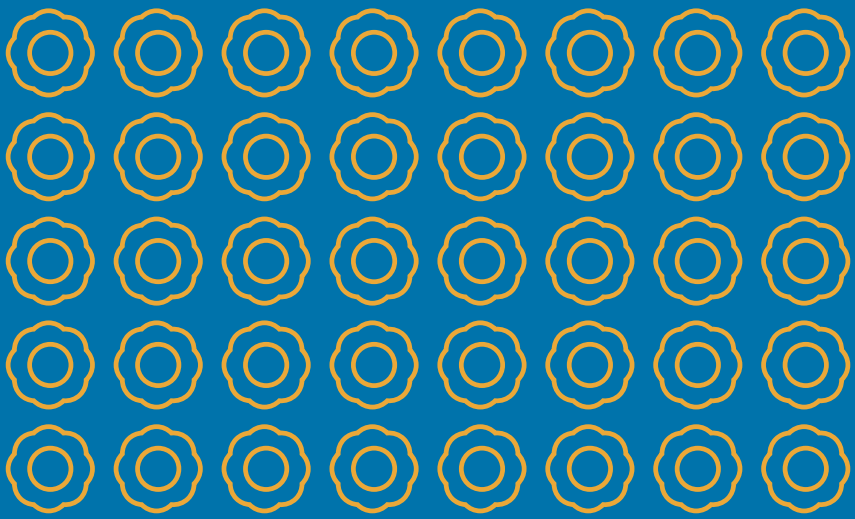
Water scarcity and Drought Conditions in the Maltese Islands

Hydrological Year 2023/2024



THE ENERGY & WATER AGENCY

1. Introduction

Droughts are a temporary decrease of the average of natural water availability. These can occur for example, due to insufficient rainfall, and are considered natural phenomena. Droughts can occur anywhere in the world, in both high and low rainfall areas, and in any season. The significance of droughts is evident in their effects on natural water resources, agriculture, and ecosystems. The purpose of this report is to analyse the occurrence of droughts in the Maltese Islands in recent years and provide insight into the severity and frequency of these drought events with particular focus on the hydrological year 2023/2024.

2. Precipitation

Rainfall is a primary source of water in the Maltese islands, replenishing groundwater reserves and supporting the island's water demand. The majority of rainfall occurs between October and March, with December typically being the wettest month, while the dry season from April to September sees little to no precipitation. On average, Malta received approximately 550mm of rainfall per year from 1940 to 2024, with considerable annual fluctuations. Table 1 shows the monthly and annual rainfall from 2008 till 2024 as measured at the meteorological station in Luqa. Orange cells represent months or years with below-average rainfall when considering the long-term average rainfall from 1940 till 2024, whereas green cells indicate above-average values. Over the past 16 years, from 2008 to 2024, 12 of these years experienced annual precipitation levels below the long-term average (average rainfall from 1940 till 2024). The months that most consistently recorded below-average rainfall were December, January, and April.

The average annual rainfall between 2008 and 2024 is of 458mm, indicating a 17% reduction in rainfall in recent years when compared to the long-term average rainfall from 1940 till 2024. The hydrological year 2023-2024 was the driest year on record during with all months throughout this year exhibiting below average rainfall. From 2008 till the present day, noticeable dry conditions were also evidenced in the hydrological year 2015-2016 with just 241mm of rainfall. From 1940 until 2024, these was just one other instance, apart from 2015-2016 and 2023-2024, where a hydrological year had a total precipitation which is less than 250mm and this occurred in 1947-1948.

Table 1 - Average rainfall from 2008-2024 based on the meteorological data provided by the National Meteorological Office. Orange cells indicate a below average value whereas green cells indicate an above average value for rainfall for that month or year.

	Average Rainfall												
Hydrological	Sep	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Annual
2008-2009	62.5	63.4	84.9	87.6	208.4	94.1	32.1	38.4	2.1	1.6	0.2	4.2	679.5
2009-2010	69.9	58.2	35.6	53.8	63.1	18.1	63.2	2.5	12.1	1.7	0.3	0.1	378.6
2010-2011	76.0	228.9	14.6	29.3	80.4	121.9	33.7	20.4	8.5	4.8	0.5	0.2	619.0
2011-2012	8.9	74.7	189.4	71.7	76.3	112.1	85.0	16.9	0.7	0.4	0.1	0.5	636.6
2012-2013	86.6	62.7	93.3	41.1	52.3	54.0	19.7	20.5	1.8	0.6	0.3	9.3	442.1
2013-2014	38.1	21.8	173.5	84.4	58.6	64.0	45.7	11.2	4.5	2.3	0.3	0.7	505.0
2014-2015	0.9	68.2	79.8	142.5	66.1	125.1	58.5	3.8	16.7	0.8	0.7	15.3	578.3
2015-2016	20.5	73.5	39.2	36.8	19.5	2.0	18.0	2.0	8.3	16.9	0.2	4.0	241.0
2016-2017	30.8	33.8	85.2	71.2	65.3	53.5	15.8	7.8	0.4	4.3	0.1	2.4	370.5
2017-2018	48.5	78.6	65.8	37.3	10.5	123.7	33.9	1.6	4.0	5.7	0.1	26.8	436.4
2018-2019	13.6	169.1	71.1	29.0	78.8	64.9	41.7	19.2	16.7	0.2	1.5	0.3	506.0
2019-2020	43.1	86.0	124.2	40.9	10.0	0.3	37.3	9.4	12.5	0.1	2.8	0.1	366.5
2020-2021	98.3	32.0	66.3	67.0	64.7	4.2	21.7	1.4	0.2	0.5	0.0	0.3	356.4
2021-2022	18.3	191.7	166.1	37.1	51.0	4.3	15.7	1.5	11.4	0.0	0.6	13.9	511.4
2022-2023	58.1	18.1	153.1	7.5	58.6	128.3	5.1	25.4	20.9	4.4	0.0	9.1	488.6
2023-2024	18.9	0.4	57.4	39.8	36.0	37.5	6.5	9.3	7.5	2.3	0.0	4.9	220.3

The occurrence and trends in rainfall patterns can also be analysed spatially given the availability of a number of rainfall gauges across Malta and Gozo. The map shown in Figure 1 indicates a general decline in rainfall trends throughout the islands with Xewkija and Valletta showing a significant decreasing trend. Throughout the period from 2008 till 2024, the meteorological station at Luqa is the only site which has experienced a non-significant increasing trend.

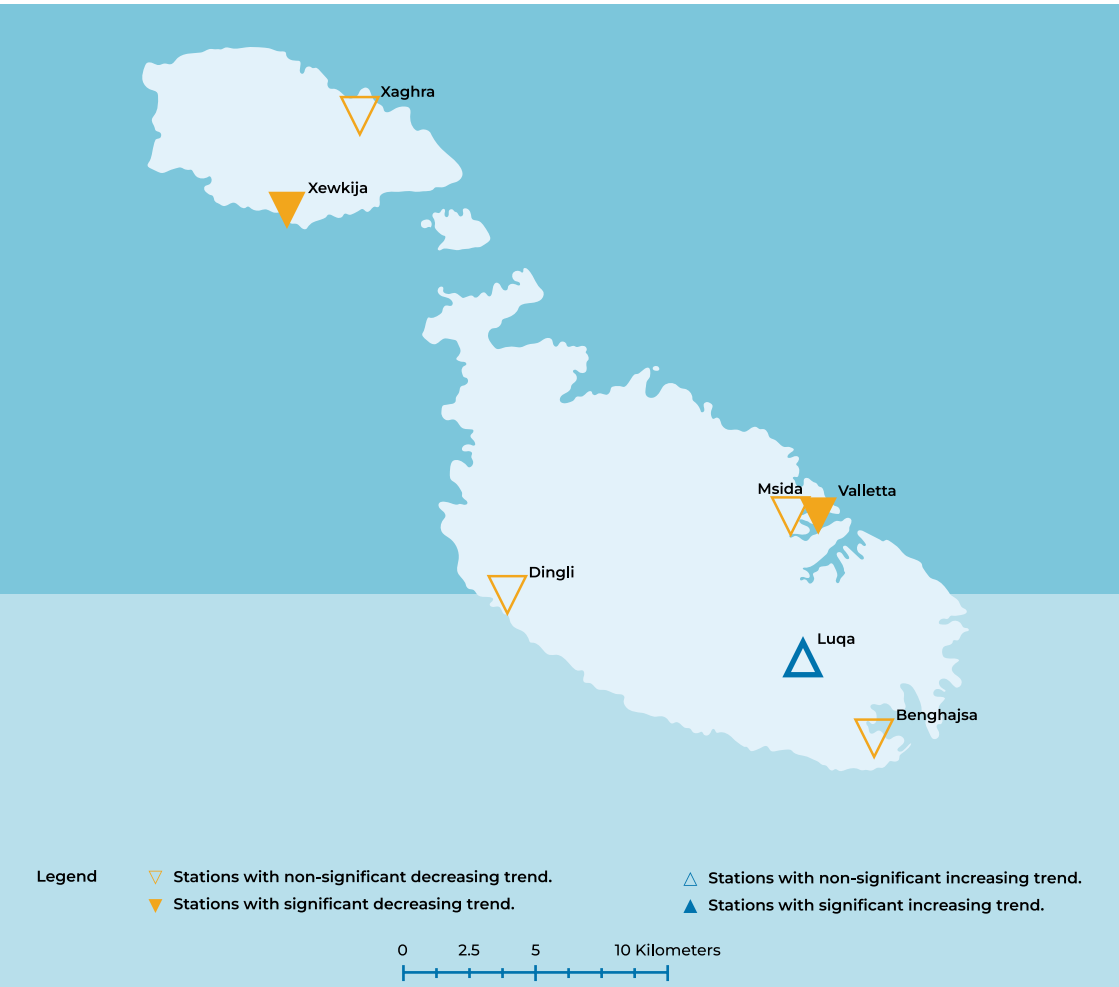


Figure 1 - Precipitation trends in the Maltese islands from 2008 till 2024 based on the meteorological data provided by the National Meteorological Office.

3. Long term analysis of Drought Indices

3.1 Standardised Precipitation Index (SPI)

Drought indices, such as the Standardised Precipitation Index (SPI), are considered and utilised at different timescales to show and highlight the occurrence of drought events. In Figure 2, the SPI values for the last 10 hydrological years are shown and categorised by different coloured zones to reflect the severity of the drought year. In the last 10 years, apart from the frequent below average rainfall values as shown in Table 1, 3 important droughts years have also occurred in 2016-2017, 2020-2021 and the last hydrological year (2023-2024). The severity of these 3 drought events increased throughout this period with the worst drought event occurring during the last hydrological year. Throughout this period no hydrological years were classified as moderately wet years..

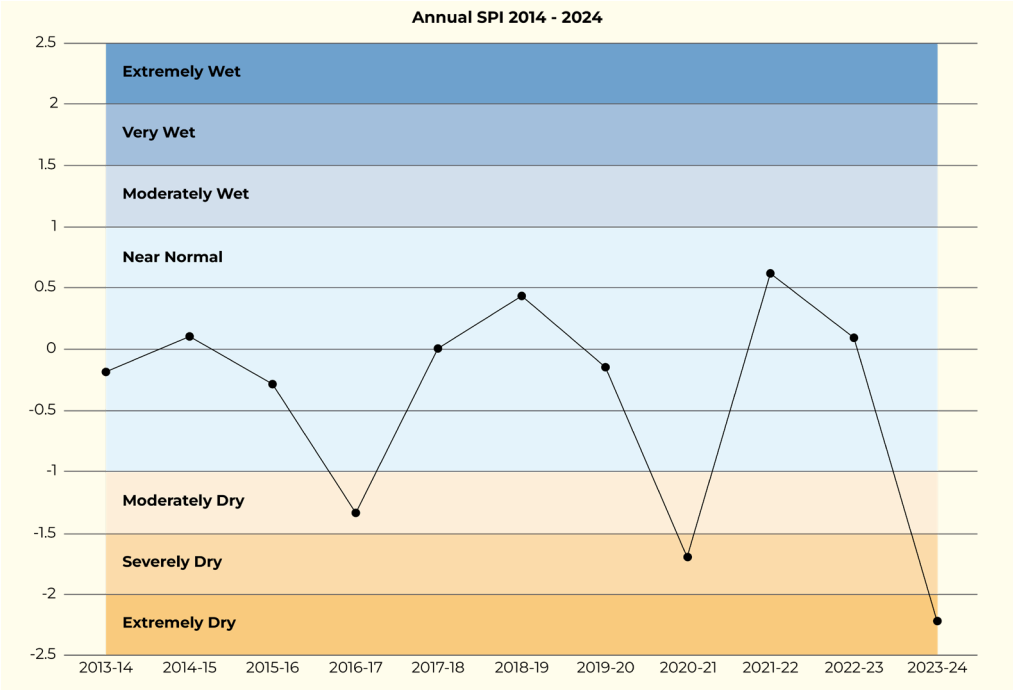


Figure 2 - Representation of the SPI on an annual basis from 2014 - 2024

When classifying and comparing the last 10 hydrological years to the period between 1961 and 2024, it is evident that there is the likelihood of having a greater proportion of drier years as opposed to wet years.

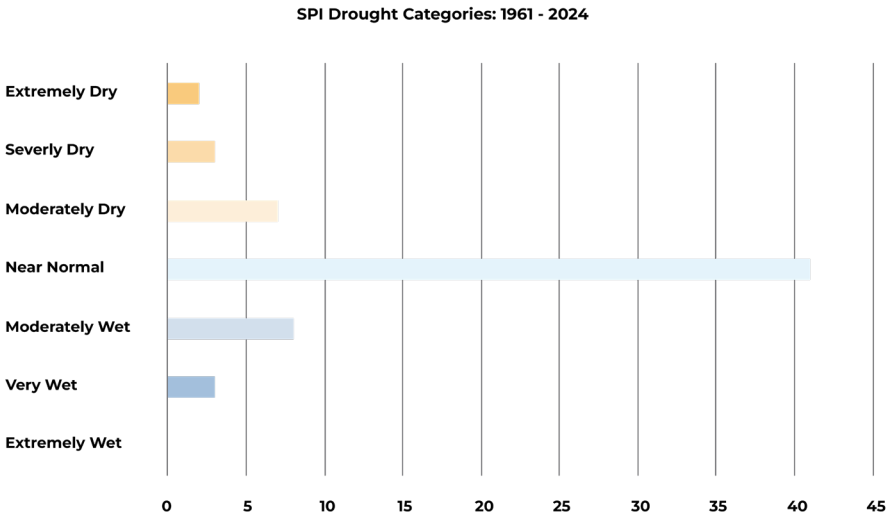


Figure 3 - The drought categories from 1961 till 2024

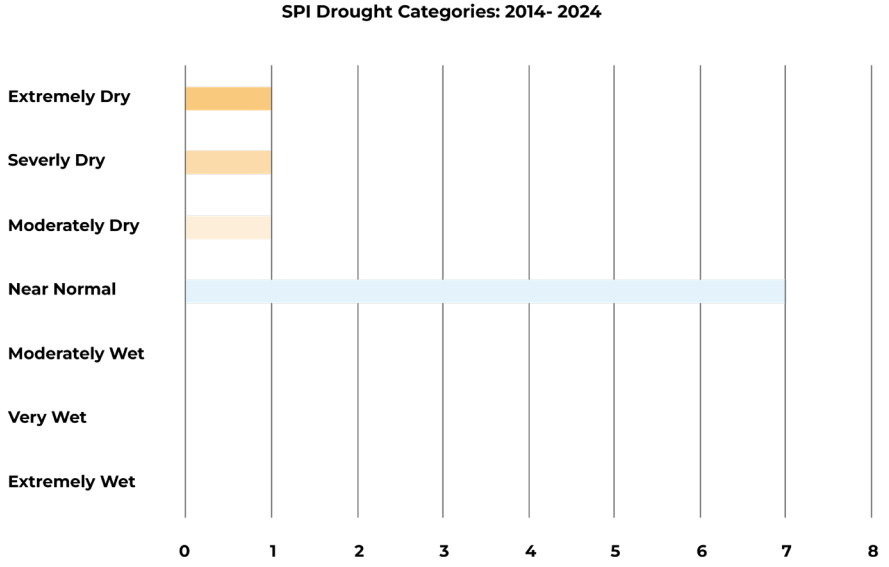


Figure 4 - The drought categories from 2014 till 2024

3.2 Aridity Index (AI)

Another important numerical indicator on the level of scarcity of natural water resources in a particular climate is the Aridity Index (AI). This index is calculated as the ratio of annual precipitation to potential evapotranspiration. Based on this index, the Maltese islands are characterised as having a semi-arid climate. Semi-arid regions are characterised by having low to moderate rainfall, typically receive between 250 and 500 millimetres of precipitation annually. The average potential evapotranspiration for the period between 2014 and 2024, using the Penman-Monteith equation, is 1292.31mm. This contrasts sharply with the average annual rainfall for the same period which is set at 475mm. The annual values and categorisation of the respective year in terms of the level of aridity are presented in Figure 5. Throughout this period, 9 years experienced semi-arid conditions, dry conditions where exhibited in the hydrological year 2021—2022 and arid conditions were experienced in the last hydrological year of 2023-2024, which was by far the driest in the last 10 years. Regions which experience such arid conditions pose several challenges to agriculture due to their harsh environmental conditions.

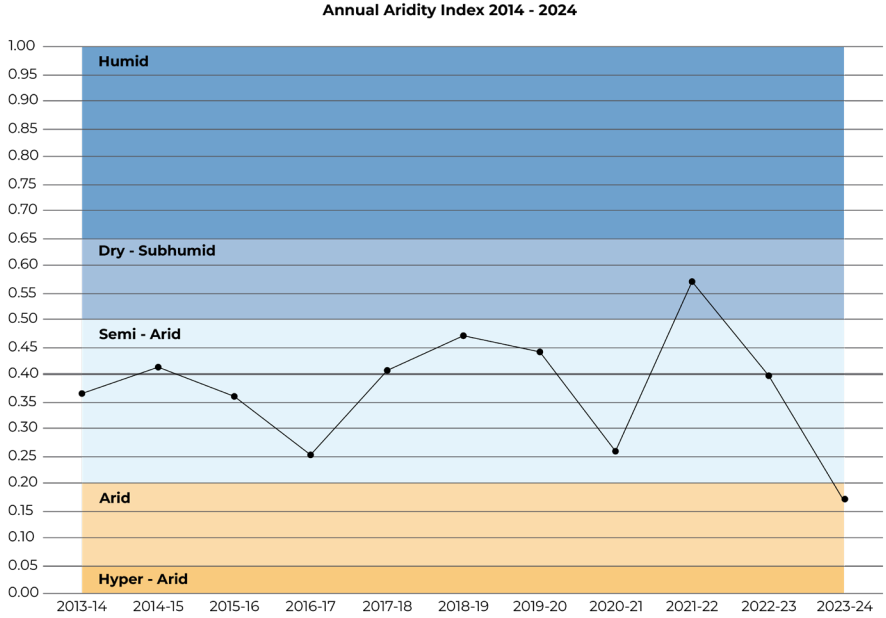


Figure 5 - Representation of the Aridity Index on an annual basis from 2014 - 2024

4. Conclusion

Reliable information on rainfall deficiencies and changing rainfall patterns is essential for water resources planning and management given Malta's semi-arid climate and the prevailing conditions of water scarcity. Drought monitoring is therefore considered as a key component of integrated water resources management in Malta's context as its occurrence not only affects the agricultural sector and food production but also natural resources, social well-being, and the national economy.

Drought monitoring will therefore continue to provide important results and feedback for water resources management to accurately integrate and adapt to the changing natural conditions of the Maltese islands through the greater diversification of water supply and the sustainable use of non-conventional water resources. This is becoming increasingly relevant given that we are already being impacted by a changing climate.