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THE BENEFITS AND CHALLENGES OF SOLAR POWERED WATER LIFTING TECHNOLOGY FOR WOMEN: IN THE CASE OF DANGILA DISTRICT, AMHARA REGIONAL STATE, ETHIOPIA

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BAHIR DAR UNIVERSITY

FACULTY OF SOCIAL SCIENCE

DEPARTMENTS OF GENDER AND DEVELOPMENT STUDIES

**THE BENEFITS AND CHALLENGES OF SOLAR POWERED WATER LIFTING
TECHNOLOGY FOR WOMEN: IN THE CASE OF DANGILA DISTRICT, AMHARA
REGIONAL STATE, ETHIOPIA**

MA Thesis

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July, 2019

Bahir Dar, Ethiopia

Bahir Dar University

Faculty of Social Science

Department of Gender and Development Studies

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TECHNOLOGY FOR WOMEN: IN THE CASE OF DANGILA DISTRICT, AMHARA
REGIONAL STATE, ETHIOPIA**

A Thesis Submitted to Faculty of Social Science, Department of Gender and Development Studies
in Partial Fulfillments of the Requirements for the Awards of Master of Arts in Gender and
Development Studies

By

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July, 2019

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Dedication

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Lists of Acronyms and Abbreviation

ANRS	Amhara National Regional State
ASMCP	Appropriate Scale up Mechanization Consortium project
BiT	Bahir Dar institute of Technology
FAO	Food and Agricultural Organization
FDRE	Federal Democratic Republic of Ethiopia
FGD	Focus Group Discussion
HH	House Hold
IGA	Income Generating Activity
KII	key Informant Interview
SPWLT	Solar Powered Water Lifting Technology
PV	Photo Voltaic
UNESCO	United Nations Educational, Scientific and Cultural Organization
USD	United States Dollar
WHO	World Health Organization
LIVES	Livestock and Irrigation Value chains for Ethiopian Smallholders

Glossary

Arekie: - locally made Ethiopian traditional alcoholic drink produced through simple distillation method.

Awudima: a selective portion of the farm land for threshing crop.

Kebele: local administrative unit below *wereda*

Tella: home- brewed Ethiopian traditional drink

Woreda: the third-level administrative divisions of Ethiopia and further subdivided into a number of Kebeles

Abstract

Bahir Dar University institute of Technology (BiT) in collaboration with Feed the future Appropriate Scale Mechanization project (ASMP) supplied solar powered water lifting technologies (SPWLT) for Dangila district, Dangeshta Kebele women small holder farmers. Like other areas, water is women's issue in this district, and they are lifting and fetching water in a traditional way. So, this SPWLT has considerable benefits for women in multi dimensions and it has its own challenges. However, little has known so far about the benefits and challenges of SPWLT for women in Ethiopia. Taking into account this knowledge gap, this study tried to explore the benefits and challenges of solar powered water lifting technology for women. To achieve the proposed objective, qualitative research approach with case study design was employed. Purposive and availability sampling technique was used to select the study site and participants. The data were extracted through semi structured interview, key informant interview and focus group discussion from the target group and the data were analyzed via qualitative data analysis technique. The study found out that time saving, work burden reduction, health improvement are the main benefits that women gained as a result of the supply of SPWLT, getting additional food/nutrition and income is the other benefit in relation to household welfare. In addition, this study revealed that affordability, inaccessibility, shortage of water source in the dry season, absence of energy storing mechanism are the main challenges that the women are facing while using this technology and potential hindering factors for sustainability. Generally, this study found out that the supply of SPWLT benefited women to save their time, reduce their work burden and to improve their health condition and this benefit has a direct effect on women to divert their unproductive tasks into income generating activities, availability of additional food item for the family, better child care and general improvement in the wellbeing of the whole family. Finally, the study recommended that BiT together with its stakeholders shall promote this technology to manufacture it locally so that it will be available for women with affordable price.

Key words: - Benefit, Challenge, Dangila district, Women, Solar Powered Water Lifting

CHAPTER ONE

1. INTRODUCTION

1.1. Background of the study

At the beginning of human history, the environment favored and promoted equality of males and females. But as the vulnerabilities of males to the natural environment differed, various actions and dangers increased, both sexes started to differ in the nature and depth of experience (Power, as cited in Yeshimeberat *et al.*, 2009).

According to Singh (2014) the contribution of women is very high in the farm sector as they are involved in majority of farm operations and are therefore subjected to extra harsh conditions of work that leads to drudgery. In this regard FAO (2018) noted that the feminization of agriculture offers a series of opportunities for increased agricultural mechanization at farm level and in the agri food value chain that are economically, environmentally and socially sustainable. As UNSCO (2007) briefly explained, rural women simultaneously manage triple responsibilities at work within the household and at community level. Introducing women friendly improved farm tools and equipment can reduce drudgery in farm operations.

Empowerment is to make one powerful or to equip one with the power to face challenges of life, to overcome the difficulties, handicaps and inequalities. Women Empowerment is an active multi-dimensional process, which would enable women to realize their full identity and powers - in all spheres of life. It consists of providing greater access to knowledge and resources, greater autonomy in decision making, greater ability to plan their lives, greater control over the circumstances that influences their lives and freedom from the shackles imposed on them by custom, belief and practice (UNFPA, 2005).

The past three decades have witnessed a steady increase in awareness of the need to empower women through measures to increase social, economic and political equity, and broader access to fundamental human rights, improvements in nutrition, basic health and education. Even in light of heightened international awareness on gender issues, it is a disturbing reality that no country has yet managed to eliminate the increasing gender gap. Several countries that do not

capitalize on the full potential of one half of their societies are misallocating their human resources and undermining their competitive potential in their developmental quest (Zahidi, 2005).

Manual material handling tasks may expose workers to physical risk factors. If these tasks are performed repeatedly or over long periods of time, they can lead to fatigue and injury (Cal/OSHA Consultation Service, 2007). Closing the gap in women's access to a broad range of technologies could help free their time for more productive activities (FAO, 2018). According to the report of Asian Development Bank (2015) in rural areas water is mostly fetched by women and sometimes by adult children, for long distances

The empowerment of women becomes a powerful agency to improve welfare and human development. It is argued that empowering women improves the well-being of the household and leads to better outcomes for children (Kabeer, 2001). Empowerment is not essentially political alone; it is a process of having personal, economic, social and political dimensions with personal empowerment being the core of the empowerment process. In fact, political empowerment will not succeed in the absence of economic empowerment (Ghadoliya, 2006).

From her birth, an Ethiopian female in most families is of lower status and commands little respect relative to her brothers and male counterparts, in Amhara Region, 48 percent of women are married before the age of 15—the highest early marriage rate in the country. The average Ethiopian woman bears 5.4 children during her lifetime; those who marry very young are likely to bear more children. (Bogalech & mengistu, 2007).

The Livestock and Irrigation Value chains for Ethiopian Smallholders (LIVES) project in collaboration with the International Water Management Institute (IWMI) has commenced the demonstration of solar water pumps with pilot households in Oromia and the Southern Nations, Nationalities and Peoples' (SNNP) regions (Muluken et al., 2017). According to Amentie et al., (2016) four solar water pumps were purchased by the project from India for 2,600USD (excluding transportation and other related costs) each of which discharges 0.5 litres of water per second from shallow wells with a maximum depth of seven metres. In early December, 2015, the solar water pumps were installed and demonstrated for selected households in Gamo Gofa and East Shoa Zones of the SNNP and Oromia regions respectively.

Numerous people across multiple disciplines have attempted to measure empowerment (Rowlands, 1996). This paper measured the empowerment process for women using Kabeer's (1999) definition of resources, agency, and achievements in which resource is empowerment potential, like material, human, financial, access to solar water lifting technology, access to land, access to input whereas agency is decision making – it is empowerment process, sense of self worth and capacity to make decision, achievement is outcome, transformation of decision to reality that is basic need.

In 2018, Bahir Dar University Institute of Technology (BiT) in its community service and Industry linkage programme together with Feed the Future in their Appropriate Scale Mechanization Consortium (ASMC) project supplied solar water lifting technology for the selected farmers in Dangila district Dangesheta kebele. Due to the fact that appropriate scale mechanization technology for water resource utilization and its contribution for women empowerment is no longer a matter of debate by many scholars and researchers throughout the world. As Asian Development Bank (2015) report since access to clean water supply closer to home have a significant impact on women's time poverty, work burden reduction, women's health improvement, to generate additional income generating activities and there is also evidence to show that time saved is reallocated to activities that might have a transformative effect on gender relations in a household, So it is clear that solar water lifting technology has a positive implication for gender equity and women empowerment. And by considering these concepts it is imperative to study the contribution of solar powered water lifting technology for women empowerment and specifically this study had investigated the different benefit women gets through the support of water lifting technology, the contribution of Solar powered water lifting technology for house hold welfare and finally, this study identified the hindering factors women faced while using the technology, in Dangila district, Dangesheta Kebele.

1.2. Statement of the problem

Time lost due to walking and waiting for water is having a ripple effect on women's lives, their communities and whole economies. Surveys from 45 developing countries show that women and children bear the primary responsibility for water collection in 76% of households. This is time NOT spent carrying out income generating activities, caring for family members, attending school or simply looking after women's needs and aspiration (Oxfam, 2015).

The Growth and Transformation Plan (GTP) commits to 98% rural water coverage and 100% urban water coverage by the year 2015, within 0.5 km's of urban households and 1.5 km's of rural households. Improved water and sanitation within closer reach of households has direct and immediate benefits for women and children, reducing the economic burden for fetching and carrying water and the financial burden of diarrheal related illnesses (Lakech, 2014).

In this regard, different investigations and published research works have been conducted across different parts of the world. For instance Willis (2012) did a research on the weight of water: female empowerment through gender mainstreaming and integrated water resource management in Texas State University-San Marcos. Further UNESCO (2015) studied world water assessment for women and they found that, the impact water has on women's time can start as young as five. In many cultures, as soon as they are able to carry the canisters they will spend hours each day fetching water with their mothers.

Likewise, there are also few research works which have been conducted in different parts of African countries. According to a study conducted by Sophie et al. (2017) entitled *What Happens after Technology Adoption, gendered aspects of small-scale irrigation technologies in Ethiopia, Ghana, and Tanzania*, examined the adoption or acceptance of small scale irrigation technology, explained the technology adoption rates that are observed and why technology adoption is often not sustained in the longer term. This has led to an emphasis on constraints exogenous to the household that prevent women from learning about or trying out a technology, while considerably less attention has been paid to the gendered impacts of a technology once a household starts using.

Jemimah et al. (2015) studied qualitative assessment of gender and irrigation technology in Kenya and Tanzania and examined women's access to and ownership of irrigation pumps, and the implications on their ability to make major decisions on crop choices and use of income from irrigated crops. And these study findings showed that rural household economies dependent on rain-fed agriculture are increasingly turning to irrigation technology solutions to counter balance weather variability, and guard against low crop yields. Organizations too are using market-based approaches to disseminate technologies to smallholder farmers, and although women are among their target group, little had been known about the extent to which these approaches were reaching and benefiting them

Similarly, there are also some research works which have been done in Ethiopia related with solar water and women empowerment. As it has been pointed out by Likimyelesh et al. (2017) Water lifting for irrigation and multiple purposes in Ethiopia, on gender and individual irrigation technologies undertaken in two Africa RISING Project sites in Ethiopia, Bale (Illu Sambitu Kebele) and Lemo (Jawe and Upper Gana Kebeles) the intra-household gender dynamics in Africa RISING pilots of water lifting technologies (rope and washer pump, tractor and drip and solar pumps) and this study focuses on the different water source.

Even if different researchers in Ethiopia and in the world have tried to assess the integration of water and women, they overlooked to specifically point out the contribution of Solar powered water lifting technology for women empowerment, So far I found out certain limitations. Hence, the aforementioned studies are not as such holistic; rather they only focused on some concepts or issues. Thus, those limitations could be categorized into three major themes as theoretical, conceptual and participant selection.

Conceptually, all those research works listed above were not holistic studies rather they focused on some specific issues. Some of them are focused on the contribution of back yard production to women's empowerment and the other focused on the adoption or acceptance of small scale irrigation technology, women's access to and ownership of irrigation pumps, the feasibility of solar water pumping system for rural areas in Ethiopia, the amount of time mothers spend carrying water and factors such as socioeconomic characteristics, women's empowerment, the relevance of gender for the sustainability of rural water supply, identifying, and documenting gender outcomes associated with water, sanitation, and hygiene (wash).

With regard to participant selection limitation, all those researches were selected their participants without considering gender dimension. The majority of their research target groups were predominantly men. And theoretically, majorities were done by irrigation and business research theories and doesn't directly touch the benefits and challenges of SPWLT for women.

This is, therefore, those studies mentioned so far were not fully able to investigate the benefits and challenges of solar powered water lifting technology for women. Having this research gaps in mind and being aware of them exactly, the researcher had intended to address those issues by applying qualitative research methods with case study research design in Dangila district of

Amhara regional state. And this study identified the different benefits women achieved through promotion of water lifting technology and investigated the contribution of Solar powered water lifting technology for household welfare and finally identified the hindering factors that women faced while using the solar powered water lifting technology.

In addition, as per my experience in the study area the solar powered water lifting technology is recently introduced in the selected district and it is individual based scheme installed in the back yard of women's house. And as per the information gathered from the BiT - ASMC project there is no study done so far on solar powered water lifting technology benefit and challenge for women in Dangila districts Dangesheta Kebele. Thus, the above research gaps motivated me to assess the benefit and challenges of solar powered water lifting technology for women.

1.3. Objectives of the study

1.3.1. General objective

The General objective of the study is to explore the benefit and challenges of solar powered water lifting technology for women in the case of Dangila district Dangesheta Kebele.

1.3.2. Specific objective

- To investigate the benefits women, gain as a result of the supply of solar powered water lifting technology.
- To identify the contribution of Solar powered water lifting technology for household welfare.
- To investigate the challenges women faced in using this technology sustainably.

1.4. Central research question

What are the overall benefit and challenges of solar powered water lifting technology for women in the case of Dangila district Dangesheta Kebele?

1.5. Significance of the study

As clearly delineated by Creswell (2009) research is a process in which we engage in a small set of logical steps. However, it adds knowledge, improves practice. In line with this, the successful accomplishment of this research would have both practical and theoretical significances. Practically, the findings of this study will be expected to enlighten individuals and organizations about the benefit and challenges of SPWLT for women, it will serve for BiT ASMC project to use as a monitoring report with respect to gender issues and to have information about the challenges women faced to use this technology and to sustain benefit for long term impact and to sensitize future new initiative. In addition to that, it will serve as an academic input and as a secondary source of data for those who want to conduct further investigation in this area. More over this research will have theoretical significance since its findings are related with the prevailing theories of women empowerment frame work.

1.6. Scope of the study

This study was limited in terms of geography, target groups and issues. And the scope of this study would delimit only to assessed the benefit and challenges of solar powered water lifting technology for women and the study had geographically delimited in Dangila district, Dangesheta Kebele. This study has been identified the different benefits women gain as a result of the supply of solar powered water lifting technology, investigated the contribution of Solar powered water lifting technology for house hold welfare, identified the hindering factors women face while using the technology constantly.

1.7. Definition of Key Terms

Drudgery: the hard work which the women invest fetches water from different water source

Benefit: - advantages that the women gained as a result of the supply of this SPWLT technology.

Solar powered water lifting technology: used to lift/pump water from different water sources by using sun light as a source of energy.

Challenges: hindrance to use the solar powered water lifting technology sustainably.

1.8. Organization of the Paper

The thesis enclosed five chapters. Chapter one deals with a general overview of the study. It presents background information, a statement of the problem, objective and research questions. Significance of the study, operational definition and organization of the paper are also included. The second chapter contains a review of related literature. The third chapter describes about the research methodology. In this section, the study design and data collection tools, source population, data collection and management, ethical consideration, and limitation of the study are incorporated. Chapter four focuses on analysis of the study and discussion of the major findings and in the final part, conclusion and recommendations are incorporated.

CHAPTER TWO

2. REVIEW OF RELATED LITERATURE

2.1. Concepts of solar powered water lifting technology

Technology refers not only to physical equipment – including infrastructures and installations but also to the knowledge, techniques and skills that surround its deployment and use. These in turn form part of a broader technological ‘regime’ or infrastructure that supports innovation and the ability for one technology to build on or link to another. We know not all technologies become innovations, and not all innovations diffuse widely and become part of a successful enterprise. Technically feasible technology is always much greater than that of economically profitable technology, and this in turn, is much greater than that of the socially acceptable technology (Tonda, 2015). Women in developing countries are often poorly integrated into new technology sectors, but technical and vocational training may be a means of empowering women to achieve such integration (Hemson & Peek, 2017).

There is a great impact of diesel driven water pumping systems on irrigation, in remote areas around the world. However, the gradual increase of fuel price worldwide has a serious effect on this system that discourages the utilization of such technology. As an alternate, it is expected to deal with the economical solar water pumping system for small scale irrigation applications (Muluken *et al.*, 2017).

2.1.1. Historical development of solar water lifting technologies

According to Walt *et al.* (2007) explained solar energy has been used since time immemorial to dry agricultural products, to provide space heat in cold seasons or to create ventilation in homes, applications which are still used in many developing countries. More than two thousand years ago, Heron of Alexandria constructed a simple water pump driven by solar energy and in 214 B.C. Archimedes of Syracuse used concentrating solar mirrors to set fire in Roman ships as more and more groundwater sources become unsafe for drinking purposes, potable water often needs to be drawn from depths that require some form of pumping. A Solar-powered water pumping system uses solar energy to power a pump to supply a village with potable water. Solar pumping

systems are commonly used where it is too far to walk to a well or where the well only provides seasonally usable water (Walt *et al.*,2007).

Manual pumping options like treadle pumps or rope pumps are often mentioned as a first step into irrigated agriculture; at reasonable cost, the farmer can start irrigating and earn additional income. Once the farmer has the means, the step to mechanized pumping is made as farmers do not prefer the drudgery of manual pumping. With affordable Chinese engine pump sets entering the market at comparable price levels with treadle and rope pumps, it is now seen that farmers skip the manual pumping step and start with mechanized pumping right away (Jan and Gert , 2014).

The first solar pumps were installed in the late 1970s. Since then, PV water pumping systems have shown significant advancements. The first-generation PV pumping systems used centrifugal pumps, usually driven by DC motors or variable frequency AC motors, with proven long-term reliability and hydraulic efficiency varying from 25 percent to 35 percent. The second-generation PV pumping systems introduced positive displacement pumps, progressive cavity pumps and diaphragm pumps for smaller water quantities, generally characterized by lower input power requirements, lower capital costs and higher hydraulic efficiencies (FAO, 2018).

Solar energy was very important from the ancient period of history, for Greek and Egyptians Sun is like their god because for them the solar energy power is the oxygen for this world. Now a days, everyone sees this solar power is a new power developed within recent years, but the truth is human beings is harnessing the power of sun for just hundreds or thousands of years (Anoop J R1, 2007).

2.1.2. Solar water lifting in Africa

As solar panels become more affordable, solar photovoltaic (PV) pumps have been identified as a high potential water-lifting technology to meet the growing irrigation demand in sub-Saharan Africa (SSA). However, little is known about the geo-spatial potential of solar-based PV pumping for irrigation taking into accounts not only solar radiation but also the availability of water resources and linkage to markets (Roy et al.,1996).

2.1.3. Solar water lifting in Ethiopia

In Ethiopia, motor water pumps are used commonly. But they have higher operational costs including for fuel, oil, labor and maintenance solar water lifting pumps are a promising alternative that could lower costs for farmers because they have relatively lower operational costs in addition to contributing fewer carbon emissions and pollution, The Livestock and Irrigation Value chains for Ethiopian Smallholders (LIVES) project in collaboration with the International Water Management Institute (IWMI) has commenced the demonstration of solar water pumps with pilot households in Oromia and the Southern Nations, Nationalities and Peoples' (SNNP) regions which makes smallholder (Lives project report, 2010).

In early December 2015, the solar water pumps were installed and demonstrated for selected households in Gamo Gofa and East Shoa Zones of the SNNP and Oromia regions respectively. The households, which were selected based on their access to shallow groundwater, interest in adopting the technology and previous experiences in household-based micro-irrigation, were briefed on the proper operation and minor maintenance services of the solar water pumps (Amenti *et al.*, 2016).

2.1.4. Solar water lifting technology in Amhara region

Since most rural areas are far from the electric service in the Amhara Region, most hand dug wells, shallow wells and boreholes are equipped by hand pumps or diesel and petrol driven generators. The drawbacks of hand pumps are first, the energy they require from women, lack of additional services and, the frequent touch of the hand pump by human leads to disrepair of the system. In addition, diesel/petrol pumps have many drawbacks such as high running and maintenance costs, unreliable supply of fuel, and poor availability of spare parts as describe above for Kule locality in Harbu Woreda. Therefore, it is important to look for and try other sources of renewable energy such as solar, wind, and mini-hydropower (Water Aid, 2010).

2.2. Benefits of Water lifting technology for women

2.2.1. Time saving

According to Likimyelesh et al. (2017) study, the solar water pump users indicated that the technology saves time and can be used for other purposes. Additionally, most respondent's using solar pump technologies mentioned that the technologies eased their domestic work (for cooking, washing, bathing and others) and livestock watering, as it saves them labor and time required to bring water from other sources. Oxfam and UNSCO (2015) entitled 'water for women every woman counts. Every second counts' that confirms time saved due to fetching water is having a ripple effect on women's lives, and this study also confirms the time lost due to water collection, is time NOT spent carrying out income generating activities, caring for family members, attending school or simply looking after women's needs and aspiration. The impact water has on women's time can start as young as five. In many cultures, as soon as they are able to carry the canisters, they will spend hours each day fetching water with their mothers.

Water fetching time has been lost; holding women back from having equal opportunities and from reaching their potential. The inter linkages between the development agendas for water availability and gender equality, in particular women's empowerment must be recognized and we need to work together to enable women to get their time back. Increasing women's access to clean water can free up to hundreds of hours annually that they can instead devote to more valuable pursuits such as strengthening families and communities, earning a living and leisure. (UNSCO ,2007)

2.2.2. Work burden reduction

FAO (2016) stated rural women simultaneously manage triple responsibilities at work within the household and at community level. Introducing women friendly improved water lifting technology reduces drudgery. FAO (2018) discovered that closing the gap in women's access to a broad range of technologies could help free their time for more productive activities.

similarly, the study by UNSCO (2015) stated Women represent 40% of the global labor force, yet in Sub Saharan Africa 40 billion working hours (equivalent to a year's worth of labor by the entire workforce in France) are lost every year to water collection.

The study conducted by Jemimah et al. (2015) and Amleset (2011) examine the effect of the supply of water lifting technology on intra house hold power relation even if women's participation in decision making and as water resource managers is uncommon, household water provision has create more opportunity for women for decision making ,women's access to and ownership of irrigation pumps, and the implications on their ability to make major decisions on crop choices and use of income from irrigated crops.

2.3. Solar powered water lifting technology for house hold welfare

2.3.1. Food

Experience show that home based agricultural (backyard farming) practice play multiple role for the family in general and women in particular. It accounts for significant amount of home consumption. Besides consuming backyard products at home, many women sell their products at the local market and use the money generated to fulfill some needs of the family, especially those of children. Moreover, it is the only means of income for thousands of poor and marginalized women. The Practice is specially play significant role for women headed households (Tonda,2015).

According to Likemyesh (2016) finding as Investment in individual smallholder irrigation technologies can be a viable means to sustainable intensification that benefits women and men smallholder farmers through double cropping of fruits and vegetables. FAO(2018) noted that the feminization of agriculture offers a series of opportunities for increased agricultural mechanization at farm level and in the agri food value chain that are economically, environmentally and socially sustainable. As Van (1998) it is assumed that with access to water resources for agricultural production, women can leap “from subsistence to marketing farming” contributing to rural development Women play pivotal roles in subsistence and market gardening, animal husbandry; food processing, waste recycling and (re)use.

2.3.2. Income

According to Likimyelesh et al.(2017) study back-yard gardening is the best opportunity for women to generate income and as per those studies illustrated the women also re invest their income for house hold needs especially for the children wellbeing. As Rathgeber (1996)

Women's participation in decision making and as water resource managers is uncommon. Because of the traditional attitudes and beliefs of the society, Household water provision is still a female responsibility in most African societies, especially in the rural areas. It is assumed that with access to water resources for agricultural production, women can leap "from subsistence to marketing farming" contributing to rural development.

2.3.3. Health improvement

Manual material handling tasks may expose workers to physical risk factors. If these tasks are performed repeatedly or over long periods of time, they can lead to fatigue and injury (Cal/OSHA Consultation Service, 2007). Closing the gap in women's access to a broad range of technologies could help free their time for more productive activities (FAO, 2018). According to the report of Asian Development Bank (2015) In rural areas water is mostly fetched by women and sometimes by adult children, for long distances .in this regard Oxfam (2015) noted that More and more communities around the world are forced to survive with limited or no access to clean water, and the burden of collecting water usually falls on the shoulders of women and girls. As it has been pointed out by UNESCO (2015) One in four girls does not complete primary school compared with one in seven boys

2.3.4. Change in power relation

Women Empowerment is an active multi-dimensional process, which would enable women to realize their full identity and powers - in all spheres of life. It would consist in providing greater access to knowledge and resources, greater autonomy in decision making, greater ability to plan their lives, greater control over the circumstances that influences their lives and freedom from the shackles imposed on them by custom, belief and practice (UNFPA, 2005).

According to Ghadoliya (2006) there is also evidence to show that time saved is reallocated to activities that might have a transformative effect on gender relations in a household, such as participation in market work, increased decision making power and control over resources and increase access to information pointed out as a result of women getting sufficient time. Women's participation in decision making and as water resource managers is uncommon. Because of the traditional attitudes and beliefs of the society, Household water provision is still a female responsibility in most African societies, especially in the rural areas

2.4. Challenges women faced in using the SPWLT sustainably

2.4.1. Affordability

The initial investment involved was excessive for rural water schemes, more than 150,000 US dollars, but included :-shallow well (~60m), the solar panels, the DC/AC inverter (converts DC to AC), submersible pump (~1.5 to 2 kW) with stainless steel casing, two imported glass-reinforced plastic (GRP) tanks of 6000 liters capacity each, a cattle trough, a shower stall, and clothes-washing basin (Seifu *et al.*, 2011).

Similarly, Misrak *et al* (2015) stated the initial cost of PV systems is high, but the maintenance, operation and replacement costs are lower. In addition, there is no energy cost needed in PV system and as a result the present cost of PV systems is much lower than the diesel-powered system. Its lower operation and maintenance costs, the longer expected useful life as well as the higher reliability of PV systems could make the system more suitable for remote areas. Letarik (2016) which states farmers also note that the solar water lifting technologies have some limitations, which could affect the use of these technologies and adoption by other farmers, the technology is expensive which makes it less accessible for women especially, who have less resources to rent or buy.

2.4.2. Absence of energy storage mechanism

As Likimyelesh, *et al.* (2017) Constraints of using drip irrigation technology evaporation, water scarcity and the risk of using the technology. the technology to be dangerous to use because a farmer must use a ladder to fill water tanks mounted on a roof for solar pump users the absence of a mechanism to store energy that would enable longer use when there is less sun is a major constraint

2.5. Theoretical Framework

This study is exploring the benefits and challenges of solar powered water lifting technology for women and accordingly the finding of this study is inductively integrated with the existing major feminist theories. There are many feminist theories, which explain the root cause of gender inequality and women's subordination. Feminists attempts to develop a comprehensive account

of the subordination of women, including their supposes, essence and origin. Each perspective has made important contributions to improving women's status. The main point feminists have stressed about gender inequality is that it is not an individual matter, but is deeply ingrained in the structure of societies (Lorber, 1999).

Theoretically, liberal feminism claims that gender differences are not based in biology, and therefore those women and men are not altogether that dissimilar, their common humanity supersedes their procreative differentiation. If women and men are not different, then they should not be treated differently under the law. Women should have the same rights as men and the same educational and employment opportunities. Their activist focus has been concerned with visible sources of gender discrimination, such as gendered job markets and inequitable wage scales, and with getting women into positions of authority in the professions, government, and cultural institutions. Liberal feminist politics took important weapons of the civil rights movement, antidiscrimination legislation and affirmative action, and used them to fight gender inequality, especially in the job market (bid.).

Liberal feminists argue that the society has a false belief that women are by nature less intellectually and physically capable than men. This perspective seeks to level the playing field that would allow women to seek the same opportunities as men, especially the opportunity to excel in various fields. Modern liberal feminists argue that patriarchal society fuses sex and gender together, making only those jobs that are associated with the traditionally feminine appropriate for women (Pasque, 2011). Many liberal feminists explain women's exclusion or inequality with reference to ideas of female inferiority or incapacity that inform the upbringing and education of both men and women (Welch, 2001).

According to feminist theory, a just society is a society that allows individuals to exercise their freedom and fulfill themselves. The society excludes women from many opportunities and the true potential of women goes unfulfilled because it has the false belief that women are by nature less intellectually and physically capable than men. Liberal feminists argue that women share the same rational human nature men do, and so should be given the same educational opportunities and civil rights as men are given. The goal of women's liberation is freeing women from oppressive gender roles that is achieving sexual and gender equality (Tong, 2009).

Likewise, the finding of this study revealed that due to the patriarchal thinking of the society, women's have a triple burden and they invest most of their labor and time for reproductive activities. And as this study finding ,collecting water is mainly a women's role, the introduction of this improve solar powered water lifting technology helped the women to save their time, to reduce work burden and to improve their health with respect to drudgery reduction consequently this benefit had also a direct effect on women to engage in IGA and the introduction of this new and improved water lifting technology offer the promise of considerable benefits and helped them to reallocate their time and labor to activities that have a transformative effect on gender relations in a household. Therefore, the above-mentioned finding of the study is directly related to the argument of liberal feminist.

CHAPTER THREE

3. RESEARCH METHODOLOGY

3.1. Description of the study Area

According to Haimanot (2015) Dangila is one of the seven districts in Awi zone with an area 772.3 square kilometer, It is known to be the fourth largest in the zone with respect to its area coverage. Its border linked in East with Mecha district (West Gojjam), in West direction with Jawi district, south with Fageta Lekoma (Adis kidam) district and to the Northeast direction with Achefer district (West Gojjam). The capital city of Dangila district is Dangila town and located 38 kms from Awi zone, town Enjebara, 78kms from Amhara region city Bahir Dar and 475kms to the Northwest from Addis Ababa, the capital city of Ethiopia. The district has 27 rural kebele² administrative and six-urban kebele administrative. The district has largely Orthodox Tewahedo Christian believers' residential area and small numbers of Muslim followers live since its establishment after 1928 Italian invasion still now.

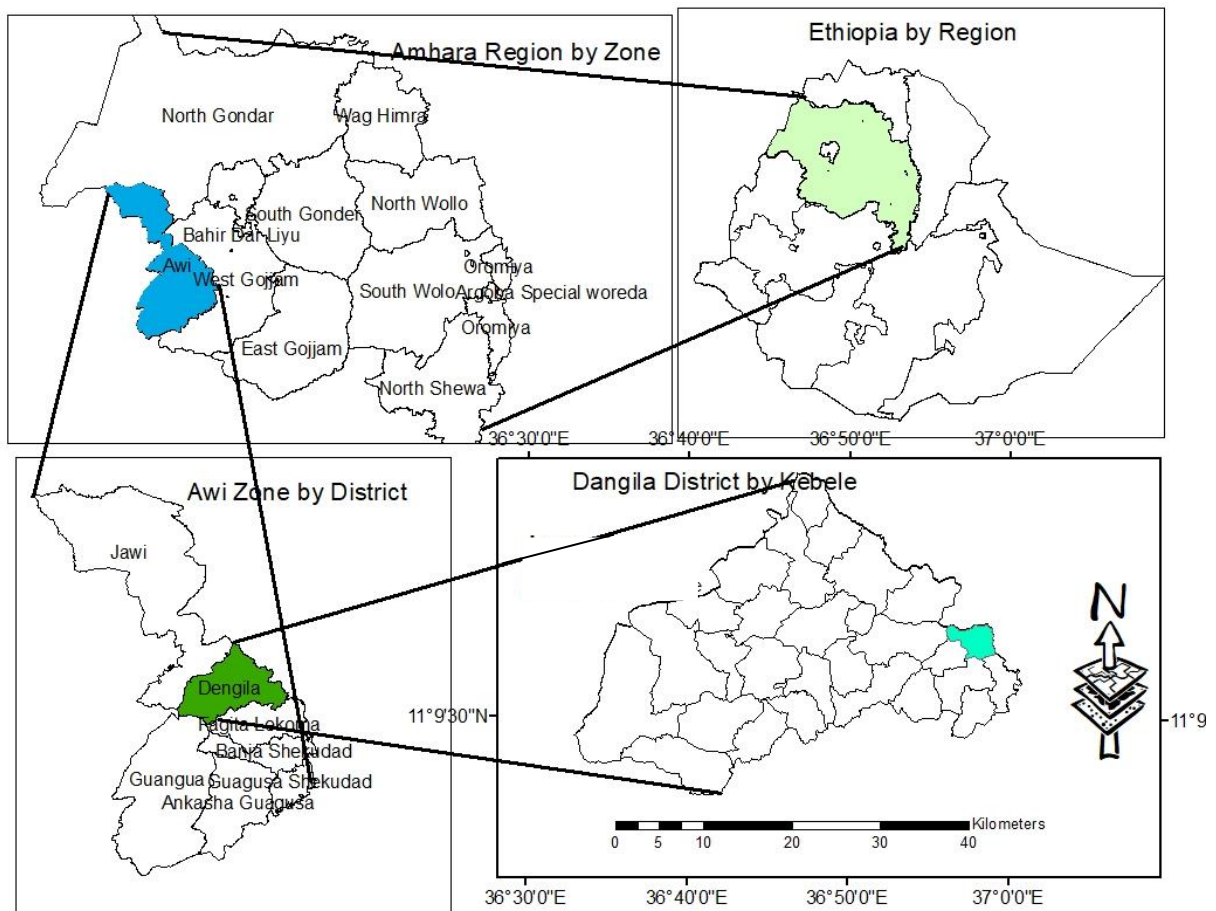
Based on 2007 population and house census and 2009/10 ANRS sample survey report projection results, about 190,943 people was expected to live in Dangila district. Among those, 94,160 were predicted to be male (49.3%) and 96,783 (50.7%) to be female. In addition, the prediction results indicated that, 155,466 (81.4%) people expected to live in rural areas (Bazew, 2012).

Dangila has a high solar energy potential, where average solar energy is between 5.12 KWh/m² per day in July to 7.0 KWh/m² per day in April, and the daily average of solar radiation intensity on horizontal surface is 6.1 KWh/m² per day while the average sunshine hours ranges from 4 hours in July to 8.96 hours in January and for the irrigation periods it is more than 7 hours (Muluken *etal.*, 2017)

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The population density of the district is about 247.3 people per kilometer. The economically active population (15-64) years of age accounts 51.8% of the total population. In terms of traditional agro ecology classification, the district can be categorized mainly into two Agro ecological zones; Woina Dega (middle altitude), which mask large about 86 percent of the total land mass, and 22 rural kebeles and all urban kebeles, and the Kola (low altitude), which covers about 14 percent of the total land mass and 5 rural kebeles. The district annual rainfall ranges from 700- 1200mms and annual temperatures ranges from 16-35 0c as the information obtain refers (CSA, 2007).

Fig1. Map of the study area



Source: Google map

3.2. Research Methodology

Mainly research approach selected depends on the number of samples which I have in Dangila district Dangeshta keble, As Moriarty, (2011) stated that qualitative research provides an in-depth and interpreted understanding of the social world of research participants by learning about their social and material circumstances, their experiences, perspectives, and histories. Mulatu (2007) also added qualitative research methods are the most appropriate means of exploring women's views of their experiences and reality. Unlike quantitative studies that are concerned more with issues of frequency and distribution, qualitative research is rooted in the perspective of participants and their subjective meanings. The approach also explores and explains the hidden and invisible issues of women.

3.3. Research Design

Case study research design is most appropriate in this case because the researcher is aimed at identifying the benefits and challenges of solar powered water lifting technology for women. According to Denscombe (2007), case study approach works best when the researcher wants to investigate an issue in depth and provide an explanation that can cope with the complexity and subtlety of real-life situations. Case studies have been used for a wide range of purposes within social research. Predominantly, they have been used in relation to the discovery of information (following an inductive logic). Case study is an excellent method for obtaining a thick description of a complex social issue. It offers rich and in-depth insight that no other method can yield (Dornyei, 2007). In addition to that, case study displays a high degree of completeness, depth of analysis and readability, and they are effective in generating new hypothesis, models and understanding about the target phenomena.

According to Zainal (2007) Case study research allows the exploration and understanding of complex issues. It can be considered a robust research method particularly when a holistic, in-depth investigation is required. Recognized as a tool in many social science studies, it enables a researcher to closely examine the data within a specific context. In most cases, a case study method selects a small geographical area or a very limited number of individuals as the subjects of study. This is therefore Case study research design is more relevant to undertake this research

in its true essence and to explore and investigate contemporary real-life phenomenon on the benefits and challenges of solar powered water lifting technology for women.

3.4. Sampling Techniques

The rationale why the researcher chooses, Dangila district Dangesheta Kebele as focus areas for this study is because the technology is distributed in this specific area by the support of BiT ASMC project. The participants in this research included were, eight SPWLT women beneficiary for semi structured interview, I end up my interview with eight women due to my data is saturated, and for FGD seven women from the selected beneficiaries participated as per their availability and purposively six men (two from field worker and data collector for the ASMC project, two of them are husbands of women SPWLT beneficiaries, one from Dangesheta kebele administrator and one researcher from BiT) were involved in key informant interview.

The researcher explored the benefit of SPWLT in relation to their time saving, work burden reduction, health improvement, income, power relation and tried to identify the hindering factors women faced while using the technology. So, to assess those prime issues, the researcher was motivated to conduct a research on the study site in the light of women's benefit and challenge.

In this study, the list of solar water lifting technology users were obtained from BiT - ASMC project document. In doing so, the researcher used the current census data. In the first stage, Dangila district and Dangesheta Kebele were selected purposively and based on data saturation eight women were undertake interview. On the other hand, the participants based on availability one FGD with seven focus group discussants were held while purposively six key informant interviewees were used for this study. The rationale using purposive sampling is, it is helpful to obtain adequate information and enabled me to understand the central phenomenon of the study. Key informant interviewees were selected from SPWLT beneficiary's husband, kebele administrator and ASMC project implementers and BiT researcher on SPWLT as a source of relevant data for this study.

3.5. Data Sources

Regarding to data sources, the researcher used primary data to obtain relevant first-hand information for this study. And this primary data source was obtained from interviewees, key informants and from focus group discussants.

3.6. Data Collection Instruments

This study was employed different data collection instruments. These instruments are discussed as follows: -

3.6.1. Semi-Structure Interview

One of the data collections instruments that the researcher used to collect information relevant to meet the objectives of the research was semi-structure in-depth interview. The reason in-depth interview was selected is that it provided an opportunity to investigate to question thoroughly certain areas of inquiry and it permits greater of responses. According to Gorra (2011) even if interview is time consuming to conduct and analysis. The researcher conducted in-depth interview for the purpose of exploring the benefits and challenges of solar powered water lifting technology for women.

3.6.2. Focus Group Discussion

The researcher also used focus group discussion as instrument of data collection. Gillham (2000) highlighted that FGD using semi-structured questions allows researchers to look more deeply into the research issues and develop new lines of inquiry that arise during interviews. . Likewise, Casey and Krueger (2000) argued that group discussion allows sensitive issues to be more freely discussed in groups when an individual would not wish to discuss them alone with a stranger

Most importantly, Campbell (2005) described as a focus group is a planned, facilitated discussion among a small group of stakeholders designed to obtain perceptions in a defined area of interest in a permissive non-threatening environment. The researcher employed FGDs to triangulate the unclear ideas and information related to the subject under study. Another reason why the researcher was conducted focus group discussion was because the use of multiple data collection instruments enabled the researcher to crosscheck the data collected from the

interviews and were also help to validate the findings. The focus group discussion was conducted in a non-threatening environment by which those participants had a trust on the researcher and each other.

3.6.3. Key Informants Interview

To get relevant data for this study, the researcher was used key informant interview. There are rationales to use this data gathering tool. It provided vital information directly from knowledgeable/professional people. Furthermore, this type of data gathering tool is flexible to explore new ideas as well as issues was not anticipated during planning. In addition to this, it resembles a conversation among acquaintance, allowing free flow of ideas and information. Moreover, it provided in-depth information about topic of interest, allows clarity of ideas and information as well as it can easily combined with other techniques.

In line with this, (Kumar,1989) stipulated that key informant interviews involve interviewing of knowledgeable individuals who are likely to provide the required information, ideas and insights on a particular subject. However, such individuals were identified carefully. Attempts to explore facts on the ground makes it a rational approach to include key informant interviews by involving selected group of individuals who are likely to provide needed information, ideas, and insights on the proposed research. Taking the above concepts into account, interviews were conducted among key informants that allowed the researcher collect data.

3.7. Data analysis techniques

Cresswell (2003) copes that data collection and data analysis must be simultaneous processes in qualitative research. Data analysis is an ongoing process taking place throughout the data collection process. The data collected from semi structured in depth interview, key informant interview and from focus group discussion were organized based on the objective of the study and analyzed through thematic analysis. Qualitative data analysis primarily entails classifying things, persons and events. Qualitative data analysis is an ongoing process involving continual reflection about the data, asking questions and writing memos throughout the study. The researcher made detailed description of the setting or individuals, followed by analysis of the data for themes or issues.

The researcher employed thematic data analysis and the generic steps followed in this qualitative data analysis are as follows.

Step 1: The data were collected through semi structured interview; FGD and KII which was conducted and collected in Amharic language are translated into English language.

Step2: The researcher organized and prepared the data for analysis. By transcribing interviews, sorting and arranging the data in to different types depending on the sources of information.

Step 3: The researcher has read all the data carefully to get a general sense of the information and reflecting on its overall meaning. And also, the researcher summarized what general ideas are said by participants, what the tones of their ideas were, what the general impression of the overall depth was, and credibility and use of the information from the literature or theories

Step4: After that, the researcher has begun detailed analysis with a coding process. These involve the process of organizing the material in to portions before bringing meaning to those masses. And it involves taking text data, segmenting sentences (paragraphs) in to categories and labeling those categories with a term.

Step 5: Then the researcher used the coding process to generate a description of the setting or categories to themes for analysis. The researcher has given codes for these descriptions. Then the researcher used the code to generate a small number of themes or categories. These themes are appeared as major findings for my studies and stated under separate headings in the finding sections.

3.8. Trustworthiness

Quantitative research relies on measures of reliability and validity to evaluate the utility of a study, but qualitative research can be evaluated by its trustworthiness. According to Alexander (2004) this term is used to represent several constructs, including credibility, transferability, dependability and conformability. The truth-value or credibility of the conclusion of the research was scrutinized through the following questions including; do the conclusions make sense?; do the conclusions adequately describe research participants' perspectives?; and do conclusions authentically represent the phenomena under study?. Transferability seeks to determine if the

results relate to other contexts and can be transferred to other contexts. Dependability refers to whether or not the results of the study are consistent over time and across researchers. Conformability assumes that the findings are reflective of the participants' perspectives as evidenced in the data, rather than being a reflection of my own perceptions or bias.

Therefore, to ensure the trustworthiness of the data, the researcher used easy and simple language and description to describe the findings and to enhance the credibility of the research the researcher held on triangulation. Triangulation involves the use of different data collection methods, especially semi structured interview, key informant interviews and focus group discussion. The researcher was also present results to participants during a concluding interview.

3.9. Ethical consideration

Before the study, official approval to conduct the study was obtained from Department of Gender and Development studies of Bahir Dar University. Permission was obtained from BiT and Dangesheta Kebele administrator. Participants of the study were included in the study only when they give informed consent. The purpose and significance of the study also be described for the study subjects, and study participants were informed as their information would be kept confidentially

3.10. Limitation of the study

This study represents an initial attempt to explore the benefits and challenges of solar powered water lifting technology for women and dig out the benefit women gained as a result of the supply of this technology, investigate the contribution of this SPWLT for house hold welfare. Further this research explored the hindering factors women faced while using the solar powered water lifting technology and proposed challenges for sustainability. This study has the following limitations. First, lack of recent secondary source of documents. And to get sufficient information about the amount of income they earn as a result of this technology intervention, the women did not well recall back exactly. Despite these limitations, the credibility of the research is not compromised.

CHAPTER FOUR

4. RESULTS AND DISCUSSION

4.1. Results

This section presents the major findings of the study; it is organized in to four parts. The first part clearly explains the demographic characteristics of the research participants and historical background of water availability in the study area. The second part describes the benefits that women get from solar powered water lifting technology. The third part explains the contribution of Solar powered water lifting technology for house hold welfare especially in related to nutrition and income. The last section describes the hindering factors/challenges that women faced while using the solar powered water lifting technology and potential challenges for sustainability.

4.1.1. Participant profile

Table 1: Demographic characteristics of interviewee

Interviewees	Age	Educ. Status	Marital Status	Family size
Interviewee 1	55	literate	Married	9
Interviewee 2	35	Illiterate	married	7
Interviewee 3	50	literate	married	11
Interviewee 4	35	Illiterate	married	6
Interviewee 5	25	Grade 2	married	7
Interviewee 6	40	Illiterate	married	8
Interviewee 7	41	Illiterate	married	5
Interviewee 8	39	Illiterate	married	6

Among ten SPWLT women beneficiaries eight of them had participated in the semi structured interview. As indicated in table one, all women are married and having the highest and least number of families eleven and five respectively. Ages of the respondents from the least to the highest respectively ranged between twenty-five and fifty-five years. The highest educational status is grade two. Only the younger woman with an age of twenty-five started formal schooling.

The two older women attended adult education program where as from age thirty-five to forty did not attend any formal education program.

Table 2: Demographic characteristics of focus group discussants

ID NO	Sex	Age	Educ. Status	Marital Status	Family size
FG 01	F	55	Adult literacy	married	9
FG 02	F	35	No	married	7
FG 03	F	50	Adult literacy	married	11
FG 04	F	35	no	married	6
FG 05	F	25	Grade 2	married	7
FG 06	F	40	No	married	8
FG 07	F	41	no	married	5

Based on their availability sampling seven SPWLT women beneficiaries participated in focus group discussion. Table two showed the demographic characteristics of focus group discussants' such as age, educational status, marital status and family size. As indicated the table, highest and the least age of the focus group discussants were fifty-five and twenty-five respectively and the second, fourth, sixth and seventh focus group discussant did not attend any educational program and this indicated that the majority of them are illiterate. Only the fifth participant who was younger started elementary school, where as the first and third FGD participants attend an adult education program that is basic numeracy and literacy. As it has been revealed from table two, all of the women are married. With regarding to family size, they varied between five and nine.

A total of six men participants was involved in key informant interview session (one field worker, one previous data collector, two husbands of solar powered water lifting technology beneficiary women, one researcher from Bahir dar institute of technology and one Kebele administrator). Although they all were from different areas of work, it was improved that they have an indirect or direct attachment with water lifting technology women beneficiaries.

Concerning the educational status of those key informants, there was great variation from no educational attainment to PhD fellow. The field worker and previous data collector completed grade ten, Kebele administrator dropped out from grade 8, the two husbands did not attend any

formal education program, and the researcher was PhD fellow, who was researching on solar powered water lifting technology and drip irrigation by conservation agriculture.

Table3: Demographic characteristics of key informants

Key Informants	Sex	Age	Position	Educ. Status	Marital Status	Experience with SPWLT beneficiaries
KI 1	M	42	Field worker	10	Married	3 years
KI 2	M	37	Previous data collector	10	married	2 years
KI 3	M	40	Husband of SPWLT beneficiary	no	Married	Husband
KI 4	M	45	BiT researcher	PhD fellow	Married	3 years
KI 5	M	42	Husband of SPWLT beneficiary	no	Married	Husband
KI 6	M	40	Dangesheta Kebele administrator	8	Married	4years of experience as Kebele leader

Regarding the age it was not as much varied like their educational status, it was ranged between thirty-seven to forty-two. All of the respondents were married and had different relation with solar powered water lifting technology beneficiaries as the table indicated on table three.

4.1.2. Major findings of the study

BiT in its appropriate scale mechanization project provided this solar powered water lifting technology for free to support the women smallholder farmer. The technology is easily movable and the women can use easily and their water source is near the farmers' household so that it is enable for multiple uses in addition to irrigation. The farmers did not participate in larger irrigation schemes or establish user groups, but operated individual technologies on own plots. Most of the research participant did not practiced irrigation before Bahir Dar university institute of technology introduced this solar powered water lifting technology. While a few of them were have prior experience on irrigation by using water from river or wells

Table 4. Summary of major finding of the study

No		Team identified	Sub team identified
1	The benefits of SPWLT for women	Time saving	Reducing the time spent in performing their task
			Changes in ability to perform another task
			Transformative effect on gender relation
		Work burden reduction	Change in women role
			Change in power relation
		Health improvement	Avoid whist, hand and shoulder exhaustion, minimize stress
2	SPWLT for Hold Welfare	Food	Change availability of food for home consumption
			Change availability of food item for marketing
			Change in Stored food
		Income	Sources of Income
			Amount of income
			Re-investing the income
			Who control over and decide on income
3	Challenges	Design	Absence of energy storage mechanism
		Dissemination	Affordability,
			Inaccessibility of the SPWLT technology, spare part, and maintenance service
		Environmental	Lack of water source in the dry season
cultural barriers	Less decision-making power women on cultivation land plowing is male dominated activity Miss conception about drip irrigation/irrigation Gaps in realizing the benefit b/n Men and women Assumption of additional work burden		

As we can see from the above table, time saving, work burden reduction, health improvement are the direct benefit women received from the introduction of this SPWLT while change availability of food for household food consumption and for market, diversification of their income source are the other benefits women got through the supply of SPWLT. In addition, as we can understand from table 4 even if this SPWLT has delivered significant benefit for women, it has also some challenges that has the potential to hinder the women to benefit sustainably.

4.1.3. The benefit of solar powered water lifting technology for women

Since women have triple responsibilities at household like taking care of children, elders and sick member of a family, preparation of food, collection of fire wood, fetching water, washing clothes, going to mills. Except plowing the women participated in major farm activities like land preparation, planting of seeds, adding different fertilizers and compost, weeding, harvesting, threshing, transport of their produce from farm to home, post harvesting activities like keeping the agricultural product in clean areas, drying, and adding insecticide. Women also involved in marketing processes such as selling of small sized crops or vegetables and buying of small items based on the demand of their family for daily uses. In addition to the above-mentioned activities, the respondents confirmed that they are also involved in different community-based tasks especially in preparing foods and fetching water when their neighbors have a special program. When considering the multitude of tasks those the research participant women perform using limited tools, it is obvious that the introduction of new and improved technologies holdout the promise of considerable benefits not only to women but to the family members as a whole.

Solar powered water lifting technology is a photovoltaic water pumping system and it is one of the best technologies that utilizes solar energy to pump water from different water sources. Similarly, with most areas of the Amhara regional state, there is an availability of abundant solar radiation and enough underground water sources in the study area of Dangilla district. Considering this natural opportunity, the researcher confirmed that the solar powered water lifting technology is viable for this community. The researcher asked those research participants about the benefit they obtained from solar powered water lifting technology. According to the response of the research participants from KII, FGD and interviewee the different benefits that women and the whole family recognized are summarized below and all of them described with direct quotes of the participants and accompanied with rigorous interpretation. To this end, the

major themes are time saving, work burden reduction, health improvement, transformative effect on gender relation. In line with these major themes, sub themes are also identified just for the sake of understanding the benefits of solar powered water lifting technology for women in a very clear manner.

4.1.3.1. Time saving

According to the finding of this study, the major benefit that the women gain from the solar powered water lifting technology is saving a significant time in their day today life. As the research participant clearly described for the researcher about their daily activity in their life from the time they wake up in the morning until they went to bed at night, they faced with different responsibility of household chores, farm work, community responsibility and market exchange so on average those research participant spent fourteen hours per a day and they expressed lack of time as a major constraints in their life. On average they can save around one hour per day due to the supply of this solar powered water lifting technology and this saved time and has different contributions on their life like reducing the time spent in performing the household tasks, changes in ability to perform other task, and providing a transformative effect on the women daily life.

A. Reduce the time spent in performing the tasks

Based on the result of the study the solar powered water lifting technology helped them to save a significant amount of time in their day today life. Most of the participants confirmed that due to the fewer time needed to lift the water by the solar water lifting technology for their domestic activity, irrigation and for their livestock, watering is a very short path and use insignificant labor. It reduces the time spent in performing their tasks: in relation to this, a twenty-five years old woman in-depth interview participant described her experience as follows:

.....Before I got this solar powered water lifting technology I was lifting water from the well using bucket pulling with rope and pulley , and it took more than two hour and I were also get tired to do the next activity but now with in less than five minute I connect the solar panel and lift enough amount of water with short period of time. To fill a five hundred litre of tanker it does not take more than fifty minutes and if I connect it within five minutes it does not need my presence. I only monitor whether the tanker is filled or

not, and at the same time I did other activity like cooking food, washing clothes and house hold equipment, cleaning the house, showering of my children, a local alcoholic drink 'Areki' preparation, livestock watering or irrigation. Within a short period of time to get enough amounts of water and it motivates us to keep our sanitation..... (Interviewee 5)

Furthermore, focus group discussants strengthened this issue by saying:

This technology eases our burden for our local drink called 'Tella;' and 'Arekie' preparation because it needs to much amount of water, especially on the holidays and in case of any social ceremony /gathering /that we prepare, we need more water for the local drink and now thanks to God with in short minute this solar water lifting technology helped us to lift enough amount of water..... (FGD5)

The above explanations of the interviewee' and focus group discussants showed how the time saved due to the access of solar powered water lifting technology helped them to reduce the time spent in performing the tasks. And it indicated that water is a women issue, and they are the ones who are most involved in drawing and transporting water to their home and storing it until used for house hold activities (for cooking, cleaning, washing, watering household animals). In addition to this, it is possible to understand that women are the main guardians of household cleanliness and the caretakers of the children. As it has been understood from the explanations of majority of the tasks the women accomplished at and around their home, they fetch water using a solar powered water lifting technology which lift water with a short period of time and helped them to reduce the time spent in performing other tasks like cooking cleaning, washing, and watering household animals.

B. Changes in ability to perform another task

As the information collected from Interviewee, KII and FGD participants showed below, the time saved due to the access to solar powered water lifting technology helped them to change their ability to perform other tasks. Those in-depth interview participants, focus group discussants and key informant interviewees explained that due to the need of a little time for the solar powered water lifting technology, almost all of them expand their irrigated land and give enough amount of water for their livestock and they are also motivated to produce frequently

more local alcoholic production called “Arekie” for their IGA and due to the water access they are keeping their sanitation better than in the previous case. Relating to this, thirty-five years old in-depth interview participant described as follows:

...now because of the technology I expand the irrigated plot and planted different types of vegetables such as onion, garlic, potato, cabbage, green pepper and I irrigate enough amount of water for the vegetables so that I can get an additional income, vegetables for household consumption when compared to last year...(Interviewee 2)

In addition, another twenty-five-year-old in-depth interview participant explained her experience as follows:

.... now I tried to plant and grow different types of vegetables since I got the solar powered water lifting technology. I am happy while I visiting my garden. I have got extra time to care my children, to feed my kid, to prepare food, and properly wash my children's clothes. This year I can serve my spiritual life even for one month, because my husband by himself can irrigate the land and fetch water for household consumption since this technology does not need too much time and labor.... (Interview 5)

Similarly, another forty-two years old key informant interview participant has supplemented the above-mentioned ideas as follows:

.....due to this, solar powered water lifting technology eases the women task of fetching water;, some of them started irrigated activity newly by the help of this solar powered water lifting technology, and the others even if they had prior experience in irrigation they were not get such kind of benefit because due to the prior technology of water lifting needs significant time and labor they did not irrigate properly but now they did it and do more production and income, and even this technology helped the women to watering of more water for their fattening and diary animals. This additional income helps for the women to buy whatever she needs, before this they were sold some maize or they are asking their husband to get money for house hold daily costs. (Key informant interview 1)

Furthermore, key informant interviewee strengthened this issue by saying:

They saved significant amount of time per a day, at least they saved one hour per each day, and minimize stress and work burden, they were feel unhappy when they go to the water source, and they get additional income and more vegetables for house hold consumption, they reduced their drudgery and physical weakness, create smooth relation between family members, the women get more exposure for market, and she gets the opportunity to decide on the benefits of her back yard gardening, and she re invest the income as per her interest and feelings, the community around this locality get motivation on using different water lifting technology(Key informant 2).

From the above quotation, It is possible to understand that the time saved due to this solar powered water lifting technology have a direct and indirect impact in change in ability to perform other tasks like to start and expand their irrigation plot, and get good vegetable production, to increase the frequency and amount of local drink production for their own IGA , to watering of enough water for their diary and fattening cows, to properly keep their house hold sanitation, and indirect benefits like getting income and exposure to market.

C. Transformative effect

Although gender discrimination can disadvantage both women and men, in every society, there are deep rooted attitudes and beliefs about women's and men's roles in society. These beliefs view women as inferior, less competent or less valuable than men and lead to practices that discriminate against women and Women most frequently experience its effects and prevent them from enjoying the same opportunities as men. As the data from the research participant collected showed, because of the solar powered water lifting technology saved significant amount of time and changes the ability to perform other tasks and this leads to reallocate to activities that have a transformative effect on gender relation. In light of this, a forty years old key informant interviewee described his observation as follow:

...I observe that as compared to last year my wife gets some leisure time, and she has now some money on her hands, even sometimes I asked her to give me some money for some purpose.... (Key informant interview 6)

Within a similar phenomenon, the following forty two years old key informant interviewee also described as follows:

Based on my observation, the women are creating job for themselves and earning income from the sale of vegetables, exercising, controlling and making decision on the money, initiating to diversify their livelihood options. They have also got an experience on backyard gardening and vegetable production and developed skill and knowledge on irrigated farm production as to how and when seeds will be planted and about the overall management of irrigated farm, even their children apply such knowledge and motivation on irrigated farm production because the benefit is very attractive and they see the practical experience of producing and collecting products three times a year at the same plot of land. Women's communication skill has been also improved. They were asking me a lot of questions when I go to their home for supervision. One of the women classify the irrigated farm land and give for her children so that each child takes care of their vegetables so that they used the income from it for their educational material and cover every cost. (Key informant interview 1)

The above explanation approved that the time saved due to the solar powered water lifting technology has helped them to reallocated to activities that have a transformative effect on gender relations in a house hold that the women increase their participation in the market and getting income, increase their decision making power and control of resources like(their solar power water lifting technology and their irrigated land) ,have an increased access to information and strengthen their relation with husbands' and children.

4.1.3.2. Work burden reduction

When comparing urban women, rural women have multiple responsibilities like collection of fuel wood and water, cooking, care work, farm land preparation, cultivation, harvesting, post harvesting, and transporting field crops, marketing and accomplished those activities in a traditional way such as pulling up a bucket full of water, carrying large amount of water on their back and shoulder, cooking on traditional open fires using traditional biomass or charcoal as fuel, looking after family while simultaneously undertaking essential domestic and productive tasks. Manual land preparation, digging and weeding with simple tools and following traditional

labor-intensive practices; often relying on local seeds. Simple manual tools (knives and sickles) which are often heavy and/or worn out, manual shelling, cleaning, drying and processing of crops; poor storage facilities and food packaging.

Travel on foot while carrying loads on their body and less infrastructure. Improvement of water supplies lessened the burden for women since pulling up a bucket full of water and carrying large amount of water on their back and shoulder are such a hard work for women. As the researcher understands from the majority of the research participant, women used manually operated pumps (hand) that extract water from surface and groundwater sources. The work burden reduction is manifested by different effects like effects of work burden reduction on women role and effects of work burden reduction on power relation.

Fig.2: while the women connected the solar panel with maji pump



A. Change women role

The study found out that the solar powered water lifting technology reduces the work burden of women to lift water for all purposes because this technology did not use any human power but solar energy, and as a result of work burden reduction for collecting water they are doing other tasks. In addition, the energy they conserve from unproductive tasks diverted to income generating activities, better child care and general increment in the wellbeing of the whole family. In related to this, those in-depth interview participant express their role at house hold in the farm and in community and describe the work burden reduction due to the supply of solar water lifting technology to their different day to day activities by providing water easily from

the nearest source. In light of this, a fifty-five years old interviewee described her experience by expressing her day to day works until she went to sleep at night as follows:

... In the working days of winter season (the off season of rain feed on farm activities) after completing the in-house activities such as cleaning, cooking foods and feeding my family members, always go to my irrigation farm and follow up it and do different agronomic activities like weeding, applying fertilizers/pesticides. In addition, I will check and strengthen the fence and connect the solar panel to the water pumping dynamo until filling the water tanker. At the recommended irrigation time (once in three days morning and evening) I irrigate the irrigation farm. After monitoring my irrigation farm, I give water for the cows and feed... (Interviewee 1)

Similarly, forty years old in-depth interviewee strengthen this issue by saying:

.....Preparing food, fetching water, washing cloth, cleaning the house including the animal dung taking care of children, going to market and grinding mill house at Dangila town, preparing local alcoholic drink called “arekie” and “tella” , supporting my husband in all the farm activities except ploughing is my responsibility .I have a controlling and decision making power on my kitchen item but almost the other thing is controlled by my husband. And all my duties directly need the presence of water, access of this solar powered water lifting technology support me to accomplish my role with little effort.....(Interviewee 7)

To strengthen this a twenty-five years old in-depth interview participant, express her experience as follows:

Before getting this technology, I had only big trees like mango & Gesho but I have planted and grow different types of vegetables after getting the solar powered water lifting technology. Now a days I am happy when visiting my garden. Manually Lifting water for domestic, irrigation and livestock watering purposes was one of the challenging activities which needs too much labor. But now thanks to this technology I can easily connect the solar panel and fetched enough amount of water, and even I did it when getting sick. This year by taking the water through plastic bottle it was

possible to prepare a land for threshing (Awudema lekilekenebetal) and also, I get the water easily to prepare a local drink called “areki” for my additional IGA. And my husband become happy because I give more time for him and stay on the farm for longer time because I fetched the water with short time and I will not be tried to do the next activity.... (Interviewee 5)

The above explanations of the interviewees’ told the researcher as how the women spend their day from the time they wake up until they went to sleep. The women have a reproductive and community responsibilities those they are undergoing in a very traditional manner. The researcher also understood that the reduction of women’s’ work burden due to solar powered water lifting technology in supporting every role of women and eases the work burden.

From the above explanations, it can be understood that though women who previously used to confine themselves to household boundaries have started doing irrigation and marketing outside their home, now they are facing additional burden because of their dual role as homemaker as well as bread earner. There are two scenarios; one is no of activities increased due to solar water lifting technology because they planted additional vegetables and they went to market frequently to sell their green pepper, they bought additional house hold utensils and the other is the work burden decreased due to this technology since they get the water easily for all purposes.

Figure 3: Women in their back-yard gardening



D. Work burden reduction and power relation

Achieving gender equality will not be feasible without closing the gaps between women and men in terms of capacities, access to resources and opportunities, and vulnerability to violence and conflict. The benefits of better water supply begin with saved time, less effort and enabled women to make choices. In line with this, forty-five years old women expressed her saying as follows:

From the above quotation, the researcher understood that the work burden reduction has indirect benefit in relation to gender aspect. The women are managing and controlling their irr*Now there is great change because in most time specially in the morning and evening I were stayed inside the farm to irrigate the plants since we did not address to water all the farm in a day. Previously, I were trying to irrigate the farm by dividing the land in to different divisions and each was taking one or two days so that in all my days, I will be in the farm. But now thanks to this technology I can address the entire farm within one day and I have got extra time to enjoy, to cook our food properly. The woman also respond strongly as ‘ ብብዛኛዉ ጊዜየን የማሳልፈዉ በማሳ ዉስጥ ነበር ዉሃ በመውጣት እና በማጠጣት , meaning I used to spend most of the day in the garden and pulling the bucket until my hand thumb get dried ’ but now thanks to God I can accomplish my work with in short period of time by little effort and now I expand my irrigated land and get income which is managed and controlled by me.*

igated farm land and income from it. In addition, there is a finding on the women as they are signed and took an agreement to get the solar water lifting technology. Some women also took on tasks which were previously carried out by their daughters thus enabling young girls to go to school.

4.1.4. SPWLT for House Hold Welfare

This part of the research presents how the solar powered water lifting technology contributes for beneficiary’s house hold welfare. The data that the researcher used to conduct this research were collected through in-depth interview focus group discussion and key informant interview.

Even if participants of the research mentioned different contributions of solar powered water lifting technology for their house hold welfare, this part of the research presents only the main contributions in which many research participants have raised.

4.1.4.1. Food

As per the findings of the study, the solar powered water lifting technology benefits the women by changing the usual food items with basic fruits and vegetables for their home consumption. The technology also enhanced them to have an increment on the amount of food they stored. They also confirmed me as the amount of food available for sale has been changed after using the solar powered water lifting technology.

A. Availability of food for home consumption

As the finding of the study showed, women in Dangishta Kebele have long working hours correlate to a triple work burden in the productive, reproductive and social spheres, and in contrast to men their work is mostly unpaid and unrecognized. The promotion and introduction of solar powered water lifting technology helped the women to increase the availability of food in their home consumption. In line with this, a woman with thirty-five years old in-depth interview participant stated that:

There is a significant change because for the last two months of Easter fasting, we were eating cabbage, salad, garlic, karotin most days. Before we got this technology most of the time, we were planted red pepper and garlic, but now different variety of vegetables, and I only sold the pepper and garlic which left over from home consumption. But In previous years that is before getting the technology, we all were eating Enjera with Shero wote during the fasting season which was not interesting. “ከዚህ በፊት እንደዚህ እንደምታይዉ ጎመን፣ ቃረያ፣ እንዲሁም ቆስጣ በጋዉን ሙሉ ተመግቦን አናዉ ቅምነበር በዚህ አመት ግን የሽሮ መሳረፊያ አግኝተናል”, meaning we never get before, this types and amount of vegetable but, mostly we were consuming “Enjera” with “Shirowote”. The other respondants also confirmed the researcher as they are producing different types of vegetables like green pepper both for their home consumption and marketing. (Interviewee2)

From the above explanation, someone can understand that due to the introduction of solar powered water lifting technology the food availability for home consumption increased. This additional food is available by two reasons first from their back-yard production and secondly, they bought from the market because they get income by selling green pepper.

B. Stored food

The other finding of the study was the contribution of solar powered water lifting technology in support to store food for the beneficiaries. It supports the women to store especially onion, garlic and maize. In this regard, one of the interviewee described that:

In this year thanks to Bahir dar university institute of technology I stored 90kg onion, 20 kg garlic by making it to dry and mixed with finger millet to protect the vegetables from spoilage. This technology supportive practice also help me to save and store more maize grains because I did not sell any maize grains this year since I was getting money from the selling of garlic and green paper for daily house hold needs like to buy salt, soap, educational materials for my children and I used this stored food to consume and to sell when the market price become good (Interviewee 3).

From the above statement, someone can discern that the solar powered water lifting technology support the women to store different food items, and this stored food will help them in the case of food shortage or they may sole when the price is increasing and getting better benefit. It also showed that the women also stored more maize than before because they get income from green pepper selling helping them to save different grains.

C. Food availability for marketing

Based on the result of the study another contribution of solar powered water lifting technology is increasing availability of food for marketing. In this regard the following in depth interviewee participant describe her experience as follows:

This year I can sold onion and garlic and I have got an income around nine thousand ETB, but before this year I were depend on maize and sometimes on butter marketing. (Interviewee4)

From the above scenario, what can be understand is that due to the availability of solar powered water lifting technology, the the amount and type of food available for sale will be increased and changed. That is the women can store crops like maize and sold vegetables.

4.1.4.2. Income

Women, who represent half of the human resource of most societies are often not recognized and regarded due to their marginalised position in society. Women perform several productive tasks in addition to reproductive role, but often, these roles are not recognized and not visible. It is their reproductive role that overwhelms their productive role of earning and meeting livelihood needs. The findings of this qualitative study suggested that the introduction of solar powered water lifting technology is increasingly transforming subsistence farming into commercial farming and enabling the women to increase their production and income. In line with this a thirty years old in-depth interview participant describes as follows:

...I sold and get income from green pepper 9,000ETB, from Onion120kg produced and I sold half of it. And I have collected 120 kg of garlic and have got additional income from the sale of it. (Interviewee 4)

As a research interviewee focus group discussants and key informants all the solar water lifting technology users gain additional income from the sale of vegetables especially from the selling of green pepper, garlic and onion, similarly one key informant interviewee clearly described and strengthened the idea by stating as follow:

Since the solar powered water lifting technology eases their task of fetching water, some of them started irrigation activity newly with the help of this technology. Even though the others had prior experience in irrigation, they were not getting such kind of benefit because the prior technology of water lifting needs significant time and labor yet they did not irrigate properly. But now the women did it which is enabling them to have more production and income, and even this technology helped the women in providing sufficient

water for their fattening and diary animals. This additional income helps the women to buy whatever they need. Before this they were sold some maize or they are asking their husband to get money for house hold daily costs. (Key informant interview 1)

As mentioned by the interviewee and KII, we can deduce that one of the major benefits of solar powered water lifting technology is supporting the women to get income, even if women have been traditionally denied role of entrepreneur. This solar water lifting technology creates an opportunity for women to engage in income generating activity, and they are managing and controlling the income from the irrigated land plot. The solar powered water lifting technology also lessened the burden for women in lifting the water from the well and river that is why all the research participant women began to use time saved income generating activities.

4.1.4.3. Health improvement

As per the finding of the study health improvement is one of the basic benefits in which the women get from the supply of solar water lifting technologies. In this regard the following interview stated as follows:

.... When I was pregnant, on maternity, when I get sick at the time of my menstrual cycle I was in a very much difficulties and feel tired. For one raw of patch it need five to six plastic bottles and we were using more than ten rows per plot and it is expected to go to river for more than fifty times. Together with my kids I was going back and forth from river to farm so many times and at the end, all of my muscular body parts were feeling weak and illness. My small kids were always crying then immediately I carried them with my back and continued to fetch the water with my shoulder. Immediately my whist gets tired and fell sickness. But after getting the solar powered water lifting technology, I am not suffering a lot as before because the present technology does not need any extra implanting energy. Our families have got additional vegetable to be consumed at house hold level due to the expansion of the irrigated farm land with the ease of the technology.... (Interviewee 2)

Similarly, one interviewer strengthens this idea by saying

Starting from my child hood fetching and collecting water were my major responsibilities which were very disappointing that is why I could not wish these responsibilities be transferred to other the next generations including my daughters. But now thanks to the almighty God to see such an interesting and useful technology in my life, the burden facing me and other women is highly decreasing and my life is becoming more or less advanced. “እጄ እና ወገቤ የወለቀ እስኪመስለኝ ድረስ ነበር ዉሃ ስቀዳ የምዉለዉ;; ስታመመ; ነፍሰጡር እና አራስ ስሆን በጣም የሚጨንቀኝ ዉሃመቅዳቱነበር፤ከቀዳሁ በኋላም ድካሙ ቶሎ አይለቀኝም ;; አጄን እንደምታይዉ ከድንጋይ የጠነከረ ;ነዉ የሚመስለዉ ዉሃ ለመሰብ ገመድስጎትት የምዉልበት”(*my hands and waist feel sick like as much as it is detached , the challenge is increasing when I become a pregnant, my hands is now seems more stronger than a stone* (Interviewee 5)

From the above quotation we can understand that the solar powered water lifting technology helped to improve the health condition of women especially their hand, shoulder, and while become tired when they pulled water with the previous older rope water lifting technology. The challenge become harder when they are pregnant, but now this solar water lifting technology reduces the drudgery of women.

4.1.5. Challenges women face in using the SPWLT constantly

There are some hindering factors and challenges the women faced while using this solar powered water lifting technologies .as the result of the study indicated affordability, accessibility, in availability of water source, absence of energy storage and in availability of spare parts and maintenance services are the main factors that have potential to challenge the women to use the water lifting technology.

I. Affordability

As per the finding of the study the solar powered water lifting technology is expensive and it is difficult for small holder women to afford the price, but we have got this technology for free

from Bahir Dar institute of technology in its appropriate scale mechanization consortium project, In line with this, one interviewee clearly described her feeling as follows;

...I did not have the right information about the price of the maji pump, I expect it is very expensive and we were not afford to purchase it directly , unless we get it free or with long term repayment loan, From the information I got informally from BIT staff they told as like it costs 25,000 ETB... (Interviewee 2)

Another key informant interviewee strengthens the idea

Even if those ten women get with cost free basis, it is challenging for the other community to get the solar powered water lifting technology. It is very expensive; even if they want to buy, they are expected to sell more than two cows. (KII2)

The focus group discussant also strengthened this idea by saying

...With our community capacity it is not affordable and we are asking BIT to get other cheap /affordable / technology to address the technology for more women (FGD3)

From the above quotation, one can cognize this distributed water lifting technology is not affordable for the small holder farmers. This is therefore it is good if there are intermediate technologies for water lifting that is with less cost and women friendly.

II. Accessibility

The study found out that accessibility is one of the major challenges for this solar powered water lifting technology, all the research participants described that this technology is not available in their locality in Dangila or Bahir Dar, rather it is imported abroad in which individual farmers do not have the capacity, knowledge to access and use it. The following participant stated how difficult to access this solar powered water lifting technology.

In my understanding being a woman do not have that much challenge to access the technology, but we need some training to know where the spare part is found and

how to maintain for some simple destructions. we have a fear about where we get the spare in case of damage, and about quality since it is a new technology, I cannot say anything, because I did not see any other technology like this before... (Interviewee 8)

For this special occasion we are imported abroad but for the future we are trying a means to avail this technology in our locality, now we are studding about the technology to manufacture in our region. (KII3)

As mentioned by the interviewee, we can deduce that right now it is not accessible in our country but for the future we have a hope to get this technology in our locality, in addition in this study I understood that being a women does not have a special challenge than men to access this technology.

III. Unavailability of water source

As per the finding of the study to have more irrigated land water is a problem especially in the dry season from February to May. A 35 years old interview described this situation as follows;

...Engaging in irrigated farm production is very attractive for the women, because with small plot of land we get much benefit from it and also we make use of the land in the dry season, now we are producing two to three times in a year from same plot of land but the challenge we faced is shortage of water in the dry season, to expand our irrigated land it is impossible with this amount of water with only one wells, but we are tiring to have three to four wells in a farm... (Interviewee 5)

From the above experience, we can understand that water is scared in the dry season and the farmer shall have more wells as well as soil and water conservation activity and constructing a shade for the well is good to keep the water availability

IV. Absence of Energy storage mechanism

Absence of energy storing mechanism in the water lifting technology is identified as one of the challenges for women. According to this study the women shall wait the sun light to get water, regarding to this, one of the participants expresses her experience as follow;

Still now no big problem happened within this technology but If it were possible I wish it to be like a solar lump which can collect light and used for any time we want , this technology works when there is sun light, sometimes we wait the sun light and keep going to other place until I fetched and filled to the tanker, we may need to go to market place, grinding mill house, farming place which is far away from home, or some funeral ceremony, so I have to wait the sun or return back early before the sun set. Or if it were fixed in one place, I was assigning any available person around home, and we fear of theft, because it is easily movable some body may took, (Interviewee 6)

From the above scenario, we can conclude that absence of energy saving mechanism is one of the challenges to use the technology at any time in the day or night. Otherwise they have to have more water tanker to access water at any time of the day otherwise the women shall wait the sun light to get water.

4.2. Discussion

The study sought to explore the contribution of solar powered water lifting technology for women empowerment in Dangila district, dangesheta keble. For this the researcher investigated the benefits that the women gain from solar powered water lifting technology due to its contribution to the beneficiaries' welfare and finally this study investigated the hindering factors of which the women faced while using the solar powered water lifting technology sustainably. Under this section, the major findings of the study were discussed in relation to the existing empirical studies done on the study topic. This discussion part is organized in line with the sub themes of the study.

I. The benefit of solar powered water lifting technology for women

. The benefits that the women gain from solar powered water lifting technology were highlighted below. The major finding of this study was discussed with the finding of the prior study in related to the topic under investigation.

A. Time saving

The study shed light hence time saving is one of the benefits which the women gained as a result of solar powered water lifting technology. On average they can save around one hour per a day because of the solar powered water lifting technology which have a great value on their life such as it reduced the time spent in performing the tasks, making them powerful in ability to perform other tasks and it has a transformative effect in gender relation. This finding of the study is consistent with the finding of the study conducted by Oxfam (2015),Likimyelesh,et al., (2017),Sophietheis.et al ,(2017),FAO (2016)that revealed the introduction of water lifting technology to homemade where the women saved a significant time in their day today life and have a multi-dimensional effect on women's life.

According to the finding of this study, time lost due to walking a long distance and waiting for water has a ripple effect on women's lives, their communities and whole economies. Women's access to ownership of irrigation pumps is an implication of their ability to make major decisions on crop choices and generating income from irrigated crops. A research report from Likimyelesh,et al.(2017) confirmed that solar pump users saved time while using the technology for different purposes. Additionally, most respondents who were using a solar powered water lifting technology mentioned as the technology eased their domestic work such as cooking, washing, bathing, livestock watering and others by saving their labor and time required to bring water from other sources. And within the same report it is indicated that **women** respondents noted improvement in workload related to water for multiple purposes like increased work efficiency and time saving.

Another benefits that the women get with the supply of water lifting technology were reduction of time spent for fetching and collecting water for all purposes,having extra ability to perform other tasks.Thesebenefits are also identified by the study conducted by Oxfam and UNSCO (2015) entitled ' water for women, every woman counts''. Every time which would be saved from the time spent for fetching water from rivers and hand daguals have a ripple effect on women's day life. . Thus, this study tried ti identify the time lost due to water collection which would be applied for income generating activities, caring for family members, attending school or simply looking after women's needs and aspiration. As the researcher confirmed from this study, the impact on which water unavailability has on women's and the community at all starts as young as five years old.

In many cultures, as soon as they are able to carry the water containers, they will spend hours each day to fetch water with their mothers.

Jemimah, et al.,(2015) and FAO (2016) on their part also reported that the time saved is reallocated to activities that might have a transformative effect on gender relations in a household such as participation in marketing, decision making and controlling over resources and increasing access to information which are pointed out as a result of women getting sufficient time. FAO (2018) discovered that closing the gap in women's access to a broad range of technologies could help free their time for more productive activities.

UNESCO (2015) strengthen my research findings as follows. The time which has been lost holds women back from having equal opportunities and from reaching their potential. The interlinkages between the development agents working for water availability and gender equality, in particular women's empowerment, must be recognized. As it has been clearly put on their report, UNESCO has a great need to work together with any agencies working on women empowerment to enable women to get their time back. Increasing women's access to clean water can free up to hundreds of hours annually that they can instead devote to more valuable pursuits such as strengthening families and communities, earning a living and leisure(UNESCO, 2015).Likewise, the present study confirmed that the introduction of solar powered water lifting technology helped the women to save significant time that will have a great value in their life.

B. Work burden reduction

Granting to the finding of this study, the supply of solar water lifting technology helped the women to reduce their work burden, improvement of water supplies, lessened the burden for women, pulling up a bucket full of water and carrying large amount of water on their back and shoulder, which are hard work for women. As it has been understood from this research, majority of the participants used manually operated water pumps (hand) to extract water from surface and groundwater sources. As revealed in this finding, the work burden reduction is manifested by different effects like effects of work burden reduction on women's role and effects of work burden reduction on power relation. FAO (2016) confirmed that rural women simultaneously manage triple responsibilities at work within the household and at community level. Introducing women friendly improved water lifting technology reduces drudgery.

The study conducted by Singh (2014) identified the contribution of women is very high in the farm sector as they are involved in majority of farm operations and are therefore subjected to extra harsh conditions of work that leads to drudgery. Supply of clean water closer to home could, therefore, have a significant impact on women's time poverty and work burden reduction. Similarly, the study by UNSCO (2015) confirms that Women represent 40% of the global labor force, yet in Sub-Saharan Africa 40 billion working hours (equivalent to a year's worth of labor by the entire workforce in France) are lost every year to water collection.

The finding of the present study is also consistent with the study conducted by Jemimah, et al., (2015) and Amleset G/her (2011) which examine the effect of the supply of water lifting technology on intra house hold power relation. Even if women's participation in decision making and as water resource managers is uncommon, household water provision has create more opportunity for women in decision making , access to and ownership of irrigation pumps, and the implications on their ability to make major decisions on crop choices and use of income from irrigated crops, Correspondingly, the present study identified the supply of solar water lifting technology helped the women to reduce their work burden.

II. SPWLT for household welfare

Under this sub-section of the study; the contribution of solar powered water lifting technology for house hold welfare especially in related to food, income and health related issues are discussed by triangulating with the existing empirical evidences

A. Food/nutrition

As per the findings of the study, the solar powered water lifting technology benefited the women to improve the quality and amount of food availability for house hold consumption and marketing. It also enables the women to store the harvested crops for a long time. Van Koppen, 1998, Asian Development Bank (2015), and Letarik (2016) similarly reported that home based agricultural practices play multiple role for the family in general and women in particular. It accounts for significant amount of home consumption. Likemyelesh (2016) also confirms my study by her finding as investment in individual's smallholder irrigation technologies can be a viable means to sustainable intensification benefiting women and men smallholder farmers through double cropping of fruits and vegetables.

Furthermore, another study conducted by Letarik (2016) revealed that Solar-powered drip irrigation systems might sound a bit too sophisticated for rural women farmers who usually have low capital investments. FAO(2018) noted that the feminization of agriculture offers a series of opportunities for increased agricultural mechanization at farm level and in the agricultural food value chain that are economically, environmentally and socially sustainable. According to Van Koppen (1998) it is assumed that with access to water resources for agricultural production, women can leap “from subsistence to marketing farming” contributing to rural development. Women play pivotal roles in subsistence and market gardening, animal husbandry; food processing, waste recycling and reuse.

The study conducted by Van Koppen (1998) also supports this finding as he stated besides consuming backyard products at home, many women sell their products at the local market and use the generated money to fulfill some needs of the family, especially those of children. This implies that, the results of this study are complemented with the findings of the above studies.

B. Income

Another benefit that the women at Dangila district in dangesheta kebele benefited with the supply of solar water lifting technology is gaining additional income. The source of this income is mainly from the selling of their backyard gardening vegetables. According to the finding of the study the women earn income from the selling of green pepper, onion and garlic. This study also confirms that women sell their products at the local market and use the generated money to fulfill the family needs. The introduction of solar powered water lifting technology is also applicable in increasingly transforming subsistence farming into commercial farming and enabling the women to increase their production and income. The researcher’s finding in this study is consistent with the finding of the study conducted by Likimyelesh, et al., (2017). Hovorka (1999), revealed as back yard gardening is the best opportunity for women to generate income and as per those studies illustrated that the women also re invest their income for house hold needs especially for the children wellbeing.

The study conducted by Letarik (2016) discovered that backyard crop and livestock production is one of the viable alternative systems for improving the livelihood of rural households. It is the only means of income for thousands of poor and marginalized women. The practice is specially

play significant role for women headed households. In addition to that, the study conducted by UNSCO (2016) also confirmed that the impact of women reclaiming time shouldn't be underestimated. Women reinvest up to 90% of their income back into their families, improving their family's health and nutrition and ensuring that their children get a good education. Correspondingly, the present study identified that water lifting technology enormously support the women to get income through back yard gardening. These also open the opportunity for women to control the income from it. Therefore, the empirical evidences of the above study support the results of the present study even if the target groups of the study are somewhat different.

C. Health improvement

As per the finding of the study, health improvement is one of the basic benefits from which the women get from the supply of solar water lifting technologies. The study showed that the solar powered water lifting technology that helped to improve the health condition of women, especially their hand, shoulder, whilst become tired when they pulled water up by the previous water lifting technology, and the challenge become harder when they are pregnant, but now this solar water lifting technology reduces the drudgery of women. Likewise, Singh (2014) report confirmed that the contribution of women is very high in the farm sector as they are involved in the majority of farm operations and are therefore subjected to extra harsh conditions of work that leads to drudgery. These results are also coherent with the study found by FAO (2016) that describes rural women simultaneously manage triple responsibilities at work within the household and at community level. The study described that introducing women friendly improved farm tools and equipment can reduce drudgery in farm operations

Drudgery reduction identified by this research is as well borne out by the study of Cal/OSHA consultation service (2007) which briefly confirmed that manual material handling tasks may expose workers to physical risk factors. If these tasks are performed repeatedly or over long periods of time, they can lead to fatigue and injury. Therefore, the empirical evidences of the above study support the results of the present study as improved water lifting technology helped the women in related to its drudgery reduction.

III. Challenges that women face while using the SPWLT constantly

Under this sub-section of the study the hindering factors those women faced while using the technology constantly are discussed by triangulating with the existing empirical evidences.

Based on this study the hindering factors that the women faced while using the SPWLT constantly are affordability, accessibility, availability of water source, absence of energy storage and availability of spare parts and maintenance services. This finding is directly supported by a study conducted by Letaric (2016), Saifu A et al. (2011), Misrak et al. (2015).

A. Affordability

According to the study, the solar powered water lifting technology is expensive and it is difficult for the small holder women to afford the price., women have got this technology with cost free from Bahir Dar institute of technology in its appropriate scale mechanization consortium project with all accessories like plastic tube, water tanker, drip irrigation likewise(Saifu A. et al, 2011). The report confirmed that the initial investment involved in solar water lifting technology was excessive for rural water schemes, more than 150,000 US dollars, but included shallow well (~60m), the solar panels, the DC/AC inverter (converts DC to AC), submersible pump (~1.5 to 2 kW) with stainless steel casing, two imported glass-reinforced plastic (GRP) tanks of 6000 liters capacity each, cattle trough, a shower stall, and clothes-washing basin. Correspondingly, the present study showed that the cost of solar powered water lifting technology is not affordable for rural small holder farmer.

Similarly, Misrak et al (2015) stated that the initial cost of PV system of water lifting is high, but the maintenance, operation and replacement costs are lower. In addition, there is no energy cost needed in PV system and as a result the present cost of PV systems is much lower than the diesel-powered system as shown in Figure 13. Its lower operation and maintenance costs, the longer expected useful life as well as the higher reliability of PV systems could make the system more suitable for remote areas.

B. Accessibility

In this study, it was observed that the solar water lifting technology is imported abroad but not available in the local market that is why it is not accessible for women. And also, the technology

is too expensive to purchase for the farmer. This determination is confirmed by the report of Letarik (2016) which states farmers also note that the solar water lifting technologies have some limitations, which could affect the use of these technologies and adoption by other farmers. The technology is expensive which makes it less accessible for women, especially who have less resources to rent or buy.

C. Water scarcity

One of the finding of this study revealed that water scarcity during the dry season in underground water is one of the challenges that hinders the women to keep the benefits of solar powered water lifting technologies constantly. Most of the women are also concerned that water scarcity is a barrier to use the technology. This finding is confirmed by the study conducted by Likimyelesh, et al., (2017) by stating Constraints of using drip irrigation technology evaporation, water scarcity the technology to be dangerous to use because a farmer must use a ladder to fill water tanks mounted on a roof.

D. Energy storage Mechanism

In addition, this study investigated absence of energy storing mechanism in the solar powered water lifting technology is one of the challenges which hinder the women to use at any time of the day. The women have to wait the sun light to get water. And this finding is confirmed by the study conducted by Hovorka (1999) for solar pump users the absence of a mechanism to store energy that would enable longer use when there is less sun is a major constraint.

CHAPTER FIVE

5. CONCLUSION AND RECOMMENDATION

5.1. Conclusion

Since women have triple responsibilities at household, in the farm and in the community and when considering the multitude of tasks, the women perform using limited tools, it is obvious that the introduction of new and improved technologies holdout the promise of considerable benefits not only to women but to the family members as a whole. BiT in its appropriate scale mechanization project provided this solar powered water lifting technology (SPWLT) for free for Dangila district, Dangesheta Kebele women to support the women smallholder farmer. Solar powered water lifting technology is a photovoltaic water pumping system and it is one of the best technologies that utilize the solar energy to pump water from different water sources. Since this technology use sun light, it has lower operational costs in addition to contributing fewer carbon emissions and pollution.

As per my observation to the study site, the technology is easily movable and does not need complicated skill and knowledge to manipulate and the women's water sources are near the farmers' household so that it is easy to enable the women for multiple uses in addition to irrigation. The women did not participate in larger irrigation schemes or establish user groups, but operated individual technologies on own plots. In addition, there is an availability of abundant solar radiation. Considering this natural opportunity, the researcher confirmed that the solar powered water lifting technology is viable for this community.

As the study showed, the different benefits that the women gain as a result of from supply of the solar powered lifting technology are:- Time saving, that is they saved significant of amount of time from their water collection activities for different purposes like, for cooking food, washing clothes, drinking, local alcoholic drink (Arekie and tella) preparation, livestock watering, irrigation, to prepare the land for crop threshing (Awudema). And as a result, the time saved due to this technology have a direct effect on women to reduce the time spent in performing their

tasks, and changes in ability to perform other task and it has also a finding which shows there is a transformative effect on gender relation.

The other benefit this study found out that the solar powered water lifting technology reduces the work burden of women to lift water for all purposes because this solar powered water lifting technology use solar energy than human power, and as a result of work burden reduction for collecting water they are doing other tasks. In addition, the energy they conserve from unproductive tasks diverted to income generating activities, better child care, leisure time and general increment in the wellbeing of the whole family. And enabled women to make choices. I understood from this study result that the reduction of women's' work burden due to solar powered water lifting technology is supporting every role of women and eases the work burden. This is mainly due to most of the reproductive role of women are in need of water.

As per the findings of the study, the solar powered water lifting technology benefits the women by changing the usual food items with basic fruits and vegetables for their home consumption. The technology also enhanced them to have an increment on the amount of food they stored. The research participant also confirmed that the amount of food available for sale has been changed after using the solar powered water lifting technology.

In addition, this study found out health improvement is one of the basic benefits in which the women get from the supply of solar water lifting technologies. Especially their hand, shoulder, and whist were become tired when they pulled water with the previous water lifting technology. And its challenge become harder when they are pregnant, but now this solar water lifting technology reduces the drudgery of women.

The study showed that there are challenges which the women faced while using the SPWLT. The major challenges identified are affordability, accessibility, shortage of water source in the dry season, absence of energy storage on SWLT, in availability of spare parts and maintenance services around their locality are the main challenges for the women to use the solar powered water lifting technology sustainably.

This study also showed that It is worth noting that much of the crop produced in the backyard garden is consumed, and little surplus to sell at the market as the finding of the study shows the

women went to market to sell green pepper and onion but no other vegetables. And concerning the income from it, the men did not give emphasis because they think as the irrigated land is very small as compared to the other agricultural land, they did not expect to earn better income from it, in addition the selling is done by the women in different days they did not know the total income she earn.

Generally, this study found out that the supply of SPWLT benefited the women to save their time, reduced their work burden and to improve their health condition and this benefit has a direct effect on women's to divert their unproductive tasks in to income generating activities, availability of additional food item for the family, better child care and general increment in the wellbeing of the whole family. In addition, affordability, accessibility, shortage of water in the dry seasons are the main challenges which were dig out in this study.

5.2. Recommendation

Based on the finding of the study, the following recommendations are proposed for all concerned bodies like donors, project staffs, BiT or other development initiatives' which are working with water supply.

This project which is implemented by BiT can be taken as best practice in its approach because their interventions in related to water supply is suitable for multiple purposes, and it is installed near the household and this create better access for women and eases the work burden of women and children, And BiT introduce conservation agriculture which is women friendly cultivation techniques since it does not need plowing, almost like zero tillage practice, and it minimized weeds. This is therefore the BIT approach shall be promoted for development initiatives so that the rural women will be befitted more

Based on the finding it is better to identify and supply other alternative or transitional water lifting technology, because this promoted solar powered water lifting technology is not affordable (costly) for small holder farmer and not feasible to address for more women.

OR from this study I recommended that Bit together with its stakeholder shall promote this technology and deal with different factories to be manufactured locally so that it will be available with better price.

Soil and water conservation work and wells covers are good to improve the best use of the technology in the dry season. And to solve the shortage of water in the dry season for their irrigation, they need to have more wells than using only one well for all purposes.

This technology shall be improved to filters the water so that they will get purified water for drinking and it is good if it has big water tanker and they use it like pipe for different use at any time. And if possible, the women will be more benefited from this solar panel if they get additional benefits like for cooking by adding some additional technology in this existing technology

BiT has to strengthen linkage with local partner like water office, agricultural office and with women and children affairs office and private sectors.

Capacity building activities for both men and women by focusing the intra house hold division of labor, on decision making and controlling skill, entrepreneurship and marketing skill, back yard gardening production knowledge and skill is better to deliver.

This solar powered water lifting technology has potential benefits for increased income and food consumption. However, who benefits the most in the household is less clear, it needs further study. Concerning the house hold decision making when I asked them their response is like we decide together; it needs further study how they do it together. Since this technology is on piloting/researching stage, it needs commitment for BiT until the government take over the responsibility to scale up and to support the private sector to manufacture locally. Further research is needed to quantify the amount of contribution of solar powered water lifting technology for women empowerment and gender analysis shall be done in the area to better understand the benefit of the technology for women.

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ANNEXES

BAHIR DAR UNIVERSITY

FACULTY OF SOCIAL SCIENCE

DEPARTMENT OF GENDER AND DEVELOPMENT STUDIES

Appendix A

Research Participant Consent Form

Good morning/afternoon, my name is Meseret Cherie, I am studying Gender and Development studies in Bahir Dar University. Now I am conducting a research for the partial fulfillment of Master's Degree. The title of my research is “**The Benefits and challenges of SPWLT for women**” The main purpose of the research is to explore the benefits of SPWLT for women and dig out the contribution for house hold welfare and exploring the potential challenges women faced while using this technology. Thus, I would like to invite you to take part in this research. You are selected as a potential participant because you are the beneficiary of this technology/ you have the information about this SPWLT. However, no special support will come to you a result of your responses to the questions. You may withdraw from the study at any time without any penalties. And this information may be used in public presentations including but not limited t articles, books, or newsletters.

If I introduce this much about me and why I am here now and if you are voluntary to participate in this research, please give me your verbal and signed confirmation to precede the interview.

Signature of Interviewee: _____

District and Kebele: _____

Date: _____

Appendix B

Interview Guideline for Interviewees

Socio-demographic Background

Kebele _____

Age _____

Educational Status _____

Marital Status _____

1. Day in the life

1.1. Can you describe your day to me? What did you do in most of the day from the time you wake up in the morning until you went to sleep at night?

- ✓ Can you specifically describe what you did in the farm, at HH and at community?
- ✓ How is your role different from your husband role?
- ✓ Do you use any technology in your HH or in the farm?
- ✓ Previously from where your water source?

✓ About Maji pump

- ✓ How long have you been using the maji pump?
- ✓ What have you used the water for?
- ✓ Who uses the maji pump?
- ✓ Do women make decisions independently of men in the household? What sort of decisions are made independently about maji pump?
- ✓ What are the benefits you get from this SPWLT?
 - ✓ Does it save your time/how, compared with the previous water source?
 - ✓ Has the amount of time you spend on the above discussed task at HH, at farm changed as a result of using the technology practices?
 - ✓ If increased how has the additional time affect your ability to perform other tasks (child/elder care, leisure, IGA, food preparation.)
 - ✓ How are you spending your time differently?

4. Does using the solar water lifting technology made your role in farming, HH made easier or harder to perform? If so in what way?

- ✓ Does the amount of activity increased /decreased as a result of this solar powered water lifting technology?
- ✓ If your work burden increased/decreased what are the other tasks you perform or ignore?
- ✓ How you enjoy the reduction of work burden?
- ✓ Is there any new role changed as a result of this technology?
- ✓ Does this technology reduce difficulty of doing another task?
- ✓ Is there any relation with in the family strengthened/ loose as a result of work burden reduction?

5. Does it improve your health condition? /how?

- ✓ Does the previous method of water lifting have any effect in your health?
- ✓ Which part of your body were getting damaged more in the process of lifting water?

6. Transformative gender effect

- ✓ How do you re allocate your time differently?
- ✓ Is there any shift of gender role?

7. How this technology helps to improve your welfare/material needs

7.1. Change in food/nutrition availability

- ✓ Has the food available for home consumption changed as a result of using the solar powered water lifting technology
- ✓ Has the amount of food you stored changed?
- Has the amount of food available for sale changed as a result of using the technology?

7.2. Income

- ✓ Do you earn any additional income as a result of this technology?
- ✓ How much? what are the sources of this income? for what purpose do you use this income? who control/decide control this income

8. What are the challenges/hindering factors you faced while using this technology and potential challenges you expect to encounter?

- ✓ Related to design of the technology
- ✓ Dissemination
- ✓ Environmental challenges
- ✓ Cultural barriers

Appendix C

Interview Guide for Key informants

Socio-demographic Background

Kebele _____

Age _____

Educational Status _____

Position _____

Work experience _____

Marital Status _____

1. What are the benefits of SPWLT women's get that you observed?
 - ✓ How it saved their time?
 - ✓ Work burden reduction, how?
 - ✓ Health improvement, How?
2. What are the contributions of SPWLT for women HH welfare that you observed?
 - ✓ How it improves/changed food intake/consumed at HH? fore stored? How it changed availability of food item marketing? Where does this food item come from?
 - ✓ Does it have any contribution on their Income? How much? what are the sources of this income? for what purpose do you use this income? who control/decide control this income?
3. What are the hindering factors that women faced while using the technology and expected to be challenges for sustainable use of this technology?
 - ✓ In related to its design?
 - ✓ In related to dissemination?
 - ✓ cultural barriers
 - ✓ Does it create additional activity/ work burden on women?
4. How do you support the women to use the SPWLT effectively?
5. Do you observe any shift of gender role as a result of this technology intervention?
6. Does it support the women to acquire resources? Do they control? Decide on it?

7. Does this benefit make the women to fulfill her basic needs? How?
8. Does the other community desire to have this SPWL technology? Why /why not? And is there any option the scale up the project?
9. What is your recommendation about the technology to make it more women friendly?

Note: For each question probing words like why, how etc. were used to get detailed information

Thank You!!

If it is necessary to conduct further interviews after the analysis of the data, I may come back again and may join you.

Appendix D

Focus Group Discussion Checklist

Socio-demographic Background

Kebele _____

Age _____

Educational Status _____

Position _____

Work experience _____

Marital Status _____

1. What was your previous water source?
 - ✓ How do you get this solar powered water lifting technology?
2. What are the benefits you got from SPWLT, as compared to the previous water lifting technology?
 - ✓ How it saved your time?
 - ✓ Work burden reduction, how?
 - ✓ Does it have any change on your health condition, how?
3. What are the contributions of SPWLT for your house hold welfare?
 - ✓ How it improves/changed food intake/consumed at HH? fore stored? How it changed availability of food item marketing? Where does this food item come from?
 - ✓ Does it have any contribution on their Income? How much? what are the sources of this income? for what purpose do you use this income? who control/decide control this income?
4. What are the hindering factors you faced while using the technology and expected to be challenges for sustainable use of this technology?
 - ✓ In related to its design?
 - ✓ In related to dissemination?
 - ✓ cultural barriers
 - ✓ Does it create additional activity/ work burden on women?

5. Do you have an access, decision making and control over the technology? Why and how?

Note: For each question probing words like why, how etc. will be used to get detailed information

Thank You!!

Appendix E

የጥናት ተሳታፊዎች ስምምነት ማድረጊያ ቅጽ

ሠላም ጤና ይስጥልኝ፤ እኔ መሰረት ቸሬ እባላለሁ፤ ባ/ዳር ዩኒቨርሲቲ ተማሪ ነኝ፤ አሁን ወደናንተ የመጣሁት ለሁለተኛ ዲግሪ የመመረቁያ ጽሑፍ ለማዘጋጀት እና ጥናት ለማድረግ የሚያስፈልገኝን መረጃ ለመወሰድ ነዉ፤ ጥናት የማደርግበት ርእስ **በፀሃይ ብርሃን ሃይል የሚሰራ የዉሃ ማዉጫ ቴክኖሎጅ ለሴቶች ምን አስተዋፅኦ እንዳለዉና ምን ችግሮች እንዳሉበት መለየት** የሚል ነዉ ። እርስዎ ለዚህ ቃለ መጠይቅ የተመረጡት በዚህ ቴክኖሎጅ እየተጠቀሙ ስለሆነ እና መረጃ ይኖርዎታል ተብሎ ስለታመንብዎት ነዉ። ይህን ቃለ መጠይቅ በማድረግዎ ለርስዎ በተለየ ሁኔታ የሚመጣ ጥቅም የለም። አስቸኳይ ነገር በመሃል ከገጠምዎ ቃለ መጠይቁን ማቋረጥ አንችላለን፤ ይህ የሚሰጡት መረጃ ስምዎ ሳይገለጥ በተለያዩ መልኩ ለህዝብ ሊደርስ ይችላል። ጥያቄ ካለዎት መጠየቅ ይችላሉ። ስለዚህ ከዚህ ጥናት ላይ ለመሳተፍ ፍቃደኛ ከሆኑ ማረጋገጫ እንዲፈረሙልኝ አፈልጋለሁ፤ አመሰግናለሁ።

የመለያ ኮድ _____

ፊርማ _____

ወረዳ/ቀበሌ _____

ቀን _____

ስልክ ቁጥር _____

Appendix F

ቃለመጠይቅ ማድረጊያ ቅጽ ለተጠቃሚዎች

አጠቃላይ መረጃ

ስም _____

እድሜ _____

የጋብቻ ሁኔታ _____

የትምህርት ደረጃ _____

ጎጥ _____

ስልክ ቁጥር _____

1. በአብዛኛዉ ቀንዎን እንዴት ያሳልፋሉ?

- ✓ በቤትዎ; በማሳ ምን ምን አይነት ስራዎችን ያከናውናሉ?
- ✓ የርስዎ ፣ የልጆችዎ እና የባለቤተዎ የስራ ክፍፍል ምን ይመስላል?
- ✓ በቤትዎ/በማሳ ምን የምትጠቀሙት ቴክኖሎጂ አለ?
- ✓ ዉሃ ከየት ነዉ የምታገኙት?
- ✓ በፀሃይ ብርሃን ሃይል የሚሰራዉን ዉሃ ማዉጫ ምን ያክል ጊዜ ተጠቀሙበት?
- ✓ ዉሃዉን ለምን ለምን አገልግሎት ያዉሉታል?
- ✓ ማነዉ የሚጠቀመዉ? መቸ? እነዴት?

2. ይህ በፀሃይ ብርሃን ሃይል የሚሰራዉ ዉሃ ማዉጫ በፊት ስትጠቀሙበት ከነበረዉ ጋር ሲነፃፀር ምን የተለየ ጥቅም አለዉ?

- ✓ ጊዜወትን ቆጥቦለዎታል?
- ✓ ጊዜወትን ምን ያክል ቆጥቦለዎታል?
- ✓ ቴክኖሎጂዉ ከመምጣቱ በፊት ያጠፉት የነበረዉ ጊዜ ተቀይሯል?
- ✓ ተጨማሪ ጊዜ ካገኙ ምን እየሰሩበት ነዉ? በተለየ ሁኔታ ጊዜወን እነዴት እየተጠቀሙ ነዉ?

3. የስራ ጭናዎን ቀንሶሉዎታል? እንዴት ?

- ✓ ይህን በፃሃይ ብርሃን የሚሰራ የዉሃ ማዉጫ በመጠቀመው በቤት እና በማሳ ያለውንን ስራ አግዘለዎታል ?
- ✓ ይህን በፃሃይ ብርሃን የሚሰራ የዉሃ ማዉጫ በመጠቀመው የሚሰሩት የስራ አይነት ጭምሯል ወይስ ቀንሷል?
- ✓ በዚህ ቴክኖሎጂ ምክንያት የስራ ጭናወ ከቀነሰ/ከጨመረ ምን ተጨማሪ ነገር አደረጉ/ቀነሱ?
- ✓ በዚህ ቴክኖሎጂ ምክንያት በቤትዎ ዉስጥ የተቀየረ የስራ ዘርፍ አለ?
- ✓ በዚህ ቴክኖሎጂ የስራ ጭና በመቀነሱ ምክንያት በቤተሰብ አባላት መካከል ያለ ግንኙነት የተቀየረ ነገር አለ?

4. ይህ በፀሃይ ብርሃን የሚሰራዉ የዉሃ ማዉጫ ጤናዎ እንዲሸሻል አድርጓል ?

- ✓ በፊት ከሚጠቀሙበት ዉሃ ማዉጫ ጋር ሲነጻፀር አካልወን ከመጉዳት አንፃር ምን ልዩነት አለ?
- ✓ የትኛዉ የሰዉነት ክፍልዎ የበለጠ ጉዳት ይደርስበት ነበር?

5. ይህ በፀሃይ ብርሃን ሃይል የሚሰራዉ ዉሃ ማዉጫ ከመጣ በኋላ በቤት ዉስጥ አስፈላጊ ነገሮች ተሟልቷል?

5.1. የምግብ አቅርቦት

- ✓ በቤት ዉስጥ ያለዉ የምግብ አቅርቦት ተቀይሯል?
- ✓ የሚያጠራቅሙት የምግብ ብዛት/አይነት ተለዉጧል?
- ✓ ለገበያ የሚያቀርቡት የምግብ አይነት/ብዛት ላይ ለዉጥ አለ?
- ✓ እርስዎ እና ቤተሰቦቸዎ የተሻለ የምግብ አይነት/መጠን መመገብ ጀምረዋል?
- ✓ ይህ ተጨማሪ የምግብ አይነት እና መጠን ከየት ተገኘ?
- ✓ ይህ በፀሃይ ብርሃን ሃይል የሚሰራዉ ዉሃ ማዉጫ ከመጣ በኋላ የገቢዎ ሁኔታ ተቀይሯል?
- ✓ ገቢዎ ጨመረ? ከየት ተገኘ? ምን ያክል ገቢ አገኙ?
- ✓ የሚያገኙትን ገቢ ምን ያክል ይቆጣጠሩታል? ለምን ለምን ይጠቀሙታል?

6. ችግሮችን መለየት

- ✓ ይህን በፀሃይ ብርሃን ሃይል የሚሰራዉ ዉሃ ማዉጫ ዘዴ እንዴት ተማሩት?

- ✓ በዚህ ቴክኖሎጂ መጠቀም የማን ዉሳኔ ነበር?
- ✓ ቴክኖሎጂዉን እንዴት እንደሚጠቀሙ ሊያስረዱኝ ይችላሉ? ከበፊቱ እንዴት ይለያል?
- ✓ ይህን ቴክኖሎጂ በትክክል እንዳይጠቀሙ ምን ችግር አጋጥሞታል?
- ✓ ስለ ቴክኖሎጂዉ አሰራር ዲዛይን፣አጠቃቀም፣የዋጋዉ ሁኔታ ፣ተደራሽነት፣ ጥራት ምን ሃሳብ አለዎት?
- ✓ ስለ ቴክኖሎጂዉ ሞያዊ ድጋፍ እንዴት ነዉ የሚያገኙት?
- ✓ ይህን በፀሃይ ብርሃን የሚሰራ የዉሃ ማዉጫ ለመጠቀም ምን ምን ሃብት ያስፈልገዋል?
- ✓ ሴት በመሆንዉ ምክንያት ይህን ቴክኖሎጂ ከመጠቀም ወደ ኋላ የሚስቀረዎ ነገር አለ?

አመሰግናለሁ

ግልጽ ያልሆነልኝ ጥያቄ ካለ ተመልሽ ልመጣ እችላለሁ፤

Appendix G

ቃለ መጠይቅ ማድረጊያ ቅጽ ለ “Key informants”

አጠቃላይ መረጃ

ስም _____

እድሜ _____

የጋብቻ ሁኔታ _____

የትምህርት ደረጃ _____

ጎጥ _____

ስልክ ቁጥር _____

1. በፀሃይ ብርሃን ሃይል የሚሰራው የዉሃ ማዉጫ በሪፖርትም ሆነ እርስዎ ከተገነዘቡት ለሴቶች ምን ጥቅም አስገኘ?

- ✓ ጊዜን ከመቆጠብ
- ✓ ጉልበትን ከመቀነስ
- ✓ ጤናቸውን ከማሸሻል አንጻር እርስዎ ከተገነዘቡት ለሴቶች ምን ጥቅም አስገኜ ?
- ✓ በሴቶች ላይ ያመጣው ተጨማሪ የስራ ጫና አለ?

2. በቤት ውስጥ አስፈላጊ የሆኑ ነገሮችን ከማሟላት አንጻር ምን ጥቅም አስገኘ?

- ✓ የምግብ አቅርቦትን፣ የምግብ እህልን ከማከማቸት፣ ለገብያ ከሚያቀርቡት ያመጠው የተለየ ነገር አለ? ካለ ከየት ነው የሚያገኙት?
- ✓ ከገቢ አንጻር ተጨማሪ ገቢ/ወጪ አለው? ካለው ማነው የሚቆጣጠረው?

3. ሴቶች ይህን በፀሃይ ብርሃን ሃይል የሚሰራው የዉሃ ማዉጫ በዘላቂነት እንዳይጠቀሙ ያጋጠማቸው/ሊያጋጥማቸው የሚችለው ችግር ምንድነው?

3.1. በአካባቢው በሴቶች ላይ ያለው ባህላዊ ተጽእኖ ይህን ቴክኖሎጂ ከመጠቀም አንጻር ወደ ኃላ ያደረጋቸው ነገር አለ?

4. በዚህ በፀሃይ ብርሃን ሃይል የሚሰራው የዉሃ ማዉጫ መምጣት ምክንያት የተገነዘቡት በቤት ውስጥ በባልና ሚስት ወይም በልጆች የተቀየረ የስራ ድርሻ አለ ?

5. ይህ ቴክኖሎጂ ከመጣ በኋላ ሴቶች በተለየ ዉኔታ እራሳቸው ሊያዝዙበት የሚችሉት ሃብት አግኝተዋል?

✓ ምን ሃብት አገኙ?

✓ ያገኙትን ሃብትስ አንዴት ይቆጣጠሩታል?

6. ሌሎች የአካባቢዉ ማህበረሰብ ስለዚህ ቴክኖሎጂ ያላቸው አመለካከት ምንድን ነዉ?

7. ይህን ቴክኖሎጂ የበለጠ ለሴቶች ምቹ ከማድረግ አንፃር እርስዎ ምኑ ቢስተካከል ይላሉ?

አመሰግናለሁ!

ግልጽ ያልሆነልኝ ጥያቄ ካለ ተመልሽ ልመጣ እችላለሁ፤

Appendix H

ቃለ መጠይቅ ማድረጊያ ቅጽ ለቡድን ወይይት

አጠቃላይ መረጃ

ስም _____

እድሜ _____

የጋብቻ ሁኔታ _____

የትምህርት ደረጃ _____

ጎጥ _____

ስልክ ቁጥር _____

1. ወሃ ከየት ነው የምታገኙት?
2. ይህን በፀሃይ ብርሃን ሃይል የሚሰራው ወሃ ማወጫ ለማግኘት እንዴት ተመረጣችሁ?
3. በፀሃይ ብርሃን ሃይል የሚሰራው ወሃ ማወጫ
 - ✓ ምን ያክል ጊዜ ተጠቀሙበት?
 - ✓ ወሃውን ለምን ለምን አገልግሎት ያወሉታል?
 - ✓ ማነው የሚጠቀመው መቸ እና እንዴት?
4. ይህ በፀሃይ ብርሃን ሃይል የሚሰራው ወሃ ማወጫ በፊት ስትጠቀሙበት ከነበረው ጋር ሲነፃፀር ምን የተለየ ጥቅም አለው?
 - ✓ ጊዜዎን ቆጥቦልዎታል? ምን ያክል ቆጥቦልዎታል?
 - ✓ ተጨማሪ ጊዜ ሲያገኙ ምን እየሰሩበት ነው? /በተለየ ሁኔታ ጊዜዎን እንዴት እየተጠቀሙ ነው?
 - ✓ የስራ ጫናዎን ቀንሶልዎታል? እንዴት?
5. የጤና ሁኔታዎን አሸሽሎልዎታል? በምን ሁኔታ?
6. በቤት ውስጥ አስፈላጊ የሆኑ ነገሮችን ከማሟላት አንፃር ምን ጥቅም አስገኘ?

- 6.1. የምግብ አቅርቦትን፣ የምግብ እህልን ከማከማቸት፣ ለገብያ ከሚያቀርቡት ያመጠው የተለየ ነገር አለ? ካለ ከየት ነው የሚያገኙት?
- 6.2. ከገቢ አንፃርስ ተጨማሪ ገቢ/ወጭ አለው? ካለው ማነው የሚቆጣጠረው?
7. ቴክኖሎጂውን ስትጠቀሙ ያጋጠማችሁ ወይም ወደ ፊት ከዚህ በላይ በዘላቂነት ለመጠቀም ሊያጋጥማችሁ የሚችለው ችግር ምንድን ነው ትላላችሁ?
- ከቴክኖሎጂው አሰራር አንፃር
 - ከተደራሽነት ዘንፃር
 - በአካባቢው በሴቶች ላይ ካዉለ የበሃል ተፅእኖ አንፃር
 - ተጨማሪ የስራ ጫና ከመፍጠር አንፃር
- 7.1. ይህን ቴክኖሎጂ የበለጠ ምቹ ከማድረግ አንፃር ምኑ ቢስተካከል ትላላችሁ?
8. በዚህ በፀሃይ ብርሃን ሃይል የሚሰራው የውሃ ማዉጫ መምጣት ምክንያት የተገነዘባችሁት በቤት ውስጥ በባልና ሚስት ወይም በልጆች የተቀየረ የስራ ድርሻ አለ ?
9. ይህ ቴክኖሎጂ ከመጣ በኋላ እናንተ በተለየ ሁኔታ ልታዝዙበት የምትችሉት ሃብት አግኝታችኋል? ምን ሃብት አገኛችሁ? ማን ነው የሚቆጣጠረው?

አመሰግናለሁ!

Declaration

I, the undersigned, declare that the thesis comprises my own work. In compliance with internationally accepted practices, I have duly acknowledged and referenced all materials used in this work. I understand that non devotion to the principles of academic integrity and fabrication of any idea/data will constitute sufficient ground for disciplinary action by the university and can also evoke penal action from the sources which have not been properly cited or acknowledged.

Name: **Meseret Cherie Nibret**

Signature_____

University Id. Number: **BDU 1016/590/**

Date: **July, 2019**