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**Institute of Water and Energy Science (Incl. climate change)**

**Evaluating Integrated Water Resource Management practices and experiences in Ethiopia (Tigray) in line with IWRM pillars and Dublin principles for sustainable water resource management: in case of Genfel River**

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## **Declaration**

I, **Yassien Kassie Mohammed**, hereby declare that this thesis presents my personal work, realize to the best of my knowledge. I also declare that all information, material and results from other works presented here, have been fully cited referenced in accordance with the academic rules and ethics.

This research has been neither submitted nor published yet by any other author (s) to any authority.

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## Certification of Approval

This is to certify that this research work entitled **“Evaluating Integrated Water Resource Management practices and experiences in Ethiopia (Tigray) in line with IWRM pillars and Dublin principles for sustainable water resource management”** was conducted by **Yassien Kassie Mohammed** under the supervision of **Dr. Solomon Habtu Mesgina**. It meets the requirement of Pan African University institute for Water and Energy Sciences (incl. Climate Change) for the award of Master of Science in Water Science.

Signature,  Date: 05/08/2017

Dr. Solomon Habtu (Supervisor)

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## Abbreviation

|     |                     |
|-----|---------------------|
| BCM | Billion Cubic Meter |
| ETB | Ethiopian Birr      |

|       |  |
|-------|--|
| GTP   | Growth and transformation Plan           |
| GWP   | Global water partnership                 |
| IWRM  | Integrated water resources management    |
| MoWIE | Ministry of Water, Irrigation and Energy |
| NGOs  | Non-Governmental Organizations           |

## Abstract

Fresh water resource is becoming a scarce resource in the world. This is due to human and natural induced factors and the impact of climate changes. To manage water resources, nowadays, integrated water resources management is advocated as a better approach. This study deals with Evaluating Integrated Water Resource Management practices and experiences in Ethiopia (Tigray), in line with IWRM pillars and Dublin principles for sustainable water resource management, as case study of Genfel River. The study aims to assess the existence and status of integrated water resources management Pillars, to evaluate the implementation of IWRM based on IWRM principles and to identify the main challenges that hinder the sustainable implementation of IWRM. Qualitative research method is utilized for the analysis of collected data. The study finds that, existing enabling environment at National, and regional level in terms of water policy, legislations and financial arrangement are in place. And different institutions working in water resources management and related fields at federal, regional and woredas level are established. However, Management instruments are not well developed and organized. The implementation of water resources management based on Principles, regarding to consideration of fresh water as vulnerable and vital resource and economic value of water are not appreciable. Different stakeholders are participating in water resources development and management. However, they do not have clear stakeholder participation platform. From the interview of local community 60 % respondents are participating in water resources development, however they are not involved in decision making processes. 18% of the respondents also participated in water resources related trainings. Women are also participating in water resources management and construction works through contribution of labour force. This study concluded that implementation of water resources management in the study site does not follow the water resources management policy. And which is not implemented purposefully with IWRM Approach. Based on the results of this study, it is recommended that, the implementation of water resources management should follow the principles and policy statements and the national water resources management strategies.

**Keywords:** *Integrated water resources Management; Genfel River; IWRM Pillars; IWRM principles*

## Resumé

Les ressources en eau douce deviennent de plus en plus rares dans le monde. Cela est dû à des facteurs humains, naturels et à l'impact des changements climatiques. De nos jours, pour gérer les ressources en eau la gestion intégrée des ressources en eau (GIRE) est préconisée comme une meilleure approche. Cette étude traite de l'évaluation des pratiques et des expériences relatives à la gestion intégrée des ressources en eau en Éthiopie (Tigray) conformément aux piliers de GIRE et aux principes de Dublin pour une gestion durable des ressources en eau du fleuve Genfel. L'étude vise à évaluer l'existence et le statut des Piliers intégrés de gestion des ressources en eau, afin d'évaluer la mise en œuvre de la GIRE basée sur les principes de GIRE et d'identifier les principaux défis qui entravent la mise en œuvre durable de la GIRE. La méthode de recherche qualitative a été utilisée pour l'analyse des données collectées. L'étude a constaté que l'environnement existant au niveau national et régional en termes de politique de l'eau, de législations et d'arrangements financiers sont en place. Et différentes institutions travaillant dans la gestion des ressources en eau et les domaines connexes au niveau fédéral, régional et local sont établies. Cependant, les instruments de gestion ne sont pas bien développés et organisés. La mise en œuvre de la gestion des ressources en eau fondée sur les Principes, en ce qui concerne la prise en compte de l'eau douce comme ressource vulnérable et vitale et la valeur économique de l'eau ne sont pas appréciables. Approche participative, les différentes parties prenantes participent au développement et à la gestion des ressources en eau. Cependant, ils n'ont pas de plate-forme claire de participation des parties prenantes. De l'interview de la communauté locale, 60% des répondants participent au développement des ressources en eau, mais ils ne participent pas aux processus décisionnels. 18% des répondants ont également participé à des formations liées aux ressources en eau. Les femmes participent également à la gestion des ressources en eau et aux travaux de construction grâce à la contribution de la main-d'œuvre. Cette étude a conclu que la mise en œuvre de la gestion des ressources en eau sur le site d'étude ne respecte pas la politique de gestion des ressources en eau. Et qui n'est pas mis en œuvre en respectant les exigences de l'approche GIRE. Sur la base des résultats et des conclusions, il est recommandé que la gestion des ressources en eau soit conforme aux principes et aux énoncés de politique avec les stratégies nationales de gestion des ressources en eau.

Mots clés :

Gestion Intégrée des Ressources en Eau (GIRE), Fleuve Genfel, Piliers de la GIRE, Principes de la GIRE

# CHAPTER ONE: INTRODUCTION

## 1.1 Background

Fresh water resource is becoming a scarce resource in the world. This is due to human and natural induced factors and impact of climate changes. Due to this, water related problems are fostering in different parts of the world especially with in the countries which have water scarcity problems, like most African countries. This water problem should be managed in a sustainable manner. To do so, people are using different strategies and ways of water resources management. One of those methods which are introduced for sustainable water management is Integrated Water Resources Management (IWRM).

As it is defined by Global Water Partnership (GWP, 2000) IWRM is "a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems". IWRM is water management system or process which is based on cooperation of different stakeholders and different resources for the purpose of sustainable economic and social improvements without affecting the Environment. This way of water management gives a chance for stakeholders work on water and related sectors to participate on the process of water resource management and decision making procedures. It also promotes the conservation of natural and environmental resources for sustainable utilization of those resources. As there is no universal blueprint for IWRM (Wilkinson et al., 2015), it has its own principles which should be incorporated when water resources management is practiced, those principles are agreed by more than 500 government experts from 100 countries representatives participated on water and Environment conference in Dublin, held in January 1992. Those four Dublin principles are 1) Freshwater is a finite and vulnerable resource, essential to sustain life, development and the environment, 2) Water development and management should be based on a participatory approach involving users, planners and policy makers at all levels, 3) Women play a central part in the provision, management and safeguarding of water, 4) Water has an economic value in all its competing uses and should be recognized as an economic good (Hassing et al., 2009). These principles are highly important to link gaps between water resources and environment management with

holistic participation of community and considering women as a key part of community on water management, and gives a conscience on water has an economic and social values for proper management of water resources. Proper IWRM implementation needs three basic foundation or pillars which should be found in implementing areas, those pillars are enabling Environment (Policy, Laws and legislations), Institutional frame works (national and local governmental institutions, private sectors, river basin management institutions,) and management instruments (water management assessment, Information management, conflict resolution and allocation instruments) (Hassing et al., 2009). Establishing and having the above three pillars helps to implement water resources management in a sustainable manner and IWRM gives high benefit on water management aspect.

## **1.2 Statement of the Problem**

Ethiopia adopted IWRM approach for water resources management within its policy, strategy, legislations and water proclamation (Jembere, 2009; ECWP, 2009). And the county implements IWRM as a water resources management approach in different areas to solve water and related management problems. Adopting and trying to implement IWRM approach is not enough and appropriate for managing water resources in a sustainable and efficient manner,

However, it needs periodical evaluation and continues follow-ups from higher to lower implementation levels. This periodical evaluation of IWRM implementation helps to find the challenges, gapes, and new implementation techniques and to improve the management, effective and sustainable utilization and benefits of water resources through improved and advanced implementation of IWRM from time to time. Even if Ethiopia adopts IWRM principles and incorporating to the policies, strategies and development plans of the country, the implementation of IWRM is not evaluated properly especially in line with the internationally and nationally accepted principles and pillars of IWRM. Hence, it is difficult to ensure sustainable water resources management and utilization at watershed level and at national level in general. In order to fill the above gaps, this study evaluated the existing practices and experiences during implementation of Integrated Water Resources Management (IWRM) by referring to the internationally recognized IWRM basic principles and pillars.

## **1.3 Objective**

### 1.3.1 General objective

The general objective of this study was Evaluating Integrated Water Resource Management practical actions and experiences in Tigray region in Ethiopia in line with the IWRM pillars and Dublin principles in contribution to sustainable water resource management.

### 1.3.1 Specific objectives

Considering the above general objectives, the specific objectives of this study were:

- ✓ To assess the existence and status of the IWRM Pillars (Enabling Environment, Institutional frame works, and management instruments) and their suitability for implementation of IWRM in Tigray region
- ✓ To evaluate the implementation of IWRM based on IWRM principles; and
- ✓ To identify the main challenges that hinder the sustainable implementation of IWRM in Tigray region

## **Research questions**

Based on the above objectives, this research addressed the following research questions,

- ✓ What are the existing Pillars (Enabling Environment, Institutional frame works, and management instruments) of IWRM in Tigray region of Ethiopia?
- ✓ Is IWRM implemented Based on the Dublin principles?
- ✓ What are the possible challenges which affect implementation of IWRM?

## **1.4 Significance of the study**

This study will help to evaluate and show the gaps on the implementation of IWRM Principles, and gives information for policy and strategy planners and decision makers in order to improve the sustainable water resources management at district and regional level. It also contributes for fellow scholars who have an interest on this subject area as a reference and bench mark for further studies.

## **1.5 Scope and limitation**

As mentioned before, this study deals with the evaluation of Integrated Water Resource Management practical actions and experiences in Ethiopia (Tigray) in line with the IWRM pillars and principles. This study tried to Evaluate IWRM implementation In Tigray region, woreda kilteawlaelo Genfel River. It covers the existence of IWRM pillars and implementation of IWRM principles at local level and regional level. Because of budget and time limitation this study covers only one district as a case study area. And the field work of this study was carried out during four months from April to July 2017.

## CHAPTER TWO: LITERATURE REVIEW

### 2.1. The concept of IWRM

Water is required for human life and well-being, management of water resources is highly important for all human development activities, food production, controlling water related problems (Tess et al., 2014). The world fresh water is surrounded by many challenges and problems; this is because of world population increment and uncontrolled economic activities on water and related resources (GWP, 2000). Water is an important resource which overlaps with many sectors of human developments (Varis et al., 2014). Global water demand is highly influenced by population increment, urbanization, food and energy security policies and Economic activities (GWP, 2000; UNWWDR, 2015). These problems are not similar and constant spatially and temporally (Biswas, 2004). Computing demands are sources of difficulties to allocate water for sectors and enhance sustainable development (UNWWDR, 2015). Shortage of water, water quality problems, flood impacts and other related problems are the main ones which needs great attention and action (GWP, 2000). As water problems are becoming complex and vague it is difficult to resolve by single minister or professionals group alone, water problems are related with other development and economic activities and sectors and also has social, economic, Environmental, legal and political impacts on a country at national and local level (Biswas, 2004). Poor water resources management and governance is the root cause for water and related problems and crisis (Patrick et al., 2004). In addition to these Narrow objectives of institutional mechanisms with in government and other structures will create fundamental management problems (UNWWDR, 2015). Managing those problems and water resources in a traditional, fragmented and sectoral approach is more problematic and can have conflict of interest with in those computing uses and sectors (GWP, 2000). Traditional water resources assessment should be changed by considering integrated water quality and quantity assessment approach (Xia, 2012). Water sector is not only single sector which has its own rights, but also which is part of many sectors like environment, agriculture, energy, health, infrastructures and other several sectors and which touches a number of management functions of different sectors and which can overlap with those sectors. Because of this it needs to have vertical and horizontal integration for management and governance with in water and related sectors (Varis et al., 2014). This issue leads to come up with one best water management approach which of integrated water resources management,

which coordinates; different water uses and sectors, resources and users and stakeholders together for the sustainable management and utilization of water resources for the economic and social benefits of the people. It is essential to have integrated management approach and policy making for equitable and sustainable development and utilization of water resources (Varis et al., 2014). As it is defined by Global Water Partnership (GWP, 2000) IWRM is "a process which promotes the co-ordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems", And is a process which can help countries water resources management efforts in a cost effective and sustainable manner (GWP, 2000). One of the best advantage of IWRM is it gives water community a common stand and language that can be implemented in a wide range from local, national and regional levels (Hassing et al., 2009). Based on this Implementing this best management approach in all aspects of water and related issues is crucial to have sustainable and effective water utilization and management.

IWRM contributes to the sustainable development of water community (Patrick et al., 2004). This approach helps to address and control water and related conflicts (Hileman, 2016). It is an important approach to improve water utilization, management and governance, and which is not a goal on itself and it is widely used approach to harmonize planning, development, management and policy making processes of water sector developments (Variset al., 2014). Integrated resources management promotes planning and management of resources and use problems and opportunities in a systematic and holistic approach to find integrative solutions (Jennifer et al., 1999). It is adopted because it has benefits in efficient production of food crop in integrated agriculture, it is also crucial in reducing water related health problems, and is also best approach to eliminate flood and drought risks and which is accepted by all managers and policy makers as water management approach (Hassing et al., 2009).

International, Regional and national water and natural resource management institutions and programs are putting IWRM management approach and principles as suitable and basic water resources and Environmental Management approach. As UN (1992) integrated water resources management is mentioned as one of the seven development program areas. African water vision 2025, also mention that adopting and implementing integrated water resources management and principles for strengthening governance of water resources (UN-water/ Africa, nd). Based on

African Development Bank’s policy for integrated water resources management, the following basic principles are adopted from the main principles of IWRM:

1. The basic principles are that water should be treated as an economic, social and environmental good, and; policies and options that guide water resources management should be analyzed within an integrated framework.

2. Its central objective is to promote efficient, equitable, and sustainable development through integrated water resources management.

According to Article VII.2 b of African Convention on the Conservation of Nature and Natural Resources (Revised Edition) (2003), Integrated water resource management is taken as a measurement for the planning, conservation, management, utilization and development of underground and surface water, as well as the harvesting and use of rain water, and shall endeavor to guarantee for their populations a sufficient and continuous supply of suitable water (AU, 2003). In Australia, Integrated resources management was advocated by government for sustainable development and environmental equity and Programs and plans related to IWRM approach help to address resources utilization issues and their appropriate management in consideration of biophysical, economic, social and institutional aspects (Jennifer et al., 1999).

## 2.2. IWRM Pillars and Principles

### IWRM Pillars

IWRM has three pillars as shown in fig 2.1

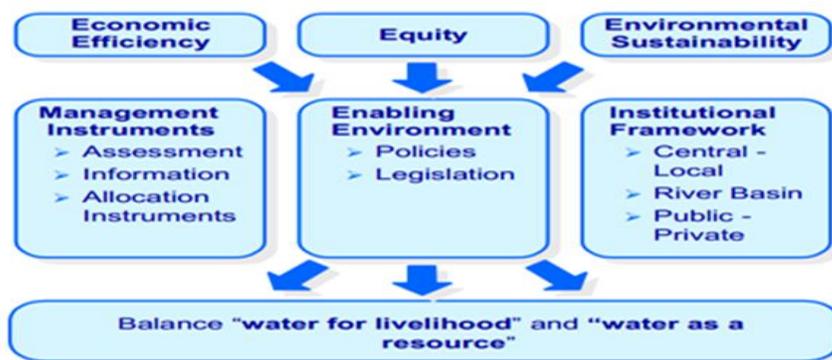


Fig 2.1. The three pillars of IWRM for sustainable implementation and management of water resources (source GWP, 2000)

IWRM implementation cannot be fully implemented without getting and strengthening the “three Pillars, which require Moving towards Enabling Environment with having conducive and implementable Policies, strategies, legislations and regulations with enough financial mechanism, putting institutional frame work in which those policies and strategies are implemented; and setting management mechanisms and instruments which are used in those institutions to do their job (GWP, 2004).

### **IWRM principles**

Based on GWP (2000), IWRM implementation should be based on the following four Principles; these principles are carefully formulated by international consultative processes universally accepted in international conference held on the issue of water and environment in Dublin, 1992.

The four fundamental principles are:

**Principle 1:** Fresh water is finite and vulnerable resource, essential to sustain life, development and the Environment.

As water is natural resource it can has naturally yield limit, which is highly vulnerable Due to human effects on its availability, quality and quantity through different economic activities, and it has upstream and downstream water user issues. There for water management should be in a holistic approach by considering water and environment, water quality and quantity, surface and ground water sources and users and institutions (GWP, 2000). It is also necessary to prepare water management policy, environmental and water quality protection legislations, water and river basin management plans and assessment mechanisms of water projects (GWP, 1999).

**Principle 2:** Water development and management should be based on participatory approach, involving users, planners, and policy makers at all levels.

Fresh water is a resource which everyone is dependent on it and it consists of different aspects of uses. Because of this, everybody who uses water is a stakeholder and should have to participate

in water and related issues, planning, decision making, and utilization of this resource (GWP, 2000).

**Principle 3:** Women play a central part in the provision, management and safeguarding of water. Women and girls are the one who are walking long distance and hour to fetch water for their house hold and in some cases for agricultural practices. They are also playing an important role in the sustainability and success of projects (GWP, 2000; Amleset, 2012). However, women are not influential as men in management, problem identification and analysis and in decision making process. Therefore, it is required to consider women as water user, and involve them in a decision-making process and enhancing gender awareness (GWP, 2000).

**Principle 4:** Water has an economic value in all its competing uses and should be recognized as an economic good.

In the past water was considered as a free good and the value of water was not fully recognized, because of this water management has failed. In order to manage water and make it usable for everyone in a sustainable way, water should be considered as an economic good and there should be economic water management mechanisms (GWP, 2000).

### **2.3. Sustainable water resources management**

Sustainable development is the efficient utilization of natural resources in order to improve social and economic developments with consideration of the environmental carrying capacity for the future generation (vanderzaag and Savenije, 2014). Sustainable development is sustaining the environment, community, and development of economy and social achievements and Sustainable water resources management is the main component of sustainable development, which can be defined as meeting the present water demand and water related development objectives without affecting the future. Water is required for human life and well-being while, management of water resources is highly important for all human development activities, food production, controlling water related problems (Tess et al. 2014). If water resources development does not have sustainable plan, it is ill planned. For sustainable development physical, economic and institutional sustainability should be considered (vanderzaag and Savenije, 2014).

As Billib et al. (2009) conclude that sustainable water resources management requires integrated and inter disciplinary approach of resource management at basin level. Integration of resources,

water uses, users, policy makers, institutions and all stake holders' involvement is a key factor to have sustainable water resources management. It is necessary to have water resources allocation between competing water uses, and balance the financial and social resources required for the development and management (Tess et al., 2014).

Almost all sustainable developments cannot be achieved without proper management and utilization of water resources, because, water is required in every aspect of human life and development activities. The 17 sustainable goals are:

GOAL1: End poverty in all its forms everywhere;

GOAL 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture;

GOAL 3: Ensure healthy lives and promotes well-being for all at all ages;

GOAL 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all;

GOAL 5: Achieve gender equality and empower all women and girls;

GOAL 6: Ensure availability and sustainable management of water and sanitation for all;

GOAL 7: Ensure access to affordable, reliable, sustainable and modern energy for all;

GOAL 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all;

GOAL 9: Build resilient infrastructures, promote inclusive and sustainable industrialization and foster innovation;

GOAL 10: Reduce inequalities within and among countries;

GOAL 11: Make cities and human settlements inclusive, safe, resilient and sustainable;

GOAL 12: Ensure sustainable consumption and production patterns;

GOAL 13: Take urgent action to combat climate change and its impacts;

GOAL 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development;

GOAL 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss;

GOAL 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels; and

GOAL 17: strengthens the means of implementation and revitalizes the global partnership for sustainable development.

#### **2.4. IWRM in Ethiopian context**

Ethiopia has a huge amount of water resources with surface flow of 122 BCM from rivers and 2.9 BCM of ground water sources and this water resource is characterized by temporal and special variability (Jembere, 2009). Because of this variability there is no equal availability and distribution of water resources throughout the country. In addition to these problems, there are other problems related to water resources management, of which drought, floods, water pollution and land degradation are the main phenomena which are observed in water resources of the country in general (Jembere, 2009). In order to solve the above and other water resources and management problems and improvement of water resources utilization to earn the maximum benefits, there should be comprehensive and sustainable water resources management. Ethiopia adopted IWRM approach for water resources management with in its policy. And this approach is launched and implemented in some parts of the country as a pilot project by Country water partnership in 2005 (Jembere, 2009; ECWP, 2009). According to Jembere (2009), after implementation of IWRM in Berki watershed, Tigray Region, Ethiopia, numbers of problems related to water resources management like water allocation problems, conflict between upstream and downstream users and water resources utilization awareness gaps and other related issues were solved.

## **CHAPTER THREE: METHODOLOGY**

### **3.1. Study Area**

The study area of this research is Tigray region in northern Ethiopia, 45 km far from the capital of Tigray region Mekelle, 829 km from Addis Ababa capital city of Ethiopia and is found between 39°25'0" and 39°41'0" East, 13°39'0" and 13°57'0" North, where water resource management activities are practiced at river basin and catchment levels. The study area (administrative city Wukro) has average temperature of 19.6°C and average yearly rainfall of 610 mm (climate-data.org, 2017). The exact case study site is Genfel River which is found in Woreda/ district Kilite Awlaelo( Fig3.1). Genfel River is found under sub Basin of Giba River, which is the main tributary of Tekeze River, flowing to Nile River.

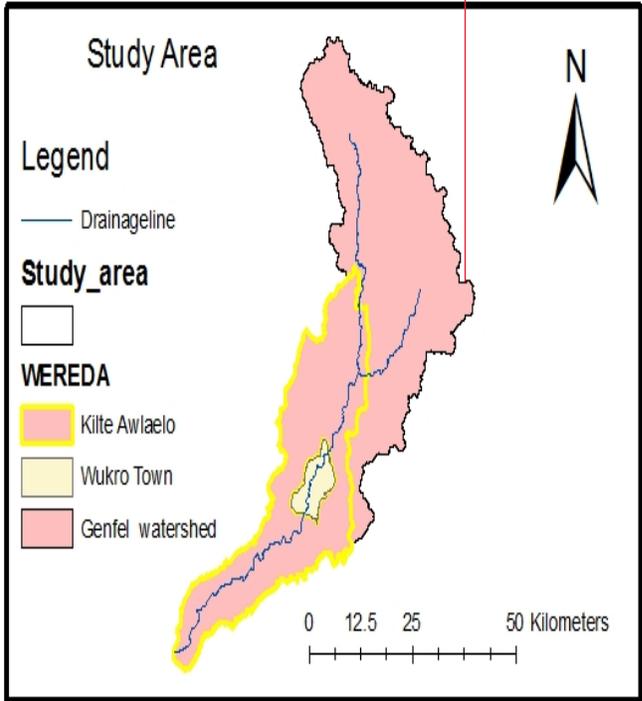
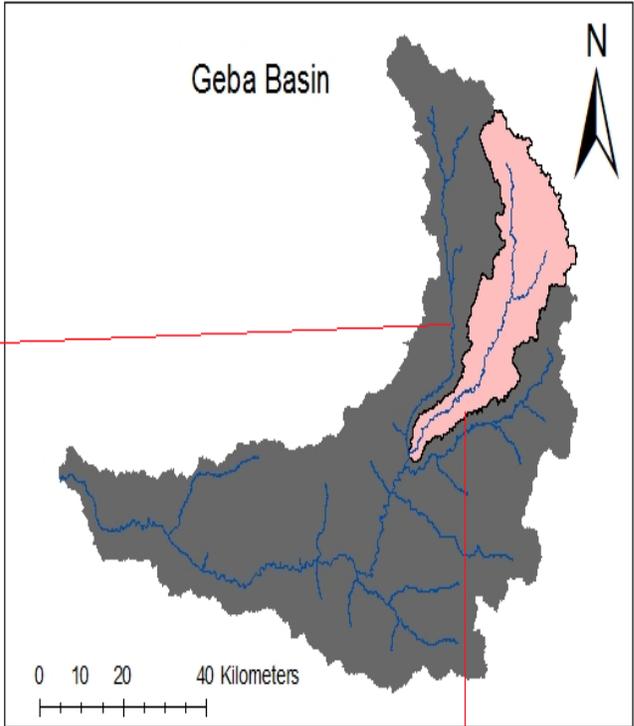
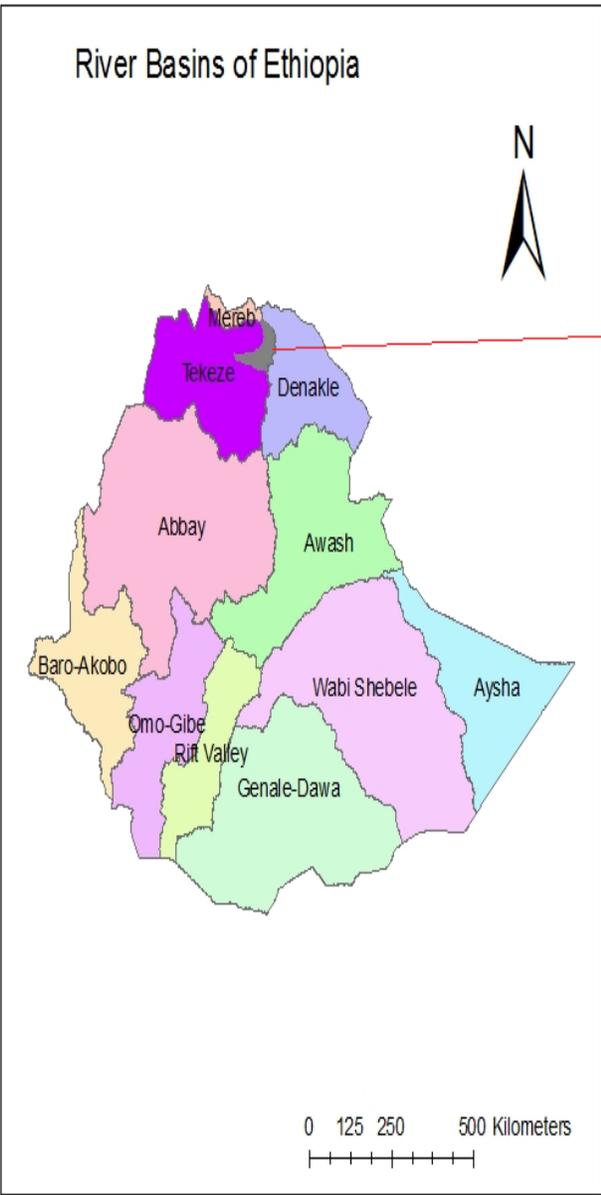


Fig 3.1. Location of study site (Genfel River)

This river was selected because of the reason that, it is utilized for many water uses such as irrigation, car washing, brick production, industrial and city sewerage disposal and other small uses. This is very important to evaluate the implementation of IWRM at local level.

Woreda Kiltawlaelo is one of the districts which is found in Eastern part of Tigray regional government. This woreda has five sub districts (Tabias) which are depending on Genfel River for different water uses and economic activities. Those sub districts (Tabias) are 1) Laelay Adisadid, 2) TahitayAdisadid, 3) Genfel, 4) Aynalemand5) DebreBirhan.

The two sub districts (Laelay Adisadid And Tahitay Adisadid ) are found at upper side of the River in The district, Sub district Genfel is found at the middle part of the river in that district and the remaining two sub districts are found at downstream side of the river in the district.

From the above five sub districts, three of them (Tahitay Adisadd, as Upstream, Genfel as middle part of the river, and Aynalem as a downstream part) were selected as study sites.

The reason to select the above sub districts as a study sites was that, the sites are nearest to the Wukro (Administrative city of the District), availability of multi water uses, and financial limitation to cover all sub districts.

### **3.2. Population**

Based on the population prediction for 2017 the study area has 5373 households in the three tabias selected for this study. As the data is collected from the Kiltawlaelo woreda's water Bureau the population and number of households is presented in table 3.1.

Table 3.1 Population and house hold of the study site

| Tabia          | Population   |              |              | Households     |                  |             |
|----------------|--------------|--------------|--------------|----------------|------------------|-------------|
|                | Male         | Female       | Total        | Male<br>leaded | Female<br>leaded | Total       |
| Tahtayadisadid | 4008         | 4274         | 8282         | 1317           | 565              | 1882        |
| Genfel         | 3160         | 3335         | 6495         | 1033           | 443              | 1476        |
| Aynalem        | 4373         | 4488         | 8861         | 1410           | 605              | 2015        |
| <b>Total</b>   | <b>11541</b> | <b>12097</b> | <b>23648</b> | <b>3760</b>    | <b>1613</b>      | <b>5373</b> |

### 3.3. Selection process of respondents

In order to gather information through semi structured interview ( see Appendix 1) and using questionnaires ( see Appendixes 2 and 3) for this study, respondents and key informants from regional water bureau, woredas water and energy bureau, different water related offices and from the Tabia experts and farmers were selected. Respondents from bureaus, offices, and key informants from Tabia were selected by using purposive sampling technique. And random sampling technique was used to select farmers. It has combination of elder people, religious leaders, water user association members and leaders women and youths were parts of the selected respondents in the villages. As it is presented in table 3.2, total number of respondents for this study was 48.

Table 3.2 Respondents category and number of respondents

| No,                                | Category of respondents  | Number of respondents |
|------------------------------------|--|-----------------------|
| <b>1</b>                           | <b>Tigray Bureau of water</b>  | <b>4</b>              |
|                                    | Irrigation department  | 2                     |
|                                    | Water supply department  | 1                     |
|                                    | Water management and regulatory department                               | 1                     |
| <b>2</b>                           | <b>Woredas water Bureau</b>  | <b>3</b>              |
|                                    | Head of the office   | 1                     |
|                                    | Irrigation case team   | 1                     |
|                                    | Water supply case team   | 1                     |
| <b>3</b>                           | <b>Other water related organizations and institutions in the woredas</b> | <b>5</b>              |
|                                    | Bureau of Agriculture in the woredas                                     | 1                     |
|                                    | World vision Ethiopia  | 1                     |
|                                    | Relief society of Tigray (REST)  | 1                     |
|                                    | Wukro St, Marry college  | 1                     |
|                                    | Bureau of health in the woredas  | 1                     |
| <b>4</b>                           | <b>Tabia (Sub district level)</b>  | <b>36</b>             |
|                                    | Agricultural (irrigation expert) (as key informant)                      | 3                     |
|                                    | Water resources expert (as key informant)                                | 3                     |
|                                    | Farmers  | 30                    |
| <b>Total number of respondents</b> |  | <b>48</b>             |

### 3.4. Data collection and analysis

#### Primary Data

Primary data were collected by using semi structured interview with water users and key informants at tabia level, and structured questioners were also distributed to regional and woreda

water and related office representatives. 30 farmers and 6 tabia water and irrigation experts were interviewed and 12 questioners were distributed. In addition to this, field observations were also made during data collection.

### **Secondary Data**

Secondary data were used from Tigray Bureau of water resources, Woreda water bureaus. Documents like national water management and other policies, proclamation laws, strategies, regulations and other relevant documents were utilized from libraries of the regional water bureau, and other online sources.



Fig 3.2. Interview and direct observation

### **Data analysis**

Existing water policy, laws and legislations and strategies of the country and the region were reviewed. Water management Institutions, which are found in the study area were being visited and questionnaires interviews were also employed. Management instruments which are used for implementation of water resources management were also examined through reviewing documents; interview, and questioner. The data which are collected from primary and secondary data sources were analyzed qualitatively. To organize and evaluate IWRM practices and implementations in line with the three pillars hierarchical approach were utilized. This approach

helped in structuring data and formation of results in a useful analytical framework (Wilkinson et al., 2015). Mainly those IWRM pillars and principles which are accepted internationally were used as an analysis and evaluation IWRM approaches. The hierarchical structure of those three pillars and principles are shown in Fig3.3. Results are presented in tables, pictures and narrations. Fig 3.3 shows main components of the 3 pillars and Principles which are covered by this study and data collection methods in order to evaluate the implementation of IWRM in a comprehensive way.

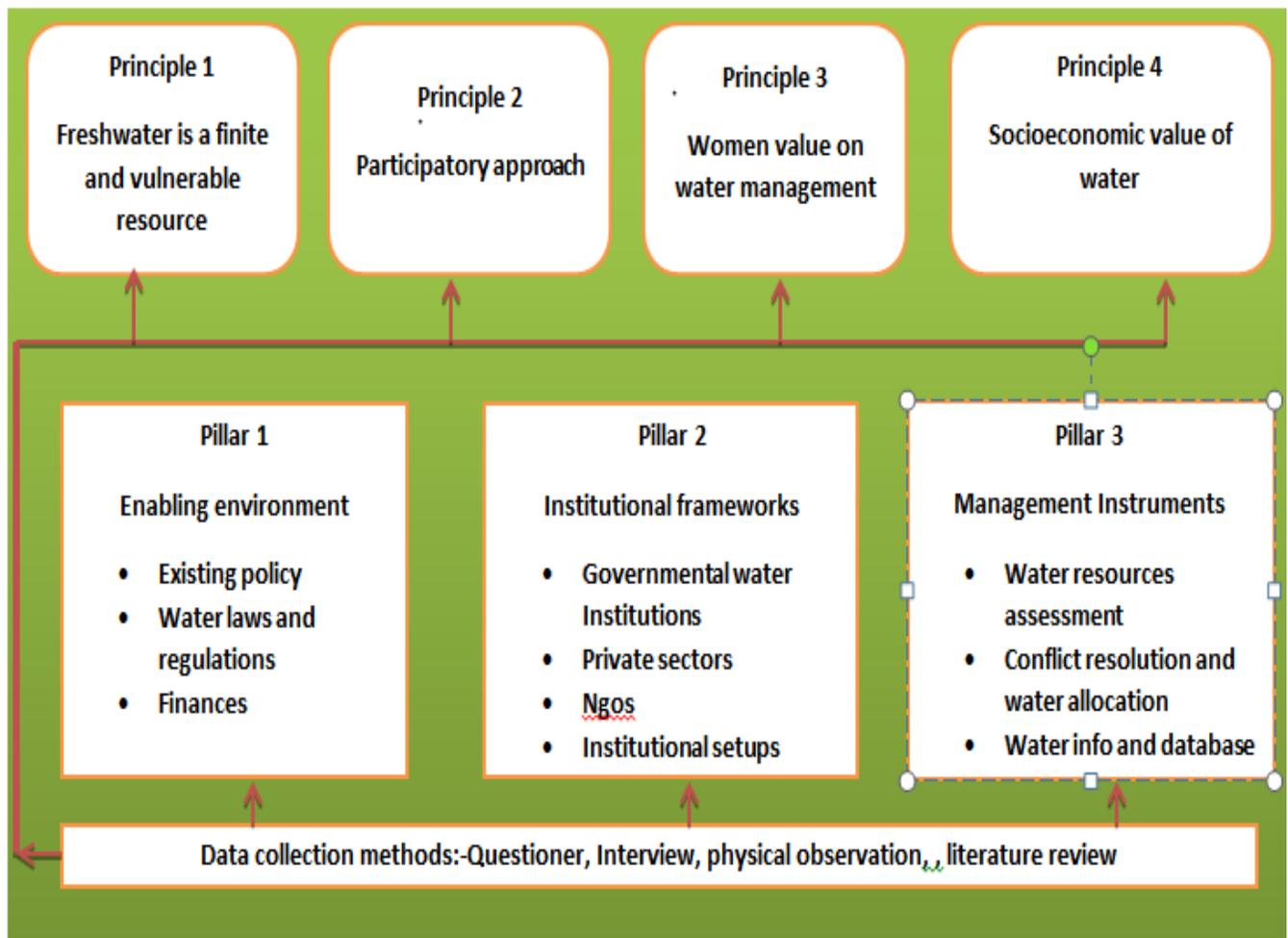


Fig 3.3 Hierarchical structure of those three pillars and principles

## CHAPTER FOUR: RESULT AND DISCUSSION

### 4.1 Profile of respondents

In this particular study, most of the participants are farmer at local level. It also included people from water bureau and related offices. Semi structured Interview (see Appendix 1) was held with 36 respondents from local level water users and water and agricultural extension workers of each Tabia. and questionnaires (see Appendixes 2 and 3) were distributed to 12 respondents of water resources management bureau at regional level and water resources development offices, other organizations and institutions. Totally, 48 people were selected as respondents of this study. From distributed questioners, 4 of them did not respond. This means the total number of respondents for this study were 44 people (91.6%).

Table 4.1 Respondents characteristics in terms of sex.

| No | Sex    | Frequency | Percent |
|----|--------|-----------|---------|
| 1  | Male   | 27        | 61.3%   |
| 2  | Female | 17        | 38.6%   |
|    | Total  | 44        | 100%    |

The above table shows the main respondents are men which are 61.3% and female are 38.6% of the total respondents.

Table 4.2 Characteristics of respondents based on educational level

| No | Educational level  | Frequency | Percentage |
|----|--------------------|-----------|------------|
| 1  | MSc holders        | 6         | 13.6%      |
| 2  | BSc degree         | 4         | 9%         |
| 3  | Diploma            | 6         | 13.6%      |
| 4  | Grade,10 completed | 3         | 6.8%       |
| 5  | Primary completed  | 11        | 25%        |
| 6  | No attend school   | 14        | 31.8%      |
|    | Total              | 44        | 100%       |

The above table shows the respondents of this study based on their educational level. The highest percent (31.8%) of respondents did not attend school and 25 % of respondents attended primary school. The others are grade ten up to MSc holders.

## **4.2. The Existing Pillars of IWRM in Ethiopia**

### **4.2.1. Enabling Environment**

Enabling environment is one of the pillars of IWRM for its implementation. Under this Enabling environment, policies, proclamations and regulations and financial mechanisms of water management should be in place.

Existing enabling environment in Tigray Region, which are used for the implementation of water resources management are presented in table 4.3.

Table 4.3 Existing Enabling Environment Documents

| 1) Enabling environment               | Document name  | Remark   |
|---------------------------------------|--|--|
| Water management policy               | Ethiopian water resources management policy 2000.  | They use national water resources management policy as a guide line but not fully implemented.       |
| Water resources management strategy   | Ethiopian Water Sector Strategy, 2001  |  |
| Water management proclamation law     | Ethiopian water resources management proclamation No,197/2000<br>Tigray region management of environmental pollution proclamation No, 199/2003,<br>Tigray region collection and disposing of waste proclamation no191/2003,<br>Tigray region Environmental impact assessment proclamation No, 200/2003 | They have also regional proclamation, under publication  |
| Water resources Management regulation | Council of ministers Ethiopia water resources management regulation No, 115/2005.<br>Water Works Design and Supervision Enterprise Establishment Council of Minister Regulations No. 42/1998   |  |
| Water resources development programs  | Ethiopian Water sector development plan, 2002.   | Regional water development programs are prepared as a part Of GTP.                                   |
| Environmental policy                  | Federal Democratic Republic of Ethiopia Environmental Policy, 1997   | They have regional environmental proclamations for environmental protections and EIA.                |
| Agricultural policy                   | Ethiopia rural development policy and strategies<br>April, 2003  | This is used for agricultural and rural development; Irrigation is part of this policy and strategy. |
| Financial mechanism                   |  | National and regional budget allocation<br>Private sectors involvement<br>Ngos, Donations            |

#### ***4.2.1.1. Ethiopian Water Resources management policy***

Policy is deliberate and careful decision of actions to solve public issues (Torjman, 2005). In this context water resources policy are policies which are designed to solve water and relates issues within the community and environment. Water policies give basic principles and frameworks for the implementation of IWRM; however, it requires understanding the complexity of water resources development and management processes by all water from national to local levels (Rahaman, 2009). Ethiopian water resources management policy was prepared to enhance all efforts in order to have efficient, equitable, and optimum utilization of the available water resources of the country for significant socio-economic development in a sustainable manner (EWRMPo, 2001). This statement is directly related to the definition and aim of IWRM. In addition to this goal; it has five general water development and management objectives, which are very important to achieve water resources development, management, utilization and environmental and aquatic life protections. These objectives are:

- 1) Development of water resources of the country for economic and social benefits of the people on equitable and sustainable basis;
- 2) Allocation and apportionment of water based on comprehensive and integrated plans and optimum allocation principles that incorporate efficiency of use, equity of access and sustainability of the resources;
- 3) Managing and combating drought as well as other associated slows on set disasters through interalia efficient allocation, redistribution, transfer, storage, and efficient use of water resources;
- 4) Combating and regulating flood through sustainable mitigation, prevention, rehabilitation, and other practical measure; and
- 5) Conserving, protecting, and enhancing water resources and the overall aquatic environment on sustainable basis.

To achieve the above policy objectives Ethiopian water resources management policy document has basic principles, which water resources management should have to consider. The main principles of this policy are directly related to/ derived from the Dublin principles of IWRM. The six general water resources management principles under this policy are:

- 1) Water is a national endowment commonly owned by all the people of Ethiopia;

- 2) As far as conditions permit, every Ethiopian citizens shall have access to sufficient water of acceptable quality, to satisfy basic human needs;
- 3) In order to significantly contribute to development, water shall be recognized both as an economic and a social good;
- 4) Water resources development shall be underpinned on rural-centered, decentralized management, participatory approach as well as integrated framework;
- 5) Management of water resources shall ensure social, equity economic efficiency, system reliability and sustainability norm; and
- 6) Promotion of the participation of all stakeholders, user communities; particularly women's participation in the relevant aspects of water resources management.

The above fundamental principles of this policy are almost similar with the principles of IWRM, and it shows Ethiopian water resources management policy enables to implement IWRM approach as a main water management mechanism.

Ethiopian water resources management policy has different policy statements regarding to the water issues. It has policy statements related to general water resources management, water related cross cutting issues ; like water allocation, trans boundary, environmental and water shed issues, gender issues, institutional and legislation issues, water economics and tariff issue. Apart from this, it contains policies for three water related sectors such as water supply and sanitation, irrigation and hydropower. The policies for each water uses in this policy document are aimed to improve the benefit of water resources of the country through enhancing and implementing integration of the stakeholders, uses and different related resources of the country general water policy statements of this national water management policy under 2.1.1 show that water management of the adopted integrated water resource management approach. The general policy statements are:

- 1) Enhance the integrated and comprehensive management of water resources that avoids fragmented approach;
- 2) Recognize that water resources development, management, utilization, protection and conservation go hand in hand and ensure that water supply and sanitation irrigation and drainage as well as hydraulic strictures, water shed management and related activities are integrated and addressed holistically;

- 3) Recognize water as a scarce and vital socio-economic resource and to manage water resources on strategic planning basis with long term vision and sustainable objectives.
- 4) Ensure the integration of water resources development and utilization with Ethiopia's over all socio-economic development frame work and be guided by those socio-economic development objectives at the federal and regional level of government;
- 5) Ensure that water resources management is compatible and integrated with other natural resources as well as river basin development plans and with the goals of other sectoral developments in health, mines, energy agriculture and others;
- 6) Recognize and adopt the hydrological boundary or "basin "as the fundamental planning unit and water resources management domain;
- 7) Ensure that all planning, studies, programs, and development projects in the water sector include protection, and conservation, operation and maintenance as well as replacement activities and budgets.;
- 8) Promote and encourage that conservation of existing water systems and efficient utilization of water is as feasible as development of new schemes;
- 9) Integrate and institutionalize metrological and hydrological services at all level, and agricultural sector should be benefited from them;
- 10) As much as conditions permit, ensure that the provision of basic necessities of water at the household level are full filled, and allocation for other uses shall be based on equitable and efficient socio-economic development criteria;
- 11) Promote inter-basin transfer of water;
- 12) Although all water resources development ought to be based on the "Economic Value" of water, the provision of water supply services, to the underprivileged sectors of the population is based on special "social strategy";
- 13) Building and strengthen the necessary capacity in terms of institutions, legislations, facilities, human resources, finance, information system research and studies. And link for better and more efficient management of water resources including capacity building at decentralized and lowest level;
- 14) Promote and advocate for institutional stability in water resources management and insure smooth transition during time of change;

- 15) Promote and enhance traditional and localized water harvesting techniques in view of the advantages provided by the schemes dependency on local and indigenous skills; and
- 16) Promote the involvement and meaning full participation of the private sector in the management of water resources.

As the definition of Postel (1992) mentioned by vanderzaag and Savenije (2014), policy should include three basic principles, these are Equity, Ecological integrity and Efficiency. Regarding to these principles, Ethiopian Water resources management policy formulated based on these principles. In general water resources management policy is comprehensive and sound water policy, and which is related to integrated water resources management approach. In addition to Ethiopian water resources management policy, Ethiopian rural development policy, which is talking about rural development, agricultural improvement and water resources utilization for agriculture, is also available in the region.

Respondents for questioner interview were asked about the Implementation of water resources management in their sector. The respondents responded that, even if the policy of the country is very useful, they are not using it and is not yet fully implemented.

#### ***4.2.1.2. Water resources management proclamation***

In order to implement water resources management policy of the country, Ethiopia had prepared Ethiopian water resources management proclamation law in 2000. This proclamation is known as Ethiopian water resources management proclamation No, 197/2000 (EWRMP, 2000). As the proclamation law stated that, the purpose of this proclamation is to insure water resources of the country are protected and utilized for the highest social and economic benefit of the people of Ethiopia, to follow up and supervise that those water resources are conserved and to be sure that harmful effects of water resources are controlled and prevented and management of water resources are carried out properly (EWRMP, 2000). Principles of this proclamation are also related to water policy of the country and are aimed at implementing water management based on integrated approach. As it is mentioned in this proclamation water resources of the country are the common property of the Ethiopian people and the state. This proclamation deals with power of supervising body (MoWR), permits and licensing, dispute settlements, water fees and charges, water services, water user associations and protection of water banks and harmful effects of water.

In addition to this, there are other proclamations used at regional level related to water resources and environmental protections, like Tigray region management of environmental pollution proclamation No, 199/2003, Tigray region collection and disposing of waste proclamation no191/2003, and Tigray region Environmental impact assessment proclamation No, 200/2003. These proclamations are prepared by Tigray regional Government to protect the environmental pollutions. Tigray region water bureau is also on preparation of irrigation proclamation for proper and efficient utilization of irrigation water and structures.

### **Regulations**

For the facilitation and enforcement of Ethiopian water resources management proclamation, Ethiopia has also water resources management regulation which is known as Council of Ministers Ethiopia water resources management regulation No, 115/2005. This regulation was prepared based on the Ethiopian water resources management proclamation No, 197/2000. And it states about water resources utilization, water works permit, water quality control which is about discharge of waste and fee, certification of professional in water construction and consultancy, water user cooperative societies, fees and discharges, dispute settlement and miscellaneous provisions. And there is also Water Works Design and Supervision Enterprise Establishment Council of Minister Regulations No. 42/1998.

Global water partnership (2004) puts some requirements on sound legislations, these requirements are

- 1) Legislations should be based on stated national water policy, that cuts across sectoral and stake holder divisions, address water as a resource and stresses the societal priority for basic human needs and ecosystem protection;
- 2) It should Secure water (use) rights to allow private and community investment and participation in water management;
- 3) It should regulate monopolized aces to raw water and water services, and prevents harm to third parties;
- 4) It should have balanced approach between resources development for economic purposes and the protection of water quality, ecosystem and other public water benefits;

- 5) It should support water development decisions to be based on sound economic, environmental, and social assessments; and
- 6) It should assure the possibility of the implementation of participatory and economic tools, where, when and to extent of the requirement.

Based on the above criteria and requirements of legislations, Ethiopian water resources management proclamation, and regulation are found in a good stand. They include and fulfill the requirements which are listed above.

In addition to water resources management policy, proclamation and regulations, there are also Environmental, Agricultural and Energy policy proclamation and regulations in order to enhance benefits of the people and conservation of natural resources of the country for the purpose of poverty alleviation and development of the country.

#### ***4.2.1.3. Financial mechanism***

For the development and utilization of water resources of the country Ethiopia prepares an action plan for 15 years from 2002 up to 2017. This action plan is called Ethiopian Water sector development plan, which has short, medium and long term targets to be achieved on 5 year intervals. This plan includes three water uses (sectors), which are water supply, Irrigation and Hydro power developments. To implement this water development plan it needs huge amount of investment that is about 7444.8 Million USD. Table 4.4 shows the overall investment required for water sector development program.

Table 4.4. Summary of overall WSDP investment requirement from 2002 -2017(USD)

| Sub-sector                                   | Short term<br>(ST) | Medium<br>term<br>(MT) | Long term<br>(LT) | Total          |
|--|--------------------|------------------------|-------------------|----------------|
| <b>Water Supply &amp; Sewerage Program</b>   | <b>876.2</b>       | <b>1,057.9</b>         | <b>1,001.7</b>    | <b>2,935.8</b> |
| Federal                                      |                    |                        |                   |                |
| Regional                                     | 876.2              | 1,057.9                | 1,001.7           | 2,935.8        |
| <b>Irrigation Program</b>                    | <b>307.9</b>       | <b>456.9</b>           | <b>918.3</b>      | <b>1,683.1</b> |
| Federal                                      | 114.7              | 268.1                  | 700.9             | 1,083.7        |
| Regional                                     | 193.2              | 188.8                  | 217.4             | 599.4          |
| <b>Hydropower Program</b>                    | <b>649.1</b>       | <b>525.9</b>           | <b>776.7</b>      | <b>1,951.7</b> |
| Federal                                      | 647.4              | 516.2                  | 764.5             | 1,928.1        |
| Regional                                     | 1.7                | 9.7                    | 12.2              | 23.6           |
| <b>General Water Resources Program</b>       | <b>183.9</b>       | <b>231.9</b>           | <b>240.5</b>      | <b>656.3</b>   |
| Federal                                      | 133.7              | 160.1                  | 153.7             | 447.5          |
| Regional                                     | 50.2               | 71.8                   | 86.8              | 208.8          |
| <b>Institution/Capacity Building Program</b> | <b>92.9</b>        | <b>63.3</b>            | <b>61.7</b>       | <b>217.9</b>   |
| Federal                                      | 13.2               | 5.3                    | 5.0               | 23.5           |
| Regional                                     | 79.7               | 58.0                   | 56.7              | 194.4          |
| <b>Total</b>                                 | <b>2,110.0</b>     | <b>2,335.9</b>         | <b>2,998.9</b>    | <b>7,444.8</b> |
| Federal                                      | 909.0              | 949.7                  | 1,624.1           | 3,482.8        |
| Regional                                     | 1,201.0            | 1,386.2                | 1,374.8           | 3,962.0        |

(Source WSDP main report, 2002)

As it is mentioned in this development plan the financial source will be from External domestic and private capital (domestic and international). The sources for the required financial resource are listed as following: -

- ✓ 24.5% from government sources
- ✓ 25.4% from international private sectors
- ✓ 10.2% from domestic private sectors

- ✓ 5.1% from communities /beneficiaries
- ✓ 34.8% from multilateral and bilateral donors

(Source WSDP main report, 2002)

As it is also described in Growth and transformation plan of Ethiopia (GTP2plan) for water supply and sanitation from 2015/16 up to 2019/20 prepared by Ministry of Water, Irrigation and Energy in 2015, to implement this plan financial arrangement is in place. Table 4.5 presents the financial plan for the achievement of the GTP2 plan for water and sanitation in the country.

Table 4.5. Financial plan for GTP2 for water supply and sanitation

| No | description                                     | Total<br>(000ETB*) | Annual plan (000ETB) (years in EC) |                   |                   |                   |                   |
|----|---|--------------------|------------------------------------|-------------------|-------------------|-------------------|-------------------|
|    |   |                    | 2008(2016)                         | 2009 (2017)       | 2010 (2018)       | 2011 (2019)       | 2012 (2020)       |
| 1  | Recurrent<br>Budget                             | 5,063,188          | 819,922                            | 850,134           | 1,207,632         | 1,183,503         | 1,001,999         |
| 2  | Capital<br>budget<br>rural water<br>supply      | 28,042,030         | 4,977,144                          | 5,115,662         | 6,448,049         | 5,649,125         | 5,852,0477        |
| 3  | Capital<br>budget, for<br>urban water<br>supply | 44,212,677         | 7,165,408                          | 7,641,320         | 8,830,502         | 10,670,839        | 9,904,608         |
| 4  | Sewerage<br>cost                                | 5,517,500          | 503,500                            | 503,500           | 2,003,500         | 2,003,500         | 503,500           |
|    | <b>Total</b>                                    | <b>82,835,974</b>  | <b>13,465,974</b>                  | <b>14,110,616</b> | <b>18,489,683</b> | <b>19,506,966</b> | <b>17,262,155</b> |

(source, GTP2 plan, 2015) 1USD = 20ETB\*

The sources and amount of the indicated financial requirements are listed in 4.6 that they are from government, donors, CSOs, urban water supply utilities, and beneficiary communities.

Table 4.6. Financial source for GTP2 plan for water and sanitation

| No | Description                  | Amount (ETB)      |             |
|----|------------------------------|-------------------|-------------|
|    |                              | Amount in(000's)  | Percent     |
| 1  | Government                   | 40,598,162        | 49%         |
| 2  | Donors                       | 25,684,551        | 31%         |
| 3  | CSOs                         | 3,314,136         | 4%          |
| 4  | Urban water supply utilities | 9,113,873         | 11%         |
| 5  | Beneficiary communities      | 4,142,670         | 5%          |
|    | <b>Total</b>                 | <b>82,853,391</b> | <b>100%</b> |

(Source, MoWIE, GTP2 plan, 2015)

In Tigray regional, GTP2 plan for water resources management and development which is prepared by bureau of Tigray region water resources from 2016/17 to 2021/22, there is financial mechanism as the table 4.7.

Table4.7 Financial plan for GTP2 for water resources development and management of Tigray Region

| No | Description   | Required amount of money(ETB) |
|----|---|-------------------------------|
| 1  | Expansion of rural water supply                           | 3,261,334,184.00              |
| 2  | Expansion of Urban water supply                           | 8,603,328,775.00              |
| 3  | Expansion of irrigation infrastructures                   | 18,663,827,799.00             |
| 4  | Water resources management and regulatory                 | 1,778,970.00                  |
| 5  | Water resources assessment and research works             | 51,450,000.00                 |
| 6  | Water resources information development                   | 28,673,2000.00                |
| 7  | Improvement of enterprises for maintenance of water works | 34,000,000.00                 |
| 8  | Capacity building   | 264,141,554.00                |
|    | <b>Total</b>  | <b>30,908,535,482.00</b>      |

(Source, Tigray region Bureau of Water resources, GTP2, 2015)

The financial sources for the above growth and transformation plan are Tigray regional government, donors, NGOs and water user communities.

In most countries funding for water comes from government budget allocation and other funding organizations, this is neither adequate nor sustainable (UNWWDR, 2015). Investments are needed for reducing spatial and temporal variation of water variability to protect people from draught risks, to deliver water to large number of users, to minimize waste and surplus of water at local regional levels, to enable water users to solve their own water related problems. It is responsibility of government to funding the overall water investment, though can be supported by private sectors, international organizations, water users and other sources (GWP, 2000). This financial arrangement for water resources development and managements in the country shows that, government is trying to arrange the investment mechanism from its own budget and other supporting sources. Enabling environment for water resources management in Ethiopia, regarding to financial mechanism as one component is found in a good statue. This means water resources management plans are planed provided that financial requirements and allocation of budget for water resources sectors is in place. Even if the financial mechanism is in place, respondents mentioned that, shortage of finance is the main challenge for implementation of water resources management.

Enabling environment is the main component and one of the basic pillars for successful implementation of integrated water resources management. As GWP (2000) stated that the policies, regulation and legislations and financial mechanisms should be in place. In Ethiopia, as a country, there are prepared water policy, water management proclamation and laws, and financial mechanisms for water development. These policies and regulations are supposed to be utilized in water resource development, utilization management and conservation and protection of this resource for equitable, efficient, sustainable development of the society and the country in large. Regarding to the existence of these requirements under enabling environment many countries are listed as an example. As it is mentioned in the global water partnership technical advisory committee back ground paper 3, many countries prepare water policy with purposes and objectives and have legislations on water utilization and management, and they have laws including policy objectives and principles, Some of these countries are Canada, Germany, Netherlands, China, Mexico, England Australia and others. These country's policies and water

acts do not only state about water utilizations but also about environmental protections, water assessments, water planning at river basins and other related concerns (GWP, 1999). Regarding to the preparation and existence of this water polices, legislation and putting financial mechanisms for water resources and environmental managements, Ethiopia is also one of the countries who are advancing on it.

In general, the Enabling environment at federal level of Ethiopian water resources management is appreciable. It has policies, regulations, plans and financial mechanisms.

#### **4.2.2 Institutional role**

##### ***4.2.2.1. Existing governmental institutions working on water and related issues***

The existence and development of Institutions critical for the preparation, and implementation of IWRM, policies and principles and it should involve consideration of rules, regulations, customs and practices, ideas and information, and interest of community groups (GWP, 2000). There are a number of institutions which are established by government to work in assessment, development and management of water and related resources of the country, region as well as at district levels. Based on respondent's opinion, some of these institutions which are found in the region and district level are;

Tigray Bureau of Water Resource, management  
Tigray Water Works Design and Construction,  
Tigray Bureau of Agriculture and Rural Development,  
Tigray region Meteorological Agency,  
Tigray Agency of Environmental Protection, and  
Tigray Bureau of Health

The above institutions are working as a branch of the Federal Ministries. Some of them are divided up to the woreda/ district level. Bureau of water resources, Bureau of agriculture, Bureau of health have branch offices in each districts of the region. These institutions have different mandates and roles in development and management of water resources of the region. Bureau of water resources management as it is Branch of Ministry of water, Irrigation and Energy of Ethiopia; it is highly participating and controlling the overall assessment, development, construction and management of water resources of the region. As water utilization and developments are based on Permit

system (EWRMP, 2000), this water utilization and development of large structures, developing deep boreholes and waste water disposals in the region and woredas are given and controlled by this regional water Bureau. Other offices and institutions are supporting in different ways depending on their role on water resources management and development. Tigray water works design and construction contributes on designing and construction of water structures, Tigray region metrological agency mainly works on collection of metrological data of the region, Tigray region agency of environmental protection activates in the assessment, protection of the environment, Tigray Bureau of Agriculture and rural development works on all agricultural activities including irrigation water managements and Bureau of Health works on quality of drinking water and controlling water born and water related diseases.

One of the policy statements in Ethiopian water resources management is “Establish water resources management institutions for sustainable development and management of the water sector” (EWRMP, 2001). To fulfill this policy statement there are water resources development and management institutions at federal, regional, district and sub district levels. These institutions have different mandates and responsibilities to do at their level of management. As it is mentioned in the Ethiopian Water resources management and proclamation and regulations the higher supervising body for water resources development and management the country is federal Ministry of Water, Irrigation and Energy. Regional and district water bureaus have also their own responsibility.

#### ***4.2.2.2 Institutional arrangement of water management office***

In integrated water resources management, it is necessary to have Top-down and bottom-up participation mechanism, in order to have this there should be organizations should be at different levels with different responsibilities to done (GWP, 2000). As it is described in the Ministry of Water, Irrigation, and Energy website, GWP (2015) and ODI and OSSREA (2010), MoWIE is the core Federal government institution with high responsibilities in water resource of the country. It formulates policy and legislations, establishing water management institutions constructed by federal budget, follow up and coordinate implementation of projects financed by foreign assistance and loans. It also provides technical support to regional water bureaus. Institutional arrangement of water resources management in the country starts from the Federal Ministry of water, Irrigation and Energy and sub divided to regional, zonal and woredas level

water resources, prepare water related standards, dealing with trans-boundary rivers, plan and administrative water resources protection, monitoring and allocation, plan and develops water supplies and sanitation, irrigation and hydro power and other energy forms, undertake basin studies, administer dams and water structures bureaus and offices.

Regional level water bureaus are mandated for the federal policies, strategies, action plans by adopting and modifying them to the stations of the region. They also implement regulatory works when they are delegated by the Ministry. Tigray region Water resources management Bureau is a sub division of Ministry of Water, Irrigation and Energy of federal democratic republic of Ethiopia. The overall institutional arrangement and hierarchy of this Ministry is represented as shown in Fig4.1. In addition to this hierarchy and sub classification of this institutional arrangement is going down up to Tabia/sub woreda administration levels. In this Tabia and woreda level there are also establishments of water user associations for different water uses, like Irrigation schemes/irrigation from Dam, Diversions or check dams/, water supply pointes/Hand dug well and boreholes/, and other water uses depending on the availability of water and number of users.

Water bureaus at zonal level are responsible for activities like supporting technically to woredas water offices, and town water supply offices. Apart from this they are also responsible organizing activities, preparing plans and reports of the woredas when they are asked by regional bureau. It is a middle facilitator between regional water bureau and woredas water offices.

Woreda water offices are mandated for assessment of water in the woreda, design and implementation of small scale water schemes, irrigation structures, are supported by regional and zonal water bureaus. It is divided in to three sub sectors such as water supply and sanitation, Irrigation designing and construction, and water resources management. And each sub sectors are organized by multi-disciplinary staff members, Environmentalist, irrigation designer, sociologist, geologist, and soil and watershed expert.

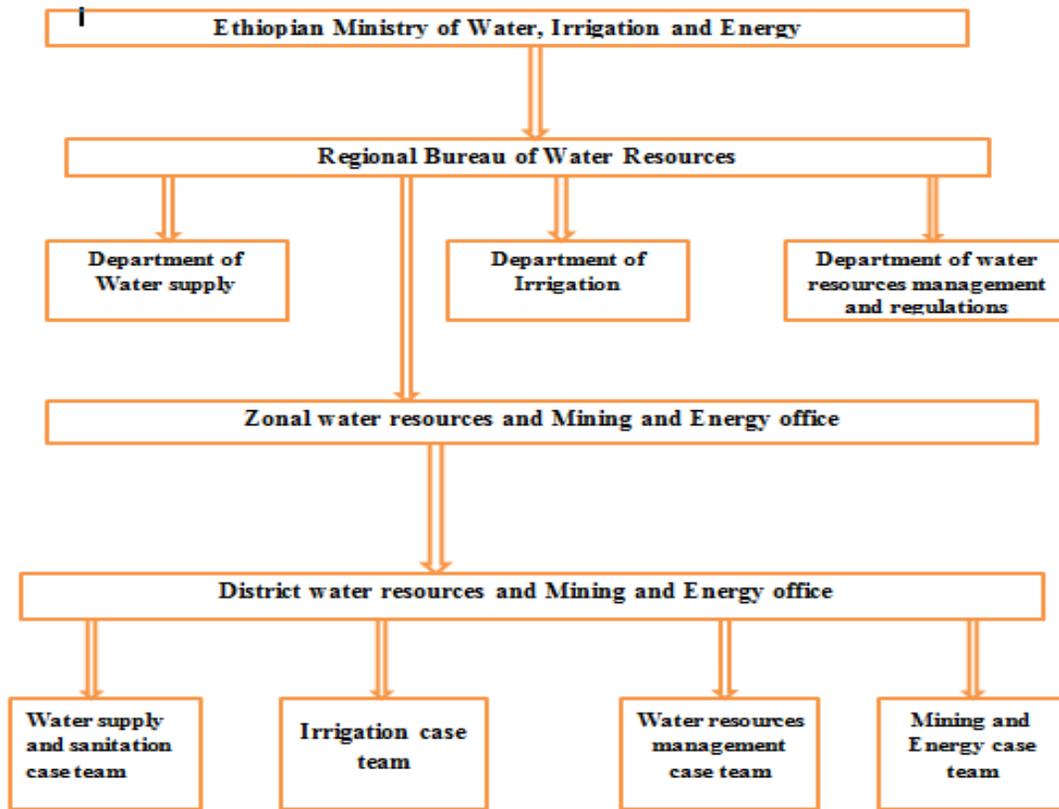


Fig 4.1 Hierarchy of water management office and Institutional Arrangement

### Existing Non-Governmental Organizations (NGOs) and private institutions

At regional level, there are a number of private and NGOs working in collaboration with governmental institutions and offices working in water and other related fields.

Private organizations / institutions are more engaged in consultancy, designing and construction of water resources structures and feasibility studies for other development activities. These private institutions are working for profit and are licensed by concerned body based on their field of activities. Some of these private institutions are private colleges, contractors in construction of Dams, consultancy offices, borehole drilling organizations and others.

NGOs are also contributing to development of water resources and natural resources conservations in the region in general. Some of these NGOs found in the region are World Vision, Unicef, GIZ, RERST (local NGO), Orthodox church, St. Mary college,

At district level in Woreda Kilde Awlaelo surrounding Genfel River Unicef, World vision, St. Mary College and Orthodox Church are working a lot of developmental and conservational activities in Genfel River. The role of these sample institutions is described in table below4.8.

Table 4.8 Institutions and their role in water resources development and management

| Institutions                     | Role of institution in water resources development and Management   |
|----------------------------------|---|
| Wukro St. Marry college          | <ul style="list-style-type: none"> <li>➤ Irrigation water development</li> <li>➤ Maintenance of water infrastructures</li> <li>➤ Capacity building in water resources management for farmers</li> <li>➤ Strengthening water user associations</li> <li>➤ Supplying spare parts for maintenance</li> <li>➤ Transfer technologies for efficient utilization</li> </ul>                                      |
| World vision Ethiopia            | <ul style="list-style-type: none"> <li>✓ Drilling and development of deep and shallow wells</li> <li>✓ Supporting irrigation canal constructions</li> <li>✓ Development of springs for irrigation</li> <li>✓ Support rain water harvesting structures construction</li> <li>✓ For human and livestock Giving capacity building on irrigation water management for farmers and water committees</li> </ul> |
| Relief Society of Tigray ( REST) | <ul style="list-style-type: none"> <li>✓ Construction of water structures for human and livestock</li> <li>✓ Construction of water harvesting structures for Irrigation (diversions, check dams, spring development, roof harvesting) etc</li> <li>✓ Construction of drinking water like hand dug wells, shallow wells, and bore holes Capacity development activities,</li> </ul>                        |

As it is presented in table 4.9, institutions are participating in water resources development, construction of water structures, maintenance activities for irrigation and water supply structures, providing water resource and related management trainings for farmers, water user association leaders, transferring technologies for water and soil conservations, and efficient water utilizations.

### **4.2.3. Management Instruments**

#### ***4.2.3.1. Water resources assessment***

Regarding to water resources assessment in the region, the assessment of water resources potential is done by using Metrological and hydrological data which is collected from metrological and hydrological data measurement stations of the region and are controlled by regional and federal metrological agencies. Tigray Bureau of Water Resources tries to quantify the availability and potential of water resources of main drainage basins of the region, though the required hydrological and metrological data are found from other separate offices of hydrology and metrology which are controlled by federal and regional governments. Because of this it is not easy to get the required data. Different institutions (Universities) also tried to assess the water resources of some rivers in the region through their research and other community service projects, though their reports are not for everyone.

Tigray region has three main river basins which are part of the national river basins, Tekeze river basin (which drains to River Nile), Mereb River basin, and Denakil river basins. Even if they are a number of rivers which are drained to these river basins, the assessment and quantification of water resources is done by federal Ministry of Water, Irrigation and Energy. Tigray bureau of water brings these hydrological data from Ministry of Water, Irrigation and Energy for their analysis and design of water structures.

According to respondents of this study, Woreda KiltAwlaelo water resources are assessed through traditional ways through physical measurement at field level, past history of the area, through assessing geological formation of the area ( for ground water development).

Water quality assessment is not well practiced in most countries, which makes difficult to determine either safe water is delivered to users or not (UNWWDR, 2015). It is found that Water

quality assessment at regional and local level is not practiced in proper way. Even if there is water quality assessment laboratory at regional level, it is not fully functional, they try to say either water is polluted or not, through physical observation of water quality problems and impacts on health, plants and soil of the farm lands. This traditional and technologically unsupported water quality assessment mechanism will affect human and animal health, and aquatic life and Environment in general.

Water resources assessment is important to identify water problems, availability and demand of water resources, and it is very crucial and useful way of acquiring information for proper management of water resources, therefore it should address the occurrence of water in space and time of surface and ground water sources, water demand and productivity, identifying the major problems related to water resources in order to put prioritization of activates (GWP, 2000). In addition to socio economic factors, biophysical aspects of water cycle and its interaction with ecosystem should be clear and understood very well in order to have scientific water assessment results for appropriate water policy development (Xia, 2012). Inadequate assessment of water resources contributes to water resources management failure (UNWWDR, 2015). Lack of knowledge and absence of instruments at basin level are the major barriers of proper implementation of water policy (Xia, 2012). Then, the above points recall to water resources assessment that it should be practiced in a proper and sufficient manner. However, the assessment of water resources and structures, problems of water demand and supply, quantification of available water resources, assessing the status and conditions of water structures is implemented in a poor manner in the study area. This can lead to complex water related problems. Science and technology have great role in assessing, identifying and understanding why water and related problems are happening in terms of water quality including climate change and human activities (Xia, 2012). As VanderZaag and Savenije (2014), stated that water is special because of its three characteristics, that water is vital to life, it is finite and is difficult to assess and quantify. Therefore, water resources assessment should have to be done through scientific mechanisms and modernized materials.

#### ***4.2.3.2 Communication and information data base***

Ethiopian water resources management policy statement related to water resources information states that it needs to:

- 1) Manage and administer water resources information on the basis of project and sector information, management information system, technical information and public information systems; and
- 2) Recognize the link between properly managed water resources and the availability of viable information systems and to develop a practical, coherent, well designed and smoothly functioning Ethiopian Water Resources Information Systems (EWRIS), by establishing the Ethiopian Water Resources Information Centre (EWRIC)”(EWRMP,2001).

The above two policy statements are indicating the relevance of establishing information and communication for water resources management. Participation of stakeholders is dependent on awareness rising among stakeholders, decision makers, professionals, interested groups, while communication and information should be in place. In order to have effective participation and involvement it is essential to have timely and relevant information and communication system (GWP, 2000). Reliable information about the status of water resources, utilization and management of many countries is very poor or not available (UNWWDR, 2015).

Based on respondents’ opinion and observations, at regional level there is documentation section in each department, which collects and stores information on what kinds of structures, developments and activities are takes place at the regional level. In this data base information on constructed structures, feasibility studies, and related information are available. In addition to this there is also preparation to create well organized computerized database which contains about water points of the region and that can be accessed through the bureau website.

Even if they have an information data base, dissemination of this information for different institutions, stakeholders, and local level users is not developed and found at lower level. However, they are giving water related information for researchers and contractors, consultancy

offices through formal inquiry letters as they need. However, because there is no periodical assessments and updating of these information the data, which is given by the office sometimes need farther validation and ground trothing.

At woreda and local tabia level information on water utilization, example number of water users and kinds of uses, irrigation potential and area of irrigated land, number of households use water points is posted at tabia offices notice board. Information on hectare of land and water potential of diversions, dames and check dames are based on r rough estimations. In addition to this every stakeholder is not well informed on the availability, potential and capacity of diversions and dames in a timely based. Yet water remains to be a driving and limiting factor for economic development, human life and environmental sustainability, and lack of information and knowledge will have massive problem on formulating appropriate policy, passing sound decisions (UNWWDR, 2015). However, information management and dissemination system in general and information and data base management in water resources in the woreda and region is not well organized. Such kind of environmental awareness problems, poor institutional arrangements and coordination and low stakeholder participation are also challenges for integrated water resources management in Lake Koka, which is in eastern part of Ethiopia (Seyum, 2011).

#### ***4.2.3.3 Water allocation and Conflict resolution mechanisms***

Water allocation is defined as a process of sharing limited water resources between computing water uses and users when the availability and distribution of water resources cannot meet the need of water users and which deals with who, how much, from where and for what purpose is water utilized (speed et al. 2013).Ethiopian water resources management policy states that water resources allocation should be based on prioritization, especially it prioritizes water uses for human and animal consumptions and the other uses are prioritized based on their social and economic benefits ( EWRMPo, 2000). As water is not like other goods and services, Water allocation should be done by considering water value for socio economic development, environmental benefits, and historical considerations between users (GWP, 2000). As water scarcity is increasing at global, regional, national and local levels, water allocation should be in place to solve water related crises (speed et a., 2013). In the study area water allocation have not been implemented between water uses, especially water allocation between irrigational consumption and environment and other economic activities are not implemented within the

Genfel river water. Responses from Interviews showed that water allocation is practiced only in irrigation water user associations, with in the farmers who are members of that water association. Allocation mechanism for irrigation water is, timely based schedule depending on the availability of land size regardless of water requirement what they are cultivated. They also said that during dry season water becomes scarce and the amount of water flowing through the river is decreased, at this time the competition to use the available water with in the diversions is increased.

Environmental water use is almost forgotten in the study area. People who are not members of water association are extracting water from the river by using motor pumps. In some parts of the river the river bank is excavated and water found under the sand is exploited for agricultural and animal consumptions.

As key informants and experts in water and agricultural said that, the government direction is advocating to use the available drop of water for economic developments, so people who are using water from the river by any means of extraction are encouraged. Because of this people who have the capability of purchasing motor pumps are highly participating in exploiting the river water.

Conflict is a common phenomenon in utilization of natural resources, especially water and related resources development, utilization and management, and which does not mean IWRM has failed, however may leads to find the best solutions for that problem (Hileman, 2016). In Tigray region conflicts are happening between water users especially irrigation water users, upstream and downstream users, between water user associations etc. However, these conflicts are most of the time solved at local level, through water user association committees. Conflicts which cannot solve at local and district levels are directly passed to the regional level and which are solved through different conflict resolution methods and steps through following the regulation which is prepared at federal and regional levels for water utilization and management. In the study site, as respondents from interview and questionnaires conflicts are raised because of competitions, and disturbances on the schedule. Although such conflicts are happened they are not exaggerated and are solved at local level through discussions. Whenever a problem is happening with in members of water user associations, the issue will be raised in a monthly meeting of the association and solutions are provided for the issue.

As respondent and key informant from Aynalem tabia said, there was a conflict between Aynalem and Genfel tabia farmers, (which is Upstream and downstream issue), because of high extraction of water by using motor pumps from the river by excavating the river bank at Genfel tabia which is up stream, because of these downstream farmers are complaining and disagreements were happened. Though, the problem has been solved through discussions, with the help of woreda water bureau experts.

Water user associations have their own bylaws to administer the water utilization of the diversions, including conflict resolutions. It contains a statement to punish for a person who creates conflict or disturbance in the water utilization process. There is also one conflict resolution mechanism when conflicts are created within the local community in any social life issue. The resolution mechanism lead by elder part of the community and is locally called” SHIMAGLE Adi” which means elders of the community. This mechanism of conflict resolution is used and implemented to solve water related conflicts.

At national and regional level policies, proclamations and regulations state conflict resolution as a main component of the water management process. Then, if water related conflicts happen they are addressed at woreda level and if not solved, it shall be handled by Regional Water Bureau through different mechanisms.

### **4.3. Implementation of IWRM Principles**

#### **4.3.1. Principle 1: - fresh water resource and its protection**

As water is natural resource it can has naturally yield limit, which is highly vulnerable Due to human effects on its quality availability and quantity through different economic activities, it has upstream and downstream water user issues. There for water management should be in a holistic approach by considering water and environment, water quality and quantity, users and institutions (GWP, 2000). It is also necessary to prepare water management policy, environmental and water quality protection legislations, water and river basin management plans and assessment mechanisms of water projects (GWP, 1999).

## **Holistic management approach**

The first Dublin principle for IWRM approach recognizes that, water resources management should be in a holistic approach, and should include all water demands, water uses, concerned bodies, and characteristics of water and water cycle (GWP, 2000). Based on the responses from questionnaires at regional and district level water resources management is practiced in a holistic management approach. They incorporate Natural resources like forest lands and tree plantations, soil and water conservation, farm land protections, different water uses like irrigation water use, domestic water use, and water for other economic activities and different institutions and NGOs; REST, Ethiopian orthodox church, Wukro St. Mary college, Wukro Agricultural college.

## **Involved sectors and water uses**

As management of water resources in a holistic approach, they tried to involve different water uses in the management of water resources of the region and districts. Water use for domestic and animals, water for irrigation, water for industries, and water for other economic activities (like care wash and construction). Having these water uses are considered as the best practices of water resources management and allocation of water resources of the district and Genfel River. However management and allocation of Genfel River water resources is very fragmented. Each water users are extracting water as they want and are not well organized in terms of management and controlling of the quality and quantity. Especially there is no water for Environmental protections. People are using water randomly without control. Different sectors and NGOs are working separately. Bureau of water resources management, Bureau of agriculture, Environmental protection agency are supposed to work holistically, however as they have different roles and responsibilities they are working individually. Even, sometimes they are conflicting to each other on using resources. And sometimes they are clashes on programs and activities which are done by organizing the community. This affects the overall development and management of water resources of Genfel River.

## **Other natural Resources**

Different natural resources have to be incorporated in management of water resources for sustainable management. In the study area, Genfel River, natural resources other than water resource,(soil, and forest) are managed as part of natural resources. Soil and water conservation, tree plantation and protection practices are well done through mobilizing the community in different ways. In some parts of the river, the two hilly sides of the river have well conserved by constructing terraces and bunds and plants are also cultivated to control erosion and to conserve the moisture of the farm lands. As it is shown in Fig 4.2 People are constructing such kinds of soil and water conservation structures.



Fig 4.2 Bench terrace constructed at side of Genfel River (TabiaAynalem, WoredaKilteAwlalaelo)

## **Water quality and quantity protection**

In the study area, main source of water for irrigation is Genfel river diversions and dames. They also use ground water sources for household consumption. The amount of water which is flowing on the river is decreased from time to time and there is a seasonal variation. This is because the decreasing of rain falls from year to year and is variation of rain fall from season to season. Rain

fall is falling during summer season from June up to September and the flow can stay steadily up to January. After that, the flow of water over the river highly decreased. During this dry season as the flow is decreased, Farmers start excavating the river bed to find subsurface water which is stored in the sand in group or individually and they pump the water for crop production and other related uses. Figure 4.3 shows the trend of Genfel river flow Variation from 2000 up to 2014.

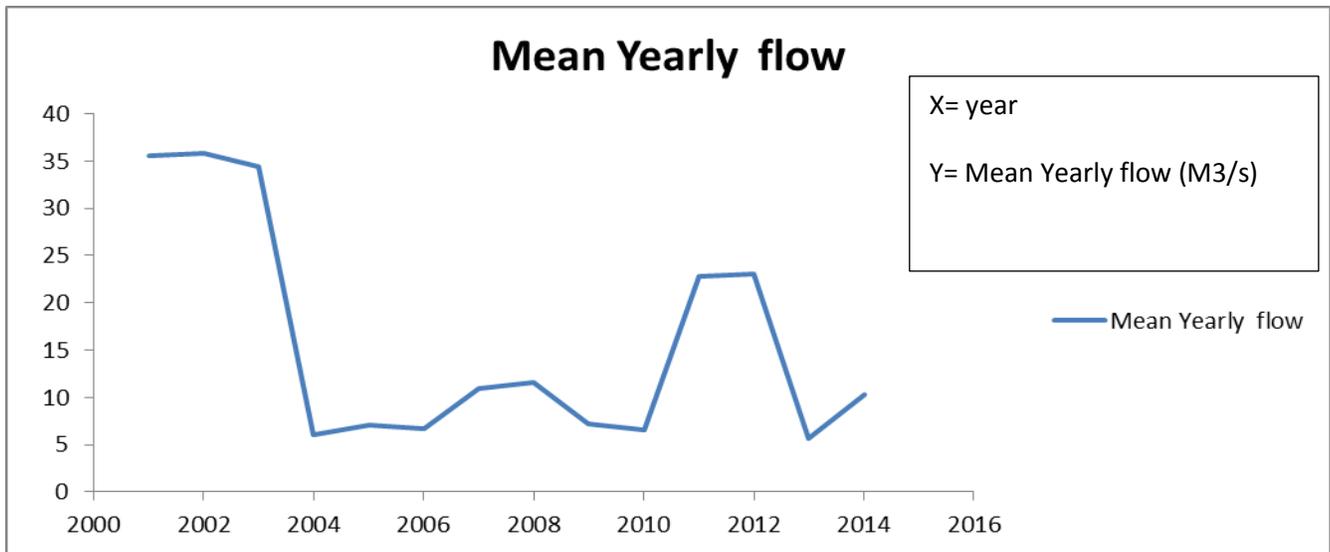


Fig 4.3 Genfel river flow variation (source Tigray bureau of Water resources)

In addition to this, the water flow is decreased when it reaches to the downstream side of the river. As the respondents from downstream side (sub district administration of Aynalem), said that, the flow of water is decreased because of high extraction of water from the river by using motor pumps in the upper parts of the river sub district administrations of Genfel and Tahitay Adisadd. As information gathered from the Water and irrigation experts of each sub districts the number of motor Pumps used to pump water from the river is increased from time to time. And the utilization of water from the river does not have limits and restrictions. Farmers can extract and use as they want without control. If they have motor pumps, they can take the amount of water they want. Number of motor pumps in Sub district Tahtay Adisadd (upstream) is about 40, in Sub district Genfel (middle part) which is about 315, and in the downstream side of the study area sub district of Aynalem, it is about 226. From the total number of motor pumps in upstream and downstream

sides, the numbers in upstream side is very high, and which openly shows how much it affects the flow of the river water from upstream to downstream.

Genfel River is facing various water quality problems, which are the results of human activities held in and outside of the river. As key informants from each sub districts stated that and my field observations, in upstream side of the river, there are formal and authorized and non-authorized car washing activities and brick manufacturing water user associations through using the river water. The drains of this car washing and brick manufacturing wastes are drained to the river. People are washing their clothes by using different kinds of detergents in all parts of the river from upstream to downstream. Because of this, the river water is contaminated from car oils and detergents.

At the mid of the river near to Wukro town there is Leather Industry (Sheba leather industry), as respondents from downstream (sub district of Aynalem) said that this industry discharges its waste water to the Genfel river during summer and rainy seasons. This affects the quality of water and health of the community, animals and agricultural products at the downstream side of this industry (in Tabia Aynalem). Study by Abrha et al.; conclude that water bodies surrounding and downstream of Sheba leather industry are contaminated by waste water released from that industry, which contains, chromium; this chromium can cause serious human and animal health problems (Abreha et al., 2009). As Teklit (2015) concluded from his study, industrial waste from Sheba leather factory affects irrigation water quality and some chemicals elements are increased on the farm land which is irrigated from contaminated water (Teklit , 2015).

Respondents also confirmed that , the main causes for water quantity and quality deterioration are, over grazing and deforestation of mountains, lack of proper sanitation and hygiene, low protection of agricultural lands, poor soil and water conservation practices, scarcity of rainfall, over utilization of water resources, drainage of waste water from industry and solid waste disposal from the town, the sewerage system of the town is drained to the river, and lack of proper controlling mechanisms of waste management and implementation of regulations. Fig 4.4 shows that activities which are affecting the quality of water resources in Genfel river.



Fig 4.4 Activities, Affecting Water quality of Genfel river

To manage this deterioration of water quantity and quality of Genfel River, some measurements and actions practiced by government and with the support of government and other organizations. Some of them are, organizing people as water user associations in order to use water properly; water user associations for irrigation from diversions, improvement of house hold hygiene and sanitation activities, developing soil and water conservation practices, giving trainings on effective utilization of water and punishing informal water users for car washing activities.

Even if they think they are managing in a holistic approach, based on the observations and responses non-governmental organizations from woreda Kilde Awlalo, practically it is not real holistic approach. Because, the coordinated management of water and other natural resources, coordination of different water uses, cooperation of upstream and downstream water users, different institutions in water resources utilization and management in the study area is very poor. As the respondents from non-governmental organizations and institutions pointing out that, the coordination of institutions, in water related activities in the woreda is not appreciable; things are worked out individually without discussion and cooperation between institutions.

### **4.3.2. Principle 2: - participation of stakeholders**

#### **Key stakeholders participating in water management**

Water is a resource and an issue in which everyone is a stakeholder and when every stakeholder is part of decision making we can say there is real participation (GWP, 2000). In the study area, there are many parts of society considered as stakeholders and participated in water resources development and management of the region and the woredas. The main ones are: -

Elder people from the community;

Farmers/ water user;

Tabia administrators;

Religious leaders;

Women and youth associations;

Different institutions; and

Governmental and nongovernmental organizations

#### **Contribution of stake holders**

People who are selected for interview were asked on the participation and their contribution in water resources development and management projects. Table 4.9 shows their response regarding to participation.

Table 4.9. Community participation in water related projects

| Questions  | Responses | Frequency | Percentage |
|--|-----------|-----------|------------|
| Do you have water projects in this area?                                   | Yes       | 30        | 100%       |
|  | No        |           | --         |
| Do you know about those projects in detail?                                | Yes       | 13        | 43.3%      |
|  | No        | 17        | 46.6%      |
| Did you get any chance to participate on those projects?                   | Yes       | 18        | 60%        |
|  | No        | 12        | 40%        |
| Do you have water management committee at watershed or local level?        | Yes       | 7         | 23%        |
|  | No        | 23        | 77%        |
| Did you participate on committee election?                                 | Yes       | 7         | 23%        |
|  | No        | 23        | 77%        |
| Do you get any capacity development trainings on water use and management? | Yes       | 5         | 18%        |
|  | No        | 25        | 82%        |

People of the district/ woreda and sub district/Tabia are contributing on development and management of water resources as a stakeholder. Based on the interview results (table 4.9), there are a number of projects which are implemented in that area and people have knowhow about the projects especially on the benefit of the structures, how it is working and who is constructing. However, 46.6% of the interviewee does not have detail knowhow and 43.3% of them have detail information about the structures. 60% of respondent are participating in the projects which are implemented in their area in terms of labor force and material supplies. 23% of respondents are member of water committees, and are participated in the committee leader election processes. However, the remaining respondents (77%) are not members of the water committees. From total number of respondents of this interview 18% of respondents were participating in water related capacity development trainings organized by different institutions and organizations and the remaining 82% are not participating on such kinds of trainings.

People are contributing in different tasks activities of the projects. They contribute in Participating on site selection for structure construction, Labor force, informing the problems of water utilization at local level for concerned body, maintaining water structures, solving water

related conflicts between users. Table 4.10 shows contribution of the community in water development.

Table 4.10 Community contribution and its level for implementation of projects

| Contribution                           | Level of contribution |
|--|-----------------------|
| Site selection                         | Low                   |
| Decision making                        | Very low              |
| Labor force                            | High                  |
| Supplying local construction materials | High                  |
| Money contribution                     | No                    |

As it is mentioned in the table 4.11, communities level of contribution in site selection and in a decision-making process is low. As the respondents said that, most of the time decision making and site selection for any project is accomplished by experts from woredas/District. Respondents from key informants of water and agricultural experts confirm that, people are contributing on water resources development and management mainly through labor force, and supplying local construction materials, and sometimes they also participating in site selection for construction of check dams and other small structures. One of the Dublin principle stated that, "Water development and management should be based on participatory approach, involving users, planners, and policy makers at all levels". Fresh water is a resource which everyone is dependent on it and it consists of different aspects of uses. Because of this, everybody who uses water is a stakeholder and should have to participate in water and related issues, planning, decision making, and utilization of this resource and there should be a plate form for real participation (GWP, 2000). Though community in the study are not part of the decision making in water related projects in their area. Fig 4.5 shows participation of local communities in construction of check dam in Tabia Aynalem.



Fig 4.5 People of Tabia Aynalem Participating in Check dam construction

People are also participating in water resources management as water user associations. Water user associations are created when they are using water as a group like water from diversions, water from dams, and from hand dug wells (hand pumps for drinking purpose). These water user associations have water committees who are elected by the group members of the water user associations.

The main activities of the water committee are;

- Preparing schedule for water utilization;
- Controlling wastage of water;
- Preparing bylaws;
- Finance;
- Controlling destruction of water structures; and
- Organizing and Calling meetings.

There are four water user associations within the three sub districts which are working in irrigation water management and using water from Genfel River by using Diversions structures. Table 4.11 shows the number of members within each water user associations.

Table 4.11 Members of water user associations in each sub District using water from Genfel river

| Tabia                   | Users |        |       |       | Water Use  |
|-------------------------|-------|--------|-------|-------|------------|
|                         | Male  | Female | Youth | Total |            |
| T/Adisadd (diversion 1) | 18    | 11     | 21    | 50    | Irrigation |
| T/Adi sad (diversion 2) | 65    | 29     | 41    | 135   | Irrigation |
| Genfel                  | 210   | 13     | 28    | 261   | Irrigation |
| Aynalem                 | 55    | 18     | 32    | 105   | Irrigation |

Institutions and organizations are also involved in construction of water structures, organizing the people for proper utilization of available water, giving trainings for water users, soil and water conservation practices, decision making on projects delivered by them, providing financial and technical supports for water and related developmental activities at local level.

Although different institutions, organizations and parts of the society are considered as a stake holder in the woredas there are a lot of problems on the implementation and participation level of these stake holders in different water projects and over all water development and management of the woreda. As the respondents said, institutions and other stakeholders are participating and working indifferent activities of water development and managements of the woreda, however the level and integration of the stakeholders is very poor especially in decision makings. Every stake holder is contributing based on their interest without considering the other institutions and stakeholders. As respondents from water and related offices, there is no clear stakeholder's participation platform at woreda level. Table 4.12 shows the response of different institutions on the challenges of stakeholder participation.

Table 4.12 Challenges of stakeholder participation

| Institutions                    | Challenges of stake holder participation  |
|---------------------------------|---|
| Wukro St. Marry college         | <ul style="list-style-type: none"> <li>➤ low participation of District and sub district administrations in maintenance and activities</li> <li>➤ poor interaction and cooperation between water and Agriculture sectors</li> </ul>  |
| World vision Ethiopia           | <ul style="list-style-type: none"> <li>➤ Low coordination of stakeholders and independent decisions.</li> <li>➤ Gaps in insuring ownership for completed and handed over projects</li> <li>➤ Low participation and contribution of community</li> </ul>   |
| Relief Society of Tigray (REST) | <ul style="list-style-type: none"> <li>➤ Low understanding of stake holders on proper participation</li> <li>➤ poor commitment of stake holders on the implementation of shared tasks, during meetings</li> <li>➤ staff turnover to conduct stake holders regular meeting</li> <li>➤ overlapping of programs and activities for different tasks from different stake holders</li> <li>➤ there is no stake holder participation platforms</li> </ul> |

### 4.3.3. Principle 3: - women involvement in water management

#### Role of women and level of participation

Women have many roles and they are the key water users and stake holders in any water uses and management practices. Women and girls are the one who are walking long distance and hour to fetch water for their hose hold and in some cases in agriculture. They are also playing an important role in the sustainability and success of projects (GWP, 2000, Amleset, 2012). However, women are not influential as men in management, problem identification and analysis and in decision making process. Therefore, it is required to consider women as water user, and

involve them in a decision-making process and enhancing gender awareness (GWP, 2000). Ethiopian water resources management policy statement about gender issue stated that “promote the full involvement of women in the planning, implementation, decision making and training as well as empower them to play a leading role in self-reliance initiatives”. This policy statement advocates the involvement of women in different water related activities from the beginning up to the implementation phase, and it calls for the empowerment of women to play leading role in water managements.

According to the respondents of questioner and interviews women are considered as they are the key stake holders and are members of existing water user associations and members of these committees of water user associations for drinking water, they collect monthly water fee (in water supply) and organizing meeting of water users. Key informants also confirm that, women have key role in water resources development and management activities through contribution of labour force to different Constructions of diversions, canals, and check dams, Maintenance of structures, Canal clearances (see fig 4.5). Women have also the right to be member of water user association leaders committee in irrigation and other water uses. According the study related to women participation in water resources development conducted by Amleset (2012), concluded that women have great role in development, management and utilization of water resources, however they do not have sayings in relation to site selection and technology selections (Amleset, 2012).

#### **4.3.4 Principle 4: - Socio Economic Value of water**

Many past water resources management familiarities are because of water has been viewed as a free and a gift from God, and ignoring the value of water (GWP, 2000). As respondents mentioned that, water is not treated as an economic good in all Sub districts. People are using water without limit and controlling mechanism, especially people who are not members of these water user associations are exploiting water from the river as much as they required. There is no water fee for irrigation water utilization. However, water which is used for drinking purpose from hand dug wells, people pay 10 ETB which is equivalent to 0.4 USD per month. This payment is used for maintenance of the hand dug well when destruction is happening.

They don't have also economic water demand management mechanism. As water is free for everyone, they are extracting without limit as the water is available in the river. There is high loose of water during conveyance of water through canals and plastic pips of motor pumps.

As respondents said and observed from the study area that, they do not have water allocation between different water users. However, water allocation is implemented within the Water user associations to divide and use diverted water for crop production. This allocation of water is done randomly based on the size of the farm land rather than crop water requirement. They schedule and give the turn of using canal water for some length of time until the farmland is fully irrigated.

Water user associations have their own bylaws, to manage water resources distribution between users, to control water loses and to solve water related conflicts. Under these bylaws, they put amount of many to punish when there is miss utilization of water and unauthorized utilization of water from diversions. In addition to this they are also governed by the regulations which are prepared by the national and regional governments.

#### **4.4. Challenges of Water Resources Management and IWRM implementation**

The study area faced challenges which are hindering the proper implementation of IWRM approach as the respondents said that the main challenges for the implementation of IWRM at woredas/district level are highly related with the absence of IWRM management plan in the district and knowhow about the approach. As they said there is no full, planed and organized implementation of IWRM in the woredas/district. The main challenges are categorized and discussed as follows:

##### **Institutional challenges**

Water and related institutions do not have experts who have knowhow about IWRM approach. Some institutions especially ornamental institutions and water related offices do not have capacity building and awareness creation for experts about IWRM. In addition to this they have shortage of budget for capacity building of staff members of these institutions.

## **Cultural challenges**

Culturally people consider water as a gift of God and they are using without proper management. They don't see as it is finite resource. There is low adoption and utilization of technologies for efficient water utilization. Farm land is irrigated traditionally, there is no scientific water utilization for crop irrigation and there is no clear water allocation mechanism. Culturally it is also believed that women are not as strong enough as men and they should have to stay at home. If the household leader is man, participation of woman in any field activities is not recommended or sometimes they are participating in the name of their husbands.

## **Awareness and capacity limitation**

Institutions in the woredas like St. Mary College, gives some trainings about efficient technologies and water utilization, crop selection, how to handle clean water, proper utilization and maintenance of water structures and moisture conservation practices. However, it is not enough and they do not implement the training they got practically. The other problem related to awareness and capacity limitation as the respondents said is lack of sense of ownership on the constructed and tendered water structures. Because of this low feeling of ownership, there are problems of canal sedimentation but not clearing it properly, Structure destruction but no maintenance, and stalling components of water structures.

## **Financial challenges**

As part of enabling environment, financial arrangement for water works and management activities at federal and regional level is in place. However, there is no enough budgets for water management activity at district level. Financial budget is allocated for sectors from district, regional government and federal governments depending on the size of the project and sectors. NGOs and private institutions are also having budget for water works. Though, most of the budget is allocated for constructing new water structures. Management, maintenance of old structures, training of stake holders is neglected and/or not have attention during budget allocation. This is because of shortage of financial sources to do for all water and related activities in the region and districts at a time. Fig 4.6 show the structure which is found in Tabia Aynalem, and destroyed but not maintained.



Fig 4.6 Destroyed but not maintained irrigation canal

### **Lake of stakeholder participation plate form**

Implementation of IWRM needs the involvement of all stake holders in all stages of water resources development, utilization, and management. It needs real participation that means everyone should be involved in decision making processes in water related activities in different ways (GWP, 2000). However, in the study area there is no clear stake holder participation plat form. Institutions (governmental and nongovernmental), organizations, and private sectors are working separately. As the key informants said that, those institutions are sometimes creating conflicts on organizing people to use as a labour force.

## **CHAPTER FIVE: CONCLUSION and RECOMMENDATION**

### **5.1 Conclusion**

This study was about Evaluating Integrated Water Resource Management practices and experiences in Ethiopia (Tigray) in line with IWRM pillars and Dublin principles for sustainable water resource management. The study found that the existence of integrated water resources management pillars in the Tigray region in terms of enabling environment (policies, legislations and financial mechanisms) and institutional frame work is in a good stand; though the policies are not fully implemented. The third pillar management instruments especially water resources assessment and information sharing and information system data base is not as good as required.

Regarding to implementation of Dublin principles, this study concludes that in the first principle; (Fresh water is finite and vulnerable resource, essential to sustain life, development and the Environment); water is not managed in real holistic approach, water quality and quantity of the study area (Grenfell River) is not managed very well. Even if some natural and soil and water conservations are practiced in that area, which is not enough to sustain water resources of the river and the environment.

Related to the second principle; (Water development and management should be based on participatory approach), involving users, planners, and policy makers at all levels the study concludes that, involvement of all stake holders in water resources development and management is very poor. Stakeholders, especially local farmers and water users are not involved in decision making process of water structure construction projects in the area. Local farmers are highly participated in construction of structures through contribution of labour force. However different institutions are involved in some decision-making processes when the project is delivered by them. In general, there is no real participation and stakeholder participation plat form.

About the third principle; (Women play a central part in the provision, management and safeguarding of water); the study concludes that, women are not really involved in water related decision-making processes, though they are participated in activities required labour forces.

Regarding the fourth IWRM principle; (Water has an economic value in all its competing uses and should be recognized as an economic good); this study found that, water is not managed as an economic good, and because of this there are a lot of water losses. There is no economic water demand management, Irrigation water is delivered for free and high extraction of water for irrigation and other uses.

It is also concluded that IWRM approach is not implemented properly and purposefully because there is no IWRM plan and there are financial, institutional, and cultural and knowhow gapes and related challenges in the woredas and region.

## **5.2 Recommendations**

Based on the above findings and gapes, the following practical recommendations are delivered for proper implementation of integrated water resources management, for sustainable water resources management and utilization of Genfel River and in the region at all.

- ❖ Water management should be implemented based on the national water resources development and management, policy, strategies and action plans.
- ❖ There should be integrated water resources management plan at regional and woredas level.
- ❖ Information sharing and data base system should be created in the regional and woredas level water offices. And it should be disseminated for all concerned stakeholders.
- ❖ Water assessment centers have to be established at regional and district levels and should have to be equipped with effective assessment tools and equipments.
- ❖ Water should be managed with the incorporation of other resources, and different water uses and users in a holistic approach.
- ❖ There should be stakeholders participation, discussion and dialog plate form at regional and woredas level.
- ❖ Women participation in water related decision-making processes should be taken as a special case and there should be a system for their involvement.
- ❖ Water has to be considered as economic good, and there should be economic and regulatory mechanisms for irrigation water consumptions.
- ❖ It is Also recommended to do further studies in relation to Policy Implementation in the region, and the status of constructed water structures.

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**Appendixes**  
***Appendix 1: Questionnaire for water users***

**PAN AFRICAN UNIVERSITY INSTITUTE OF WATER AND ENERGY SCIENCE  
INCLUDING CLIMATE CHANGE**

***Program: MSc in Water policy***

**Dear Respondents;**

**This study is conducted in partial fulfillment of the requirement for the Degree of Masters of science in water policy. The main purpose of this interview is to gather the relevant information about the Implementation of integrated water resources management approaches in your water resources utilization and management practices. Therefore, I would like to request dependable information. Be sure that the information to be obtained from you shall be treated with at most confidentially and it is used only for academic purpose.**

**Thank you in advance!**

**General Information**

- 1) **Date:** \_\_\_\_\_
- 2) **Address: Woreda:**  
\_\_\_\_\_ **Tabia(subworeda):** \_\_\_\_\_ **Kushet(village):** \_\_\_\_\_
- 3) **Sex of respondent:** \_\_\_\_\_
- 4) **Age of respondent:** \_\_\_\_\_
- 5) **Marital status of respondent: -**      1) single    2) married    3) divorced
- 6) **Educational level: -**    1) No formal education    2) primary Education 3) grade 8 complete 4) grade 12 complete 5) other

**Sources and uses of water**

- 7) **What kinds of water resources do you have and use in your watershed /river basin?**

- A) Rivers
- B) Ponds
- C) Dams
- D) Deep Ground water boreholes
- E) Shallow wells
- F) Hand dug wells
- G) Or other (specify)\_\_\_\_\_

8) For what purpose do you use these water resources

- A) Drinking
- B) Irrigation
- C) Animal
- D) Other uses(specify)\_\_\_\_\_

**Principle 1**

9) Do you have water quality problems?

- 1) Yes 2) No

10) What are the pollutants of water resources?

.....  
 .....

11) How do you control pollution of water on those water sources?

.....  
 .....

**12) Do you think you have enough amounts of Available water sources?**

- 1) Yes 2) No

**13) How do you use the available water efficiently?**

.....  
.....  
.....

**14) What kind of technologies do you use? For irrigation, water supply, and other uses.**

.....  
.....

**Principle 2**

**15) Do you have water projects in this area?**

- 1) Yes 2) No

**16) Do you know about those projects in detail?**

- 1) Yes 2) No

**17) Did you get any chance to participate on those projects and how?**

- 1) Yes 2) No

**18) What is the level of stakeholders' participation on the following ways of participation? High, Medium, low or no participation?**

- A) Site selection \_\_\_\_\_
- B) Decision making on technology selection \_\_\_\_\_
- C) Free labor contribution \_\_\_\_\_
- D) Financial contribution \_\_\_\_\_
- E) Providing local construction materials \_\_\_\_\_

**19) Do you have water management committee at watershed or local level?**

- 1) Yes    2) No

**20) How this water management committee is working?**

.....  
.....

**21) Did you participate on committee election?**

- 1) Yes    2) No

**22) Do you get any capacity development trainings on water use and management?**

- 1) Yes                    2) No

**23) What was it about?**

.....  
.....  
.....

**Principle 3**

**24) Are women parts of this water management committee?**

- 1) Yes                    2) No

**25) Do women participate on water management and development activities in this watershed?**

- 1) Yes                    2) No

**26) How is women's participation on running projects?**

.....  
.....  
.....

**27) How many women are participating on decision making process of water management in this water shed?**

.....

**Principle 4**

**28) Do you have water charging mechanisms?**

- 1) Yes                      2) No

**29) How do you pay for water fee?**

.....  
.....  
.....

**30) Do you have local regulations on waste disposal and water loses control?**

- 1) Yes                      2) No

**31) How this regulation is working?**

.....  
.....  
.....

**32) Do you have water allocation mechanisms at local level?**

- 1) Yes                      2) No

**33) How is this water allocation mechanism implemented?**

.....  
.....  
.....

**Management instruments**

**34) Do you have experiences of conflict on water use?**

- 1) Yes                      2) No

**35) How these water conflicts happened?**

.....  
.....  
.....

**36) Do you have conflict resolution mechanisms at local level?**

- 1) Yes                      2) No

**37) How do you solve the conflicts?**

.....  
.....  
.....

**38) What are the roles of water management related offices on conflict resolutions?**

**Specify the office and their roles**

.....  
.....  
.....

**Institutions**

**39) Which institutions and NGOs are working with you on water resources and environmental managements? List out them?**

.....  
.....  
.....

**40) What are the roles of these institutions and NGOs on water management?**

.....  
.....  
.....

**41) What are the main challenges that you face on water use and managements?**

.....  
.....  
.....

**42) How are you trying to solve these water management challenges?**

.....  
.....  
.....

## **Apendex2: Questionnaire for water resources management offices**

### **PAN AFRICAN UNIVERSITY INSTITUTE OF WATER AND ENERGY SCIENCE INCLUDING CLIMATE CHANGE**

*Program: MSc in Water policy*

**Dear Respondents;**

**This study is conducted in partial fulfillment of the requirement for the Degree of Masters of science in water policy. The main purpose of this questionnaire is to gather the relevant information about the Implementation of integrated water resources management approaches in your water resources utilization and management practices. Therefore, I would like to request dependable information. Be sure that the information to be obtained from you shall be treated with at most confidentially and it is used only for academic purpose.**

**Thank you in advance!**

#### **General information**

**1. Sex: 1) Male 2) Female**

**2. Level of education and field of study: 1) Below Diploma 2) Diploma 3) First Degree 4) Masters holder 5) PhD and above**

**Field of study** \_\_\_\_\_

**3. Name of your organization** \_\_\_\_\_

**4. Position/title** \_\_\_\_\_

**5. Your experience: 1) Below 5 years 2) 5-10 years 3)10 to 20 years 4) more than 20 years**

**Principle 1)**

**1) Is water considered as a finite and vulnerable resource in your office / department?**

**A) Yes    B) No**

**2) What are the main human effects on water quality and quantity of the water resource?**

.....  
.....  
.....

**3) Do you have human effects controlling measures on quantity and quality of water resources?**

**A) Yes    B) No**

**4) What are those water quality and quantity controlling measures?**

.....  
.....  
.....

**5) Is water resources management based on holistic approach?**

**A) Yes    B) No**

**6) If your answer for No, 6 is “Yes” what kind of Natural resource management coordinated with water resources management?**

.....  
.....  
.....

7) If your answer for No, 6 is “Yes” What different kinds of water uses considered in this holistic approach?

.....  
.....  
.....

8) Dose different institutions working together on water utilization and management?

A) Yes B) No

9) Which are these different institutions working with you on water utilization and management?

.....  
.....  
.....

10) Do you have Upstream and downstream users conflict and dialog platform and conflict controlling and resolving mechanisms?

A) Yes B) No

How is it working?

.....  
.....  
.....  
.....  
.....

**Principle 2)**

1) Do you consider all water users as stakeholders?

A) Yes B) No

2) Who are the main stakeholders participating in water management planning decision making process?

.....  
.....  
.....  
.

3) Are there participation platforms for all stake holders on decision making process?

A) Yes B) No

4) How stakeholders are participating in decision making process?

.....  
.....  
.....

5) Do you follow bottom up and top down participation mechanisms?

A) Yes B) No

6) Do you have stakeholder capacity development programs and how?

A) Yes B) No

.....  
.....  
.....

**Principle 3)**

1) Do you think women have central role on water resources management?

A) Yes B) No

2) Do women participate in water resources management planning process?

A) Yes B) No

3) What are the roles of women on water management practices?

.....  
.....  
.....

4) What are the criteria to select women as a participant in planning and decision-making process?

.....  
.....  
.....

5) How many women do participate in decision making in your department/sector?

.....

6) Do you have gender awareness enhancement programs and systems?

A) Yes B) No

**Principle 4)**

1) How do you think about social and economic value of water?

.....  
.....  
.....

2) Do you have water fee or water charging mechanisms?

A) Yes B) No

3) How do users pay water fee?

.....  
.....  
.....

**4) Do you have full cost recovery systems?**

**A) Yes B) No**

**If your answer is “Yes”, how do you implement it?**

.....  
.....  
.....

**5) Do you have subsidization mechanism for those who cannot afford?**

**A) Yes B) No**

**Enabling Environment**

**1) Does Ethiopian Water resources management policy and strategy create a conducive Environment /situation for water management and utilization in your sector?**

**A) Yes B) No**

**2) Do you think Ethiopian water resources management policy, and strategy is fully implemented in your sector?**

**A) Yes B) No**

**3) If your answer for Q1 is “No” what do you think the main challenges are?**

.....  
.....  
.....

**4) Do you think Ethiopian water resources management proclamation law and water management regulation contribute to water management processes?**

**A) Yes B) No**

**5) In which aspect of water resources management, the proclamation and regulations are utilized?**

.....  
.....

**6) Where and how do you get financial resources for water resources development management?**

.....  
.....  
.....

**Institutional role**

**1) What is the role of your institution / office on water management practices?**

.....  
.....  
.....

**2) What are other governmental institutions contribute to water resources management and what is their responsibility?**

.....  
.....  
.....

**3) What are privet sectors and NGOs work with you and what are their roles?**

.....  
.....  
.....

**Management instruments**

**1) Do you have water resources management assessment mechanism?**

A) Yes B) No

**2) How do you assess water resources availability, quantity and quality of water?**

.....  
.....  
.....

**3) Do you have water allocation mechanisms for proper water resources management?**

**A) Yes    B) No**

**4) How is this water allocation mechanism implemented?**

.....  
.....  
.....

**5) How are you solving conflicts among water uses?**

.....  
.....  
.....

**6) Do you have water resources data base in your office?**

**A) Yes    B) No**

**7) How do you share / disseminate the information for all water users and stakeholders?**

.....  
.....  
.....

**8) Do you have training and awareness enhancement mechanisms on water resources management for users and stakeholders?**

**A) Yes    B) No**

**9) What kinds of trainings do you provide to users related to water resources utilization and management?**

.....  
.....  
.....

**10) How do you mitigate and control water resources risks on the community and other resources?**

.....  
.....  
.....

**Achievements and challenges**

**1) Do you think integrated water resources management (IWRM) approach is implemented in your water resources management process?**

A) Yes    B) No

**2) What benefits do you gain from implementing IWRM approach?**

.....  
.....

**3) Do you have challenges that you face on implementation of IWRM on the following aspects?**

**Institutional challenges**

.....  
.....  
.....

**Cultural challenges**

.....  
.....  
.....

**Awareness and Capacity limitation**

.....  
.....  
.....

**Financial challenges**

.....  
.....  
.....  
.....

**Other related management challenges**

.....  
.....  
.....

**4) How do you try to solve those challenges?**

.....  
.....  
.....

**5) What is the role of Government and institutions on solving those challenges?**

.....  
.....  
.....

### ***Appendix3: Questionnaire for water related organizations***

#### **PAN AFRICAN UNIVERSITY INSTITUTE OF WATER AND ENERGY SCIENCE INCLUDING CLIMATE CHANGE**

***Program: MSc in Water policy***

**Dear Respondents;**

**This study is conducted in partial fulfillment of the requirement for the Degree of Masters of science in water policy. The main purpose of this questionnaire is to gather the relevant information about the Implementation of integrated water resources management approaches in your water resources utilization and management practices. Therefore, I would like to request dependable information. Be sure that the information to be obtained from you shall be treated with at most confidentially and it is used only for academic purpose.**

**Thank you in advance!**

#### **General information**

**1. Sex: 1) Male 2) Female**

**2. Level of education and field of study: 1) Below Diploma 2) Diploma 3) First Degree 4) Masters holder 5) PhD and above**

**Field of study\_\_\_\_\_**

**3. Name of your organization \_\_\_\_\_**

**4. Position/title \_\_\_\_\_**

**5. Your experience: 1) Below 5 years 2) 5-10 years 3)10 to 20 years 4) >20 yr**

#### **Participation**

**1) Did you participate in any water resources development and management programs in this woreda/district?**

**1) Yes 2) No**

2) What are your organization's role in water resources development and management of the woreda?

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3) Is your office/organization part of decision making process in water resources development and management activities of the woreda/ district/?

1) Yes      2) No

4) What do you think about participation and integration of different stake holders in water resources development and management of the woreda?

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#### Challenges of water resources management

5) What are the main water resources developments, utilization and management challenges in this woreda?

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6) What kinds of stakeholders participation challenges you faced (related to water and other related resources development and management) in this woreda?

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7) What do you recommend to solve the above problems?

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