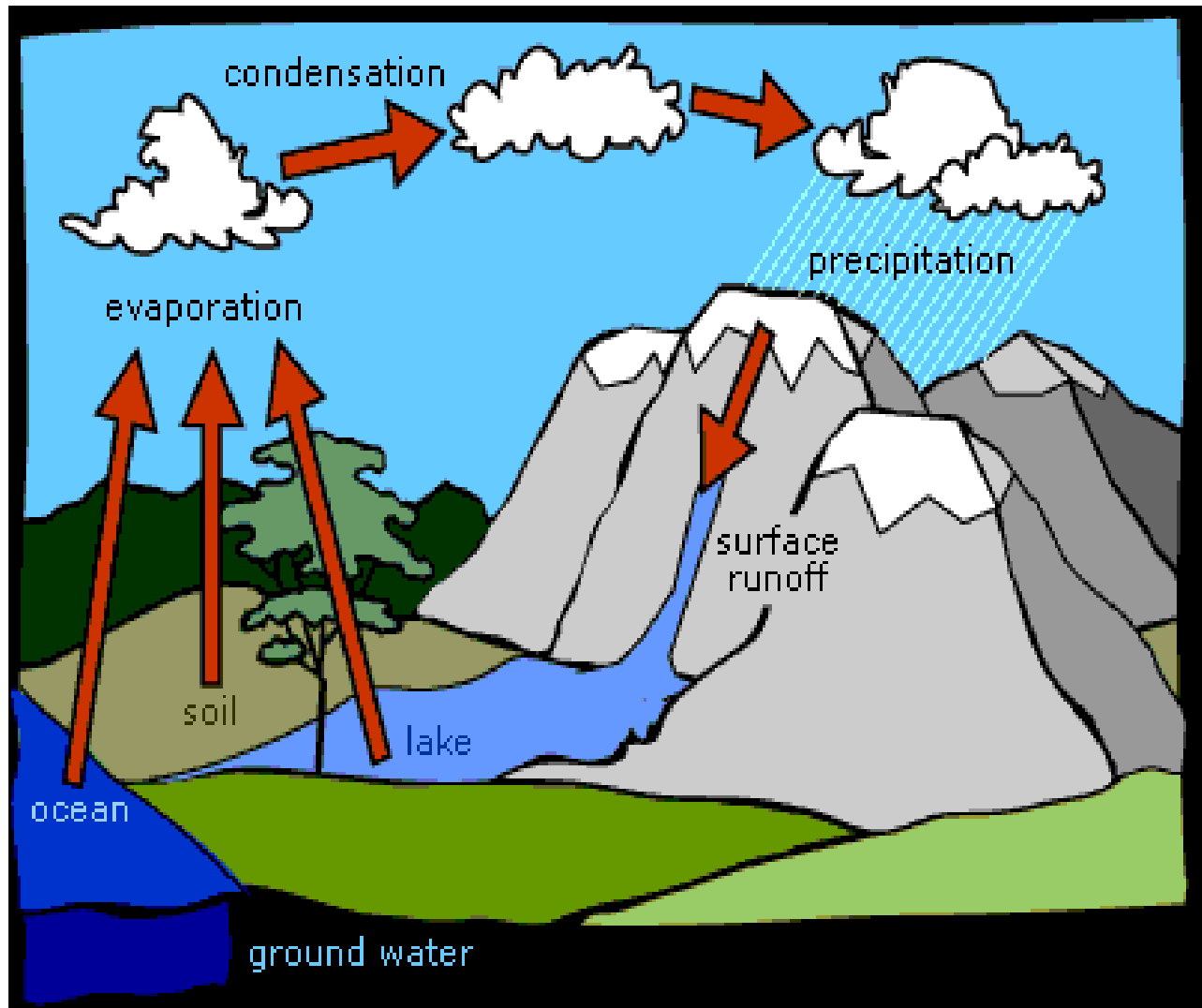


National Meteorological Agency



Hydro Meteorological Bulletin for Bega, 2014/15

Foreword

This seasonal hydro meteorological bulletin is prepared and disseminated by the National Meteorological Agency (NMA) of Ethiopia, for the purpose of providing hydro meteorological information to different sectors of the community involved in water related activities.

In general, Hydrometeorology is concerned with the study of the atmosphere and land phases of the hydrologic cycle, particularly, on the interrelationships involved. In this bulletin, more emphasis is given to presenting the results of analyses done on the extreme rainfall events as well as the moisture status prevailed over river catchments.

Accordingly, the data used in producing this bulletin are collected from selected indicative meteorological stations, which are believed to represent each of the main river catchments (hydrological regimes) of the country and the results of the hydro meteorological analyses are presented in maps format. Analysis presented in the forms of maps indicates comparisons of the total and extreme monthly rainfall events, monthly mean temperature and aridity index conditions for each basin.

Thus, the information contained in this bulletin is believed to be helpful in monitoring the performances of many hydraulic structures such as culverts, bridges, reservoir spillways, road embankments, dikes, flood prone areas as well as in planning and designing such new structures over the respective basins. It also gives the user an insight into the value as well as the contributions of the hydro-meteorological information towards the accomplishment of water resources assessment and management with respect to sustainable development of the country. Meanwhile, your comments and constructive suggestions are highly appreciated to make the objectives of this bulletin a success.

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I. Introduction

Ethiopia is located between latitudes of 3.8°N to 14.5°N and longitudes of 33°E to 48°E with an area of about 1.12 million km². The varied topography of the country shows extreme changes in altitude with its lowest point at about 120 meters below sea level (Kobat Sink Afar depression) and its highest point about 4620 meters above sea level (Ras dashen.). These physiographic variations create a large difference in meteorological and hydrological conditions both by time and space.

From meteorological point of view, there are three seasons in Ethiopia; Belg, Kiremt and Bega.

Belg (February-May) is the small rainy season in Ethiopia. Much of the northeastern, central, southern, southwestern, eastern and southeastern parts of the country receive considerable amount of rainfall during this season.

Kiremt (June-September) is the main rainfall season for most parts of the country except for the lowlands of southern and southeastern Ethiopia.

Bega (October-January) is mostly a dry season for most parts of the country except for southwestern as well as the lowlands of south and southeast Ethiopia.

In general the mean annual rainfall amount ranges from 2400mm (over south western) to 500 and below over the northeastern and southeastern lowlands. Hydro meteorologically a rainy day is considered as the one with 2.5 mm of rain or more but in this publication a rainy day is one regardless of the amount.

In Ethiopia, water resources availability in terms of space shows a marked discrepancy when one goes from east to west. The eastern part of the region comprises 7 catchments with only 11 percent of the water resource and while the west comprises 5 catchments with 89 percent of water resources.

II. Catchments profile

Catchment

Location

Mereb – Gash Catchment: -

Northwestern tip of Tigray.

Atbara-Tekeze Catchment: -

The Tekeze River basin is situated in the northwest of Ethiopia between 11° 04' and 15° 02' N, and 36° 03' and 39° 50' E. It is bordered by the Mereb River basin and by Eritrea in the north, the Atbara River plains in Sudan in the west, the Abay River basin in the south and Danakil basin in the east.

Blue Nile/ Abbay Catchment: -

Roughly 130 N South of Gondar to 110° 30' N, and west of 39° 45' E of Wollo, northwestern parts of Shoa; Gojam except the South Western and Western narrow area, Wellega and extreme Eastern tip of Illubabor together with a narrow northeastern strip of Keffa. It is the largest catchment that covers about 16 percent of the total area of Ethiopia. The Catchment that includes the Lake Tana, Upper Abbay (to Guder confluence), Middle Abbay (to didessa confluence), Didessa, Dabus, Lower Abbay, Dinder and Rahad Sub-basin.

Baro –Akobo Catchment: -

The south western and western narrow strip of Wellega, except the eastern tip, the whole of Illubabor and southwestern tip of Keffa. The Catchment has upper and lower sub-basins along Baro River. The Catchment It is the wettest catchment because of the highest rainfall over the area.

Danakil – Afar Catchment: -

East of 40° E of Tigray, North of 11° N of Wollo, narrow coastal strip south of 14° 30' N of Eritrea. The basin is the lowest region in the country where the kobar sink; with an elevation of about 120 meters b.s.l is found.

Awash Catchment: -

North of Garamuleta mountains, south of 11° 40' N of Wollo, south of 9° N of Shoa, Northern tip of Bale and North part of Arsi. The catchment has upper, middle and lower sub-catchments. In general the catchment is narrow at the upper part marked by

numerous volcanic mountains and wider at the lower part joining major tributaries from northwestern highlands and a number of seasonal wadies from the southeast highlands.

Gulf of Aden – Aysha Catchment): - Eastern narrow strip of Hararghe. It is a very dry area with no stream flow representative meteorological station. Thus, no assessment is done for this catchment in this publication.

Omo-Ghibe Catchment: -

Southwestern narrow strip of Shoa, the whole of Keffa except the southwestern tip, southwestern tip of Wellega, Western half of northern Omo and northwestern tip of Sidamo. The upper part of the catchment starts from the plateaus in north part of Ghibe and extends southward to the lower part of it (known as Omo River).

Central Lakes-Rift Valley Catchment: -

The whole of North and South Omo, west and southwestern narrow strip of Sidamo, southwestern portions of Shoa and western narrow tip of Bale and western part of Arsi. The catchment is found in the Great Rift Valley system and typically known by its lakes and streams. Lakes which adjoin the Awash catchment are found in its upper part, while Lake Awassa and Bilate in its central part and end to chamo bahr in its lower part.

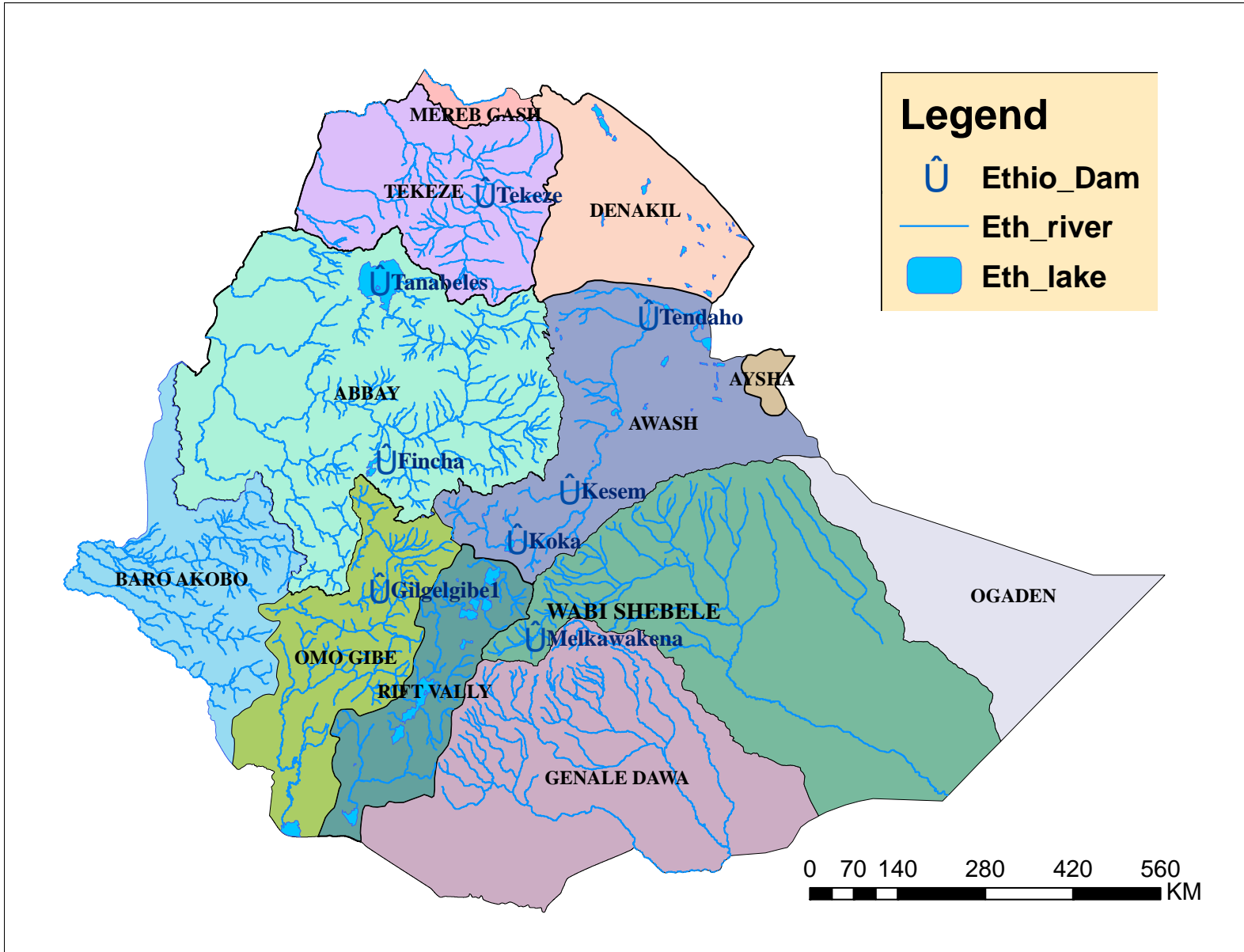
Genale Dawa Catchment: -

The western half of Bale (South of Goba) and southeast, southwestern and northeastern parts of Sidamo. The catchment constitute three river systems namely Dawa ,Genalle and Wabi Gestaro that meet each other before they cross the Ethio-Somalia border.

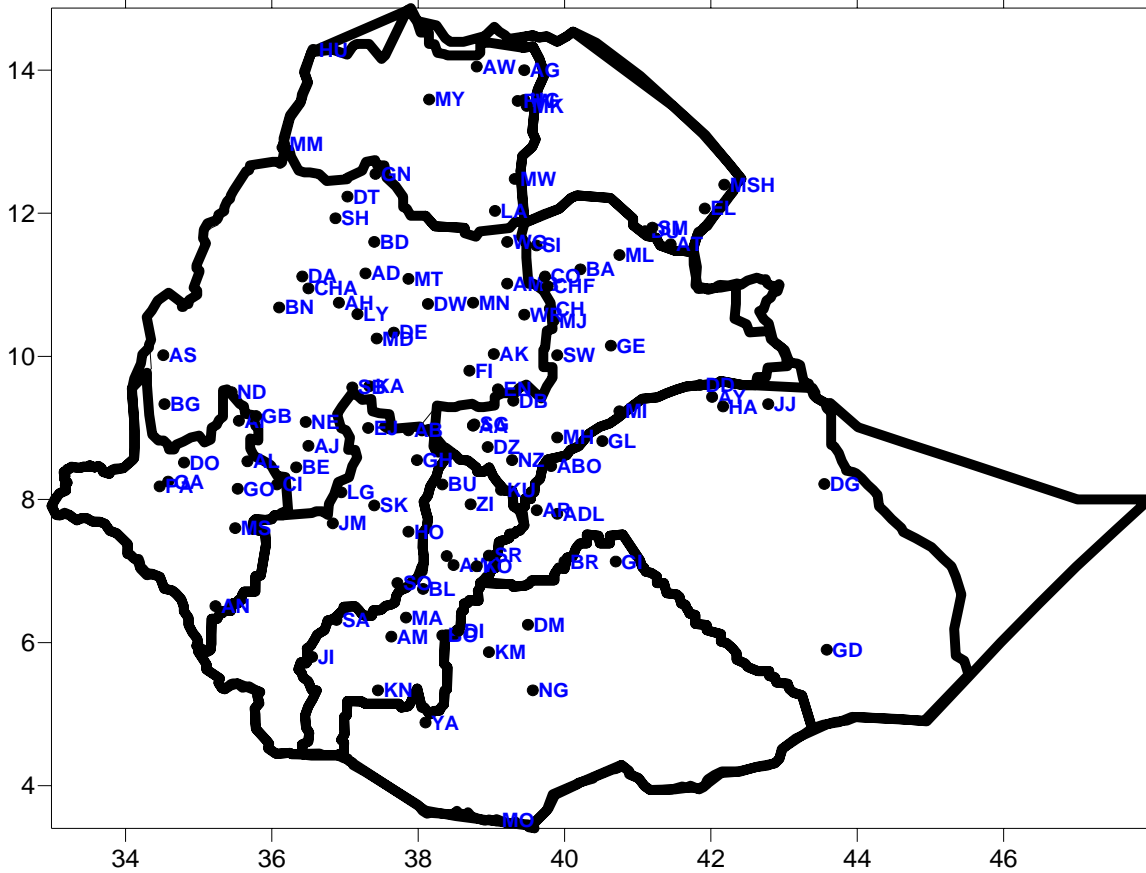
IV. Major River Catchments in Ethiopia, Location and Spatial Status

No.	Catchement Name	Area (km ²)	Length in Kilo meter			Volume of water bm ³ /An num	Altitude (meter)
			Within Eth.	Outside Eth.	Total		Peaks (Highest & Lowest)
01	Mereb-Gash	5,700	440	160	600	0.15	North tip of Tigray
02	Tekaze – Atbar	90,001	608	560	1168	8.13	4620 Ras Dashen 125 Tikil -Dengay
03	Blue Nile(Abbay)	204,100	800	650	1450	52.62	4231 Guna 200 Horekelife
04	Baro - Akobo	75,912	227	280	557	23.55	3700 Masha 410 Jikawo
05	Afar (Denakil)	62,882	-	-	-	0.86	
06	Awash	112,696	1200	-	1200	4.6	4000 N.Shewa 4001 NW mt. 4002 of A.A 250 L.Abe
07	Aysha	2223				0.86	
08	Omo-Ghibe	78,213	760	-	760	17.96	4203Guge/Gurage Mt. 195 Chiri
09	Rift valley	54,900	-	-	-	5.63	
10	Genale - Dawa	171,042	480	570	1050	5.88	4310 Bale mt./Batu 500 Dolo Odo
11	Wabi - Shebele	205,697	1340	660	2000	3.16	3626 Mt.Gololcha 200 Somalia Desert
12	Ogaden	77,121	-	-	-	-	1500 Turkile 350 Gelad

V. Basin map of Ethiopia



VI. Meteorological Station distribution used for hydro meteorological Bulletin.



STATION	CODE	STATION	CODE	STATION	CODE	STATION	CODE
A.A (Bole)	AA	Cheffa	CHF	Gonder	GN	Mille	ML
Abomsa	ABO	Chercher	CH	Gore	GO	Mira Abaya	MR
Adet	AD	Chira	CI	Hageremariam	HG	Motta	MT
Adigrat	AG	Combolcha	CO	Harer	HA	Moyalle	MO
Adwa	AW	Dangla	DA	Hossana	HO	Mytsebery	MY
Aira	AI	Debrebrhan	DB	Humera	HU	Nazaret	NZ
Alem ketema	AK	Degehabur	DG	Jijiga	JJ	Nedjo	ND
Alemaya	AY	Debre markose	DE	Jimma	JM	Negele	NG
Alge	AL	Debre Tabore	DT	Jinka	JI	Nekemt	NE
Ambamariam	AMB	Debre Zeit	DZ	Kachise	KA	Pawe	PA
Ambo	AB	DembiDolo	DO	Kibremengist	KM	Sawla	SA
Arbaminch	AM	Dilla	DI	Konso	KN	Sekoru	SK
Arjo	AJ	DireDawa	DD	Kulumsa	KU	Semera	SM
ArsiRobe	AR	Dolomena	DM	Koffele	KO	Freweyni	FW
Assaita	AT	Dubti	DU	Konso	KN	Shahura	SH
Assossa	AS	Ejaji	EJ	Kulumsa	KU	Shambu	SB
Awassa	AW	Elidar	EL	Lalibela	LA	ShewaRobit	SW
Ayehu	AH	Enewary	EN	Layber	LY	Shire	SR
Aman	AN	Elidar	EL	Limugenet	LG	SholaGebeya	SG
Bale Robe	BR	Enewary	EN	Maichew	MW	Sirinka	SI
BahiDar	BD	Fitche	FI	Mankush	MA	Sodo	SO
Bati	BA	Gambella	GA	Masha	MSH	WegelTena	WT

Beddele	BE	Gelemso	GL	Mehalmeda	MD	Wereillu	WR
Begi	BG	Gewane	GE	Mekaneselam	MN	Yabello	YB
Blate	BL	Ghion	GH	Mekele	MK	Ziway	ZY
Bui	BU	Gimbi	GB	Metehara	ME		
Bullen	BN	Ginir	GI	Meisso	MS		
Chagni	CG	Gode	GD	Metema	MM		

The above stations have five basic meteorological elements they send daily records for Addis Ababa main office of NMA. We use the meteorological elements which are the main factors for hydro meteorological impacts. These are rainfall, temperature, wind speed, evaporation and sunshine duration. This information is important to guide for different water resource activities.

1. Introduction

Bega from October to January is mostly a dry season for most parts of the river basin except Ogaden, lower and middle Wabishebele, Rift valley, lower OmoGibe, middle and lower Genale Dawa as well as lower Rift Valley catchments. The main rainy months with Bega season are October and November provides rainfall mainly for southern, south eastern and south western catchments. Sunny and windy condition dominated across many river basins thus it increase the loss of water by evaporation. Surface runoff not occurs during Bega hence, the flow of river water is low. In the mean time springs and ponds starting to dry up after mid Bega season. Availability of water is also decrease across upstream of main river basins. In some years unseasonal rain slightly fevered for water availability.

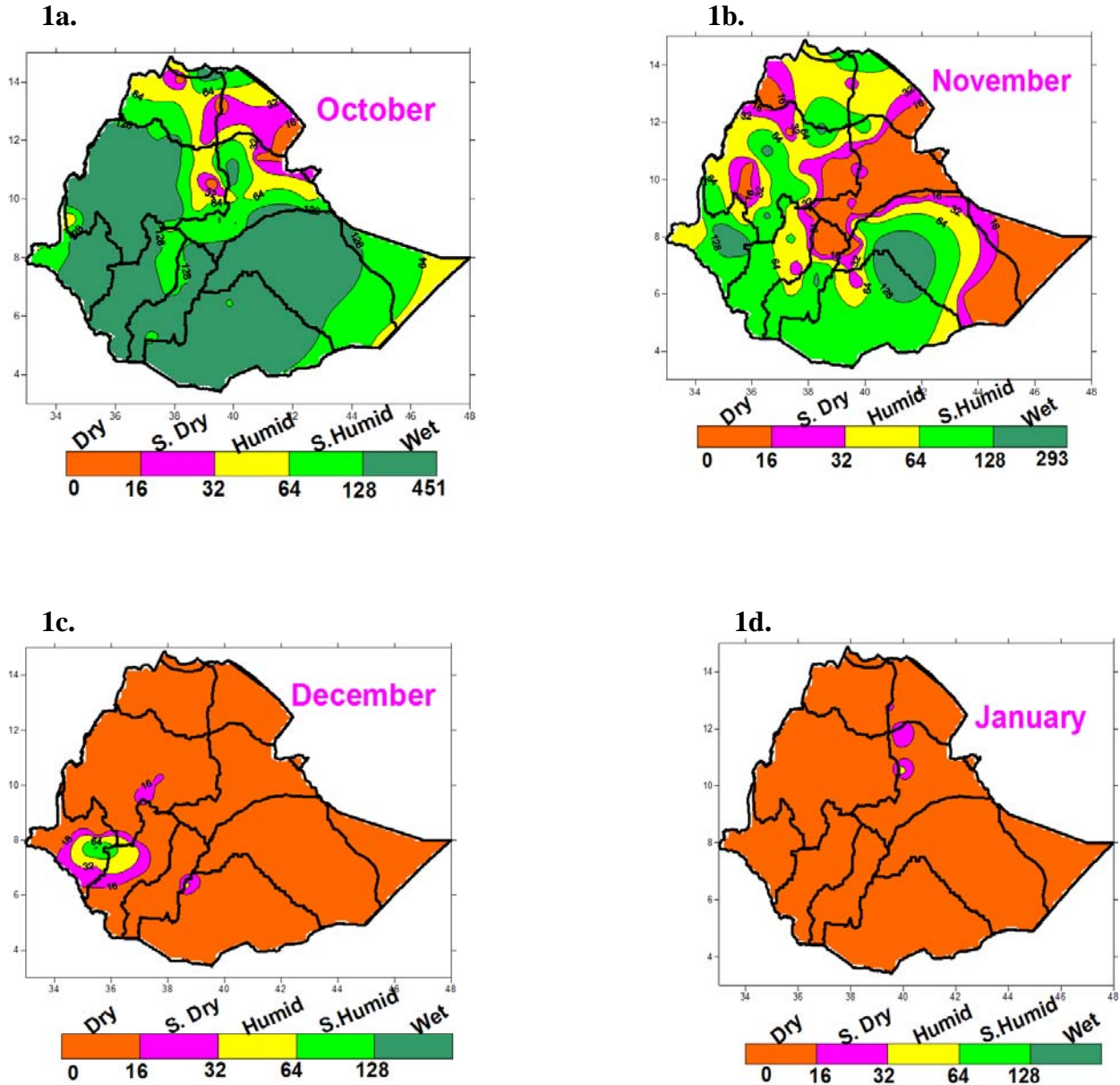
Methods

To compute the aridity index we use Thornthwait method, which is computed from the monthly values of rainfall and evaporation. The evaporation is computed empirically from mean monthly air temperature. In assessing the effectiveness of rainfall, in terms of water availability relationships between the rainfall and air temperature has been worked out in terms of moisture indices. The aridity index values above 128 which shaded in deep green were show wet condition. Light green to yellow value indicates humid to semi humid and pink to red values show semi dry to dry condition.

Where R_f = monthly rainfall in mm; T = monthly mean temperature in °C

2. Aridity status for Bega 2014/15 at different basins

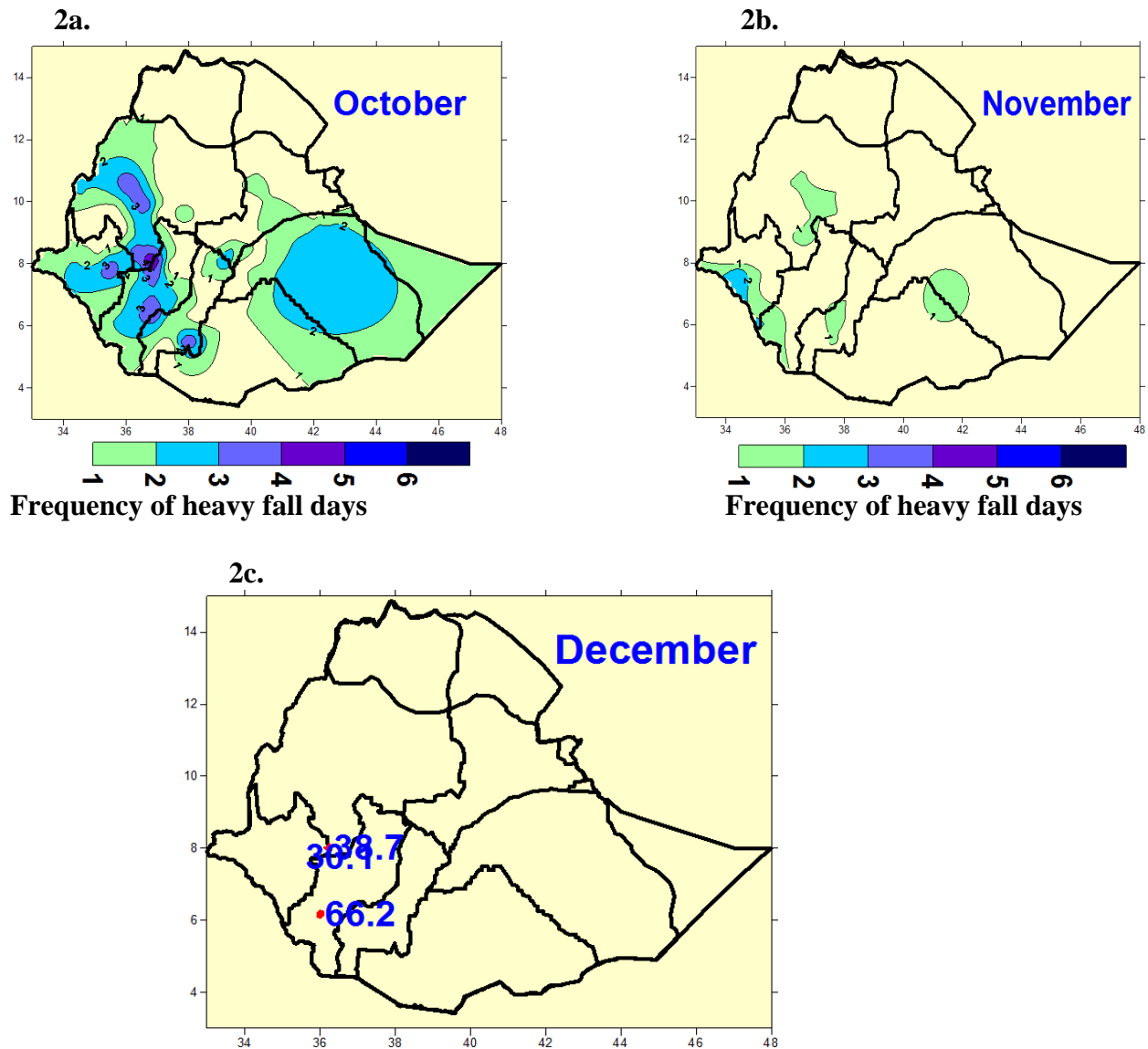
The moisture performance of October across western, southern and southeastern half of the country had wet condition. According to this most of Wabishebele, Genaledawa, BaroAkobo, OmoGibe, Rift Valley, western half of Abay and pocket areas of upper and middle Awash were remained in wet condition. During November in the margin of Wabishebele and Genaledawa, upper BaroAkobo, pocket places of Abay and Rift valley catchments were performed wet moisture condition. The moisture performance of December and January was insignificant over all river basins. While across the divide areas of Omogibe and Baro Akobo catchments were preformed humid to semi humid weather condition in December. The rest all main river basins were remained under dry weather condition shown below in figure (1a-d).



(Fig.1a-d) Aridity Index for October, 2014 to January, 2015.

3. Distribution of heavy fall days exceeding 30mm during October to December, 2014 over different river basins.

The occurrence of heavy fall during October across OmoGibe, Abay, Baroakobo, Wabishebele, RiftValley, Awash and Genaledawa catchments were recorded one to five heavy fall days. The maximum frequency of heavy fall days was recorded over OmoGibe basins at Limugenet station for five days and the maximum heavy fall amount were recorded over middle Awash at Mezezo station 170mm rainfall in one day which causes flood in middle Awash plane areas. In November and December some station were recorded heavy fall over Genaledawa, OmoGibe, Baroakobo, Rift valley and southern tip of Abay catchments shown below in figure (2a-c) .

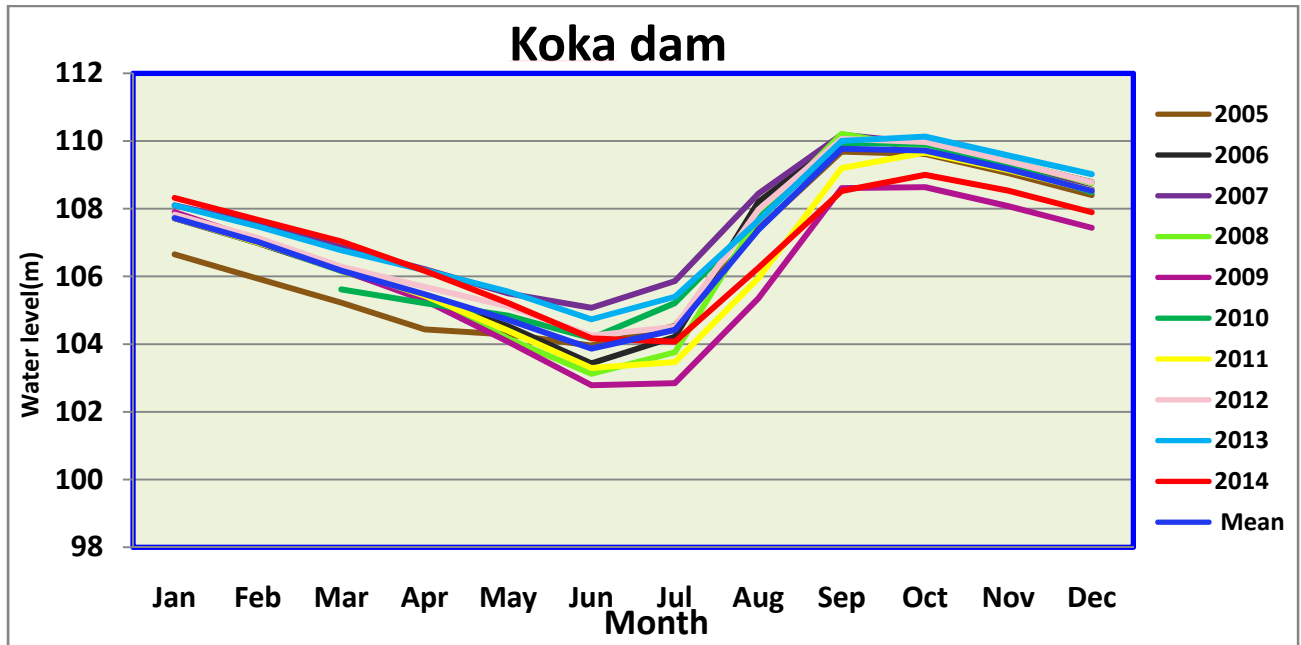


(Fig.2a-c) Distribution of heavy fall October to December, 2014

4. Performance of Dams and Reservoirs water level in Bega 2014/15 season

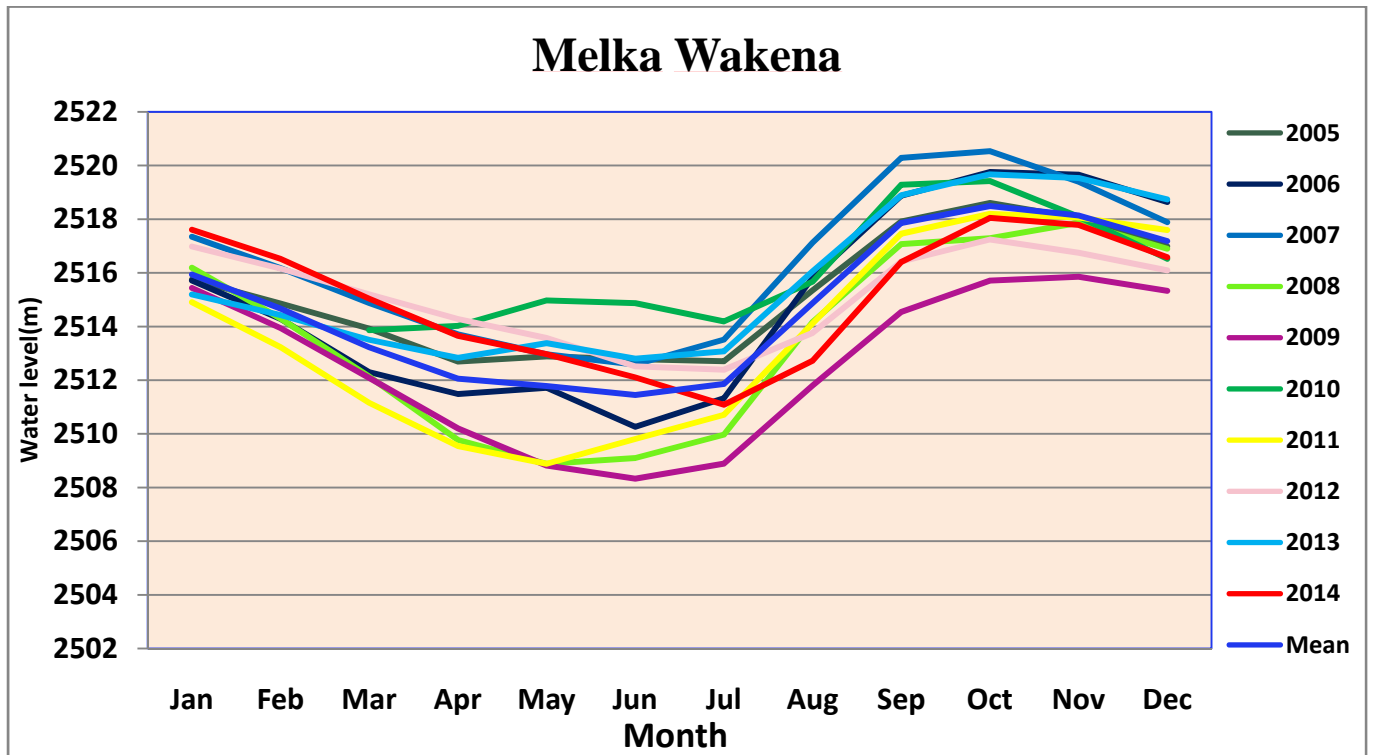
The main source of runoff is rainfall which is the input for Dams, reservoirs and ponds but in Bega season runoff is not occur and flow of river is low. While during in some years Bega may give rain for some catchments which contribute for availability of water. The performance of 2014 Bega season water level of different dams and reservoirs was in good condition compare to the previous year's except Koka and Melkawakena shown below in figure (3a-f).

4a.

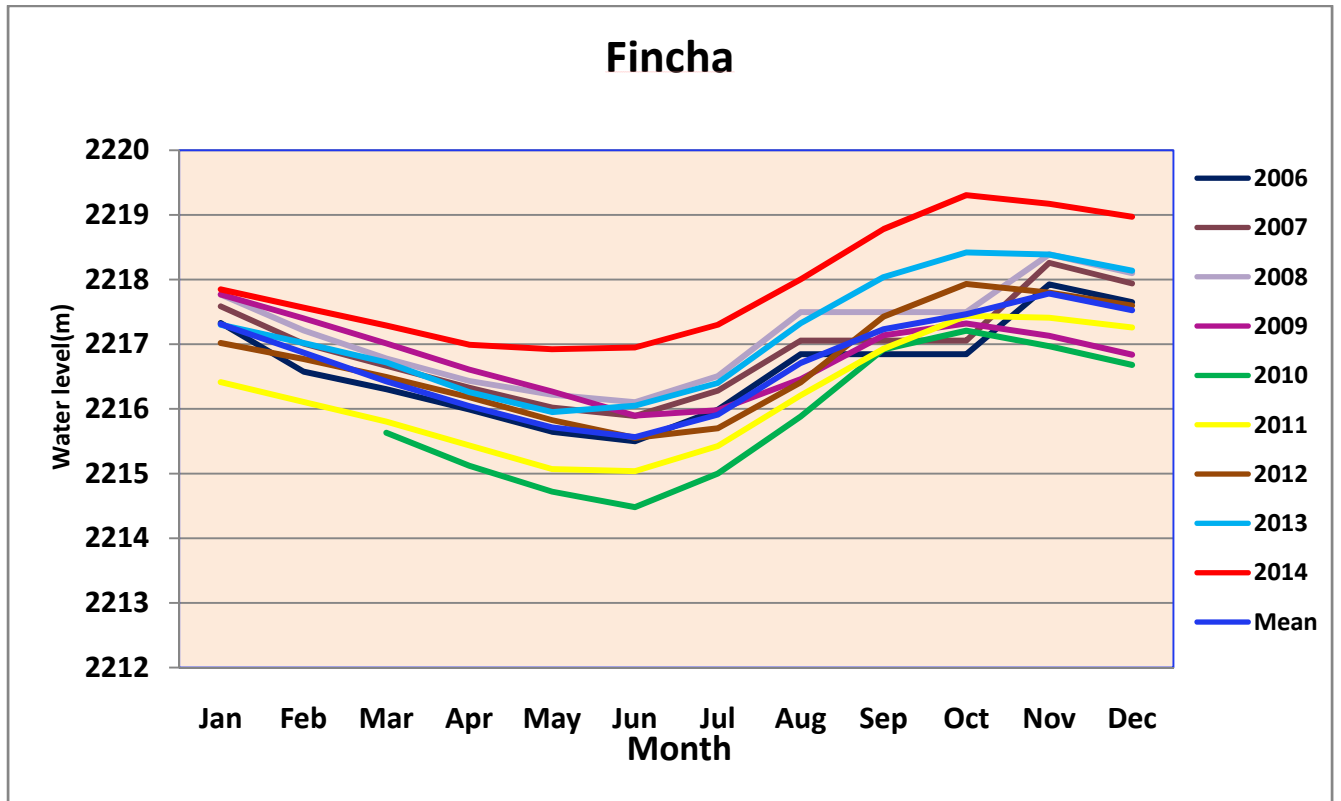


Data source: EEPU

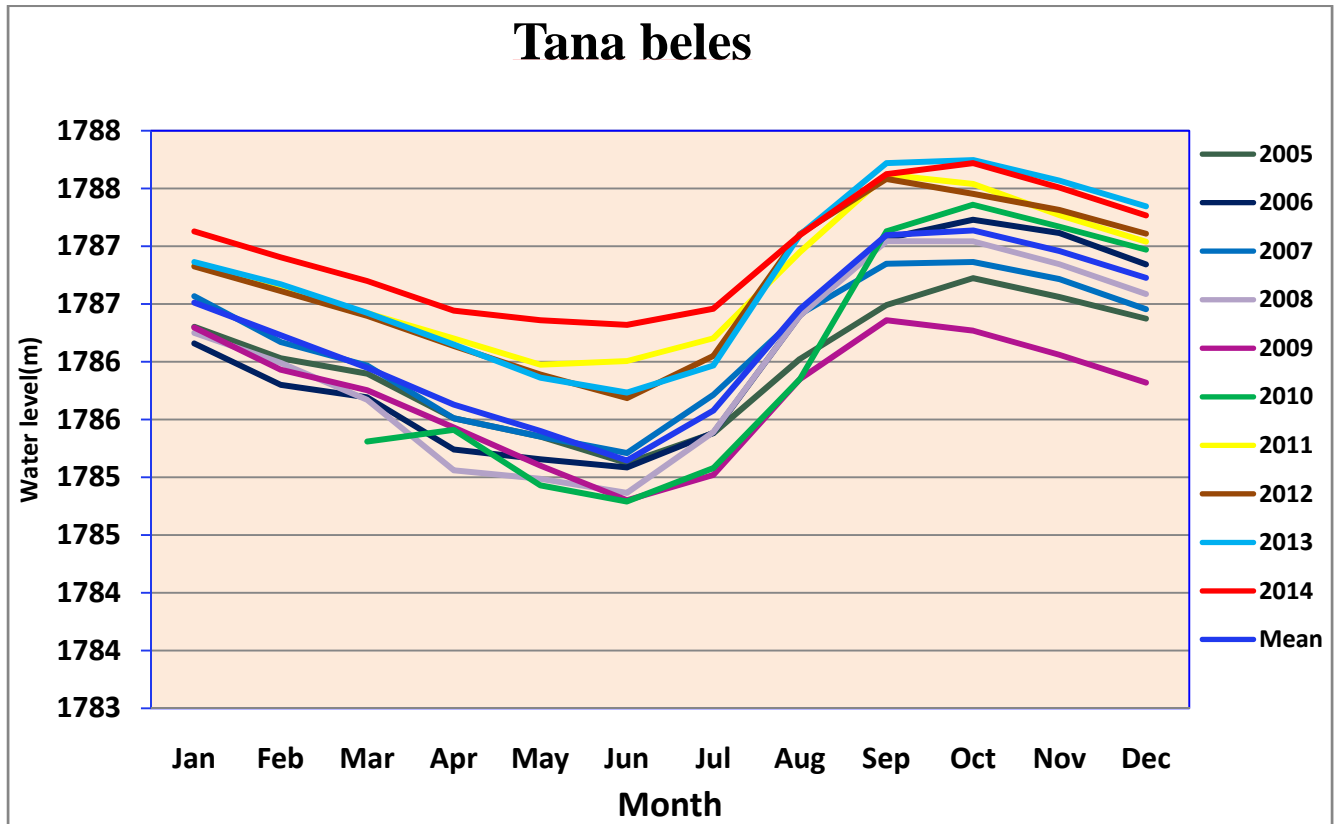
4b.



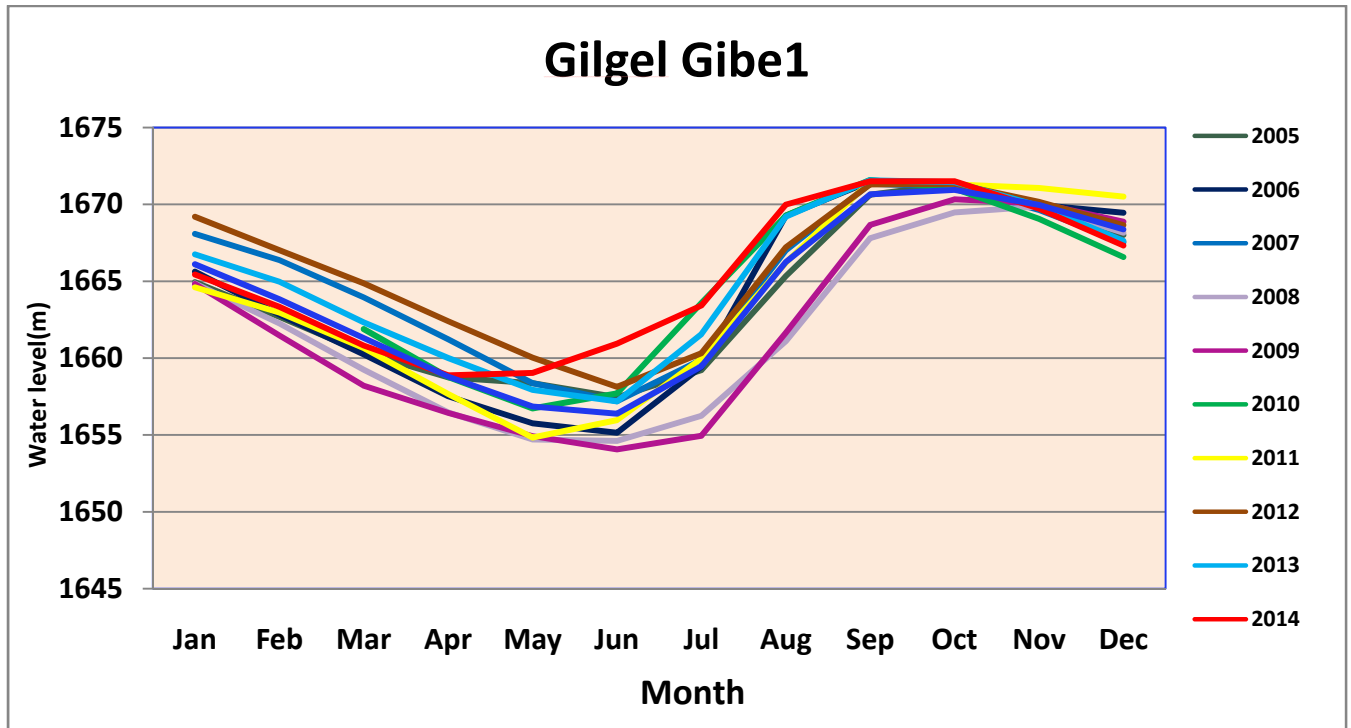
4c.



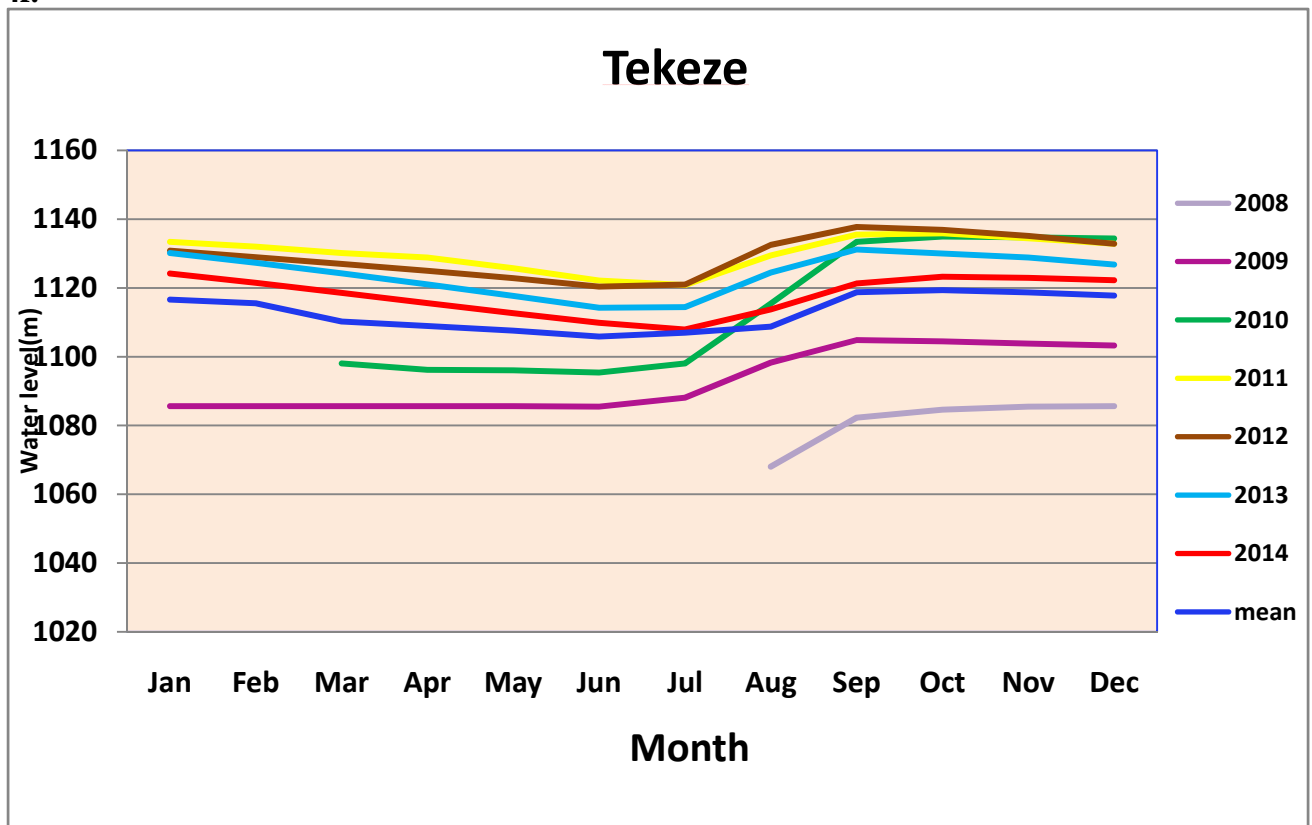
4d.



4e.



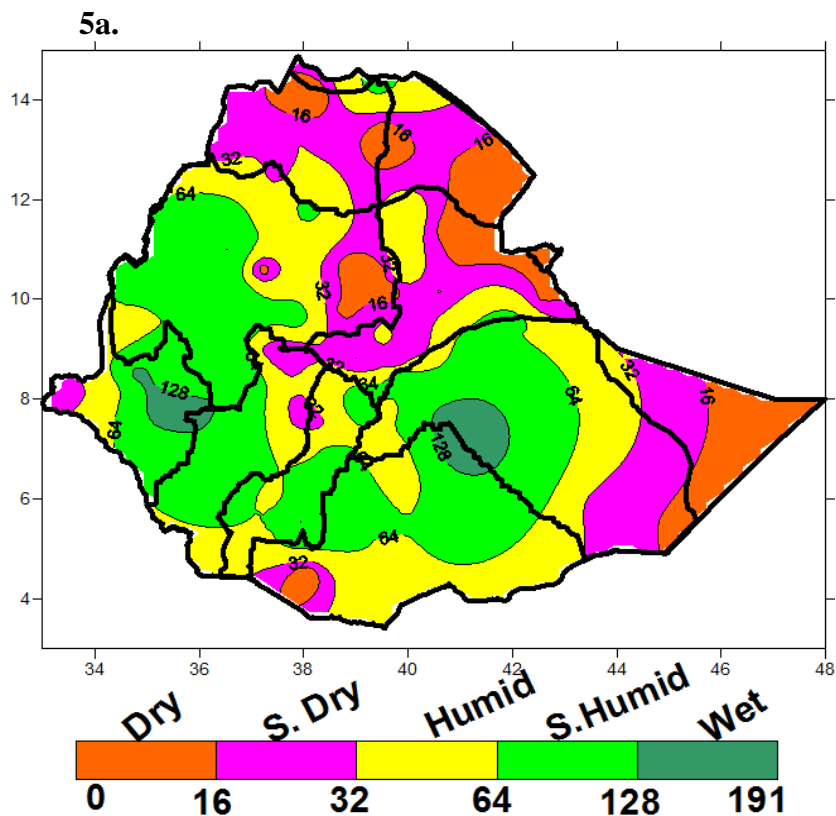
4f.



(Fig.3a-f) water level of different dams.

5. Seasonal aridity status of Bega 2014/15

The seasonal aridity index indicated that GenaleDawa, Wabishebele, BaroAkobo, south western Abay, middle OmoGibe and Rift Valley catchments were received the better amount of rainfall through this the wet to humid condition observed over those catchments. The rest catchments were experienced dry to semi dry condition. In general the moisture performances of Bega 2014/15 over western, south western southern and south eastern catchments were performed wet to humid condition in the first two months; it had contributed for water availability shown below in figure (5a).



Hydro meteorological outlook for the coming Belg, 2015 over different river basins.

1. Introduction

Belg rainfall contributed for surface runoff about 5 to 7% during wet Belg season. Belg rain benefiting catchments are found across eastern half, central and southern portion of the country. It has more benefited: to compensate the shortage of water during the previous dry condition effect (Bega season) and to minimize evaporation from open water surface across Belg rain benefiting catchments.

2. Selected analogue Year

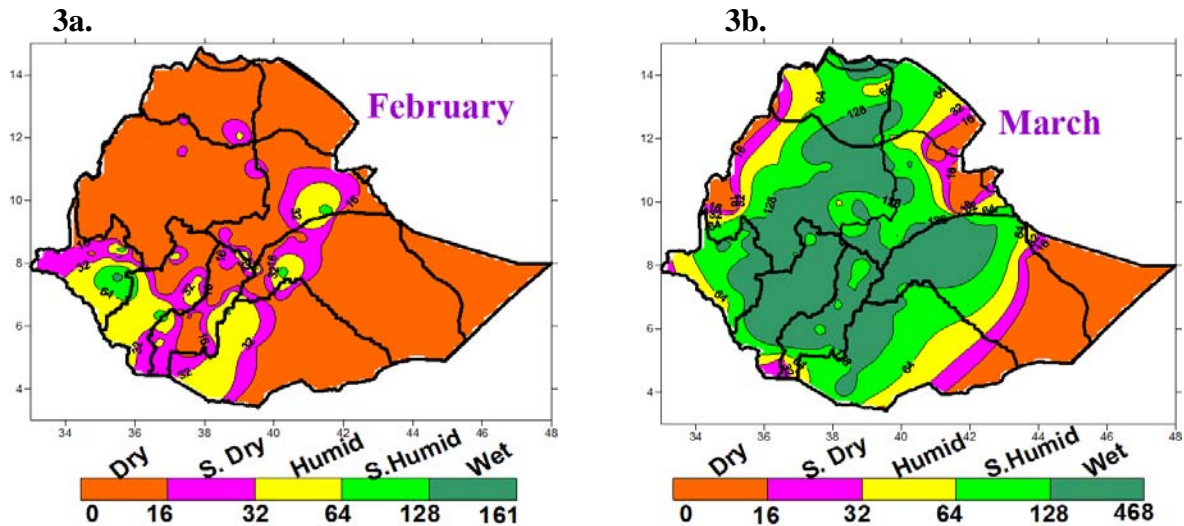
For the coming season the selected analogue year 1978, 1995, 2005 and 2007 were compared based on probabilistic seasonal forecast for Belg 2015 and viewed out on catchments based map using geostatistical kriging method. Among those are 2005 and 2007 are the best analogue year that can enlighten the Aridity status in the coming Belg season.

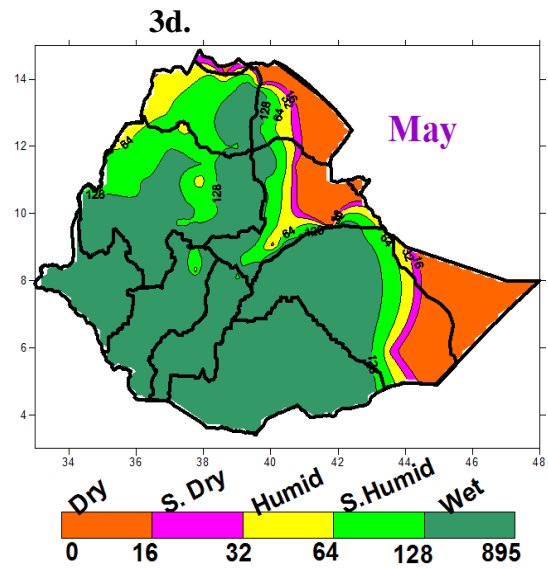
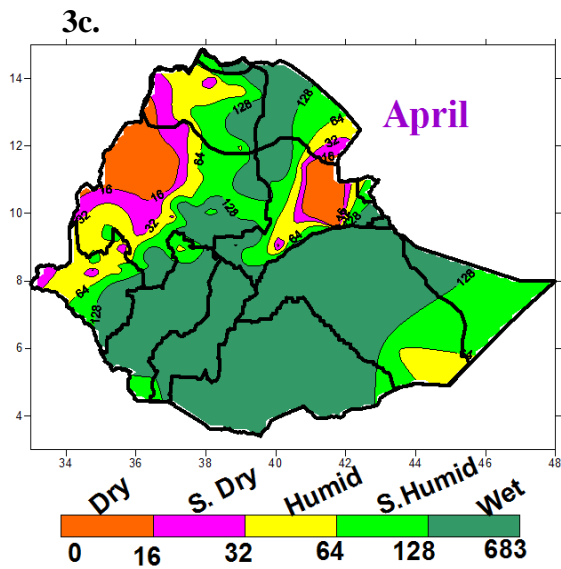
3. Methodology

Thornthwaite introduced the concept of the precipitation effectiveness index, which is computed from the monthly values of rainfall and evaporation. The evaporation is computed empirically from mean monthly air temperature. In assessing the effectiveness of rainfall, in terms of water availability relationships between the rainfall and air temperature has been worked out in terms of moisture indices.

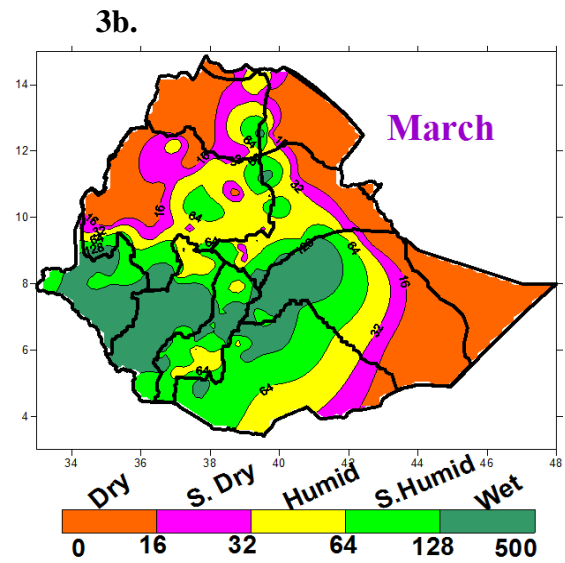
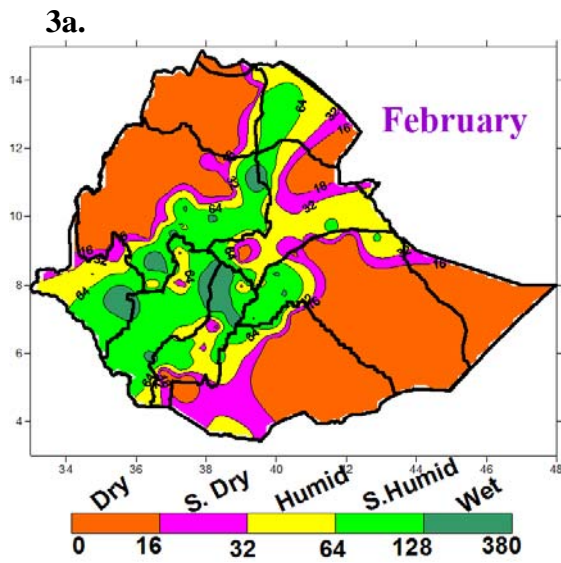
Where, R_f = monthly rainfall in mm;
 T = mean monthly temperature in $^{\circ}\text{C}$

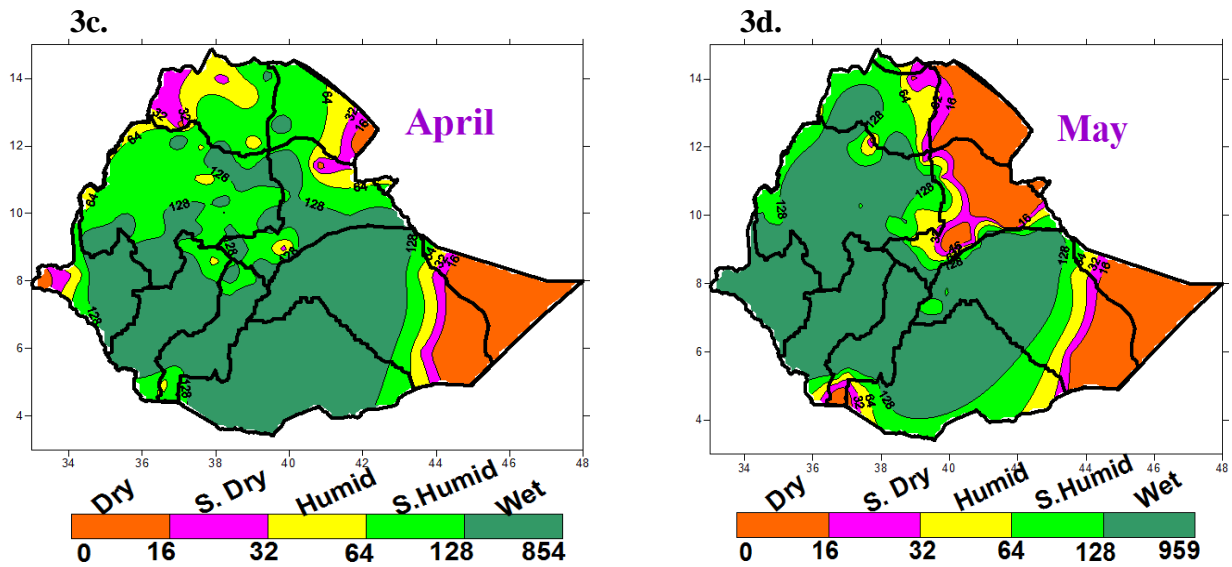
2005:- During this year Belg benefiting catchments of main river basins were experienced in wet to humid condition after February shown below in figure(3a-d).





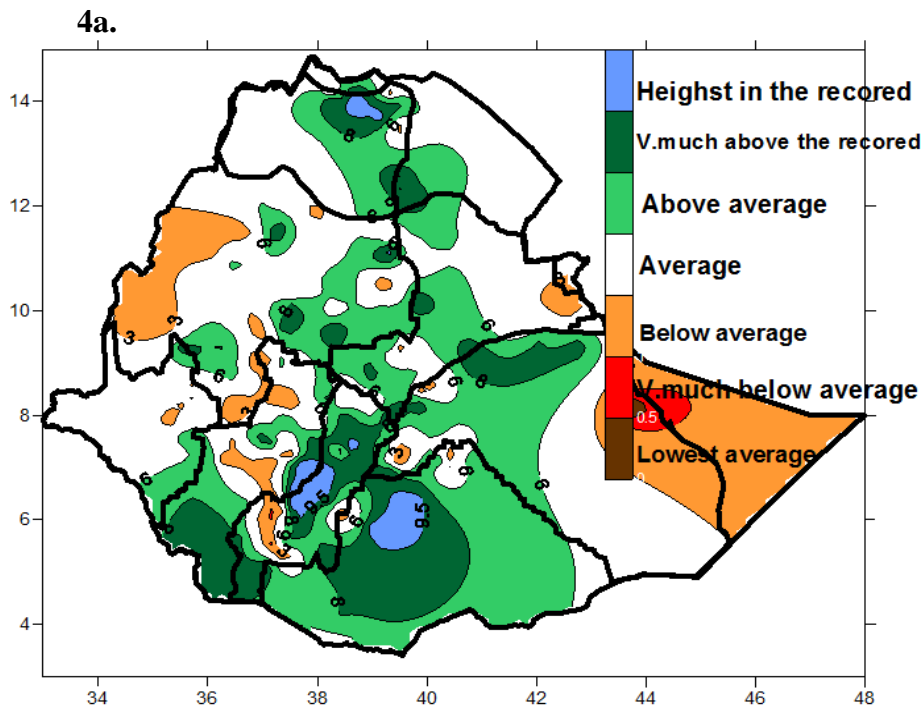
2007:- The wet and humid condition were covered across the middle and upper parts of Wabishebele, GenaleDawa, Rift valley, Omogibe eastern Abay, BaroAkob and upper Awash catchments shown below in figure(3a-d).

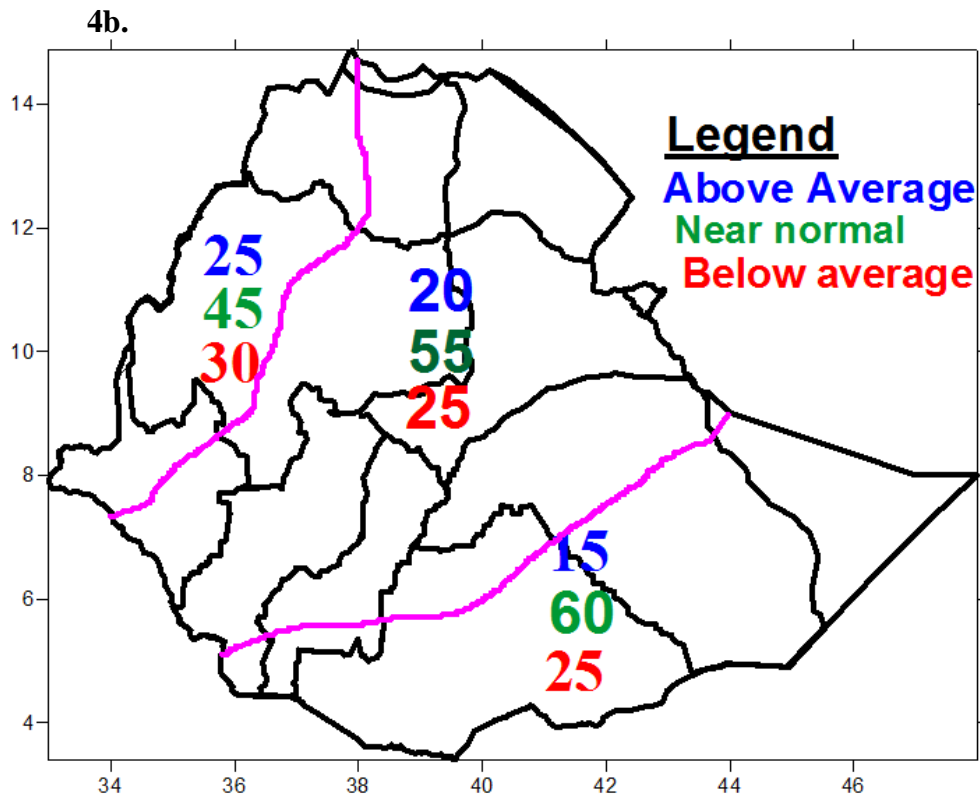




4. Tercile rainfall probability for Belg, 2015 season and rainfall deciles ranking of Belg 2005

Based on the map of decile Belg 2005 the highest record of rainfall was observed across Belg benefiting catchments of Genaledawa, Rift valley and Tekeze. In addition to this better rainfall distribution was observed over eastern half of Abay, Awash, Tekeze, lower OmoGibe, Baro Akobo, Rift Valley, Genale Dawa, upper and middle Wabishebele and some parts of Afar Denakel. The Tercile probability also indicated that most of Belg rain benefiting catchments will be under near normal tends to below normal condition shown below in figure (4a and b).





5. Conclusion

For the coming Belg season in most of Genale Dawa, Baro Akobo, Omo Gibe, Rift valley, upper and middle Wabi shebele, upper Awash and eastern Abay will expect to be wet to humid condition. Tekeze, middle and lower Awash, most parts of Abay, lower Wabishebele, Afar Denakel and lower Genale Dawa will be dominated under semi humid to dry condition. The wet condition and the occurrence of cloud coverage in the surrounding catchments of reservoirs and dams such as Gilgel Gibe1, Koka and Wabishebele have a better chance to balance the loss of water due to evaporation. Though, it should be noted that Belg rain has small contribution for surface runoff. However, it is important that catchment which are under Belg rain benefiting area for availability of water in small streams. In the other hand hot and long dry spell condition will be dominated in most parts of middle and lower catchments.