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THE IMPACT OF CLIMATE CHANGE ON THE AVAILABILITY OF IRRIGATION WATER AT THE RIFT-VALLEY LAKES BASIN IN SOUTHERN ETHIOPIA: A REVIEW

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Abstract: Agriculture is one of the foremost climate-responsive businesses, with open-air production systems sensitive to temperature and rainfall. This paper reviews recent literature and assesses the impact of climate change on the accessibility of water resources for irrigation. The paper critically reviews recent research findings on climate change effect on the potential of surface water and groundwater for irrigation in Ethiopia's south rift valley (Abaya-Chamo) Sub-basin. Surface water in the south rift valley Ethiopia sub-basin, including the Abaya and Chamo lakes, is estimated to be just over 5,718 million m^3yr^{-1}. Finally, the implications for future study and development are emphasized. The effect of climate change (rainfall and temperature) on the water in the Abaya-Chamo lakes feeder Rivers is different for the near future (2021–2050) and extreme future (2071–2100) time using the RCP 8.5 scenario. Overall, findings show that the availability of water resources for irrigation purposes in the south rift valley Ethiopia sub-basin will be more vulnerable to changes in rainfall and temperature. In conclusion, Stream flow future projection (%) for each feeder river Bilate, Kulfo, Gidabo, and Hare are -9.07, -11.24, 3.89, 4.135, − 0.95, − 1.5, 13.4, and 15.4% respectively

Keywords: Abaya-Chamo, Climate change, Lake, River, Water Resource, irrigation

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1.0 Introduction

Agriculture is one of the foremost climate-sensitive businesses, with open-air production systems that are amazingly delicate to temperature and rainfall. Climate change significantly affects crop yield by bringing down crop water use due to expanded evapotranspiration and changing precipitation patterns.

The influence of Climate change on water supplies is a hot point of investigation worldwide (Repel et al., 2007). Expanded warmth and decreased stream flow during the crop flowering season have a critical effect on crop yield. Expanding temperature may decrease the rural developing season and increment the number of water system days required.

Food uncertainty has resulted from climate inconstancy, especially precipitation changeability and going with dry seasons in Ethiopia (Rosell, 2011). As a result, irrigated farming is a critical technique for accomplishing food security by expanding rural generation, forcing cropping designs (number of crops per year), and utilising accessible irrigation water.

According to Tudorancea, and Taylor (2002), among twelve Ethiopian river basins Rift Valley basin is one of the basins with a chain of permanent lakes and tributary streams. According to the creator Wondwosen et al., (2015), the Ethiopian Rift Valley has interconnected lakes, tributary rivers, and groundwater. Abaya-chamo catchment is one of the rift valley basins called southern Rift Valley. It is found in southern Ethiopia.

The effect of climate change on stream flow and river accessibility for crop yield within the catchment of Abaya-chamo (Ethiopian Southern Rift Valley) was examined for its significance in expanding irrigation agricultural production yields within the area.

This paper aims to bring together information on the joins between climate change and the availability of water resources for irrigation within the southern Ethiopian Rift Valley basin based on academic literature.

2.0 Water on the surface of Abaya – Chamo sub-basin

According to Ayele et al., 2019 Southern Ethiopian Rift Valley catchment is a portion of the rift valley basin in Ethiopia, which is found within southern Ethiopia. Its' latitude ranges from 5°51.5'N to 8°8'N, and its longitude ranges from 37°16.3'E to 38°39.3'E, with an elevation run of 4200 m to 1108 m.

The yearly total precipitation ranges of the Ethiopian Southern Rift Valley sub-catchment is from 400mm-2300 mm. The Southern Ethiopian Rift Valley sub-basins water resources are divided into Chamo and Abaya lakes and their feeder streams. Southern Ethiopian Rift Valley lakes' total surface water resource is 5,718 million m^3yr^{-1}. This can be assessed utilizing the river's average flow into a system of lake

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underneath "current" situations, counting agriculture and household water sources. (Mulugeta and colleagues, 2015; MoWE, 2012; Ermias Mekonnen, 2019).

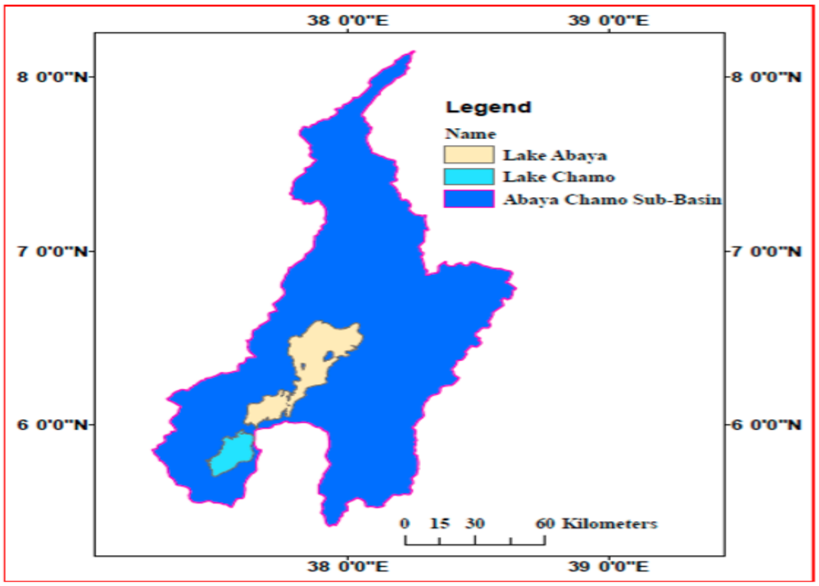

Figure 1. Southern Ethiopian Rift Valley Sub-Basin. (Source: (Ayele et al., 2019)

surface water of Southern Ethiopian Rift Valley sub-basin a tributary streams is additionally evaluated as the Min. stream flow discharge 3.5, 1.5, 2.9, 1.7, 1.8, and 0.85m^3s^{-1} and Max. Stream flow discharge 8.5, 3.9, 43.9, 9.1, 14, and 6.2 m^3s^{-1} Kulfo, Rabbit, Bilate, Gidabo, Gelena, and Kola separately (MoWR, 2008).

3.0 Climate Change on Southern Ethiopian Rift Valley Sub-basin water

Southern Ethiopian Rift Valley is generally composed of the two lakes and several rivers and streams that flow into them. Ethiopian precipitation within the Southern Ethiopian Rift Valley sub-basin described is lower average in most of the region, which is shown by direct to serious Dry spells periods. Dry spells happened nine times between 1988 and 2015, resulting in failure and serious food uncertainty. The precipitation data was measurably downscaled utilizing the NCEP-NCAR, and CanESM2 demonstrated predictions.

The extents of month-to-month measured and downscaled precipitation were exceptionally comparable. According to Beyene et al., (2021), the RCP2.6, RCP4.5, and RCP8.5 forthcoming scenarios were calculated to survey future dry spell designs. For a long time 2030; 2050; and 2080; the average yearly rainfall situation dropped by 0.2-13.7%; 0.5-6.4%; and 0.1-1.3% for the time of 2030; 2050; and 2080 individually.

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3.1 Climate Swap on Chamo lake water availability

Chamo-lake is a portion of the most Ethiopian Southern Rift Valley category, which has 1108 m elevation.

Table1. Lake Chamo water by volume

Name	Area (km^2)	Maxi. Depth (m)	mean Depth (m)	Total Water Resource (Mm^3 per year)
Chamo	18,575	551	14.2 6	506

Source: Mulugeta et al., 2015; MoWE, 2012; and Ermias Mekonnen , 2019

According to Elias Gebeyehu (2017), the predicted stream flow within the 2030s and 2090s utilizing the RCM A1B scenario shows a decrease in runoff within the watersheds, specifically related to a diminish in rainfall and an increment in potential evapo-transpiration. Within the 2030s and 2090s, the mean yearly inflow is down 16.3% and 42.8%, individually, compared to the base period. In this scenario, evaporation over the lake is upgraded by 0.73 and 2.6 per cent within the 2030s and 2090s separately. Ungagged streams account for 32.1% of Lake Chamo's input, whereas gaged streams account for 67.9%.

Table 2. Lake Chamo water balance components and their value due to climate change ($mmyr^{-1}$).

component of water-balance	1996 to 2004	2030	2090
Areal rainfall of Lake	897.0	869.0	808.0
inflow River (Gauged)	161.0	153.0	98.0
river inflow (Ungauged)	96.0	62.0	49.0
evaporation from Lake	1217.0	1226.0	1249.0
outflow from Lake	Zero	zero	Zero

Source: Elias Gebeyehu , (2017)

3.2 Climate Variation influence on Lake Abaya water resource

Lake Abaya incorporates a surface estimate of 1160km^2 and is found at an elevation of 1268 meters. Bilate Stream, which joins from the north and other streams from the south-east and South-west Mountains, nourishes the lake. The streams recharge to the Abaya Lake is 383,119,189 and 60 million cm for Bilate, Gelana, Gidabo and Hare, separately.

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Table 3. Lake Abaya Water Resources

Name	Area (km^2)	Maxi. Depth (m)	Mean Depth (m)	Total Water Resource (Mm^3yr^{-1})
Abaya	1,162	24.5	7.1	2512

Source: Mulugeta et al., 2015; MoWE, 2012; and Ermias Mekonnen , 2019

4.0 Climate Change on Abaya-Chamo catchment Rivers water resource

4.1 Climate Change on Bilate River Water resource

According to Hailu et al. (2021), using RCP.4.5 and RCP.8.5 scenarios, climate change in 2021-2050 and 2051-2080 time was estimated by utilizing, and gathering means regional climate models as appeared in Table 4.

Table 4. climate change scenarios on (2021-2050) and (2051 -2080)

Scenario	Period	PET (%)	ET (%)	SUR_Q (%)	GW_Q (%)	WYLD (%)	Rainfall (%)	Mean temp. (°C)
RCP4.5	2021–2050	12	13.6	−7.15	8.22	−7.96	−27.11	0.7
	2051–2080	15	14	−10.25	−11.11	−9.22	−15.39	1.3
RCP8.5	2021–2050	14	14.7	−9.07	−10.46	−8.52	16.79	1.0
	2051–2080	19	13.9	−11.24	−12.54	−11.53	−46.26	2.0

According to Behailu et al. (2018) influence of climate changes on surface water was studied in Bilate catchment within the Ethiopian Southern Rift Valley watershed in Ethiopia. Using RCP.2.6 and RCP.8.5 model scenarios, the yield uncovers that annually stream decreases of up to 12.1 and 16.21% are possible. In any case, real abuse of these resources within the basin is very low, with domestic, animal, and minor agricultural operations accounting for 51.49 MCM (9.03%). Four scenarios were made in the basin up to 2035, each based on a particular set of assumptions. For the reference, in scenarios one, two, and three, total annual utilization is expected to be around 14.53, 20.43, 37.47, and 44.46%, respectively.

Table 5. Average yearly rainfall change of Bilate River up to 2035s

Hydrological parameter	Values' Simulated (mm)		Weighted average	% Rainfall
	Calibration	validation		
Evapotranspiration	772.50	769.60	7712.0	77.30

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Total AQ recharge	123.70	116.50	120.20	12.0
Percolation	123.20	117.10	120.10	12.0
Shallow AQ recharges	105.20		102.90	10.30
Total water yield	93.80		101.40	10.10
Surface runoff	54.70	70.70	62.70	6.20
Base flow	40.0	40.0	40.0	4.0
Deep AQ recharges	6.20	5.50	6.0	0.60
Transmission losses	0.90	0.90	0.90	0.160
Groundwater evap.	1.50	0.70	0.710	0.070

AQ = Available discharge

According to Yoseph ArbaOrke and Ming-Hsu Li (2022), the Bilate Stream is the central water source for the encompassing populations' household and agriculture purposes. As a result, unpredictable precipitation and water shortage could critically affect agricultural productivity throughout crop developing seasons. Climate estimates in the future close 2021-2050 and distant future 2071-2100 duration were produced from Coordinated Regional Downscaling Try (CORDEX) Africa under two RCP,4.5, and RCP,8.5. With CORDEX-Africa data, the SWAT model was utilised to assess watershed hydrology changes.

To determine the characteristics of meteorological, hydrological, and agricultural dry spells, Standardized Precipitation Record (SPI), Stream flow Dry drought Record (SDI), and Observation Dry season File (RDI) were calculated. By the conclusion of the twenty-first century, evapotranspiration will have expanded up to 16.8% due to a huge rise in temperature. The yearly average precipitation is anticipated to decrease by 38.3% within the distant future time under RCP.8.5 model scenario, coming about in a 37.5% diminishment in stream flow. Diminished diurnal temperature run projections may advance crop development, but they may show expanded warm stress. The yearly mean stream flow within the Bilate watersheds declined by 3.64 $mmyr^{-1}$.

According to Getahun et al., a collaborative and combined of 20 Model Inter evaluation Forecast Stage5 (CMIP5), and common models circulation (GCMs) were utilized to produce 24 future climatic scenarios for the watershed in 2021, utilizing two figurative strength pathways and 6 GCM structure. The simulation of stream flow within the catchment and the soil and water assessment tool (SWAT) software were selected. Table 6. Show that the impact of climate varies on river flow in 2080.

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Table 6. Climate change scenarios in the 2080s.

Parameter	Description	Process of model	range of Variation	Fitted value	Rank
CN2	SCS runoff curve number for moisture condition II	Runofl	-25 to +25		1
ESC0	Soil evaporator compensation factor	Evaporation	0 to 1	1*	2
Sd Awe	Availed soil water capacity	Soil water	-25 to +25	15a	3
Gwqmn	The threshold water level in the shallow aquifer for return flow to occur (mm)	Groundwater	0 to 1000	258*	4
Ch K2	Effective hydraulic conductivity in main channel alluvium (mm h 1)	Channel low	0 to 150	31a	5
Alpha Bf	Base how the recession is constant (days)	Groundwater	0 to 1	0.09	6
Ch N2	Manning's roughness coefficient for the main channel	Channel flow	0 to 1	0.43"	7
Surlag	Surface runoff Iag coefficient	Runoff	0 to 12	9.64•	8
Gw Delay	Groundwater delay t me	Groundwater	0 to 10	6.45a	9
Rchrge Dp	Aquifer percolation coefficient	Ground-water	0-1	0.49a	

a=default values (absolute change); b= default values multiplied by one (relative change); c=defauk values are increased by this value (absolute change).

4.2 Climate Change on Kulfo River Water resource

According to Nega *et al*.,(2018), evaluating the potential effect of climate change action on river water resources is basic for future water resource plans and management. The future scenario for 2050 and 2080 river flow size within Kulfo watershed was explored utilizing a hypothetical climate vary scenario based on the Climate change of intergovernmental panel on (IPCC) fifth evaluation report predict the effect of climate variation on River flow.

The capacity affect of climate change on river flow was evaluated takes after: expanding temperature by 0.5°C from 2.5-3°C and 4.5-5°C, the average yearly flow on stream of the Kulfo River is anticipated within the 2050 to increase by 2.86% and 2080 by 2.99%; whereas from -10 to -20% by 10% drop rainwater come about in a stream diminishment by four per cent. The discharge of the Kulfo River has been observed to extend as precipitation increments and diminish when temperature increments within the twenty-first century. In general, the findings imply that the flow of streams within the Kulfo catchment will be more sensitive to precipitation changes than temperature changes.

4.3 Climate Change on Hare River Water resource

According to Biniyam Yisehak Menna (2017), downscaled climatic data (RCP.4.5 and RCP.8.5 scenarios) were utilized for the future period assessment. For RCP4.5 scenario, precipitation is anticipated to extend by 6.40, 2.56, and 16.30 per cent on a month-to-month premise within 2020, 2050, and 2080, respectively.

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RCP8.5 scenario repeated the average yearly increment with 8.56, 8.08, and 15.85% within 2020, 2050, and 2080, respectively. The maxi. and min. Temperature projections for both RCP scenarios are predicted to rise with time. The month-to-month mean percentage changes in climate factors from the baseline period were utilized to model future stream flow estimates,. For RCP.4.5 scenario, the month-to-month mean stream flow is expected to extend by 12.2%, 8.0%, and 13.9%n from the standard period within 2020, 2050, and 2080, respectively, while for the RCP.8.5 scenario, it is projected to extend by 7.3, 13.4, and 15.4% within 2020, 2040, and 2080, respectively. Only future climate change conceivable outcomes were examined within the model runs, with all spatial data held constant.

Biniyam Y. and Abdella K. (2017) utilized bias-balanced RCPs climate data to assess the effects of climate variation on precipitation and flood rate within the Hare catchment. Future precipitation size changes in Peak flow amplitude and frequency are clearly governed Within the 2080s.

Table 7: Climate change effect on Rainfall and flood sizes at 2020, 2050 and 2080 periods.

period of Return		a. flood magnitude Change (%)					
		2	5	10	25	50	100
Period	2020	-3.58	-13 08	-20.94	-25.12	-29.63	-32.84
	2050	10.94	24	19.26	24.66	19.35	16.28
	2080	18.63	22.14	14.44	17.76	12.41	9.72

period of Return		b. Rainfall magnitude Change (%)					
		Two	Five	Ten	Twenty five	Fifty	One Hundred
Period	2020	-7.340	-16.750	-22.830	-30 010	-34.860	-39.340
	2050	9.960	13.90	14.20	12.970	11.450	9.480
	2080	27.150	25.840	22.450	16.810	12.210	7.460

4.4 Climate Change on Gidabo River Water resource

According to Beyene et al. (2021), the study determines the potential implications of climate swap on a hydro-climate pattern of variables at little sizes within the catchment of Gidabo. The MK drift of min. and max. temperature, as well as potential evapotranspiration (PET), appears that they are all growing, while precipitation (RF)

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and stream flow are both diminishing irrelevantly additionally , the deviation to reference period of RF negative(58.7, 34.5, and 62.2percent); Temperature(T°) positive(1.15, 2.2and 4.2percent); PET positive(55.5, 73 and 99.9percent); and stream flow negative(2.63, 2.17 and 3.63percent) in Meso river; negative(0.27, 0.20 and 0.40percent) in Kolla river; positive (0.40, 0.13 and 0.53percent) in Apusto river; and negative (0.13, 0.10 and 0.03percent) in Bedessa river beneath RCP.2.6, RCP.4.5 and RCP.8.5 respectively. Hence, diminish in seasonal rainfall and the rise in To result in expanded potential evapotranspiration, which essentially impacts stream flow.

Table 8. climate change effect on future RF, PET, and temperature.

Period		Rainfall			Tmin.			Tmax			PET		
		2020	2050	2080	2020	2050	2080	202 0	205 0	20 80	2020	2050	2080
RC P 2.6	Annual	-29.2	- 5.7	-82.1	1.1	0.9	1.3	0.9	0.9	] .4	40.6	62.6	48.5
	Spring	-0.7	4	-10.5	1	1.1	1.2	1	0.9	1.3	15.4	19.2	16.5
	Winter	-77.5	*40.8*	-97.7	1.1	0.9	1.4	1.2	1	1.6	17. 4	20.5	14.2
	Summer	11.9	-7.6	-44.7	1.1	1	1.4	1	1	1.5	7. 4	16.6	12
	Autumn	4b.2	38.6	30.8	1	0.9	1 .2	0.5	0.7	1.1	0.7	6.6	5.7
RC P 4.5	Annual	-91	- 64.7	-86.3	1.4	1.9	2.8	1.3	1.8	2.5	41.4	83.4	94.5
	Spring	0	7.1	-3.4	1. 3	1.9	2.9	1 .4	1 .8	2.6	11.4	21.1	23.4
	Winter	-82.7	-88.3	- 76.7	1 .4	2	2.8	1.5	2.1	2.9	13.7	26.7	30.6
	Summer	-30..8	-20.3	-4 3.7	1.5	1.9	2.7	1.5	2	2.8	10.5	21.4	24.1
	Autumn	22. 5	56.9	67.1	1.4	1.8	2.8	0.9	1.5	2	5.76	14.2	16.4
RC P 8.5	Annual	-56	- 33.1	-13.1	1.2	2.3	4. 1	1.1	2. 1	4.9	65.7	110	124.7
	Spring	-5.8	0.7	4.9	1. 4	2.3	4. 1	1.3	2	4.4	16.3	28.7	47.2
	Winter	35.3	-64.2	- 103. 3	1.2	2.3	4	1.1	2.4	4.3	21.3	37.9	57.2
	Summer	40.9	21.9	-53.8	1.2	2.2	3.9	1.2	2.2	4. 1	17.4	30.4	55
	Autumn	14.5	53.7	79	1.1	2.2	3.6	0.8	1.8	3.6	10.8	19	35.3

Amba Shalishe Shanka (2017) talks about the impressions of climate swap on runoff within the Gidabo River watershed. Daily rainfall and temperature within the river basin were downscaled utilizing the Statistical Downscaling Model version 5.1. To depict future climate change, HadCM.3 Ocean coupled atmosphere model output for

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A.2a and B.2a scenarios determined. Climate swap scenarios for rainfall and To were developed for three future times: 2030, 2050, and 2080.

For both the A.2a and B.2a model scenarios, climate change action impact may result in increments in average monthly runoff within 2020, 2050, and 2080. The total average yearly runoff within the Gidabo stream basin is expected to extend by 3.4, 2.9, and 6.8percent within 2020, 2050, and 2080 respectively.

4.5 Climate Change on Gelana River Water resource

According to MoWR (2008), The Gelana Stream flows from the eastern to feed the Abaya Lak. The average yearly min., and max. Discharge is 0.5 and 12.5 $m^3s^{-1,}$ respectively.

5.0 Climate Change on Abaya –Chamo Sub-Basin Groundwater resource

According to Daniel et al. (2022), groundwater resource availability within the Southern Ethiopian Rift Valley Basin has been underweighted due to ongoing financial exercises and climatic change. Abaya–Chamo lakes basin's steady-state groundwater flow modelling. Moreover, the through-flow system in terms of groundwater flow direction and gradient, with groundwater flow from the high level toward the floor into the lakes from different directions with a high slope as shown in table 9.

Table 9. Water balance of Abaya Lake from ground water

Term of Flow	In	out	In- out
Storage	0.0E+00	0.0E+0	0.0E+0
Constant Head	1.970E+04	4.420E+06	- 4.40E+06
Horizontal Exchange	1.150E+06	1.170E+04	1.140E+06
Lower Exchange	3.270E+06	9.040E+03	3.260E+ 06
Recharge	3.770E+02	0.0E+00	3.770E+02
Saturation of the layer	4.440E+0	4.440E+00	1.0E+00
Discrepancy (%)	0		

Table10. Water balance of chamo Lake from ground water

Term of Flow	In	out	In-out
Storage	0.0E+0	0.0E + 0	0.0E+0
Constant Head	0.0E+0	5.710E + 05	- 5.710E+0
Horizontal Exchange	8.60E+04	4.750E + 0l	8.550E+04

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Lower Exchange	4.850E+05	0.0E + 0	4.850E+05
Recharge	8.710E+01	0.0E + 00	8.710E+0l
Sum of the layer	5.710E+05	5.710E + 05	0.0E+00
Discrepancy (%)	0		

6.0 CONCLUSION

There are several rivers and two lakes of various sizes in the Southern Ethiopian Rift Valley Basin. Though much of the blame may be attributed to rising demand, climate effect and variability will be found to place significant strain on Southern Ethiopian Rift Valley irrigation water.

Climate change has the potential to negatively affect water supply, stability, access, utilization, and demand in the Abaya chamo rift valley sub-basin. According to recent studies, the basin is extremely susceptible to variations in precipitation and temperature. As a result, river flows and runoff to lakes, as well as groundwater and lake water levels, are anticipated to fall in future and will be inadequate to meet the water demand of the country's population growth.

Climate change impacts agricultural land used for irrigation, making the design, operation, and management of water-use systems more difficult. As a result, livelihoods may be disrupted, poverty and marginalization of the poor may increase, and inequality may expand. Climate change is increasingly linked to many concerns and difficulties surrounding water resources. Climate risk is too costly to be tolerated, given the economic importance of water supplies, and immediate efforts to minimize the effects must be made using practical solutions.

The Abaya-chamo Sub-basin feeder Rivers have a maximum annual discharge of 3.5 m^3s^{-1} from the Kulfo River and a minimum annual discharge of 0.85 m^3s^{-1} from the Kola of flow water, as shown in table 11. The Bilate river has a maximum annual flow of 43.9 m^3s^{-1}, whereas the Hare river has a minimum annual flow of 3.9 m^3s^{-1}. Except for the Bilate and Kulfo rivers, most rivers have flow rates of less than 2m^3s^{-1} dry season period. During the dry season period, the flow rate of these rivers likewise diminishes. As a result, as indicated in table 8, this review seeks to the study influence of climate effect on river and lake water supply.

Table 11. Abaya-chamo Sub-basin Rivers discharge

Rivers	Kulfo	Hare	Bilate	Gidabo	Gelena	Kola
Min.discharge (m^3s^{-1})	3.5	1.5	2.9	1.7	1.8	0.85
Max.discharge (m^3s^{-1})	8.5	3.9	43.9	9.1	14	6.2

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The considering of different base the climate effect on the annual water balance in Abaya-chamo lakes Feeder Rivers for future 2021–2050 and future 2071–2100 periods using RCP 8.5 scenario is tabulated below table 12.

Table 12. Climate change on the annual water balance

Rivers	years	Tmax future projection (%)	Tavg future projection (%)	Tmin future projection (%)	RF future projection (%)	PET Future projection (%)	Streamflow future projection (%)
Bilate	2050s	-	1	-	16.79	14	-9.07
	2080s	-	2	-	-46.26	19	-11.24
Kulfo	2050s	2.5	3.5	4.5	-10	-	3.89
	2080s	3	4	5	-20	-	4.135
Gidabo	2050s	2.1	-	2.3	-33.1	110	− 0.95
	2080s	4.9	-	4.1	-13.1	124.7	− 1.5
Hare	2050s	0.03ºc	-	0.15ºc	8.08	-	13.4
	2080s	0.11ºc	-	0.13ºc	15.85	-	15.4
Gelana	2050s	-	-	-	-	-	-
	2080s	-	-	-	-	-	-

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7.0 RECOMMENDATIONS

In this study, climate change's effect on groundwater and the availability of some river bodies for irrigation like Gelana has been investigated. Future works can consider the effect of climate change on water resources for industrial & domestic purposes. Furthermore, the effect of climate change on lakes, feeder rivers and other water use projects in the future (2021–2050) and (2071–2100) needs to be studied.

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