AWASH RIVER BASIN WATER ALLOCATION STRATEGIC PLAN

December, 2016

Contents

List of tables

List of figures

Acronyms

AwBA – Awash Basin Authority

BCM – Billion cubic meter

BHC – Basin High Council

CSA – Central statistical Agency

DEM – Digital Elevation model

EEP – Ethiopian Electric power

FAO – Food and Agriculture Organization

FDRE – Federal Democratic Republic of Ethiopia

GTP – Growth and transformation plan

GW – Ground water

Ha – hectare

IWRM – Integrated Water Resources Management

MCM – Million cubic meter

MoWIE – Ministry of Water Irrigation and Electricity

WAM - Water allocation Model

WAM&CR – Water allocation Model and conflict resolution

WWCE – Water works construction Enterprise

WWDSE – Water works Design and Supervision Enterprise

1 Background

1.1 Introduction

Water allocation is the process of sharing a limited water resource between different regions and competing users. It is a process made necessary when the natural distribution and availability of water fails to meet the needs of all water users – in terms of quantity, quality, timing of availability, or reliability. In simple terms, it is the mechanism for determining who can take water, how much they can take, from which locations, when, and for what purpose. Water allocation plans and agreements have taken on increasing significance in resolving international, regional and local conflicts over access to water (R. Speed, et.al. 2013).

Globally, water allocation objectives have evolved over time, and different approaches have emerged to calculating, defining and managing water resources. Ultimately though, water resources allocation has remained the process of deciding who is entitled to the available water. The water policy of the Federal Democratic Republic of Ethiopia (FDRE 2001) also suggested adopting the water allocation should follow the principle that shall not be made on permanent basis, rather it has to varied on an agreed time horizon that fits best with the socioeconomic development plans, especially pertinent to water resources, subjected to appraisals and revisions in light of new developments.

Growing competition for water resources in Awash Basin has led to develop a strategic water allocation river basin plan addressing the emerging challenges and maintain sustainable development. With all these basic concepts and principles of water allocation systems plan for Awsah River Basin, developed to addressing the spatial-temporal variation of surface and ground water resource to different regional and sectorial water users. Water allocation should be in an equitable and viable manner, without compromising the sustainability of the aquatic ecosystems through building knowledge for informed decisions, networking with stakeholders and regulating and enforcement of water use for sustainable development in the basin.

1.2 Objective of the plan

The overall objective of water allocation strategic plan is to set out framework of water allocation to ensure the dynamic and efficient utilization of available water resource in the basin considering past experience, current situation and future plans thereby resolving the conflict between water users and support decision making and development in the basin.

1.3 Vision

The overall vision of this water allocation strategic plan is to realize water secured river basin able to support any development which comprises intuitional cooperation and free from water conflict.

1.4 Scope

This strategic plan outlines the strategic views for 10 planning years from 2008 -2017 E.C. the planning units or areas considered for the planning are the six sub basins namely Awash up-stream Koka, Awash at Awash, Awash Halidebe, Awash Adaitu, Awash Terminal and Eastern catchment. The strategic issues are detailed at a sub basin (planning area) level and its implementation will include all relevant stakeholders from Federal institutions to regions.

2 SITUATION ANALYSIS

2.1 Legal and Institutional Framework

Legal and Institutional frameworks are among the factors that can influence management and utilization of natural resources. Water allocation in a basin is one of other natural resources management processes that is highly affected by these factors. The following are among the policy and institutional frameworks of Ethiopia which are reviewed in relation to water allocation.

2.1.1 The Federal Constitution

The institutional framework for water resources management in a river basin consists of established Policies, rules, norms, practices and systems that provide a structure to actions related to integrated water Resources management. The Federal Democratic Republic of Ethiopia (FDRE) Constitution states that all national policies, laws and institutional arrangements of the country, including those related to the management and administration of water resources must be in line with constitutional provisions. Among these provisions is the utilization of rivers and lakes linking two or more regional states or crossing the boundaries of the national territorial jurisdiction [Article 51(11),]. This provision gives the Federal Government the mandate to manage and administer such rivers and lakes determining of the use, allocation and protection of water resources.

2.1.2 The Ethiopian Water Resources Management Policy

The Ethiopian Water Resources Management Policy, coined with constitutional provisions and IWRM, is essential instrument to further articulate and elaborate the overall principles and directions that the country should follow regarding water resources management. As per Article 1.1 of the Ethiopian Water Resources Management Policy, the main goal of the policy is to insure efficient, equitable and optimum utilization of water. To achieve this, one of the objectives (Article 1.2; No.2) is 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 resource. Moreover, the water allocation and apportionment part (Article2.2.1), indicates how water allocation shall be done. In addition to this, the Policy provides

a step-by-step establishment of River Basin Organizations for efficient, successful and sustainable joint management of the water resources of the basins through concerted efforts of relevant parties by providing the legal basis for active and meaningful participation of all stakeholders.

2.1.3 The Ethiopian Water Resources Management Proclamation

The Ethiopian Water Resources Management proclamation ensures that all water resources of the country are the common property of the Ethiopian people and the state (Proclamation No. 197/2000; Article 5). This needs allocating the available water resources (both basin and nationwide) so that optimum use and equitable distribution of water can be achieved, in turn this will avoid conflict for a common water source.

The Proclamation (534/2007) gives the mandate to examine and decide on water allocation rules and principles in normal times and in times of water shortage as well as in times of drought or flooding, which further delegate to Awash Basin Authority as one of its major activities in basin water governance. Moreover, as indicated in the proclamation (115/20005; article 4:2), the dealing with the application for water use permit, the supervising body shall insure that the application is in line with the policy, the river basin master plans, the proclamation, regulations and directives; while water use is defined as use of water for drinking, irrigation, power generation, transport, animal husbandry, fishing, mining and uses of water for other purposes (Proclamation 115/2005; 2: definitions,6).

In addition to this, the proclamation (197/2000) assures that all water resources of the country are the common properties of the Ethiopian people and the state. However, the proclamation (197/2000; 6: fundamental principles) indicates that, the social and economic development programs, investment plans and programs and plans and water resources development activity of any person, shall be based on the countries water resources policy, the relevant master plan studies and water resources laws. Therefore, water allocation and other water resources management works are vital to assure this issue.

2.2 Significant Pressures

2.2.1 Social Pressures

According to the 3rd Population and Housing Census of 2016, the total population of Ethiopia was estimated to be 92,206,005.00. Out of that 20 % (18.3M) of the total population is found in Awash Basin. Out Of the total population in Awash basin 37.3 % (6825900) and 62.7% (11474100) resides in rural and urban areas of the basin respectively.

Related to the rapid population growth and increased water demand in the last few years, the water resource in the basin has become issues of concern and source of conflicts. Over- and inefficient utilization triggered by no or limited knowledge of the water resources availability regardless of the spatial and temporal distribution is significantly facilitating competition and conflicts for water in the basin. The most common cause of conflicts is upstream and downstream water use conflicts. The upstream users abstract much water without considering the downstream users. The conflicts could arise among individuals, communities, groups, clans, districts and so on.

Users abstract excess water triggered by lack of awareness on equity, efficiency and sustainable development. As a result, some users abstract excess water while others not. Traditional beliefs such as “water as a gift of nature” are among the challenge that hinders water allocation of the basin.

Implementation of effective water allocation to satisfy the growing and competing water demands of different uses demands awareness at individual, groups, community and social level.

2.2.2 Economic Pressures

The main driving factors that exacerbate the extent and intensity of the economic pressures in Awash Basin are expansion of agricultural development, industrialization and lack of integrated approaches to water resources management system .Due to its strategic location, good accessibility and availability of land and water resources, awash basin is the most developed basin in the country in terms of irrigation.

Mechanized sugarcane state farms are widely expanding in this basin compared to the other basins in the country. Wonji Shoa and expansion, Metahara, Middle Awash, Kessem and Tendaho sugar plantations are among the major ones .Small, medium and large scale private investment agricultural farms mainly cultivating vegetables and fruits are increasing from time to time. In addition government resettlement programs which shifted the pastoralists especially in Afar region to mixed farming system is changing pasture to irrigable lands.

On the other hand the development of many industries, industrial zones, construction of real state, condominium houses, roads, rail ways and other infrastructures are utilizing more water for production and other activities which is imposing significant pressures on water resources.

In addition to increasing consumption of water there are issues of inefficient water use (poor water management). releasing and drainage of untreated effluents to the river system (Fertilizer or manure runoff from farmland, improper disposal of sewage, chemical and industrial waste) and lack of proper mechanism to allocate water for the users. Poor water management arises from the technologies used especially surface irrigation method has an efficiency of 40-45% that wastes so much water. These problems decrease the amount of water to be utilized. Due to high consumption and reduction in quantity of water, water shortage and other related problems will raise a negative impact in the basin.

2.2.3 Environmental Pressures

Environmental pressure is of paramount importance in the current situation of our country as industrial based economy is being followed, hence, the adverse effects on the environment are inevitably going to be extreme unless proper actions start to be undertaken immediately. The extreme negative consequence of unchecked industrialization on the environment has been experienced in the world which should be a lesson learnt not to repeat the same mistakes that have already been made with dire consequences. In addition to the undeniable health effects of severe pollution in current highly industrially thriving nations a state of conflict over uncontaminated water is also becoming a common place occurrence. Furthermore, it should be noted that remedial measures if in fact achievable at the first place are by far more complex and costly than preventive measures, necessitating actions which take into account undesirable consequences that have to be faced in the future if appropriate measures are not taken.

There are numerous methods of identification of the necessary environmental flow to maintain specified values of ecosystems which will have severe adverse effects if not adhered to. Continuous exploitation of the basin might lead to the depletion of the water body and consequently might result in serious water stress and irreparable damage to the environment. Hence, this monitoring should be undertaken continuously to address the various needs arising at various time intervals.

The adverse effect on the environment is manifested in various ways in the Awash Basin. Water scarcity during dry spells which is resulting in social tension and conflict is one issue. In addition, water-logging problem is also a serious concern in Becho plain, Gedabassa and Borkona swamp. Flooding hazards in the Awash Awash, Awash Halidebi, Awash Adaitu and AwashTerminal Planning Areas were also the other threatening phenomena which are critical to the basin. Salinity is also a potential problem in the middle valley.

During dry-season since there is no sufficient base-flow in the river system for water supply and associated water quality maintenance for dilution and ecological processes it creates water stress on the users who abstract water directly from rivers, such as for local water supply, livestock watering and irrigation, and as important component of environmental flow requirements.

3 Scenario Analysis

The water use types of the basin possibly categorized as Irrigated agriculture, domestic, livestock and industrial. However, the major water use types, which account 83% of the total water use of the basin is the irrigated agriculture. The irrigated agriculture also further classified as small, medium and large irrigation based on the scheme size or Wereda based and scheme based irrigation based on the operation types. The oldest irrigation schemes, Wonji, Nura era, Metehara, Amibara and the new schemes developed because of the introductions of the two new dams, Kesem, and Tendaho and the two diversions, Tibila and Fentale are the major water users among the total irrigation uses (AwBA WAM&CR study, 2016). Therefore, the basin water allocation scenario analysis has to focus on the different situations of irrigated agriculture with the general priority given to other water uses. In other side if we see the water supply side of the basin, we can have different conditions due to the variability of the rainfall situation as wet, normal and dry year water flow, due to supply side development like the introduction of planned dams and ground water exploration can varied the water allocation system of the basin radically. Therefore, the scenario analysis of the basin as well as sub basin water allocation system has to be analyzed based on the combination of the demand and supply side situations. Further the planning procedure also followed the scenario that address the major water uses as current and future situation, possible supply side developments and mitigate major conflicts among water uses in the basin.

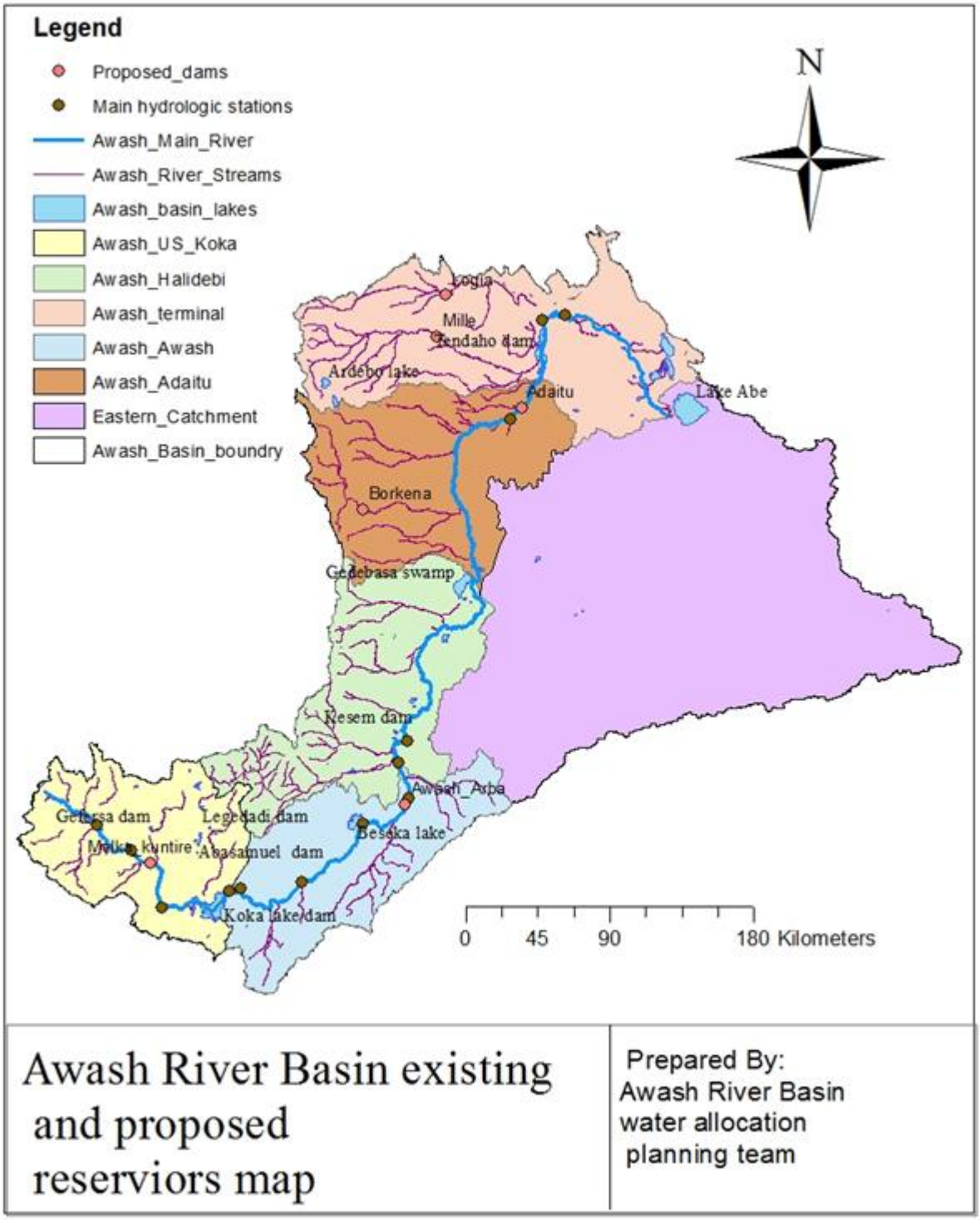

Figure 1: Map of Awash basin with existing and proposed reservoirs in 6 planning areas.

3.1 Current Scenario

The current water use assessments study of the basin confirmed that there are 18.3 million human population, 34.4 million livestock population, 199234 ha irrigated land and different commercial and industrial activities as major water users in the basin. The annual water demand of these users also accounted as 3.411BCM, 0.298BCM, 0.121BCM and 0.283BCM for irrigation, domestic, livestock and industrial uses respectively. If we aggregated the total water use demand in the basin it accounted as 4.114BCM (AwBA WAM&CR study, 2016). In the other side if we see the annual amount of the supply side of the basin it is more than sufficient to provide these demands. However, its temporal variability doesn't help to support all demands in any water flow condition (wet, normal and dry).

Spatially the water demand-supply interaction per six planning areas shows different characteristics for each of them. The Awash Up-Stream Koka planning area required 400.7MCM annual water for all types of water uses. However the major share of the water requirement in this planning area is the domestic and industrial water demand of Addis Ababa, which currently accounted as 38% of the water demand of the planning area. It indicates that this planning area water allocation mainly characterized with urbanization and its related issues. The second planning area, Awash Awash has 1260.2mcm annual water demand that mainly accounted for the irrigation water requirement. The water supply system of this planning area is mainly dependent of the annual water stored in Koka reservoir, which currently has a 1071MCM maximum storage capacity. Here there is significant gap between the available water supply and the demand, which needs serious focus on the water allocation system of the basin. The third planning area, Awsah Halidebe, has annual water demand of 643.7MCM annual water demand that mainly accounted for the irrigation water requirement, which is supplied from two reservoirs, Koka and Kessem. As we see in above the storage capacity of Koka reservoir doesn't satisfied the other planning areas. Therefore the major attention of this planning area is Kessem reservoir which also has annual storage capacity of 500MCM, which is still under the demand of the planning area and needs additional supply system development. The fourth planning area, Awash Adaitu has annual water demand 393.3MCM annual water demand that mainly accounted for the irrigation water requirement, which is less developed and less stress planning area among the Planning areas in related to water allocation perspective. The fifth planning area, Awash Terminal, has a water

demand of 1057mcm, which is much less than from the storage capacity of its supporting reservoir, Tendaho that has 1700MCM storage capacity. Lastly the Eastern Catchment, which has 358.8MCM annual water demand and possibly covered with two potential developments. One with the help of newly designed middle awash reservoir or other alternative that can see inside the planning area.

Ser. No.	Planning area	Water demand in MCM
1	Awash upstream Koka	400.7
2	Awash at Awash	1260.2
3	Awash Haledebi	643.7
4	Awash Adaitu	393.3
5	Eastern Catchment	358.8
6	Awash Terminal	1057
	Total	4113.7

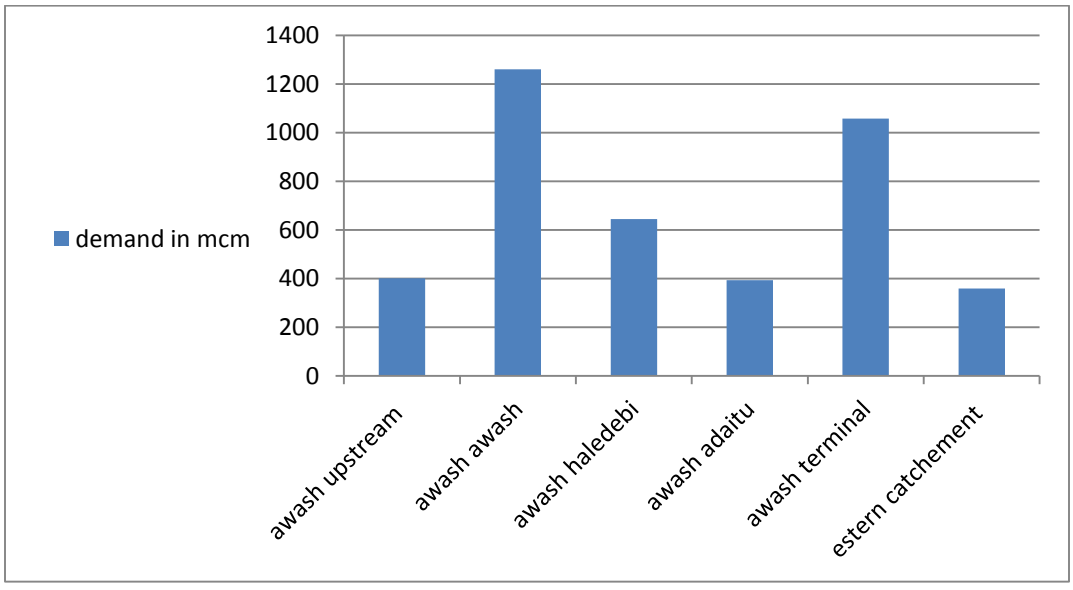

Figure 2: Annual water demand of Awash Basin.

3.2 Future Scenario

The future scenario in this basin plan document was compiled from different studies. Population growth in each reclassified sub basin was estimated and forecasted considering Wereda level growth rates both for human and livestock population using data from CSA (2008) population census report. The irrigation expansion for the next ten year, 338259ha (MoWE and FAO, 2013), is estimated considering the GTP plans of Wereda's agricultural office and the full capacity of all the major irrigation schemes in the basin. The amount of water requirements for these expansion also estimated as 6560mcm(AwBA WAM&CR study, 2016), which can possible attend through the construction of water harvesting structures, improvement of the water use efficiency in the basin, and the improvement of water regulating and monitoring approach.

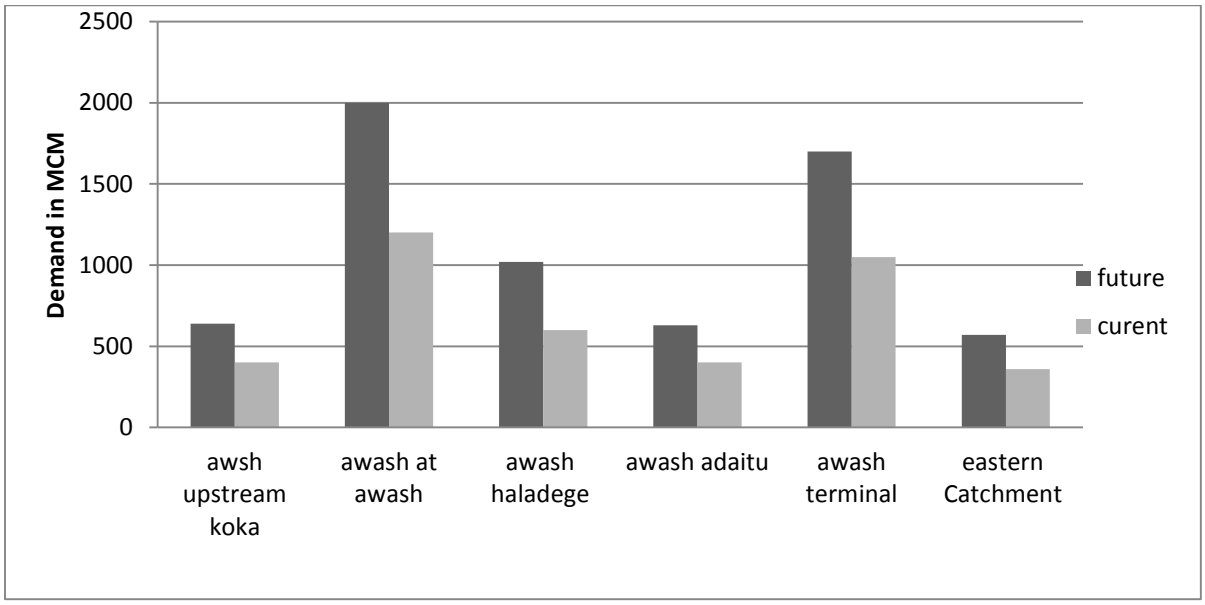

Figure 3: Comparison of future and current water demand of planning areas in MCM

On other view for the future basin development has emerging from the water and land resources systems of the basin. For instance the water harvested in the middle Awsah dam possibly deliver water with left and right canal and can provide water for the irrigation and domestic requirements for Oromia , Afar and Somalia regions (Figure 3).

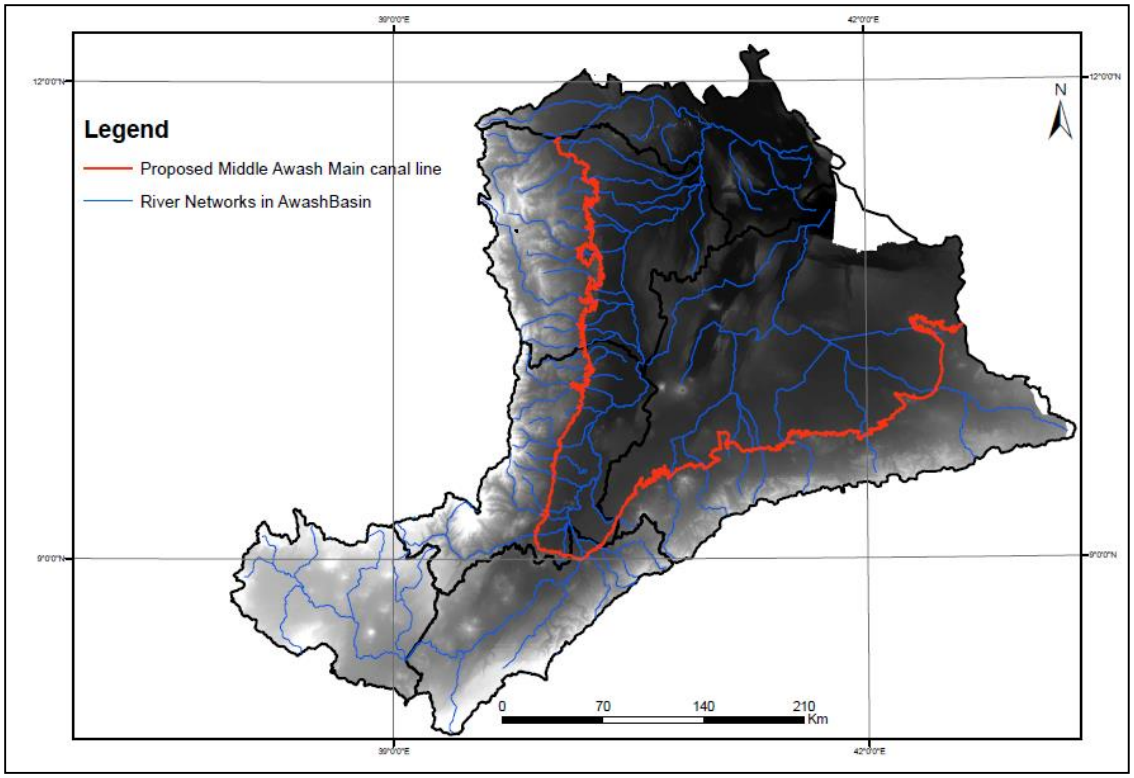

Figure 4: Proposed Middle Awash reservoir water delivery system

With the process of Basin water balance modeling 6 multipurpose dams are proposed in the basins. Three of these dams are located on the mainstream line of the Awash River and the other three are at the three different tributaries. The locations of these dams described in the table 1.

Table 1: Description and locations of Multi-purpose Dams proposed in Awash River Basin, (AwBA WAM&CR study, 2016)

No	Name of Proposed Dam	Name of River	Nearest Hydrological Station	Coordinates (UTM)	
				Easting	Northing
1	MelkaKunture Dam	Awash	Awash @ MelkaKunture	468,390	954,392
2	Awash Arba Dam	Awash	Awash @ Awash Arba	627,647	990,798
3	Borkena Dam	Borkena	Borkena @ Kombolcha	601,378	1,175,187
4	Adayitu Dam	Awash	Awash @ Adayitu	700,234	1,238,697
5	Mille Dam	Mille	Mille @ Mille	647,577	1,283,037
6	Logiya Dam	Logiya	Logiya @ Logiya	652,675	1,308,826

The Elevation-capacity curve of the reservoirs accessed from the feasibility study of the two dams (Middle Awash and Logiya) and from DEM data analysis for other proposed dams. Moreover, their capacity fixed based on the input stream flow above the sites of each dams (Table 2).

Table 2: The size and the capacity of proposed multipurpose Dams in Awash River Basin

Source (AwBA WAM&CR study, 2016)

	Name	Height (m)	Crust Length (m)	AREA (km2)	Volume (MCM)
1	MelkaKunture Dam	100.00	1414.0	12.50	501.70
2	MiddelAwash Dam	120.00	593.0	12.51	500.92
3	Borkena Dam	10.00	72.0	61.92	330.00
4	Adayitu Dam	30.00	669.0	85.41	1270.00
5	Mille Dam	40.00	386.0	40.85	428.00
6	Logiya Dam	48.00	335.0	60.46	697.12

The provision of these reservoirs in the basin will increases the water harvesting capacity at the basin, mitigates the water demand stress in the current use, and supports the future developments of the basin.

From ground water potential assessment work and the water allocation balance computation annually rechargeable potential of 10.3 BCM ground water capacities identified (AwBA WAM&CR study, 2016). Although it has spatial variability as indicated in the table3 , its development and exploration according to the gap in the demand will mitigate the water stress in the basin as well it support the future developments also.

Table 3: Ground water potentials of sub basins with exploration depth up to 300m

: Source Awash Basin WAM & CR study, 2016)

s/no	Sub basin	GW potential in MCM
1	Awash upstream Koka	1584.84
2	Awash at Awash	1325.05
3	Awash Haledebi	1810.28
4	Awash Adaitu	2597.99
5	Eastern Catchment	155.09
6	Awash Terminal	2844.38
	Total	10317.63

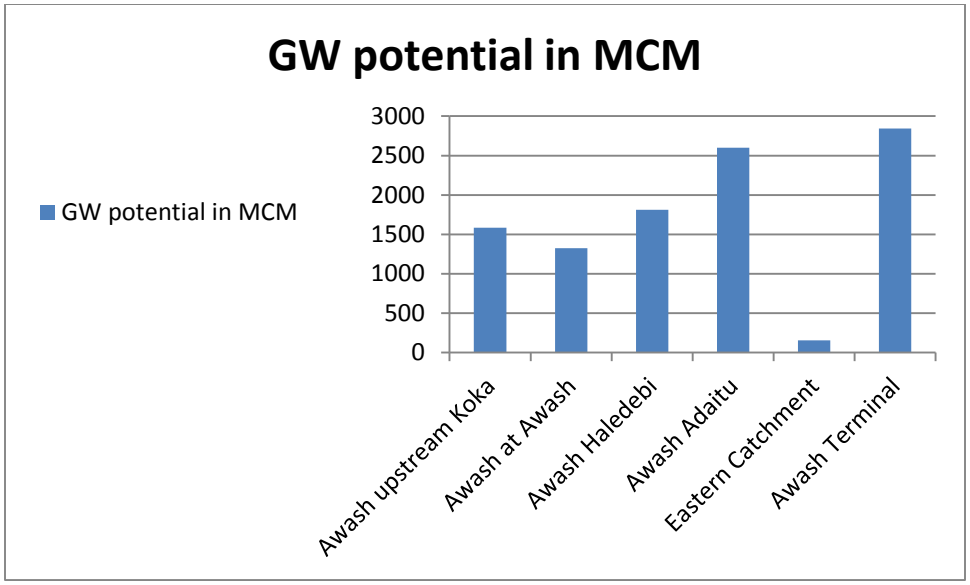

Figure 5: Ground water potential of Awash basin at 6 planning areas

4 Goal, Objective, Measures Logical framework

4.1 Goal

The water allocation plan of the basin will targeted to provide water for the forecasted irrigation use (340000ha), domestic, livestock and industries uses with sustainable, equitable and rationally manner.

The present annual water demand of different water use nodes of Awash Basin (irrigation, domestic, industry, and livestock) is estimated as 4.114BCM. However, the available water from the existing three dams (Kessem, Koka and Tendaho) is about 2.307BCM which can't satisfy the current demand. Moreover, the forecasted water use demand of the basin by the next ten years is estimated as 6.56BCM which needs 4.253BCM extra water source to satisfy the water use demand. To fill this gap the plan focuses on three main objectives which are improve water availability in the basin, improve water use efficiency in the basin and using innovated technologies. To meet these main objectives different measures are considered as described below.

4.2. Objectives

4.2.1 Improve water availability

If their full capacity is utilized, the current water availability of the basin from the existing three dams /Koka, Kessem and Tendaho / is 3.271BCM while the current demand is 4.114BCM. Based on 44.3% overall irrigation water use efficiency of the basin, the forecasted overall water demand in the basin in the coming ten years will be 6.56BCM. Considering overall efficiency of the basin to be 55% the forecasted demand for the coming ten year will be 5.271BCM. To meet these demand different measures has to be taken. Some of these are improving the capacity and delivery of the existing reservoirs to their full capacity, development of surface water harvesting systems and ground water exploration.

Improving capacity of the exiting reservoirs

The current available water from the three reservoirs is 2.307BCM. However, if their capacity is utilized, it is possible to get 3.271BCM water from these reservoirs. Considering the location of these reservoirs in relation to the plan areas used for this planning purpose, this water can satisfy

part of domestic, livestock, industrial water use demands and additional 56,000ha of land will be irrigated.

Surface water harvesting

Although the full capacity of the existing reservoirs are utilized, as the irrigable area will increase from 200, 000ha 340,000ha in the coming ten years, it is impossible to satisfy the demand with the available water. Therefore, additional water harvesting reservoirs which can harvest 1.16BCM additional water using three dams (Middle Awash, Melka Kuntre and Logia dams) are planned. This water can satisfy part of domestic, livestock, industrial water use demands and additional 41,000ha of land will be irrigated.

Develop ground water

It is known that, there are ground water potential areas in the basin. Therefore, it is planned to develop 1.0BCM ground water from selected potential sites as shown in the detail plan to satisfy part of domestic, livestock, industrial water use demands and to irrigate 40,000ha additional irrigable land

4.2.2 Improve water use efficiency

Most of the irrigation practice in Awash basin is surface irrigation system with design efficiency of 35-40%. In the strategic river basin planning it is prepared to reach efficiency for the following irrigation systems. For the next 10 years the community and mechanized Surface irrigation efficiencies of irrigation farms is planned to be 60% , improving sprinkler system from 70% to 80%, Hydro flume from 65% to 75% and drip from 80% to 90%.

Enhance loss control systems:

The current overall water use efficiency of the basin is 44.3%. In the coming ten years, it is planned to cover 67,000ha land by modern irrigation technologies and to increase the overall efficiency to 55%.

Establish water use rules and regulations

It is planned that, in the next ten years all water users of the basin will be registered and out of this 200,000ha irrigation water users, 1500 industrial water users and all town water supply providers will be framed within permit system of the basin.

4.2.3 Promote research & innovation

Research and innovation is an instrumental ongoing activity in the basin (and outside) to contribute to sustainable, equitable and rational water utilization in Awash and the development of the Basin in general. Promotion of research and innovation can be done through: 1) identifying research areas; 2) setting up of pilots and physical models; and 3) adaptation and dissemination of technologies. In line with these activities, more detailed activities will entail the establishment of an archive with current and past research, which should be kept up to date over the years. Moreover, challenges in the basin need to be explicitly identified and linked to research activities in order to keep theory and practice in tandem. In doing so, existing research is supplemented with new relevant studies. Pilot studies to (field) test new technologies, regulatory instruments and other interventions hitherto untried in the Awash Basin need to be conducted in a scientifically responsible manner. Hence a manual for pilot-testing is needed to safeguard the quality of the pilots and minimize the risk of false feedback and spurious results. This manual has to be kept up to date with experiences gained from pilot-testing. The concept of pilot-testing may be new to many stakeholders in Awash. Raising awareness is therefore important, including consulting stakeholders for feedback. Finally, before technologies are adapted and disseminated, opportunities to this end need to be identified. Twice a year, an overview of such opportunities can be produced. The chosen opportunities are subsequently prioritized. To stimulate innovation, an 'innovation fund' will be set up that will finance a small number of ideas which meet certain innovation criteria. Students, entrepreneurs and citizens should all be eligible to apply to this fund.

4.3 objective trees

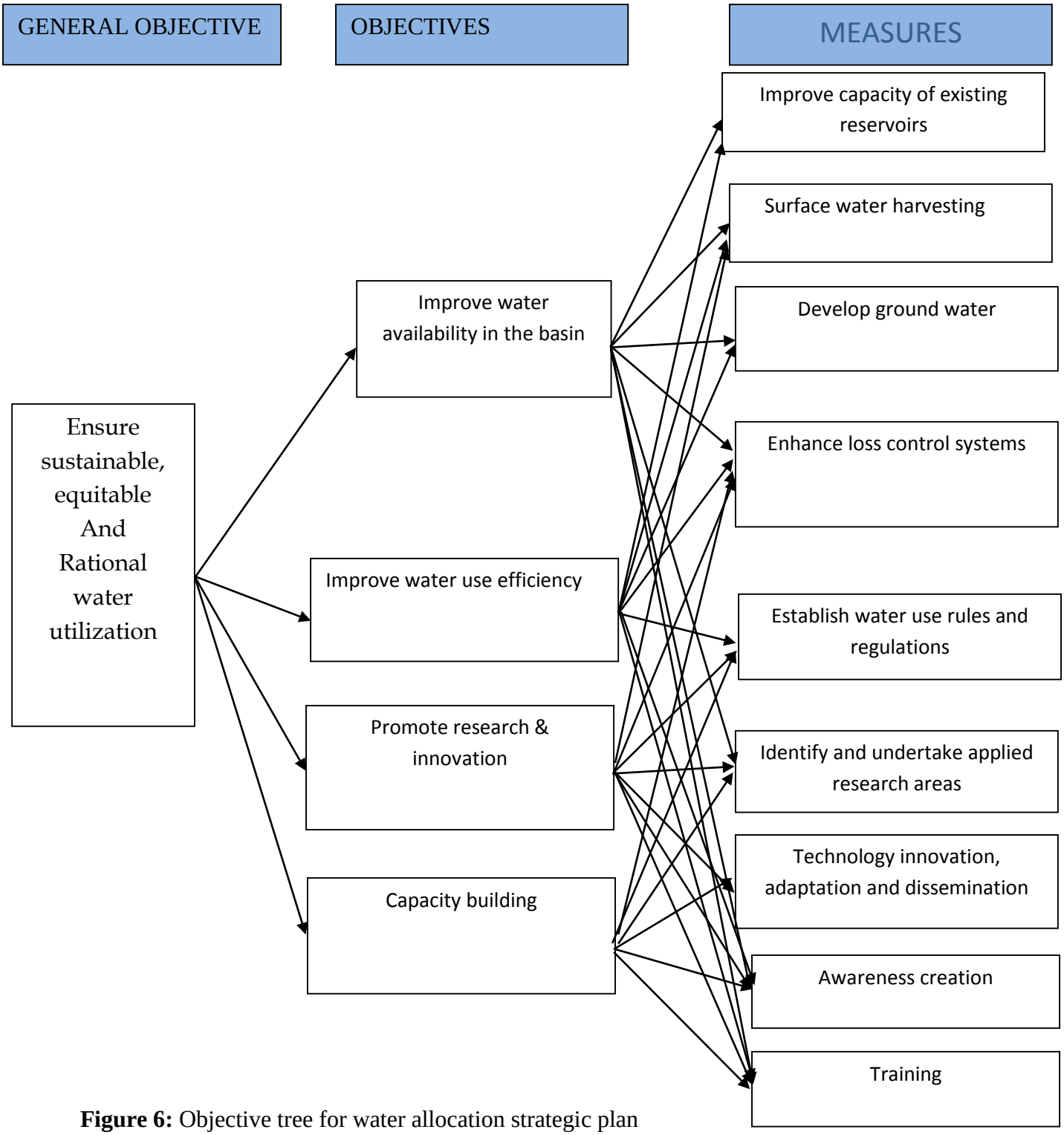

Figure 6: Objective tree for water allocation strategic plan

4.4. Target and Evaluation criteria

Table 4: goal, general objective, specific objective, target and evaluation criteria

Goal	General objective	Specific objective	Target	Evaluation Criteria
Ensure sustainable, equitable and Rational water utilization	Improve water Availability in the basin	increase capacity of existing reservoirs	increase the storage capacity of existing reservoir from 2307MCM to 3271MCM	satisfy all domestic, livestock water supply needs and additional 56000 ha of land irrigated
		surface water harvesting	harvest additional 1160 MCM of water from 3 new dams	satisfy all domestic, urban, livestock, industrial water supply and additional 41000 ha of land irrigated
		Develop Groundwater	production of 1000 MCM ground water source	satisfy urban and Industrial water supply and additional 40000 ha of land irrigated
	Improve water use efficiency	enhance loss control systems	increase the overall irrigation efficiency of the basin from 44.3% to 55%	67,000 ha irrigated land equipped by modern irrigation system
		establish Water use rules and regulation	register all water users, permit 200,000 ha irrigated land users, permit 1500 industrial water users and permit all town water providers	200,000 ha irrigated area users, all town water supply providers and 1500 industry water users are licensed (certified) in the basin
	Promote Research and Innovation	Identify and undertake applied Research	identify and conduct 50 researches	research output Implemented
		technology innovation adaptation and dissemination	innovate and adopt 10 technologies	adopted and innovated technologies
			disseminate 6 technologies	disseminated technologies
	Capacity building	Awareness creation	Conducting 18 workshops and forums	Organized workshops and forums
		Training	Technical training and experience sharing for 400 experts and technicians	Long term and short term training

5. Detail Action Plan

This water allocation strategic basin planning has one major goal, three objectives, seven measures and thirteen activities as show in table

Table 5: Goal, objective, measures and activities

Goal	objectives	Measures	Activities
Ensure sustainable, equitable And Rational water utilization	Improve water availability in the basin	Improve capacity of existing reservoirs	Increase the potential of existing dams to their full capacity
		surface water harvesting	Establish surface water harvesting & delivery structures
		Develop ground water	Establish ground water source areas
	Improve water use efficiency	Enhance loss control system	develop water allocation guideline and measures
			Expand the area coverage efficient water delivery Technologies
			improve water use efficiency with management and scheduling
			improve distribution system
		establish Water use rules and regulation	Develop water use permitting system
			improve the rate and water use fee collection
			improve inspection and enforcement mechanism of water utilization
	Promote research and innovation	Identify and undertake applied research	identify gaps and conduct researches
		Technology Innovation adaptation and dissemination	technology adaptation
			technology dissemination
	Capacity building	Awareness creation	Workshops and forum
		Training	Short term and long term training

Table 6: Sub activities and ten years target

no	Sub activities	unit	10 YEARS TARGET
1	maintained the water delivery system of koka dam	%	100
2	Store water at full capacity of Tendaho dam.	MCM	15300
3	Store water at full capacity of Kessem dam.	MCM	4500
4	Finalizing the detail design of 500MCM Middle Awash dam	%	100
5	constructing 500 MCM Middle Awash dam	%	100
6	Conducting the study of conveyance system for Middle Awash dam	%	100
7	constructing the conveyance infrastructures of Middle Awash dam	%	100
8	Finalizing the detail design of 160MCM Logia dam	%	100
9	constructing Logia dam	%	100
10	Conducting the study of conveyance system for Logia dam	%	100
11	constructing the conveyance infrastructure of Logia dam	%	100
12	Conducting the feasibility study and detail design of Melka Kuntre dam	%	100
13	Construction of 500MCM Melka Kuntre dam	%	100
14	Conducting the study of conveyance system for Melka Kuntre dam	%	100
15	constructing the conveyance infrastructure of Melka Kuntre dam	%	100
16	Conduct detail study for ground water development in selected sites	no	18
17	Develop 300MCM ground water source by Wonji sugar cane scheme	%	100
18	Develop 200MCM ground water source by Metehara sugar cane scheme	%	100
19	Develop 85MCM ground water source by Upper Awash Agro Industry/nuraera /	%	100
20	Develop 15MCM ground water source by Africa Juice S.C	%	100
21	Develop 240MCM ground water source at Awash Elwa (Halidebie) area	%	100
22	Develop 160MCM ground water source by Adea Becho area	%	100
23	prepare water allocation guideline for all uses and different scenarios for the next 10 years	no	1
24	prepare annual water allocation for all users	no	9
25	preparing operation rule for the reservoirs	no	32
26	installing Sprinkler system (wonji =6000,upper awash= 2000,metehara = 3000, Amibara=2000)	ha	15000
27	installing drip system for vegtable and fruit farms	ha	8110
28	install hydro flume (metehar=5000,kessem=15000=,Amibara=4000,Tendaho=20000)	ha	27450
29	enhance alternate furrow ,cut back flow and re-use system for furrow irrigation	ha	6100
30	change flood irrigation to furrow irrigation	ha	27700
31	construct pipes & lined canal system transport main ,primary and secondary canals (Fentale=20,tibila=7,middle=10,amibara)	km	375
32	upgrade and modernize diversion weirs to enhance water distribution	no	4
33	water distribution for various uses	MCM	48890
34	establish water users registration system	%	1
35	issuing new permit	no	3350

36	renewing existing permit	no	6805
37	establish grassroots water use permitting	no	2730
38	prepare water use tariff	no	1
39	collect water use fee for 15.6 BCM water	mill. birr	90.8
40	establish Water users association	no	570
41	establish advisory committee	no	1
42	creating linkage with legal bodies to enforce rules and regulations	no	5
43	preparing directives inspection manuals & monitoring mechanisms for effective water utilization	no	1
44	follow up and supervision	no	40
45	Establishment of current and past research collections	no	1000
46	Identifying researchable issues and conduct researches on water allocation	no	100
47	Technology identification	no	10
48	select and set pilot and physical model sites	no	6
49	technology adaptation and evaluation	no	10
50	demonstrate technologies for users	no	6
51	disseminate verified technologies for uses	no	10
52	Awareness creation for Irrigation water users	no	18
53	Awareness creation for Industrial water users	no	18
54	Awareness creation for urban water utilities	no	20
55	Awareness creation for recreation, fishery and parks water users	no	10
56	Awareness creation for regional water related sectors	no	9
57	Awareness creation for Federal water related sectors	no	18
58	providing training for expertise	no	400
59	Local and international Experience sharing	no	45
60	providing training for decision makers	no	9

Table 7: Sub activities, action owner and other actors

no	Sub activities	Responsible body
1.	maintain the water delivery system of Koka dam	AWBA, MoWIE, WWDSE, EEP users,
2.	maintain the water delivery system of Kessem dam	AWBA MoWIE, WWDSE, WWCE, AwBA
1.	maintain the water delivery system of Tendaho dam	AWBA MoWIE, WWDSE, WWCE,, AwBA
2.	Finalizing the detail design of 500MCM Middle Awash dam	AWBA MoWIE, WWDSE, WWCE,, AwBA
3.	constructing 500 MCM Middle Awash dam	AWBA MoWIE, WWDSE, Regions
4.	Conducting the study of conveyance system for Middle Awash dam	AWBA MoWIE, WWDSE, Regions
5.	constructing the conveyance infrastructures of Middle Awash dam	AWBA MoWIE, WWDSE, Regions
6.	Finalizing the detail design of 160MCM Logia dam	AWBA MoWIE, WWDSE, Regions
7.	constructing Logia dam	AWBA MoWIE, WWDSE, Regions
8.	Conducting the study of conveyance system for Logia dam	AWBA MoWIE, WWDSE, , Regions
9.	constructing the conveyance infrastructure of Logia dam	AWBA MoWIE, WWDSE, Regions
10.	Conducting the feasibility study and detail design of Melka Kuntre dam	AWBA MoWIE, WWDSE, , Regions
11.	Construction of 500MCM Melka Kuntre dam	AWBA, WWDSE, MoWIE, Regions
12.	Conducting the study of conveyance system for Melka Kuntre dam	AWBA, WWDSE, MoWIE, Regions
13.	constructing the conveyance infrastructure of Melka Kuntre dam	AWBA WWDSE, MoWIE, Regions
14.	Conduct detail study for selected sites	AWBA MoWIE, WWDSE, MoWIE, Regions
15.	Develop 300MCM ground water source by Wonji sugar cane scheme	Sugar Corporation, AWBA MoWIE
16.	Develop 200MCM ground water source by Metehara sugar cane scheme	Sugar Corporation, AwBA MoWIE, AWBA
17.	Develop 85MCM ground water source by Upper Awash Agro Industry/nuraera /	Sugar Corporation, AwBA MoWIE, AWBA
18.	Develop 15MCM ground water source by Africa Juice S.C	Upper Awash A.Industry, AwBA MoWIE, AWBA
19.	Develop 240MCM ground water source at Awash Elwa (Halidege) area	Africa Juice S.C MoWIE, AWBA
20.	Develop 160MCM ground water source by Adea Becho area	Region, AwBA MoWIE, Regions

21.	prepare water allocation guideline for all uses and different scenarios for the next 10 years	AWBA MoWIE & UNIVERSITIES
22.	prepare annual water allocation for all users	AWBA, MoWIE & UNIVERSITIES
23.	preparing operation rule for the reservoirs	AWBA, MoWIE & UNIVERSITIES
24.	installing Sprinkler system (wonji =6000,upper awash= 2000,metehara = 3000, Amibara=2000)	USERS, AwBA AWBA,WWDSE
25.	installing drip system for vegetable and fruit farms	USERS, AWBA,WWDSE
26.	Install hydro flume (Metehara=5000,kessem=15000=,Amibara=4000,Tendaho=20000)	USERS, AWBA,WWDSE
27.	Enhance alternate furrow ,cut back flow and re-use system for furrow irrigation	USERS, AWBA,WWDSE
28.	change flood irrigation to furrow irrigation	USERS , AWBA,WWDSE
29.	construct pipes & lined canal system transport main ,primary and secondary canals (fentale=20,tibila=7,middle=10,amibara)	USERS , AWBA,WWDSE
30.	water distribution for various uses	AWBA, REGIONS
31.	establish water users registration system	REGIONS, AWBA
32.	issuing new permit	REGIONS , AWBA
33.	renewing existing permit	REGIONS, AWBA
34.	establish grassroots water use permitting	REGIONS, AWBA
35.	prepare water use tariff	MOWIE, AWBA
36.	collect water use fee for 15.6 BCM water	REGIONS, AWBA
37.	creating linkage with legal bodies to enforce rules and regulations	AWBA , BHC, Region, MoWIE
38.	use irrigation water users association for water distribution, monitoring and water use fee collection	AWBA , REGIONS
39.	preparing directives inspection manuals & monitoring mechanisms for effective water utilization	AWBA , MoWIE
40.	follow up and supervision	AWBA , REGIONS
41.	Establishment of current and past research collections	AWBA , MoWIE, Universities
42.	Identifying researchable issues and conduct researches on water allocation	AWBA , Research centers, MoWIE, Universities
43.	Technology identification	AWBA , Research centers, MoWIE, Universities
44.	select and set pilot and physical model sites	AWBA , water users, regions
45.	technology adaptation and evaluation	AWBA , Research centers, MoWIE, Universities
46.	demonstrate technologies for users	AWBA , Research centers, MoWIE, Universities, regions
47.	disseminate verified technologies for uses	AWBA , Research centers, MoWIE, regions

Table 8 : Sub activities action plan

no	Sub activities	unit	Total Awash basin					
			Detail action plan for 6 planning areas					
			2008	2009	2010	2011	2012	2013-2017
1	maintain the water delivery system of koka dam	%		20	40	40	0	0
2	Store water at full capacity of Tendaho dam.	MCM		1700	1700	1700	1700	8500
3	Store water at full capacity of Kessem dam.	MCM		500	500	500	500	2500
4	Finalizing the detail design of 500MCM Middle Awash dam	%		100	0	0	0	0
5	constructing 500 MCM Middle Awash dam	%		0	20	30	30	20
6	Conducting the study of conveyance system for Middle Awash dam	%		0	0	0	100	0
7	constructing the conveyance infrastructures of Middle Awash dam	%		0	0	0	0	100
8	Finalizing the detail design of 160MCM Logia dam	%		100	0	0	0	0
9	constructing Logia dam	%		0	20	30	30	20
10	Conducting the study of conveyance system for Logia dam	%		0	0	30	40	30
11	constructing the conveyance infrastructure of Logia dam	%		0	0	10	30	60
12	Conducting the feasibility study and detail design of Melka Kuntre dam	%		70	30	0	0	0
13	Construction of 500MCM Melka Kuntre dam	%		0	0	40	30	30
14	Conducting the study of conveyance system for Melka Kuntre dam	%		0	100	0	0	0
15	constructing the conveyance infrastructure of Melka Kuntre dam	%		0	0	40	30	30
16	Conduct detail study for ground water development in selected sites	no		4	6	1	2	5
17	Develop 300MCM ground water source by Wonji sugar cane scheme	%		0	40	30	30	0
18	Develop 200MCM ground water source by Metehara sugar cane scheme	%		0	0	60	40	0
19	Develop 85MCM ground water source by Upper Awash Agro Industry/nuraera /	%		0	60	40	0	0
20	Develop 15MCM ground water source by Africa Juice S.C	%		0	50	50	0	0
21	Develop 240MCM ground water source at Awash Elwa (Halidebie) area	%		0	10	50	40	0
22	Develop 160MCM ground water source by Adea Becho area	%		20	40	40	0	0
23	prepare water allocation guideline for all uses and different scenarios for the next 10 years	no		0	1	0	0	0
24	prepare annual water allocation for all users	no		1	1	1	1	5
25	preparing operation rule for the reservoirs	no		3	3	3	3	20
26	installing Sprinkler system (wonji =6000,upper awash= 2000,metehara = 3000, Amibara=2000)	ha		700	1250	1800	2400	8850
27	installing drip system for vegtable and fruit farms	ha		20	40	40	0	0
28	install hydro flume (metehar=5000,kessem=15000=,Amibara=4000,Tendaho=20000)	ha		20	40	40	0	0
29	enhance alternate furrow ,cut back flow and re-use system for furrow irrigation	ha		20	40	40	0	0
30	change flood irrigation to furrow irrigation	ha		20	2550	40	0	18550
31	construct pipes & lined canal system transport main ,primary and secondary canals (fentale=20,tibila=7,middle=10,amibara)	km		20	40	40	0	255
32	upgrade and modernize diversion weirs to enhance water distribution	no		0	1	1	1	1
33	water distribution for various uses	MCM		4010	4010	4010	4010	20050
34	establish water users registration system	%		0	1	0	0	0

35	issuing new permit	no		210	385	515	690	1550
36	renewing existing permit	no		280	590	975	1540	3420
37	establish grassroots water use permitting	no		170	325	380	535	1320
38	prepare water use tariff	no		1	0	0	0	0
39	collect water use fee for 15.6 BCM water	mill. birr		9.5	9.5	9.6	9.7	52.5
40	establish Water users association	no		45	70	80	100	275
41	establish advisory committee	no		1	0	0	0	0
42	creating linkage with legal bodies to enforce rules and regulations	no		0	1	0	0	0
43	preparing directives inspection manuals & monitoring mechanisms for effective water utilization	no		0	1	0	0	0
44	follow up and supervision	no		5	5	5	5	20
45	Establishment of current and past research collections	no		100	100	100	100	600
46	Identifying researchable issues and conduct researches on water allocation	no		0	10	15	15	60
47	Technology identification	no		0	1	2	2	5
48	select and set pilot and physical model sites	no		0	0	2	2	2
49	technology adaptation and evaluation	no		0	1	2	2	5
50	demonstrate technologies for users	no		0	0	2	2	2
51	disseminate verified technologies for uses	no		0	1	2	2	5
52	Awareness creation for Irrigation water users	no		2	2	2	2	10
53	Awareness creation for Industrial water users	no		2	2	2	2	10
54	Awareness creation for urban water utilities	no		2	2	2	2	12
55	Awareness creation for recreation, fishery and parks water users	no		1	1	1	1	6
56	awareness creation for regional water related sectors	no		1	1	1	1	5
57	Awareness creation for Federal water related sectors	no		2	2	2	2	10
58	providing training for expertise	no		30	30	40	50	250
59	Local and international Experience sharing	no		3	5	7	10	20
60	providing training for decision makers	no		1	1	1	1	5

6 Risk management

6.1 Planning assumption

To implement this strategic plan some assumptions are taken in to consideration such as:

- FDRE development policy supports water resource development.
- All the action owners will allocate enough budgets for their respected activities.
- There will be full implementation of water allocation model developed in the basin.
- All stake holders and concerned bodies will take part in the implementation of the plan.
- There will be strong integration between all stakeholders and concerned bodies.

6.2 Expected challenges

- Lack of political commitment and awareness
- Absence of stakeholder legitimacy and cooperation
- Limited institutional mandate and capacity – Key institutions need to have the power and capacity to give effect to the strategic actions of the plan.
- Poor information and communication
- Water shortage due to drought which is caused by climate change.
- Expansion of development activities results in water shortage and stress on water
- Illegal water abstraction and unpermitted water use
- Expansion of saline water and sedimentation of reservoirs

6.2 Possible solution

- adequate leadership to drive implementation and allocate resources
- Appropriately constructed stakeholder engagement process linked to the development of the plan.
- Policy and legislation to be in place, as well as institutional strengthening and capacity-building.
- Sound monitoring systems, communications strategies, formal communication
- Development of infrastructure such as dams and develop early warning mechanism
- Strengthening enforcement and controlling mechanisms
- Water quality monitoring and undertake watershed management activities

7 Monitoring & Evaluation mechanisms

Periodic evaluation of the river basin is an essential function of management. This evaluation should be carried out periodically by an interdisciplinary team that includes personnel from the operating authority, the federal and regional government in which Awash River basin is located, and experts from outside. Some of monitoring and evaluation mechanisms are:

- Establish advisory committees
- Establishing periodic reporting system
- Establish strong feedback system
- Regular follow up and supervisions
- Regular meeting and discussions

8 References

Addis Ababa Institute of Technology, 2016: Awash Basin water allocation modeling and Conflict Resolution Study. Draft final Report, Work Packages Surface water study, Ground water study and Water allocation modeling

CSA (2008). *Statistical Report of the 2007 Population and Housing Census,* Central Statistical Agency of Ethiopia, Addis Ababa, Ethiopia.

FDRE (1998), Water Works Design & Supervision Enterprise, Council of Minister Regulation No. 42/1998

FDRE (2000), Ethiopian Water Resources Management Proclamation, Proclamation No. 197/2000.

FDRE (2005), Ethiopian Water Resources Management Regulations, Council of Minister Regulation No. 115/2005

FDRE (2007), River Basin Councils and Authorities Proclamation, Proclamation No. 534/2007

FDRE (2010), Definitions of Powers and Duties of Executive Organs, Proclamation No. 691/2010

Halcrow, Sir William & Partners, 1989. Master Plan for the Development of Surface Water Resources in the Awash Basin. Final report, Volume 4, Annex A, Climate and Hydrology

MoWIE and FAO (2013) Coping with water scarcity – the role of agriculture: developing a water audit for Awash basin, part 4: water resources modeling, Ethiopia, GCP/INT/072/ITA

R. Speed, Li Y., T. Le Quesne, G. Pegram and Z. Zhiwei (2013) Basin Water Allocation Planning. Principles, procedures and approaches for basin allocation planning, UNESCO, Paris.

9. Appendix and Glossary

Appendix A: Awash Upstream Koka planning area detail action plan

no	Sub activities	unit	Planning areas					
			Awash Up Stream Koka					
			2008	2009	2010	2011	2012	2013- 2017
1	Conducting the feasibility study and detail design of Melka Kuntre dam	%		70	30			
2	Construction of 500MCM Melka Kuntre dam	%				40	30	30
3	Conducting the study of conveyance system for Melka Kuntre dam	%			100			
4	constructing the conveyance infrastructure of Melka Kuntre dam	%				40	30	30
5	Conduct detail study for ground water development in selected sites	no		2	1			
6	Develop 160MCM ground water source by Adea Becho area	%		20	40	40		
7	installing drip system for vegetable and fruit farms	ha		60	120	180	240	900
8	enhance alternate furrow ,cut back flow and re-use system for furrow irrigation	ha		50	100	150	200	1000
9	change flood irrigation to furrow irrigation	ha		250	350	800	0	2800
10	construct pipes & lined canal system transport main ,primary and secondary canals	km		4	5	11	0	40
11	water distribution for various uses	MCM		400	400	400	400	3200
12	issuing new permit	no		50	100	150	200	500
13	renewing existing permit	no		80	180	280	430	1030
14	establish grassroots water use permitting	no		50	100	150	200	500
15	collect water use fee for 15.6 BCM water	mill. birr		2	2	2	2	10
16	establish Water users association	no		10	15	15	20	40
17	Identifying researchable issues and conduct researches on water allocation	no		x	x	x	x	x
18	Technology identification	no		x	x	x	x	x
19	select and set pilot and physical model sites	no		x	x	x	x	x
20	technology adaptation and evaluation	no		x	x	x	x	x
21	demonstrate technologies for users	no		x	x	x	x	x
22	disseminate verified technologies for uses	no		x	x	x	x	x
23	Awareness creation for recreation, fishery and parks water users	no		x	x	x	x	x
24	awareness creation for regional water related sectors	no		x	x	x	x	x
25	providing training for expertise	no		x	x	x	x	x
26	providing training for decision makers	no		x	x	x	x	x

Appendix B: Awash @ Awash planning area detail action plan

NO	Sub activities	unit	Planning area					
			Awash at Awash					
			2008	2009	2010	2011	2012	2013-2017
1	maintain the water delivery system of Koka dam	%		20	40	40		
2	Conduct detail study for ground water development in selected sites	no		2	2			
3	Develop 300MCM ground water source by Wonji sugar cane scheme	%			40	30	30	
4	Develop 200MCM ground water source by Mathura sugar cane scheme	%				60	40	
5	Develop 85MCM ground water source by Upper Awash Agro Industry/Nuraera /	%			60	40		
6	Develop 15MCM ground water source by Africa Juice S.C	%			50	50		
7	preparing operation rule for the reservoirs	no		1	1	1	1	5
8	installing Sprinkler system (Wonji =6000,upper awash= 2000,metehara)	ha		500	1000	1500	2000	8000
9	installing drip system for vegetable and fruit farms	ha		240	480	720	960	3600
10	install hydro flume (Metehar=5000)	ha		780	1092	1404	1716	6708
11	enhance alternate furrow ,cut back flow and re-use system for furrow irrigation	ha		200	350	550	700	3500
12	change flood irrigation to furrow irrigation	ha		450	600	1300	1750	4600
13	construct pipes & lined canal system transport main ,primary and secondary canals	km		5	10	20	25	70
14	upgrade and modernize diversion weirs to enhance water distribution	no				1	1	
15	water distribution for various uses	MCM		1200	1200	1200	1200	10000
17	issuing new permit	no		50	100	100	150	400
18	renewing existing permit	no		120	220	320	470	870
19	establish grassroots water use permuting	no		50	100	100	150	400
20	collect water use fee	mill. birr		3	3	3	3	15
21	establish Water users association	no		10	15	15	20	40
23	Identifying researchable issues and conduct researches on water allocation	no		x	x	x	x	x
24	Technology identification	no		x	x	x	x	x
25	select and set pilot and physical model sites	no		x	x	x	x	x
26	technology adaptation and evaluation	no		x	x	x	x	x
27	demonstrate technologies for users	no		x	x	x	x	x
28	disseminate verified technologies for uses	no		x	x	x	x	x

Appendix C: Awash Halidebi planning area detail action plan

no	Sub activities	unit	Planning area					
			Awash Halidebi					
			2008	2009	2010	2011	2012	2013- 2017
1	Store water at full capacity of Kessem dam.	MCM		500	500	500	500	2500
2	Finalizing the detail design of 500MCM Middle Awash dam	%		100				
3	Constricting 500 MCM Middle Awash dam	%			20	30	30	20
4	Conducting the study of conveyance system for Middle Awash dam	%					100	
5	Constricting the conveyance infrastructures of Middle Awash dam	%						100
6	Conduct detail study for ground water development in selected sites	no			1			
7	Develop 240MCM ground water source at Awash Elwa (Halidebie) area	%			10	50	40	
8	preparing operation rule for the reservoirs	no		1	1	1	1	5
9	installing Sprinkler system, Amibara=2000	ha		200	250	300	400	850
10	installing drip system for vegetable and fruit farms	ha		120	240	360	480	1800
11	install hydro flume, Amibara=4000	ha		800	1100	1400	1700	6700
12	enhance alternate furrow ,cut back flow and re-use system for furrow irrigation	ha		150	300	450	600	3000
13	change flood irrigation to furrow irrigation	ha		250	350	800	1050	2800
14	construct pipes & lined canal system transport main ,primary and secondary canals	km		4	5	11	15	40
15	upgrade and modernize diversion weirs to enhance water distribution	no			1			1
16	water distribution for various uses	MCM		600	600	600	600	5100
17	establish water users registration system	%						
18	issuing new permit	no		50	50	100	100	200
19	renewing existing permit	no		80	130	180	280	580
20	establish grassroots water use permitting	no		10	15	15	20	70
21	collect water use fee for 15.6 BCM water	mill. birr		2	2	2	2	12
22	establish Water users association	no		10	15	15	20	70
23	Identifying researchable issues and conduct researches on water allocation	no		x	x	x	x	x
24	Technology identification	no		x	x	x	x	x
25	select and set pilot and physical model sites	no		x	x	x	x	x
26	technology adaptation and evaluation	no		x	x	x	x	x
27	demonstrate technologies for users	no		x	x	x	x	x
28	disseminate verified technologies for uses	no		x	x	x	x	x

Appendix D: Awash Adaitu planning area detail action plan

no	Sub activities	unit	planning area					
			awash Adaitu					
			2008	2009	2010	2011	2012	2013- 2017
1	Conduct detail study for ground water development in selected sites	no			1			
2	installing drip system for vegetable and fruit farms	ha		100	200	300	350	1400
3	enhance alternate furrow ,cut back flow and re-use system for furrow irrigation	ha		25	50	75	100	500
4	change flood irrigation to furrow irrigation	ha		350	500	1050	1400	3700
5	construct pipes & lined canal system transport main ,primary and secondary canals	km		5	10	15	20	30
6	water distribution for various uses	MCM		400	400	400	400	3150
7	issuing new permit	no		10	10	15	15	50
8	renewing existing permit	no			10	20	35	50
9	establish grassroots water use permitting	no		10	10	15	15	50
10	collect water use fee for 15.6 BCM water	Mill. birr		1	1	1	1	5
11	establish Water users association	no		5	5	10	10	30
12	Identifying researchable issues and conduct researches on water allocation	no		x	x	x	x	x
13	Technology identification	no		x	x	x	x	x
14	select and set pilot and physical model sites	no		x	x	x	x	x
15	technology adaptation and evaluation	no		x	x	x	x	x
16	demonstrate technologies for users	no		x	x	x	x	x
17	disseminate verified technologies for uses	no		x	x	x	x	x

Appendix E: Awash Terminal planning area detail action plan

no	Sub activities	unit	planning area					
			awash terminal					
			2008	2009	2010	2011	2012	2013- 2017
1	Store water at full capacity of Tendaho dam.	MCM		1700	1700	1700	1700	8500
2	Finalizing the detail design of 160MCM Logia dam	%		100				
3	Constricting Logia dam	%			20	30	30	20
4	Conducting the study of conveyance system for Logia dam	%				30	40	30
5	Constricting the conveyance infrastructure of Logia dam	%				10	30	60
6	preparing operation rule for the reservoirs	no		1	1	1	1	10
7	installing drip system for vegetable and fruit farms	ha		100	200	300	350	1300
8	install hydro flume ,Tendaho=20000)	ha		1050	1500	1900	2300	9000
9	enhance alternate furrow ,cut back flow and re-use system for furrow irrigation	ha		100	200	300	400	2000
10	change flood irrigation to furrow irrigation	ha		450	600	1300	1750	4600
11	construct pipes & lined canal system transport main ,primary and secondary	km		5	10	20	25	75
12	water distribution for various uses	MCM		1050	1050	1050	1050	8500
13	issuing new permit	no		50	100	100	150	300
14	renewing existing permit	no			50	150	250	640
15	establish grassroots water use permitting	no		50	100	100	150	300
16	collect water use fee for 15.6 BCM water	mill. birr		1.5	1.5	1.5	1.5	10
17	establish Water users association	no		10	15	15	20	70
18	Identifying researchable issues and conduct researches on water allocation	no	x	x	x	x	x	x
19	Technology identification	no	x	x	x	x	x	x
20	select and set pilot and physical model sites	no	x	x	x	x	x	x
21	technology adaptation and evaluation	no	x	x	x	x	x	x
22	demonstrate technologies for users	no	x	x	x	x	x	x
23	disseminate verified technologies for uses	no	x	x	x	x	x	x

Appendix F: Eastern catchment planning area detail action plan

no	Sub activities	unit	planning area					
			Eastern catchment					
			2008	2009	2010	2011	2012	2013- 2017
1	Conduct detail study for ground water development in selected sites	no			1	1	2	5
2	installing drip system for vegetable and fruit farms	ha		100	200	250	360	1100
3	enhance alternate furrow ,cut back flow and re-use system for furrow irrigation	ha		50	50	100	100	500
4	change flood irrigation to furrow irrigation	ha		100	150	200	250	500
5	water distribution for various uses	MCM		360	360	360	360	2900
6	issuing new permit	no			25	50	75	100
7	renewing existing permit	no				25	75	250
8	establish grassroots water use permitting	no			25	50	75	100
9	collect water use fee for 15.6 BCM water	mill. birr				0.1	0.2	0.5
10	establish Water users association	no			5	10	10	25
11	Identifying researchable issues and conduct researches on water allocation	no		x	x	x	x	x
12	Technology identification	no		x	x	x	x	x
13	select and set pilot and physical model sites	no		x	x	x	x	x
14	technology adaptation and evaluation	no		x	x	x	x	x
15	demonstrate technologies for users	no		x	x	x	x	x
16	disseminate verified technologies for uses	no		x	x	x	x	x