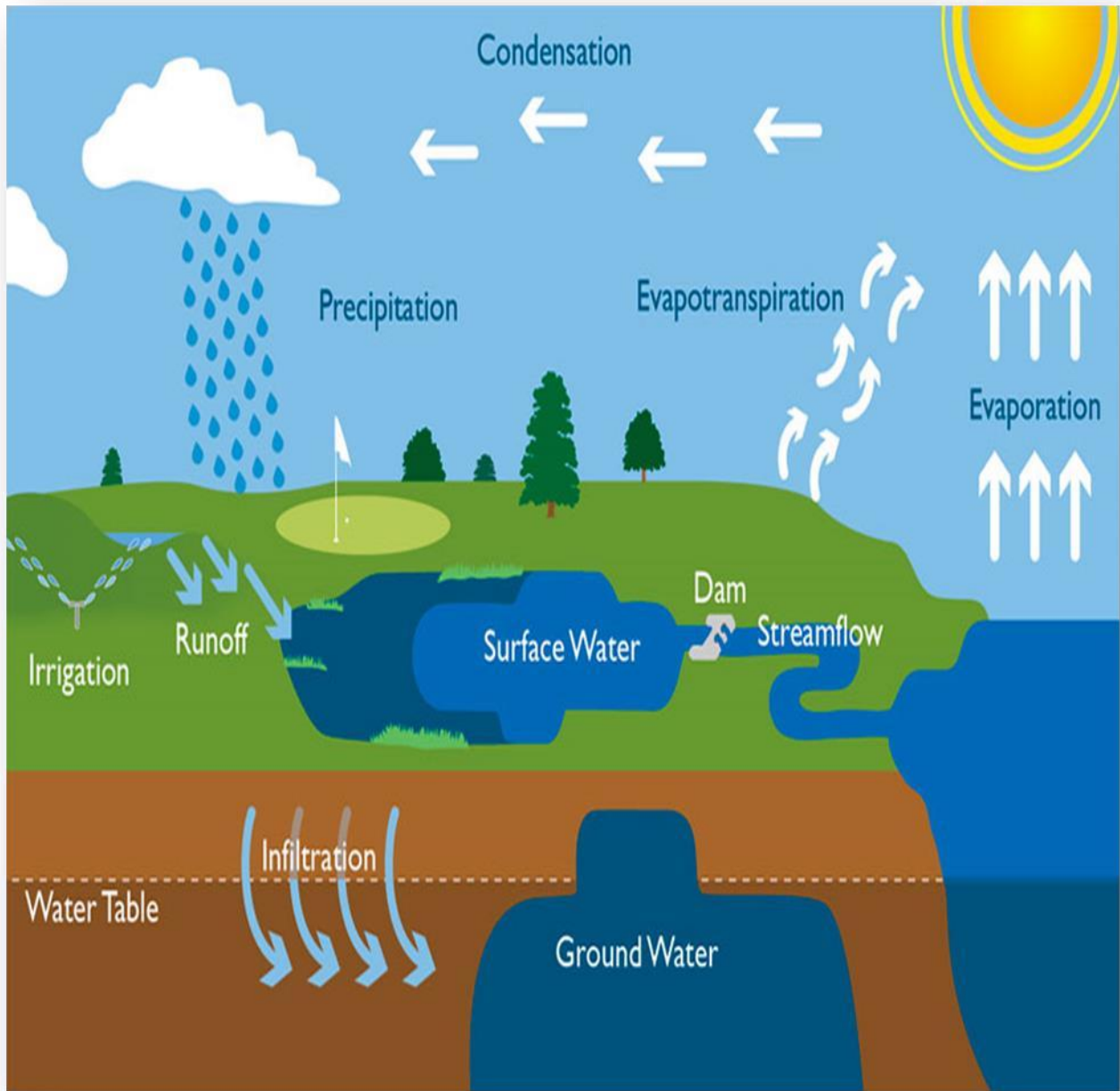


Ethiopia Meteorology Institute



Hydro Meteorological and flood monitoring Bulletin for Belg impact assessment and Hydro meteorological impact outlook for Kiremt, 2026

Foreword

This seasonal hydro meteorological bulletin is prepared and disseminated by the Ethiopia Meteorological Institute (EMI) 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 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 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 11 040` and 15 012` N, and 36 0 30` and 390 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 390 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 40⁰ E of Tigray, North of 11⁰N of Wollo, narrow coastal strip south of 14⁰30`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 11⁰ 40` N of Wollo, south of 9⁰ 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.

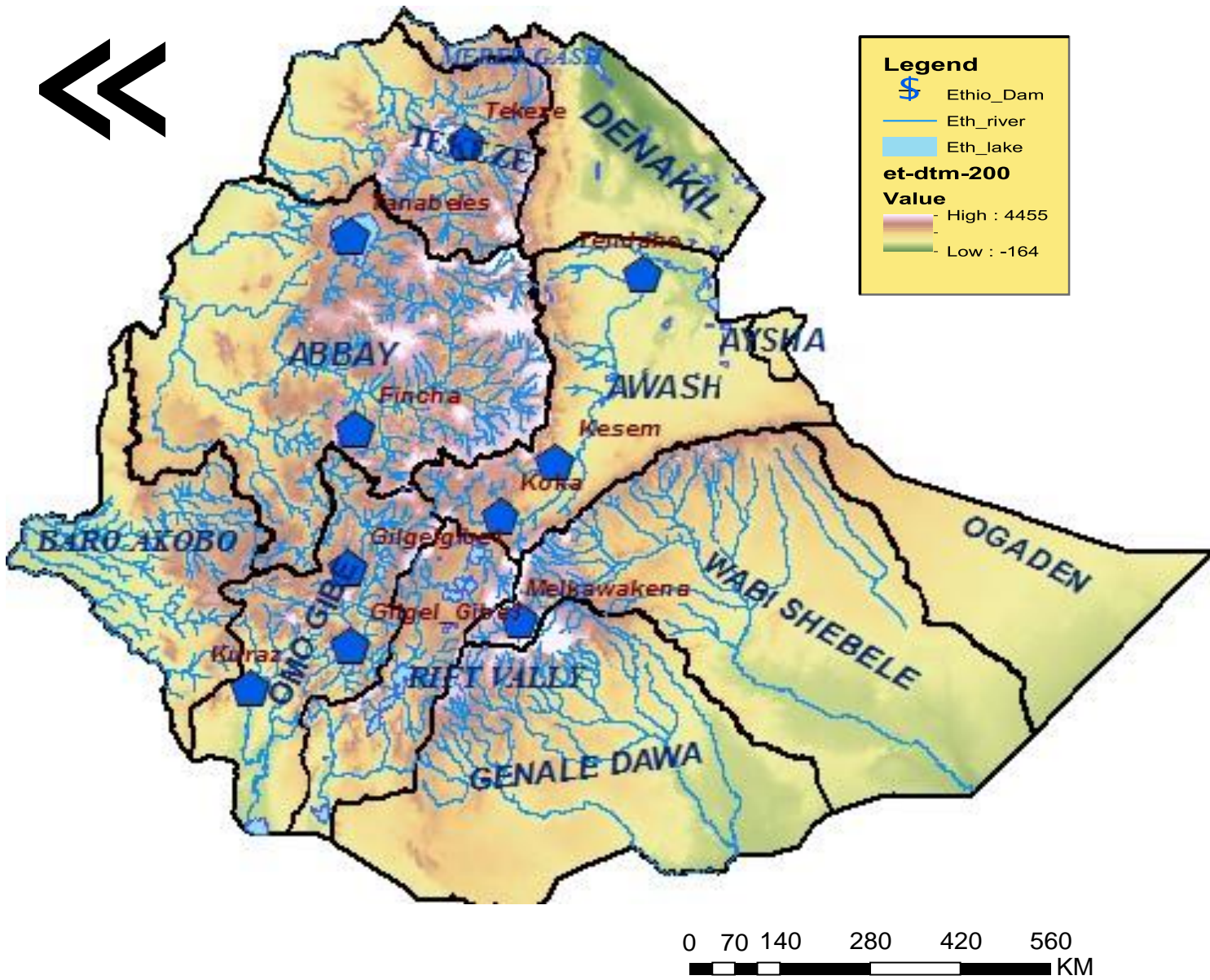
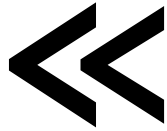
Genale Dawa Catchment: -

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.

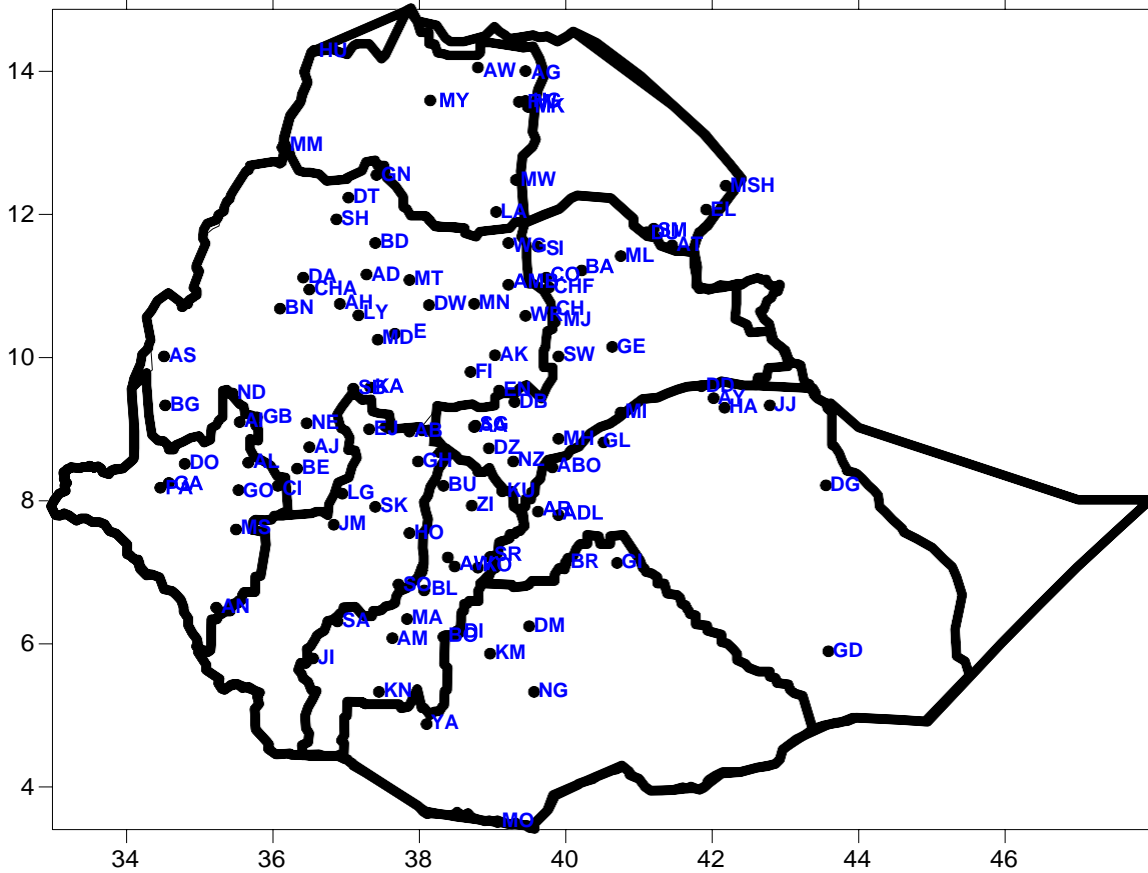
III. Major River Catchments in Ethiopia, Location and Spatial Status

No.	Catchement Name	Area (km ²)	Length in Kilo meter			Volume of water bm ³ /An num	Altitude (meter) <i>Peaks (Highest & Lowest)</i>
			Within Eth.	Outside Eth.	<i>Total</i>		
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

IV. Basin map of Ethiopia



V. 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	Debremarkose	DE	Jimma	JM	Negele	NG
Alge	AL	Debre Tadore	DT	Jinka	JJ	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 EMI. 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. Belg season description

Belg rainfall contributes significantly to surface runoff generation, particularly over the Belg rain-benefiting catchments of Ethiopia. During a normal to wet Belg season, rainfall received from February to May helps replenish rivers, reservoirs, wetlands, and shallow groundwater systems across the eastern, central, and southern parts of the country. The season plays a vital role in improving water availability before the onset of the main Kiremt rains, thereby supporting domestic water supply, livestock, small scale irrigation, and ecosystem functions. Adequate Belg rainfall helps alleviate water shortages that commonly develop during the prolonged dry Belg season and reduces the adverse impacts of evaporation losses from open water bodies. Furthermore, the rainfall received during Belg enhances soil moisture conditions, supports agricultural activities, and contributes to sustaining stream flow in Belg-dependent catchments. However, one of the characteristic features of the Belg season is the occurrence of relatively high temperatures across many river basins, which can increase evapotranspiration rates and partly offset the gains obtained from seasonal rainfall.

Methods

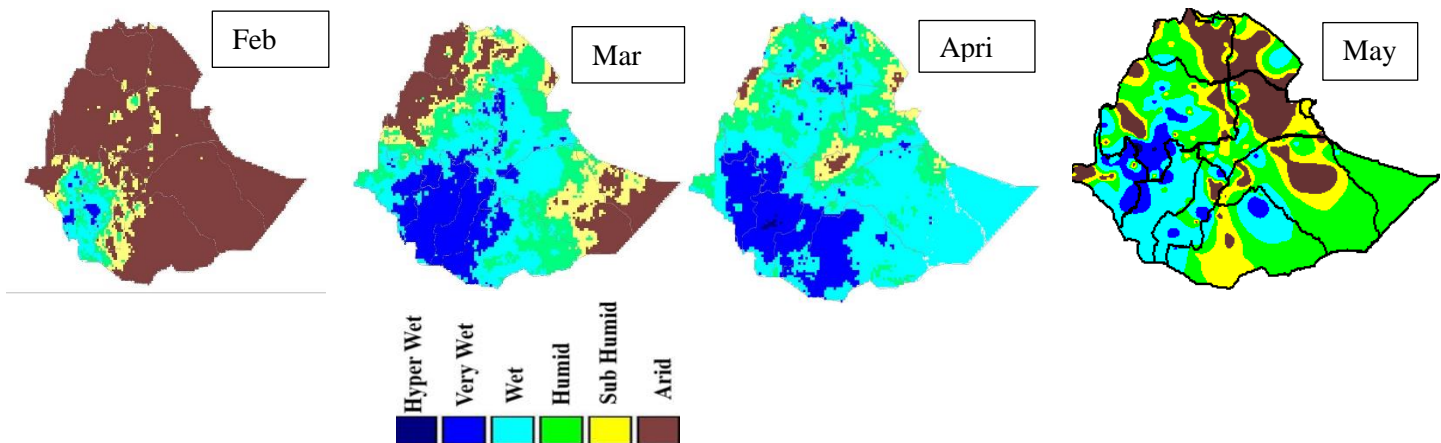
To compute the aridity index we use Thornthwait method, which is computed from the monthly values of rainfall and evaporation. The evaporation is computed empirically from mean monthly air temperature. In assessing the effectiveness of rainfall, in terms of water availability relationships between the rainfall and air temperature has been worked out in terms of moisture indices. The aridity index values above 350 which shaded in deep blue were show extreme wet condition, Light blue- very wet, dark Green wet, green humid, yellow sub humid and dark red arid condition.

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

2. Aridity status for Belg at different river basins

February:- In this month, most part of Genale Dawa, Wabi shebele, Afar Denakil, Tekeze, Awash, Ogaden, Mereb gash Lower and middle Omogibe, Rift Valley, lower divide area of Tekeze, Abay are dominantly prevailed under arid and semi-Arid condition . And most of Omo gibe, rift valley, and upper Baro Akobo, basins have skilled humid to wet moisture condition. This condition has positive impact for water availability over Belg Benefiting catchments.

During March the wet moisture condition has increased from the south and south east shift to most basins, during this month most part of Baro Akobo, Rift valley, Omo Gibe, Genale Dawa and upper and southern part of Abay had Humid to wet moisture condition. During April, most part of Baro Akobo, Rift valley, Omo Gibe, Awash, Ogaden and most catchments had Humid to wet moisture condition. Last month of belg may month also most belg benefiting basins are experiencing sub humid to wet moisture conditions. In figure 1.

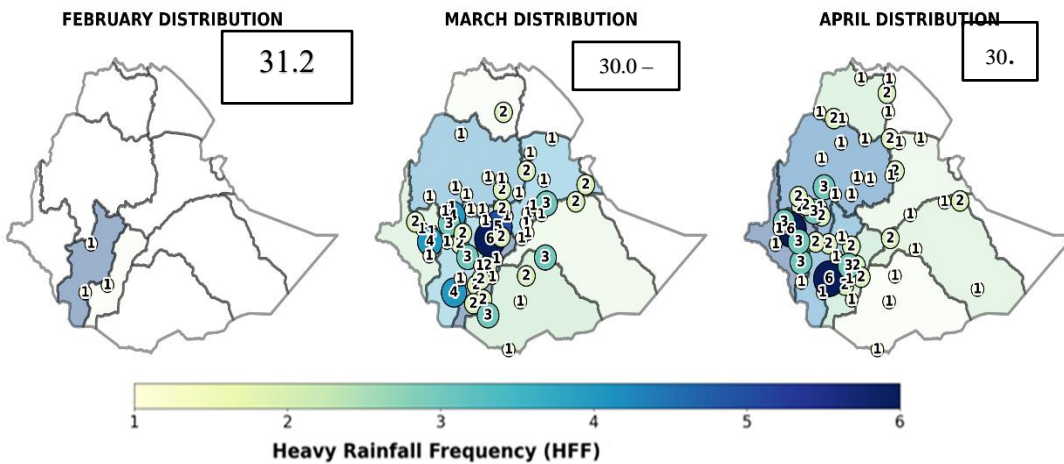


(Fig.1) Aridity Index for February to may.

Distribution of heavy fall days exceeding 30mm during February to may, over different river basins.

In February 1- day's heavy fall was recorded over Omo-Gibe and Rift- Valley Catchments. In days march 1-6 over different basins in Abay, Omogibe, rift valley, Awash, upper wabi shebele and Genale, and Tekeze catchments, April and may month are recorded most belg benefiting basins such as Omo Gibe , wabi shebele , Genale Dawa , rift valley, in addition to Awash Tekeze, Abay, and Baro Akobo basins are received heavy fall and may month 1-4 days recorded over different station over , most of Omo gibe , rift valley, Baro Akob, Awash upper Genale Dawa, Tekeze and wabi shebele 30 mm to 85 mm.

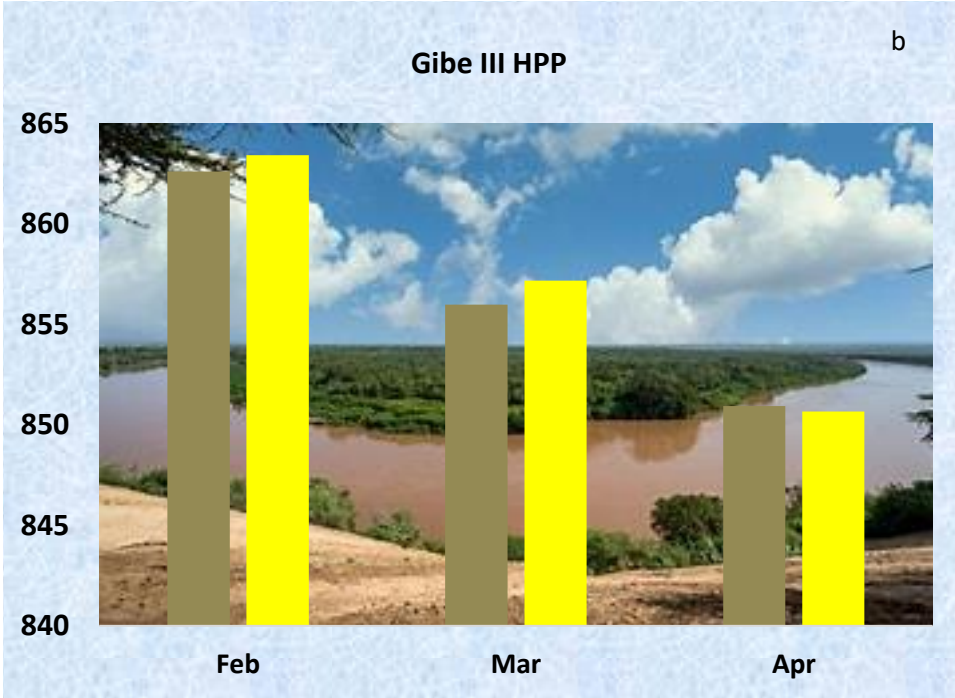
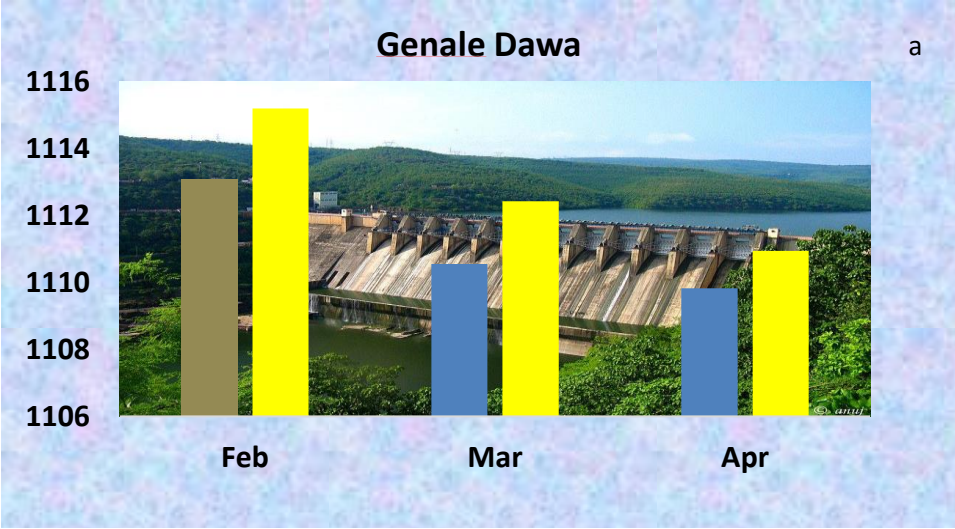
Distribution of heavy fall exceeding 30 mm per day over different river basins 2026

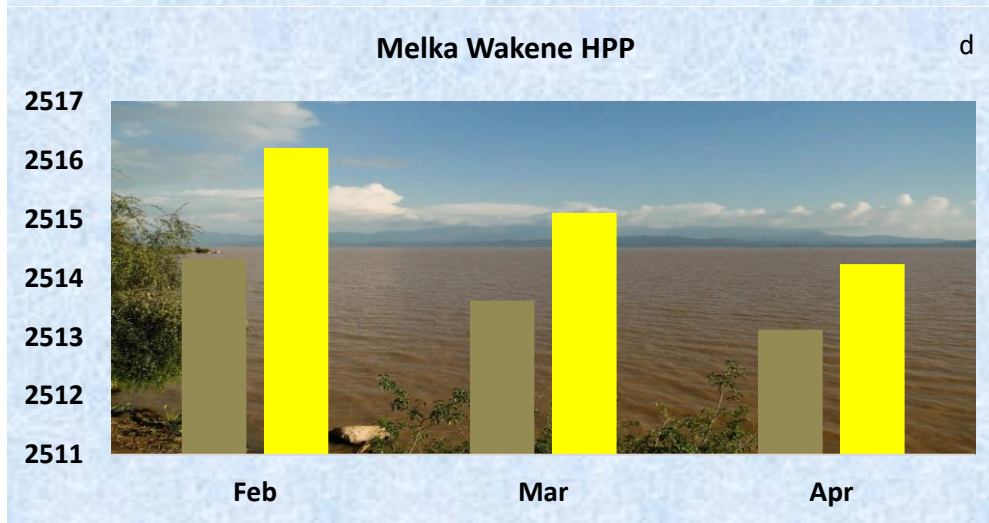
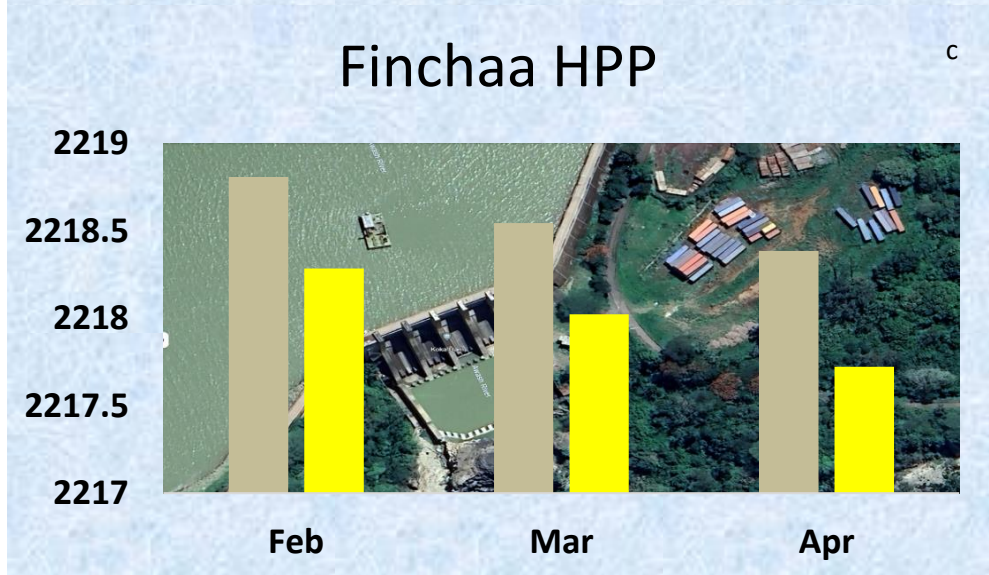
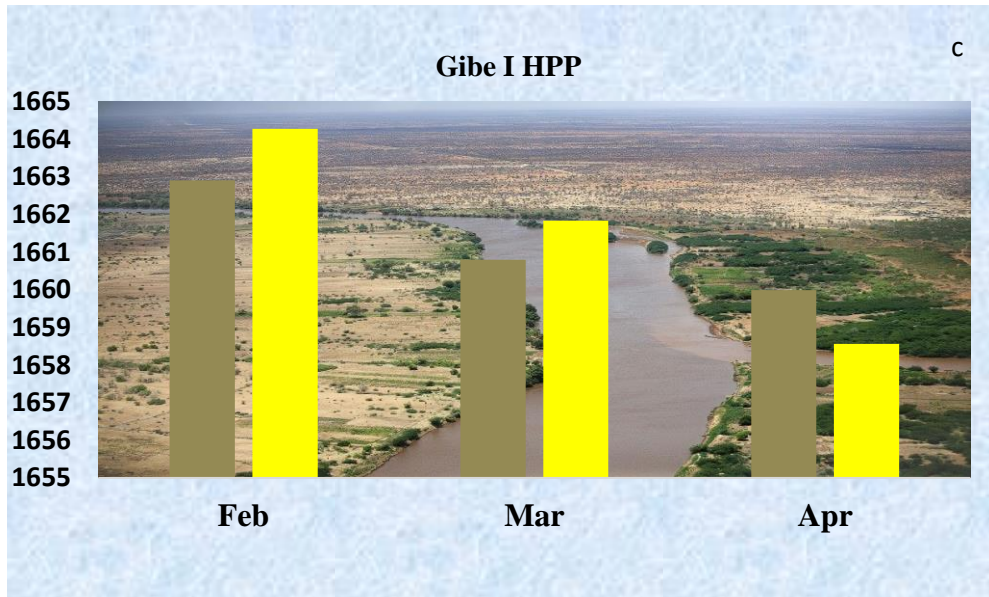


(Fig 2) Distribution of heavy fall February to May, 2026

3. Performance of Dams and Reservoirs water level in belg season compared to long mean

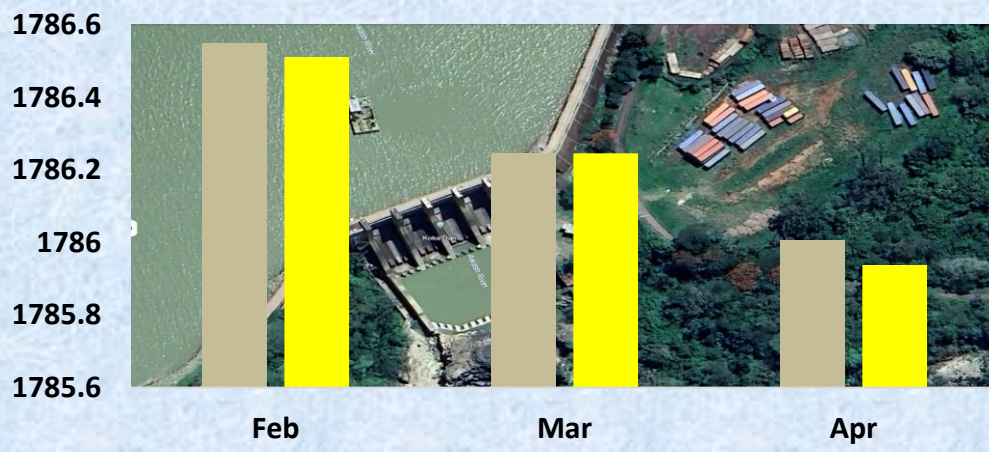
The main source of runoff is rainfall which is the input for Dams, reservoirs and ponds but in Belg season runoff is reduce somehow received south and south eastern basins and flow of river is moderate and good with most belg . While during in some years Belg may give rain for some catchments which contribute for availability of water. The Performance of 2026 was sub humid to wet condition over most belg benefiting catchments, however dams and reservoirs current water level in comparison to long mean shown better condition. Shown below in figure (4a-g).





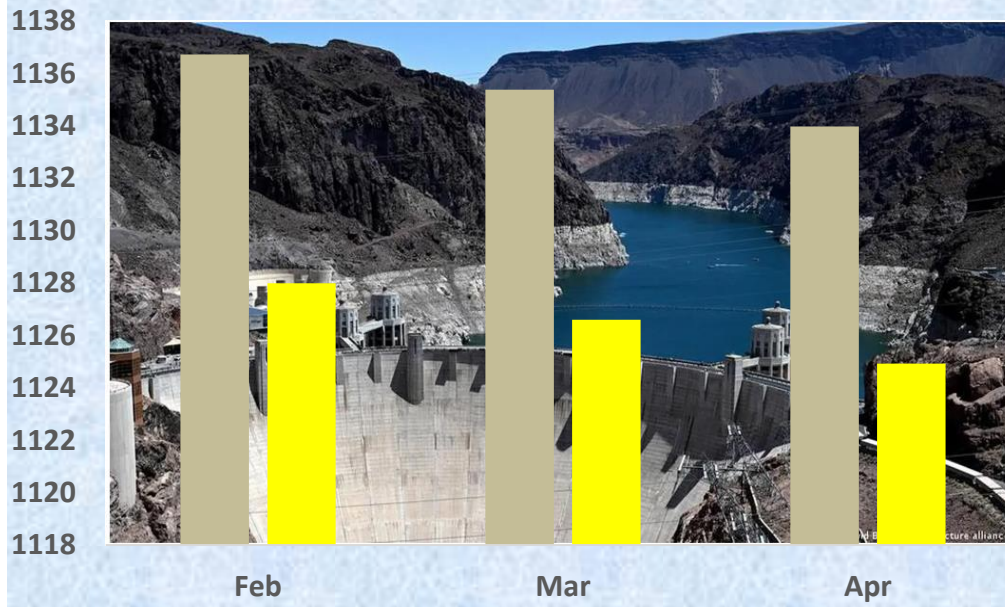
Tana Beles (Tis Abay)HPP

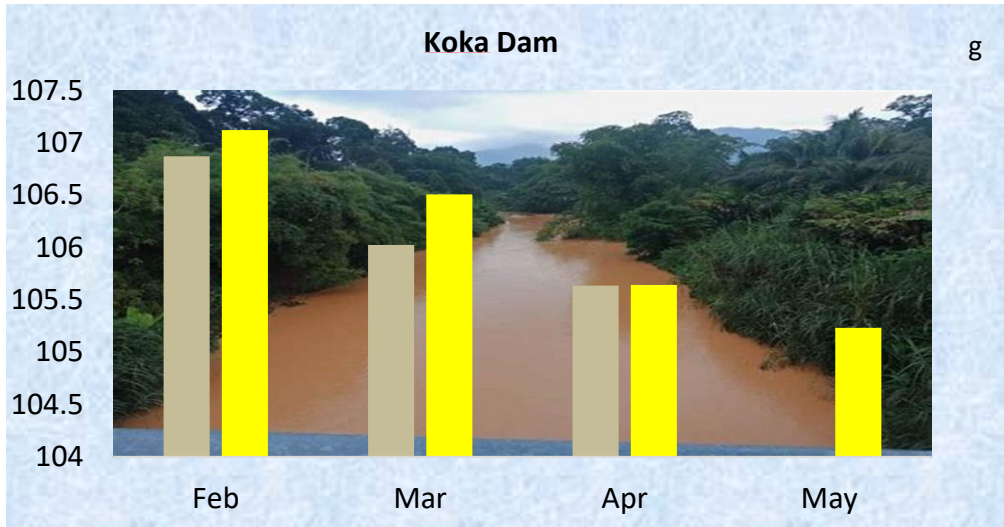
e



Tekeza

f





(Fig.4a-f) Water level of different dams.

4. Summary

In February most part of river basins especially over lower and southern Abay, most part of BaroAkobo, Omogibe, Rift Valley, Genale Dawa, Wabi shebele, lower divide area of Tekeze, lower marginal Ogaden have experienced humid to wet moisture condition. This condition has positive impact for water availability over Belg Benefiting catchments. Moisture status of March and April was best for the seasons. Most part of Baro Akobo, Rift valley, Omo Gibe, Genale Dawa and upper and southern part of Abay had Humid to wet condition. In March up to 1-6 days heavy fall was recorded over Abay, Baro-Akobo, Omo-Gibe Rift-Valley, Awash and Genale- Dawa Catchments. Maximum frequency of heavy fall days were observed over Abay catchment for 6 days. In April and May heavy fall observed over Baro Akobo, Omo gibe, rift valley, and Genale Dawa, upper and middle Awash etc. basin. Generally current last season 2026 belg was best season according to water harvesting for dam and other water harvesting activities.

Conclusion

- The moisture performances of belg was dominated under humid and wet ~~and~~ over most river basin.
- Better moisture performance was observed in March and April over middle catchments of southern, south west, south eastern, Central and western catchments of the country.
- Reservoirs and dams water level performance have shown better status in comparison to the mean.

Hydro-meteorological outlook for Kiremt over different riverbasins

1. Introduction

Kiremt rainfall is the dominant source of surface water and annual runoff generation in Ethiopia, accounting for the largest contribution to river flows, reservoir inflows, and groundwater recharge across most river basins. During a normal to above-normal Kiremt season (June–September), substantial rainfall over the Abay, Baro-Akobo, Tekeze, Omo-Gibe, Central Rift Valley, and parts of the Wabi Shebelle and Genale-Dawa basins significantly enhances water availability for hydropower production, irrigation development, domestic water supply, livestock watering, and environmental sustainability. The season plays a crucial role in replenishing major reservoirs, lakes, wetlands, and groundwater systems that support socioeconomic activities throughout the year.

The expected Kiremt rainfall is likely to generate favorable runoff conditions and improve water storage in major catchments, thereby strengthening water resource availability during the subsequent dry periods. Enhanced soil moisture and groundwater recharge associated with the season are also expected to support agricultural production and sustain stream flow in both perennial and seasonal rivers. However, areas receiving persistent heavy rainfall may experience localized flooding, waterlogging, increased soil erosion, and sedimentation in rivers and reservoirs. Therefore, while the anticipated Kiremt rainfall is generally expected to have a positive impact on national water resources, continuous monitoring of rainfall distribution, river flow conditions, reservoir levels, and flood-prone areas remains essential for effective water resources management and disaster risk reduction.

2. Selected analogue Year

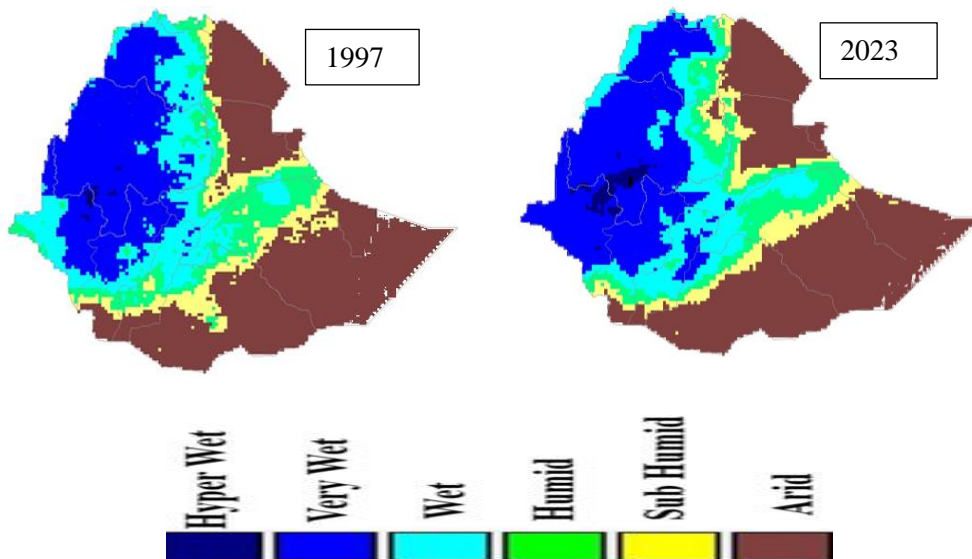
For the coming kiremt season the selected analogue year **1997, 2023**. Were compared based on probabilistic seasonal forecast for **kiremt 1997** and viewed out on catchments based map using geostatistical kriging method. Among those **1997** is the best analogue year that can enlighten the Aridity status in the coming kiremt season.

3. Methodology

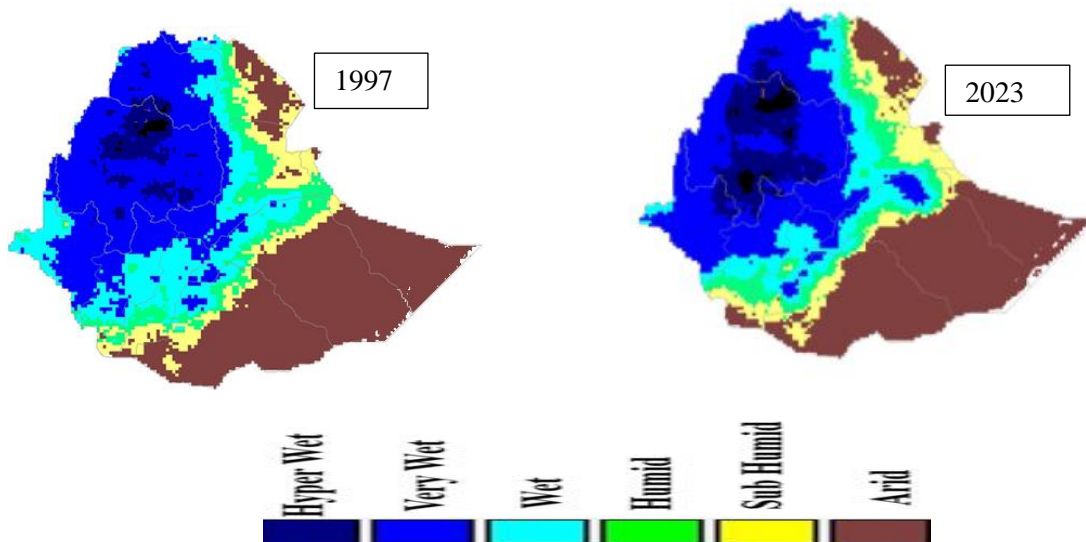
Thornthwaite introduced the concept of the precipitation effectiveness index, which is computed from the monthly values of rainfall and evaporation. The evaporation is computed empirically from mean monthly air temperature. In assessing the effectiveness of rainfall, in terms of water availability relationships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

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

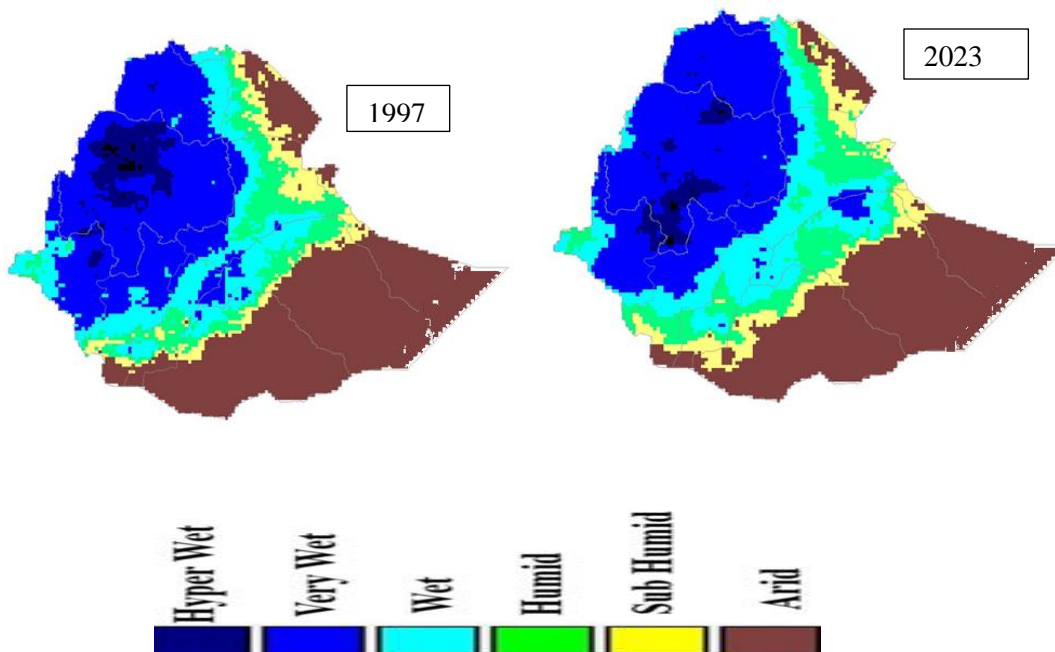
June: - Based on the two analogue years, kiremt moisture benefiting catchments start getting some amount of moisture over central, western, and northern river basins. Most of Abay, Tekeze, Omo gibe Baro Akobo, Mereb gash basis were humid to very wet moisture conditions. The rest most of Ogaden, afar Denakil, middle and lower wabi sheble, Genale Dawa, lower awash, Rift valley ,Upper pocket parts of Wabi shebele, Genale Dawa, catchments have performed Arid humid moisture condition both selected Analogue year.



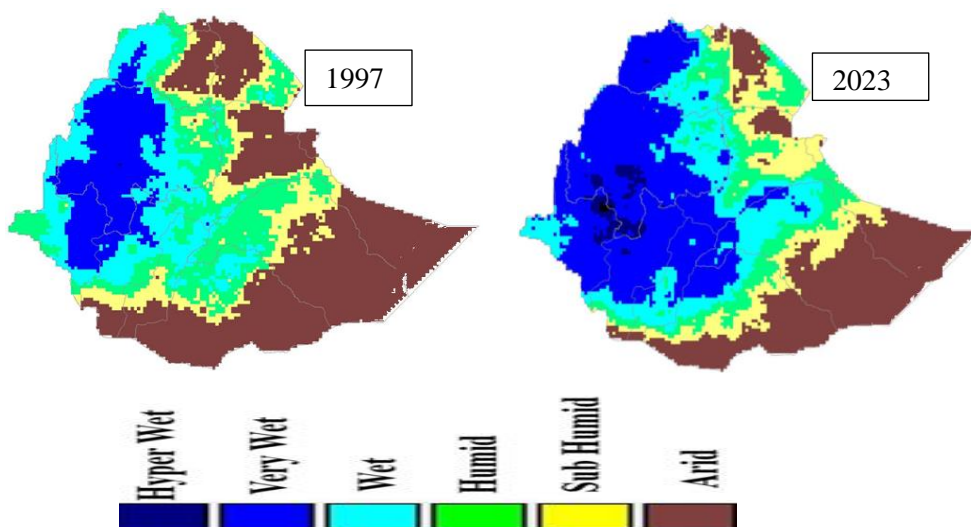
July:- In this month, there would be starting spatial distribution of kiremt moisture benefiting catchments. According to this, except analogue year 1997, the 2023 year showed domination of sub humid to wet moisture condition over most part of Abay, Omo-Gibe, Tekeze, Awash, Abay and upper and middle Rift valley, upper Genale Dawa, Wabi shebele, catchments. And the most of rest Ogaden, middle and lower wabi sheble, Genale Dawa, lower rift valley and afar Denakil basis were under Arid condition.



August:- In this month Better moisture distribution performed across Kiremt benefiting catchments of both selected analogue years. In line with this: most BaroAkobo, Abay, Tekeze, Awash, Omo Gibe, Rift valley, catchments were performed under wet to very wet moisture condition, And the most of rest Ogaden, middle and lower wabi sheble, Genale Dawa, lower rift valley and afar Denakil basis were under Arid condition.



September: - In September 1997, Hydrometeorological conditions across major Ethiopian basins such as the Abay, Baro-Akobo, Tekeze, Omo-Gibe, and parts of the Rift Valley basins were generally wet to very wet, supporting sustained surface water availability, strong runoff, and low aridity conditions. In contrast, September 2023 showed a stronger spatial contrast, with very wet to hyper-wet conditions in the Baro-Akobo and Omo-Gibe basins, while the Wabi Shebelle and Genale-Dawa basins experienced relatively arid to moderately dry conditions, and the Abay and Tekeze basins showed mixed near-normal to wet conditions. Overall, 1997 was more uniformly wet across basins, whereas 2023 exhibited a clear arid-to-hyper-wet, shown below figure.

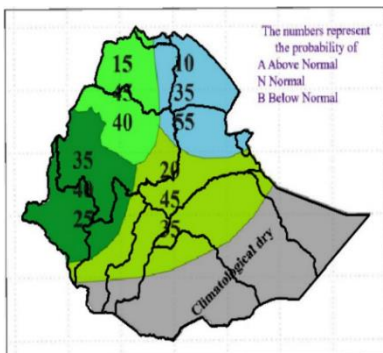


Hydro-Meteorological Summary and advisory for coming Kiremt (JJAS), 2026

Advisory

- ❖ The Kiremt season is expected to show near-normal to slightly variable rainfall conditions across most river basins.
- ❖ Moderate moisture conditions will support soil moisture, runoff generation, and water resource replenishment.
- ❖ Impacts on agriculture and water availability are generally expected to be balanced.
- ❖ Localized flooding or waterlogging may still occur in some vulnerable areas.
- ❖ Continuous monitoring of rainfall and river conditions remains necessary for effective management.

Across the Kiremt rainfall-benefiting catchments, particularly the northeastern, central, southern highlands, and parts of the eastern catchments, moisture conditions are expected to range from sub-humid to humid. These conditions are likely to enhance soil moisture, support runoff generation, and improve water availability across the major river



Negative Impacts

- ❖ Heavy Kiremt rainfall may induce flash and riverine flooding in vulnerable basins.
- ❖ High rainfall intensity increases surface runoff and accelerates soil erosion.
- ❖ Elevated sediment transport can reduce river conveyance and reservoir storage capacity.
- ❖ Waterlogging conditions may develop in poorly drained agricultural areas.

Positive Impacts (Kiremt Season)

- ✚ Across Kiremt rainfall-benefiting catchments (northeastern, central, southern highlands, and parts of eastern catchments), moisture conditions are expected to range from sub-humid to humid.
- ✚ These conditions enhance soil moisture availability across major agricultural zones.
- ✚ They support increased surface runoff generation in major river basins.
- ✚ They improve water availability for domestic, agricultural, and ecosystem uses.

ADVISORY:-

- ✓ Monitor updates on rainfall forecasts and river level conditions regularly.
- ✓ Take precautionary measures in flood-prone and low-lying areas.
- ✓ Strengthen drainage systems to reduce waterlogging impacts in urban and agricultural fields.
- ✓ Avoid settlement or activities near riverbanks during periods of heavy rainfall.
- ✓ Ensure early preparedness for potential flash and riverine flooding in vulnerable basins.
- ✓ Support continuous communication between local authorities and communities for timely warnings and other Medias.

Summary

The Kiremt season is expected to exhibit near-normal to slightly variable rainfall conditions across most river basins, leading to generally moderate Hydro meteorological moisture availability. These conditions will support soil moisture recharge, surface runoff generation, river flow maintenance, and partial groundwater replenishment, thereby benefiting agricultural production, water supply systems, and ecosystem functions. Overall hydro meteorological conditions are likely to remain balanced, with no strong dominance of either excess rainfall or drought conditions at the seasonal scale. However, due to the inherent spatial and temporal variability of Kiremt rainfall, localized hydro meteorological hazards such as flash floods, riverine flooding, and waterlogging may still occur in vulnerable catchments and low-lying areas. Therefore, continuous monitoring of rainfall patterns, river discharge, and flood-prone zones remains essential for effective early warning and seasonal water resources management.