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THE OUTLOOK FOR DECEMBER 2023 AND THE WEATHER REVIEW FOR NOVEMBER 2023

1. HIGHLIGHTS

1.1. The Outlook for December 2023

The outlook for December 2023 indicates that most parts of the country are likely to experience above-average (generally enhanced) rainfall except over Northwestern parts of the country where near average rainfall is expected. During the first half of the month, generally sunny and dry conditions are likely to prevail over the northeast and northwest parts of the country, while the southern regions are likely to receive occasional rainfall throughout the month. The rainfall distribution, both in time and space, is expected to be generally good over the Southern sector of the country. Episodes of heavy rainfall are likely to continue being experienced over several parts of the country during the period. This coupled with the already saturated grounds is likely to continue causing occasional floods and landslides in affected parts of the country. The above average rainfall will be driven by the current El Nino conditions which are expected to continue into early 2024 and a positive Indian Ocean Dipole which is expected to remain positive till January 2024. The October-November-December (OND) 2023 seasonal rainfall is likely to extend into January 2024 over most parts of the country except over Northwestern Kenya where cessation is expected during the fourth week of December.

1.2. The Outlook for The Next Three Months (December- January-February)

The outlook for the next three months indicates that most parts of the country are likely to experience above-average (enhanced) rainfall. December is likely to be wet over most parts of the country while in January, rainfall is expected during the first half of the month with some areas over the eastern sector also expected to receive rainfall towards the end of January. February is likely to be dry over most areas but a few days may experience rain. The above average rainfall will be driven by the current El Nino conditions which are expected to continue into early 2024 and a positive Indian Ocean Dipole which is expected to remain positive till January 2024.

Temperatures are expected to be warmer than usual over several parts of the country except over some parts of Northeastern, Southeastern lowlands (Kitui) and Coastal region (Tana River).

1.3. The Weather Review for November 2023

The month of November marked the peak of the seasonal rainfall. Several parts of the country experienced very heavy rainfall during the month of November 2023. These severe storms led to floods and landslides especially in Central, Coast, South Eastern, Northwestern, Western and North Eastern Kenya. Most meteorological stations across the country recorded monthly rainfall totals that exceeded their November monthly Long-Term Means (LTMs). Mombasa meteorological station recorded 508% of its November LTM.

2. The Weather Outlook for December 2023

This climate outlook for December 2023 is mainly based on the prevailing and expected Sea Surface Temperature Anomalies (SSTAs) over the Pacific, Indian Ocean and Atlantic Ocean. **Figure 1a** illustrates the climatology of December.

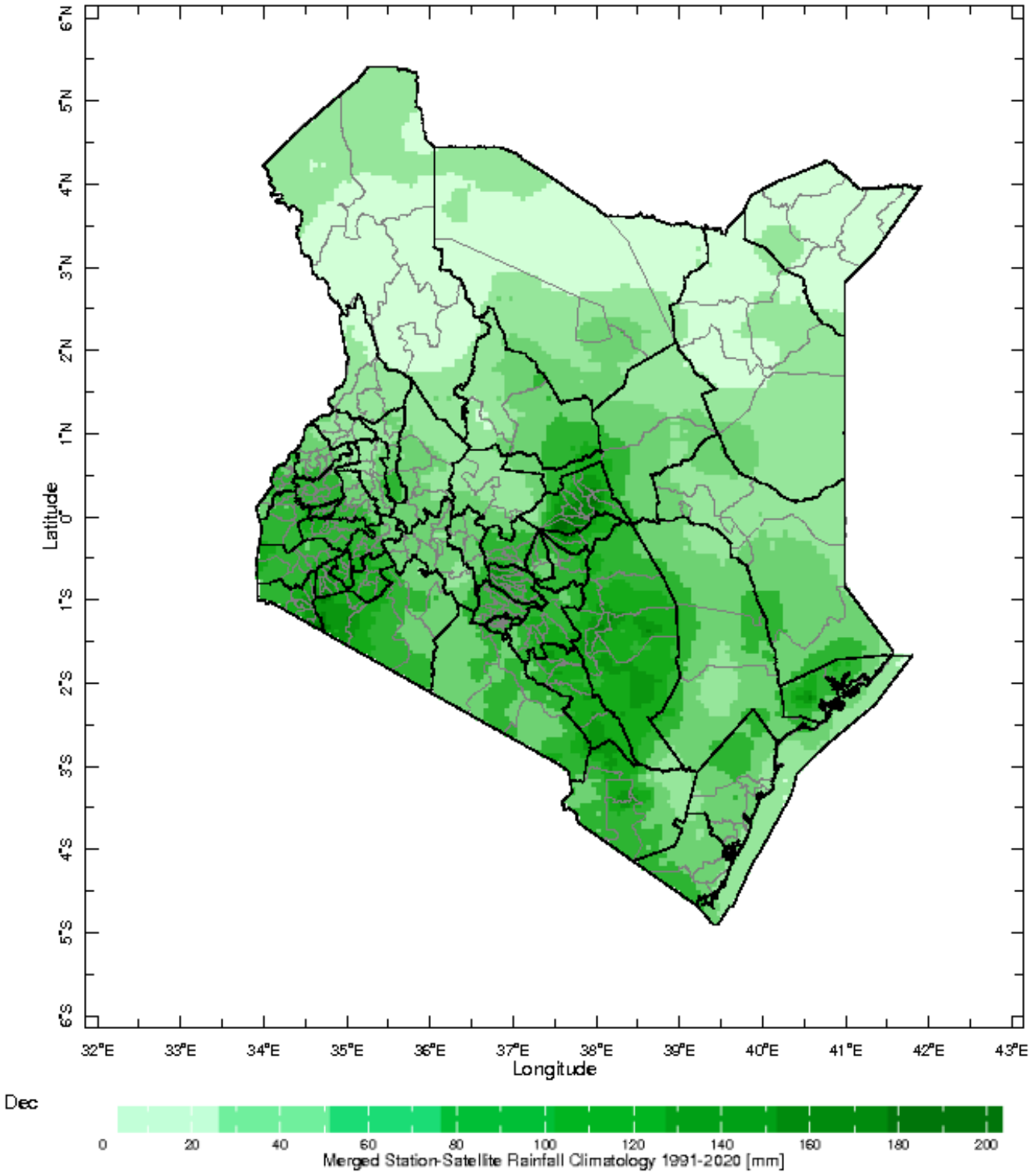

Fig. 1a December Rainfall Climatology

2.1. Rainfall Forecast for December 2023

In the last four weeks, equatorial SSTs have been above average across eastern parts of the Pacific Ocean. This was an indication that positive ENSO (El Nino) conditions are still present in the Pacific Ocean. This configuration is associated with above normal rainfall over the country. During this period, warmer than average SSTs have also been observed along the equatorial Eastern Indian Ocean and near average SSTs over equatorial Western Indian Ocean indicating the existence of a positive IOD.

The predicted cessation and distribution of rainfall has been derived from statistical analysis of past years which exhibited similar characteristics to the current year.

The forecast indicates that most of the country is likely to experience above-average rainfall during the month of December 2023 as depicted in **Figure 1b.**

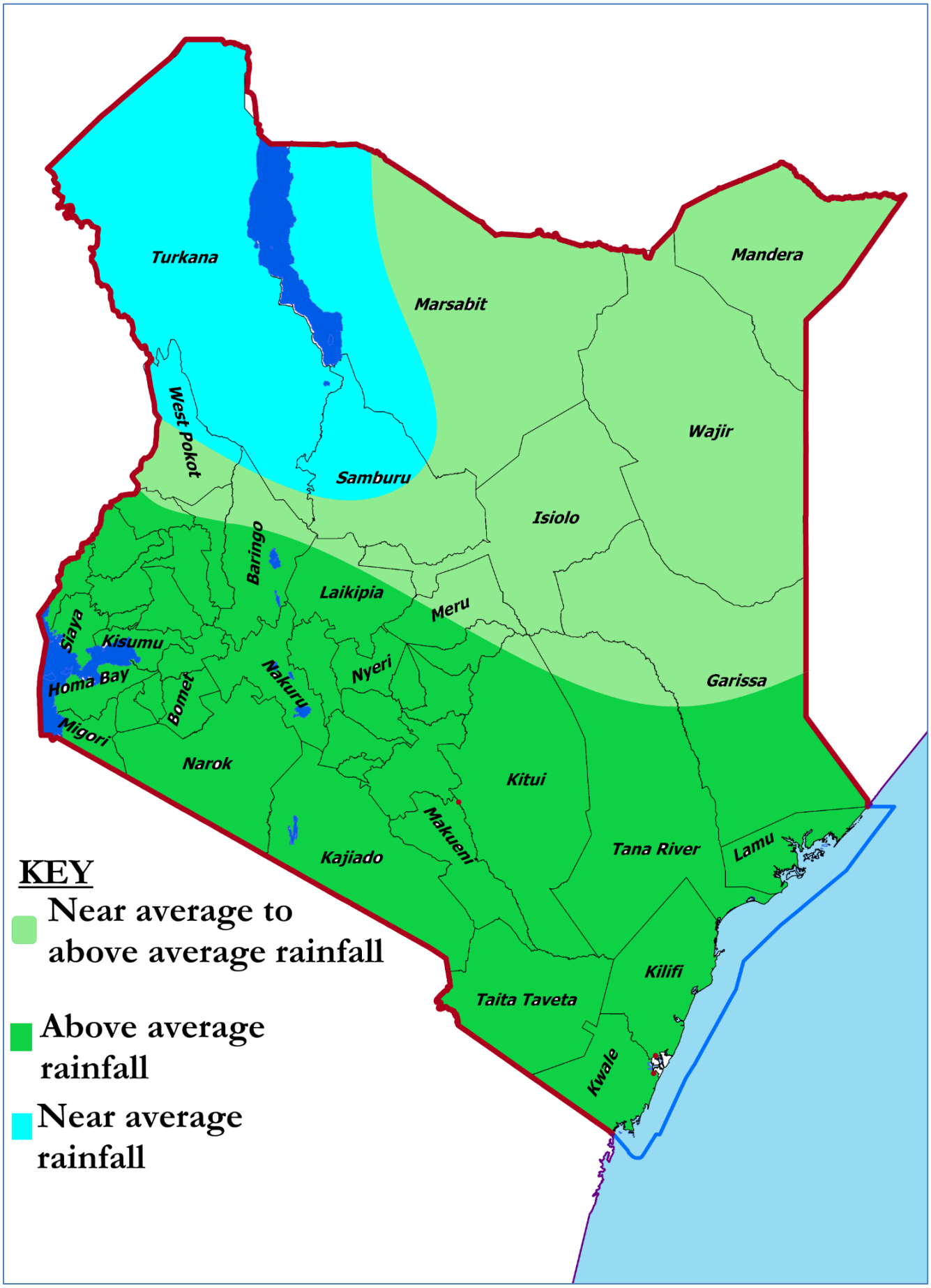

Figure 1b: December 2023 Forecast

The rainfall distribution, both in time and space, is also expected to be generally good over the southern and western parts of the country but poor over the northern parts of the country.

2.2 Outlook for Specific Areas

The specific outlook for individual areas is as follows:

2.2.1 The Lake Victoria Basin, Highlands West of the Rift Valley and Central and South Rift Valley (Siaya, Kisumu, Homa Bay, Migori, Kisii, Nyamira, Trans Nzoia, Baringo, Uasin Gishu, Elgeyo-Marakwet, Nandi, Laikipia, Nakuru, Narok, Kericho, Bomet, Kakamega, Vihiga, Bungoma and Busia): Significant amounts of rainfall are expected during the month of December. The rainfall is likely to be higher than the long-term average amounts received during the same month in other years.

2.2.2 North-western Region (Turkana, West Pokot and Samburu): Occasional rainfall is expected during the second half of the month of December 2023. The expected rainfall amounts are likely to be near the long- term average amounts received in December.

2.2.3 Highlands East of the Rift Valley and Central Kenya (Nairobi, Nyandarua, Nyeri, Kirinyaga, Murang'a, Kiambu, Meru, Embu, and Tharaka): Rainfall is expected during the month of December 2023. The expected amount of rainfall is likely to be higher than the long-term average amounts received in December.

2.2.4 North-eastern Region (Marsabit, Mandera, Wajir, Garissa and Isiolo): Generally sunny and dry conditions are likely during the first half of the month with occasional light rains. Rainfall is expected during the second half of the month of December 2023. The expected amount of rainfall is likely to be near to above the long-term average amounts received in December.

2.2.5 South-eastern Lowlands (Kajiado, Kitui, Makueni, Machakos and Taita Taveta): Rainfall is expected during the month of December 2023. The expected amount of rainfall is likely to be higher than the long-term average amounts received in December.

2.2.6 The Coastal Strip (Mombasa, Tana River, Kilifi, Lamu and Kwale): Rainfall along the Coastal strip is expected to continue in December 2023. The expected amount of rainfall is likely to be higher than the long-term average amounts received in December.

2.3 POTENTIAL IMPACTS

The following are the likely impacts during the month of December 2023:

2.3.1 Agriculture and Food Security

The anticipated rainfall in Kenya is expected to have diverse impacts on agriculture. For farmers in the high-potential regions, encompassing the Highlands West and East of the Rift Valley, the Lake Victoria Basin, Central and South Rift Valley, as well as the Southeastern lowlands, this rainfall provides favorable conditions for crop cultivation. It is an opportunity to expand their agricultural endeavors, increase crop yields, and ensure food security. Conversely, in the arid and semi-arid (ASAL) areas of the Northern, Southeastern, and Coastal regions, the same rainfall is anticipated to rejuvenate pasturelands. This is particularly beneficial for livestock farmers, as it ensures the availability of nutritious forage for their animals. For those in the midst of harvesting, the impact of increased rainfall can be mixed. It can extend the growing period and enhance yields for certain crops but may also pose challenges during the harvest, potentially leading to crop damage.

2.3.2 Disaster Management

There is a significant risk of isolated storms developing, and this weather pattern may lead to various forms of flooding. Areas prone to flooding include flood plains and locations with inadequate drainage systems, especially in urban settings. Riverbanks are also susceptible to overflow, and flash floods can occur, primarily in regions with low-lying terrain such as Northeastern and Northwestern areas, the Southeastern lowlands, the Coastal region, Lake Victoria Basin, and segments of the Central and South Rift Valley. To safeguard lives and property, it is of utmost importance that the general public exercises caution during these weather conditions. It is strongly advised to refrain from venturing on foot or by vehicle through flooded areas. Attempting to cross swollen rivers should be avoided at all costs to prevent any loss of life. Additionally, there is a probability of lightning strikes happening over the Lake Victoria Basin, South Rift Valley and Western parts of the country, notably in areas like Kisumu, Narok, Kisii, Nandi, Kakamega, West Pokot and Bungoma (specifically, Mt. Elgon areas). The public is cautioned against seeking shelter under trees or near metallic structures, particularly during rainy conditions. Landslides and mudslides are likely over parts of the Highlands East and West of the Rift Valley, Central and South Rift Valley as well as parts of Southeastern lowlands.

2.3.3 Water Resources Management and Energy

The rains expected in December will boost water availability. The public is encouraged to adopt rainwater harvesting and storage practices. The increased inflow into hydropower reservoirs is expected to boost hydropower generation and contribute to groundwater recharge for geothermal power production. However, it's important to note that this heightened rainfall, along with accompanying winds, may lead to disruptions in power supply, potentially resulting in social and economic losses and damage to transmission infrastructure.

2.3.4 Environment

The expected enhanced rainfall can significantly support widespread afforestation and reforestation initiatives. It remains imperative for relevant authorities to proactively raise awareness about the value of tree cultivation, and the public is strongly encouraged to actively participate in tree planting campaigns to expand the nation's forest cover. However, it's essential to remain vigilant regarding the potential consequences of enhanced rainfall. While this increased precipitation is a valuable resource for sustainable forestry practices, it may also introduce the risk of land degradation, particularly in the form of soil erosion and landslides. To effectively address these challenges and ensure the long-term success of afforestation and reforestation efforts, the implementation of restoration measures becomes increasingly critical.

2.3.5 Health

The increased rainfall is expected to have a positive impact on food availability, which, in turn, should help decrease nutrition-related diseases. However, there is a potential risk of higher instances of waterborne and vector-borne diseases due to water source contamination resulting from flooding and the presence of stagnant water, which can serve as breeding grounds for disease-carrying insects like mosquitoes.

2.3.6 Transport and Public Safety Sector

Anticipated intermittent flash floods could result in the disruption of transportation infrastructure, particularly in regions including the Highlands West of the Rift Valley, the Lake Victoria Basin, South Rift Valley, Tana River Basin, Northeastern, and sections of the Southeastern lowlands. Additionally, reduced visibility caused by the weather conditions may lead to a rise in road, marine, and aviation accidents. Motorists are advised to take caution while driving in rainy conditions to minimize road accidents.

3. OUTLOOK FOR DECEMBER 2023- FEBRUARY 2024

The outlook for the next three months indicates that most parts of the country are likely to experience rainfall that is above the December to February Long Term Mean. The Highlands West of the Rift Valley, Lake Victoria Basin, Central and South Rift Valley are expected to receive rainfall in December and most of January and remain generally dry in February but a few days may experience rainfall. The Highlands East of Rift Valley, the Southeastern lowlands and the Coastal region are expected to receive rainfall in December and the first half of January with a few areas expected to receive some rain again towards the end of January. February will be generally dry with a few rainy days. The Northeastern region is expected to receive rainfall from the second half of December and the first half of January with a few areas expected to be wet again towards the end of January. February is expected to be dry though a few days may experience rainfall. The Northwestern region is expected to receive occasional rainfall from the second half of December and remain generally dry in January and February.

The mean temperatures are expected to be warmer than usual over several parts of the country except over parts of Northeast (Southeastern parts of Marsabit, most of Isiolo and Wajir), Southeastern lowlands (eastern Kitui) and most of Tana river county where near to below average temperatures are expected.

4. WEATHER REVIEW FOR NOVEMBER 2023

The month of November is normally the peak month for the October-November-December (OND) "short-rains" season. An analysis of rainfall performance during the month upto 29th shows that most stations experienced rainfall throughout the month except over Lodwar which recorded no rainfall at all. The rainfall was above average over most parts of the country except over Kitale and Lodwar which recorded near average and below average rainfall respectively. The Coast, Northeastern parts of the country and isolated areas over Central Rift Valley (Laikipia) recorded rainfall that was above 300% of their November Long Term Mean. Mombasa recorded the highest with 510.2% followed by Mtwapa with 495.3%. Others include Lamu (492.5%), Garissa (470.9%), Mandera (440.5%), Msabaha (420.9%), Malindi (410.5%), Wajir (373.7%) and Laikipia 323.4%). All the other stations recorded between 130% and 290% except Kitale which recorded 93.2% and Lodwar with 0%.

The highest monthly rainfall total of 1178.8mm was recorded in Kiguru Tharaka rainfall station of Kitui County. This was followed by Lower Chure Secondary school in Meru with 726.5mm. Meru and Mtwapa recorded 679.5mm and 678.3mm respectively. Other stations that recorded more than 500mm are shown in **Table 1**. The rest of the stations recorded less than 500 mm of rainfall.

The month was characterized by severe storms over the Coastal region, Southeastern lowlands, Northeastern, Highlands East of the Rift Valley including Nairobi County and parts of the Highlands West of the Rift Valley. For instance, Meru meteorological station recorded 96.1mm in twenty-four hours on 1st November. Wajir, Msabaha, Mtwapa and Mombasa recorded 108mm, 82.3mm, 98.0mm and 81.3mm respectively on 2nd November. On 3rd November, Kabete recorded 73.9mm while Lamu, Malindi and Msabaha recorded 97.4mm, 93.2mm and 105.1mm respectively on the same day. Kitui and Eldoret Airport recorded 63.5mm and 60.7mm respectively on 5th. Garissa and Machakos recorded 78.2mm and 96.6mm respectively on 6th while Laikipia recorded 112.6mm on 12th November. On 15th November, Mtwapa recorded 102.6mm while Mombasa recorded 134.3mm. Mtwapa and Mombasa recorded 169.0mm and 110.7mm respectively on 16th November. Other rainfall stations that recorded above 100mm of rainfall in 24 hours are shown in **Table 2.**

The distribution both in time and space was generally good, especially over most parts of the country except over Lodwar where dry weather conditions persisted throughout the month. Figure 2a shows the total rainfall amount recorded in November (**Blue bars**) as compared to the November LTMs (**Red bars**) while Figure 2b shows the rainfall performance in November 2023 as a percentage of the November LTM, Figure 2c shows the November 2023 rainfall totals.

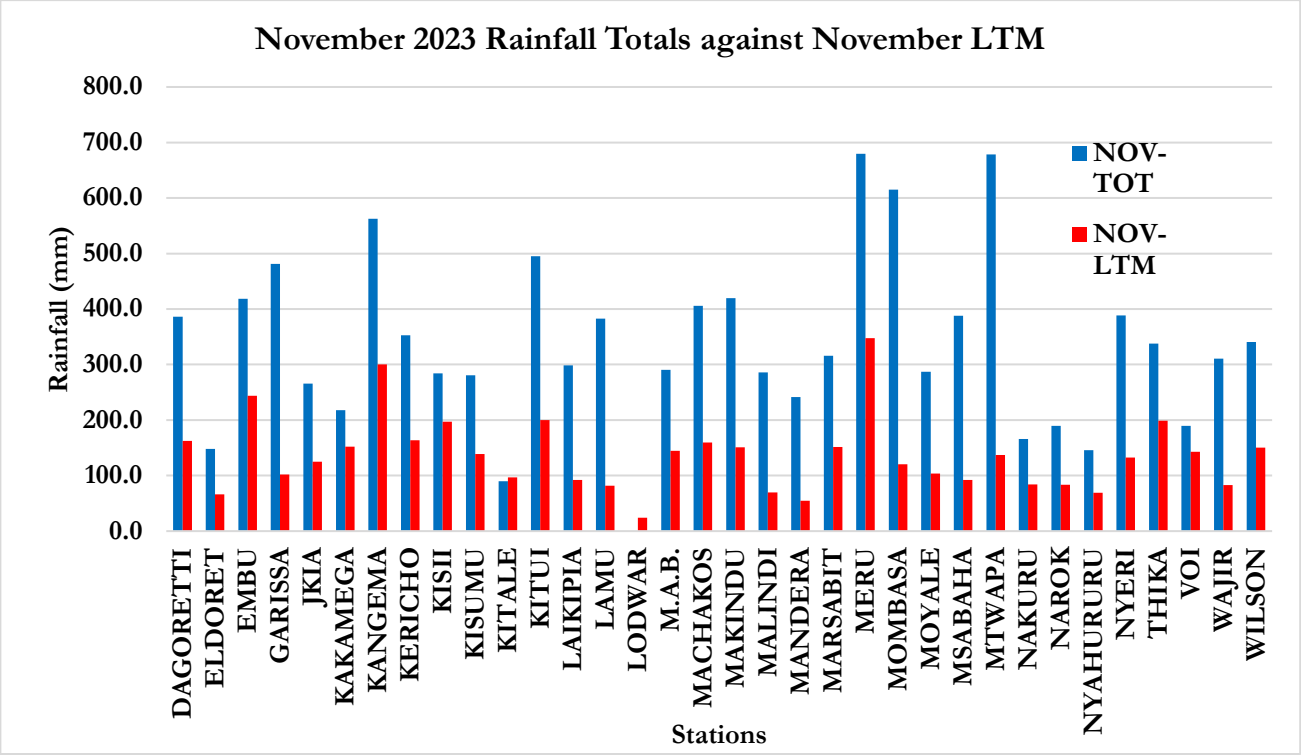

Figure 2a: November 2023 Rainfall Totals against November LTMs

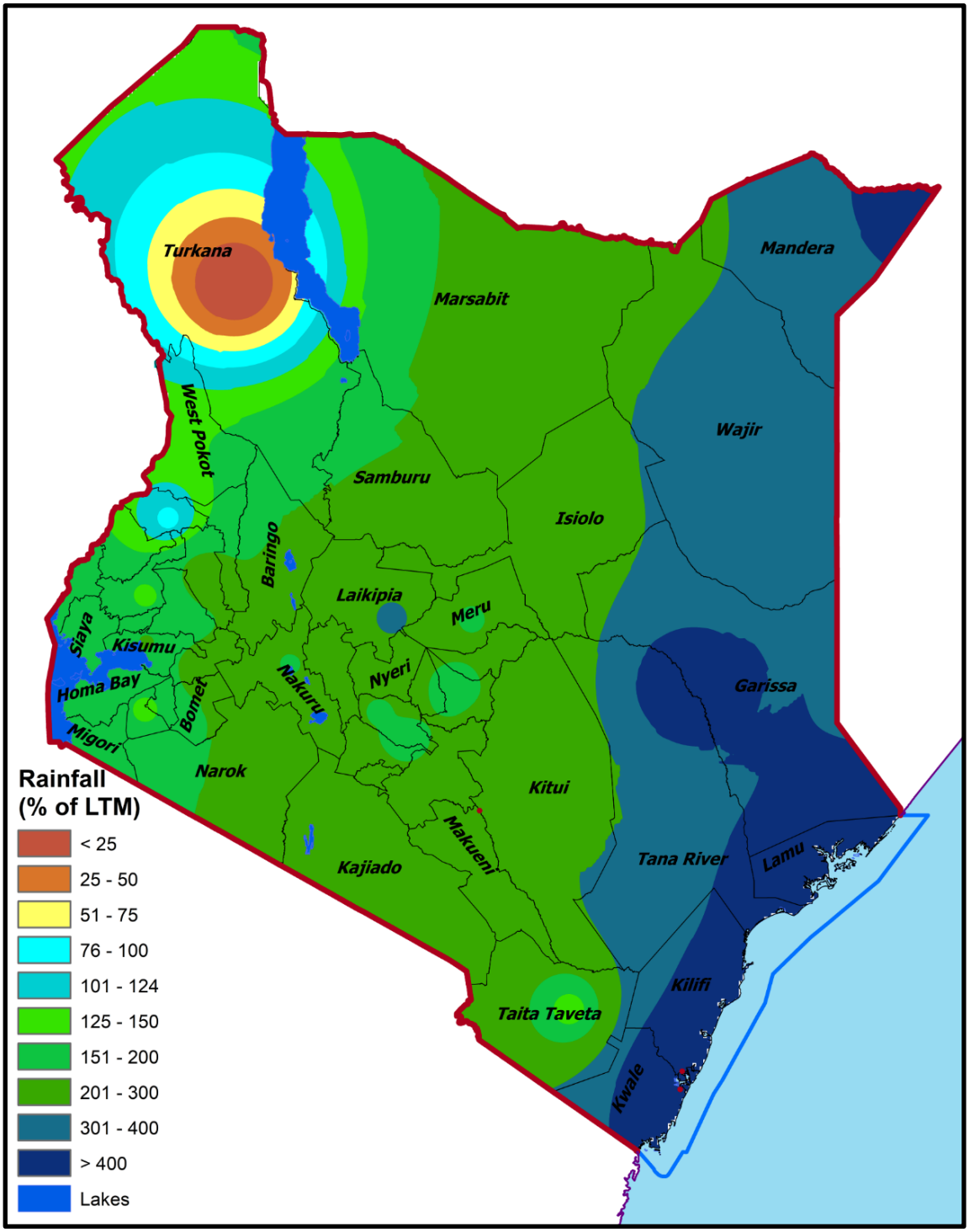

Figure 2b: November 2023 Rainfall percent of Normal

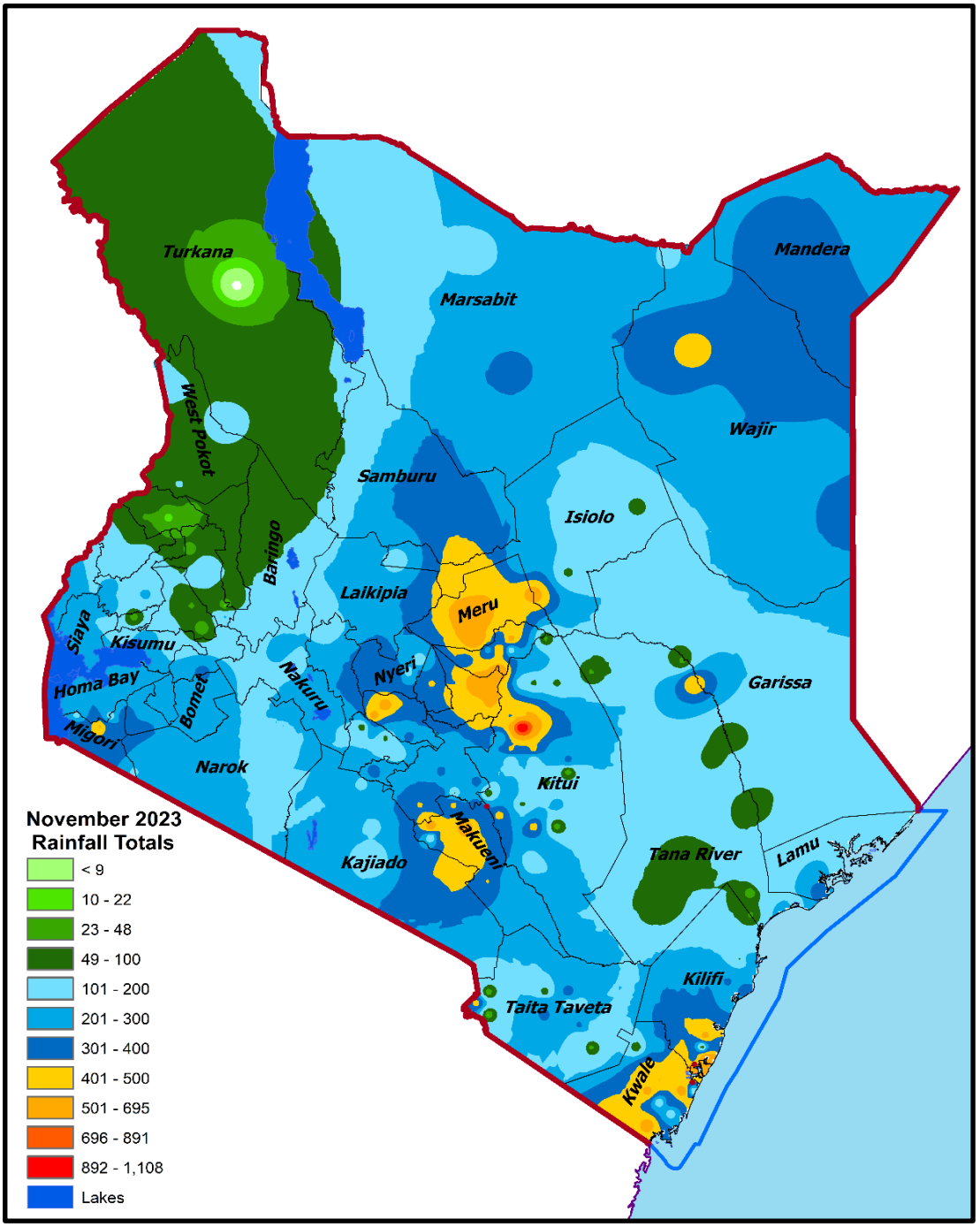

Figure 2c: Rainfall total in November 2023

Table 1: Stations that recorded more than 500mm of rainfall in November

S/NO	STATION	COUNTY	AMOUNT
1	Gitii Ngura	Embu	676.7
2	Managia	Embu	659.2
3	Wote Nziu	Makueni	650.1
4	Kasafari	Embu	629.9
5	Mtepeni	Kilifi	626.8
6	Kwale Veterinary Office	Kwale	614.9
7	Nyaroya	Migori	602.1
8	Ndaka-ini	Muranga	596.9
9	Mivumoni Primary School	Kwale	582.6
10	Kirie	Embu	568.7
11	Tharaka University	Tharaka Nithi	566.9
12	SOS Nyali	Mombasa	565.6

13	Kinna	Isiolo	565.1
14	Kangema	Muranga	564.8
15	Dzitsoni Library	Kilifi	555.4
16	Nkondi Primary School	Tharaka Nithi	553.1
17	Gulanze Primary School	Kwale	545.1
18	Gitoro KWS	Meru	531.7
19	Vigurungani Chief's Office	Kwale	516.6
20	Mbandi Kinango	Kwale	506.5
21	Gatunga MRG	Tharaka Nithi	505.2
22	Uwanja wa Ndege (Lunga Lunga)		500.8

Table 2: Stations that recorded high amounts of rainfall in 24 hours

County	Station	Amount in mm	Date
Mandera	Takaba ACC Office	106.4	17-11-2023
Isiolo	Kinna	106 and 140.3	6th and 7th Nov respectively
	NEMA-Isiolo	124.0	13-11-2023
	Malka Galla	106.2	14-11-2023
Embu	Kirie	102	2-11-2023
	Managia	104.5	2-11-2023
	Kasafari	111.3	13-11-2023
Meru	Gitoro KWS	120.0	1st and 7th Nov
	Lower Chure Secondary School	129.0	1-11-2023
Tharaka Nithi	Tharaka University	114.8	21-11-2023
Kitui	Kavoo-Kanyangi	109.0	10-11-2023
	Mutomo Agricultural Office	103.0	10-11-2023
	Kiguru Tharaka	110.4, 104.7 and 127.9	19th, 22nd and 23rd Nov respectively
Makueni	Mavindini Ward	142.0	10-11-2023
	Mukaa	112.3	6-11-2023
	Wote Nziu	103.3	10-11-2023
Taita Taveta	Kasaani Pofo FFS	105.0	22-11-2023
Tana River	Makere Dispensary	134.0	4-11-2023
	Tarassaa	143.0	4-11-2023
Lamu	Manda Bay AWS	109.9	2-11-2023
Kilifi	Dzitsoni Library	177.7	24-11-2023
	Mariakani Ward	102,118, and 108.5	2nd, 15th and 16th Nov respectively
	Mnarani Ward	108.6	2-11-2023
	Mtepeni	196.5	16-11-2023
	Ruruma Chief's Office	100.9	2-11-2023
Mombasa	SOS Nyali	110.8, 147.2 and 201.6	2nd, 15th and 16th Nov respectively
Kwale	Dzombo Primary	115.6 and 106.3	2nd and 15th Nov respectively
	Gulanze Primary School	112.8	15-11-2023
	Kwale Veterinary Office	160.0	15-11-2023
	Kasemeni Primary School	191.9	15-11-2023

	Kinango Agricultural Office	160.0	15-11-2023
	Mbandi Kinango	141.6	15-11-2023
	Mivumoni Primary School	130.3 and 124.5	15th and 17th Nov respectively-
	Uwanja wa Ndege	216.3	15-11-2023
Nandi	Baraton University of Eastern Africa	102.0	5-11-2023

5. REVIEW OF OCTOBER-NOVEMBER (ON) 2023

The seasonal rainfall analysis from 1st October to 29th November 2023 indicates that above average rainfall has so far been recorded over all the stations in the Coast and Northeast, most stations over the Southeastern lowlands, several stations over the Highlands East of the Rift Valley and a few stations over the South and Central Rift Valley (Narok and Laikipia). Most stations over the Highlands West of the Rift Valley, Lake Basin and Northwestern Kenya have so far recorded near average rainfall except Kitale which has recorded below average rainfall. Voi is the only station over the Southeastern lowlands that has so far recorded below average rainfall.

The highest seasonal rainfall total of 1377.9mm has been recorded in Kiguru Tharaka rainfall station followed by Meru with 1087.5mm. Other stations that have so far recorded more than 600mm are Lower Chure Secondary School (968.4mm), Gitii Ngura (906.6mm), Nyaroya (898.0mm) Kasafari (827.9mm), Mtwapa (805.2mm), Managia (795.2mm), Kwale Veterinary Office (792.9mm), Kangema (766.5mm), Mombasa (747.3mm), Mtepeni (709.2mm), Marsabit (697.7mm), Wote Nziu (667.3mm), Kitui (650.3mm), and Embu (643.9mm). All the other stations have recorded less than 600mm of rainfall with Lodwar recording the least amount of rainfall (49.3mm).
Figure 3 shows the total rainfall amount recorded in October-November 2023 **(Blue bars)** as compared to October – November LTMs **(Red bars).**

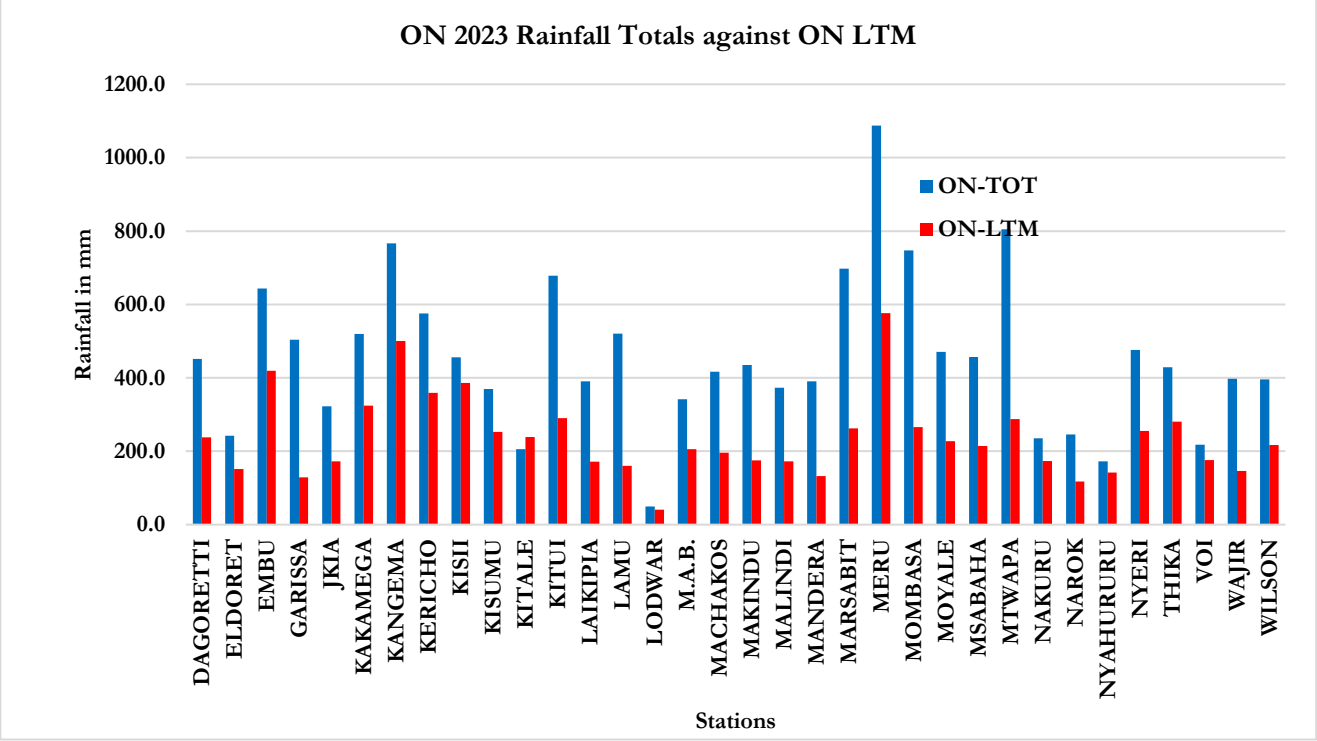

Figure 3: October-November 2023 Rainfall Totals (mm) against ON LTM (1st Oct -27th Nov 2023)

6. Experienced Impacts in November 2023

6.1. Agriculture and Food Security

The enhanced rainfall experienced during the month was conducive for agricultural practices in the high potential areas of the western sector of the country, the Highlands East of the Rift valley,the southeastern lowlands and parts of the Coastal region. However, massive flooding led to destruction of crops in some areas such as Nyandarua, Meru, Makueni, Kitui, Taita Taveta, Kilifi and Tana River Counties. In Nandi county, crops were destroyed by a falling rock in Olomotit village of Tinderet sub county after heavy rains were experienced in the area on 7th November. Crops in Rombo, Kajiado south got spoiled as the roads that access the farms were destroyed by heavy rains. Livestock was washed by floods in some parts of the Highlands East of the Rift Valley, the Southeastern lowlands and the northern parts of the country. In Isiolo county, bee hives in Malka Bisanandi were destroyed by floods after river Bisanandi burst its banks following heavy rains experienced in the area.

6.2. Disaster Management

The heavy rainfall that was experienced in November 2023 had the following impacts

- Several lives were lost over the Southeastern lowlands, parts of the Highlands East of the Rift Valley (Meru), the Coastal region, the northeast and over the Lake Victoria Basin (Migori) as residents of these areas attempted to cross flooded rivers. One person was killed in Bangala La Juda in Mombasa county when his house caved in on 3rd November following heavy rains experienced in the area from 2nd November. Another person died on 17th November in Majajani village of Kilifi county after his house collapsed following heavy rains experienced in the area
- Property including homes were destroyed in several counties over the coast, Southeastern lowlands, Northeast, Northwest (Samburu), Lake Basin (Migori) and parts of the Highlands East of the Rift Valley (Nyandarua and Meru).
- Thousands of families were displaced by floods over the Northeast, Coast, Southeastern lowlands, parts of the Highlands East of the Rift Valley (Meru and Tharaka Nithi), Lake Victoria Basin (Kisumu and Migori) and isolated areas over the Highlands West of the Rift Valley (Kisii)
- Landslides and mudslides were reported in different parts of the country on diverse dates, destroying property and killing one person. For instance, a mudslide occurred on 4th November in Igembe south and destroyed a building. Several houses were destroyed by a mudslide in Kimandeni village of Makueni on 8th November. Another mudslide destroyed houses in Llima village of Makueni county on 15th November. In Kiambu county, several houses were destroyed by a mudslide in Site village on 21st November. A child was killed in Llima village of Makueni county after their house was hit by a mudslide on 25th November.
- One person died and two others sustained injuries on 6th November after they were struck by lightning while sheltering under a tree during a downpour in Chesilyot village, Sotik of Kericho county.

6.3. Water Resources Management and Energy

Water availability over most parts of the country was enhanced following the above average rainfall experienced during the month. Most rivers over the Southeastern lowlands, Northeastern, Highlands East of the Rift Valley, Lake Victoria Basin and the Coast were full beyond their capacity. Most dams over the Southeastern lowlands and the Highlands East of the Rift Valley were also full beyond their capacity and were at risk of spilling. Power supply was temporarily disrupted in Muranga after and electricity pole fell after heavy rains were experienced in the area on 2nd November

6.4. Health

Health services were disrupted in Mandera, specifically in El Wak sub County referral hospital and Adra health center after heavy rains were experienced in the area on 3rd November marooning the two institutions. In Makueni county, health services were also affected on 11th and 13th November as the roads leading to the health facilities were inaccessible as a result of heavy rains experienced in the area.

Water borne diseases (Cholera) was reported in Lamu County.

6.5. Transport and Public Safety

Transport services were disrupted over several counties in the Northeast, northwest, Coast and Southeastern lowlands and a few areas over the Highlands East of the Rift Valley (Meru and Tharaka Nithi), Highlands West of the Rift Valley (Nandi and West Pokot) and South Rift Valley (Narok) after roads were either washed away by floods or were temporarily flooded.

Transport along the Meru-Mikinduri-Maua road and Gitogoto road in Tharaka Nithi was also disrupted after sections of the road were blocked by a mudslide on 3rd November.

Transport of Cargo along the Mombasa -Nairobi standard gauge railway line was suspended on 18th November after a landslide occurred between the Mombasa Terminus and Mariakani. The landslide also caused delays in departure and arrival of passenger trains at the Mombasa Terminus.

Rail transport was disrupted along the Kikuyu-Nairobi railway line on 21st November after floods and a mudslide blocked a section of the railway line in Thogoto.

The heavy rains destroyed two bridges over the Coast and Highlands West of the Rift Valley. The Milima 10 bridge located at the border of Tambul and Chemelil location was destroyed by floods on 7th November while the Mbogolo bridge which lies along the Mtwapa-Kilifi road was washed by floods on 24 th November.

6.6. Environment

Landslides and mudslides were reported on diverse dates over the Southeastern lowlands (Makueni), Highlands west of the Rift Valley (Nandi and West Pokot) and several counties of the Highlands East of the Rift Valley (Meru, Tharaka Nithi, Kiambu and Muranga). These landslides and mudslides led to environmental degradation and soil erosion in the affected areas.

NB: This outlook should be used together with the 24-hour, 5-day, 7-day, monthly, special forecasts and regular updates/advisories issued by this Department as well as Weekly and Monthly County forecasts developed and availed by County Meteorological Offices.

Benard Chanzu

FOR DIRECTOR OF KENYA METEOROLOGICAL DEPARTMENT