2014

Flood Based Farming Practices in Tigray: Status and Potential

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5/10/2014

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1. Introduction

In all residents of the arid zone of Tigray, the villagers or inhabitances of the areas have struggled for years with drought, lack of access to safe drinking water, and serious water-related challenges to agricultural productivity. Soil is severely eroded, with little or no topsoil in many areas. Agriculture is almost entirely dependent on rainfall that is both seasonal and highly variable from year to year. And therefore people must seek a solution to maintain their livelihood condition.Accordingly, floods are becoming the only source of livelihood in arid areas of Tigray. Then finally yet importantly a notion flood based farming has come in to being.

What is flood base farming?Flood base farming is a form of water management that includes all forms irrigation that uses flood as a main source or supplementary i.e. starting from building of big dams up to constructing of check dams, small ponds might be on spring or off spring in addition to this spate irrigation can occur particularly where mountain catchments border lowlands. Short duration floods from a few hours to a few days come down from the catchments in ephemeral streams. These short duration floods are diverted from river beds and spread over land to cultivate crops, feed drinking water ponds, or irrigate pasture areas or forest land. Spate irrigation is found in the Middle East, North Africa, West Asia, East Africa and parts of Latin America (Mehari 2010). In some countries it has a long history more than 5000 years in Yemen, Pakistan and Iran. In the Blue Nile countries spate irrigation is more recent and particularly in Ethiopia and Eritrea spate irrigation is on the increase (International spate network 2010).

Spate irrigation differs from other flood-based farming systems. The short duration floods on which it is based are often forceful in nature, requiring special techniques and special organization to manage it and distribute the water. Spate irrigation is different for instance from flood recession farming, where the moisture left behind after river flood plains or lake plain are flooded is used or from inundation canal s – where canals flow when water levels in a river reach a certain level.

Spate systems are also categorically different from perennial systems. For one they are risk-prone and variable. The floods may be abundant or minimal and occurrence and volume varies from year to year. The fluctuation also brings along an unavoidable degree of inequity, with some lands always better served than others. Spate systems, moreover, have to deal with occasional high floods that – unless properly controlled - can cause damage to river beds and command areas. Another feature that sets spate systems apart from perennial irrigation is the high sediment load of the water, in its nature of hydrology, and its design approach is quite different from conventional once. This sediment is a blessing as well as a curse:(Mehari 2010) it brings fertility and makes it possible to build up well-structured soils. On the other hand it can also cause rapid rise of the command area and the sedimentation of canals. Finally, in many spate systems floods come ahead of the cultivation season and storing moisture in the soil profile is as important for crop production as the diversion of water.

People narrate specially in Raya that spate irrigation has been practicedfor all their lifelong. This tells that spate irrigation system for supplementary purpose has been experienced for centuries in a traditional way and nowadays population pressure in the region is giving new impetus to this more difficult resource management system.

Therefore, this report encompasses the current status of Flood base farming development, summarizes the experiences so far and formulates a number of recommendations on the development of this upcoming resource management system. It first discusses the status and spate irrigation in the Raya valley then goes to the potential there is and the different techniques of flood based farming practicing in Tigray.

2. Ethiopia's Irrigation Potentials

2.1 The Importance of Irrigation in Agricultural Development

The development of irrigation and agricultural water management holds significant potential to improve productivity and reduce vulnerability to climactic volatility in any country. Although Ethiopia has abundant rainfall and water resources, its agricultural system does not yet fully benefit from the technologies of water management and irrigation. The majority of rural dwellers in Ethiopia are among the poorest in the country, with limited access to agricultural technology, limited possibilities to diversify agricultural production given underdeveloped rural infrastructure, and little to no access to agricultural markets and to technological innovations. These issues, combined with increasing degradation of the natural resource base, especially in the highlands, aggravate the incidence of poverty and food insecurity in rural areas. Improved water management for agriculture has many potential benefits in efforts to reduce vulnerability and improve productivity. Specifically, primary rationales for developing the irrigation sector in Ethiopia include:

- Increased productivity of land and labor, which is especially pertinent given future constraints from population growth
- Reduced reliance on rainfall, thereby mitigating vulnerability to variability in rainfall
- Reduced degradation of natural resources
- Increased exports
- Increased job opportunities, and promotion of a dynamic economy with rural entrepreneurship. Despite significant efforts by the Government of Ethiopia (GOE) and other stakeholders, improving agricultural water management is hampered by constraints in policy, institutions, technologies, capacity, infrastructure, and markets. Addressing these constraints is vital to achieve sustainable growth and accelerated development of the sector in Ethiopia.

2.2 Overview of Ethiopian Irrigation

Ethiopia comprises 112 million hectares (Million ha) of land. Cultivable land area estimates vary between 30 to 70 Million ha. Currently, high estimates show that only 15 Million ha of land is under cultivation. For the existing cultivated area, our estimate is that only about 4 to 5 percent is irrigated, with existing equipped irrigation schemes covering about 640,000 hectares (see details below). This means that a significant portion of cultivated land in Ethiopia is currently not irrigated. This section examines Ethiopia's water sources for irrigation, current irrigation schemes, and potential to increase irrigated lands. Our premise is that well-managed irrigation development is key in helping Ethiopia overcome major challenges including population pressure; soil and land degradation;high climate variability, and low agricultural productivity. In addition, agricultural water development is crucial to improve smallholder livelihood and income in Ethiopia, since irrigation can help farmers increase their crop production, increase crop variety, and lengthen their agricultural seasons. As explained in subsequent sections, the study (IWMI 2011) estimates that over the next two decades, Ethiopia could irrigate over 5 Million ha with existing water sources, contributing around ETB 140 billion *per annum* to the economy and ensuring food security for up to six million households (~30 million direct beneficiaries).

2.2.1 Rainfall in Ethiopia

Rainfall is the ultimate source of water in Ethiopia, with surface water, ground water, and other water sources fed by rain. To understand the country's irrigation potential, it is important to understand these water sources. Ethiopia has significant rainfall. Based on grid-based average annual rainfall and the land area, the study (IWMI 2011) estimates that Ethiopia receives about 980 billion (~1 trillion) cubic meters (m3) of rain a year. Ethiopia is divided into 32 major agro-ecological zones (AEZ) based on temperature and moisture regimes classification data[viii]FIGURE **1**: Three Ethiopia's . These 32 AEZs can be classified further into three primary zones within Ethiopia. This classification mirrors that found in the Rural Development Policy and Strategy (2001) and the Plan for Accelerated and Sustained Development to Eradicate Poverty (PASDEP). The three zones are: high rainfall areas, moisture deficit zones, and pastoralist zones. Figure 1 shows these three zones, based on rainfall and evapo- transpiration.

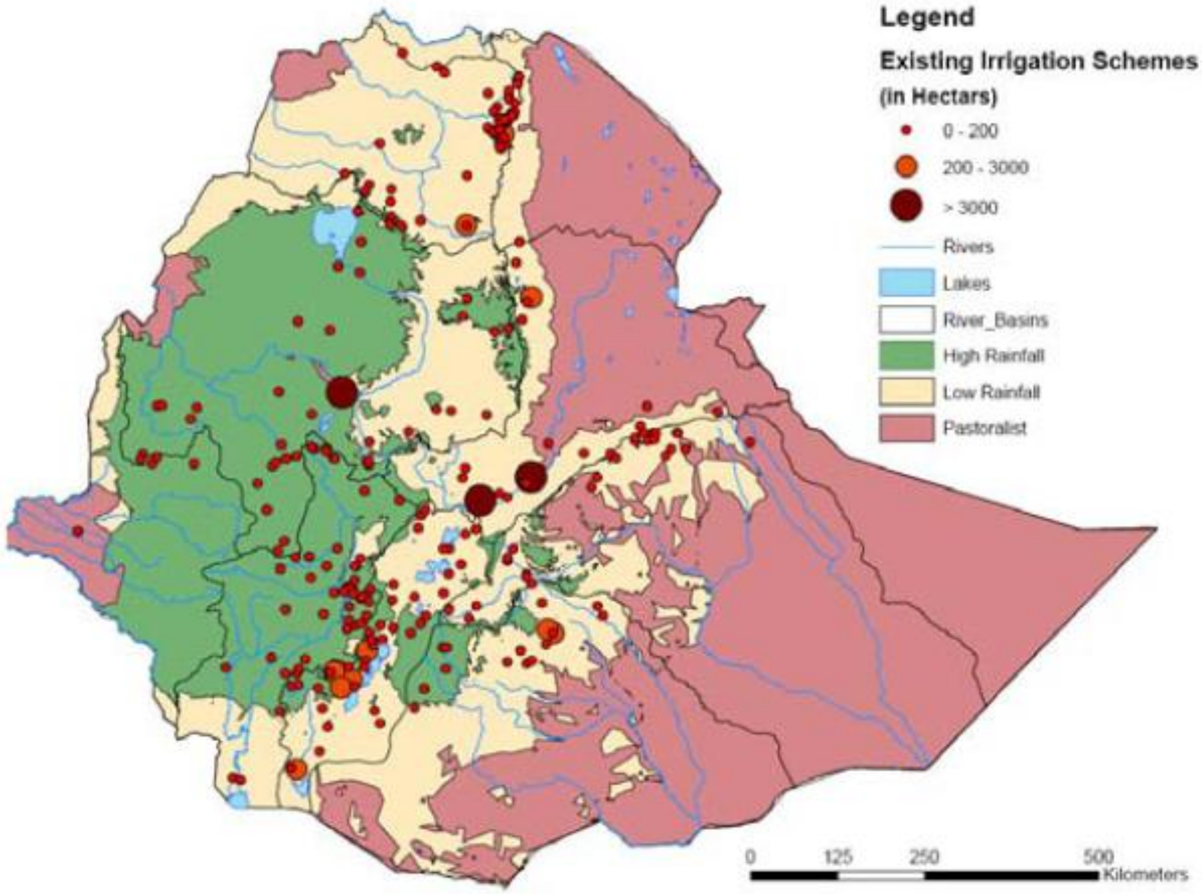


Figure 1*Existing irrigation schemes and rainfall amount*

Source: IWMI

3. Flood based farming practices in Tigray

Flood based farming have been practiced in Tigray for the past decades by a very few exemplary farmerseven though it waswithout its full understanding of the behavior of the system. In the past one decade there was a massive construction activity of flood harvesting structures and at the same time awareness creation of this flood based farming. However, it was not incorporated with full scale understanding of the complexity of the system that includes, rain fall pattern in the area catchment characteristics, amount of flood generated from the catchment, its land use, slope, type of structure that suits the flood base farming, availability of the command area, the amount of flood whether it meets the demand of crops in the farm and extra. These were the bottlenecks and finally bring a question to the government to think wisely and make the massive works to be a little bit manageable but it still however isa problem yet addressed.

The fallowing pictures are some of the success of flood based farming practiced in Tigray .

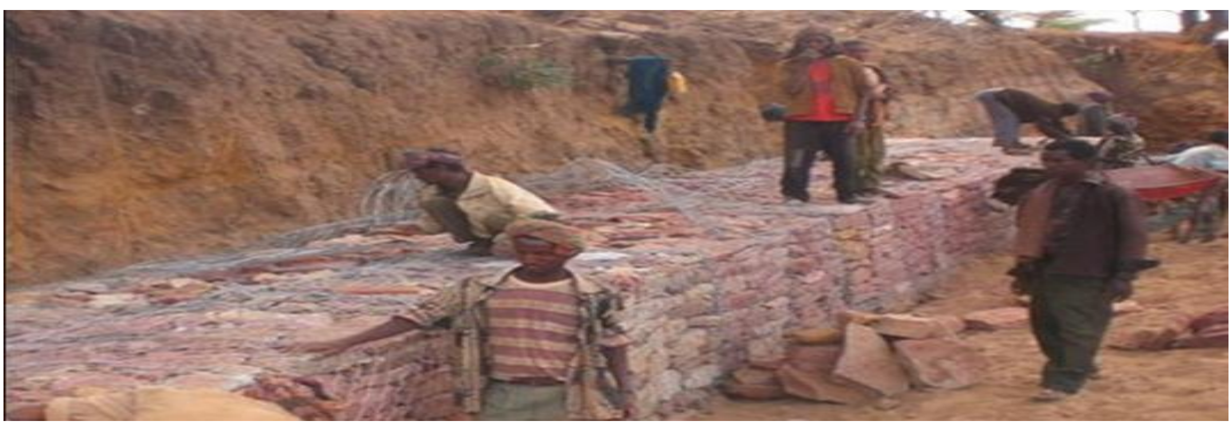


Figure 2Construction of check dams in Ahferomwereda in the area of food insecure

Figure 3Construction of canal structures in spate scheme

3.1. Flood based farming potential areas in Tigray

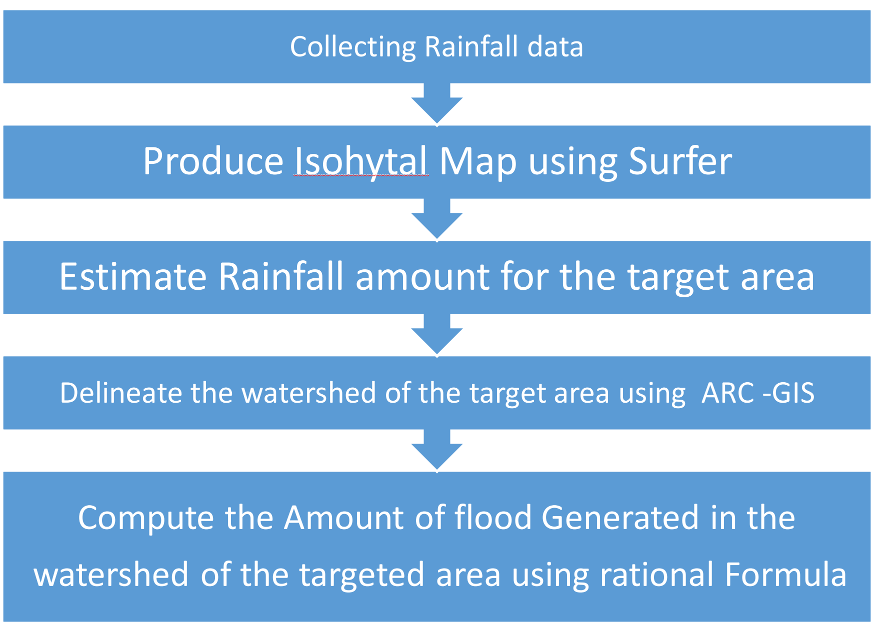
In Tigray region, though agriculture plays an important role in the regional economy, crop production and productivity is limited due to various factors. One of these factors, which led to recurrent draught, is moisture stress. The main cause of the stress is the erratic nature of the rainfall and its variability both in time and aerial distribution. In addition to the constraints of rainfall, luck of modern agricultural practices have contributed a lot to the recurrent draught. This can be further strengthened by the fact that Tigray having an estimated over 1000,000 ha of land that is suitable for irrigation only 20% of it is under permanent or supplementary irrigation. Thus, the regional government has planned a development strategy, which focused on expansion of this irrigation development infrastructure. The main goal of the strategy is to utilize the land and water resources of the region efficiently.

Thus, the regional government has shouldered responsibility to undertake an intensive study regarding the development of the potential of land and volume of water that comes as a direct runoff from higher mountains to the potential areas in the region under the concept ofFlood based Farming systems for improving the moisture stress areas by supplementary rain fed agriculture practices prevailing in the region. Thus, this concept will help to utilize the flood amount that comes from those mountains as maximum as possible in order to sustain thelivelihoodof the inhabitance theregion rather than its devastating nature.

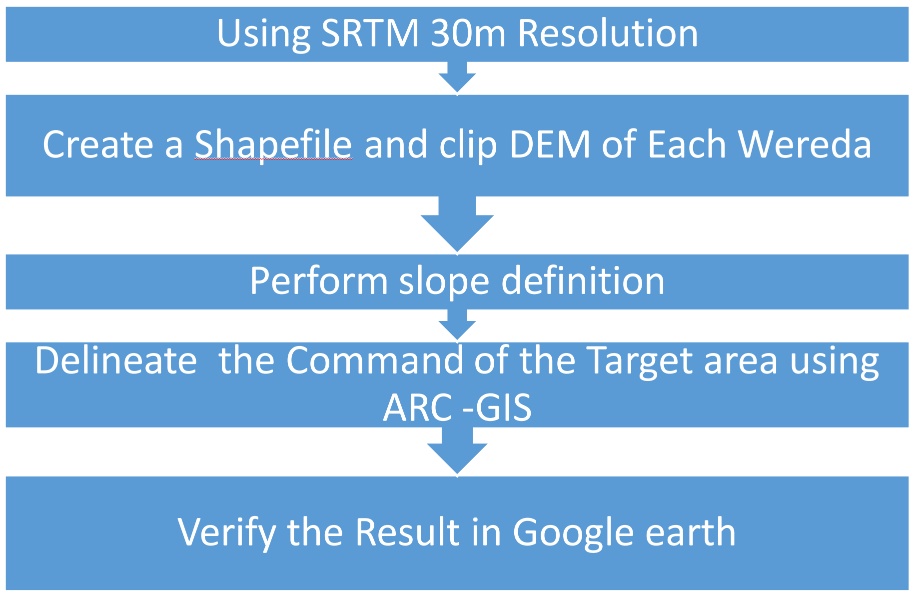
Figure 4 below shows some of the potential areas which have been visited by the team of experts to asses some of the possible potentials of flood base farming system in Tigray and the detailed investigation of each area is discussed below in its sub titles which is rather different in all its aspect from place to place on the bases of its topography, land use, culture and awareness. In one way or the other it has been recognized that floods are now becoming a matter of livelihood in Tigray. .

3.2 Methodology of Potential Assessment

3.2.1 Flood potential



3.2.2Land potential


Using SRTM 30m Resolution
Create a Shapefile and clip DEM of Each Wereda
Perform slope definition
Delineate the Command of the Target area using ARC -GIS
Verify the Result in Google earth

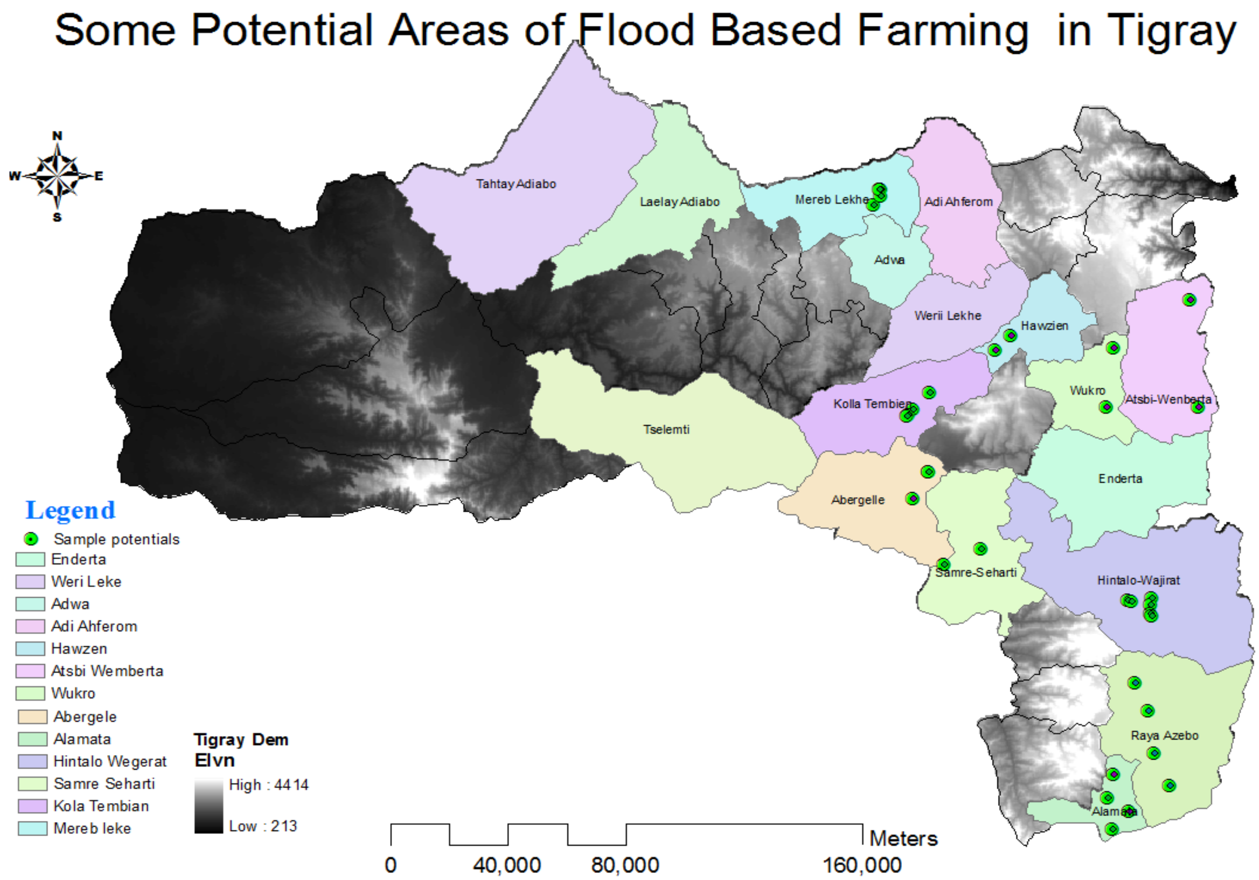


Figure 4Some flood base farming identified potentials

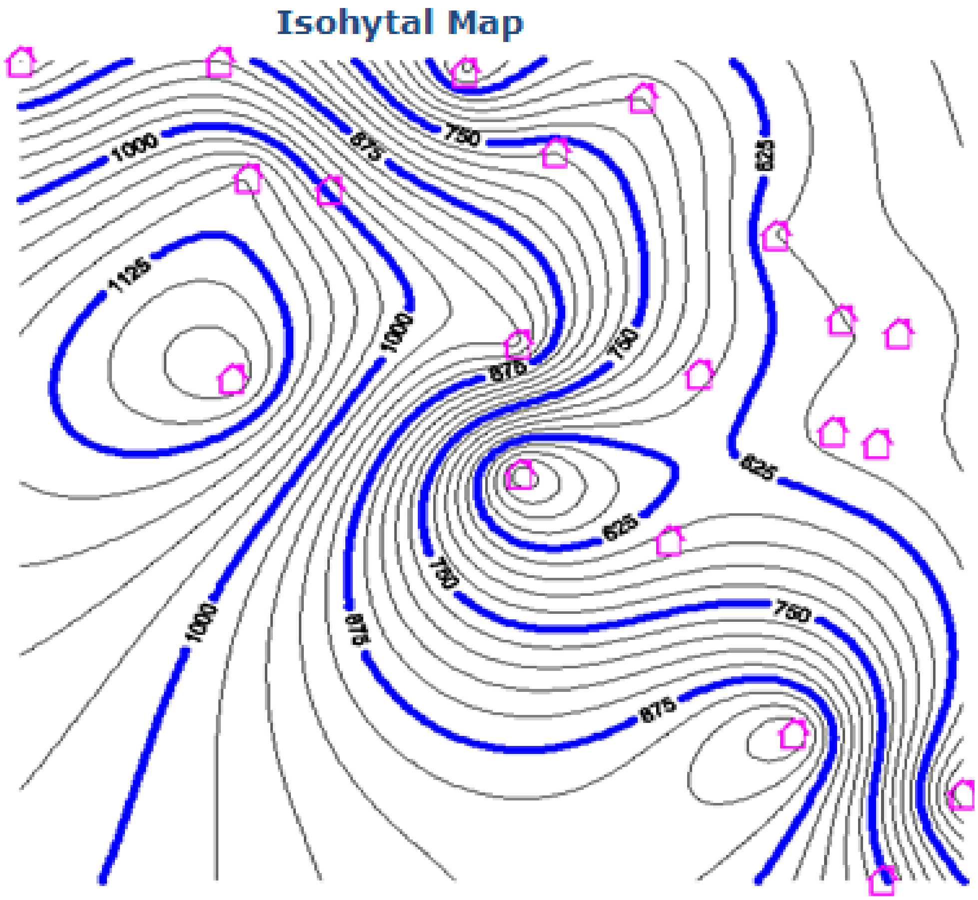


Figure 5 ISOHYTAL Map

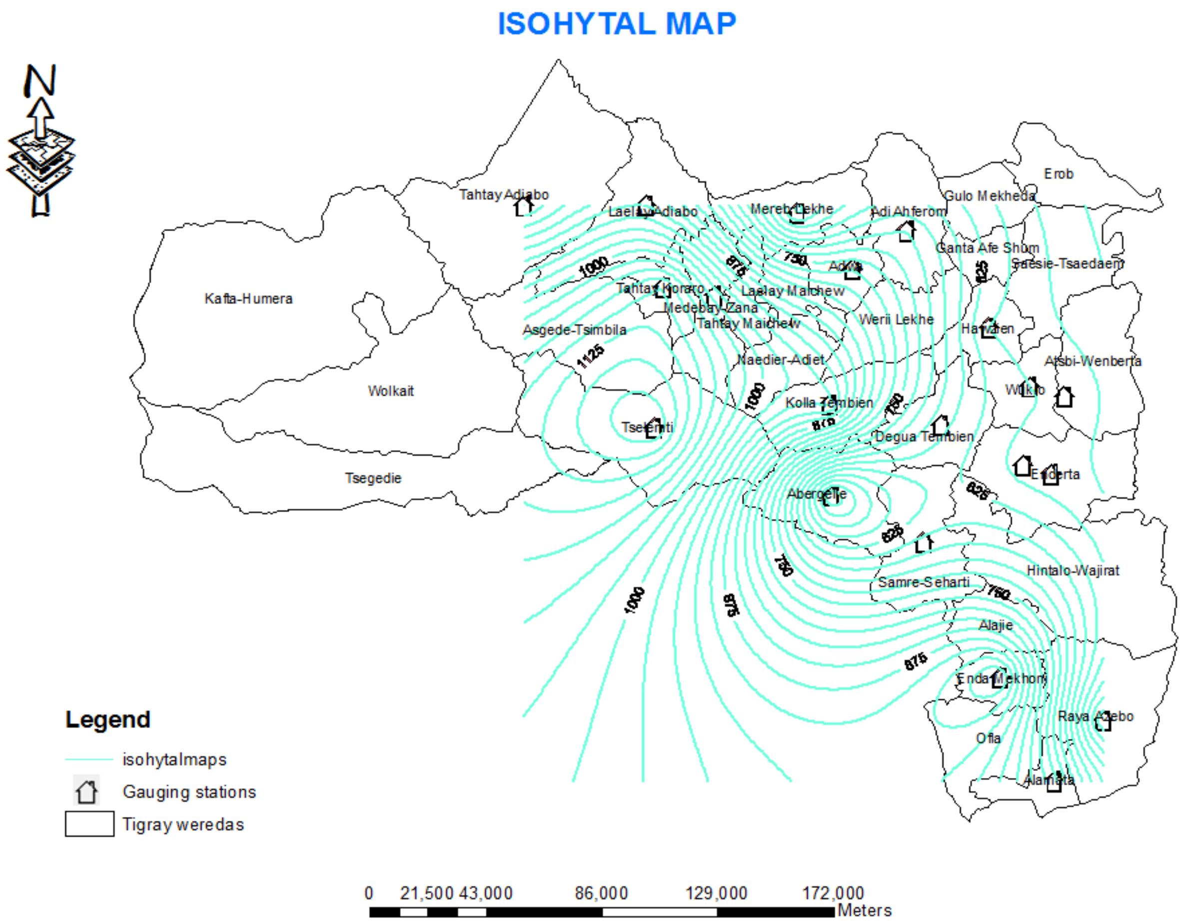


Figure 6 Overlaid ISOHYTAL Map

Table 1 Summery of potential assessments performedin Tigray

S/N	Name of the wereda	Watershed Area (Km^2)	Rainfall (mm)	Potential Flood ($10^6 m^3$)	Potential Command (ha)	Estimated Command (ha)
1	Merebleke	2000	578	346.80	24771	30,000
2	H/Wegerat	3500	600	630.00	45000	50,000
3	Abergele	3500	550	577.50	41250	25,000
4	S/ Samre	3000	658	592.20	42300	25,000
5	R/Alamata	3700	765	849.15	60653	35,000
6	Raya Azebo	3000	550	495.00	35357	80,000
7	Enderta	2000	590	354.00	25285	50,000
8	K/Tembian	2000	958	574.80	41057	30,000
9	D/Tembian	1500	750	337.50	24107	15,000
10	A/Ahferom	2000	700	420.00	30000	20,000
11	Adwa	2000	775	465.00	33214	30,000
12	Hawzen	2000	600	360.00	25714	40,000
13	T/ Adyabo	4000	800	960.00	68571	100,000
14	L/Adyabo	2000	900	540.00	38571	40,000
15	Tselemti	4000	1200	1440.00	102857.1	100,000
16	Wukro	1800	600	324.00	23142.86	25,000
Total				**9265.95**	**661853.6**	**695,000**

3.3 Model Potential Areas visited

3.3.1. AlamataWereda

Alamatawereda is located in the southern zone of Tigray as shown in the map, where flood based farming have been practiced for centuries in Raya valley. Though there is no any exact documentation about it but people tell that floods are our lives. Almost up to 35,000 ha of land can be irrigated under flood base (from the GIS map) either by traditionally or by upgraded ones. In most of the areas of the wereda spate type of flood based farming is practiced.The picture below shows one of the traditional spate scheme.

Figure 7 Traditional flood base farming (spate type in this case) at Alamatawereda

3.3.2 HintaloWegerat

HintaloWegeratwereda is located in the southern zone of Tigray as shown in the map, where flood based farming have been practiced for decades which is quite in different approach than Raya valley. In this weredatraditional spate type of flood based farming is also practiced widely and mostly farmers also build a check dam to supplement the moisture stress which is a little bit experienced in the area. The picture below shows another type of flood based farming constructed on spring. From the GIS map there is a potential around 50,000 ha of land to be supplemented by flood base. The picture below shows the check dam built in the wereda.

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Figure 8Flood based farming scheme at HintaloWegerat

3.3.3 AhferomWereda

Ahferomwereda is located in the centeral zone of Tigray as shown in the map, where flood based farming have been practiced for decades which is quite in different approach than Raya valley. In this wereda traditional spate type of flood based farming is also practiced rarely and mostly farmers also build a check dam to supplement the moisture stress which is a little bit experienced in the area. The picture below shows another type of flood based farming constructed on spring. From the GIS map there is a potential around 20,000 ha of land to be supplemented by flood base either spate, check dams, and or Communal ponds constructed off spring. The picture below shows the check dam built in the wereda before and after construction of the scheme.

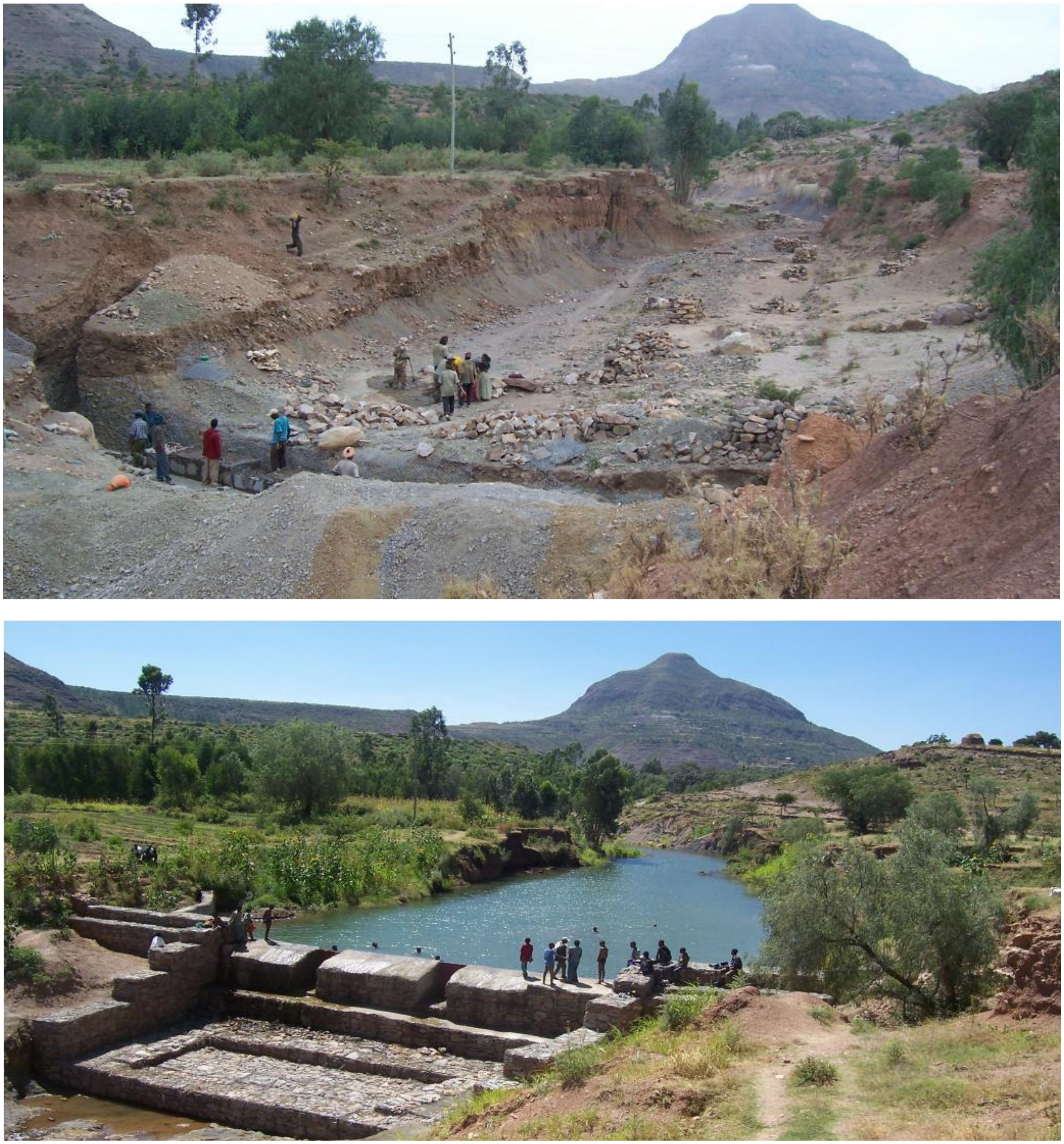

Figure 9Flood base farming before and after the construction of the check dam in AhferomWereda

3.3.4 Kola TembianWereda

Kola Tembianwereda is located in the centeral zone of Tigray as shown in the map, where flood based farming have been practiced for decades which is quite in different approach than Raya valley. In this wereda traditional spate type of flood based farming is also practiced rarely and mostly farmers also build a communal and or individual ponds and underground water tankers to supplement the moisture stress which is a little bit experienced in the area. The picture below shows another type of flood based farming constructed off spring. From the GIS map there is a potential around 30,000 ha of land to be supplemented by flood base either spate, check dams, underground tankers and or Communal ponds constructed off spring. The picture below shows the series of underground tankers constructed off spring .

Figure 10Series of underground tankers atKola TembianWereda

3.3.5 EndertaWereda

Endertawereda is located in the South Eastern zone of Tigray as shown in the map, where flood based farming have been practiced for decades which is quite in different approach than Raya valley. In this wereda traditional spate type of flood based farming is also practiced rarely and mostly farmers also build a communal and or individual ponds and underground water tankers to supplement the moisture stress which is a little bit experienced in the area. The picture below shows another type of flood based farming constructed off spring. From the GIS map there is a potential around 50,000 ha of land to be supplemented by flood base either spate, check dams, underground tankers and or Communal ponds constructed off or on spring. The picture below shows the communal ponds constructed off spring.

Figure 11Communal ponds at EndertaWereda

3.3.6 MerebLekeWereda

MerebLekewereda is located in the central zone of Tigray as shown in the map, where flood based farming have been practiced for decades which is rather in different approach than Raya valley. In this wereda traditional spate type of flood based farming is also practiced rarely and mostly farmers also build a communal and or individual ponds and underground water tankers to supplement the moisture stress which is more experienced in the area. The picture below shows another type of flood based farming constructed on spring. From the GIS map there is a potential of flood base farming which is around 30,000 ha of land to be supplemented by flood base farming either by spate, sub surface dam, check dams, underground water tankers and or Communal ponds constructed off or on spring are all possible. The picture below shows the check dam constructed by the wereda.

Figure 12Check dams at Merebe Leke

4. Conclusions and Recommendations

Flood base farming is a complex way of farming system in which farmers need to understand itscomplexity and devastating nature of floods. Therefore, we can learn how to live with floods?How to change its devastating nature in to a matter of livelihood? That is there must be a clear understanding that floods are not threats but they are sources of income and livelihood in arid zones/areas like Tigray. So far, there are a lot of truck records in different weredas of Tigray in understanding the behavior, importance and benefits of flood base farming.Thisneeds to spread out all over the region because there are a lot of potentials in the region where flood can be changed in to main source of economy. Thus, this is the only way out to pave the way for the development of the region in achieving its food security program and then create a subsistence farming there by to the country as a whole.

Therefore, If properly planned, designed, implemented and managed, it will have a significant contribution to the economic development and livelihood improvement of the region:

Assuming an increase in yield of 20 quintal/ha compared to purely rain fed and poorly managed FBFS:

- *As indicated above, the surveyed total FBF potential is 661,854 ha*
- *6,618,536 quintal of additional yield can be harvested from 50% of the potential area alone*
- *This will support extra 3,078,389 population of Tigray*

Finally yet importantly, even in times of poor rainfall situation, one flood can make a significant different in yield.