and thoughtful consideration. This thesis would not have been completed without her generous suggestions and help. I am gratefully indebted to him for his very valuable comments on this thesis.

Finally, my deepest appreciation goes to my parents, family, friends, and all of my colleagues for their support and encouragement throughout my studies. This accomplishment would not have been possible without them. Thank you.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURE

LIST OF ABBREVIATIONS

BAJ	Bridge Asia Japan
CSO	Central Statistical Organization
DDA	Department of Development Affairs
DRD	Department of Rural Development
EE	Executive Engineer
FAO	Food and Agriculture Organization of the United Nations
INGO	International Non-Governmental Organization
IWMI	International Water Management Institute
IWRM	Integrated Water Resources Management
JMP	Joint Monitoring Programme
LMICs	Lower Middle-Income Countries
MDG	Millennium Development Goals
MOGE	Myanmar Oil and Gas Enterprise
MOHS	Ministry of Health and Sports
SDG	Sustainable Development Goal
UNDP	United Nations Development Program
UNESCO	United Nations Educational, Scientific and Cultural
UNICEF	The United Nations Children's Fund
WASH	Water, Sanitation and Hygiene
WB	World Bank
WFP	World Food Programme
WHO	World Health Organization
WRUD	Water Resources Utilization Department

CHAPTER I
INTRODUCTION

1.1 Rationale of the Study

Water is a main resource and is a great necessity for food production, drinking purposes, sanitation, and many other uses. Unfortunately, due to the lack of access to safe water and basic sanitation, at least 1.6 million children under five die every year (WHO/UNICEF, 2006).

People's food security, incomes, and lifestyles can only improve as they move toward socioeconomic development if they have a reliable water supply. However, unfortunately, people in the Magway Region are poor, and their social and economic development could be faster because they need access to enough water.

The main problems with getting water from rivers or storage reservoirs are the need for more infrastructure and the high cost of pumping. In cities and townships, municipal committees provide the water supply system.

In cities, the role of public water supplies in making people healthier needs to be improved. However, some towns in the countryside need to catch up, and the water supply in some cities needs to be fixed. Because of this, facilities are on time in coming, as also related systems and human resource development. So, there needs to be overall development, including coordination with the health sector, the creation of systems, better management of the Water Supply Board, and the growth of human resources.

Japan sent long-term and short-term experts to the waterworks utility in Yangon City and Mandalay City in 2000 before Myanmar started moving toward democracy to help with the country's water supply systems. The goal was to ensure that Myanmar had a steady and safe water supply. At the moment, the "Preparatory Study for Cooperation in the Water Supply Improvement Program (JICA Master Plan 2013)" is being put into action. This is a development study for bringing water to Yangon City and its surrounding areas. A plan for urgently fixing up water supply

facilities with grant aid are also in the works, as is the sending of advisors to help with domestic water supply. These are anticipated to contribute to steady and safe water supply operations.

The Dry Zone of Myanmar is located in the country's central plains, which are east and west flanked by mountains. The Magway region includes the Dry Zone in Myanmar. The Dry Zone, the most water-scarce region, has the second highest population density in Myanmar and remains one of the least developed in the country. (Myanmar IWRM Strategic Study, 2014). Moreover, the Dry Zone is vital to Myanmar's agriculture sector by producing sesame, groundnuts, and pulses, one of the country's primary export earners, and 22% of its rice (IWMI, 2013).

People living in the Dry Zone have a hard time making a living and staying healthy because they do not have enough water for their homes and farms. Access to water and the safety of the water supply is essential if people in rural areas have better food security, incomes, and ways of making a living, which is suitable for socioeconomic development. Therefore, the main factors affecting poverty, social development, and economic growth in the Dry Zone are how easy it is to get and how much water is available.

Access to water is a big problem in the Dry Zone, not just for agriculture but also for everyday life. This is a big problem for people's livelihoods and well-being. Access to water and the water supply's security are the most important things to do to improve the food security, incomes, and ways of life of people in rural areas and help them move toward socioeconomic development. People in the dry zone are poor, and their social and economic development is slow because they need access to enough water.

Accessing surface water from rivers or storage reservoirs is hard because there is little infrastructure, and it costs a lot to pump the water. Since groundwater is the primary water source in the Dry Zone, it needs to be planned and developed to be used in the long term. The IWMI 2013 report says that small-scale technologies for managing water can bring many benefits that would help local communities improve their ways of making a living and their food security.

Chauk Township is a township of Magway District in the Magway Division of Myanmar. The principal town and administrative seat is Chauk. Chauk is one of the most water scarcity townships in Magway Region. Department of Rural Development

under the Ministry of Agriculture, Livestock and Irrigation is prioritizing the availability of clean water in rural areas.

The groundwater in the study area might be reachable at a depth of up to 900 feet, but there were other options besides drilling with personal drilling equipment. Only a few government-owned drilling rigs from WRUD and DDA could attempt to drill such kinds of deep tube wells. However, the expense of employing these government-owned drilling rigs to drill deep tube wells was high since not only did the rig's spare parts (drill pipes, carry horse pipes, mud pumps) need to be imported, but also drilling equipment like bits, bentonite, etc.

Also, the number of drilling experts was minimal, particularly for dealing with issues like lost circulation and cutting drill pipes while drilling new tube wells. Because of those challenges regarding cost, materials, and technology, the study area had long-standing water scarcity problems. Therefore, starting in 2000, there were different water supply projects by different donors with the implementation of their government counterparts to solve those water scarcity problems.

When figuring out how to fix the problem with services in Chauk Township, water supply, and access must be given a high priority. This study examines ways to improve water supply in Chauk Township, Magway Region. This study looks at how a change in the water supply affects the growth of the economy and society in Chauk Township, Magway Region.

1.2 Objectives of the Study

The objectives are as follows;

(1) To identify the water supply situation in Chauk Township, Magway Region.

(2) To examine improving water supply in Chauk Township, Magway Region.

1.3 Method of Study

This study mainly used the secondary data sources. Secondary data are collected from the Department of Rural Development (DRD) in Chauk, Bridge Asia in Japan, Chauk Township Development Affairs, other internet websites, and library articles. Furthermore, to ensure the validity of this study, different data sources were triangulated. Therefore, this study examined evidence from various data sources, such as document analysis and informal conversation.

1.4 Scope and Limitations of the Study

This study mainly compares improving water supply and access in Chuk Township, Magway Region. The study period is in 2023. This study only uses secondary data based on the data of the 15 wards in Chuk Township. The limitation is that it needs to analyze the water quality scientifically. Moreover, the time frame for collecting questionnaires and situations was limited during this COVID pandemic.

1.5 Organization of the Study

This study is organized into five chapters. Chapter one includes an introduction, the rationale of the study, the objectives, the method, the scope and limitations, and the organization of the study. Chapter two presents the literature review. Chapter three presents an overview of the water supply and water access in Chuk Township. Chapter four compares the water supply and water access in Chuk Township. Finally, chapter five concludes with findings, suggestions, and the need for further study.

CHAPTER II
LITERATURE REVIEW

2.1 Water Scarcity and Water Supply

Water scarcity significantly impacts several areas, including the environment, socioeconomic development, and human health. Lack of drinking water and hunger are two of the most severe effects of water scarcity. In addition to dehydration, they directly impact raising crops and caring for livestock, which can cause food shortages and starvation.

People who don't have enough water can't take showers, wash their clothes, or clean their homes well, which makes things less clean. Those without access to clean water must consume untreated water, which causes sanitary issues. When there is a lack of water, people keep it at home, breed mosquitoes, and spread diseases like dengue and malaria. Additionally, lack of water creates other diseases such as trachoma (an eye infection that can cause blindness), plague, and typhus.

Access to water is a major economic issue around the world and one of the main reasons why countries fight with each other. Lack of water resources frequently causes local conflicts, which occasionally escalate to war. Moreover, these tensions could multiply with the increasing global population and growing needs.

Water scarcity negatively impacts rivers, lakes, and other freshwater resources. Therefore, it harms the environment in several ways, such as through nutrient pollution, increased salinity, and the loss of floodplains and wetlands. In addition, the lack of water resources threatens ecosystems and biodiversity.

In 2000, one-sixth (1.1 billion people) of the global population needed access to an improved water supply. Most of these people live in Asia and Africa. However, Asia has the second-lowest water supply coverage in the world (Africa, Asia, Latin America and the Caribbean, Oceania, Europe, and North America) (WHO/UNICEF, 2000).

The amount of water available to humans is increasing due to changing lifestyles and a rising population, which depends on spatial and temporal variations in water availability. This means that the water needed to produce food for human consumption, industrial processes, and other uses is becoming scarce.

Less water is available for industrial and agricultural growth when more water is made available to people. Moreover, it profoundly affects aquatic ecosystems and their dependent species. As a result, environmental balances are disturbed, and they cannot play their regulating role.

Since the 1980s, the world's water supply has grown by about 1% per year due to economic changes, population growth, and how people use water. The demand for water worldwide is also expected to keep going up at the same rate until 2050. This is primarily due to rising demand in the industrial and domestic sectors (UN-Water, 2019).

Internationally, more than two billion people live in countries with high levels of water stress, and about four billion people suffer water scarcity for at least one month of the year. Because people are using more water and climate change's effects are worsening, water stress will continue to rise. (UN-Water., 2019) According to the WHO, about 50 liters of water per person per day are required to meet the most basic needs while keeping public health risks low (WHO/UNICEF, 2017).

2.2 Importance of Water Supply and Water Access

Water is essential for economic and social growth. It is needed to keep people healthy, grow food, care for the environment, and create jobs. Water was a critical factor in determining where the first communities were built, and the development of public water systems is directly linked to the growth of cities.

Most likely, digging shallow wells was the first thing that was done to get water from places other than rivers, lakes, and springs. As the number of things that needed water grew and tools got better, wells got deeper.

Water is a natural resource that all living things need to survive, and it is also the key to making things last. It is crucial for socioeconomic development, healthy ecosystems, and human survival. It is also central to producing and preserving many benefits and services for people.

Therefore, people should know that water is a finite and irreplaceable resource in time and space and is only available if well managed. Where water is reliably

available, economic opportunities are enhanced. On the other hand, where water is unreliable, of inadequate quality, or water-related hazards are present, there will be dragged-on growth.

Water can pose a serious challenge to sustainable development. Still, it is managed efficiently and equitably. In that case, water can play a critical enabling role in strengthening social, economic, and environmental resilience in light of rapid and unpredictable changes. Therefore, water supply and access are essential for social, economic, and environmental development.

(1) Importance of Water Supply

Water supply systems and infrastructure collect, transport, treat, store, and distribute water for homes, businesses, industries, irrigation, and public needs like fighting fires and cleaning the street. Of all municipal services, providing potable water is the most critical. People rely on water for drinking, cooking, washing, carrying away waste, and other domestic necessities.

Water supply systems must satisfy public, commercial, and industrial requirements. Therefore, the water must always fulfill both quality and quantity criteria. In addition to the quantity of supply, water quality is also of concern. Even the ancients had an appreciation for the importance of pure water. Water treatment alters a water source to achieve a quality that meets specified goals.

At the end of the 19th century and the beginning of the 20th, the main goal was the elimination of deadly waterborne diseases. Public drinking water treatment to remove pathogenic or disease-causing microorganisms began at about that time. Treatment methods included sand filtration as well as the use of chlorine for disinfection. The virtual elimination of diseases such as cholera and typhoid in developed countries proved the success of this water-treatment technology. However, the waterborne disease remains the principal water quality concern in developing countries.

(2) Importance of Water Access

Universal access to freshwater resources is a crucial requirement for human dignity. Ensuring access for all would significantly reduce disease and mortality, particularly among children. Drinking water services that are "safely managed" indicate an ambitious new rung on the drinking water progress ladder. Since the year

2000, 2 billion people have gained access to safely managed services. (i.e., accessible on-premises, available when needed, and contamination-free).

5.8 billion people worldwide will use safely managed services in 2020, and 2 billion will use critical services, which are better water sources that can be reached within 30 minutes round trip. Nevertheless, 771 million people lack access to even the most basic water service. Of these people, 282 used "limited" water service, an improved source from which it takes more than 30 minutes to get water; 367 million used unimproved sources; and 122 million still drank water straight from rivers, lakes, and other surface water sources.

The numbers show that there are significant differences. The poorest people and those living in rural areas are less likely to use an essential service. Collecting water falls primarily on women and girls in most countries.

2.3 Relationship between Water, Education, and Health

Education and health are the primary objectives of social development, whereas health is central to well-being, and education is essential for a good and rewarding life. Education is also crucial for a growing country's ability to use new technology and build the foundation for its growth and development. (Thet Htar Hsu, 2018).

Water and Education

Water and bathroom facilities are essential for schools to promote good hygiene, which is important for the health and well-being of children. By 2016, about 58 out of the 92 countries surveyed had over 75% school drinking water coverage. However, almost half of the schools in Sub-Saharan Africa and more than a third of the small island developing states lacked access to safe drinking water.

Also, over 75% of people in 67 of the 101 countries had access to improved single-sex sanitation facilities that were considered to be a basic sanitation service. However, an estimated 23% of schools did not have sanitation services, and more than 620 million children worldwide did not have a basic sanitation service at their schools (WHO/UNICEF, 2018).

Water and Health

People who need to travel more than 1 km to fetch water using very little for bathing or laundering, which is very sensitive to service levels (Mellor, 2009). According to WHO standards, people need about 20 liters per day, which they consider direct access to water. There can be serious concerns about health and well-being if there is less of this level. After this amount, communities must focus on protecting water sources by setting up good hygiene, sanitation, and household treatment.

Carrying water seems to have direct adverse effects on a person's mental and physical health and on his or her ability to do formal, informal, and domestic work. Diouf et al. (2014) say that fetching can also cause mental and emotional stress, changing how people feel about their general health, disability due to musculoskeletal disorders, work performance, and job satisfaction. In addition, children and women who go to get water say that they have seen or been afraid of physical and sexual violence (Sorenson, 2011).

2.4 Reviews on Previous Study

Many scholars and researchers studied water, sanitation, and hygiene from different points of view.

Andrea C. Telmo (2002) described a water supply and sanitation study of the Mali (West Africa) town of Gouansolo. The goal of this study is to find out about the water supply and sanitation in Gouansolo, a small town in the southwest of Mali, West Africa. By doing an assessment, the study finds out how many people have access to water and sanitation, identifies water and sanitation problems in the village, and suggests ways to improve access to water and sanitation. Forty-four households were included in the survey. This study found that 48% of the households in Gouansolo used improved water supplies (i.e., borehole pumps), and 91% used improved sanitation facilities (i.e., simple pit latrines).

Zin Mar Lwin (2005) studied the water supply status in the Bagan-Nyaung U township. This study discovered that 45 villages in the Bagan-Nyaung U area lacked access to water supplies, and 68 villages lacked sufficient water. Only 105 villages could enjoy their water supply facilities during her study period.

Thet Htar Su (2018) studies the socio-economic conditions in Tharrawaddy Township, Bago Region. This study found that education and health services,

including safe water resources and the number of latrines, are the main factors for socio-economic development.

Megersa Olumana Dinka (2018) studies "Safe Drinking Water: Concepts, Benefits, Principles, and Standards." This study shows how essential water regulations are for ensuring safe, accessible, acceptable, affordable, and reliable drinking water. Drinking water rules manage the water source, water treatment, distribution, use, wastewater, and gray water systems (Dinka, 2018).

Hlaing Phyu Min (2019) wrote about how to improve access to water in the dry central part of Myanmar. This study aims to find out what the WASH situation is, what the benefits of having access to water are, and how the households in Te Ma, Zee O, and TaungShey in Bagan-Nyaung U Township, Dry Zone of Myanmar, are doing economically. The survey found that every village has access to water, and only 8% of the population still needs more water. In addition, the residents reduce the burden of fetching water due to transportation distance. According to the survey, 74% of respondents are satisfied with paying water costs, just as they accept the electricity fees to operate the tube wells. Additionally, 95% of survey respondents state that their family incomes have improved because of the direct and indirect effects of having more water points in their villages. Furthermore, about 94% of respondents stated that their social conditions improved after receiving water resources in their villages, and about 96% of the survey respondents agreed that their health improved after receiving the water resources in their villages.

CHAPTER III
INFORMATION OF WATER SUPPLY AND WATER ACCESS IN CHAUK TOWNSHIP

3.1 Overview of Improving Supply and Access to Water

In Myanmar's past, there have been a lot of different government agencies in charge of getting water to villages. The Rural Water Supply and Sanitation Board (RWSSB) was set up in 1952, and the Rural Sanitation and Water Supply Board (RSWSB) was set up in 1953. The Ministry of Social Welfare mostly set up both boards. The Ministry of Agriculture took over the water supply activities and made the Agriculture and Rural Development Corporation and the Rural Water Supply Division (RWSD) in 1959 and 1972, respectively.

In 1985, UNICEF started working with the Rural Water Supply Division (RWSD), the Agricultural Mechanization Department, and the Ministry of Agriculture and Forestry to construct deep tube wells in the Central Dry Zone of Myanmar.

The Water Resources Utilization Department (WRUD), which replaces the Rural Water Supply Department (RWSD) and is part of the Ministry of Agriculture and Irrigation, will be in charge of rural water supply in 2005. In 1994, the Ministry of Border Areas, National Races, and Development Affairs set up the Department of Development Affairs (DDA). It was in charge of rural water supply activities.

In 2012, the DDA was dissolved and renamed the Department of Rural Development (DRD). In 2013, the DRD moved to a new ministry called the Ministry of Livestock, Fisheries, and Rural Development. However, the DDA at the state and regional levels has yet to dissolve, divided into the DDA and the DRD, with the DDA reporting to the General Administration Department and the Ministry of Home Affairs.

During the Drinking Water Decade (1981–1990), the Rural Water Supply Department (RWSD) and the UNICEF-WASH Section worked together to build

water supply systems in rural areas of Myanmar. These included deep tube wells with mono pumps, shallow tube wells with hand pumps, and gravity flow systems. With the help of the Department of Rural Development (DRD), the UNICEF-WASH section has been building water supply facilities in rural areas across the country. This includes testing the water quality, making a plan for water safety, and building up the skills of DRD engineers and technicians.

In 1999 and 2000, the Department of Development Affairs (DDA) looked at how well data was being collected on access to water supply systems in rural areas. At the same time, DDA also set up a 10-year rural water supply project (RWSP) from 2000–2010 to increase access to water supply in 27,052 villages throughout Myanmar. However, after ten years of RWSP, some remaining villages still faced water scarcity.

Therefore, DDA made a new RWSP for the next five years, from 2011 to 2016, so these last few villages could also get water. Meanwhile, DRD also set up the 20-year rural water supply plan for 2011–2031 to contribute to one of the five rural development tasks in the National Comprehensive Development Plan (NCDP).

To align with the Millennium Development Goals (MDG) and the vision of the framework, DRD developed the "Strategic Framework for Rural Development" jointly with the World Bank in March 2014 in order to improve the socioeconomic life of the rural populace and narrow down urban-rural divides". The current rural water supply plan (2017–2030) will improve the rural populace's socioeconomic life by providing equitable, effective, efficient, and affordable water supply and sanitation services and safe hygiene behavior by 2030.

The percentage of the population in households with access of water in dry and rainy seasons is shown in Table 3.1.

Table (3.1) Percentage of Population in Households with Access of Water in Dry and Rainy Seasons

State / Region	Dry	Rainy	Union Dry	Union Rainy
Rakhine	42	45	74	80
Kayin	72	74	74	80
Tanintharyi	80	80	74	80
Chin	78	84	74	80
Magway	72	84	74	80
Ayeyarwaddy	53	85	74	80
Shan	85	87	74	80
Bago	76	89	74	80
Sagaing	91	92	74	80
Kayah	87	92	74	80
Mandalay	92	92	74	80
Mon	92	94	74	80
Kachin	95	95	74	80
Yangon	86	95	74	80
Nay Pyi Taw	95	96	74	80

Source: CSO, UNDP, and WB, 2018

3.2 National Water Policy of Myanmar

In the past few years, it has become more apparent that the growing need for freshwater across the country has made water security problems worse. In the past few years, it has become more apparent that the growing need for freshwater across the country has made water security problems worse.

Water is a finite resource with a spatial and temporal variation. Myanmar processes 12% of all of Asia's freshwater resources and 16% of those of the ASEAN nations. However, there are limits on the utilizable quantities of water during the dry season across the country owing to the uneven distribution of rain over time and space. As a result, the availability of utilizable water will be further strained.

Myanmar has a tropical monsoon climate with three different seasons: summer, rainy, and cold. 90% of the rain is received during the rainy season. Annual

rainfall ranges from 750 mm in the central dry zone to 1500 mm in the eastern and western mountains and 4000 to 5000mm in the coastal regions.

Myanmar has a total area of about 700,000 sq km. It extends 2090 km from north to south and 925 km from east to west at its widest point. Myanmar shares international borders with Bangladesh, India, China, Laos, and Thailand. In Myanmar, there are 8 major river basins, and the catchment area of these basins covers 90% of the country's territory. These basins contribute 1082 cu km of surface water, 495 cu km of groundwater potential, and 28 cu km of renewable groundwater annually to Myanmar.

Myanmar has reached an essential turning point in its ability to use water resources reasonably, effectively, and efficiently. Women's participation should be upgraded in the water sector. Gender mainstreaming efforts play an essential role in water management.

The whole country needs to be aware of the IWRM principle. The critical point is not to reduce flows below minimum ecological needs in a river or stream. Several concerns mentioned about water resource management include:

(1) The rapid increase in the number of people, the growth of cities, and the use of water by industries pose severe problems for water security.

(2) Water governance needs to be addressed adequately. Water-related disasters include floods, droughts, cyclones, landslides, sedimentation, and erosion.

(3) The sea level is rising in the delta, and more salt water is getting in. This is bad for these areas' homes, farms, roads, rails, and businesses.

(4) In many places, people still have trouble getting clean water to drink, keeping their homes clean, and meeting other basic needs.

(5) Drinking and irrigation water standards should be formulated.

(6) One cause of pollution is releasing wastewater without proper treatment, which must be stopped.

(7) Overexploitation of groundwater resources is as essential as freshwater resources.

(8) Water resources projects are being planned and implemented in a fragmented manner.

(9) Dam safety and sedimentation are issues for irrigation structures.

(10) It is essential to introduce groundwater recharge in Myanmar.

(11) Less safe water is available because some industries need facilities to clean waste.

(12) The relationship between urbanization and environmental issues must be seriously addressed.
(13) The public agencies responsible for taking water should consult with stakeholders.
(14) Watershed management should be promoted.
(15) Methods and a budget should be used for river and beach erosion wells.

In the original report, Myanmar's national water policy is summarized and evaluated under the following headings;

3.2.1 National Water Policy in Myanmar Goal

The goal is to apply IWRM for sustainable development. The policy covers two broad areas, such as (1) water resource management and (2) water resource use. Moreover, the Human Resources Development Initiative should be strengthened in the water sector. The fundamental principle, which is the principle to achieve the vision, should be addressed.

Vision

Myanmar Water Vision was made in 2003 with the help of UNESCAP, FAO, and the Irrigation Department. All of the stakeholders were involved in making the plan. It stated that "by the year 2030, the country will have attained sustainability of water resources to ensure sufficient water quantity and acceptable quality to meet the needs of the country's people regarding health, food security, economy, and environment".

Principles

Some principles are fundamental to achieving the vision.

- Water is an essential human need and one of the most important natural resources. It is also a valuable national asset.
- The state owns all water and water resources, such as the beds and banks of waterways, bodies of water, and wetlands.
- Drainage basins and aquifers are the fundamental units of water resources management because these are where water naturally collects and flows. Rainfall, river water, surface ponds and lakes, and groundwater are all parts of the same system of water resources.

- Fresh water is a limited and fragile resource needed to keep all life, human growth, and the environment going.
- Where it is naturally available, all people have the right to sufficient water for drinking, hygiene, and growing their food.
- High-quality water is becoming rare and should be treated as an economic good and managed as such. A national perspective must oversee water resource planning, development, and management.

3.2.2 Fair Water Allocation

A portion of river flow (environmental flow) should be kept aside to meet ecological needs. The different kinds of infrastructure for water may also be needed for the Ayeyarwady River's navigability. Rainwater harvesting campaigns should be strengthened across the country. Water demands should be given priority in the following order:

(1) Drinking water

(2) Water for urban and rural sanitation

(3) Water for food security

(4) Water for other uses

Based on the "30-Year Agricultural Master Plan" made by MOAI in 2000, the country's vast water resources are now used for agriculture, drinking, and domestic water; industrial needs, such as hydropower generation; and other needs, such as transportation, recreation, etc.

The government should look at the allocation again and make sure it is clear, and it should be reviewed from time to time to figure out what is most important. For example, a 2003 study for the water sector profile found that approximately 90% of water use is from agriculture, 6% is from domestic consumption, 3% is from industry, and some could have been provided for other uses. Therefore, a reassessment should be undertaken to register the withdrawals by different sectors.

3.2.3 Water Supply and Sanitation

The development of water quality standards by the Ministry of Health should be highlighted. The Ministry had organized several workshops and forums on water quality issues. As a result, the WHO standard was adopted as a reference for the present moment.

Water quality control measures are being taken as case-wise practices, especially for bottled drinking water production. WRUD, DDA, and UNICEF also test for arsenic and other parameters.

Access to clean water, sanitation, and hygiene for people and the environment should be a top priority. Based on the WHO/UNICEF report from 2010, the assessment showed that it got up to 71% for safe drinking water nationally. By 2015, Goal 10 of the MDG will have cut in half the number of people who do not have access to safe drinking water.

The Ministry of Health should work with UNICEF to do regular surveys to get more accurate data. Also, irrigation and other projects that serve more than one purpose should include drinking water whenever possible.

As part of the program to give people more power, YCDC will work with a community-based organization to give them control over the water supply in a specific area. Also, the beneficiary groups are expected to work together to plan how much water they need, how it will be distributed, how repairs will be made, and how to settle conflicts between members. The Housing Department held a groundwater law-making meeting in August 2014, the most recent thing to happen with the groundwater forum.

3.2.4 Regulations for Customers Who Want to Install a Water Connection

Magway Region provided the water connection rules under DRD. The following are regulations for customers or users who want to install water connections.

Every water connection must be equipped with water meters.

- No one is allowed to fix, detach, destroy, or change the water meter that the committee put in, and no one is allowed to connect water before the water meter.
- No one is allowed to install illegal branch pipelines or connect them to other people from a legal water connection, and no one is allowed to sell water to other people.
- Water charges must be paid within 10 days of getting notice of the water meter bill.
- The owner of a house or piece of land that uses water with a water connection permit has failed or refused to let the tenants in or on that land keep using

water from the existing pipeline. In that case, the Township Development Committee will take action by cutting off the water supply pipeline.

- Every water connection shall have a water storage system that should be enough for one and a half days for the people living in the building.
- Every water connection must have an electric water pump with the allowed horsepower. Service fees must be paid for installing an electric water pump with more horsepower.
- The charges for water used during the construction of the building shall be paid at the commercial rate, and after the construction, water charges shall be paid according to the categories of water use.

If the rules above are not followed, DRD will take action under the Chuak Township Development Committee Law already in place in the Magway Region.

3.3 Profile of the Department of Rural Development (DRD) in Chauk Township

The Department of Rural Development under the Ministry of Agriculture, Livestock and Irrigation dig artesian wells in five villages in Chauk Township, Magway Region in an attempt to prevent from water shortage in rural areas.In addition to digging 900 ft. deep artesian-wells in Mindaunt, Magyipintut, Mahlataung, Taungnauk and Nyaungbintha Villages, the department build four water tanks that will be 20 ft. in height and can store 2,400 gallons of water, one brick cement tank capable of accommodating 5,000 gallons of water and five water treatment factories measuring 10 ft. in length, 8 ft. in width and 8 ft. in height.

Chauk is one of the most water scarcity townships in Magway Region. Department of Rural Development department is prioritizing the availability of clean water in rural areas. The regional lawmakers and the township management committee chose the villages where residents can face water shortage on a prioritized basis. The department also implemented a water supply project in rural areas in 2018 by spending Ks. 7 million contributed by the government and local people.

In Myanmar, the Union government is in charge of urban areas, and the municipalities are in charge of rural areas. The Department of Rural Development (DRD), which is part of the Union Ministry of Livestock, Fisheries, and Rural Development, and the Department of Municipal Affairs (DMA), which is part of the Regional Ministry of Development Affairs, are both in charge of making sure people

have clean water to drink. The DRD vision, aim, policy, and process are presented as follows:

Vision

Department of Rural Development Vision, under the goal of sustainable development, is expected to develop rural society.

(a) The aim

The Department of Rural Development Goals

(1) Rural infrastructure, rural development, and rural livelihood development activities to bring socioeconomic

(2) Department workers who do their jobs well and people who live in rural areas who do research and develop new technologies for the economy's long-term growth.

(3) A community-centered approach by the country's citizens to accessing basic socio-economic infrastructure and services.

(b) Policy

The policy of the Department of Rural Development

(1) Ensure the social and economic development of rural roads and bridges, including developing drinking water production, rural drinking water projects that will be done outside the power grid, and rural power planning activities.

(2) Using a people-centered approach, other social infrastructure development in rural areas

(3) to improve rural people's ways of making a living and their family incomes so that funding sources can be put in place and stay in place. Lost operating funds (the revolving fund) are one way to make money, and community grants (the block grant) are another.

(4) Support the need for skilled labor in rural areas to fulfill vocational training. As a result, training on performance enhancements was implemented.

(5) Given the chance of disasters and the fact that people who are more likely to lose their homes tend to have them destroyed, the restrictions on rural housing will be enough to build latrines.

(6) the employees' performance improvements Positive developments in the management mechanism, ensuring that research and development projects.

(7) relating to poverty reduction, rural development (stakeholders), and cooperation.

(c) Process

The Department of Rural Development Process

(1) 2030 aims sufficiently and results in at least one of the main roads in all villages being able to communicate at any season. In addition, rural road bridges will have strategies implemented.

(2) Interest in the measures to implement rural water supply projects in a particular region

(3) Clean drinking water is made available in rural areas with the help of technical know-how.

(4) Rural power planning activities are part of the national electrification project outside the power grid.

(5) to switch the power to follow through private entrepreneurs and rural cooperation.

(6) The necessary regulations and procedures will be enacted to switch the power sector in rural areas to small power lines (mini-grid).

(7) Homes lost in natural disasters and emergencies, rural homes that were destroyed, and rural latrines that will be built.

(8) other rural areas' social infrastructure development to ensure high performance and implemented through people-centered projects.

(9) To improve rural livelihoods and household income, work with the Green Village project resources to set up operating funds (a revolving fund).

(10) Vocational training, contributing to family income, and increased business development will be addressed.

(11) Research, technology, and the development of human resources are essential parts of putting plans into action (www.Department of Rural Development, 2000).

3.4 Situation of Water Supply in the Chauk Township

Magway regional government will carry out three projects: a tube well, a 2,400-gallon water tower, and a power meter box in Chauk Township, another three projects: a tube well, a water tank, and one earthen lake maintenance in Yenangyoung Township; four projects: a tube-well and water tanks; two earthen lake maintenance

works in Natmauk Township; and three projects: tube-wells and water tanks in Myothit Township, using K790.610 million of the union budget of the department (www.watersupplyproject.org; 2022).

The Township Department of Rural Development is working on water supply projects in 240 Magway Region villages to ensure that people there have enough water to drink. The Magway Region Department of Rural Development says that all of the projects have been finished to a 100% level.

According to an official from the Region Department of Rural Development, 39 deep tube wells, three shallow tube wells, seven hand-dug wells, 38 earthen lakes, water pipeline installation, and 96 water supply projects totaling 243 water supply projects were undertaken with K 4100.6375 million. Upon completion, 169253 people from 36297 households in 240 villages will have access to enough drinking water for all purposes (www.water distribution, 2021).

Five villages in Chauk Township, Magway Region, will get artesian wells dug by the Department of Rural Development, which is part of the Ministry of Agriculture, Livestock, and Irrigation. This ensures that rural areas have enough water in addition to digging 900 feet. Deep artesian wells in Mindaunt, Magyipintut, Mahlataung, Taungnauk, and Nyaungbintha Villages, the department to build four water tanks that will be 20 feet in height and can store 2,400 gallons of water; one brick cement tank capable of accommodating 5,000 gallons of water; and five water treatment factories measuring 10 feet in length, 8 feet in width, and 8 feet in height.

Moreover, the rural water supply project is expected to cost about Ks. 106.93 million and is scheduled to be completed during the summer of 2023. Chauk is one of the most water-scarce townships in the Magway Region. Therefore, the department is prioritizing the availability of clean water in rural areas. The regional lawmakers and the township management committee chose the villages where residents could face water shortages on a priority basis.

3.5 Condition of Water Supply Distribution in Chauk Township

Chauk, a town, and port in north-central Myanmar (Burma), situated in the Irrawaddy River basin, is a petroleum port for the Singu-Chauk oil fields. Traditionally, the Mon group gathered asphalt in the area to weatherproof houses. However, in 1902, the British discovered the Chauk-Lonywa oil field. Later, crude oil from Chauk was sent by a 350-mile (563-kilometer) pipeline to Syriam for refining.

After World War II, insurgents destroyed pipelines, meaning Chauk's oil could only be sold in northern Myanmar. Since the pipeline was broken, oil tankers have started running on the Ayeyarwady River as an alternative way to move the oil. In 1954, the Chauk refinery was fixed up, and the pipe between Chauk, Tagaing, Yenenma, Pyay, and Syriam was fixed. A pipeline connecting Man and Syriam was completed in 1979. Abundant natural gas reserves are found in the Chauk oil fields.

There are 15 wards, private buildings, religious buildings, and government department buildings, a total of about 9,000 houses, and the population of about 40,000 in the Chauk township.

Chauk lives in a tropical area where underground water cannot be used for drinking or anything else. If underground water is mined at around 10,000 feet, it is unsuitable for drinking due to its high iron and lime content. Therefore, the primary drinking water source is the Ayeyarwady River.

Until 1970, residents in the city had to go to the Ayeyarwady River to bathe and carry drinking water using various methods. When the British governed Myanmar in 1901, the BOC oil company established the required water levels in the oil well and pumped the oil from the water to the ground. The BOC company began to use the necessary water directly from the Ayeyarwady River to the oil well and the water supply of Chauk city began.

When the BOC company first arrived, the local population was small, and most miners lived there. To supply drinking water to the workers and residents and to send water to the oil wells, they built a pontoon water lifter to lift water in the Ayeyarwady river and drove engines to get water.

The land surface of Chauk City is characterized by high hills on the east side of the town and a low land surface on the west side of the city. The Ayeyarwady river is used to push water to reservoirs on Chauk City's eastern hills. It is put into iron water reservoirs and storage tanks, where it stays until gravity lets it flow into homes. This system provides a reliable water source for the residents of Chauk City, which is especially important during the dry season when water scarcity is a common problem in the region.

After the BOC oil company stopped operations and transferred it to the Myanmar government, Myanmar Oil and Gas Enterprise (MOGE) continued to take over the water supply of Chauk city, and MOGE supplied water to 1,200 household water pipes from wards 1 to 14 in the town.

According to the Township Municipalities Law, it is stated that the members of the township municipality are responsible for carrying out the city's water supply. In 1972, MOGE transferred the Chauk Township Development Affairs, water collection tanks, and water pipelines used in the township's water supply work to the Chauk Township Development Committee. As the MOGE noted, the water distribution was carried out only to the residents where the oil workers' families lived.

Based on the taxes and other money they get, Chauk Township Development Affairs oversees the city's roads, bridges, water supply, and other development projects. According to Chauk Township Development Affairs, the city's water supply has been improved by building new pontoon water lifters, 6-inch, 4-inch, and 3-inch lines, and buying motors and pumps.

These changes depend on the annual water supply usage permit. As of January 20, 2023, 27 departmental water poles, 755 water poles, 20 fixed water poles, and 6998 poles for religious buildings and neighborhood residents are being supplied with water for a total of 7800 poles in 15 wards of Chauk City.

The Chauk Township Development Affairs has been supplying water once every two days to homes with water pipes. The rate per unit of water collected by the township municipality was 350 kyats. However, it has been increased to 550 kyats since 1.8.2022 and is still being collected today.

Chauk Township Development Affairs supplies water to Chauk City by pumping water from three places in the Ayeyarwady River to the reservoirs on the hill east of the town. In providing water to the neighborhoods from the reservoirs, the No. 1 water plant pontoon supplies water to 1,272 water poles in Areas 1, 2, 3, and 4. The office water plant supplies water to 1,738 water poles in the neighborhoods of Nos. 5, 6, 7, 8, 9, 10, 11, 12, 13, and 14. In addition, the Zicho Pin water plant supplies water to 1,783 water poles in ward No.15.

Although there is a small profit in terms of the monthly water pole fee for the water produced and used in the Chauk City water supply and the labor costs, electricity fees, maintenance costs, the city water supply is losing money every year due to the capital expenditure invested in improving the city water supply.

CHAPTER IV
EXAMINE OF IMPROVING WATER SUPPLY IN CHAUK TOWNSHIP

4.1 The Profile of the Study Area

The main profile of the study area is Chuck Township. In 2014, Census publications comprised township and sub-township reports. Their preparation involved the collaborative efforts of the Department of Population and UNFPA. This report contains selected demographic and socio-economic characteristics of Chauk Township in the Magway Region. The information included in this report is from the 2014 March 29 Census. Township-level information is critical.

However, the confidence level in township estimates differs from union-level information. Some of the townships have relatively small populations; these estimates should be interpreted cautiously. Some indicators, such as IMR and U5MR, were adopted only after careful analysis considering several factors to ensure consistency in the results. Estimates for townships with a relatively small number of observations should be taken as a different estimate of the mortality level. However, instead, they should be regarded as reasonable indicators for the scale of mortality risk they experience, indicating which townships are better off and which are more vulnerable.

Chauk Township has 15 war ds and 40 villages, with more females than males, with 80 males per 100 females. Most people in the township live in rural areas, with only 24.3% living in urban areas. The population density of Chauk Township is 187 persons per square kilometer. There are 4.1 persons living in each household in Chauk Township. This is slightly lower than the Union average.

65.5 percent of the people in Chauk Township who are between 15 and 64 years old and can work are in this age group. The proportion of children aged 14 and below, together with the elderly aged 65 and over, is less than that of the working-age population. When there are fewer children and older people, they don't need as much help from people who are working.

The birth rate has been noticeably declining in Chauk Township for the last 10 years. The population has markedly declined from ages 15–19 but has slowly declined from ages 20–24 to 40–44. Compared to the Union level, the percentage of the working-age group (15–64) in Chauk Township is similar to the Union level. Starting from age groups 5–9, there are fewer males than females in all age groups.

At the union level, the composition of the population by religion is 87.9% Buddhist, 6.2% Christian, 4.3% Islam, 0.5% Hindu, 0.8% Animist, 0.2% Other Religion, and 0.1% No Religion. In Magway Region, it is 98.8% Buddhist, 0.7% Christian, 0.3% Islam, 0.1% Hindu, 0.1% Animist, and less than 0.1% each for other religions and those with no religion, respectively. The tables (4.1) and figures (4.1) below show the population pyramid and demographics of Chauk Township.

Table (4.1) Demographic Characteristic of Chauk Township

Total Population	**185,189***		
Males	82,385		
Females	102,804		
Sex ratio	80 males per 100 females		
Percentage of urban population	24.3%		
Area (km^2)	991.5**		
Population density (persons per km^2)	186.8 persons		
Number of wards	15		
Number of village tracts	51		
	Total	Urban	Rural
Population in convention households	181,519	43,021	138,498
Number of convention households	44,618	10,401	34,217
Mean household size	4.1 persons***		

Source: Ministry of Labor, Immigration and Population, 2014

According to table (4.1), the total population is 185,189 in Chauk township. Males and females are 82,385 and 102,804, respectively. The sex ratio is 80 males per 100 females, and the percentage of the urban population is 24.3%. The population density (people per square kilometer) is 186.8.

The number of wards is 15, and the number of village tracts is 51. The population of convention households is 181,519 in total, 43,021 in urban areas, and 138,498 in rural areas. The total number of convention households is 44,618; 10,401 are in urban areas, and 34,217 are in rural areas. The mean household size is 4.1 people.

4.2 Compare Improving Water Supply and Water Access in Chauk Township

This section presents the two parts. These are the different types of use for drinking water and non-drinking water, and the difference in cost and water price for households in Chauk Township. The following tables (4.2) and (4.3) present the main sources of drinking water use and non-drinking water use in Chauk Township, Magawy Region.

4.2.1 Source of Use for Drinking Water and Non-Drinking Water

In Chauk Township, 63.5 percent of households use improved sources of drinking water (tap water, piped water, a tube well, a borehole, a protected well or spring, bottled water, or a water purifier). Compared to other townships in Magway Region, the proportion of households that use improved sources of drinking water belongs to this group (57–76), and it is lower than the Union average (69.5%). Some 35.0 percent of the households use water from the tube well and borehole, and 24.4 percent use water from a pool, pond, or lake. In rural areas, 42.5 percent of households use water from unimproved sources for drinking water. Table (4.2) presented the main sources of drinking water use in Chauk Township.

According to Table (4.2), the primary sources of total drinking water use are tube wells and boreholes (35%), pools, ponds, and lakes (24.4%), and bottle and water purified is 0.9%.

In the table (4.3) presented the primary sources of non-drinking water use are tube wells and boreholes (37.1%), pools, ponds, and lakes (23.9%), and tap water or piped water (20.4%). In Chauk Township, about 40 % per cent of households used non drinking water. Some 36.5 per cent of the households use water from unimproved sources. Table (4.3) presented the main sources of non-drinking water use in Chauk Township.

Table (4.2) Main Source of Drinking Water Use in Chauk Township

Source of Drinking Water		Total	Urban	Rural
Tap water / Piped		20.5	77.8	3.1
Tube well, borehole		35.0	3.0	44.7
Protected well / Spring		7.5	0.5	9.2
Bottled water / Water purifier		0.9	1.9	0.5
Total improved drinking water		*63.5*	*83.2*	*57.5*
Unprotected well / Spring		1.0	0.5	1.2
Pool / Pond / Lake		24.4	0.1	21.8
River / Stream / Canal		9.4	10.3	9.2
Water fall / Rain water		0.2	0.1	0.2
Other		1.5	5.8	0.1
Total unimproved drinking water		*36.5*	*16.8*	*42.5*
Total	Percent	100.0	100.0	100.0
	Number	44,618	10,401	34,217

Source: Source: Chauk Township Report by Ministry of Labor, Immigration, and Population, 2017

Table (4.3) Main Source of Non-drinking Water Use in Chauk Township

Main source of water for non-drinking use	Number	Percent
Tap water / piped	9,092	20.4
Tube well / borehole	16,561	37.1
Protected well / Spring	3,228	7.2
Unprotected well / Spring	242	0.5
Pool / pond / lake	10,655	23.9
River / stream / canal	4,135	9.3
Waterfall / rainwater	29	0.1
Bottled / purifier water	*	<0.1
Other	664	1.5

Source: Source: Chauk Township Report by Ministry of Labor, Immigration, and Population, 2017

4.2.2 Difference between Water Supply Cost and Water Access Price in Chauk Township

Myanmar water taking into account the 2012 study report of the Ministry of Health, Labor, and Welfare, the operation and maintenance costs for the mobile water purifier was examined, and the selling price of the drinking water was also preliminarily estimated. As a result, the willingness of residents to pay for drinking water was confirmed, and this study presented the difference between water supply costs and water access prices in Chauk Township. The following table (4.4), (4.5), (4.6), (4.7), (4.8), (4.9) and (4.10) show detailed information on these differences in fiscal year. Repair and maintenance costs, labor costs, electricity costs, payment for MOGE, investment costs, total cost, total revenue (received from water price), and difference are shown in tables.

Total costs (repair and maintenance cost, labor cost, electricity cost, payment for MOGE and investment cost) of April, May, July, September, October and December in 2022 and January, February, and March in 2023 are greater than total revenue (receiving from water price).

This means that the water supply costs are used for repairs and maintenance of the machine, hiring workers, and paying for electricity during these months. In June, August, and November, total revenue was greater than total costs. This indicates that the revenue from water access is increasing. Furthermore, the cost per unit of water is 350 kyats until July 2022. And then, the cost per unit of water increased by 550 kyats in August 2022.

Table (4.4) Difference between Water Cost and Water Price in Chauk Township (2016-2017)

(Kyats)

Sr. No.	Yr/Month	Repair and Maintenance Cost	Labor Cost	Electricity Cost	Payment for MOGE	Investment Cost	Total Cost (MMK)	Total Revenue (Receiving from Water Price)	Difference (MMK)
1	4/2016	3754000	3428500	12378575	817920	3917000	24295995	16542250	(-)7753745
2	5/2016	3754000	3428500	10055600	845184	3917000	22000284	24726300	(+)2726016
3	6/2016	3754000	3428500	10670800	817920	3917000	22588220	20644000	(-)1944220
4	7/2016	3754000	3428500	12073200	817920	3917000	23990620	19991100	(-)3999520
5	8/2016	3754000	3428500	8966450	845814	3917000	20911764	20206350	(-)705414
6	9/2016	3754000	3428500	9274075	817920	3917000	21191495	19359750	(-)1831745
7	10/2016	3754000	3428500	9641875	845184	3917000	21586559	17353250	(-)4233309
8	11/2016	3754000	3428500	8842950	790656	3917000	20733106	19295750	(-)1437356
9	12/2016	3754000	3428500	10244375	845184	3917000	22189059	16975150	(-)5213909
10	1/2017	3754000	3428500	11093550	845184	3917000	23038234	17719450	(-)5318784
11	2/2017	3754000	3428500	11138975	763392	3917000	23001867	15799100	(-)7202767
12	3/2017	3756000	3428500	12544050	845184	3913000	24486734	18131300	(-)6355434
	Total	45050000	41142000	126924475	9897462	47000000	270013937	226743750	(-)43270187

Source: Municipal Report in Chauk Township, 2023

Table (4.5) Difference between Water Cost and Water Price in Chauk Township (2017-2018)

(Kyats)

Sr. No.	Yr/Month	Repair and Maintenance Cost	Labor Cost	Electricity Cost	Payment for MOGE	Investment Cost	Total Cost (MMK)	Total Revenue (Receiving from Water Price)	Difference (MMK)
1	4/2017	3408000	3673000	13328825	817920	2046000	23273745	17666450	(-)5607295
2	5/2017	3408000	3673000	13936675	790656	2046000	23854331	24512750	(+)658419
3	6/2017	3408000	3673000	10752300	817920	2046000	20697220	23678950	(+)2981730
4	7/2017	3408000	3673000	10093400	845184	2046000	20065524	20983450	(+)917866
5	8/2017	3408000	3673000	11642475	845184	2046000	21615289	21184500	(-)430789
6	9/2017	3408000	3673000	10882950	817920	2046000	20827870	20877400	(+)49530
7	10/2017	3408000	3673000	11224500	845814	2046000	21197314	22362100	(+)1164786
8	11/2017	3408000	3673000	11189225	817920	2046000	21134145	19295700	(-)1838445
9	12/2017	3408000	3673000	11043875	845814	2046000	21016059	19142200	(-)1873859
10	1/2018	3408000	3673000	11287400	817920	2046000	21232320	20264600	(-)967720
11	2/2018	3408000	3673000	11932025	736128	2046000	21795153	17978850	(-)3816303
12	3/2018	3412000	3673000	13021500	845184	2044000	22995684	19416250	(-)3579434
	Total	40900000	44076000	140335150	9844194	24550000	259704654	247363200	(-)12341514

Source: Municipal Report in Chauk Township, 2023

Table (4.6) Difference between Water Cost and Water Price in Chauk Township (2018-2019)

(Kyats)

Sr. No.	Yr/Month	Repair and Maintenance Cost	Labor Cost	Electricity Cost	Payment for MOGE	Investment Cost	Total Cost (MMK)	Total Revenue (Receiving from Water Price)	Difference (MMK)
1	4/2018	7330000	5391000	13925775	817920	3900000	31364695	21834550	(-)9530145
2	5/2018	7330000	5391000	13224525	845814	3900000	30691339	27283600	(-)3407739
3	6/2018	7330000	5391000	10991100	817920	3900000	28430020	26634500	(-)1795520
4	7/2018	7330000	5391000	13133525	845184	3900000	30599709	25213850	(-)5385859
5	8/2018	7330000	5391000	11643575	845184	3900000	29109759	27687050	(-)1422709
6	9/2018	7350000	5391000	11300100	817920	3900000	28759020	23637800	(-)5121220
7	10/2018	1958000	5112000	12628225	845184	11074000	31617409	23331000	(-)8286409
8	11/2018	1958000	5112000	10577175	817920	11074000	29539095	24433250	(-)5105845
9	12/2018	1958000	5112000	10611175	845184	11074000	29600359	21448900	(-)8151459
10	1/2019	1958000	5112000	11091450	845184	11074000	30080634	24159750	(-)5920884
11	2/2019	1958000	5112000	10910375	763392	11074000	29817767	19786900	(-)10030867
12	3/2019	1958000	5112000	11558100	845184	11074000	30547284	22684400	(-)7862884
	Total	55748000	63018000	141595100	9951990	89844000	360157090	288135550	(-)72021540

Source: Municipal Report in Chauk Township, 2023

Table (4.7) Difference between Water Cost and Water Price in Chauk Township (2019-2020)

(Kyats)

Sr. No.	Yr/Month	Repair and Maintenance Cost	Labor Cost	Electricity Cost	Payment for MOGE	Investment Cost	Total Cost (MMK)	Total Revenue (Receiving from Water Price)	Difference (MMK)
1	4/2019	1958000	5112000	12847825	817920	11074000	31809745	27012750	(-)4796995
2	5/2019	1958000	5112000	13785550	845184	11074000	32774734	30398250	(-)2376484
3	6/2019	1958000	5112000	10876175	817920	11074000	29838095	33843100	(+)4005005
4	7/2019	1958000	5112000	17123765	845184	11074000	36112949	30795750	(-)5317199
5	8/2019	1958000	5112000	13022070	845184	11074000	32011254	28484350	(-)3526904
6	9/2019	1962000	5112000	21369875	817920	11076000	40337795	25774700	(-)14563095
7	10/2019	4600000	5188000	7819035	1340268	9909580	28856883	27415350	(-)1441533
8	11/2019	4600000	5188000	15176235	1695904	9909580	36569719	26623700	(-)9946019
9	12/2019	4600000	5188000	14430385	1501604	9909580	35629569	22184900	(-)13444669
10	1/2020	4600000	5188000	16347815	1427100	9909580	37472495	30246300	(-)7226195
11	2/2020	4600000	5188000	16927970	1406196	9909580	38031746	23496650	(-)14535096
12	3/2020	4600000	5188000	17293405	1692688	9909580	38683673	26431650	(-)12252023
	Total	39352000	61800000	177020105	14053072	125903480	418128657	332707450	(-) 85421207

Source: Municipal Report in Chauk Township, 2023

Table (4.8) Difference between Water Cost and Water Price in Chauk Township (2020-2021)

(Kyats)

Sr. No.	Yr/Month	Repair and Maintenance Cost	Labor Cost	Electricity Cost	Payment for MOGE	Investment Cost	Total Cost (MMK)	Total Revenue (Receiving from Water Price)	Difference (MMK)
1	4/2020	4600000	5188000	18266485	1573696	9909580	39537761	27575850	(-)11961911
2	5/2020	4600000	5188000	18237985	1644448	9909580	39580013	36247000	(-)3333013
3	6/2020	4600000	5188000	18038430	1521168	9909580	39257178	38608300	(-)648878
4	7/2020	4600000	5188000	16774345	1688936	9909580	38160861	36986250	(-)1174611
5	8/2020	4600000	5188000	14806930	1697244	9909580	36201754	41166500	(+)4964746
6	9/2020	4600000	5188000	14451150	1692420	9909620	35841190	32422350	(-)3418840
7	10/2020	6018300	5474000	13914575	1930672	4400000	31737547	39313150	(+)7575603
8	11/2020	6018300	5474000	13708265	2146412	4400000	31746977	32508200	(+)761223
9	12/2020	6018300	5474000	14544045	2010268	4400000	32446613	36447900	(+)4001287
10	1/2021	6018300	5474000	14446065	1650612	4400000	31988977	30166850	(-)1822127
11	2/2021	6018300	5474000	13676595	997496	4400000	30566391	4013200	(-)26553191
12	3/2021	6018300	5474000	16513935	942288	4400000	33348523	7586300	(-)25762223
	Total	63709800	63972000	187378805	19495660	85857520	420413785	363041850	(-) 57371935

Source: Municipal Report in Chauk Township, 2023

Table (4.9) Difference between Water Cost and Water Price in Chauk Township (2021-2022)

(Kyats)

Sr. No.	Yr/Month	Repair and Maintenance Cost	Labor Cost	Electricity Cost	Payment for MOGE	Investment Cost	Total Cost (MMK)	Total Revenue (Receiving from Water Price)	Difference (MMK)
1	4/2021	6018300	5474000	16718040	1738248	4400000	34348588	32509950	(-)1838638
2	5/2021	6018300	5474000	19167285	2101656	4400000	37161241	41737950	(+)4576709
3	6/2021	6018300	5474000	14367340	2130868	4400000	32390508	46132550	(+)13742042
4	7/2021	6018300	5474000	15354610	2045376	4400000	33292286	21982700	(-)11309586
5	8/2021	6018300	5474000	14374920	1890472	4400000	32157692	20561450	(-)11596242
6	9/2021	6018700	5474000	13157655	2090400	4400000	31140755	28377400	(-)2763355
7	10/2021	4466000	5432000	13961035	1686792	-	25545827	36390450	(+)10844623
8	11/2021	4466000	5432000	13909020	1668032	-	25475052	44680000	(+)19204948
9	12/2021	4466000	5432000	15234650	1705820	-	26838470	37160150	(+)10321680
10	1/2022	4466000	5432000	14113995	1605588	-	25617583	20918700	(-)4698883
11	2/2022	4466000	5432000	12975240	1299800	-	24173040	18801700	(-)5371340
12	3/2022	4470000	5432000	16107705	1299800	-	27309505	27968850	(+)659345
	Total	62910200	65436000	179441495	21262852	26400000	355450547	377221850	(+) 21771303

Source: Municipal Report in Chauk Township, 2023

Table (4.10) Difference between Water Cost and Water Price in Chauk Township (2022-2023)

(Kyats)

Sr. No.	Yr/Month	Repair and Maintenance Cost	Labor Cost	Electricity Cost	Payment for MOGE	Investment Cost	Total Cost (MMK)	Total Revenue (Receiving from Water Price)	Difference (MMK)
1	4/2022	4480000	5430000	16770765	1398156	26789100	54868021	20792600	(-)34075421
2	5/2022	4480000	5546000	17355205	1872248	26789100	56042553	29943400	(-)26099153
3	6/2022	4480000	5548000	17798115	1809536	26789100	56424751	61383300	(+)4958549
4	7/2022	4480000	5601000	17153510	1693224	26789100	55716834	47138250	(-)8578584
5	8/2022	4480000	5601000	15977620	1543412	26789100	54391132	67063900	(+)12672768
6	9/2022	4480000	5601000	14949495	1049220	26789100	52868815	49557550	(-)3311265
7	10/2022	4480000	5601000	14703320	1129888	26789100	52703308	41908700	(-)10794608
8	11/2022	4480000	5601000	14279610	1018132	26789100	52167842	71651400	(+)19483558
9	12/2022	4480000	5601000	15496830	1207608	26789100	53574538	52230250	(-)1344288
10	1/2023	4480000	5601000	14122345	1177860	26789100	52170305	38000350	(-)14169955
11	2/2023	4480000	5601000	12723850	1363316	26789100	50957266	37974000	(-)12983266
12	3/2023	4480000	5453000	15731215	1366800	26789900	53820915	45988950	(-)7831965
	Total	53760000	66785000	187061880	16629400	321470000	645706280	563632650	(-)82073630

Source: Municipal Report in Chauk Township, 2023

4.2.3 Financial and Economic Studies

In studying the water supply service of Chauk township, it was found that the total revenue's monthly income is lower than the total costs. To put the rural development policy into action, however, planning activities for both drinking and non-drinking water production need to be made. Also, it is found that clean drinking water is made available in Chauk township with the help of money and technical know-how.

The Chauk's water supply shows that it is not financially feasible. However, the water supply aims to improve living conditions in the residences by supplying safe and sufficient water. The implementation of the project can be justified from the viewpoint of basic human needs. Additionally, Chauk Township's water supply system is a crucial component of the public service that the regional government supports. Additionally, there are many challenges facing the Chauk water supply industry. These are

1. Drought and flooding affect all regions of Chauk Township, and they represent one of the water supply's biggest challenges.
2. Water scarcity is permanent and ongoing. Water scarcity also affects all wards and individuals.
3. Energy accounts for 55–60 percent of the life-cycle cost of a pumping station.
4. On average, up to 25–30% of a utility's water is lost in the network due to leakage and other types of non-revenue water. These losses cost Chauk Township Development Affairs vast sums of money, not only in lost revenues but also in the cost of treating and pumping water that leaks into the ground.
5. The regional government is overloaded with project financing and does not have the resources to handle more. Funding a water project, however much it is needed.
6. The quality of drinking water and wastewater is a constant challenge for utilities.
7. The revenues earned do not cover their operating costs. So, a shrinking tax base has to make up the difference.
8. Aging infrastructure needs to be renewed every 10 years, depending on the type.

CHAPTER V
CONCLUSION

5.1 Finding

There are a number of previously built and drilled wells in Myanmar's Dry Zone, which includes Chauk Township and the Magaway Region, that are now inoperable due to limited availability of materials, outdated technology, high cost, and other factors. Due to the absence of technology transfer and, more crucially, engineering training for indigenous engineers, these earlier ventures did not solve these concerns.

Due to the main limitations of the drilling rig, such as the fact that drilling equipment like bits, drill pipes, mud pumps, bentonite, and pumps had to be brought in from Japan and Australia, costs, technical skills, and the study area, the local drilling machine, which always needs help from the government and INGOs, could not drill a deep tube well.

Some positive signs are emerging. A number of INGOs and international aid agencies, including JICA, Bridge Asia Japan (BAJ), ADRA, Proximity, and ActionAid, with the cooperation of government counterparts such as WRUD, DDA, and DRD, have been implementing water supply projects. BAJ, JICA, and DDA/DRD bring valuable support not only by providing the tube wells but also by providing technical training (geophysical survey, pumping test, logging, drilling method, maintenance and rehabilitation technique, etc.) to the local drillers and DRD engineers and technicians.

By using these techniques, skills, and knowledge, there were qualified local drillers and geophysical surveyors who could perform the tube well construction process professionally for the Dry Zone area. This is a very big achievement, not only for the job opportunity for those local people but also for the people in the Dry Zone because they could solve their water scarcity problem. With the calculations of the geophysical surveyors, the drillers can estimate the tube well depth, water level, and water quality as well.

On the other hand, different types of drilling equipment, such as drill bits, pumps (mono, submersible, and compressor), pipes, engines, and solar systems, have been put on the Myanmar market at reasonable prices and with good quality. This market helps encourage local drillers to continue their drilling activities.

The study found that the villagers in Chauk Township can save time and reduce the burden of fetching water because there is no transportation distance. In fact, each household can get water from the tube well in their village by connecting it to the pipeline system. All households have sufficient potable water for both drinking and domestic purposes.

And only a few households are willing to pay for the water fees because easy access to water makes their family members use water more than the requirement, which creates the cost of water fees. Some people are also willing to pay for water because they know how much electricity it costs to run the tube wells and think the price, they pay for it is fair.

In the conclusion, the study found that if poor communities had better access to basic water and sanitation services, their health would improve, their healthcare costs would go down, and they would save time. Good management of water resources makes productivity in all economic sectors more certain and efficient, and it also helps keep the ecosystem healthy.

On the other hand, Chauk's water supply project shows that it is not financially feasible for Chauk Township Development Affairs. However, the committee aims to improve living conditions in the residences by supplying safe and sufficient water. The implementation of the project can be justified from the viewpoint of basic human needs. Additionally, the water supply system is a public service provided by the regional government and an important part of Chauk Township.

5.2 Suggestions

Since tube wells are the main source of water in this research area, the Magway Region of Myanmar, they need to be kept in good shape and fixed up so they can be used for a long time. The amount of water discharge may decrease after approximately ten years of life due to a drop in pump capacity or clogging of the old screen pipes in the tube wells. These wells should be restored through tube well rehabilitation and repair or replacement of the pumps or their spare parts.

In order to make the most of these existing wells, a set of tube well repair tools and accessories should be made readily available on the market. As a prevention measure, the villagers need to save money by selling the water from the existing tube well and keeping the spare parts (engine), water management fund for tube well maintenance (developing, cleaning, and replacing spare parts of the pump) in order to be sure to handle any unexpected damage to the existing tube wells.

Even though there isn't much known about groundwater, the Dry Zone has a moderate amount of it. Local recharge is estimated to be 4,777 m3 per year. This is equivalent to about half of the current surface water storage and less than 2% of total surface water resources. Groundwater is very important to the Magway Region, but its use must be carefully planned and developed to make sure it can be used in a way that is sustainable in the long run. The lack of easy access to data has been a big problem for current and past studies.

Many sets of data are spread out among different government departments, and they are often kept at the division and district levels. Some information can only be found at the level of each scheme, and some just can't be found.

A lot of monitoring, especially of groundwater, has been limited and done on the fly instead of being thorough and planned. There is an urgent need to set up an effective data management system for water that includes current monitoring networks, proper protocols for collecting data, easily accessible databases, and tools for analyzing data. A system like this needs to be made, and it needs to be made as a national project that includes both surface water and groundwater (IWMI, 2013).

Investing in systems to collect and store rainwater is needed to provide extra irrigation at the beginning of a crop's life cycle. For the early stages of crop growth, extra watering may be needed. Building structures that collect and store rainwater is one way to accomplish this. Rooftop rainwater collection isn't likely to be enough for anything other than household use.

However, building small reservoirs that collect water from a small catchment area could provide enough water for supplemental irrigation during the wet season (to fill in dry spots) and at the beginning of the summer dry season. Such reservoirs could make a substantial contribution to safeguarding wet-season yields.

The Irrigation Department is well-positioned to provide technical assistance in the placement and construction of reservoirs. At the moment, a local NGO called Proximity is working to build and repair earth embankments in the dry Zone.

However, the primary focus is the supply of domestic and livestock water, not irrigation. Past attempts at small reservoirs and tanks have had limited success due to problems of siltation and collapse of the embankments.

Because erosion is a big problem in the Magway Region, there are a lot of reservoirs that need to be fixed up. Because of this, sustainability needs to be thought about more, and upstream watershed management (measures that reduce flood runoff and sediment transport), along with building and fixing up embankments, is very important.

REFERENCES

CTDA. (2022). Chauk Township Development Affairs, Annual Report (2021-2022)

Central Statistical Organization (CSO), UNDP and WB. (2018). "Myanmar Living Conditions Survey 2017: Key Indicators Report"

Central Statistical Organization/UNDP. (2017). Measuring Myanmar's starting point for the Sustainable Development Goals, SDG Indicator Baseline Report.

Chauk Township Development Affairs (2023), Municipal Report in Chauk Township (2023)

Department of Rural Development. (2016). National Strategy for Rural Water Supply, Sanitation and Hygiene (WASH) and WASH in Schools.

FAO. (2012). Coping with water scarcity, An action framework for agriculture.

Min, H. P. (2019). *A Study on Improving Water Access in Central Dry Zone, Myanmar* (Case study: Three Villages in Bagan-Nyaung U Township) (Doctoral dissertation, MERAL Portal).

Ministry of Labor, Immigration, and Population (2017). Chauk Township Report (2017)

Telmo, A. C. (2002). *A water supply and sanitation study of the village of Gouansolo in Mali, West Africa* (Doctoral dissertation, Michigan Technological University).

Thet Htar Hsu. (2018). A Study on the Socio-Economic Conditions of Tharrawaddy Township, Unpublished MPA thesis, Yangon University of Economics.

United Nations. (2018). The Sustainable Development Goals Report.

United Nations., African Union., & African Development Bank. (2009). The Africa Water Vision for 2025: Equitable and Sustainable Use of Water for Socioeconomic Development.

UN Water. (2018). Sustainable Development Goal 6, Synthesis Report on Water and Sanitation.

Zin Mar Lwin. (2005). An Evaluation on Rural Water Supply Project with Special Reference to Water Supply Status in Bagan Nyaung Oo Township, Mandalay Division, Unpublished MPA thesis, Yangon University of Economics.

Website References

1. www.gwp.org/globalassets/global/gwp-sea_files/assessment-on-the-national-water-policy-of-myanmar.pdf
2. www.mdn.gov.mm/en/water-distribution-projects-240-villages-magway-region-completed
3. www.gnlm.com.mm/magway-govt-to-implement-24-water-supply-projects/
4. www.devex.com/organizations/department-of-rural-development-drd-myanmar-125085
5. https://www.britannica.com/place/Chauk
6. https://www.iiot-world.com/industrial-iot/connected-industry/challenges-and-opportunities-in-the-world-of-water/

APPENDIX

Chauk Township, Magway Region

Source: Ministry of Labor, Immigration and Population, 2019