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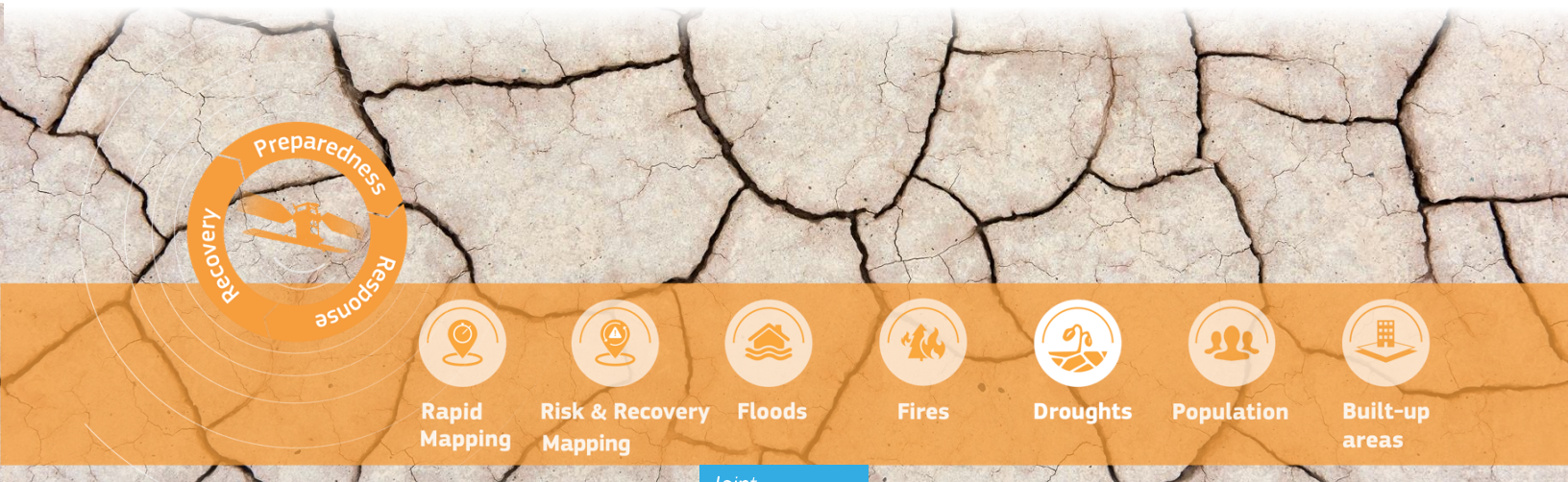
Water scarcity in the Netherlands August 2022

GDO Analytical Report

2022



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GDO Analytical Report

Drought in the Netherlands - August 2022

JRC Global Drought Observatory (GDO) of the Copernicus Emergency Management Service (CEMS) - 05/08/2022

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Executive summary

- The Dutch government declared a "*de facto* water shortage (level 2)" on August 3rd, scaling up from a "threat of water shortage (level 1)". With this declaration, the management of the water distribution is delegated to a national commission (Management Team Water Scarcity) with the aim of following the development of the water scarcity more closely and being able to react faster if the need for more measures arises. Currently, mostly preventive measures are taken.
- Europe has been experiencing a severe-to-extreme drought since the beginning of 2022 with forecast for the coming months still pointing to drier-than-normal conditions.
- The main impacts on the Netherlands are related to the severely low flow in the Rhine River, affecting commercial navigation, dike stability in the peatland areas in the western part of the country, and causing related - still manageable - problems such as water distribution difficulties and sea water intrusion throughout the strongly interconnected water system.

Standardized Precipitation Index (SPI)

Europe is experiencing a severe-to-extreme long-lasting drought affecting most of the region.[1]

Precipitation over Rhine and Meuse basins and over central Europe has been below average from mid-May to mid-July (Fig. 1). In combination with the dry winter and spring over the Alps, the lack of precipitation has been causing heavy reduction of river flows.

[1] https://edo.jrc.ec.europa.eu/documents/news/GDO-EDODroughtNews202207_Europe.pdf

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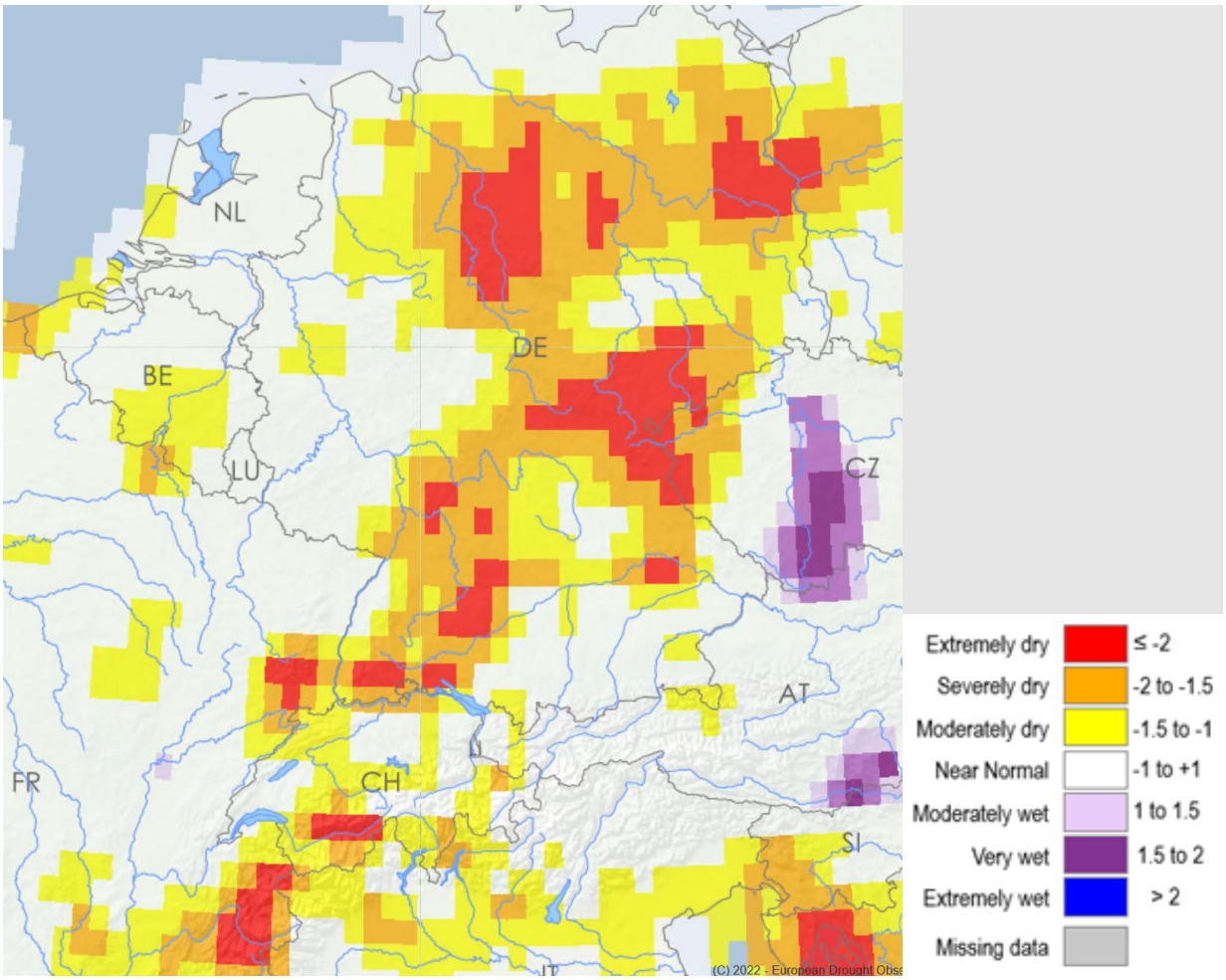

Figure 1: *Standardized Precipitation Index SPI-3, mid-May to mid-July 2022.*

Focusing on the Netherlands, precipitation from mid-May to mid-July is close to average values and no major anomalies are detected by the SPI-3 (Fig. 2). However, some regions have experienced precipitation deficit in July and other ones already from March-April (Fig. 3)

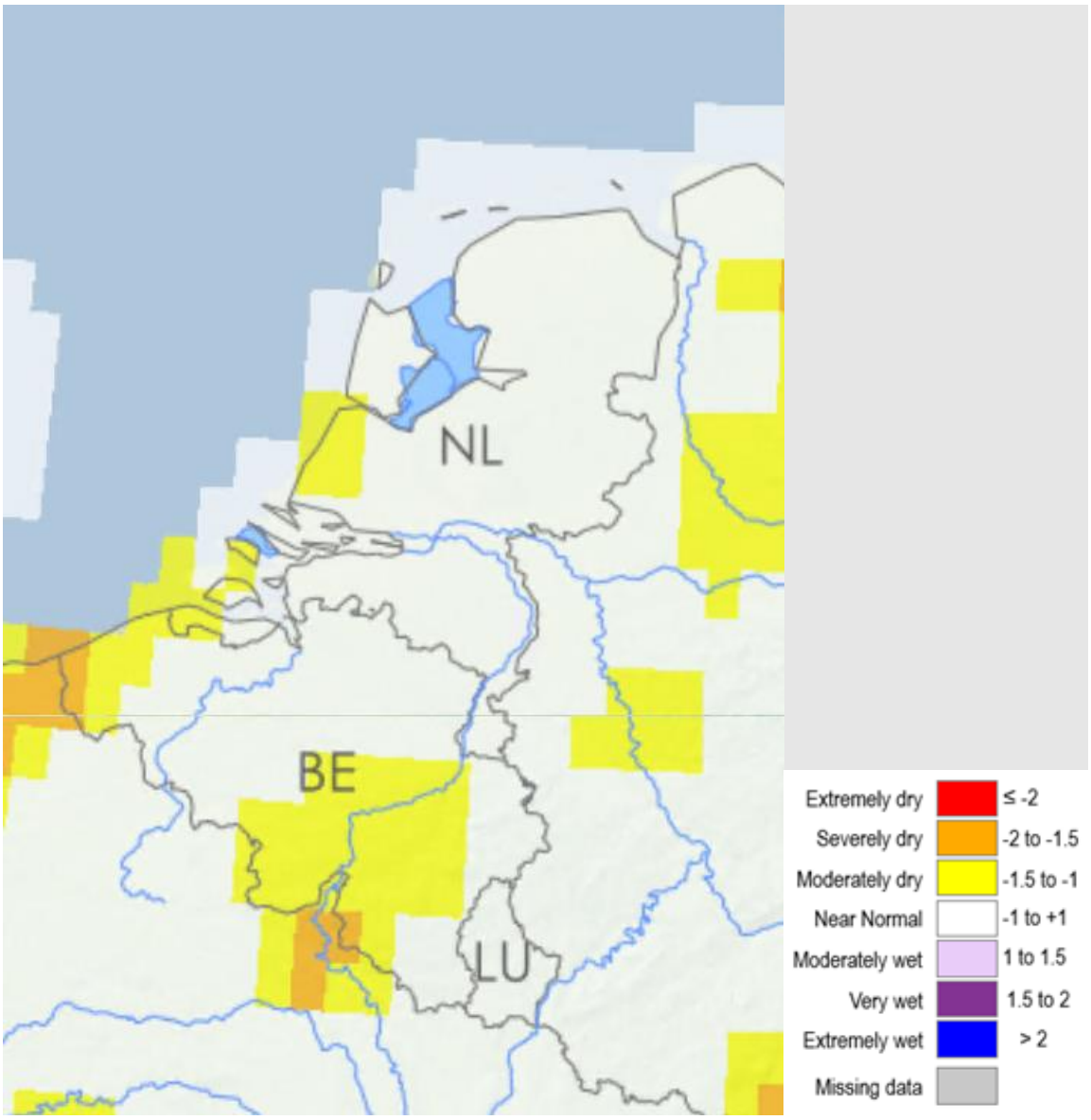

Figure 2: *Standardized Precipitation Index SPI-3, mid-May to mid-July 2022.*

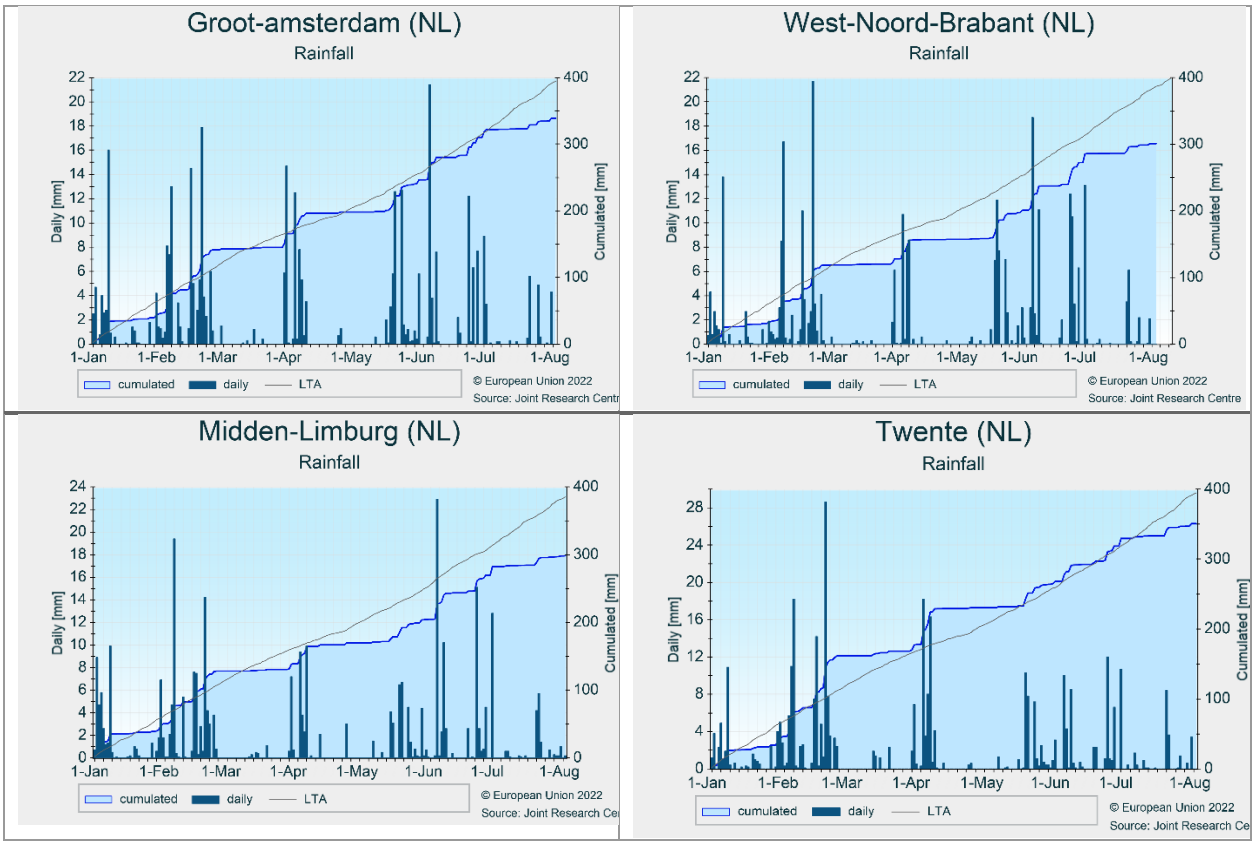

Figure 3: *Daily total precipitation (blue bars) and cumulated precipitation (blue line) over 4 regions in the Netherlands in 2022. The long-term average of cumulated precipitation is shown by the grey line.*

By analysing more in detail the last month SPI-1 of July 2022, the northern and the southern regions of the Netherlands are severely drier than average (Fig. 4) confirming the recent critical lack of precipitation lack.

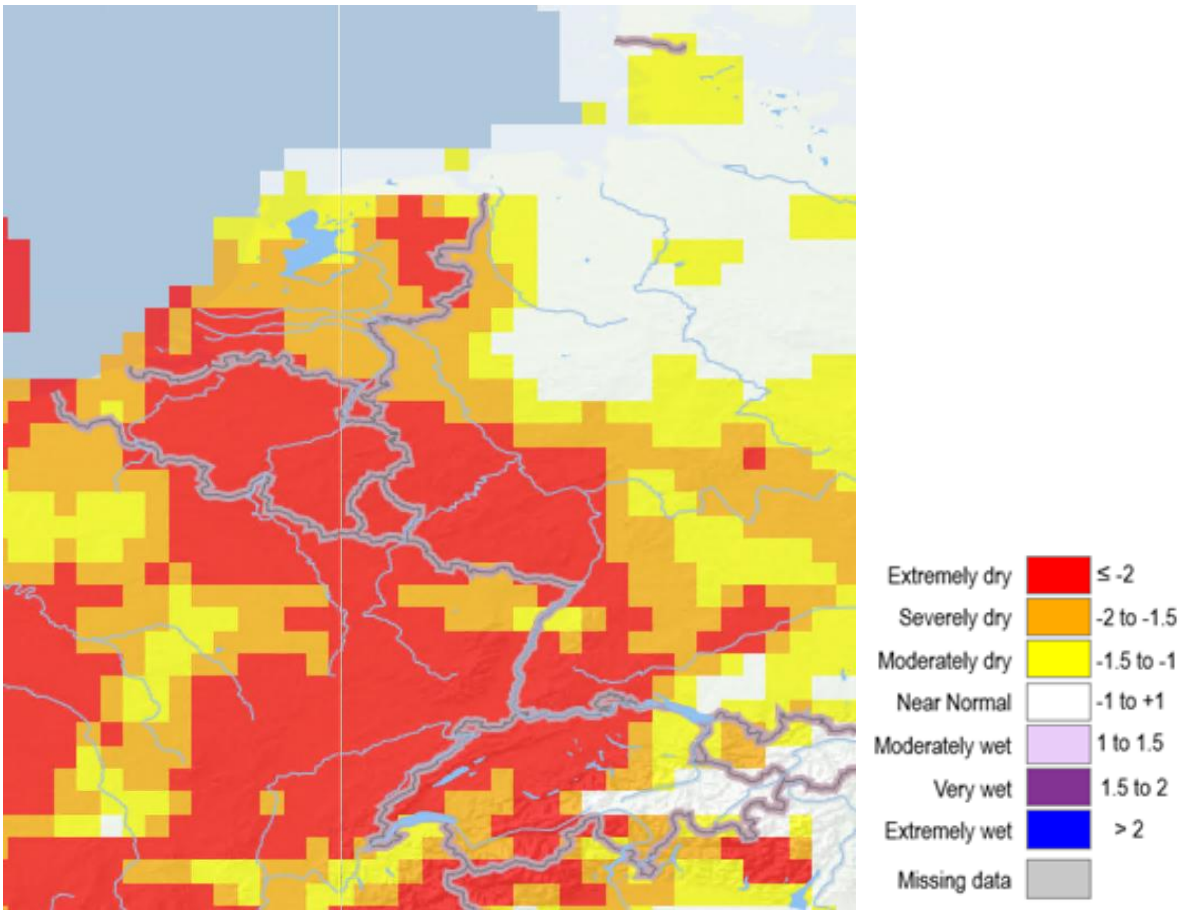

Figure 4: *Standardized Precipitation Index SPI-1, July 2022.*

Key hydrological features

The Netherlands consists of four main distinct areas with respect to soil characteristics and hydrological properties (Fig. 5).

Figure 5: *Main soil types in the Netherlands (World Reference Base), grouped approximately according to dominant texture. Source: Soil Atlas of Europe, 2005*[2].

[2] Soil Atlas of Europe, European Soil Bureau Network, European Commission, 2005, 128 pp.

In the south and in the east, sandy soils dominate. These areas highly depend on rainfall and are covered with irrigated crops. In the centre, along the river Rhine - branching in Waal, IJssel and Lek, and the Meuse - we find river clays. The "polders", land reclaimed from peatlands, are located in the west. These areas are often below sea level or below the level of the natural hydrology and can only be maintained by a system of dikes, pumps, and other waterworks. An extensive canal system allows to drain these lands with high vertical precision. In the south-west and in the north, sea clays are found, often also reclaimed from the sea (rather than from marsh- and peatland).
Almost 100 years ago the "Afsluitdijk" (closure dike) was constructed, creating a large artificial lake, the "IJsselmeer" out of a large inland bay. The Ijsselmeer is fed by water from the IJssel branch of the Rhine. The lake is essential a freshwater basin for polders. When they become too dry, water from the lake is used to prevent salt intrusion from the sea and to keep the polders wet to a certain minimum, avoiding cracking of clayey soil or peat.

Low-Flow Index

At the end of July 2022, the Low-Flow Index shows lower values over most of the main rivers in Europe. The Netherlands is severely affected by the low flow in the Rhine river, as shown by both the LFI and the measured data detecting moderate low flow levels (Fig. 6). The latter ones are provided by the International Commission for the Protection of the Rhine (ICPR).[3] The Rhine basin has been affected by a severely dry winter in the Alps with scarce snow accumulation[4], followed by a dry spring and summer with below average precipitation and above average temperature. As a consequence, the Rhine river discharge has been continuously reduced. This has major effects especially in the Netherlands, as their highly interconnected water system mainly relies on the Rhine for its water resources. In addition, also the rain-fed Scheldt and Meuse rivers (the other main rivers flowing into the Netherlands) show reduced flow levels.

[3] Ihttps://www.iksr.org/en/

[4] See also https://edo.jrc.ec.europa.eu/documents/news/GDO-EDODroughtNews202203_Northern_Italy.pdf

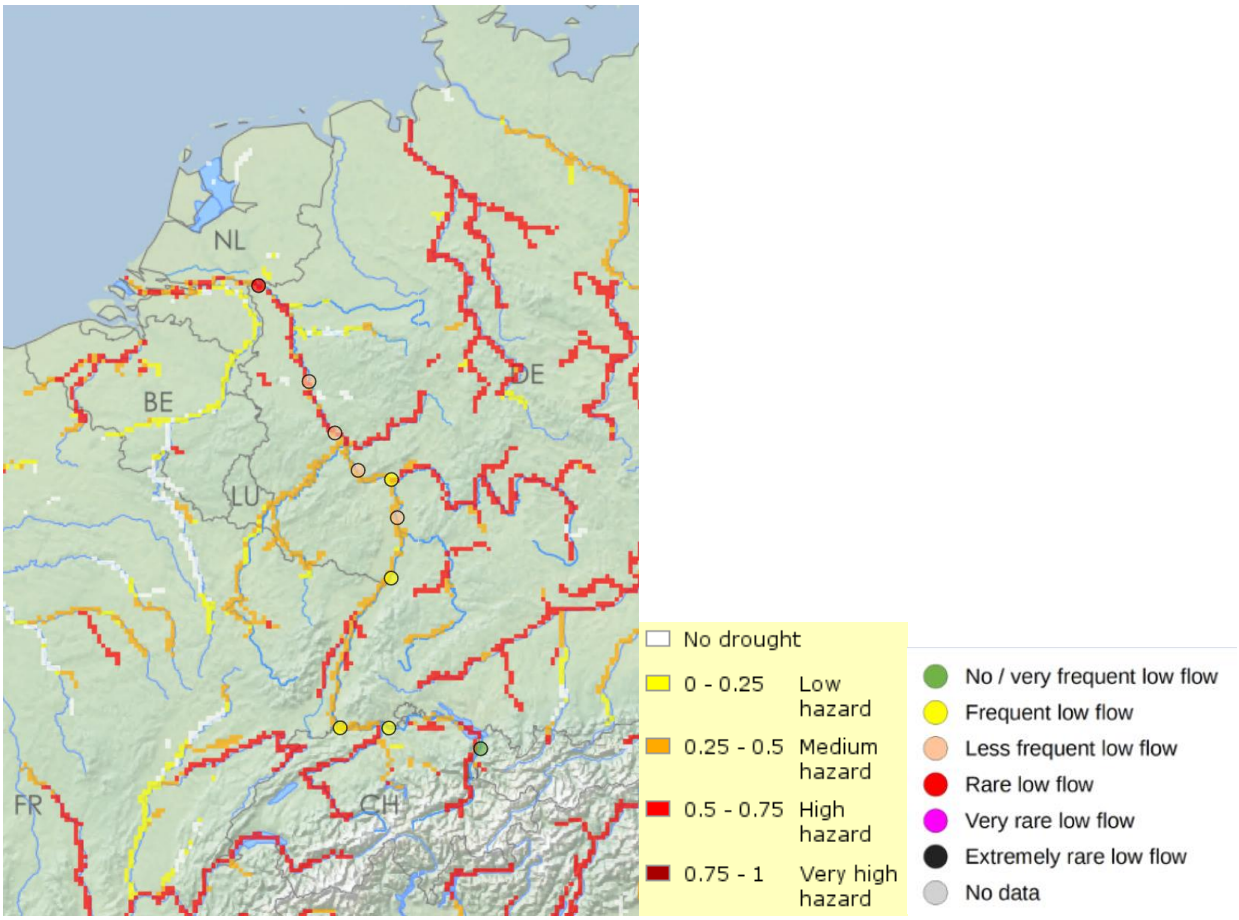

Figure 6: *Low-Flow Index (LFI) at the end of July 2022. A Low-Flow Index of 0 corresponds to no drought and a value of 1 to the highest drought hazard. Circles represent low flow situation at Rhine gauges provided by ICPR - International Commission for the Protection of the Rhine[5], through the Undine Information Platform[6]. Data are classified by low flow, based on return periods[7].*

Critical conditions are confirmed by the measured water levels below normal values as provided by Ministry of Infrastructure and Water Management[8] (Fig. 7).

[5] https://www.iksr.org/en/

[6] https://undine.bafg.de/index_en.html

[7] https://undine.bafg.de/rhein/zustand-aktuell/rhein_nw_mon_en.html

[8] https://waterinfo.rws.nl/#!/kaart/waterhoogte/

Figure 7: Water height as provided by Rijkswaterstaat - Dutch Ministry of Infrastructure and Water Management (August 5th, 2022).

Combined Drought Indicator (CDI)

According to the CDI (Fig. 8), warning levels are observed mainly in the north, the east and the south of the country, i.e. soil moisture is negatively affected by a combination of soil properties, lack of precipitation, and higher evapotranspiration due to long-lasting relatively high temperatures. This indicator is not reflecting the water level in the rivers, which is of more

importance for the current situation in the Netherlands. Few alert spots in the central-eastern region also show initial vegetation worsening.
Looking at the whole Rhine and Meuse watersheds, warning to alert levels are detected over the whole region, with the worst conditions in central Germany.

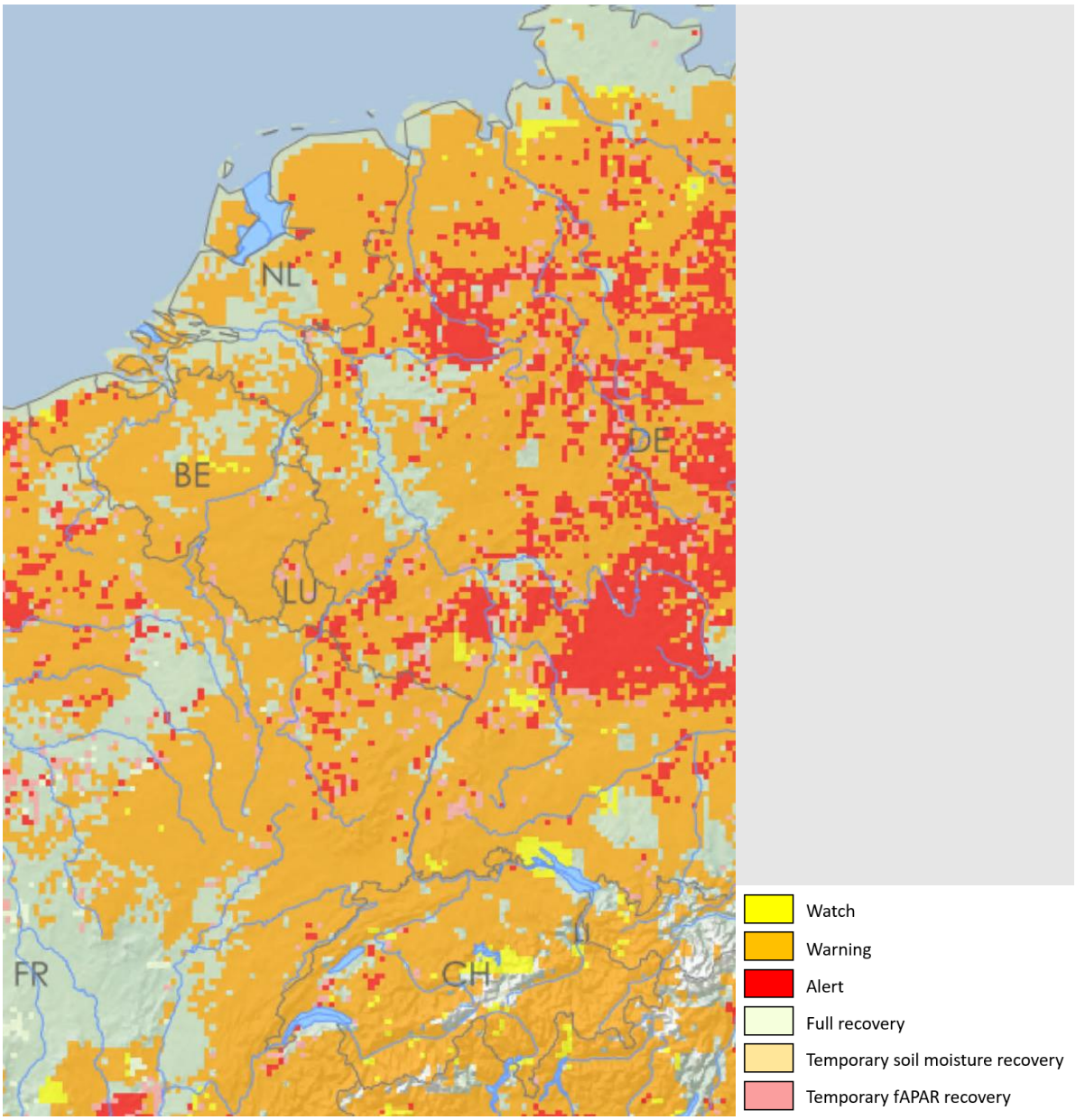

Figure 8: Combined Drought Indicator (CDI v.2.1) – mid-July 2022.

Soil Moisture Anomaly

Soil moisture anomalies register slightly drier than normal values, with the most critical values in the north-eastern and southern part of the Netherlands (Fig. 9). Considering that the precipitation contribution has been close to normal values until June in many areas, the drier conditions may be more related to the soil properties and to higher evaporation. In these areas, indeed, we find sandy soils.

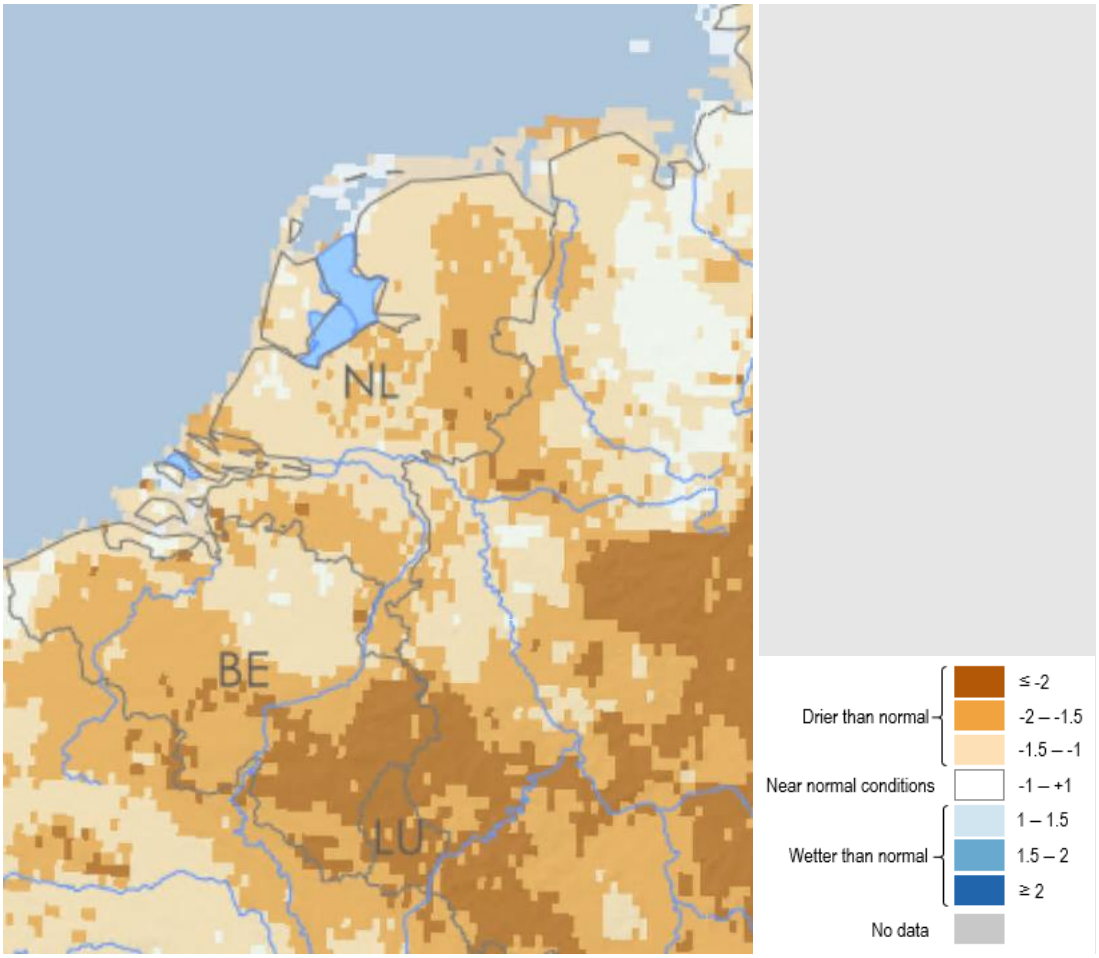

Figure 9: *Soil Moisture Anomaly - end of July 2022.*

FAPAR anomaly

An impact on vegetation growing conditions is not strongly visible so far, even if the first lower than normal photosynthetic activity signals are starting to appear over the northern regions (Fig. 10).

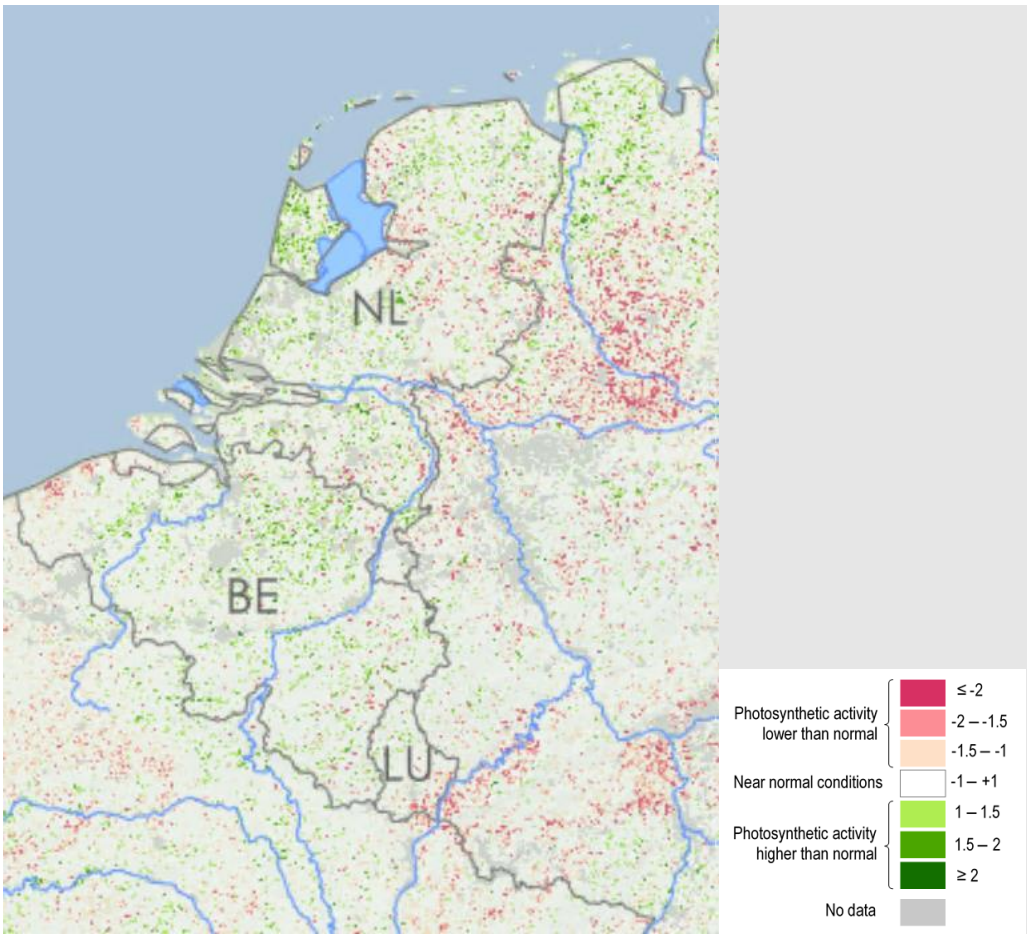

Figure 10: *fAPAR anomaly – mid-July 2022.*

Seasonal forecast

Severely drier than normal conditions are predicted for the period July-September over the Netherlands and surrounding countries raising concerns for water resource management and availability in the coming months. Precipitation in central Europe is expected to be widely and severely below the average affecting the whole Rhine and Meuse watersheds (Fig. 11).

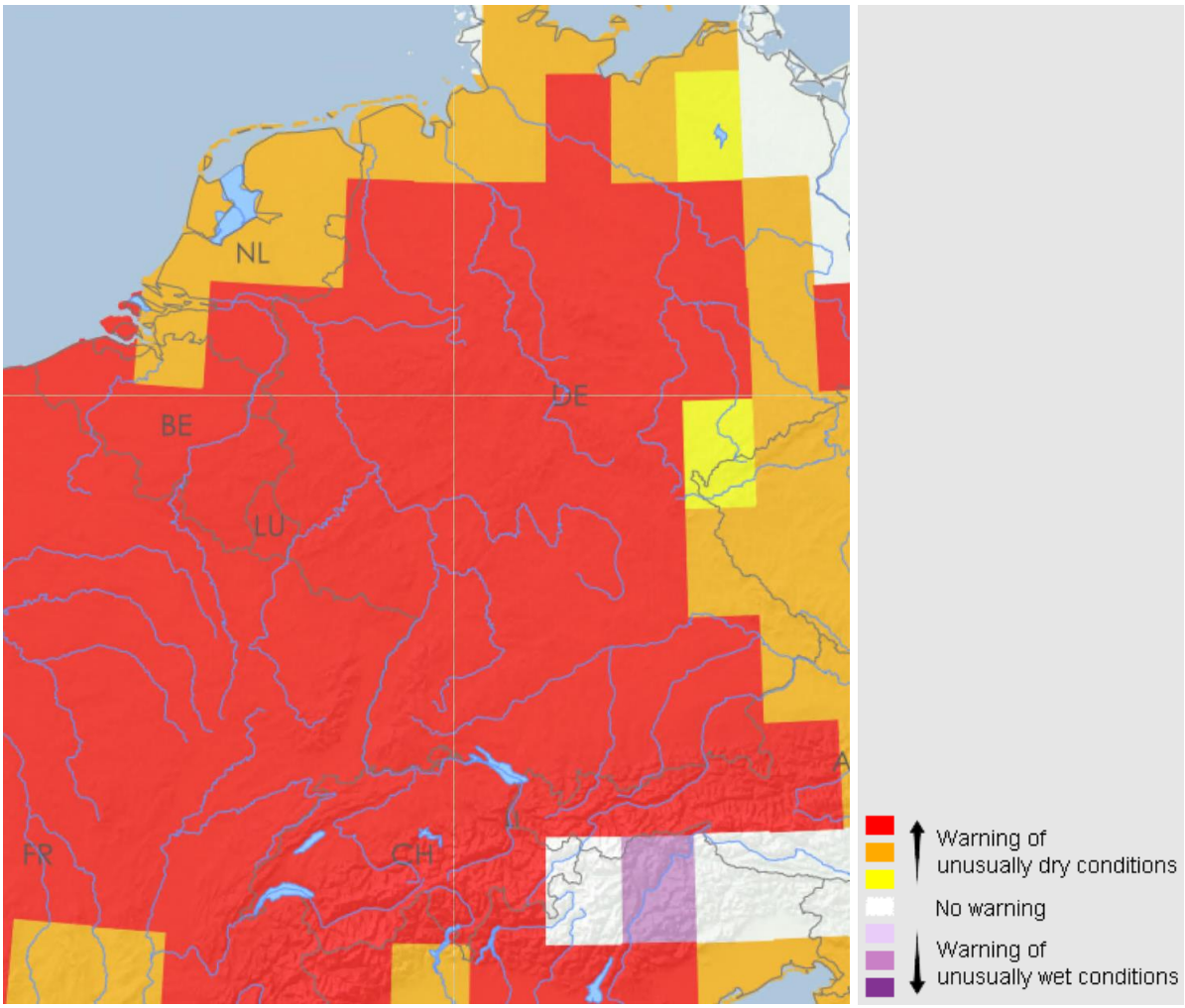

Figure 11: *Indicator for forecasting unusually wet and dry conditions from July to September 2022 (based on ECMWF SEAS5).*

Also the short term forecast for the coming days of August points to extremely low or negligible precipitation (Fig. 12).

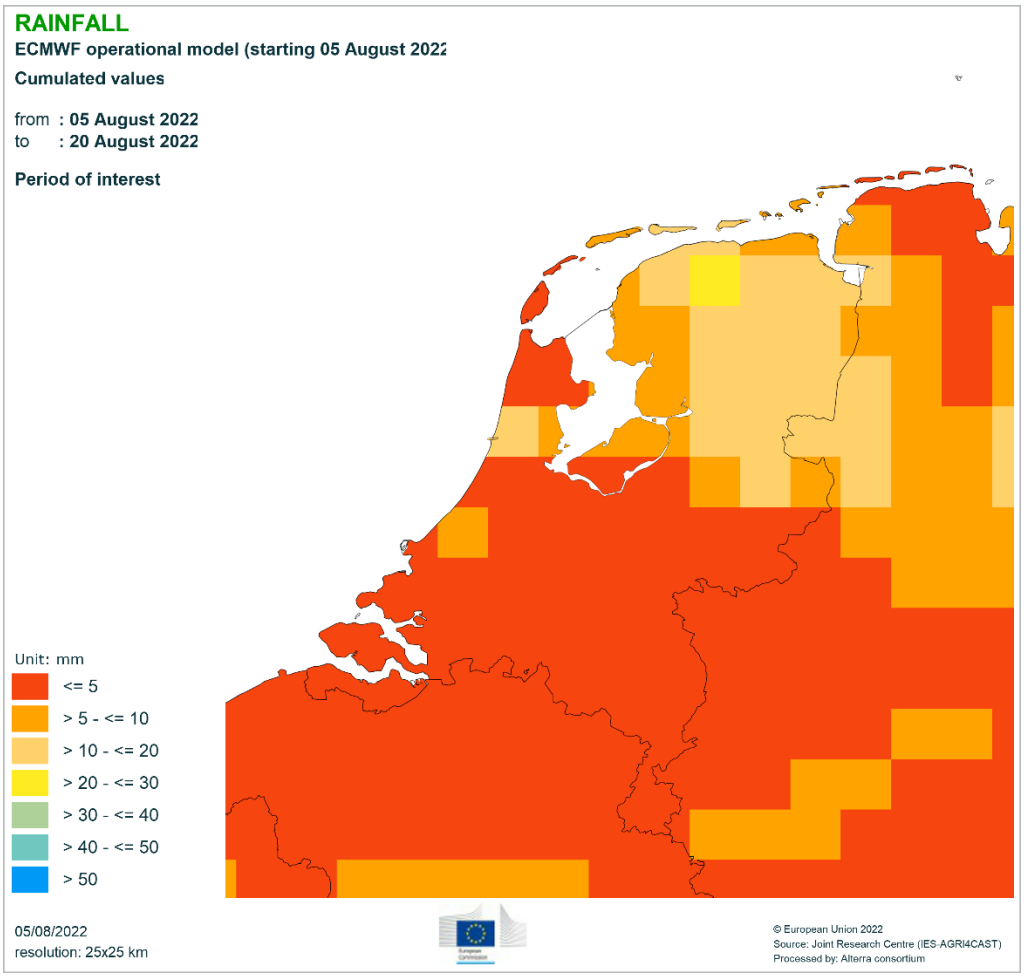

Figure 12: *Short term precipitation forecast from August 5th to August 20th 2022.*

Reported impacts

According to the JRC MARS Bulletin of July 2022[9] water stress causes concerns for agriculture in the southern part of the Netherlands. Yield expectations for potatoes in south-western parts of the Netherlands have been negatively impacted. With no rainfall in the coming period, summer crops yields may be also compromised. While restrictions in irrigation in the southern regions of the Netherlands were already in place in July 2022, the new decisions taken on 4 August will allow swift the implementation of more restrictions where locally necessary across

[9] https://publications.jrc.ec.europa.eu/repository/handle/JRC127963

the country. As reported by Reuters, low water levels in the Rhine River are impacting commercial navigation on the lower Rhine, operating at less than half capacity. Problems may arise for dike stability as many of them, and especially peat dikes, need to be kept wet as they require the weight of the water to maintain their strength.[10] With the low level of the Rhine, the function of "IJsselmeer" lake to prevent salt intrusion from the sea and to keep the polders wet to a certain minimum (avoiding cracking of clayey soil or peat) may be compromised.

Appendix

The Combined Drought Indicator (CDI) of the European Drought Observatory (EDO) is used to identify areas that may be affected by agricultural drought. The CDI is derived by combining the Standardized Precipitation Index (SPI), the Soil Moisture Index Anomaly (SMA), and the FAPAR anomaly. Areas are classified according to three primary drought classes: (1) "Watch", indicating that precipitation is less than normal; (2) "Warning", indicating that also soil moisture is in deficit; and (3) "Alert", indicating that also vegetation shows signs of stress. Two additional classes - "Partial recovery" and "Recovery" - identify the stages of the vegetation recovery process.

The Standardized Precipitation Index (SPI) provides information on the intensity and duration of the precipitation deficit (or surplus). SPI is used to monitor the occurrence of drought. The lower (i.e., more negative) the SPI, the more intense is the drought. SPI can be computed for different accumulation periods: the 3-month period is often used to evaluate agricultural drought and the 12-month period for hydrological drought, when rivers fall dry and groundwater tables lower.

Lack of precipitation induces a reduction of soil water content. The Soil Moisture Anomaly index provides an assessment of the deviations from normal conditions of root zone water content. It is a direct measure of drought associated with the difficulty of plants in extracting water from the soil.

[10] https://www.reuters.com/world/europe/dutch-government-declares-water-shortage-due-drought-2022-08-03/

The satellite-based fraction of Absorbed Photosynthetically Active Radiation (FAPAR) monitors the fraction of solar energy absorbed by leaves. It is a measure of vegetation health and growth. FAPAR anomalies, and specifically negative deviations from the long-term average, are associated with possible drought impacts on vegetation.

The Low-Flow Index (LFI) is based on the daily river water discharge simulated by the LISFLOOD hydrological model. It captures consecutive periods of unusually low streamflow. It compares the consequent water deficit during those periods with the historical climatological conditions.

The indicator for 'forecasting unusually wet and dry conditions' provides early risk information for Europe. The indicator is computed from forecasted SPI-1, SPI-3 and SPI-6 derived from the ECMWF seasonal forecast system SEAS5.

Glossary of terms and acronyms:

CEMS	Copernicus Emergency Management Service
EDO	European Drought Observatory
EC	European Commission
ECMWF	European Centre for Medium-Range Weather Forecasts
EFFIS	European Forest Fire Information System
ENTSO-E	European Network of Transmission System Operators for Electricity
ERA5	ECMWF Reanalysis v5
ERCC	European Emergency Response Coordination Centre
FAPAR	Fraction of Absorbed Photosynthetically Active Radiation
GDO	Global Drought Observatory
ICPR	International Commission for the Protection of the Rhine
JRC	Joint Research Centre
LFI	Low-Flow Index
MARS	Monitoring Agricultural ResourceS
SMA	Soil Moisture Index (SMI) Anomaly
SMI	Soil Moisture Index
SPI	Standardized Precipitation Index
WMO	World Meteorological Organization

EDO indicators versioning:

The GDO/EDO indicators appear in this report with the following versions:

EDO Combined Drought Indicator, v.2.1.0
EDO FAPAR (fraction of Absorbed Photosynthetically Active Radiation) Anomaly, v.1.3.2
GDO Indicator for forecasting unusually wet and dry conditions v .1.0.0
EDO Low Flow Index (LFI) , v.2.1.0
EDO Soil Moisture Anomaly (SMA) (version 2.1.1)
Standardized Precipitation Index SPI ERA5 (1/4-dd resolution)

Check https://edo.jrc.ec.europa.eu/download for more details on indicator versions.

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