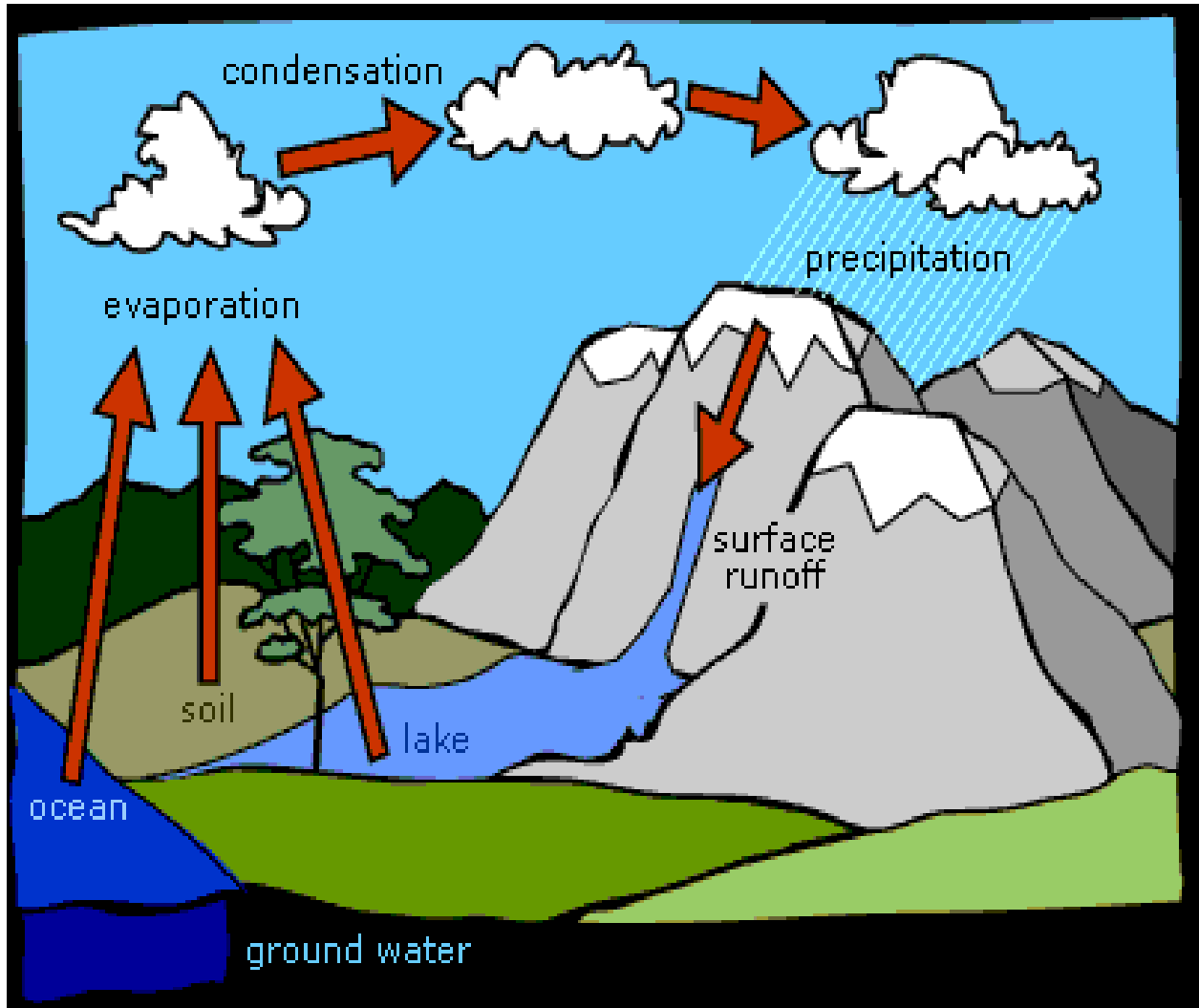


National Meteorological Agency



Hydro Meteorological seasonal bulletin for Kiremt, 2014

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.

Director General
NMA
P.O.Box 1090
Tel: 011661-57-79
FAX 00251-11-6625292
Addis Ababa

Web site: - <http://www.ethiomet.gov.et>
<http://www.Ethiopia.ranet.net>

I. Introduction

Ethiopia is located between latitudes of 3.8°N to 15°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 120meters below sea level (Kobat Sink Afar depression) and its highest point about 4620 meters above sea level (Ras dashen.).These physographic variations create a large difference in meteorological and hydrological condition 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 compromise 7 catchments with only 11 percent of the water resource and while the west compromise 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 $11^{\circ}40'$ and $15^{\circ}12'$ N, and $36^{\circ}30'$ and $39^{\circ}50'$ 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 13° N South of Gondar to $11^{\circ}30'$ N, and west of $39^{\circ}45'$ 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 $14^{\circ}30'$ 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 $11^{\circ}40'$ 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.

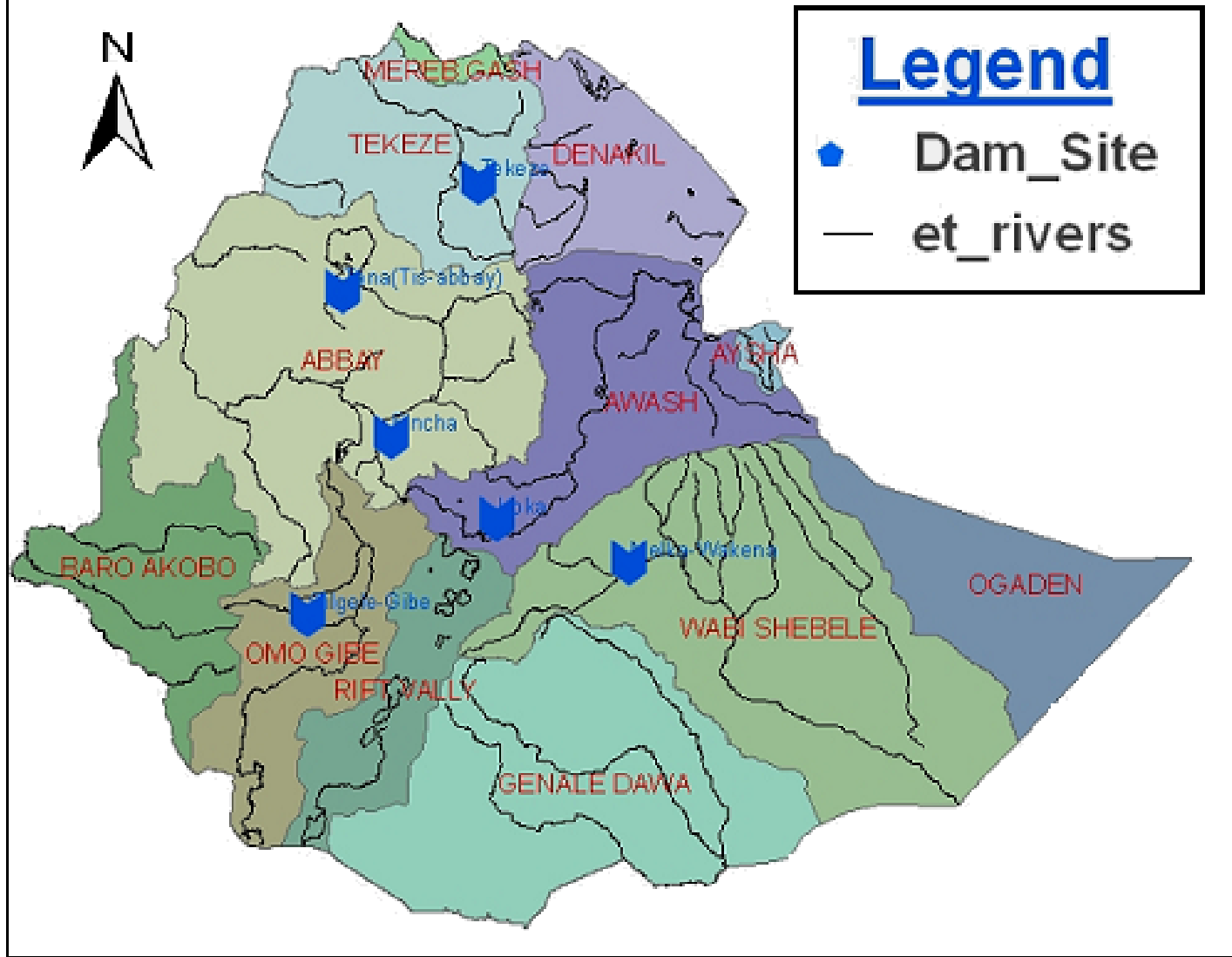
Genale Dawa Catchment: -

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.

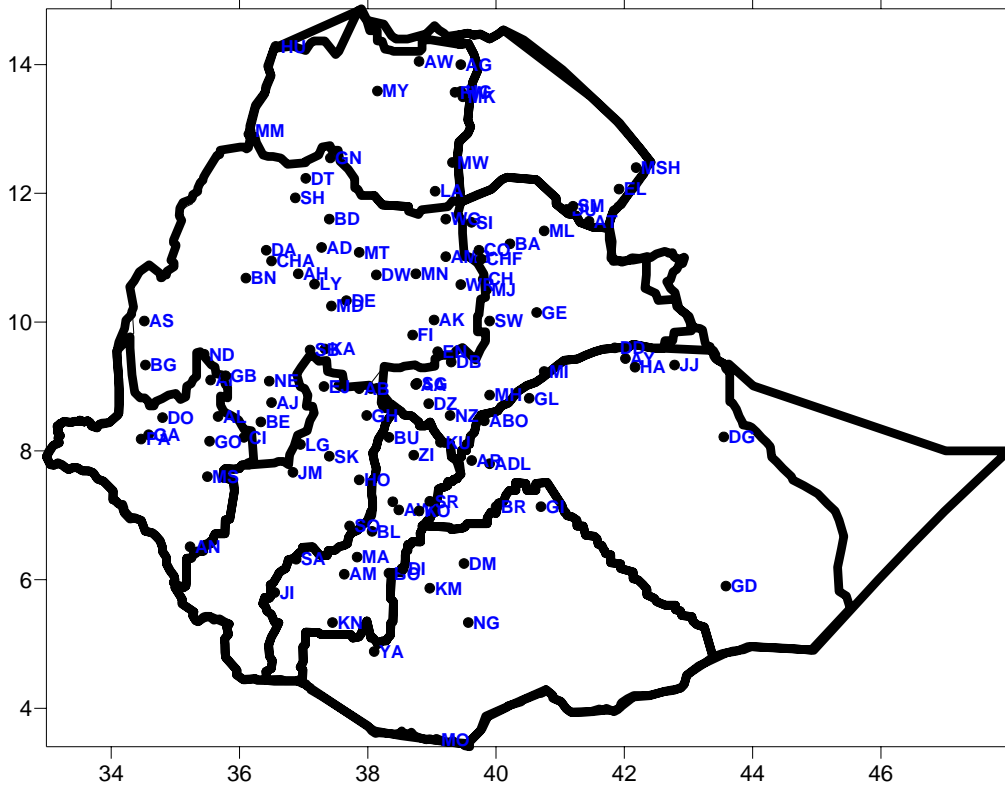
III. Major River Catchments in Ethiopia, Location and Spatial Status

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

Basin Map of Ethiopia



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	ShewaRobot	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.

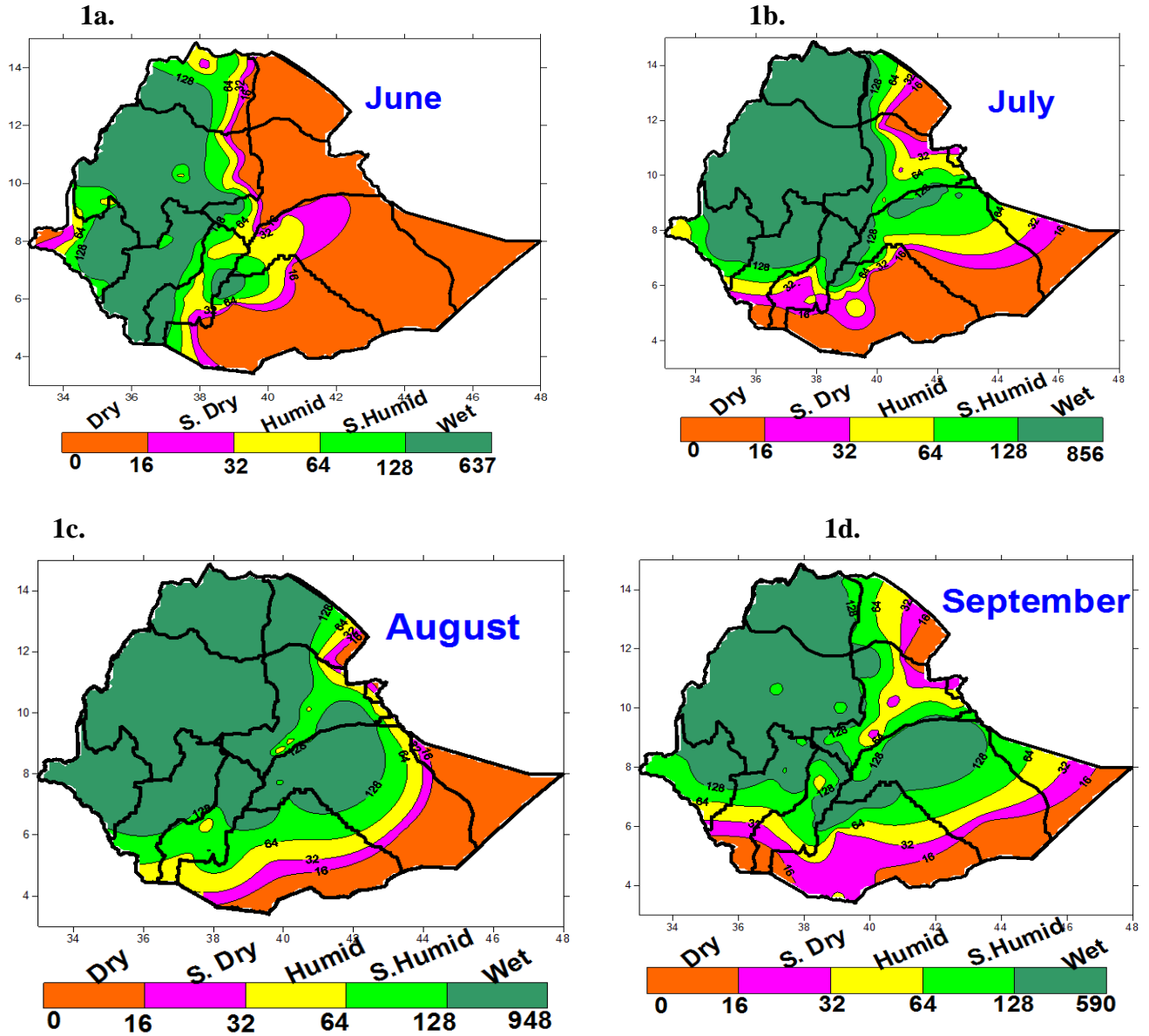
Kiremt (June-September) is the main rainy season across most part of the river basins except middle and lower parts of Genale Dawa, lower Wabishebele and Ogaden catchments. The maximum availability of surface and ground water is during Kiremt season. The main source of runoff is also with Kiremt rainfall which occur high flow period. Dams, reservoirs and ponds can capture the highest volume of water during this season. The occurrence of flood and land slide is widely known phenomenon in flood prone areas and rugged surface of the country during Kiremt season respectively.

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

1. During June the western Tekeze, Omogibe, western half of Abay and BaroAkobo catchments were performed wet condition, but north eastern, central, eastern and south eastern catchments of the country were dominated under humid to dry condition. July to September across Kiremt rain benefiting basins were received normal to above normal amount of rainfall. In this case most of upper and middle catchments of Abay, Tekeze, Awash, Omogibe , Baro Akobo, central Rift valley and upper Wabishebele and Genale dawa were performed wet condition. The rest middle and lower Genale Dawa and Wabishebele, Ogaden and north eastern tip of Afar Denakel catchments were experienced dry to semi dry condition shown below in figure (1a-d).

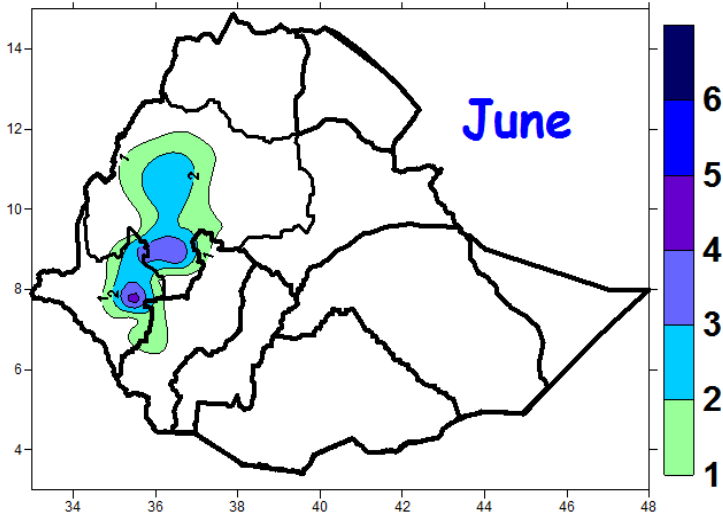


(Fig.1a-d) Aridity Index for June to September, 2014.

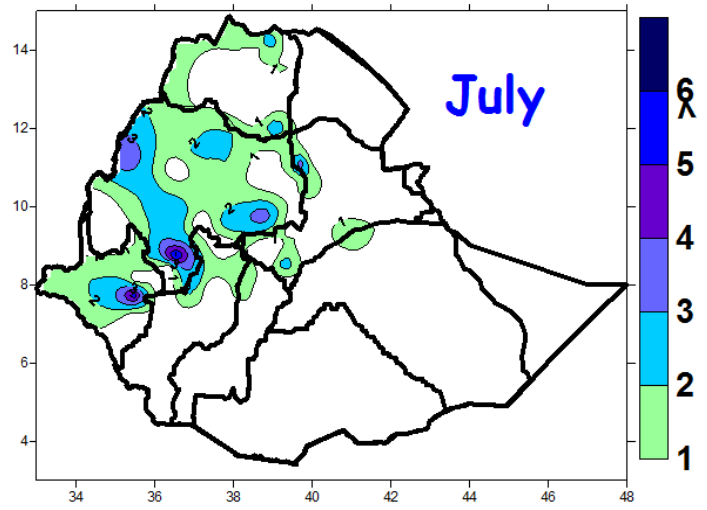
2. Occurrence of heavy fall days exceeding 30mm during Kiremt, 2014 season over different river basins.

The occurrence of heavy fall in Kiremt season is happened frequently over most river basins. Abay, Tekeze, Baro Akobo, Awash, Omogibe, Rift valley, upper Genaledawa and upper Wabishebele catchments were received heavy fall from one to eight days. This event during Kiremt 2014 was mainly observed in the Abay and BaroAkobo catchments. The highest frequent heavy fall days was observed in the western Abay catchments at BahirDar station for eight days in August within a month shown below in figure (2a-d).

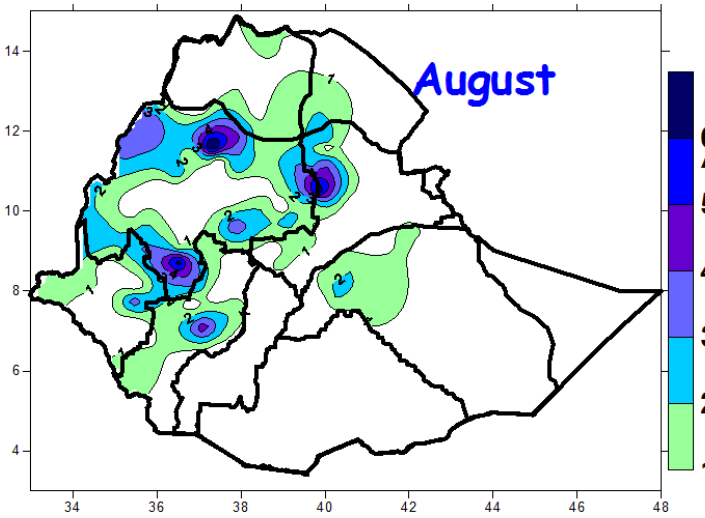
2a.



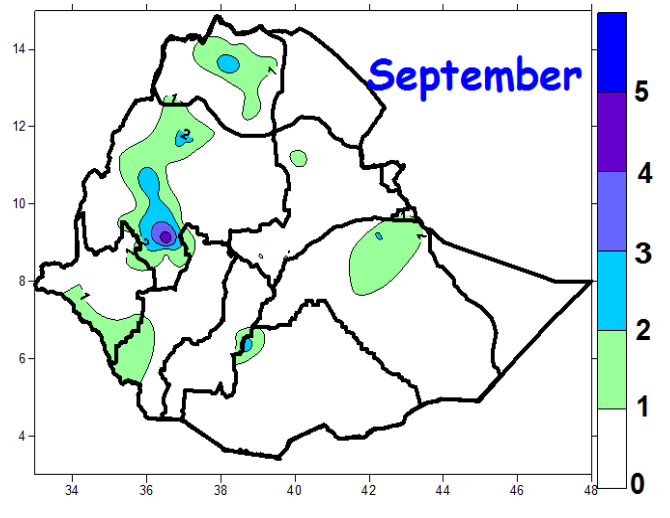
2b.



2c.



2d.

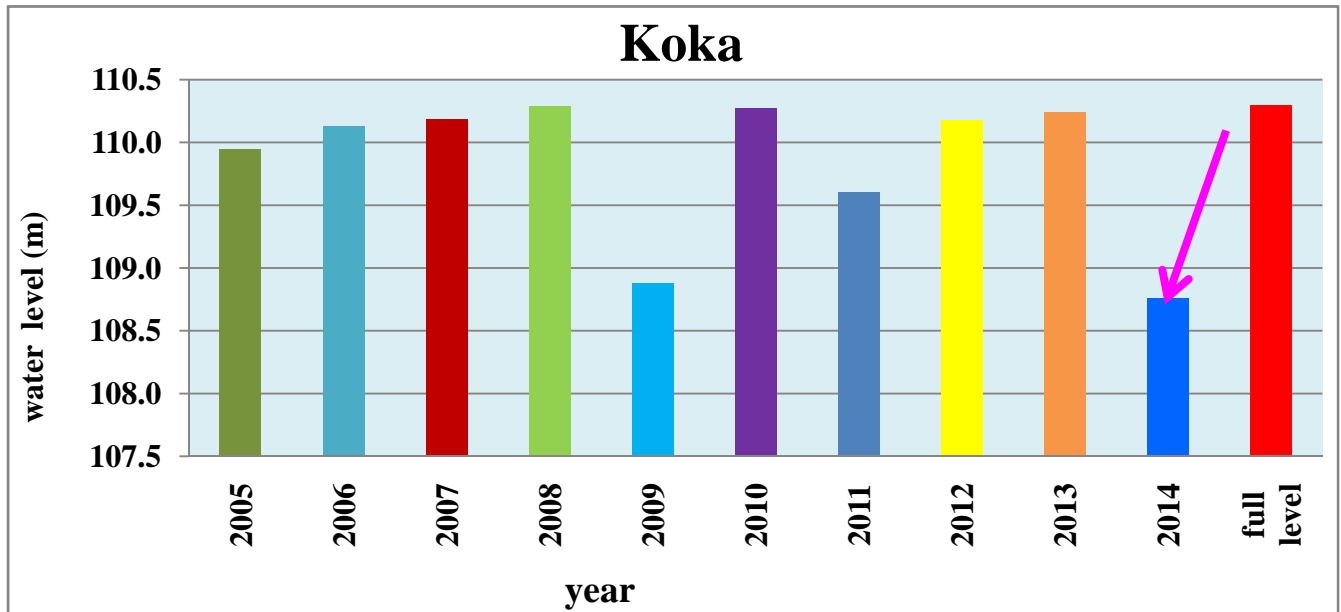


(Fig.2a-d) Distribution of heavy fall days during June to September, 2014

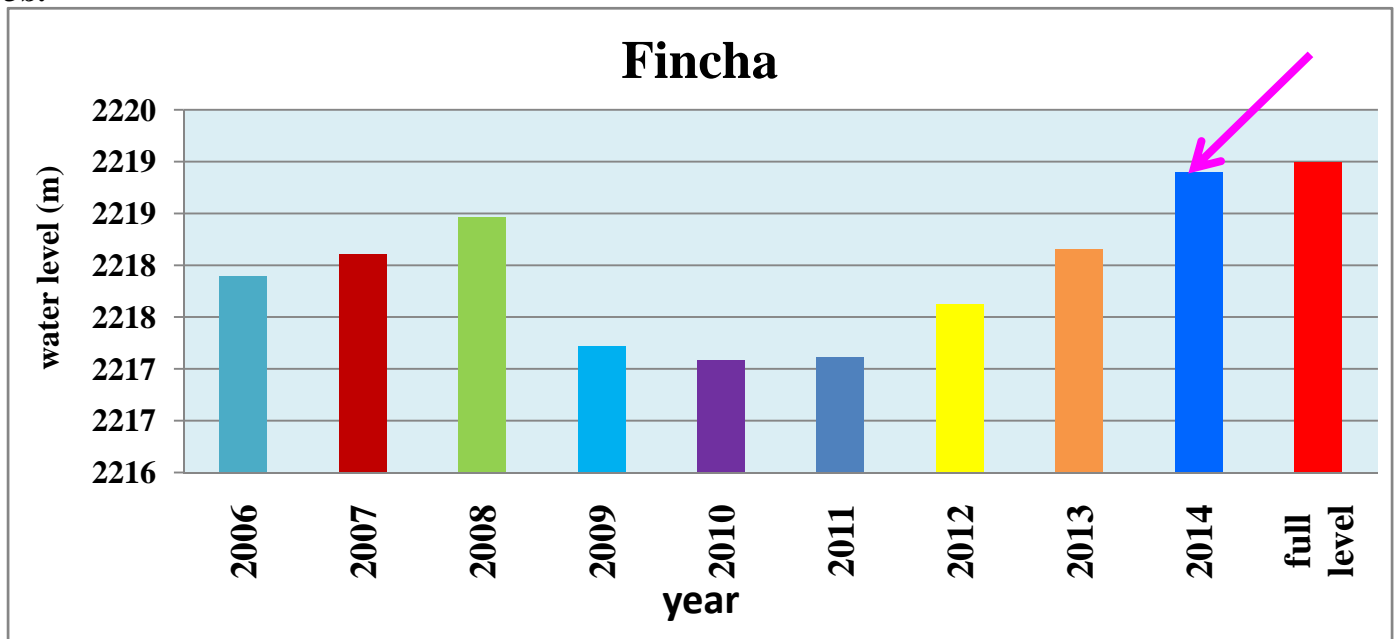
3. Hydrological situation for reservoirs and dams water level during end of Kiremt season at different years

The main source of runoff is rainfall which is the input for Dams, reservoirs and ponds from June to September. The maximum availability of surface and ground water is also during Kiremt season. In this case the contribution of Kiremt 2014 rainfall season had better performance compare to the previous years and the full level except Koka and Melka Wakena dams shown below in figure (3a-f)

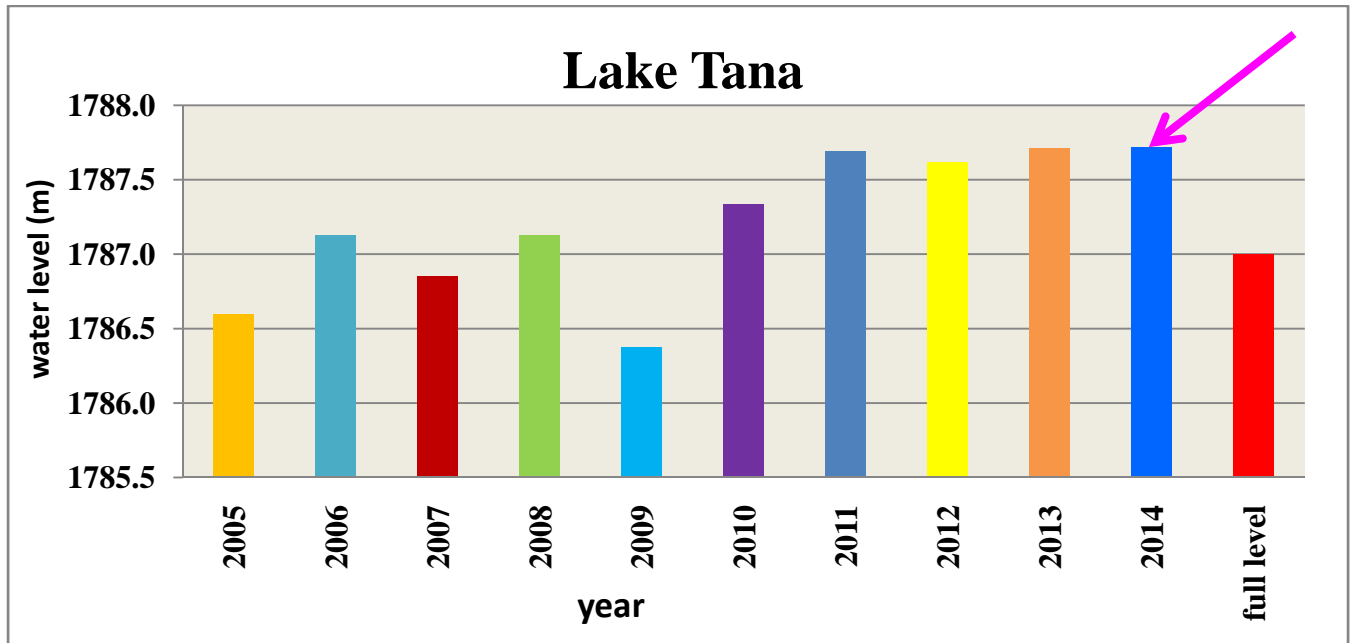
3a.



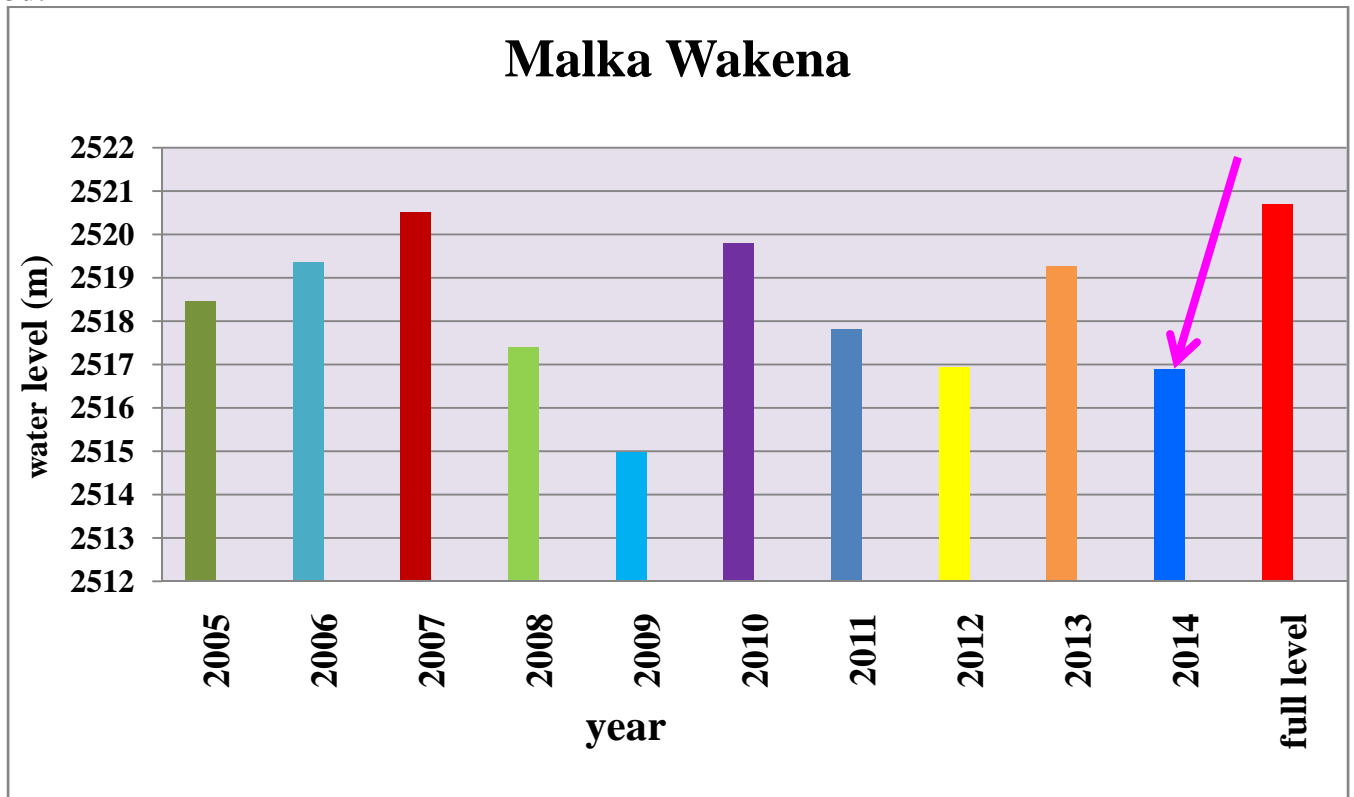
3b.



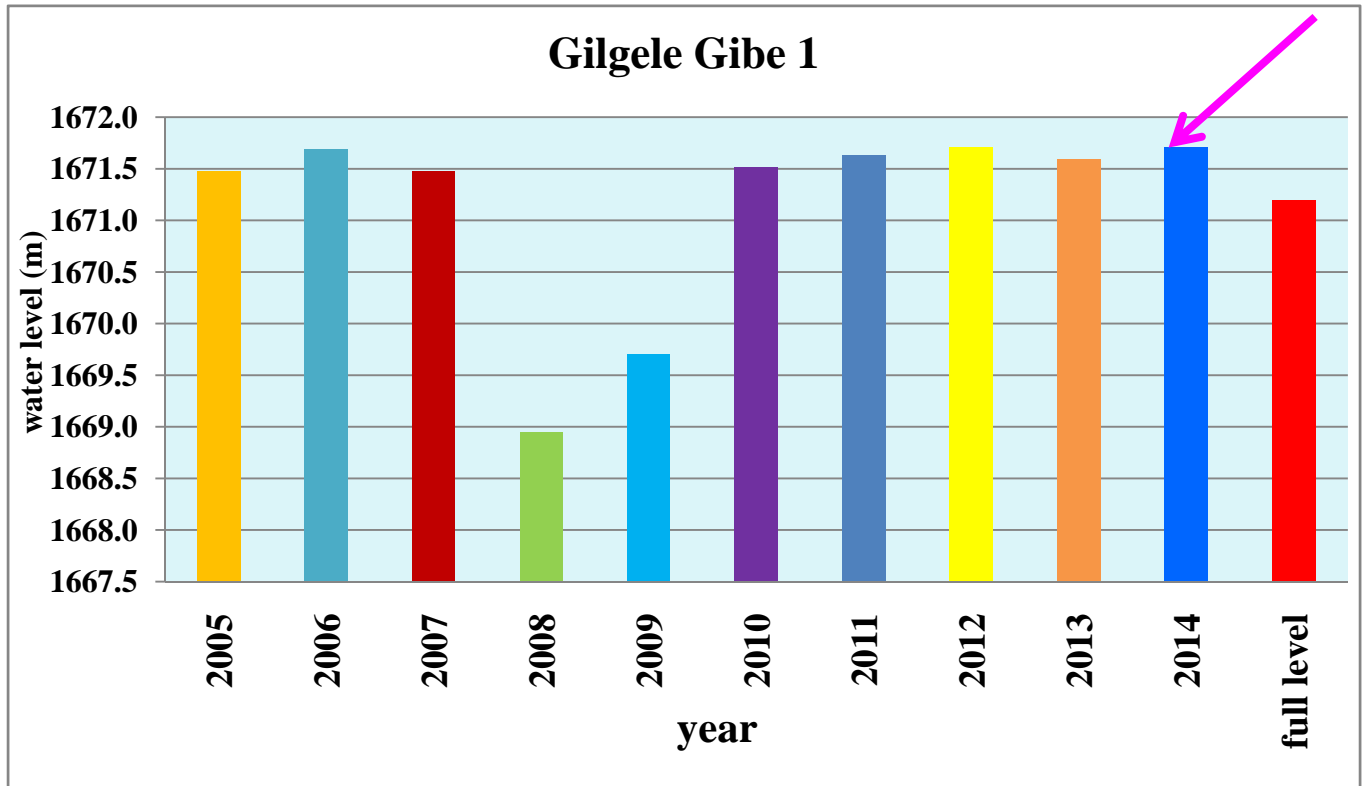
3c.



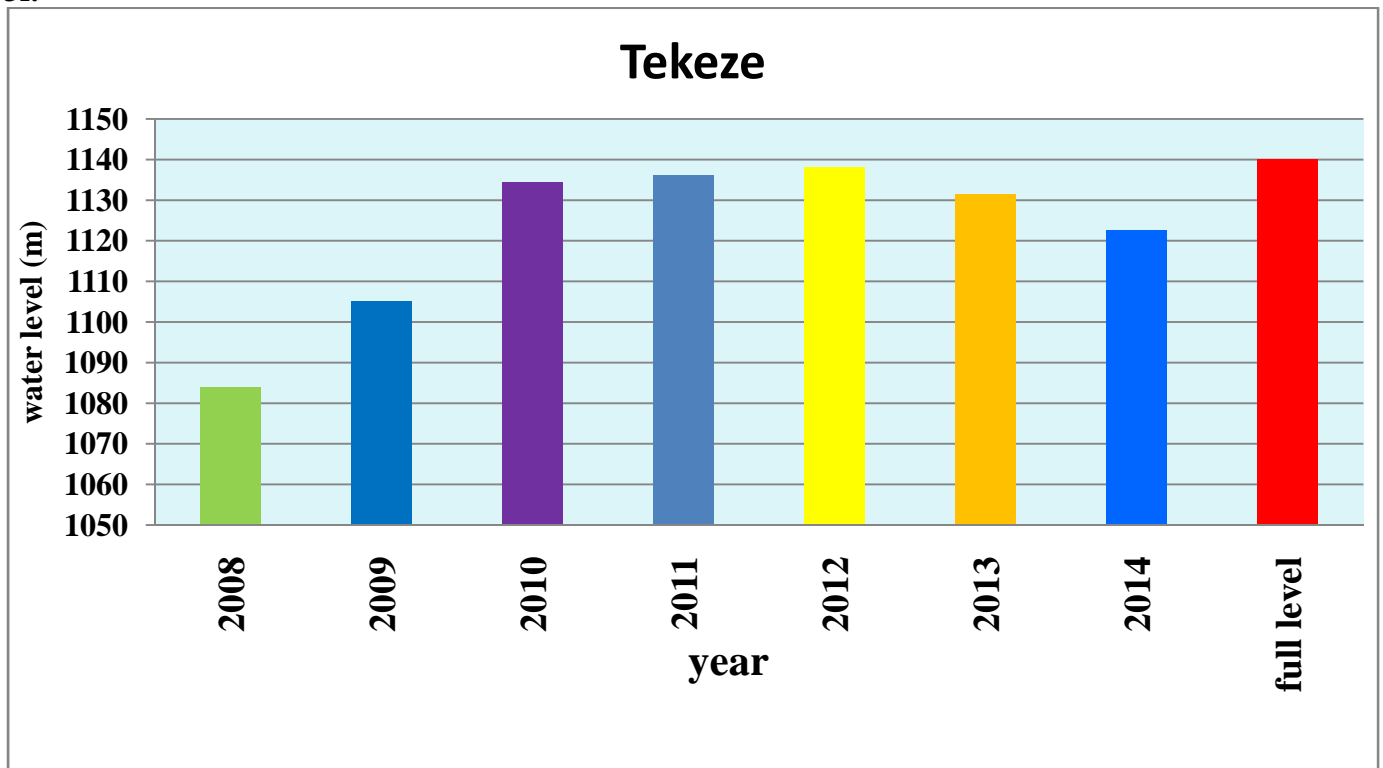
3d.



3e.



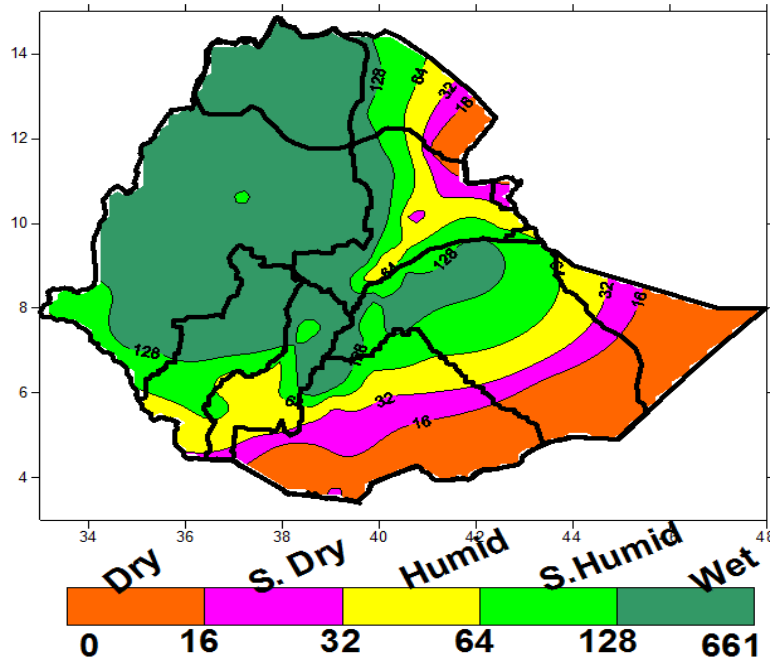
3f.



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

4. Seasonal aridity status of Kiremt 2014

The upper catchments of main basins had got the normal seasonal rainfall. In general the moisture performances of Kiremt 2014 over Kiremt rain benefiting catchments were performed wet condition and also had good contribution for the supply of water for different economic sector shown below in figure (4).



(Fig.4) Seasonal aridity index for Kiremt, 2014

Summery

During June most catchments were remained under dry and semi dry condition except Abay, OmoGibe, BaroAkobo and western Tekeze catchments. In July most parts of Kiremt benefiting upper catchments of main river basins were received rainfall. In line with this the wet condition were covered wide areas including upper Wabishebele and some parts of upper Genale Dawa. During August the wet and humid weather condition performed across all river basins except the lower Wabishebele, lower GenaleDawa and Ogaden catchments. The wet condition also was continued until September across the upper catchments of main basin. The maximum aridity index value was observed over Abay and OmoGibe basins. The occurrence of heavy fall in this season was observed over many catchments during June to September. The maximum frequency of heavy fall days was observed over Abay, Awash and upper BaroAkobo catchments during July and August respectively.

Hydro Meteorological outlook for Bega 2014/15 over different river basins.

Introduction

Bega (October-January) is mostly a dry season for most parts of the river basin except Ogaden, lower and middle Wabishebele , middle and lower Genale Dawa as well as lower Rift Valley. 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. Springs and ponds starting to dry up after mid Bega season. The availability of water is decrease across upstream of the main river basins. In some years unseasonal rain slightly fevered for water availability.

Selected analogue Year

For the coming season the selected analogue year **2006/07, 2001/02, 1979/80 and 1990/91** were compared based on probabilistic seasonal forecast for **Bega 2014/15** and viewed out on catchments based map using geostatistical kriging method. Among those are **2006/07 and 2001/2** are the best analogue year that can enlighten the aridity status in the coming Bega season.

Methods

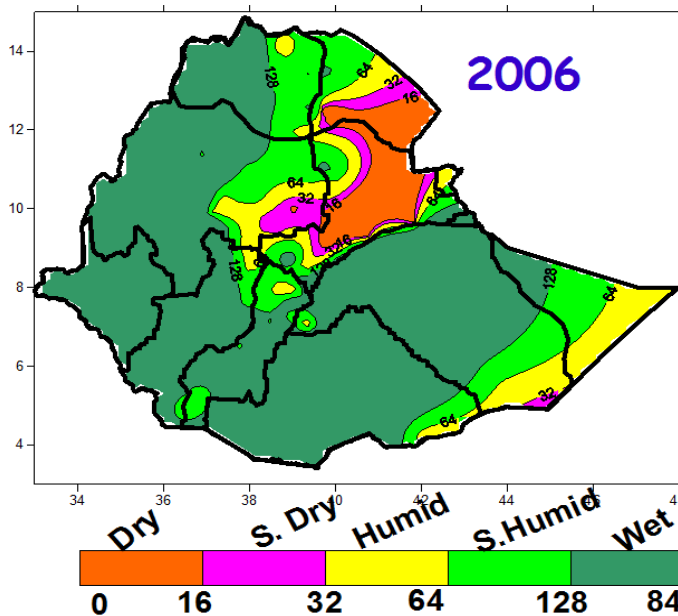
Thornthwaite introduced the concept of the precipitation effectiveness index, which is computed from the monthly values of rainfall and evaporation. The evaporation is computed empirically from mean monthly air temperature. In assessing the effectiveness of rainfall, in terms of water availability relationships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

Where, Rf= monthly rainfall in mm;

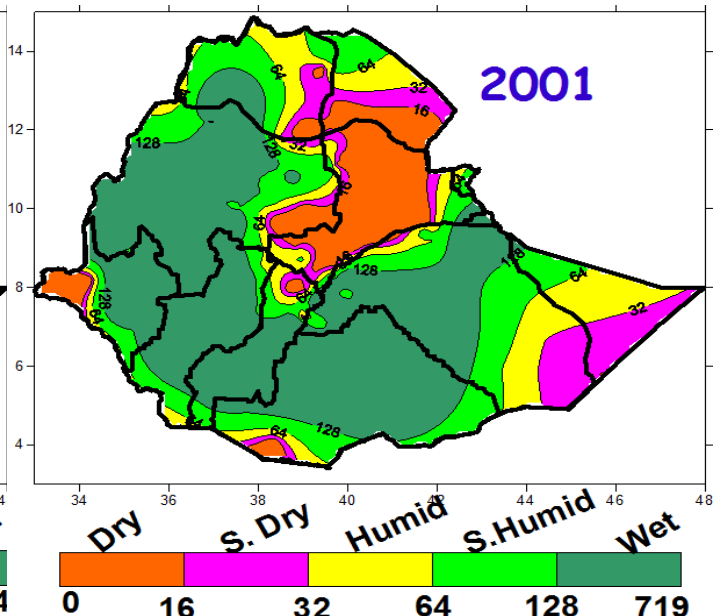
T = mean monthly temperature in C°

October:- During this month western and southern half of Abay and Tekeze, most parts of Baro Akobo, Genale Dawa, Omo Gibe, Rift Valley and some parts of upper and middle Wabishebele were experienced in wet condition shown below in figure (5a and b).

5a.

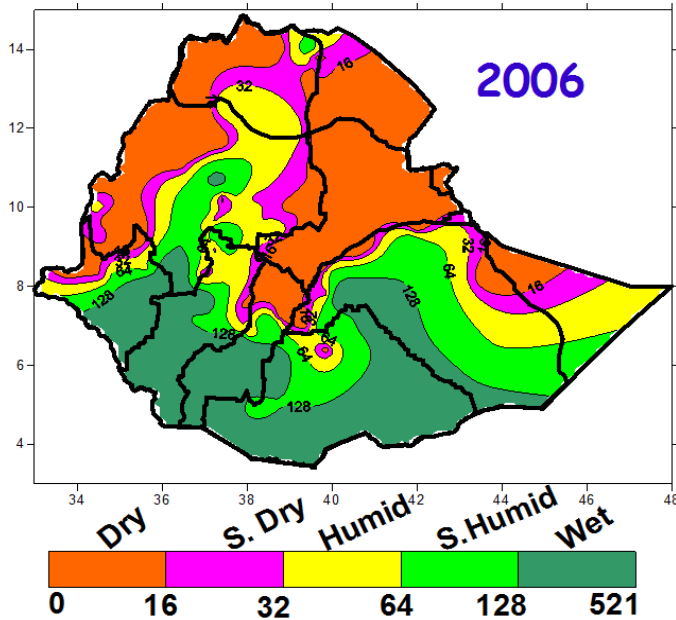


5b.

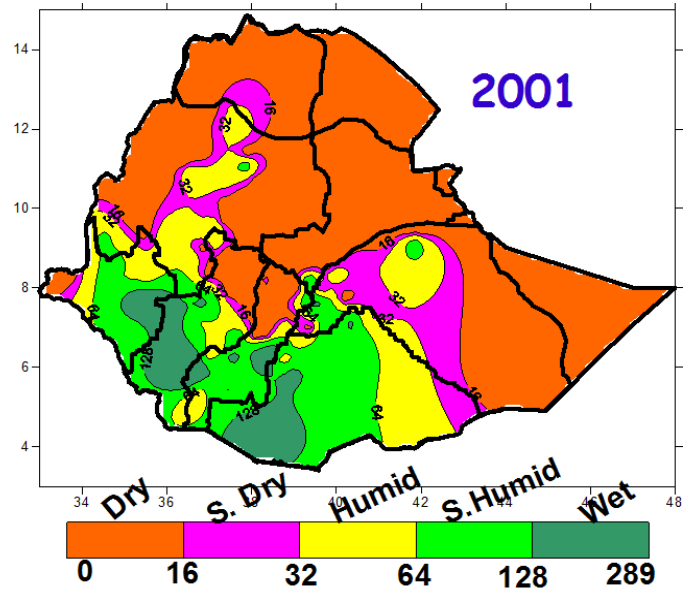


November:- The wet condition were performed in the lower parts of over the divided areas of Omo Gibe and Baro Akobo, Rift valley and OmoGibe, lower and middle GenaleDawa catchments. In the rest the dry condition were dominated over most parts of river basins.

6a.

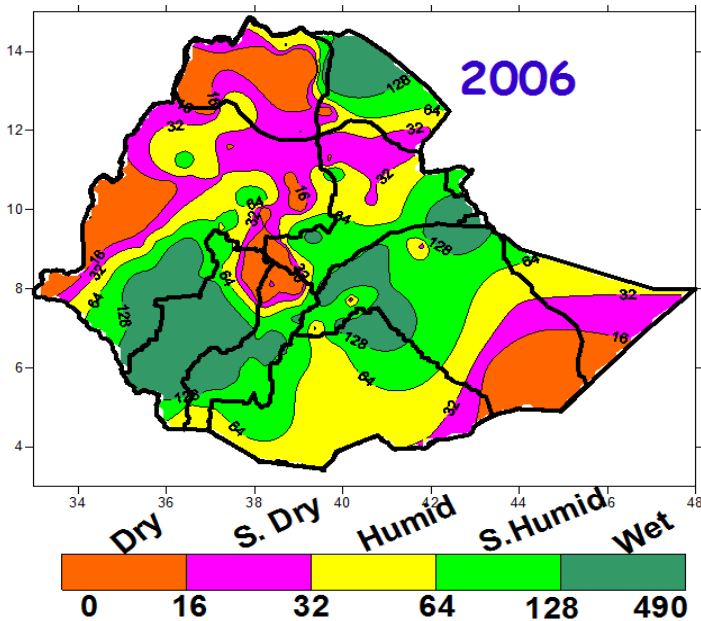


6b.

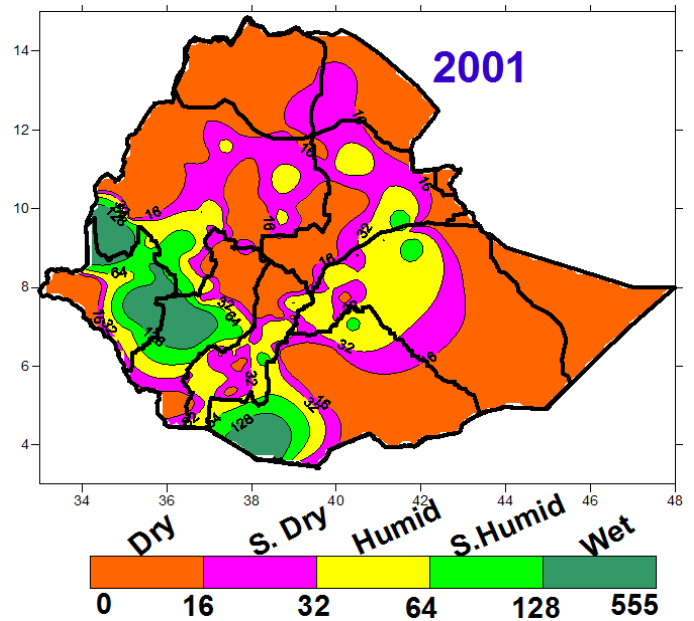


December: - During this month most catchments are dominated dry weather condition. Though based on the analogue years in 2006 the wet condition was observed across the periphery of Rift valley catchments and in 2001 middle Baroakobo and OmoGibe and lower Genale dawa had wet condition shown below in figure (7a and b).

7a.



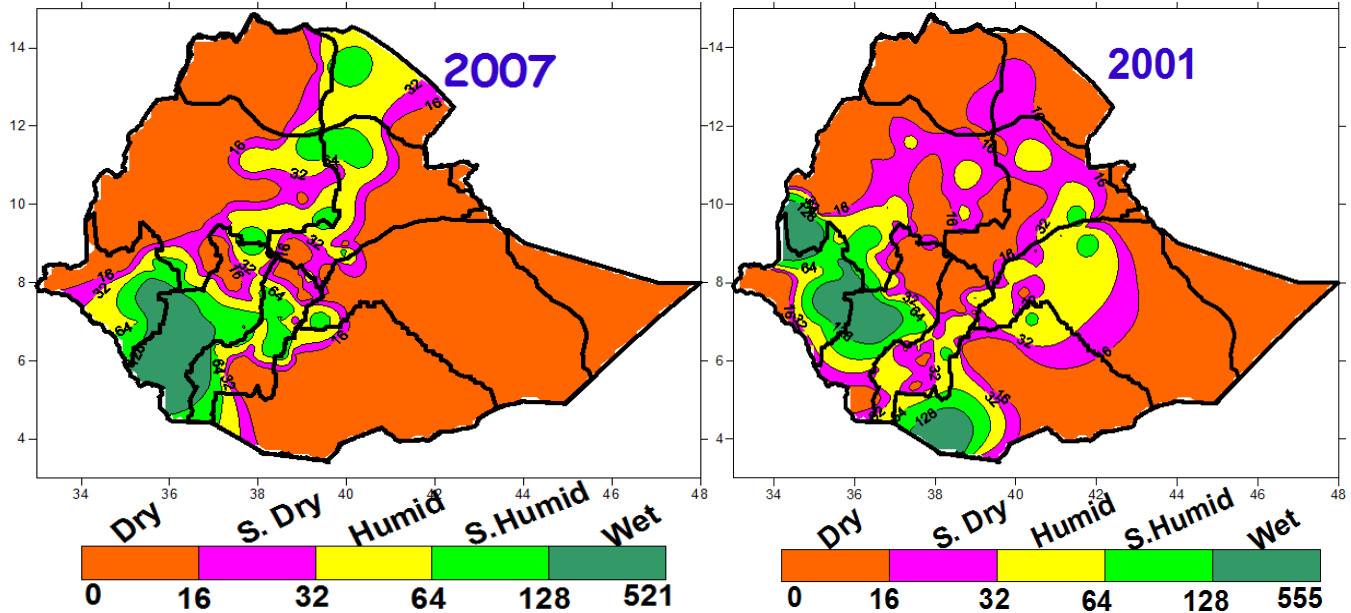
7b.



January:- The wet weather condition were observed pocket areas of middle and lower Awash, Rift valley, eastern BaroAkobo, middle and lower OmoGibe as well as Afar Denakel. The rest most catchments of the country were dominated under dry condition shown below in figure (8a and b).

8a.

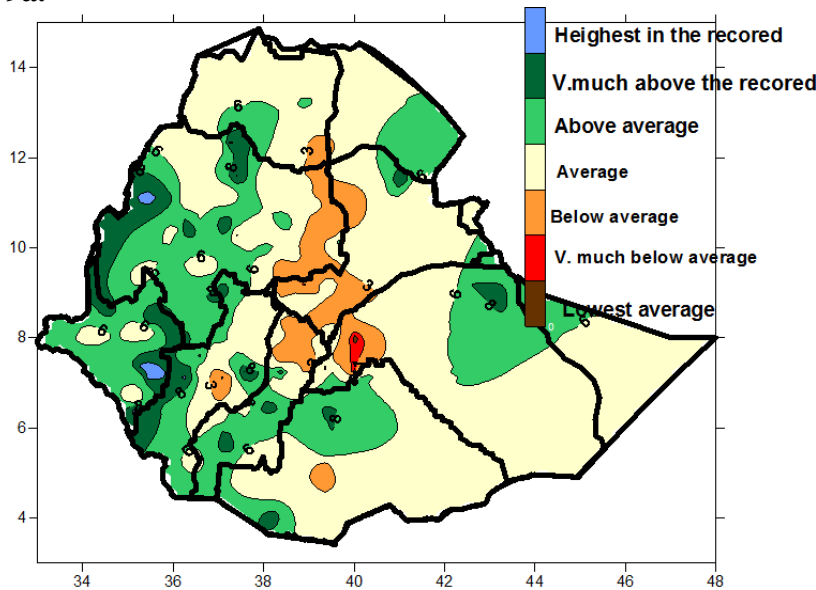
8b.



Rainfall Deciles Ranking of Bega 2001

Based on decile Bega 2001 most catchments had average and above average rainfall and the highest record of rainfall was observed across pocket areas of lower Abay and in the margin of Omogibe and in the eastern parts of Baro Akobo catchments shown below in figure (9a).

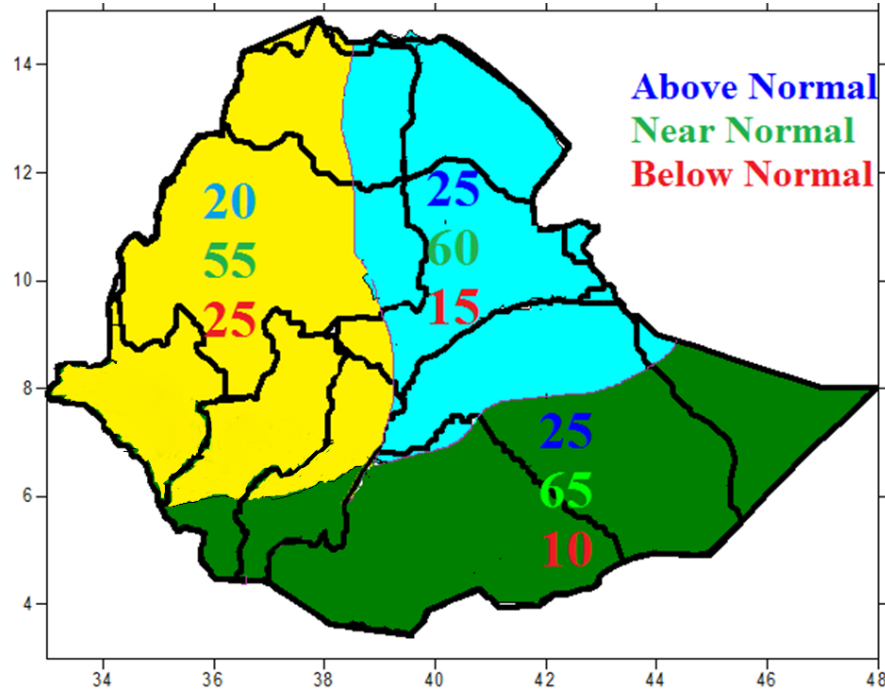
9a.



Tercile rainfall probability for Bega 2014/15 season across Ethiopian river basin.

The rainfall probability indicated the western and central catchments will have normal tends to below normal rainfall, the north east and eastern catchments will have normal tends to above normal and south and south eastern catchments will have better probability to be normal tends to above normal condition.

10a.



Conclusion

In the coming Bega season during the first month of October, with exception of eastern Tekeze, Awash, lower Wabishebele, eastern Abay, Ogaden and Afar Denakel across the rest catchments the moisture performance will performed wet condition. From November to January the Bega dry condition will dominated over all river basin except lower parts of OmoGibe, Baro Akobo, Rift Valley and Genale dawa catchments. The occurrence of heavy fall is insignificant in Bega season however, in the presence of unseasonal rainfall some catchments irregularly will received heavy fall. The coming October rain will have advantage for reservoirs and dams to capture some amount of water. Though, it should be noted the dry and windy Bega condition will prevail in most upper catchments. In the lower BaroAkobo and OmoGibe catchments due to the extended wet condition there will be excess water over the lowland flood plane areas.