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中国科学院空天信息创新研究院
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CropWatch

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Aerospace Information Research Institute (AIR), Chinese Academy of Sciences
P.O. Box 9718-29, Olympic Village Science Park
West Beichen Road, Chaoyang
Beijing 100101, China

This bulletin is produced by the CropWatch research team, Aerospace Information Research Institute (AIR), Chinese Academy of Sciences, under the overall guidance of Professor Bingfang Wu.

Contributors are Diego de Abelleyra (Argentina), Rakiya Babamaaji (NASRDA, Nigeria), Jose Bofana (Mozambique), Mengwei Chen (Henan, China), Sheng Chang, Mansour Djamel (Algeria), Abdelrazek Elnashar (Egypt), Li Fu, Zhijun Fu, Wenwen Gao (Shanxi, China), Yueran Hu, Yang Jiao (Hubei, China), Kangjian Jing, Hamzat Ibrahim (NASRDA, Nigeria), Riham Khozam(Syria), Mengxiao Li, Yuanchao Li, Zhongyuan Li (Hubei, China), Wenjun Liu (Yunnan, China), Xiaoyan Liu (Anhui, China), Yuming Lu, Zonghan Ma, Linghua Meng (Jilin, China), Elijah Phiri (Zambia), Elena Proudnikova (Russia), Xingli Qin, Igor Savin (Russia), Jatuporn Nontasiri (OAE, Thailand), Buchsarawan Srilertworakul (OAE, Thailand), Urs Christoph Schulthess (CIMMYT), Grace Simon Mbaiorga (NASRDA, Nigeria), Binfeng Sun (Jiangxi, China), Fuyou Tian, Huanfang Wang, Linjiang Wang, Mingxing Wang (Hubei, China), Qiang Wang (Anhui, China), Yixuan Wang, Yuandong Wang (Jiangxi, China), Zhengdong Wang, Bingfang Wu, Yan Xie, Cong Xu, Jiaming Xu (Zhejiang, China), Nana Yan, Leidong Yang, Zhishan Ye (Anhui, China), Hongwei Zeng, Miao Zhang, Weiye Zang (Hubei, China), Xiwang Zhang (Henan, China), Dan Zhao, Hang Zhao, Xinfeng Zhao, Yifan Zhao (Henan, China), Zhaoju Zheng, Liang Zhu, Weiwei Zhu, and Qifeng Zhuang (Jiangsu, China).

Editor: Zonghan Ma

Corresponding author: Professor Bingfang Wu
Aerospace Information Research Institute, Chinese Academy of Sciences
Fax: +8610-64858721, E-mail: **cropwatch@radi.ac.cn**, **wubf@aircas.ac.cn**

CropWatch Online Resources: The data and charts of this report are available at http://cloud.cropwatch.com.cn/.

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Abbreviations

5YA	Five-year average, the average for the four-month period from January to April for 2018-2022; one of the standard reference periods.
15YA	Fifteen-year average, the average for the four-month period from January to April of for 2008-2022; one of the standard reference periods and typically referred to as “average”.
AEZ	Agro-Ecological Zone
BIOMSS	CropWatch agroclimatic indicator for biomass production potential
BOM	Australian Bureau of Meteorology
CALF	Cropped Arable Land Fraction
CAS	Chinese Academy of Sciences
CPI	Crop Production Index
CWAI	CropWatch Agroclimatic Indicator
CWSU	CropWatch Spatial Units
DM	Dry matter
EC/JRC	European Commission Joint Research Centre
ENSO	EI Niño Southern Oscillation
FAO	Food and Agriculture Organization of the United Nations
GAUL	Global Administrative Units Layer
GVG	GPS, Video, and GIS data
Ha	hectare
Kcal	kilocalorie
MPZ	Major Production Zone
MRU	Mapping and Reporting Unit
NDVI	Normalized Difference Vegetation Index
OISST	Optimum Interpolation Sea Surface Temperature
PAR	Photosynthetically active radiation
PET	Potential Evapotranspiration
AIR	CAS Aerospace Information Research Institute
RADPAR	CropWatch PAR agroclimatic indicator
RAIN	CropWatch rainfall agroclimatic indicator
SOI	Southern Oscillation Index
TEMP	CropWatch air temperature agroclimatic indicator
Tonne	Thousand kilograms
VCIx	CropWatch maximum Vegetation Condition Index
VHI	CropWatch Vegetation Health Index
VHIn	CropWatch minimum Vegetation Health Index
W/m^2	Watt per square meter
CPI	Crop Production Index

Bulletin overview and reporting period

This CropWatch bulletin presents a global overview of crop stage and condition between January and April 2023, a period referred to in this bulletin as the JFMA (January, February, March and April) period or just the "reporting period." The bulletin is the 129th such publication issued by the CropWatch group at the Aerospace Information Research Institute (AIR) of the Chinese Academy of Sciences, Beijing.

CropWatch indicators

CropWatch analyses are based mostly on several standard as well as new ground-based and remote sensing indicators, following a hierarchical approach.

In parallel to an increasing spatial precision of the analyses, indicators become more focused on agriculture as the analyses zoom in to smaller spatial units. CropWatch uses two sets of indicators: (i) agroclimatic indicators—RAIN, TEMP, RADPAR, and potential BIOMSS, which describe weather factors and its impacts on crops. Importantly, the indicators RAIN, TEMP, RADPAR, and BIOMSS do not directly describe the weather variables rain, temperature, radiation, or biomass, but rather they are spatial averages over agricultural areas, which are weighted according to the local crop production potential; and (ii) agronomic indicators—VHIn, CALF, and VCIx and vegetation indices, describing the actual crop production and stresses experienced during the monitoring period. (iii) PAY indicators: planted area, yield and production.

For each reporting period, the bulletin reports on the departures for all seven indicators, which (with the exception of TEMP) are expressed in relative terms as a percentage change compared to the average value for that indicator for the last five or fifteen years (depending on the indicator).For more details on the CropWatch indicators and spatial units used for the analysis, please see the quick reference guide in Annex B, as well as online resources and publications posted at www.cropwatch.cn.

CropWatch analysis and indicators

The analyses cover large global zones; major producing countries of maize, rice, wheat, and soybean; and detailed assessments for Chinese regions, 45 major agricultural countries, and 228 Agro-Ecological Zones (AEZs).

This bulletin is organized as follows:

Chapter	Spatial coverage	Key indicators
Chapter 1	World, using Mapping and Reporting Units (MRU), 105 large, agro-ecologically homogeneous units covering the globe	RAIN, TEMP, RADPAR, BIOMSS
Chapter 2	Major Production Zones (MPZ), six regions that contribute most to global food production	As above, plus CALF, VCIx, and VHIn
Chapter 3	44 key countries (main producers and exporters) and 221 AEZs	As above, plus NDVI, GVG survey, and CPI
Chapter 4	China and seven agro-ecological zones	As above plus high-resolution images; Pest and crops trade prospects
Chapter 5	Production outlook, and updates on disaster events and El Niño.	
Online Resource	http://cloud.cropwatch.com.cn/	

Regular updates and online resources

The bulletin is released quarterly in both English and Chinese. E-mail **cropwatch@radi.ac.cn** to sign up for the mailing list or visit CropWatch online at **http://cloud.cropwatch.com.cn/**. Additionally, by accessing the website, you can obtain information on methods, overviews of major producing countries, and their trends in the medium and long term.

Executive summary

The current CropWatch bulletin describes world-wide crop condition and food production as appraised by data up to the end of April 2023. It is prepared by an international team coordinated by the Aerospace Information Research Institute, Chinese Academy of Sciences.

The assessment is based mainly on remotely sensed data. It covers prevailing agri-climatic conditions, including extreme factors, at different spatial scales, starting with global patterns in Chapter 1. Chapter 2 focuses on agroclimatic and agronomic conditions in major production zones in all continents. Chapter 3 covers the major agricultural countries that, together, make up at least 80% of production and exports (the "core countries") while chapter 4 zooms into China. Special attention is paid to the production outlook of main crop producing and exporting countries where major cereal and oil crops (maize, rice, wheat and soybean) are harvested this year or currently still in the field. Subsequent sections of Chapter 5 describe the global disasters that occurred from January to April 2023.

Agroclimatic conditions

Europe had its warmest January and the second warmest winter since the start of industrialization. Global warming does not only affect temperatures. Another record was set by tropical cyclone Freddy, which traversed the southern Indian Ocean for more than five weeks in February and March 2023. It was the longest-lasting and highest accumulated cyclone energy-producing **tropical cyclone** ever recorded worldwide. It started on February 5, 2023, off the coast of Australia and finally dissipated on March 14 over Mozambique. It caused flooding conditions in southeast Africa, mainly in Malawi. La Niña ended its unusually long cycle, which lasted for three years and caused droughts in East Africa and Argentina. It also brought abundant rainfall to Australia. The end of La Niña already improved the rainfall situation in Argentina and East Africa. Another noteworthy improvement is the end of the multi-year drought in the West of the USA. California benefitted from abundant precipitation caused by a series of so-called atmospheric rivers, which helped restore groundwater and replenish reservoirs.

Global crop production situation

In the current monitoring period, the Crop Production Index (CPI) for global crop production improved from 1.12 to 1.15, indicating slightly better conditions. It was still slightly lower than the 10-year average (CPI=1.16) and significantly lower than the 1.21 value obtained for 2020.

Maize: In Brazil, production of the less important first maize decreased, while the cultivation area and yield of second maize increased, bringing Brazilian maize production to 100.68 million tonnes (+10.3%). However, in Argentina, the drought caused a decrease in production by 9.6%. In Africa south of the Equator, rainfall was somewhat irregular, but all in all, production levels remained unchanged.

Early monitoring indicators of crop cultivation area based on remote sensing indicate that the progress of maize planting in the United States and Canada is slower, lagging behind by 8% and 10%, respectively. However, maize planting in most European countries is progressing much faster. Soil moisture conditions for crop establishment have been mostly favorable in North America and Europe. Global maize production is estimated to increase by 0.4% to 1,049 million tonnes.

Rice: Production of irrigated rice during the dry winter-season was generally normal in South and Southeast Asia, with small increases in rice production in Indonesia, Thailand, Vietnam and Sri Lanka. Small decreases in rice cultivation area in Bangladesh (-3%), Cambodia (-2.2%), Myanmar (-1.7%), India (-1.4%) and the Philippines (-0.8%) were estimated. The production also decreased in Angola (-4.5%), Argentina (-3%) and

Brazil (-0.6%) due to drought conditions. As a result, global rice production decreased by 0.5% to 750.87 million tonnes.

Wheat: Conditions for wheat production were rather favorable in India (+1.9%) and Pakistan (+1.2%), resulting in an increase by 1.9% and 1.2% respectively. In China, untimely frost and snow in April had caused yield reductions in Shanxi (-3.2%), western Hubei (-4.7%), and eastern Gansu (-4.4%). However, in the North China Plain, both area and yield increased in Henan and the neighboring provinces. At the national level, production increased by 1.8% to 136,33 million tonnes. In the USA, Kansas, an important winter wheat producer, continued to be affected by drought conditions. Wheat production in the USA is forecasted to drop by 5.2% to 48,870 million tonnes. Conditions in Morocco were slightly better than last year, resulting in an increase in production by 14.8% to 6.94 million tonnes. Similarly, production in Turkey is estimated to increase by 12.7% to 18.99 million tonnes. Winter wheat production in Western, Central and Eastern Europe benefitted from a mild winter with above average precipitation. Hence, a higher production than in 2022 can be expected. Global wheat production is estimated to increase by 0.7% to 745,53 million tonnes.

Soybean: The soybean production of Brazil and Argentina is only second to that of the United States. CropWatch predicts that Brazil's soybean production will reach 108.4 million tonnes (+13.9%) due to an expansion of the cultivated area and favorable weather conditions resulting in higher yields. In Argentina, the drought conditions caused a reduction in area and yield, resulting in a production by 18.9% to 42,01 million tonnes. Conditions for sowing have been favorable in North America and Europe. Global soybean production is estimated to increase by 2.2% to 327,17 million tonnes.

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Chapter 1. Global agroclimatic patterns

Chapter 1 describes the CropWatch Agroclimatic Indicators (CWAIs) rainfall (RAIN), temperature (TEMP), and radiation (RADPAR), along with the agronomic indicator for potential biomass (BIOMSS) in 105 global Monitoring and Reporting Units (MRU). RAIN, TEMP, RADPAR and BIOMSS are compared to their average value for the same period over the last fifteen years (called the “average”). Indicator values for all MRUs are included in Annex A table A.1. For more information about the MRUs and indicators, please see Annex B and online CropWatch resources at www.cropwatch.com.cn. Compared to the previous bulletin, some of the larger MRU with several different phenology and agroclimatic conditions have been subdivided. Thus, the number of MRU wad increased by 40 in this bullletin.

1.1 Introduction to CropWatch agroclimatic indicators (CWAIs)

This bulletin describes environmental and crop growth conditions over the period from January 2023 to April 2023, JFMA, referred to as "reporting period". CWAIs are averages of climatic variables over agricultural areas only inside each MRU and serve the purpose of identifying global climatic patterns. For instance, in the "Sahara to Afghan desert" MRU, only the Nile Valley and other cropped areas are considered. MRUs are listed in Annex B. Refer to Annex A for definitions and to table A.1 for 2023 JFMA numeric values of CWAIs by MRU. Although they are expressed in the same units as the corresponding climatological variables, CWAIs are spatial averages limited to agricultural land and weighted by the agricultural production potential inside each area.

We also stress that the reference period, referred to as "average" in this bulletin covers the 15-year period from 2008 to 2022. Although departures from the 2008-2022 are not anomalies (which, strictly, refer to a "normal period" of 30 years), we nevertheless use that terminology. The specific reason why CropWatch refers to the most recent 15 years is our focus on agriculture, as already mentioned in the previous paragraph. 15 years is deemed an acceptable compromise between climatological significance and agricultural significance: agriculture responds much faster to persistent climate variability than 30 years, which is a full generation. For "biological" (agronomic) indicators used in subsequent chapters we adopt an even shorter reference period of 5 years (i.e., 2018-2022). This makes provision for the fast response of markets to changes in supply.

Correlations between variables (RAIN, TEMP, RADPAR and BIOMSS) at MRU scale derive directly from climatology. For instance, the positive correlation between rainfall and temperature results from high rainfall in equatorial, i.e., in warm areas.

Considering the size of the areas covered in this section, even small departures may have dramatic effects on vegetation and agriculture due to the within-zone spatial variability of weather. It is important to note that we have adopted an improved calculation procedure of the biomass production potential in the bulletin based on previous evaluation.

1.2 Global overview

Europe had its warmest January and the second warmest winter on the 174 year record. Another record was set by tropical cyclone Freddy, which traversed the southern Indian Ocean for more than five weeks in February and March 2023. It was the longest-lasting and highest accumulated cyclone energy-producing tropical cyclone ever recorded worldwide. It had started on February 5, 2023, off the coast of Australia and finally dissipated on March 14 over Mozambique. It caused flooding conditions in southeast Africa, mainly in Malawi.

1.3 Rainfall

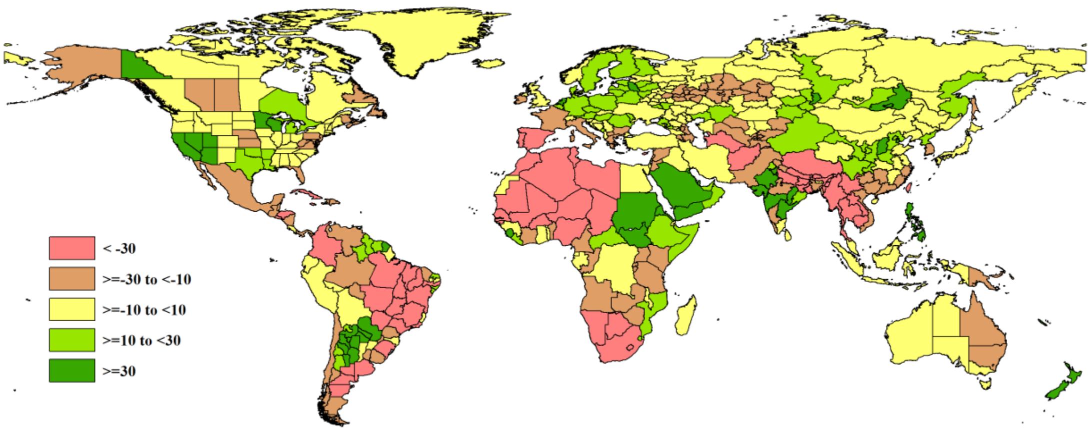

Figure 1.1 Global map of rainfall anomaly (as indicated by the RAIN indicator) by CropWatch Mapping and Reporting Unit: Departure of January 2023 to April 2023 total from 2008-2022 average (15YA), in percent.

Many important crop production regions around the globe suffered from moderate (-10 to -30%) or severe (<-30%) rainfall deficits, as compared to the 15YA. The most severe rainfall deficits were recorded for Central, Eastern and the Northeast of Brazil, the Caribbean and the Mexican Highlands in the Americas. Moderate deficits were observed for the Amazon basin and the Andes north of Argentina, as well as Central America. In the USA, only one region, the north of the High Plain, suffered from a rainfall deficit that was greater than 10%. In the other regions of the USA, conditions were average to above average. In Canada, parts of the Prairies also had a rainfall deficit. It is noticeable that the long lasting droughts in the west and southwest of the USA as well as in Argentina, have come to an end. Almost all regions bordering the Mediterranean continued to experience a rainfall deficit. The most severe ones with deficits greater than 30% were recorded for the Maghreb, Northeast Spain and southern France. The drought conditions also continued for the Levant and Central Asia, the Hindukush and Himalayas. Southern Africa also experienced severe or moderate rainfall deficits. The multi-year drought conditions in East Africa continued as well. All the mainland countries in Southeast Asia also had a severe rainfall deficit, whereas, in Southeast China, a moderate deficit was recorded. Most of the crop production regions of Australia also suffered from a rainfall deficit. Conditions were average or above average in Central and Eastern Europe and South Asia.

1.4 Temperatures

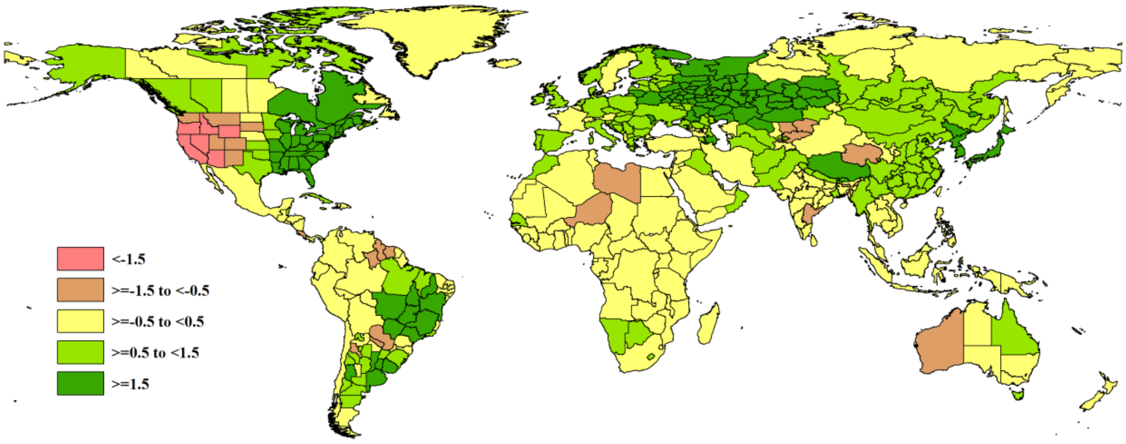

Figure 1.2 Global map of temperature anomaly (as indicated by the TEMP indicator) by CropWatch Mapping and Reporting , Unit: departure of January 2023 to April 2023 average from 2008-2022 average (15YA), in °C.

Temperatures were more than 1.5ºC warmer in Central and Eastern Brazil, the Eastern half of the USA, Russia west and east of the Ural, as well as Northeast China, the Koreas and Japan. Cooler than average temperatures in the range of -1.5 to -0.5ºC were recorded for the coastline along the Pacific Ocean in South America and the Western half of the USA. The strongest negative departures, exceeding -1.5ºC were recorded for the entire West coast of the USA. South West Australia also experienced cooler than normal temperatures.

1.5 RADPAR

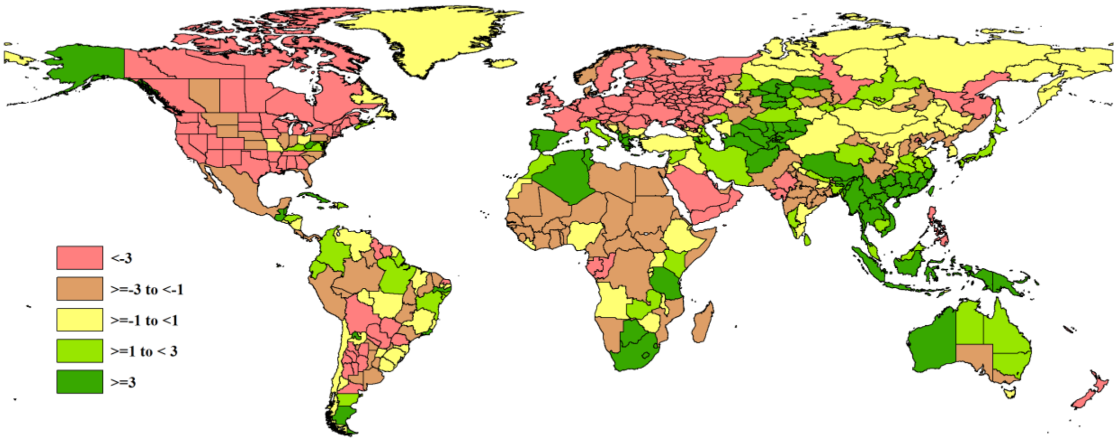

Figure 1.3 Global map of photosynthetically active radiation anomaly (as indicated by the RADPAR indicator) by CropWatch Mapping and Reporting Unit: departure of January 2023 to April 2023 average from 2008-2022 average (15YA), in percent.

In the important crop production regions of South America, photosynthetically active solar radiation (RADPAR) was below average. The strongest deficits were recorded for the Andes in Argentina and the coastlines of Chile and Peru. Conditions on Central America were average, whereas in most of Mexico and the entire USA, as well as the crop production regions of Canada either a severe negative departure exceeding -3% or a moderate departure in the range of -1 to -3% was observed. A strong positive departure was observed for the regions bordering the Mediterranean Sea. The other regions of Europe had a strong negative departure. In Africa, most regions south of the Equator had normal to above normal solar radiation, apart from the coastal zones in South-west Africa. Pakistan also had below average solar radiation. The weather was sunnier than usual in most of Central and southern China, as well as Southeast Asia and most of Australia.

1.6 BIOMSS

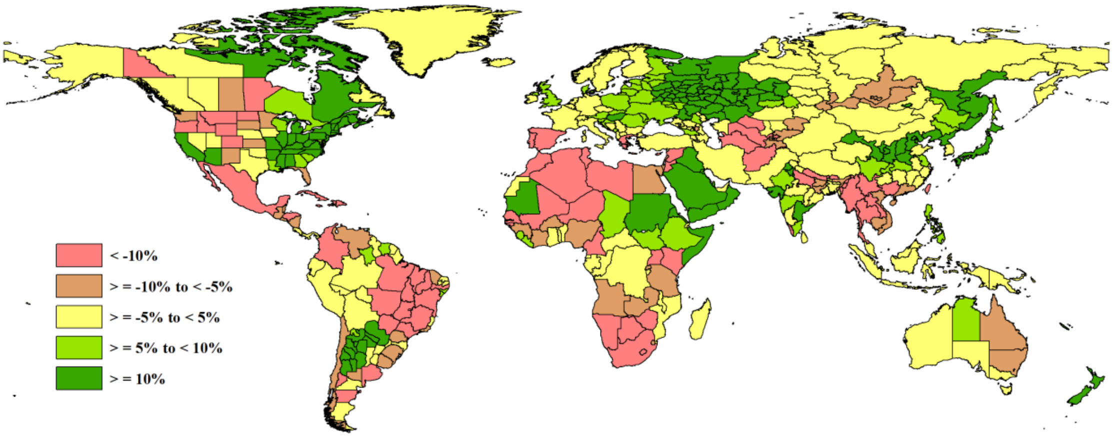

Figure 1.4 Global map of biomass accumulation (as indicated by the BIOMSS indicator) by CropWatch Mapping and Reporting Unit: departure of January 2023 to April 2023 average from 2008-2022 average (15YA), in percent

The most severe negative departure in estimated biomass, exceeding -5%, was observed for Central and northern Brazil, Central America and the Mexican Highlands as well as the High Plains in the USA. For the drought stricken Mediterranean basin, the Hindukush, Himalayas and Southeast Asia as well as the crop production regions in Australia, moderate (-2 to 5%) or severe (<-5%) departure was observed. In Africa, most regions south of the Sahel also had a moderate or severe negative departure. The west coast of the USA, as well as the eastern half of the USA, Central and Eastern Europe, South Asia and Northeast China, the Koreas and Japan, had above average biomass production, exceeding +5%.

Chapter 2. Crop and environmental conditions in major production zones

Chapter 2 presents the same indicators—RAIN, TEMP, RADPAR, and BIOMSS— as those used in Chapter 1, and combines them with the agronomic indicators—cropped arable land fraction (CALF), maximum vegetation condition index (VCIx), minimum vegetation health index (VHIn) and cropping intensity (CI)— to describe crop condition in six Major Production Zones (MPZ) across all continents. For more information about these zones and methodologies used, see the quick reference guide in Annex B as well as the CropWatch bulletin online resources at http://www.cropwatch.com.cn/htm/en/bullAction!showBulletin.action#.

2.1 Overview

Tables 2.1 and 2.2 present an overview of the agroclimatic (Table 2.1) and agronomic (Table 2.2) indicators for each of the six MPZs, comparing the indicators to their fifteen and five-year averages, respectively. The text mostly refers simply to "average" with the averaging period implied.

Table 2.1 Agroclimatic indicators by Major Production Zone, current value and departure from 15YA (January-April 2023)

	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
West Africa	107	-17	26.9	-0.3	1305	-1	568	-8
North America	363	4	5.8	1.3	723	-5	493	3
South America	372	-56	23.9	1.3	1149	-1	894	-22
S. and SE Asia	107	-24	23.5	0.1	1215	1	548	-3
Western Europe	303	-5	5.5	0.7	564	-4	504	-4
Central Europe and W. Russia	268	5	1.0	1.8	443	-9	406	10

*Note: Departures are expressed in relative terms (percentage) for all variables, except for temperature, for which absolute departure in degrees Celsius is given. Zero means no change from the average value; relative departures are calculated as (C-R)/R*100, with C=current value and R=reference value, which is the fifteen-year average (15YA) for the same period (January-April) for 2008-2022.*

Table 2.2 Agronomic indicators by Major Production Zone, current season values and departure from 5YA (January-April 2023)

	CALF (Cropped arable land fraction)		Maximum VCI
	Current	5A Departure (%)	Current
West Africa	54	-1	0.85
North America	38	-10	0.71
South America	99	0	0.87
S. and SE Asia	81	2	0.82
Western Europe	93	-2	0.87
Central Europe and W Russia	68	3	0.87

Note: See note for Table 2.1, with reference value R defined as the five-year average (5YA) for the same period (January-April) for 2018-2022.

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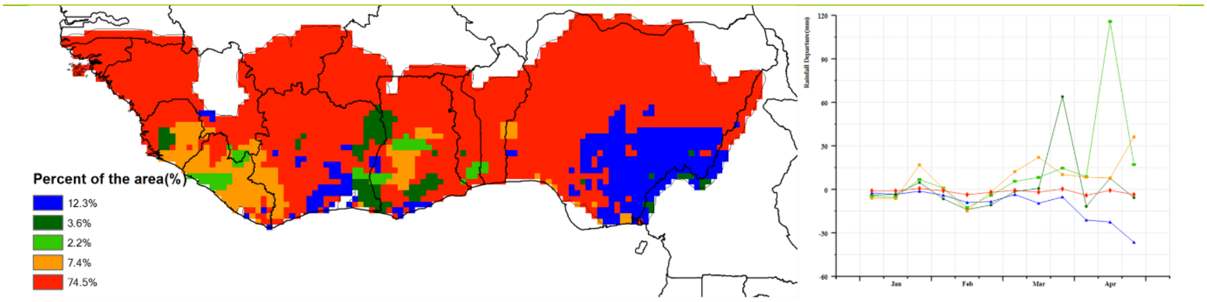
2.2 West Africa

This report covers the dry season in West Africa. Harvest of the main season crops ended in January. They include maize, sorghum, millet, and rainfed rice. In the coastal regions, maize, yam, and rice were grown.

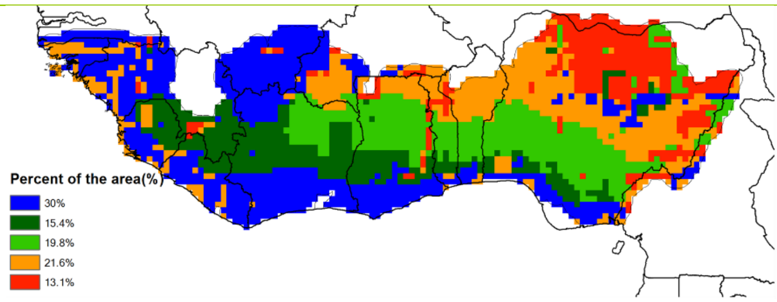
The climatic indicators for this MPZ from January to April showed a decrease in annual rainfall (107 mm, -14%), with the highest rainfall observed in Equatorial Guinea (1206, +4%), Gabon (1073 mm, -2%) and Liberia (503 mm, +26%). The rest of the MPZ (75%) experienced negative rainfall departures as observed in Guinea Bissau (0 mm, -97%), Burkina Faso (3 mm, -58%), Nigeria (75 mm, -41%), and Cote d Ivoire (167 mm, -19%). The temperature profiles indicated a regional average temperature of 26.7ºC (-0.3%) with negative temperature departures stratified from coastal areas to the northern parts of the region. In terms of agricultural activities, the coastal areas were predominantly cropped with rainfed crops. At the same time, the areas of the region's north remained uncropped due to the reduced rainfall events (dry season). The regional radiation potential was 1305 MJ/m2 (-1%), and the potential biomass production of 568 gDM/m^2 (-8%) reflected the reduced rainfall amounts during this reporting period. The MPZ region's Vegetative Health Index (VHI) varied from moderate to severe throughout the region and more severe in the northern parts of the MPZ. These climatic indicators indicated a dry season with reduced agricultural activities, as shown by the CALF and rainfall profiles.

Figure 2.1 West Africa MPZ: Agroclimatic and agronomic indicators, January – April 2023.

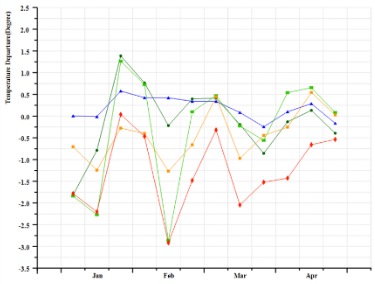


a. Spatial distribution of rainfall profiles

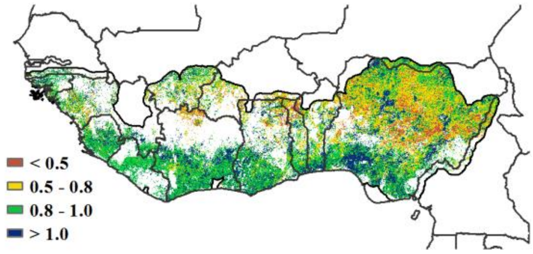
b. Profiles of rainfall departure from average (mm)



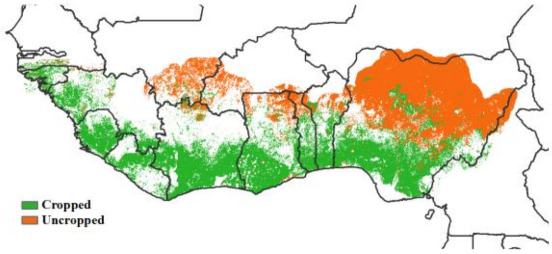
c. Spatial distribution of temperature profiles



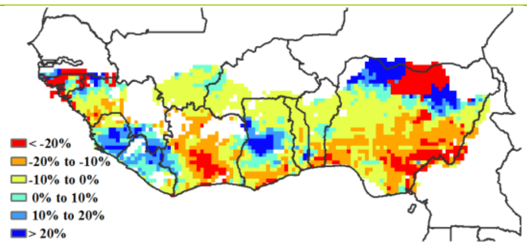
d. Profiles of temperature departure from average (mm)



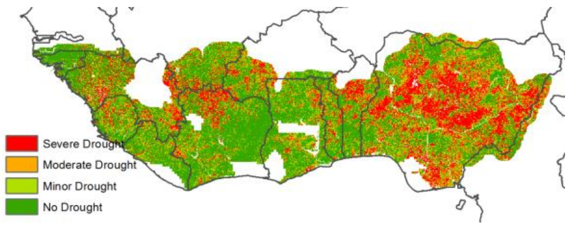
e. Maximum VCI



f. Cropped arable land



g. Biomass accumulation potential departure



h. VHI minimum

Note: For more information about the indicators, see Annex B.

2.3 North America

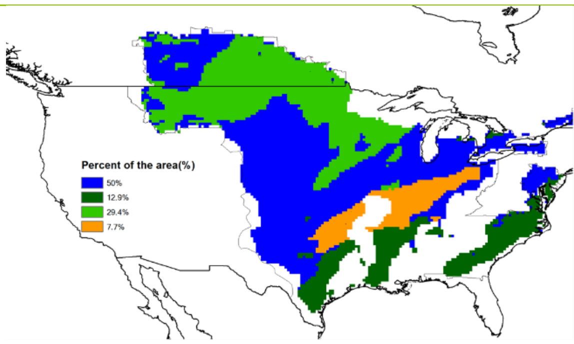
This reporting period runs from January to April 2023. It covers the growing season for the winter cereals, which includes the tillering, green-up, jointing and heading periods. Overall, crop conditions for winter cereals were poor due to severe drought in the major production regions, especially in Kansas and the surrounding states.

Agronomic conditions in North America were close to average, with rainfall and temperature above average (RAIN +4% and TEMP +1.3°C), while radiation was lower than average(RADPAR -5%) and biomass production potential was above average (BIOMSS +3%). The results of the cluster analysis showed that the temperature fluctuated dramatically in the main production areas. After a warm period in January, temperatures began to drop in late February, reaching 4-5°C below average in mid-March, affecting the winter wheat production areas of the Southern Plains. In mid-April, temperatures warmed up to 0-4°C above average. It seems that the unusually cold temperatures did not cause much damage to wheat, but they slowed its growth and development. Rainfall was rather stable and evenly distributed. In the Corn Belt and Great Plains, it was above average until March, after which it dropped to below average in the Southern Plains. However, during the previous observation period, persistent meteorological drought conditions in North Texas and Kansas were observed. That area continued to experience below average precipitation starting from mid March, resulting in a potential biomass estimation that was 20% below average.

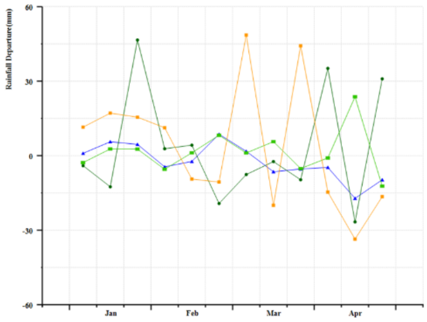
The VCIx value of 0.71 indicates average crop conditions. Regions with low VCIx values (<0.5) were mainly located in the southern part of the main winter wheat production area, coinciding with drought conditions indicated by the Minimum VHI map. CALF was 10% lower than the average of the last 5 years.

In summary, CropWatch assessed conditions for winter cereals for this monitoring period as below average. This period is a critical growth stage for winter wheat, and significantly reduced cropland acreage across the region and drought in the Southern Plains will result in below-average winter wheat yields in the region.

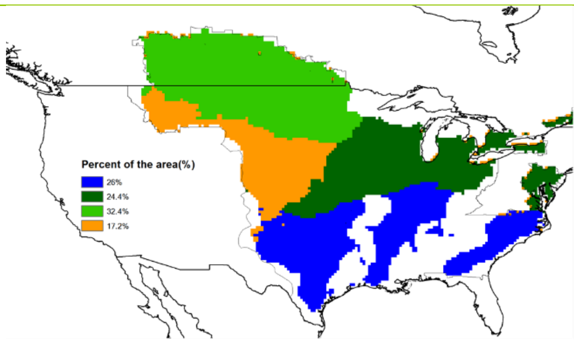
Figure 2.2 North America MPZ: Agroclimatic and agronomic indicators, January - April 2023.



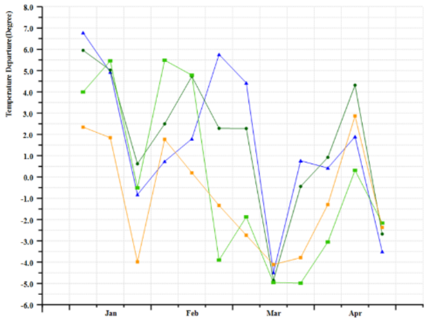
a. Spatial distribution of rainfall profiles



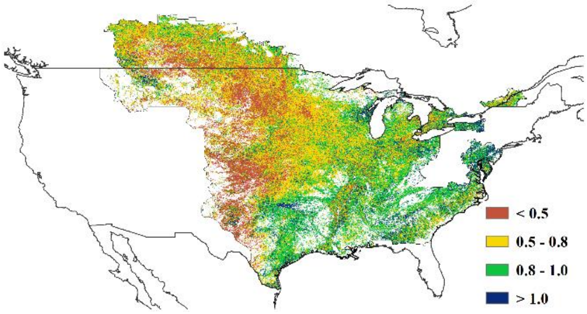
b. Profiles of rainfall departure from average (mm)



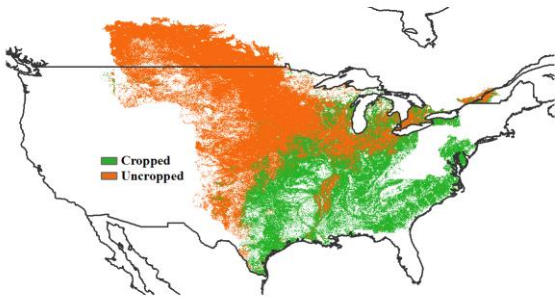
c. Spatial distribution of temperature profiles



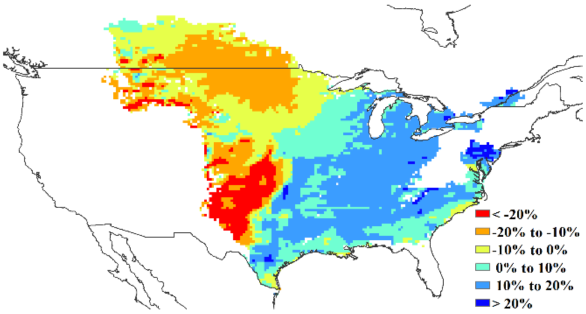
d. Profiles of temperature departure from average (mm)



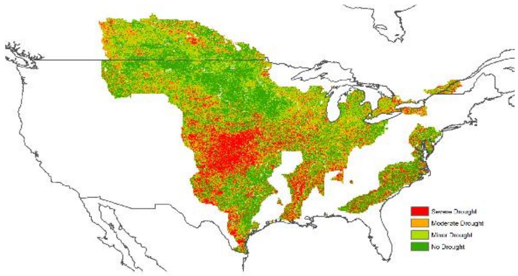
e. Maximum VCI



f. Cropped arable land



g. Biomass accumulation potential departure



h. VHI minimum

Note: For more information about the indicators, see Annex B.

2.4 South America

This reporting period covers the main growing period of early and late summer crops. Early crops include soybean, maize and rice and late crops include soybean and maize. The planting of late summer crops, as well as maturity and harvest of early summer crops took place during this reporting period. Conditions were poor in the North of the MPZ, while they improved in Argentina, which had suffered from drought conditions during the last reporting period.

The spatial distribution of rainfall profiles showed in most of the area slight or no anomalies (dark green pattern) with departure values fluctuating around +25 mm and -25 mm. Regions with this pattern include most of Pampas, Chaco and Mesopotamia in Argentina, Uruguay, Paraguay and Rio Grande do Sul, Santa Catarina and Paraná states in Brazil. A profile with high positive anomalies during January and early-February and moderate positive anomalies during late March and early April (light green profile) was observed in Subtropical Highlands and in small areas in North West Pampas in Argentina and in North West Paraná state in Brazil. A profile with moderate negative anomalies (near -50 mm) from January to March (blue profile) was observed in West Mato Grosso, South Mato Grosso do Sul, South Sao Paulo and Rio de Janeiro states in Brazil. Finally, an orange profile with strong negative anomalies from January to March (near -100 mm) was observed in East Mato Grosso, North Mato Grosso do Sul, North Sao Paulo, Goias and Minas Gerais in Brazil.

Temperature profiles showed five homogeneous profiles. A profile with strong positive anomalies during almost the entire reporting period (red profile) was observed in East Mato Grosso, Goias, Minas Gerais and North Sao Paulo states in Brazil. A pattern with moderate positive anomalies from mid-January to mid-February and from the end of February to the end of March (blue profile) was observed in West Mato Grosso, East Mato Grosso do Sul, Sao Paulo, South East Minas Gerais and Rio Grande do Sul in Brazil, and in Chaco and part of Subtropical Highlands in Argentina. A profile with moderate negative anomalies at the beginning of January, February and April and positive anomalies at the end of January and end of March was observed in Paraguay, North Chaco and North Mesopotamia in Argentina, and South Mato Grosso do Sul, Paraná and Santa Catarina States in Brazil. Finally, two profiles with similar variability in anomalies showing strong negative anomalies in mid-February and strong positive anomalies from the end of February to mid-March (light and dark green profiles) were observed all along the Humid Pampas in Argentina, Uruguay and South Rio Grande do Sul state in Brazil.

BIOMSS departure map showed poor conditions (more than -20 % departure) in Mato Grosso, Goias, Minas Gerais, Mato Grosso do Sul, and Sao Paulo states in Brazil and in South East and part of South West Pampas in Argentina. Moderate to poor conditions were observed in Rio Grande do

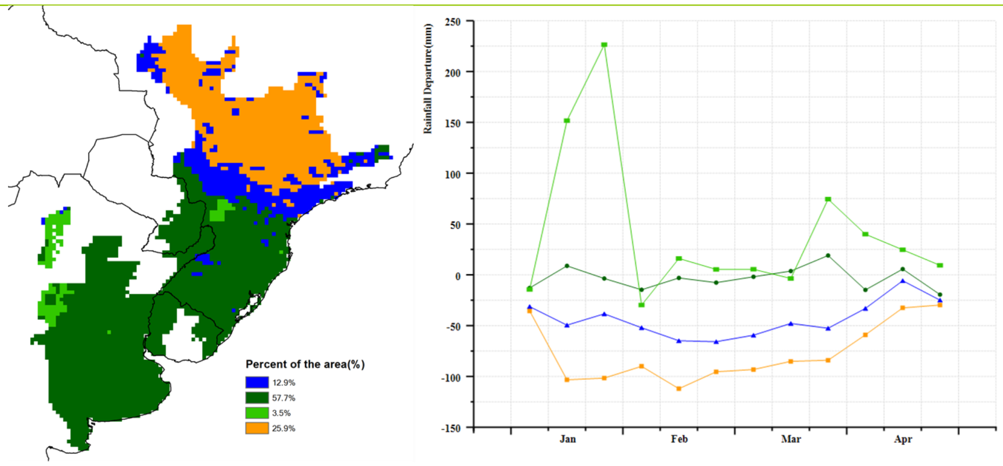
Sul in Brazil and North East Pampas and South Mesopotamia in Argentina. Positive anomalies in BIOMSS were observed in Paraná and Santa Catarina states in Brazil, in Paraguay and in Chaco, Subtropical Highlands and North West Pampas in Argentina.

Maximum VCI showed good conditions in Paraguay and most of Brazil, but showed low values in West Rio Grande do Sul state. Low VCI values were observed in West Uruguay and Center East, North East and part of South West Pampas, South Mesopotamia and East Chaco in Argentina. The other parts of Argentina showed good conditions. Unexpected differences between BIOMSS and VCIx were observed in the North of the MPZ, with low values in BIOMSS and normal conditions in VCIx. Differences in these indices are mainly that BIOMSS describes potential conditions derived from weather parameters (which showed anomalies in this region), while VCIx represents the actual crop condition with respect to historical observations based on NDVI. Poor BIOMSS but normal to high VCIx values in Brazil could have been the result of irrigation practices.

Crop Arable Land Fraction was almost complete, with the exception of a small portion in South West Pampas, showing a recovery from the last reporting period where several areas remained uncropped over Argentina.

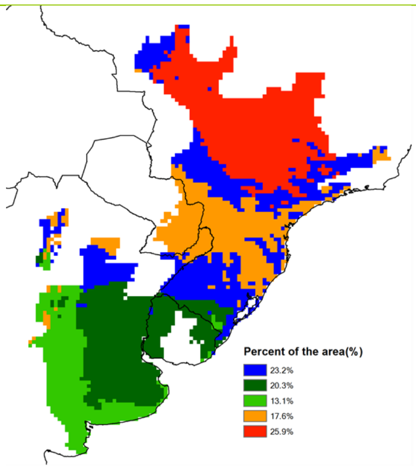
In summary, several indices showed poor weather conditions and low BIOMSS values in the North of the MPZ, while VCIx, which is derived from NDVI, presented a normal situation. In contrast, Argentine Pampas and southern Brazil showed poor conditions in both BIOMSS and VCIx, especially in East Pampas in Argentina and in Rio Grande do Sul in Brazil. Argentina also showed strong negative and positive anomalies during this period.

Figure 2.3 South America MPZ: Agroclimatic and agronomic indicators, January - April 2023.

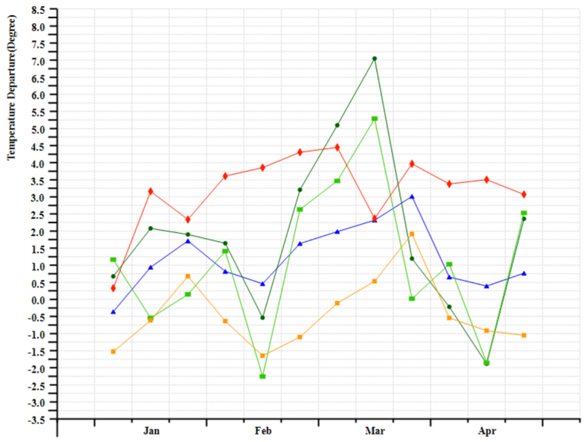


a. Spatial distribution of rainfall profiles

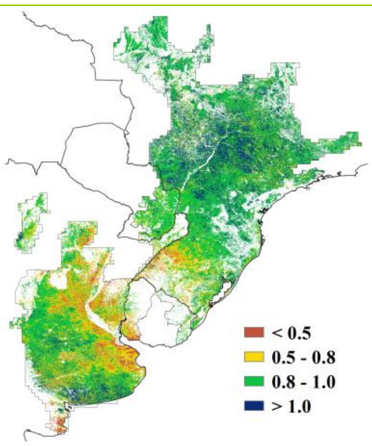
b. Profiles of rainfall departure from average (mm)



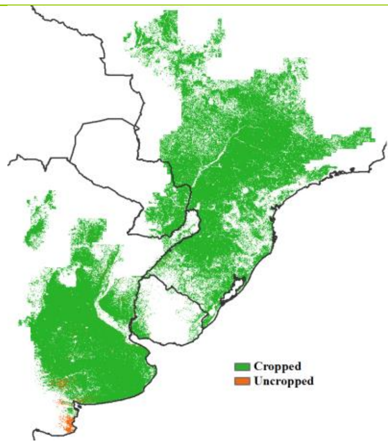
c. Spatial distribution of temperature profiles



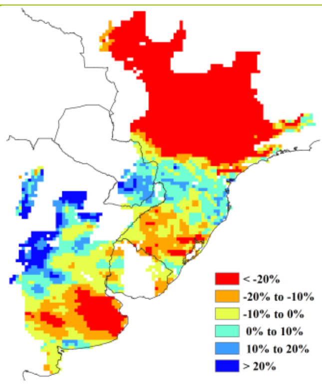
d. Profiles of temperature departure from average (mm)



e. Maximum VCI



f. Cropped arable land



g. Biomass accumulation potential departure

Note: For more information about the indicators, see Annex B.

2.5 South and Southeast Asia

The South and Southeast Asia MPZ includes India, Bangladesh, Cambodia, Myanmar, Nepal, Thailand, Laos and Vietnam. This monitoring period covers the harvesting period of winter crops (wheat), along with the sowing and the growing period of spring crops (rice, corn, and soybeans) in the region.

According to the agroclimatic and agronomic indicators, the RADPAR (+1%) was above the 15YA and the average temperature was slightly above the 15YA (TEMP +0.1℃), while the accumulated precipitation was below the 15YA (RAIN -24%), resulting in an estimated biomass decrease

(BIOMSS -3%). Compared with the 5YA, the CALF increased by 2% to 81%. The VCIx of the MPZ was 0.82, indicating favorable crop growth.

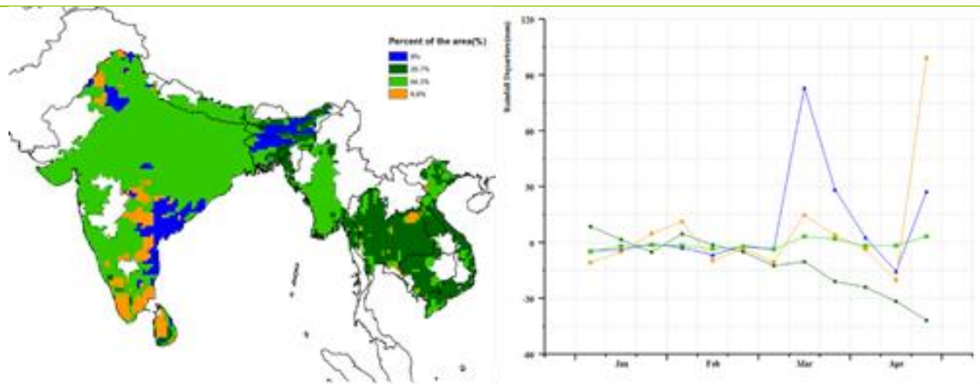
The spatial distribution of rainfall profiles shows that the precipitation for 8% of the MPZ (eastern, southeastern, and northwestern India, Bangladesh) exceeded the 15YA in mid-March, and then fluctuated around the average level. Starting from early February, the precipitation for 20.7% of the MPZ (eastern India, Thailand, Laos, Cambodia, and Vietnam) sustained a consistent decline and then fell below the average level around mid-February. The continuous reduction in precipitation has led to severe drought, resulting in adverse impacts on the growth of crops irrigated and causing the potential biomass in the region to be lower than the average for the same period. Throughout the monitoring period, 64.3% of the MPZ experienced precipitation levels close to the same period in previous years, mainly distributed in India, Nepal, and Myanmar. Around 6.9% of the MPZ (southern and northwestern India, Sri Lanka, and northeastern Thailand) had fluctuations in precipitation above and below the average level, with levels significantly exceeding the 15YA in late April.

According to the spatial distribution of temperature profiles, the average temperature in 26.4% of the MPZ (eastern and southern India, Sri Lanka, and southern Vietnam) was lower than the 15YA, except for late January and mid-April. The average temperature in 21.2% of the MPZ (India, Sri Lanka, Nepal, Bangladesh, and Myanmar) was slightly higher than the 15YA except for late March and early April. The average temperature in 1.7% of the MPZ (northern India, Nepal, and western Myanmar) was significantly higher than the 15YA. Moreover, the average temperature in 50.7% of the MPZ (northern India, Thailand, Laos, Cambodia, and Vietnam) fluctuated alternately above and below the average level.

The BIOMASS departure map displays that the potential biomass of southern and northwest India was 20% greater than the average for the same period, whereas the potential biomass in northern and eastern India, Myanmar, Thailand, and northern Vietnam was below the average. The Maximum VCI shows that the index in scattered areas of central Myanmar, eastern India, eastern Thailand, and western India was below 0.5. The VHI Minimum map shows that most of the MPZ were severely impacted by drought, except for some scattered areas and western India. The CALF map indicates that a significant portion of the region was planted, except for eastern and western India, northern Myanmar, and eastern Thailand.

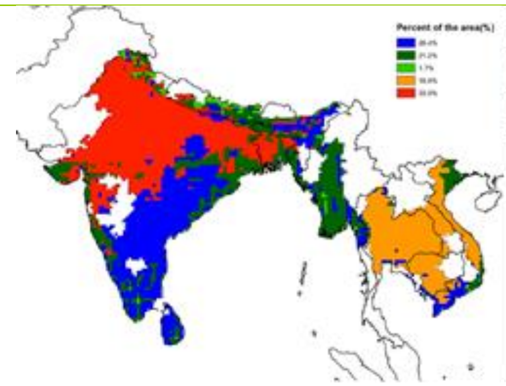
In general, the crop conditions in the MPZ have been impacted by drought and are expected to be below average.

Figure 2.4 South and Southeast Asia MPZ: Agroclimatic and agronomic indicators, January 2023 to April 2023.

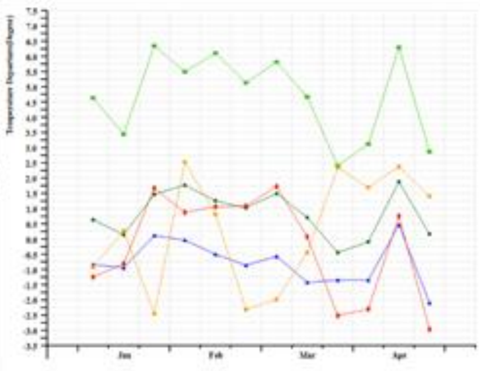


a. Spatial distribution of rainfall profiles

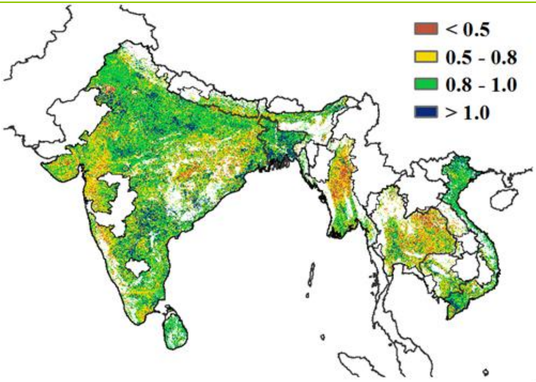
b. Profiles of rainfall departure from average (mm)



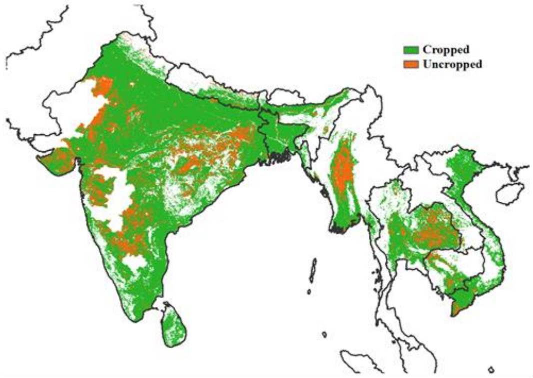
c. Spatial distribution of temperature profiles



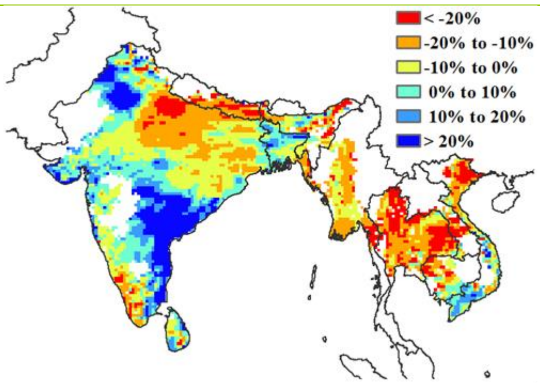
d. Profiles of temperature departure from average (mm)



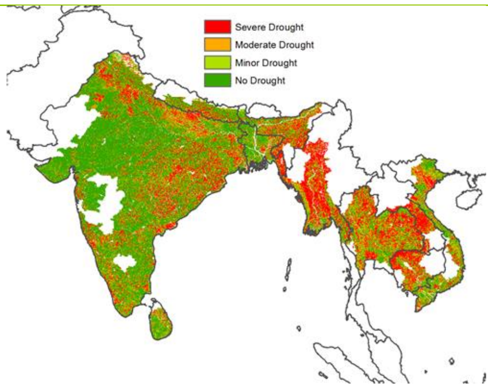
e. Maximum VCI



f. Cropped arable land



g. Biomass accumulation potential departure



h. VHI minimum

Note: For more information about the indicators, see Annex B

2.6 Western Europe

This reporting period runs from January to April 2023, which covers the over-wintering and spring green-up periods for the important winter cereals, and the sowing periods of the spring crop in the Western European Major Production Zone (MPZ). Crops in this region are mainly rainfed and agro-meteorological conditions play a crucial role. The south of France and Spain were affected by severe drought conditions. Crop conditions in the other regions of the MPZ were above average or close to average based on the interpretation of agro-climatic and agronomic indicators monitored by Cropwatch (Figure 2.5).

Overall, the temperature was above the 15YA (Temp, +0.7℃), the RADPAR and the accumulated precipitation were both below average (RADPAR -4%, RAIN -5%), and the continued precipitation deficit that had started last summer led to a decrease in the potential biomass (BIOMSS -4%). More than 93% of arable land was cropped, which was a decrease by 2% compared with the 5YA, and the uncropped areas of arable land were mainly located in the north-west of Italy, south-east France, eastern and south-east Spain, and a few pockets in parts of Germany, northern and south-west of France and the UK. The average maximum VCI for the MPZ reached a value of 0.87 during this reporting period, which is at a normal level.

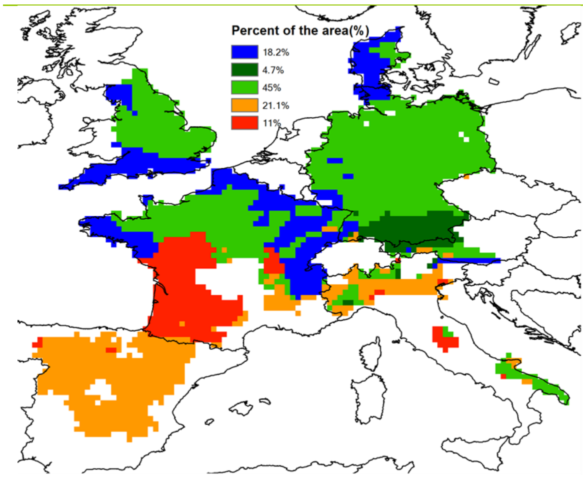
According to the spatial distribution of rainfall profiles, the spatial and temporal distribution of rainfall varies considerably between countries, and rainfall patterns can be characterized as follows: (1) Precipitation was significantly below average across almost the entire MPZ from late January to mid-February; (2) 21.1% of the MPZ (the orange area in Fig. 2.6a) received below-average precipitation for almost the entire monitoring period, except for mid-January when it was marginally above average. This includes most of Spain, most of northern Italy and the southern part of the Auvergne-Rhône-Alpes region; (3) Precipitation was below average in 11% of the MPZ (red areas in Fig. 2.6a), with the exception of early and mid-January, late-February, late-March and mid-late-April, when precipitation was well above average. This includes central Italy, most of Aquitaine Limousin Poitou-Charentes and Languedoc-Roussillon Midi-Pyrenees in France; (4) Precipitation was above average after late February in 4.7% of the MPZ (dark green areas in Fig. 2.6a), with the exception of below average precipitation in early March mainly in the south of Germany; (5) above average during the monitoring period only in early and mid-January and after March in 63.2% of the MPZ (blue and green areas in Fig. 2.6a). It mainly affected the UK, north-central Germany, and north-central France. The countries with the most severe precipitation deficits were Spain (RAIN -56%), Italy (RAIN -19%), France (RAIN -13%), and UK (RAIN -5%). The pronounced and intermittent precipitation deficit in the southern part of the MPZ may have negatively impacted winter crop growth, and may also have delayed the sowing and germination of spring crops in northern Italy, south-east France, and eastern and south-east Spain.

As shown in the spatial distribution of temperature profiles, 3.4 percent of the MPZ areas (northwestern Italy) experienced warmer-than-usual conditions throughout the monitoring period; 75.4 percent of the MPZ areas (UK, Germany, most parts of France and most parts of Italy) experienced significant below-average temperatures throughout the monitoring period, except for early and mid-January, mid-February, late-March and early-April; 21.2 percent of the MPZ areas (Spain and southwestern France) experienced warmer-than-usual conditions during the monitoring period, except for the period from late-January to early-March. The relatively mild weather in the MPZ has resulted in very limited winter frost damage to winter crops but may increase pest and disease pressure later in the season.

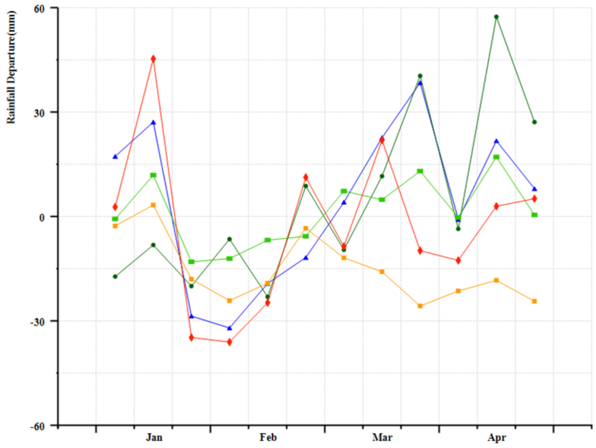
The lowest BIOMSS values (-20% and less) were observed for most parts of Spain and southern France. In contrast, BIOMSS was above average (+10% and more) mainly in western Frace, southern UK and center Germany. The VHI minimum map shows that some pockets of France, Germany, the UK, Spain and Italy were affected by short spells of drought conditions.

Generally, the conditions of winter crops in the MPZ were favorable, but more rain will be needed in several important crop production areas to ensure an adequate soil moisture supply during the grain-filling phase of the winter cereals and growth of summer crops.

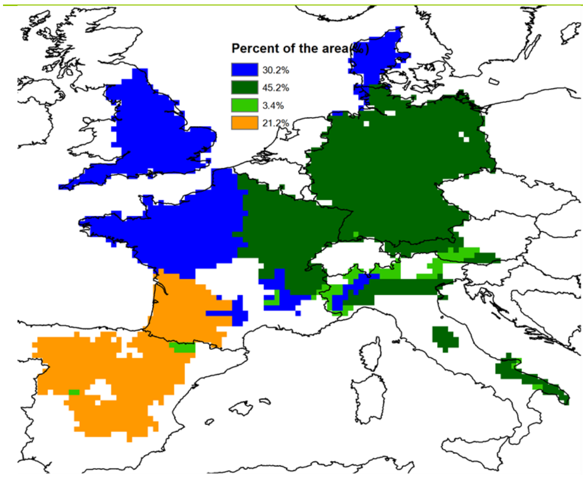
Figure 2.5 Western Europe MPZ: Agroclimatic and agronomic indicators, January-April 2023.



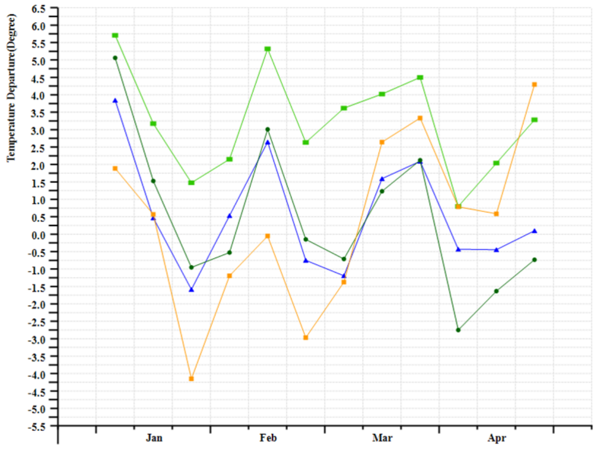
a. Spatial distribution of rainfall profiles



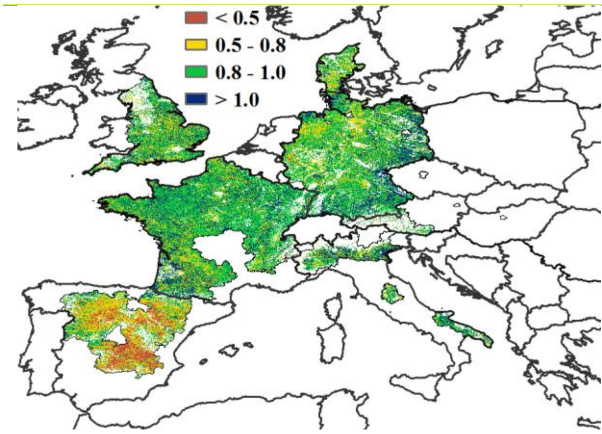
b. Profiles of rainfall departure from average (mm)



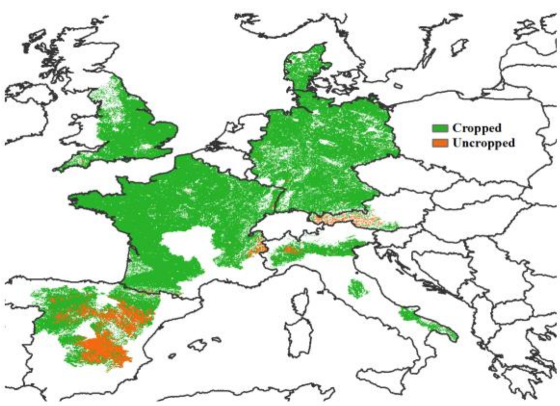
c. Spatial distribution of temperature profiles



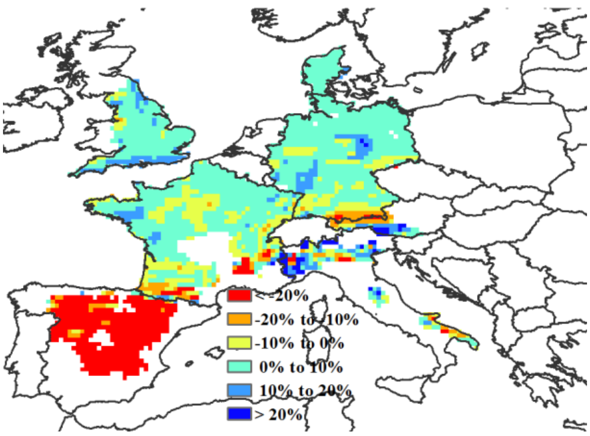
d. Profiles of temperature departure from average (mm)



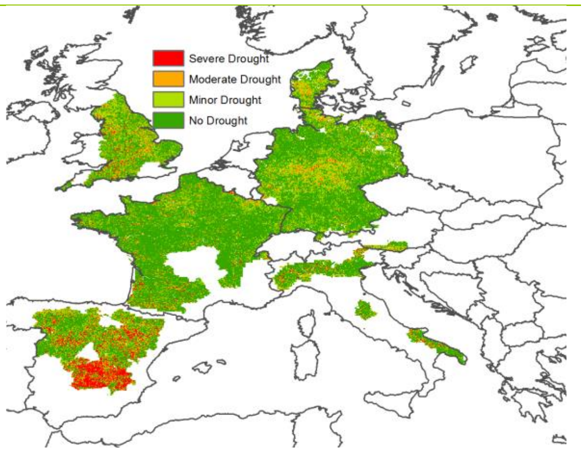
e. Maximum VCI



f. Cropped arable land



g. Biomass accumulation potential departure



h. VHI minimum

Note: For more information about the indicators, see Annex B.

2.7 Central Europe to Western Russia

This monitoring period covers the dormant winter season and the spring green-up of winter cereals in Central Europe and Western Russia. In general, the RADPAR was lower than average(-9%), with higher TEMP(+1.8℃), and rainfall(+5%), which was conducive to the sowing and growth of crops in most areas of the MPZ. Crops of this region are mainly rainfed, the agro-meteorological conditions play a decisive role in crop growth.

According to the spatial distribution map of precipitation distance level clustering, the precipitation in most areas of the MPZ fluctuated above and below the average value during this monitoring period. The spatial and temporal distribution characteristics were as follows: in mid-January, 19.3% of precipitation in the MPZ was significantly high, and then in late January, precipitation in the region returned to the average level. It was mainly concentrated in most regions of Belarus, Slovakia, and Hungary, as well as in eastern Poland, western Romania, and western Russia; from early February to late March, the variation of precipitation in the MPZ fluctuated less, among which the precipitation in the MPZ was above average in late February and late March; in April, regional precipitation continued to intensify in 23.1% of the MPZ until late April, when the region reached its maximum precipitation, mainly in southwestern Russia and in eastern Ukraine.

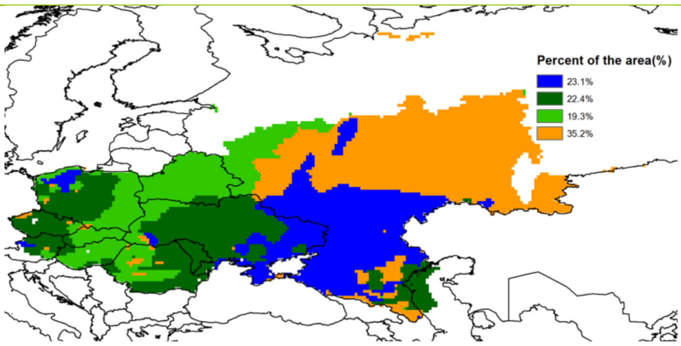
The map of the distribution of average temperature levels shows that in January, the trend of temperature changes in the MPZ showed significant east-west differences, with significant temperature increases in the eastern part of the MPZ (68.3% of the MPZ), mainly in western Russia, eastern Ukraine, and eastern Belarus; the western part of the MPZ (31.7% of the MPZ) reached the highest temperatures in the first half of January, followed by a gradual decrease in temperatures in the region until the first half of February, when temperatures in the region were below average, mainly in the central part of Europe; from late January to early April, 47.2% of the regions in the MPZ had above-average temperatures, mainly in west-central Russia and eastern Belarus.

During the monitoring period, the potential cumulative biomass in the MPZ was 10% higher than the average level. The potential cumulative biomass in most areas of the MPZ has increased to varying degrees. The potential cumulative biomass in the northeast of the MPZ is more than 10% higher, and the central and western regions of Russia are more than 20% higher. Affected by the drought in some areas, only a small part of the MPZ has low potential cumulative biomass. The areas with possible cumulative biomass lower than 20% are mainly distributed in southern Russia and southern Ukraine.

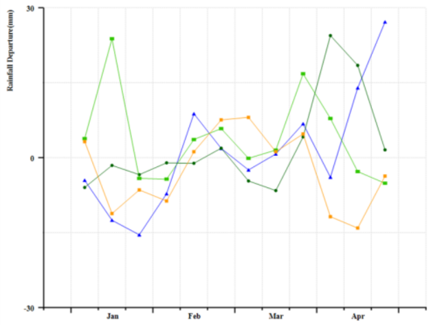
From January 1 to April 30, the cropped arable lands proportion was 68% (3% above average). The uncropped areas are mainly distributed in the northeastern part of Russia, and Ukraine. The average maximum VCI for the MPZ reached a value of 0.87. Despite the high potential cumulative biomass, most of northern Russia and northern Ukraine in the MPA had an optimal vegetation condition index below 0.8, mainly due to uncultivated land. The VHI minimum map shows that the drought has affected the eastern part of the MPA and parts of Belarus.

Overall, CropWatch agroclimatic and agronomic indicators show that during this monitoring period, crop growth was expected to be above average and food production was expected to be high.

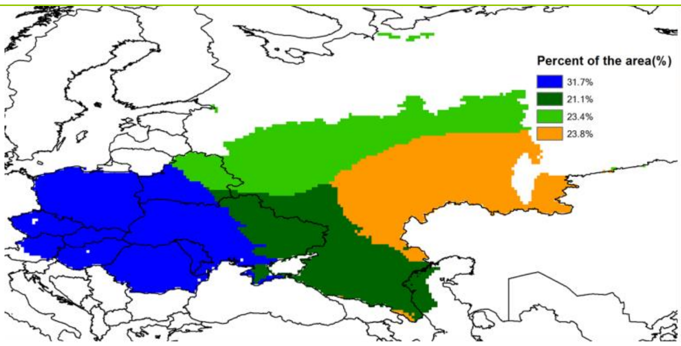
Figure 2.6 Central Europe to Western Russia MPZ: Agroclimatic and agronomic indicators, Juanuary-April 2023.



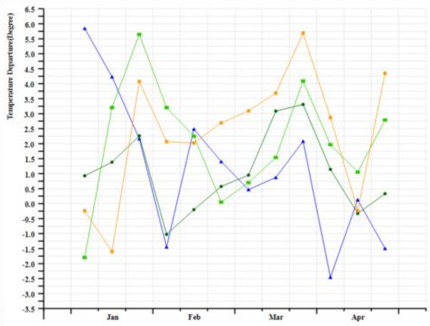
a. Spatial distribution of rainfall profiles



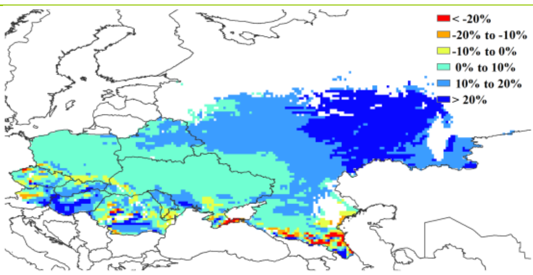
b. Profiles of rainfall departure from average (mm)



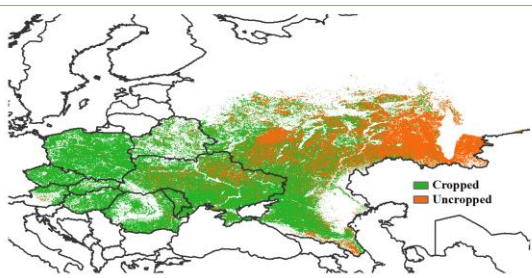
c. Spatial distribution of temperature profiles



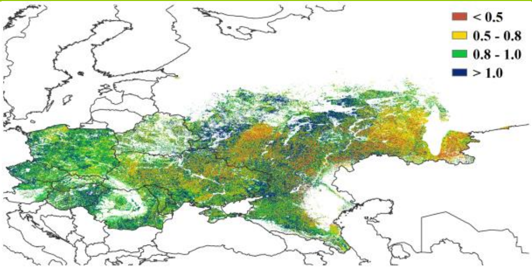
d. Profiles of temperature departure from average (℃)



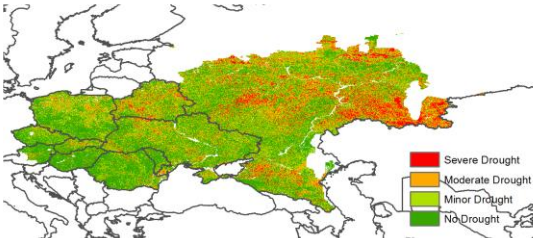
e. Biomass accumulation potential departure



f. Cropped arable land



g. Maximum VCI



h. VHI minimum

Note: For more information about the indicators, see Annex B.

Chapter 3. Core countries

3.1 Overview

Chapter 1 has focused on large climate anomalies that sometimes reach the size of continents and beyond. The present section offers a closer look at individual countries, including the 44 countries that together produce and commercialize 80 percent of maize, rice, wheat, and soybean. As evidenced by the data in this section, even countries of minor agricultural or geopolitical relevance are exposed to extreme conditions and deserve mentioning, particularly when they logically fit into larger patterns.

The global agro-climatic patterns that emerge at the MRU level (chapter 1) are reflected with greater spatial detail at the national and sub-national administrative levels described in this chapter. The "core countries", including major producing and exporting countries are all the object of a specific and detailed narrative in the later sections of this chapter, while China is covered in Chapter 4. Sub-national units and national agro- ecological zones receive due attention in this chapter as well.

In many cases, the situations listed below are also mentioned in the section on disasters (chapter 5.2) although extreme events tend to be limited spatially, so that the statistical abnormality is not necessarily reflected in the climate statistics that include larger areas. No attempts are normally made, in this chapter, to identify global patterns that were already covered in Chapter 1. The focus is on 166 individual countries and sometimes their subdivisions for the largest ones. Some of them are relatively minor agricultural producers at the global scale, but their national production is nevertheless crucial for their population, and conditions may be more extreme than among the large producers.

1. Overview of weather conditions in major agricultural exporting countries

The current section provides a short overview of prevailing conditions among the major exporters of maize, rice, wheat, and soybeans, conventionally taken as the countries that export at least one million tons of the covered commodities. There are only 20 countries that rank among the top ten exporters of maize, rice, wheat, and soybeans respectively. The United States and Argentina rank among the top ten of all four crops, whereas Brazil, Ukraine and Russia rank among the top ten of three crops.

Maize: Maize exports have been dominated by just 4 countries: USA, Brazil, Argentina and Ukraine. Together, they have supplied three quarters of maize being traded internationally. So far, the Ukraine has been able to sustain exports at a relatively high level, despite the war. Above average precipitation in recent months has helped with replenishing soil moisture and provided favorable conditions for maize planting and crop establishment. However, many other factors, such as the cost and availability of inputs and the war situation, impact production levels as well. In Argentina, conditions for maize production were generally unfavorable, although the rainfall situation gradually improved over the summer months. However, yields of late sown maize are generally lower. While precipitation in Brazil was also far below average, it was still sufficient to ensure good yields. In the USA, a cool spring, yet combined with favorable moisture conditions, delayed the sowing and germination of maize. However, prospects for USA maize production remain favorable. Maize production in South Asia, as well as in Southern Africa, is mostly for domestic consumption. In South Asia, maize production during the dry winter months usually takes place under irrigated conditions.

They were generally favorable, although high temperatures during the grain filling period were recorded in Bangladesh and India. In South-East Asia, drier than usual conditions caused water stress conditions. However, rainfall was still sufficient in the first half of the growing season. In East Africa south of the Equator, the prolonged drought impacted production in Tanzania and Kenya. Whereas in southern Africa, rainfall tended to be irregular, yet on average, it was sufficient to ensure normal production.

Rice: Conditions for winter (Rabi) season rice production were generally favorable in India, the largest rice exporter. The region of irrigated dry season (Boro) rice production is limited to West Bengal, Telangana, Andhra Pradesh and Assam. However, Boro rice yields are much higher than those obtained in the Kharif (rainy) season. Another region with important dry season rice production is Southeast Asia. Thailand and Vietnam rank in the 2nd and the 3rd position of exporting countries. In these two countries, crop conditions were favorable, thanks to average water levels in the Mekong river. However, the rainfall deficit registered during this monitoring period may negatively impact rice production in the coming months. In anticipation of drought conditions, Thailand already asked its farmers to reduce the irrigation of paddy fields. Conditions in the Philippines and Indonesia were favorable. In Brazil, the prolonged rainfall deficit hampered the production of rice in Rio Grande do Sul, the main rice-producing state. Similarly, Entre Rios and Corrientes, the two main rice production provinces of Argentina, also suffered from drought conditions, which negatively impacted production levels. In the USA, favorable rainfall conditions in California and the South, will help ensure good conditions for rice planting.

Wheat: During this monitoring period, wheat reached maturity in the Maghreb, Middle East and South Asia. Production in the Maghreb, which predominantly takes place under rainfed conditions, suffered from a severe rainfall deficit. Conditions were better than last year, but still below average. Drought conditions prevailed in Jordan and Syria, whereas in Iran, conditions were close to normal. For Afghanistan, low production levels are anticipated, due to the multi-year drought and bad governance. In South Asia, which includes the second largest wheat producer, India, as well as Pakistan, conditions were normal. Wheat reached maturity before the onset of the first heat waves. In the USA, dry conditions in Kansas, the most important winter wheat producing state, and the surrounding regions prevailed. Below average production has to be expected. In Canada, conditions were normal for Ontario. In southern Europe, the regions bordering the Mediterranean Sea were affected by drought conditions. Conditions were favorable in Western, Central and Eastern Europe. Precipitation levels ranged from average to above average and temperatures were also warmer than usual. In China, conditions for winter wheat production were favorable.

Soybean: In the USA, Canada and Ukraine, soybean sowing started at the end of this monitoring period, in late April. Soil moisture conditions are mostly favorable in these countries, but in Ukraine, the war causes high uncertainties for its production and export. Argentina, Brazil, Paraguay and Uruguay produce more than half of the world's soybeans traded on the international market. Soybean production in Argentina and neighboring Uruguay was hampered by drought conditions, causing large yield losses. Conditions were favorable in Paraguay and Brazil.

2. Weather anomalies and biomass production potential changes

2.1 Rainfall

In South America, rainfall was far below average in most countries. The only exceptions were the Dry Pampas and the foothills of the Andes in Argentina and Paraguay, where rainfall exceeded the 15YA by more than 30%. Only Bolivia, Ecuador and Peru had average rainfall, although the distribution within these countries was not even. The highlands in the Andes were impacted by drought conditions, which caused a reduction in potato and maize production. The coastal regions of Peru faced several floods. Despite the large rainfall deficit in Brazil, rainfall levels were generally still sufficient to ensure good crop production in most of the country. All of Central America, including Mexico, suffered from a severe rainfall deficit. However, most of the crop production takes place during the summer months in that region. Abundant rainfall ended the prolonged drought in the West and Southwest of the USA. Above average precipitation was also recorded for the South of the USA. Only Kansas, which is important for US winter wheat production, continued to be affected by a rainfall deficit in the range of -10 to -30%.

The Iberian Peninsula was affected by a rainfall deficit of more than 30%. Winter wheat production in the Maghreb was also reduced by the second year of drought conditions in a row. Conditions in France and Italy generally improved, although the deficit was still in the range of -10 to -30%. Normal to above normal precipitation was registered for Central and Eastern Europe, and Turkey.

Apart from the Maghreb, Egypt and Sudan, crop production during this period is not relevant in Africa north of the Equator. Hence, the general rainfall deficits had a limited impact on local food production. Rainfall in southern Africa was somewhat irregular, but still sufficient to sustain crop production. However, Kenya and Tanzania continued to be affected by the multi-year drought conditions.

The prolonged drought conditions in Afghanistan continued, hampering the production of winter wheat. In the Indo-Gangetic Plains, most winter wheat production takes place under irrigation. Hence, the rainfall deficit had little impact on wheat production. Rainfall conditions turned from normal to below normal for mainland South-East Asia and Southern China. This will negatively impact water flow in the Mekong River in the coming months. Precipitation was normal to above normal in Central and Northern China.

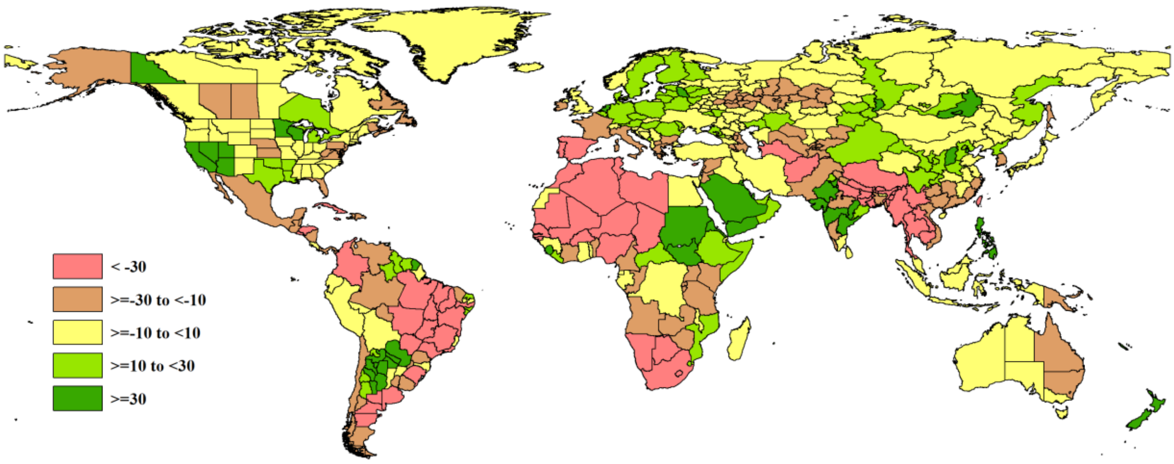


Figure 3.1 National and subnational rainfall anomaly (as indicated by the RAIN indicator) of January 2023 to April 2023 total relative to the 2008-2022 average (15YA), in percent

3.2 Temperatures

The temperature profile tends to show opposite trends as compared to rainfall. Regions with above-average rainfall experienced relatively cooler conditions, whereas, in dryer-than-usual regions, temperatures were above average. Temperatures in most of South America were above average. Especially in Brazil and Argentina. However, in those countries, they do not tend to limit crop production. In the USA, the West experienced below, and the East above average temperatures. In Europe, including the regions of Eastern Ural, temperatures ranged from average to above average. Notably, the milder temperatures were combined with more humid conditions. In most of China, temperatures were warmer than usual. For almost all of Africa, average temperatures had been recorded.

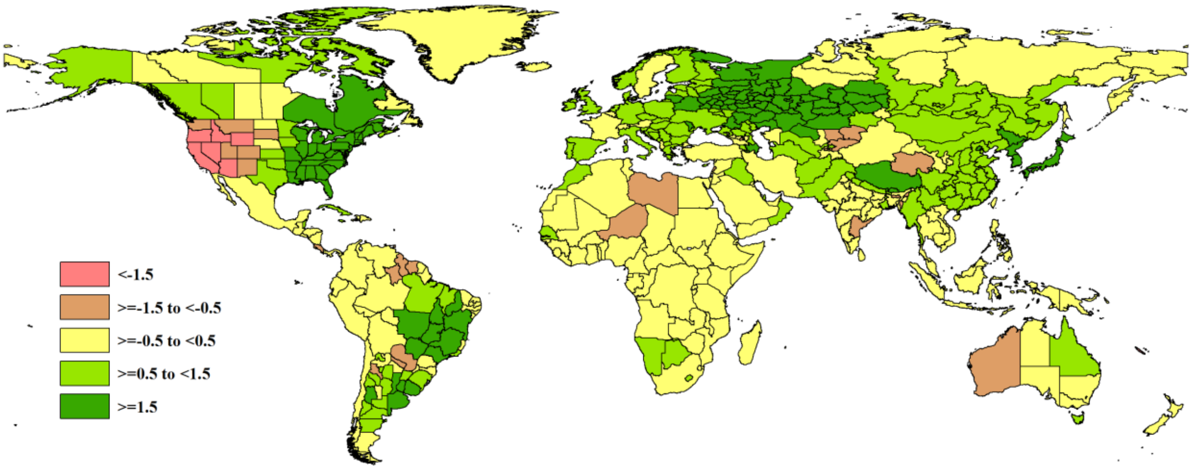


Figure 3.2 National and subnational sunshine anomaly (as indicated by the TEMP indicator) of January 2023 to April 2023 total relative to the 2008-2022 average (15YA), in °C

3.3 RADPAR

In Argentina and Brazil, conditions continued to be heterogeneous. However, negative departures dominated these 2 countries. Almost all of North America experienced below average solar radiation levels to various degrees. Solar radiation was below average by more than -3% in Western, Central and Eastern Europe. The Iberian Peninsula and Maghreb, which had been affected by drought conditions, had above average levels of solar radiation. In south-eastern Africa, solar radiation also tended to be above average, whereas it was generally below average in the other African nations. Central Asia experienced above average solar radiation levels, whereas the opposite was the case for South Asia. All of South-East Asia and southern China had above average solar radiation levels.

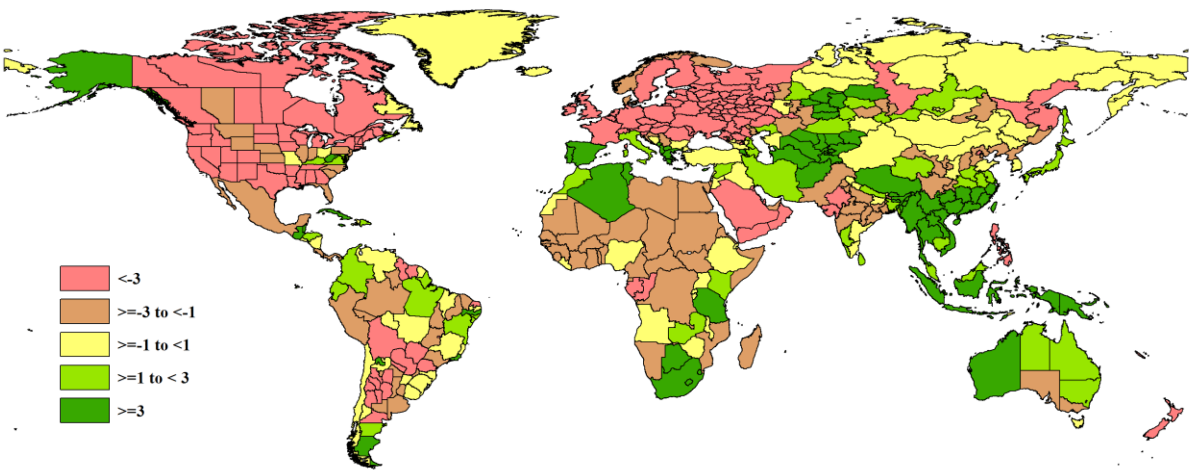


Figure 3.3 National and subnational sunshine anomaly (as indicated by the RADPAR indicator) of January 2023 to April 2023 total relative to the 2008-2022 average (15YA), in percent

3.4 Biomass production

The BIOMSS indicator is controlled by temperature, rainfall, and solar radiation. In some regions, rainfall is more limiting, whereas in other ones, mainly tropical ones, solar radiation tends to be the limiting factor. For high-latitude regions, the temperature may also limit biomass production. In the central and eastern crop production regions of Brazil, the estimated biomass production was mostly far below average (<-10%). The opposite was the case for the Dry Pampas of Argentina Paraguay, where biomass production was above the 15YA by more than 10%. Conditions were less favorable in Central America. For California and the Eastern halves of the USA and Canada, above average production was estimated in the range of +5 to above

+10%. In the drought-stricken Iberian Peninsula and the Maghreb, production was estimated to be below the 15YA by more than -10%. Normal to above normal production estimates were calculated for the rest of Europe. A drop in biomass production was estimated for southern Africa, whereas above average production levels were calculated for the Horn of Africa. In Central Asia, production levels were far below average (<-10%), as well as in mainland Southeast Asia. For most of China, normal to above normal production levels were estimated.

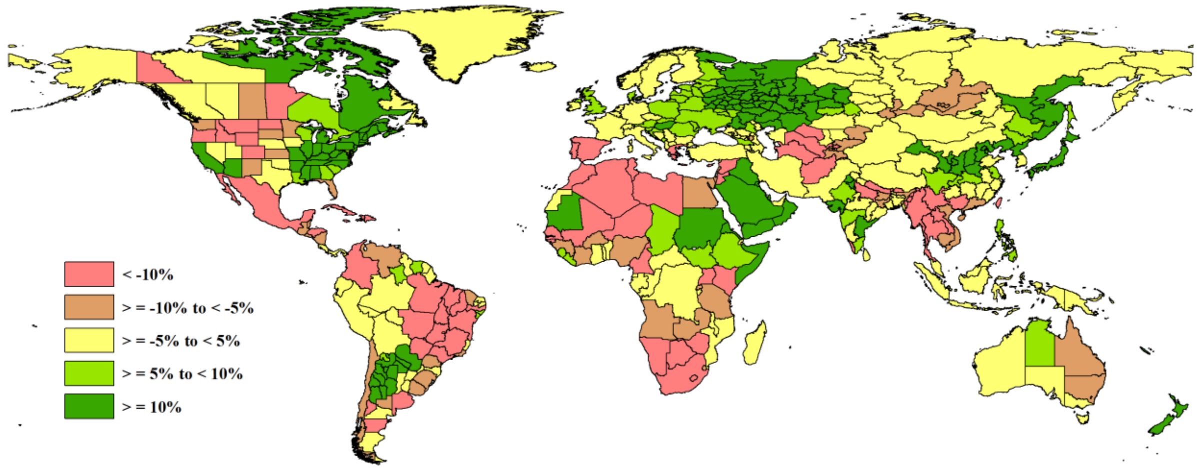


Figure 3.4 National and subnational biomass production potential anomaly (as indicated by the BIOMSS indicator) of of January 2023 to April 2023 total relative to the 2008-2022 average (15YA), in percent

3.2 Country analysis

This section presents CropWatch analyses for each of 44 key countries (China is addressed in Chapter 4). The maps and graphs refer to crop growing areas only: (a) Phenology of major crops; (b) Crop condition development based on NDVI over crop areas at national scale, comparing the January 2023- April 2023 period to the previous season and the five-year average (5YA) and maximum; (c) Maximum Vegetation Condition Index over arable land (VCIx) for January 2023- April 2023 by pixel; (d) Spatial NDVI patterns up to January 2023- April 2023 according to local cropping patterns and compared to the 5YA; and (e) NDVI profiles associated with the spatial pattern under (d). Next, separate graphs (labeled as figures (f), (g), and subsequent letters) are included to illustrate crop condition development graphs based on NDVI average over crop areas for different agro-ecological zones (AEZ) within a country, again comparing the January 2023- April 2023 period to the previous season and the five-year average (5YA) and maximum.

Refer to Annex A, Table A.1-A.11 for additional information about indicator values by country. For country agricultural profiles please visit the CropWatch Explore module of the cloud.cropwatch.com.cn website for more details.

Figures 3.5 - 3.48; Crop condition for individual countries ([AFG] Afghanistan to [ZMB] Zambia) including agro-ecological zones (AEZ) from January 2023- April 2023..

[AFG] Afghanistan

Winter and spring wheat were the primary cereal crops cultivated in Afghanistan. Winter wheat was mainly grown in the northern border provinces and harvested in May, while spring wheat was planted between March and April.

The agro-climatic conditions showed that RAIN decreased by 38%, TEMP increased by 0.9°C and RADPAR increased by 3%. BIOMSS decreased by 19% as compared to the 15YA. The CALF decreased by 11%, reaching only 11%, and the VCIx was recorded at 0.48.

According to the crop condition development graph based on NDVI, crop growth across the country remained close to the average level in February and March but was below average in January and April. However, throughout the entire monitoring period, the crop growth was lower than last year.

According to the last CropWatch bulletin, it was found that negative NDVI departures were observed in 44% of the cultivated land areas in January, predominantly in the northern regions of Afghanistan. These anomalies can be attributed to exceptionally cold weather conditions and heavy snowfall. The affected areas have been experiencing the coldest winter in the past 15 years, with temperatures plummeting as low as minus 34º C. The TEMP rapidly increased in February and March to above the average levels. It returned to the average level in April. In March, precipitation in Afghanistan was close to its highest level in 15 years, leading to floods in the northern region, especially in the Balkh province.

In addition, as shown in the spatial NDVI profiles and distribution map, in regions covering 41.9% of the total cropped areas, namely Kandahar, Juzjan, and Herat provinces, the crop growth was below average. Conversely, in regions covering 10.7% of the total cropped areas, particularly Kunduz and Juzjan, the crop growth was above average. Additionally, in regions covering 24.9% of the total cropped areas, including Takhar province, Badghis, and the northern parts of Herat, the crop growth was affected by a temperature drop in mid to late January, resulting in below-average growth during that month. Maximum VCI showed similar results. In addition, the CPI of Afghanistan was 0.92, indicating a poor overall agricultural production situation.

Afghanistan has experienced a multi-year drought. Precipitation levels continued to stay far below average. Therefore, conditions for winter cereals were unfavorable, further threatening the food security of the people.

Regional analysis

CropWatch subdivides Afghanistan into four zones based on cropping systems, climatic zones, and topography. They are described below as Central region with sparse vegetation (1), Dry region (2), Mixed dry farming and irrigated cultivation region (3), and Mixed dry farming and grazing region (4).

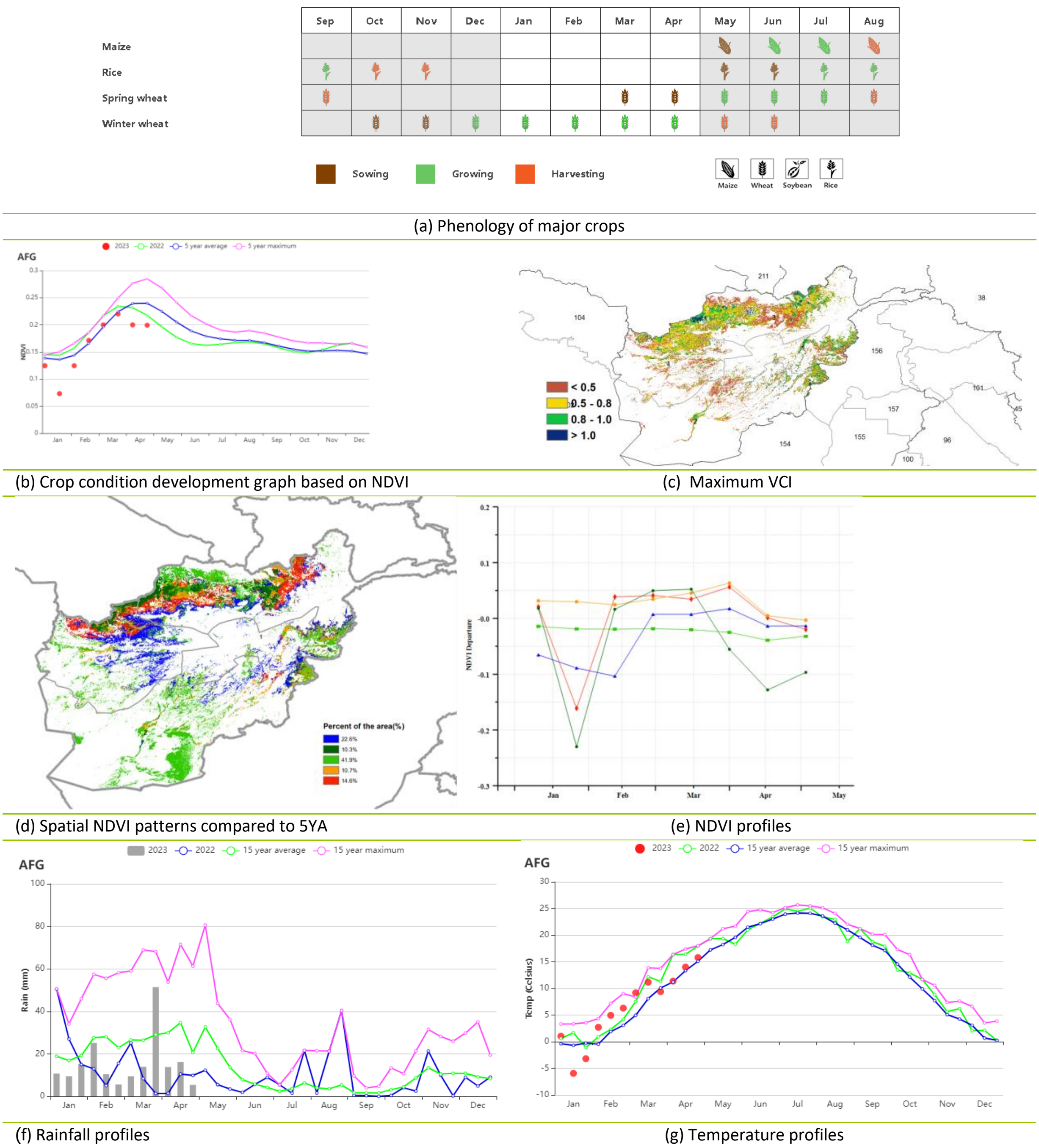
The RAIN in the Central region with sparse vegetation was 158 mm (-42%). The TEMP was 2.3°C (+2.1°C). The RADPAR was 1022MJ/m2, at an average level. BIOMSS experienced a 6% decrease, CALF had increased by 2% and VCIx was 0.58. According to the NDVI-based crop condition development graph, the crop conditions in this region were below average level in January and generally close to the average between February to April.

The Dry region recorded 153 mm of rainfall (RAIN -29%), TEMP was higher than average at 9.9°C (+1.2°C), and RADPAR was 1058 MJ/m2. According to the NDVI-based development graph, crop conditions were below average. CALF in this region was only 4% and VCIx was 0.29.

In the Mixed dry farming and irrigated cultivation region, the following indicator values were observed: RAIN 258 mm (-38%); TEMP 4.1°C (+0.5°C); RADPAR 946 MJ/m2 (+6%). BIOMSS decreased by 16% and CALF was 12% below average. According to the NDVI-based crop condition development graph, NDVI was close to the average level during February and March and below the average level in January and April. VCIx was 0.59.

The Mixed dry farming and grazing region recorded 101 mm of rainfall (RAIN -54%). TEMP was 7.7°C (+1.2°C) and RADPAR was 1008 MJ/m2, near average levels. CALF was 9%. VCIx was 0.48. BIOMSS experienced a significant decrease of 29%. According to the crop condition development graph, the NDVI was much lower than the 5YA in January and April, indicating poor conditions.

Figure 3.5 Afghanistan's crop condition, January - April 2023



(a) Phenology of major crops

(b) Crop condition development graph based on NDVI

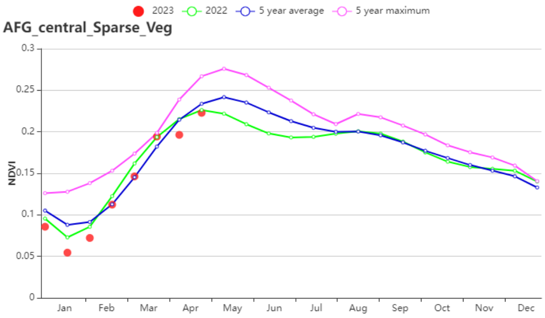
(c) Maximum VCI

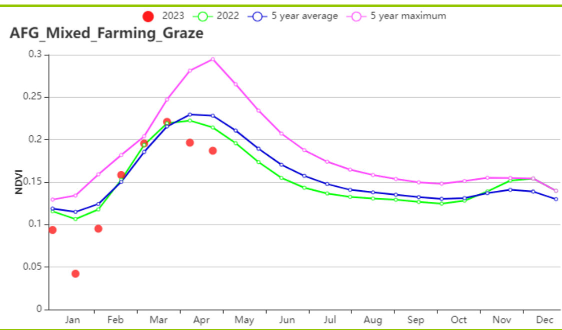
(d) Spatial NDVI patterns compared to 5YA

(e) NDVI profiles

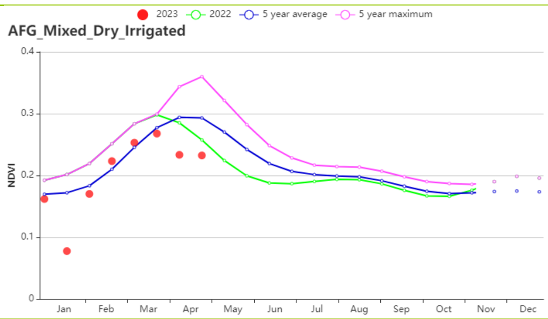
(f) Rainfall profiles

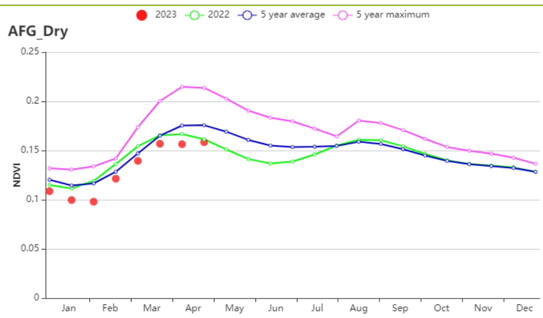
(g) Temperature profiles





(h) Crop condition development graph based on NDVI (central_Sparse_Veg Region (left) and Mixed_Farming_Graze Region (right))





(i) Crop condition development graph based on NDVI (Mixed_Dry_Irrigated Region (left) and Dry (right))

Table 3.1 Afghanistan's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, January - April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Central region	158	-42	2.3	2.1	1022	2	351	-6
Dry region	153	-29	9.9	1.2	1058	0	391	-16
Dry and irrigated cultivation region	258	-38	4.1	0.5	946	6	405	-16
Dry and grazing region	101	-54	7.7	1.2	1008	2	340	-29

Table 3.2 Afghanistan's agronomic indicators by sub-national regions, current season's values and departure from 5YA, January - April 2023

Region	Cropped arable land fraction		Maximum VCI
	Current (%)	Departure (%)	Current
Central region	7	2	0.58
Dry region	4	-20	0.29
Dry and irrigated cultivation region	17	-12	0.59
Dry and grazing region	9	-5	0.48

AFG **AGO** ARG AUS BGD BLR BRA CAN DEU EGY ETH FRA GBR HUN IDN IND IRN ITA KAZ KEN KGZ KHM LKA MAR MEX MMR MNG MOZ NGA PAK PHL POL ROU RUS THA TUR UKR USA UZB VNM ZAF ZMB

[AGO] Angola

During the monitoring period from January to April 2023, the maize harvest was completed, while the rice harvest was still ongoing and will continue until May. This same period also included land preparation for wheat sowing. The agroclimatic indicators for this period showed a significant decrease in rainfall (RAIN -19%), accompanied by a 0.3ºC increase in temperature. Furthermore, there were decreases in photosynthetic active radiation (RADPAR -1%) and total biomass production (BIOMSS -8%).

The national crop development graph, based on the NDVI, indicated below-average crop conditions compared to the average of the past 5 years throughout the entire monitoring period. This can be attributed to the below-average rainfall recorded during this period. Spatial NDVI patterns, combined with the NDVI profiles, revealed that 40.9% of the cropped area exhibited favorable crop conditions, particularly in the provinces of Benguela, Huila, and Cunene. Nationwide, the cropped arable land (CALF) increased by 1%, and the recorded maximum VCIx was 1.2%. The crop production index for Angola during the reporting period reached 1.12. Overall, the crop conditions during the January-April reporting period were below average, which will cause slight yield reductions in most regions.

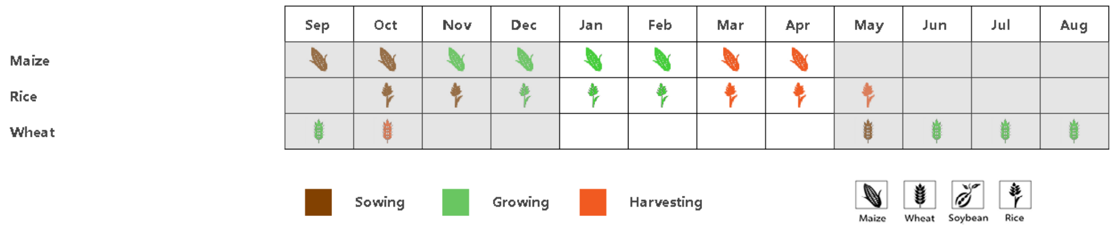
Regional Analysis

Considering the cropping systems, climate zones, and topographic conditions, CropWatch has divided Angola into five agroecological zones (AEZs), including the Arid zone (5), Central Plateau (6), Humid zone (7), Semi-arid zone (8), and Sub-humid zone (9).

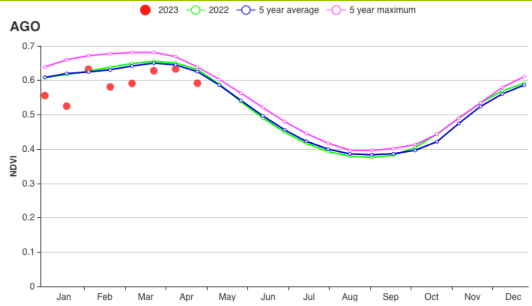
At the regional level, the agroclimatic indicators revealed decreases in rainfall across all the agroecological zones, with the highest deficits recorded in the Central Plateau (-26%), Semi-arid zone (-25%), and Sub-humid zone (-17%). In the Arid zone, rainfall decreased by 5%, and in the Humid zone, it decreased by 3%. Increases in temperature were observed in the Arid zone (+0.3ºC), Central Plateau (+0.2ºC), and Semi-arid zone (+0.8ºC), while it decreased in the Humid zone (-0.1ºC). In the Sub-humid zone, the temperature was around the average for the past 15 years. Except for the Central Plateau region and the Semi-arid region, where radiation remained unchanged compared to the average of the past 15 years, it decreased in the other zones by 3% in the Arid zone, 2% in the Humid zone, and 1% in the Sub-humid zone.

The regional total biomass production decreased in all the regions, with the highest decrease observed in the Semi-arid zone (-12%), followed by the Sub-humid zone (-6%). The regional crop development graph based on the NDVI indicates below-average crop conditions in all the agroecological zones, except for the Arid zone, which showed above-average crop conditions in late January and early February, as well as in late April. Looking at the agronomic indicators, except for the Humid zone (which had the CALF around the average), the remaining zones showed increases in CALF, with the highest increase of 7% recorded in the Arid zone. The maximum VCIx varied from 0.84 in the Humid zone to 0.93 in the Central Plateau, and the CPI varied from 1.04 to 1.16 in the zones except Humid zone.

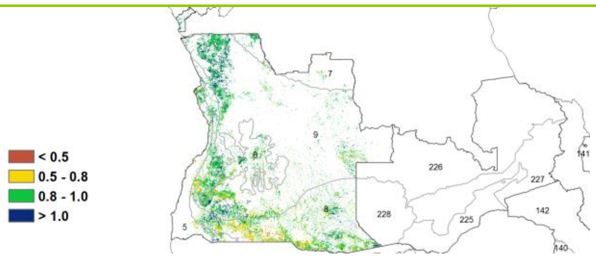
Figure 3.6 Angola's crop condition, January – April 2023



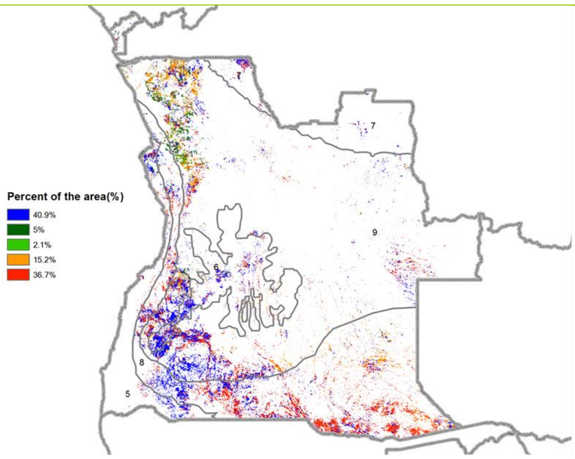
(a) Phenology of major crops



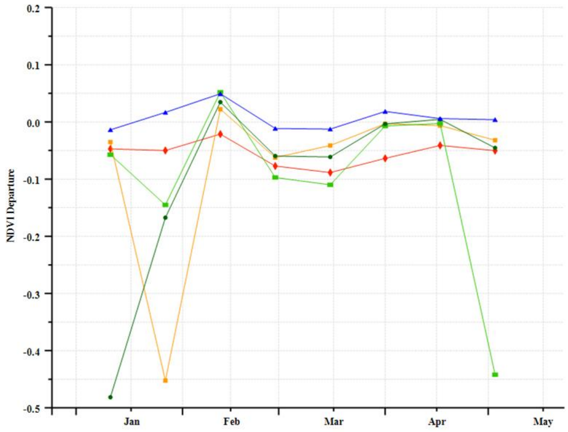
(b) Crop condition development graph based on NDVI



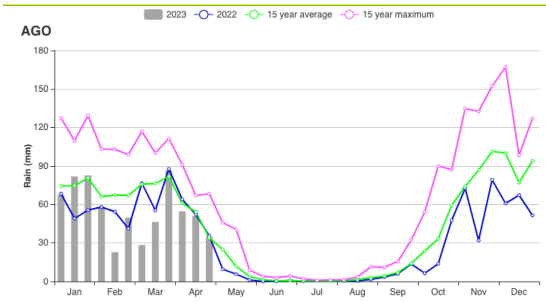
(c) Maximum VCI



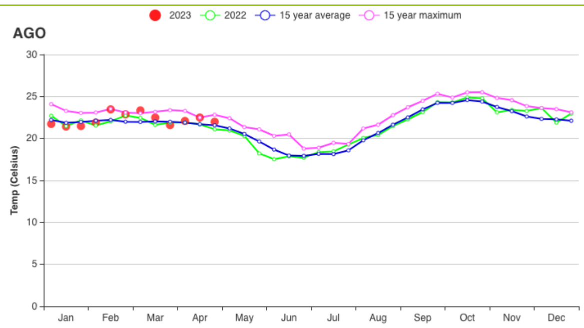
(d) Spatial NDVI patterns compared to 5YA,



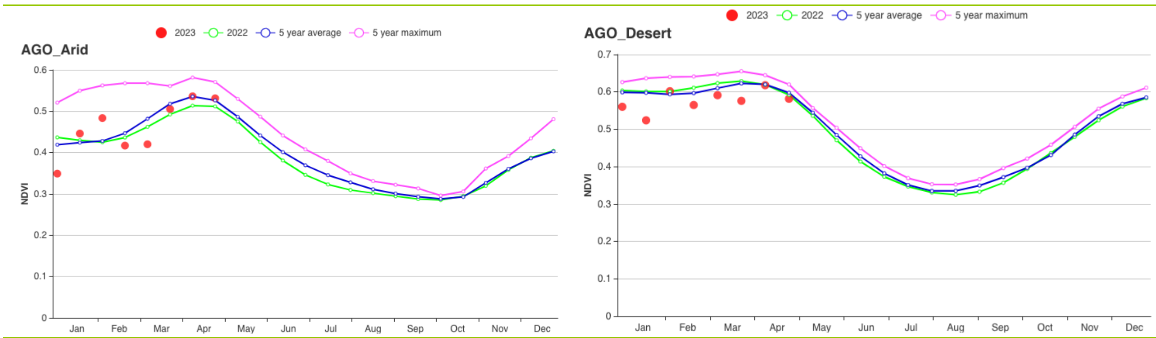
(e) NDVI profiles



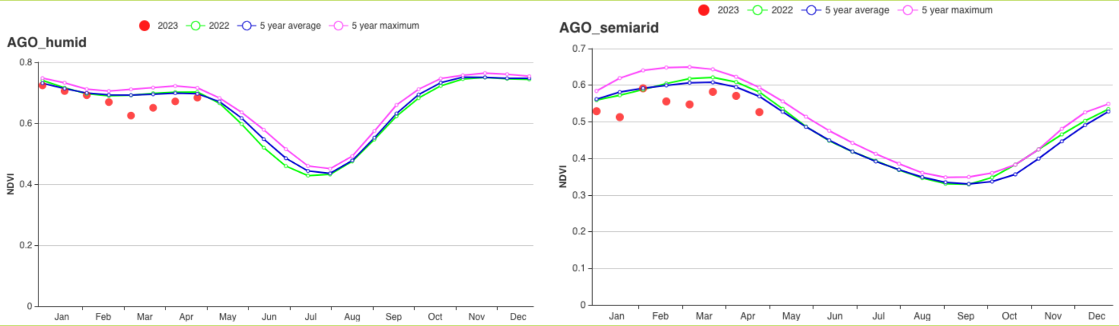
(f) National time-series rainfall profiles



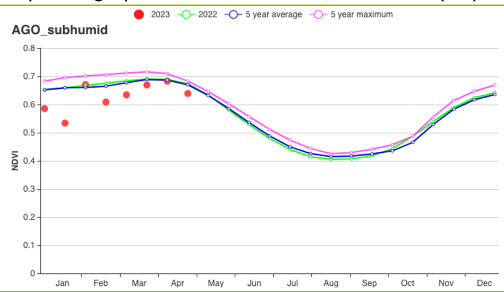
(g) National time-series temperature profiles



(h) Crop condition development graph based on NDVI - Arid zone (left) and Central Plateau (right)



(i) Crop condition development graph based on NDVI - Humid zone (left) and Semi-arid zone (right)



(j) Crop condition development graph based on NDVI-Subhumid zone

Table 3.3 Angola's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, January – April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m2)	Departure (%)	Current (gDM/m2)	Departure (%)
Arid region	469	-5	25.0	0.1	1217	-3	1032	-3
Central Plateau	691	-26	18.2	0.2	1127	0	1153	-4
Humid zone	1017	-3	22.1	-0.1	1151	-2	1443	-2
Semi-Arid Zone	476	-25	23.3	0.8	1207	0	1010	-12
Sub-humid zone	761	-17	21.5	0.0	1148	-1	1228	-6

Table 3.4 Angola's agronomic indicators by sub-national regions, current season's values and departure from 5YA, January – April 2023

Region	Cropped arable land fraction		Maximum VCI
	Current (%)	Departure (%)	Current
Arid region	89	7	0.89
Central Plateau	100	2	0.90
Humid zone	100	0	0.93
Semi-Arid Zone	99	2	0.84
Sub-humid zone	100	1	0.92

[ARG] Argentina

The reporting period covers the harvesting period for early soybean, early maize and rice, and the main growing period for late soybean and late maize. In some regions, conditions were poor due to a lack of precipitation and extreme temperatures. In some regions, the conditions recovered to close to average levels by the end of this reporting period. CropWatch subdivides Argentina into eight agro-ecological zones (AEZ) based on cropping systems, climatic zones, and topography; they are identified by numbers on the NDVI departure cluster map. During this monitoring period, most crops were grown in the following four agro-ecological zones: Chaco (11), Mesopotamia (12), Humid Pampas (13), and Subtropical Highlands (17). The other agro-ecological zones are less relevant for this period. In Chaco, Subtropical Highlands, Pampas and South Mesopotamia main crops growing during this period are soybean and maize, while in North Mesopotamia, the main crop is rice.

For the whole country, rainfall showed a positive anomaly of +14%, TEMP showed a positive anomaly of +1.1° and RADPAR showed a -3% negative anomaly. Two of the main AEZs showed negative anomalies in RAIN: Humid Pampas (-19%) and Mesopotamia (-9 %), while Subtropical Highlands and Chaco showed positive anomalies of +50% and +44%, respectively. TEMP showed positive anomalies in the four AEZs: Humid Pampas (+1.7°C), Mesopotamia (+1.2°C) , Chaco (+0.4°) and Subtropical Highlands (+0.3°). RADPAR showed negative anomalies in the four AEZs: Chaco (-3%), Pampas (-3%), Subtropical Highlands (-2%) and Mesopotamia (-1%).

For the whole country, rainfall showed negative anomalies only during short periods, namely at the beginning of February and at the end of April. Nevertheless, in specific regions, strong negative anomalies in rainfall were observed. Pampa showed strong negative anomalies at the beginning and end February and at the beginning March, as well as negative anomalies during April. Mesopotamia showed negative anomalies during January and February and in part of April. TEMP showed negative anomalies in mid-February and mid-April, and strong positive anomalies in March.

At the national scale, the crop condition development graph based on NDVI showed values below the five years average during the whole reporting period. Values were also lower than in the 2022 growing season. Chaco, Mesopotamia and Pampas showed also negative anomalies during the entire reporting period, but at a lower magnitude at the end. Subtropical Highlands showed no anomalies in NDVI since April. High precipitation events and reduction of temperature observed since mid-March could have explained this recovery.

Spatial distribution of NDVI profiles allowed for the clustering of the area into five classes. Orange profile showed the highest values with almost no anomalies or slight positive anomalies during the reporting period. It was observed mainly in South and West Pampas and in West Subtropical Highlands. A profile with near no anomalies during January and February and with negative anomalies during March and April (dark green profile) was observed in Center and West Pampas. A profile with negative anomalies since January and no anomalies since the end of March (blue profile) was observed in all the zones. A profile with strong negative anomalies during January and February and no anomalies during April (light green profile) was observed in North East Pampas and South Mesopotamia. Finally, a profile with negative anomalies all along the reporting period (red profile) was observed in Center, Center East and North Pampas and in East Chaco.

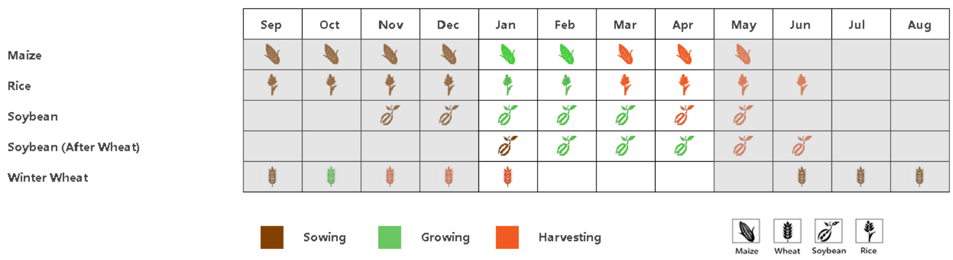
For the whole country, BIOMSS showed a +5% positive anomaly, CALF showed no anomaly and VCIx showed a value of 0.78. VCIx showed values lower than 0.8 in North East, Center East and South West Pampas, South Mesopotamia and East Chaco. Good conditions were observed in the rest of the agricultural area of Argentina. Higher values of VCIx were observed in South Pampas.

Variations of weather conditions resulted in a large discrepancy of BIOMSS departures: Strong positive anomalies of BIOMSS were observed in Chaco (+19%) and Subtropical Highlands (+17%) where almost no anomalies in rainfall were observed. Zones with negative anomalies in rainfall like Mesopotamia and Humid Pampas showed near average values (+1%) and negative anomaly (-6%), respectively.

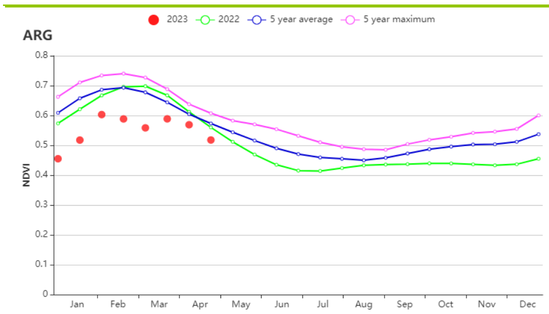
CALF was almost complete in the four AEZs (99%) and showed a slight negative anomaly (-1%) in Mesopotamia, Chaco and Subtropical Highlands and no anomaly in Humid Pampas. Although recent increased rainfall accelerated crop development, the drought impacts at the early stage was not fully mitigated and VCIx showed regular to slightly poor conditions in the four AEZ: Subtropical Highlands (0.83), Humid Pampas (0.80), Chaco (0.74) and Mesopotamia (0.68). CPI values observed were: Subtropical Highlands (1.06), Humid Pampas (1.04), Chaco (0.95) and Mesopotamia (0.81). Observed CPI values were among the lowest in the last ten years in the mentioned AEZs, mainly due to the early onset of the prolonged drought conditions.

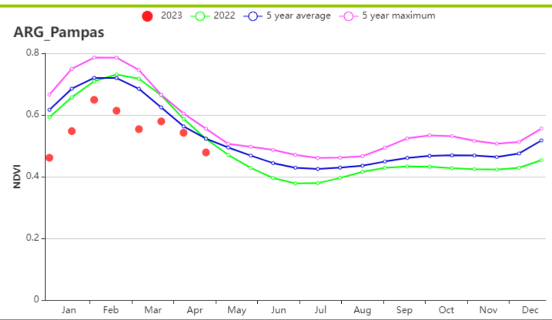
In general, normal agro-climatic conditions were observed in Argentina during the four months of this monitoring period, but crops were still suffering from the severe drought conditions that prevailed during the last monitoring period from October to January. Strong temperature anomalies at the national level and precipitation anomalies in some regions were observed during part of the current reporting period. Poor conditions (low precipitation, low VCIx and temperature anomalies) were observed in the main agricultural areas during this period too. In addition, the delay in planting observed during the last reporting period (low CALF values) could have incremented the proportion of late summer crops which have lower yield potential. CPI of Argentina showed a value of 1.03, one of the lowest in the last ten years. In summary, reductions in yields are expected for the main summer crops (soybean, maize and rice). The last reporting period showed poor conditions for growth during the main stages of early summer crops.

Figure 3.7 Argentina's crop condition, January - April 2023

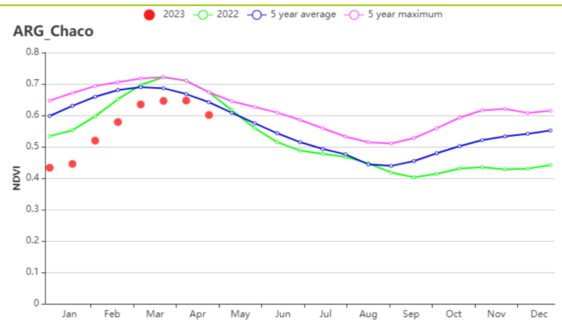


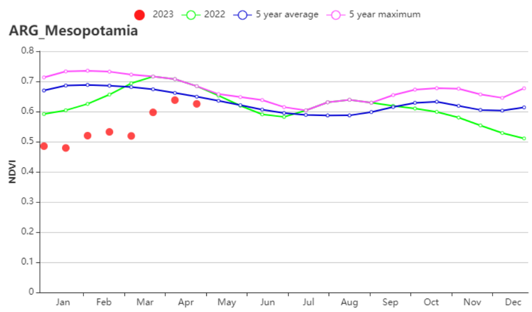
(a) Phenology of major crops



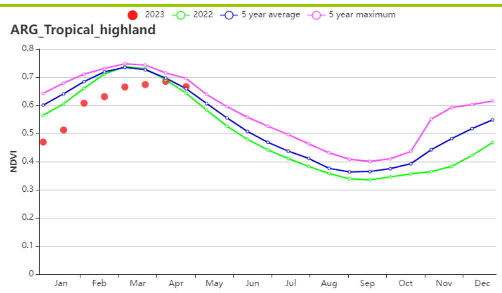


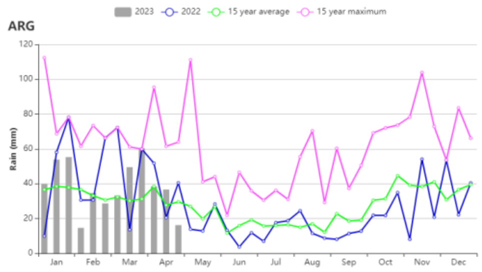
(b) Crop condition development graph based on NDVI (Argentina) (c)Crop condition development graph based on NDVI (Humid Pampas))





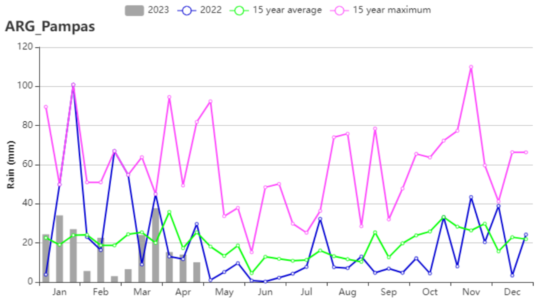
(d) Crop condition development graph based on NDVI (Chaco) (e) Crop condition development graph based on NDVI (Mesopotamia)

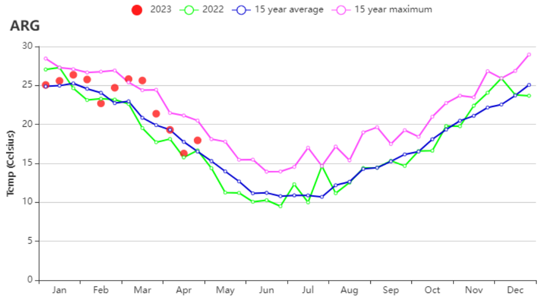




(f) Crop condition development graph based on NDVI (Subtropical Highlands)

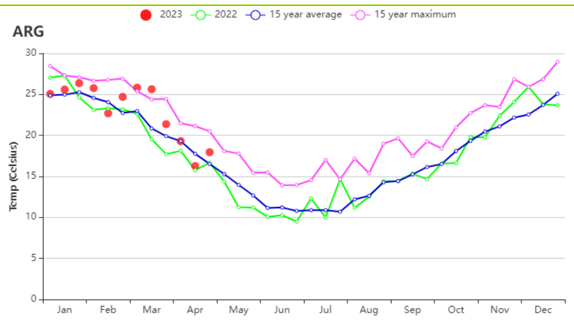
(g) Time series rainfall profile (Argentina)

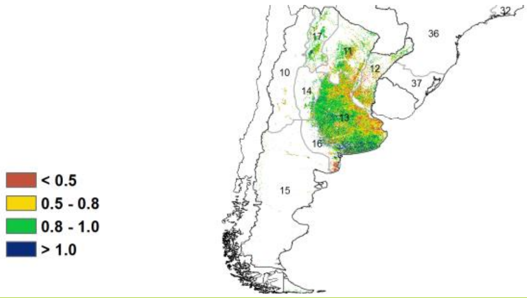




(h) Time series rainfall profile (Humid Pampas)

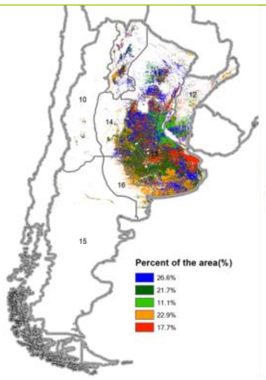
(i) Time series rainfall profile (Mesopotamia)

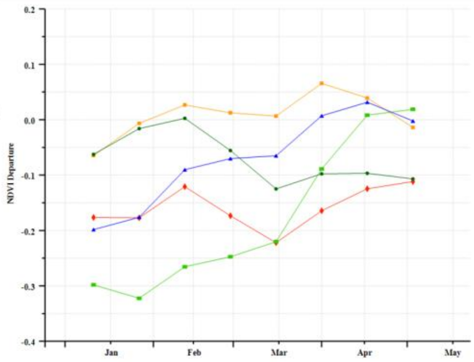




(j) Time series temperature profile (Argentina)

(k) Spatial distribution of NDVI profiles





(l) Spatial NDVI patterns compared to 5YA

(m) NDVI profiles

Table 3.5 Argentina's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, January - April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Chaco	656	44	25	0.4	1110	-3	1223	19
Mesopotamia	451	-9	24.5	1.2	1171	-1	1045	1
Humid Pampas	225	-19	23.2	1.7	1176	-3	759	-6
Subtropical Highlands	1219	50	20.9	0.3	1078	-2	1288	17

Table 3.6 Argentina's agronomic indicators by sub-national regions, current season's values and departure from 5YA, January - April 2023

Region	Cropped arable land fraction		Maximum VCI
	Current (%)	Departure (%)	Current
Chaco	99	-1	0.74
Mesopotamia	99	-1	0.68
Humid Pampas	99	0	0.8
Subtropical Highlands	99	-1	0.83

AFG AGO ARG **AUS** BGD BLR BRA CAN DEU DZA EGY ETH FRA GBR HUN IDN IND IRN ITA KAZ KEN KGZ KHM LKA MAR MEX MMR MNG MOZ NGA PAK PHL POL ROU RUS SYR THA TUR UKR USA UZB VNM ZAF ZMB

[AUS] Australia

The harvest of wheat and barley ended in January. The sowing of the next wheat crop will start in May. In the current period, Australia had relatively dry weather with below average rainfall (RAIN, -13%), which will be unfavorable for the wheat planting in the next period. The temperature (TEMP +0) and radiation (RADPAR +1%) were both close to the average The dry weather led to below-average biomass accumulation potential (-4%). Additionally, CALF increased by 15% compared with the recent five-year average, while the maximum VCI was 0.86.

In the four main wheat production states, only South Australia with above-average rainfall (+6%) had positive biomass estimates (+3%). The other 3 states all received below-average rainfall (New South Wales, -18%; Victoria, -7%; Western Australia, -4%), and biomass by -7%, -3%, -4%, respectively.

The NDVI profile was generally close to the average levels observed over the past 5 years, except in later February and March.

Regional analysis

This analysis adopts five agro-ecological zones (AEZs) for Australia, namely the Arid and Semi-arid Zone (marked as 18 in NDVI clustering map), Southeastern Wheat Zone (19), Subhumid Subtropical Zone (20), Southwestern Wheat Zone (21), Wet Temperate and Subtropical Zone (22). The Arid and Semi-arid Zone, in which hardly any crop production takes place, was not analyzed.

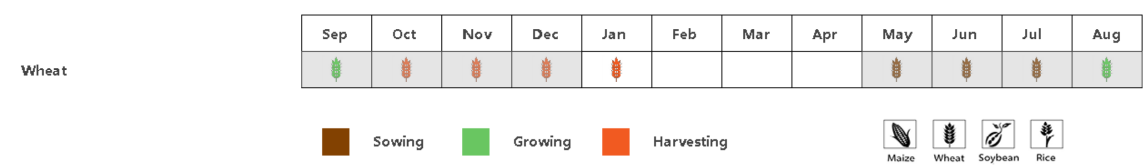
Both the Southeastern wheat area and Southwestern wheat area had similar agro-climatic conditions, which were characterized by below-average rainfall (-11%, -17%), slightly cooler temperature (-0.2°C, -0.7°C), and more or less average radiation (-0%, +3%). The below average rainfall caused a low biomass accumulation potential (-3%, -7%). The CALFs in these two AEZs were improved by 28% and 30%, respectively, with maximum VCI of 0.9 and 0.88.

The Subhumid subtropical zone recorded largely below-average rainfall (-33%), while the temperature was slightly above (+0.4°C). The radiation was slightly above average (+2%). Consequently, the biomass was 12% lower than 15-year average. The CALF was decreased by 5%, while maximum VCI was 0.72.

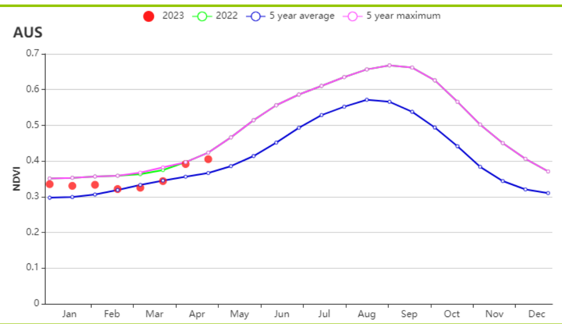
The Wet temperate and subtropical zone had slightly below average rainfall (-9%), slightly above average temperature (+0.2°C) and radiation (+1%). The biomass was average. The CALF was 99%, and the maximum VCI was 0.82.

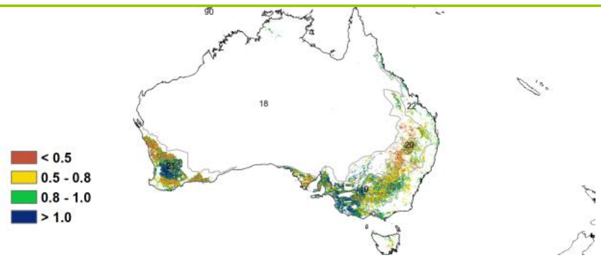
Overall, the agro-climatic indicators in the reporting period, especially rainfall, predict moderate prospects for the coming wheat planting season in Australia.

Figure 3.8 Australia's crop condition, January - April 2023

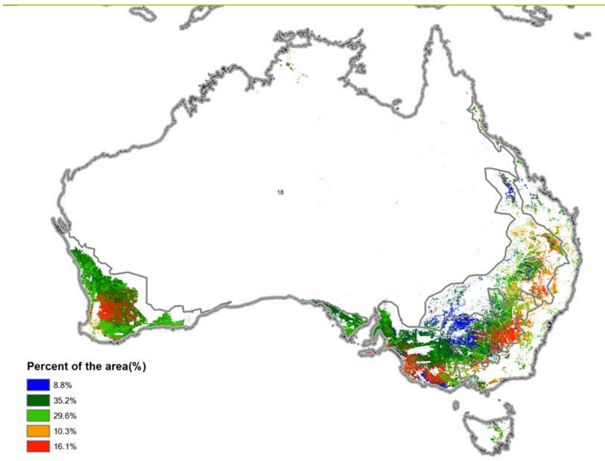


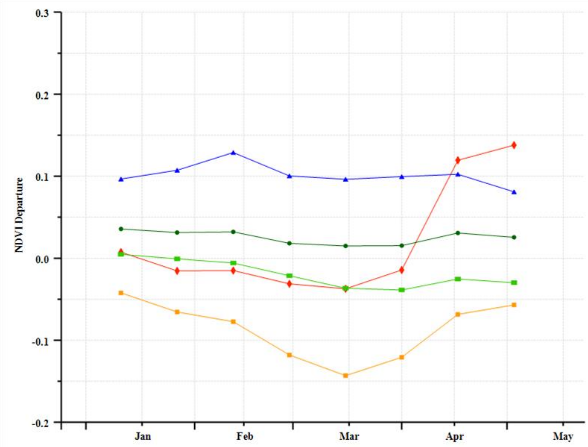
(a) Phenology of major crops



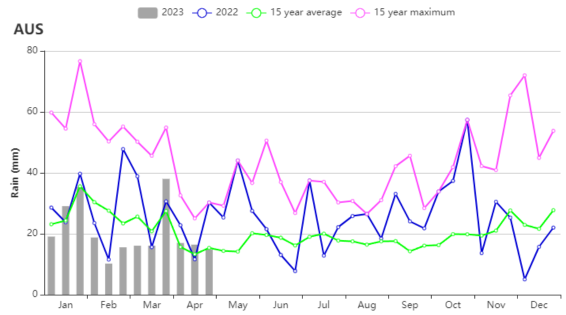


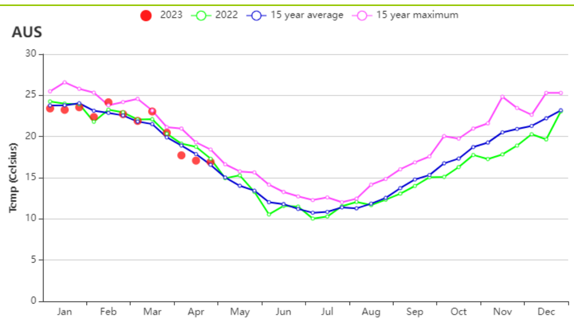
(b) Crop condition development graph based on NDVI (c) Maximum VCI



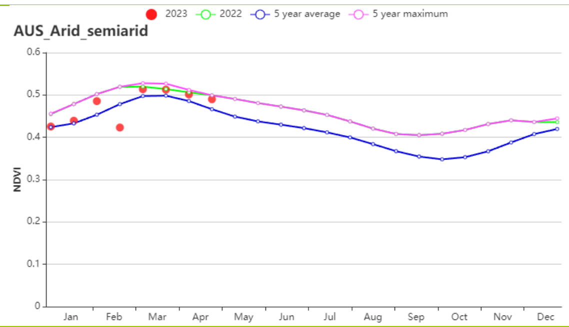


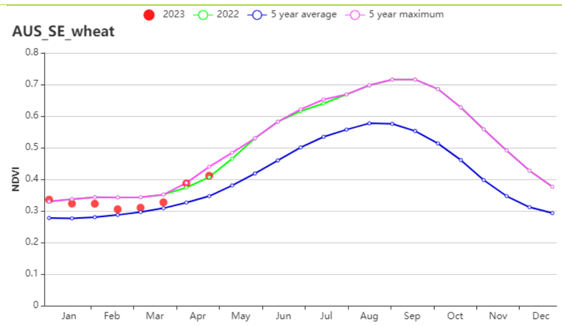
(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles



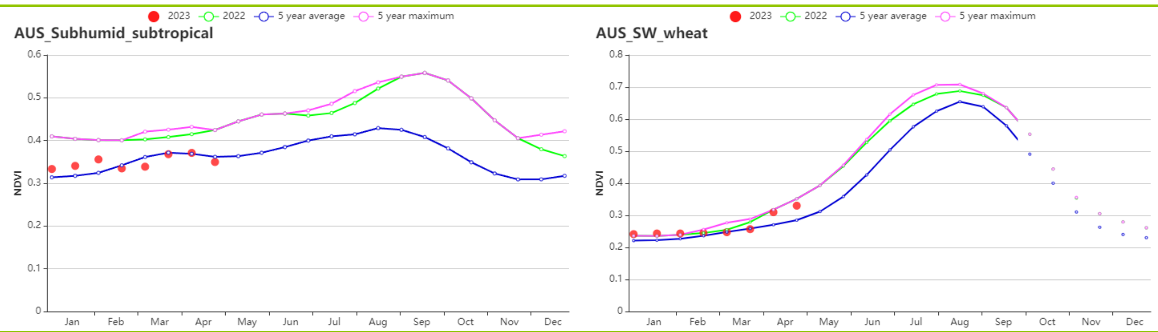


(f) Rainfall profiles (g) Temperature profiles

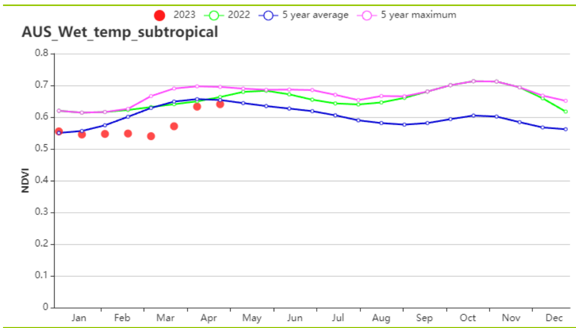




(h) Crop condition development graph based on NDVI (Arid and semiarid zone (left) and Southeastern wheat area (right))



(i) Crop condition development graph based on NDVI (Subhumid subtropical zone (left) and Southwestern wheat area (right))



(j) Crop condition development graph based on NDVI (Wet temperate and subtropical zone)

Table 3.7 Australia agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, January - April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Arid and semiarid zone	767	4	25.9	-0.1	1264	2	1086	8
Southeastern wheat area	148	-11	20.6	-0.2	1198	0	628	-3
Subhumid subtropical zone	167	-33	23.9	0.4	1276	2	692	-12
Southwestern wheat area	88	-17	20.4	-0.7	1286	3	541	-7
Wet temperate and subtropical zone	380	-9	19.7	0.2	1144	1	859	0

Table 3.8 Australia's agronomic indicators by sub-national regions, current season's values and departure from 5YA, January - April 2023

Region	Cropped arable land fraction		Maximum VCI
	Current (%)	Departure (%)	Current
Arid and semiarid zone	70	3	0.87
Southeastern wheat area	41	28	0.90
Subhumid subtropical zone	42	-5	0.72
Southwestern wheat area	20	30	0.88
Wet temperate and subtropical zone	99	4	0.82

AFG AGO ARG AUS **BGD** BLR BRA CAN DEU EGY ETH FRA GBR HUN IDN IND IRN ITA KAZ KEN KGZ KHM LKA MAR MEX MMR MNG MOZ NGA PAK PHL POL ROU RUS THA TUR UKR USA UZB VNM ZAF ZMB

[BGD] Bangladesh

This report covers the full cycle of Boro rice and wheat, both of which are irrigated. The sowing of Aus rice is from March to May. The winter months were drier than usual. Rainfall was 16% below average during this reporting period. Both temperature and sunshine were above the 15YA (TEMP +0.2°C, RADPAR +1%). BIOMSS was slightly above average (+1%). Below average rainfall and continuous high temperatures in February were unfavorable for crop growth. Conditions gradually recovered in March. However, extreme heat events in April affected the sowing of Aus rice, as the national NDVI development curve showed. The nationwide NDVI spatial pattern shows that all crops in Bangladesh showed positive performance at the end of March due to the increased rainfall but also had sharp drop in April due to the extreme heat events. Only 25% of the cultivated area was close to the 5YA, mainly distributed in the Coastal region, and the rest was below the 5YA in April. The maximum Vegetation Condition Index (VCIx) map shows that the conditions for the winter crops were favorable, with most areas showing values higher than 0.8. CALF is close to the 5YA (96%) and VCIx is 94 in Bangladesh. CPI is 1.18. Overall, crop conditions in the country were close to average.

Regional analysis

Bangladesh can be divided into four Agro-Ecological Zones (AEZ): the Coastal region (23), the Gangetic plain (24), the Hills (25), and the Sylhet basin (26).

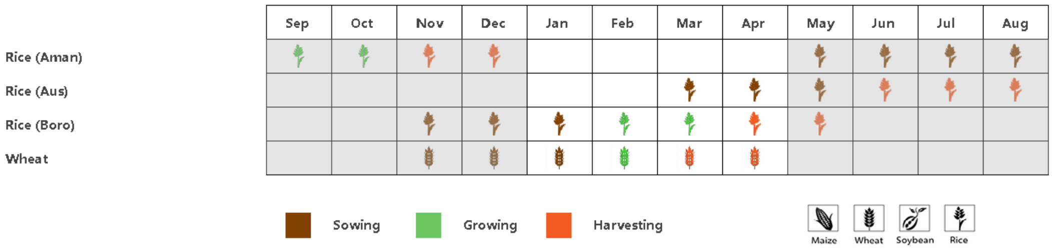
In the Coastal region, RAIN was below average (-25%), while TEMP was slightly above average (+0.1°C). RADPAR was close to the 15YA. The rainfall deficit had a limited effect on the irrigated rice and wheat production, BIOMASS was increased by about 2%. The crop condition development graph based on NDVI showed that crop conditions returned to the 5-year average in March and April. CALF was at 89% and VCIx at 0.97. They indicated average conditions in this region.

The Gangetic plains also experienced a slight drop in rainfall (-5%). Both TEMP and RADPAR were above the 15YA (+0.3°C, +1%). BIOMASS was also above the average (+3%). The crop condition development graph based on NDVI shows that crop conditions were below the 5-year average during the whole monitoring period except for the end of March due to the increased rainfall. CALF (97%), VCIx at 0.91 and CPI (1.07) indicated average prospects.

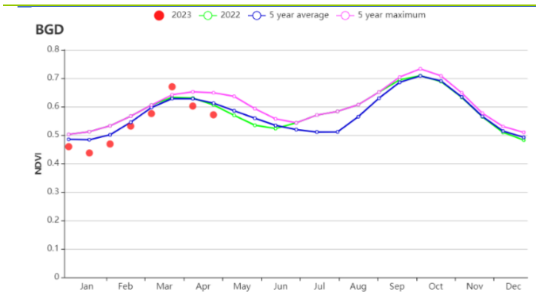
The Hills experienced a large drop in rainfall (-66%). But the TEMP and RADPAR were above average (+0.2°C and +2%, respectively). The crop condition development graph based on NDVI shows that crop conditions were above the 5YA at the beginning of the monitoring period, and then returned to the average at the end of March and April. BIOMSS was below average (-14%) with scarce precipitation, CALF was 96%, VCIx was 0.87 and CPI was 1.10, indicating crop conditions were close to average.

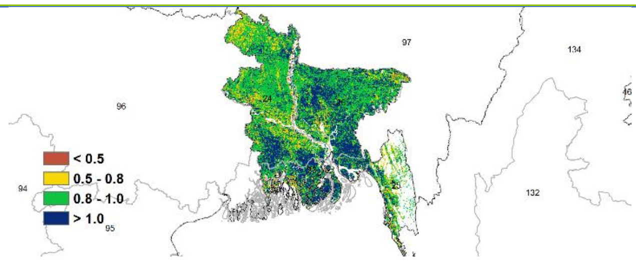
In the Sylhet Basin, RAIN was slightly below average (-2%), while both TEMP (+0.1°C) and RADPAR (+2%) were above the 15YA. The crop condition development graph based on NDVI shows that crop conditions were below average except at the end of March. BIOMSS increased by 5%, with favorable VCIx (0.97) and CALF (98%) and CPI (1.18), indicating average crop conditions.

Figure 3.9 Bangladesh's crop condition, January -April 2023.



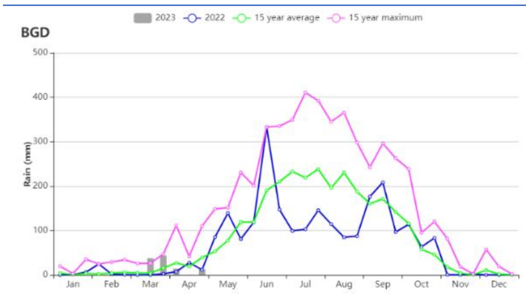
(a). Phenology of major crops

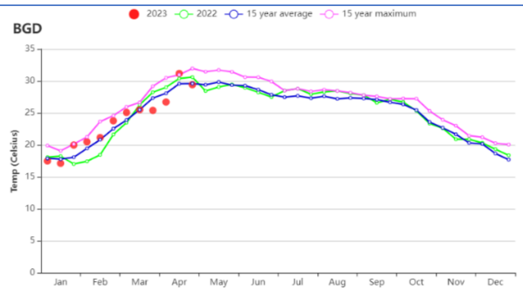




(b) Crop condition development graph based on NDVI

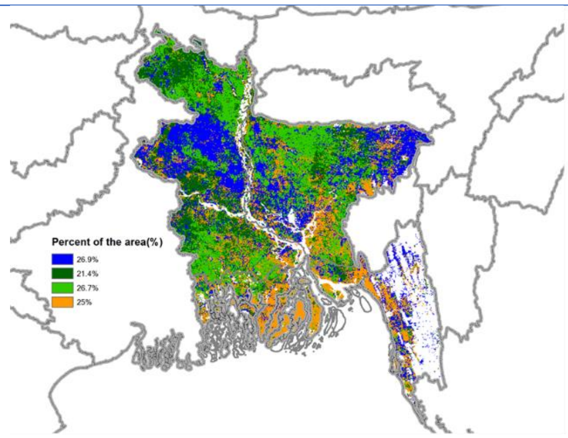
(c) Maximum VCI

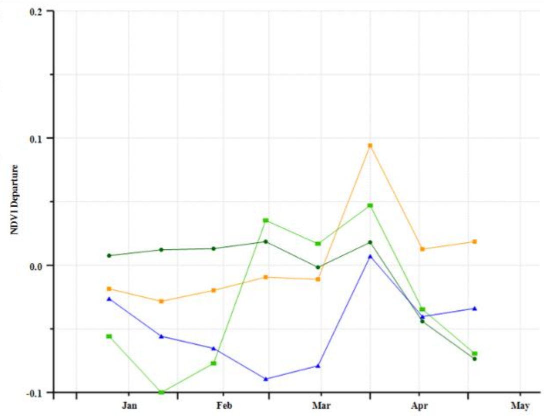




(d) Rainfall Index

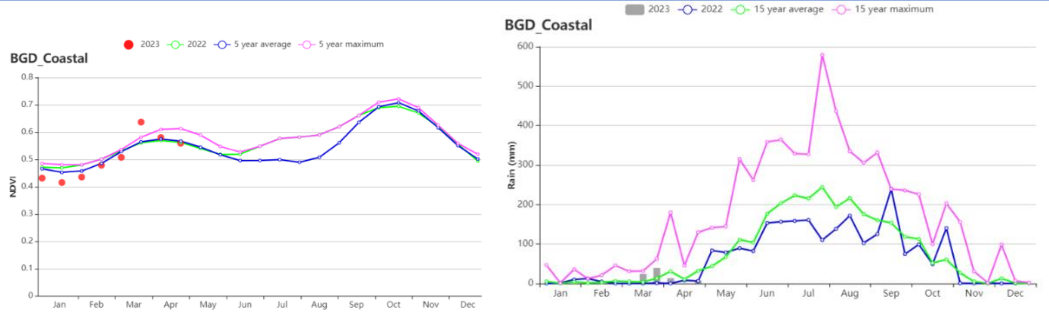
(e) Temperature Index



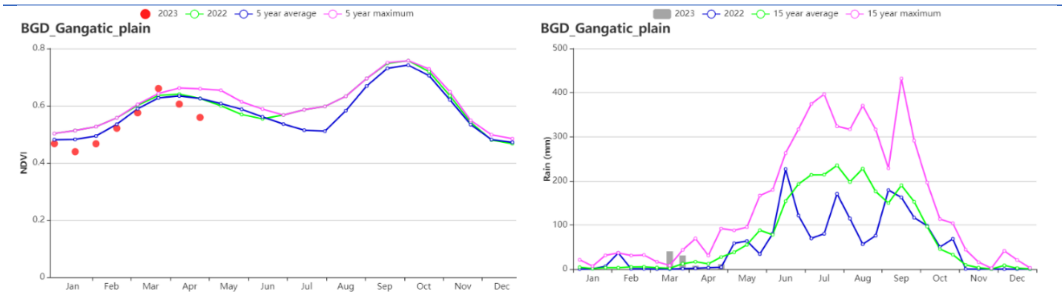


(f) Spatial NDVI patterns compared to 5YA

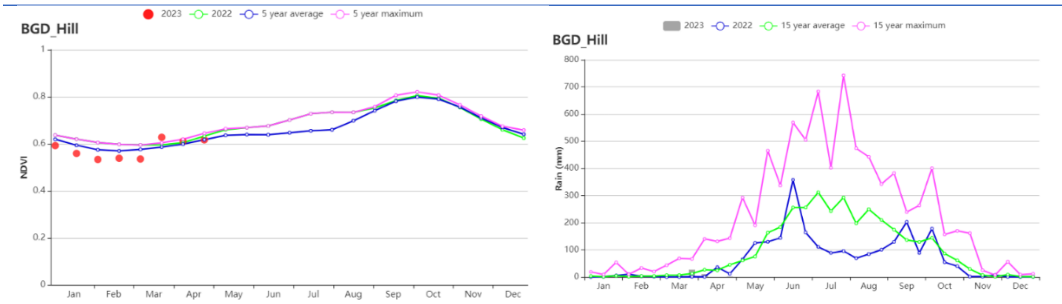
(g) NDVI profiles



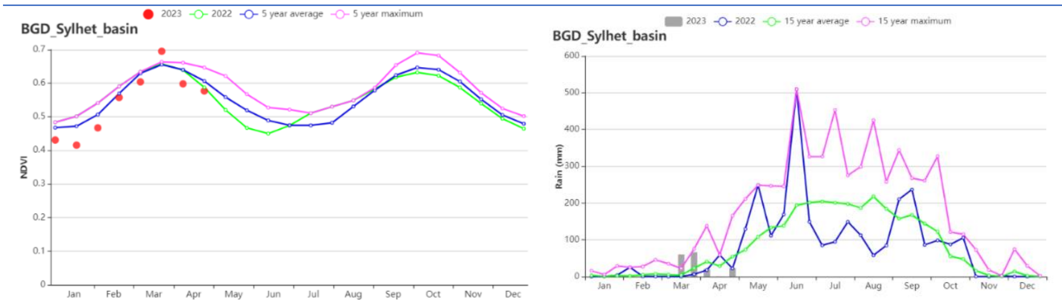
(h) Crop condition development graph based on NDVI (left) and rainfall profile (right) of Coastal region



(i) Crop condition development graph based on NDVI (left) and rainfall profile (right) of Gangetic plain



(j)Crop condition development graph based on NDVI (left) and rainfall profile (right) of Hills



(k)Crop condition development graph based on NDVI (left) and rainfall profile (right) of Sylhet basin

Table 3.9 Bangladesh's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, January-April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure from 15YA (%)	Current (°C)	Departure (°C)	Current (MJ/m2)	Departure from 15YA (%)	Current (gDM/m2)	Departure from 15YA (%)
Coastal region	84	-25	24.9	0.4	1224	0	581	2
Gangetic plain	90	-5	24.0	0.3	1184	1	565	3

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure from 15YA (%)	Current (°C)	Departure (°C)	Current (MJ/m2)	Departure from 15YA (%)	Current (gDM/m2)	Departure from 15YA (%)
Hills	47	-66	22.7	0.2	1282	2	499	-14
Sylhet basin	171	-2	23.1	0.1	1185	2	639	5

Table 3.10 Bangladesh's agronomic indicators by sub-national regions, current season's values and departure from 5YA, January-April 2023

Region	CALF		Maximum VCI
	Current (%)	Departure from 5YA (%)	Current
Coastal region	89	4	0.97
Gangetic plain	97	0	0.91
Hills	96	0	0.87
Sylhet basin	98	0	0.97

[BLR] Belarus

Winter wheat, which was sown in October, is the major crop in the field during this monitoring period. The nationwide rainfall had increased compared to 15YA average (RAIN 326 mm; +24%). The temperature (TEMP 1.6°C; +1.7°C) increased, but radiation (RADPAR 348 MJ/m2; -15%) decreased. More than 85% of the arable land was cropped (CALF was 88%), and the maximum vegetation condition index (VCIx) was good (0.88). Weather based projected potential biomass was above the 15YA (+9%).

At the national level, NDVI was below average before March, and then close to the 5YA in April. Crop condition in about 23.4% of the cropped area was above or close to the 5-year average, in agreement with the national VCIx map. According to the spatial distribution maps, although VCIx was satisfactory in most areas of the country (>0.8), there was an apparent drop in NDVI profiles in many areas in January. Most likely, this artifact was caused by snow cover. The crop production index (CPI) was 1.15, which indicates a favorable prospect considering the sufficient rainfall during this period.

Regional analysis

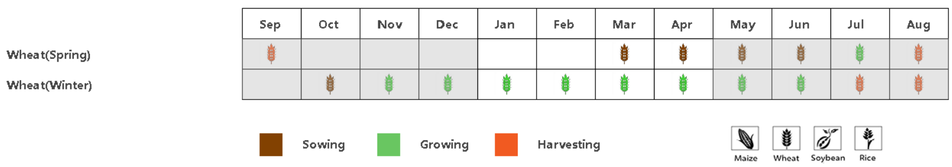
Based on the cropping system, climatic zones and topographic conditions, regional analyses for three agro-ecological zones (AEZs) are provided, including Northern Belarus (028, Vitebsk, the northern area of Grodno, Minsk and Mogilev), Central Belarus (027, Grodno, Minsk and Mogilev and Southern Belarus (029) which includes the southern halves of Brest and Gomel regions.

Northern Belarus (Vitebsk, northern area of Grodno, Minsk and Mogilev) had more rainfall (34%) and increased temperature (+1.8°C) than average, but radiation had decreased (-13%). The BIOMSS is projected to increase by 10%. Agronomic indicators showed satisfactory values: 84% for CALF and 0.87 for VCIx. CPI value was 1.12. The crop condition is good.

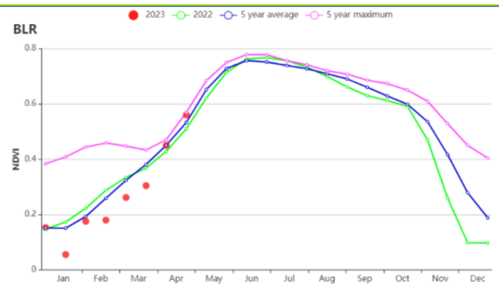
In Central Belarus, the regions of Grodno, Minsk and Mogilev recorded higher rainfall (+18%), higher temperature (+1.7°C) and below average radiation (-16%). The BIOMSS is projected to increase by 9%. A high degree of cropped arable land (CALF at 90%) and a VCIx value of 0.87 with a CPI of 1.11 were observed. The overall situation was favorable for winter crops.

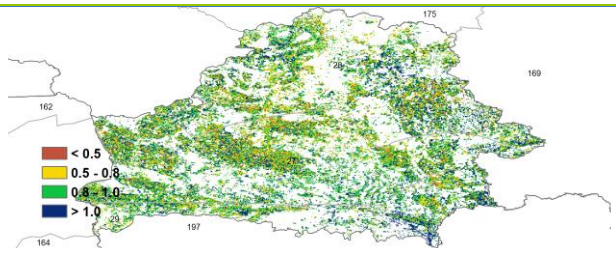
The Southern Belarus (southern halves of Brest and Gomel regions) experienced the same agro-climatic condition as the Central area. Higher rainfall (16%), higher temperature (+1.4°C) and lower radiation (-17%) were recorded. The BIOMSS is projected to increase by 7%. Favorable agronomic indicators (CALF 92%, VCIx 0.92) were observed. CPI value was 1.24. The conditions for winter wheat were favorable.

Figure 3.10 Belarus's crop condition, January -April 2023.

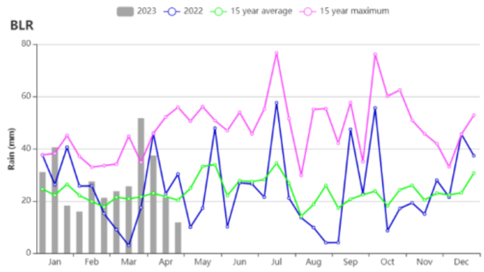


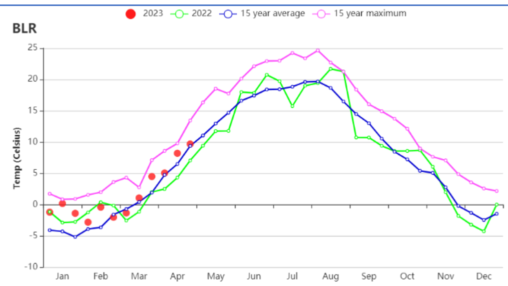
(a). Phenology of major crops



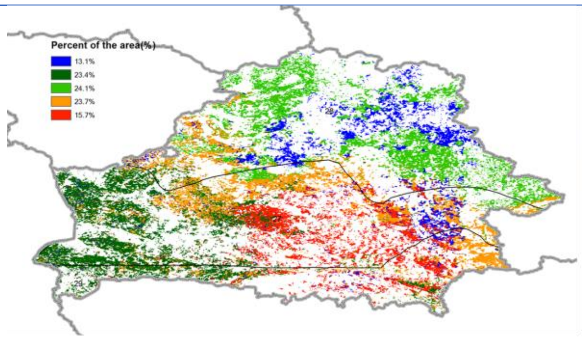


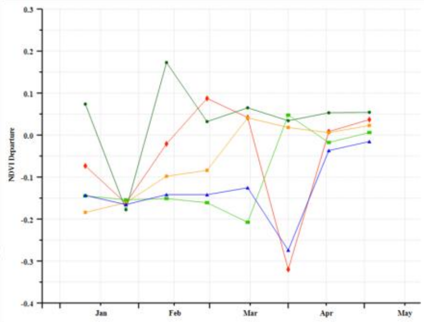
(b) Crop condition development graph based on NDVI (c) Maximum VCI



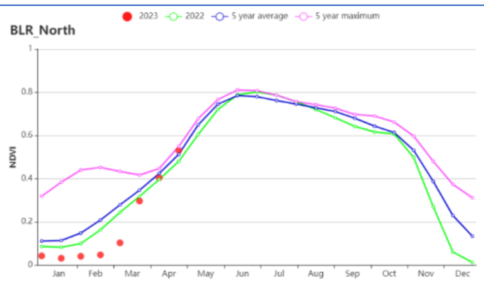


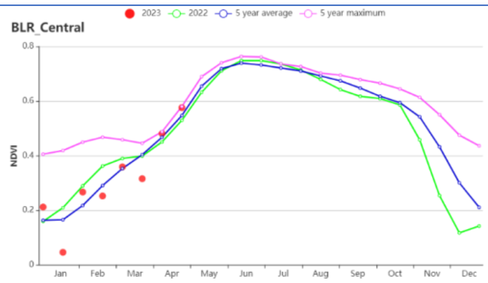
(d) Rainfall Index (e) Temperature Index



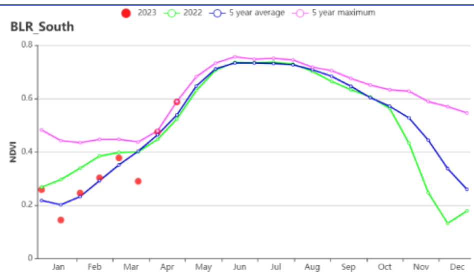


(f) Spatial NDVI patterns compared to 5YA (g) NDVI profiles





(h) Crop condition development graph based on NDVI (North Belarus) (i) Crop condition development graph based on NDVI (Central Belarus)



(j) Crop condition development graph based on NDVI (South-west Belarus)

Table 3.11 Belarus's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, January-April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure from 15YA (%)	Current (°C)	Departure (°C)	Current (MJ/m2)	Departure from 15YA (%)	Current (gDM/m2)	Departure from 15YA (%)
Center	309	18	2.1	1.7	349	-16	430	9
North	354	34	0.9	1.8	344	-13	390	10
South-west	297	16	2.4	1.4	360	-17	441	7

Table 3.12 Belarus's agronomic indicators by sub-national regions, current season's values and departure from 5YA, January-April 2023

Region	CALF		Maximum VCI
	Current (%)	Departure from 5YA (%)	Current
Center	90	2	0.87
North	84	3	0.87
South-west	92	4	0.92

AFG AGO ARG AUS BGD BLR **BRA** CAN DEU EGY ETH FRA GBR HUN IDN IND IRN ITA KAZ KEN KGZ KHM LKA MAR MEX MMR MNG MOZ NGA PAK PHL POL ROU RUS THA TUR UKR USA UZB VNM ZAF ZMB

[BRA] Brazil

This bulletin summarizes the main growing periods for soybean, rice, and maize in the Center-South regions of Brazil. The harvest for these crops was almost completed by the end of April. The second season maize, known as "safrinha," which is mainly cultivated in the Centre-South, reached its peak growing stage in March and April, and the harvest is expected to begin in late May. Rice in the North and Northeast regions reached the peak of its growth in April. The sowing of maize in the Northeast and wheat in Parana and Rio Grande do Sul will start at the end of the monitoring period.

In Brazil, only 12% of cropland is irrigated, and agro-meteorological conditions play a crucial role in the growth of most crops. Brazil has experienced almost two years of continuous drier and warmer-than-usual weather since mid-2021. The country received an average rainfall of 505 mm, which is 49% below the 15-year average from January to April. The negative departure of the rainfall was the same as for the February Bulletin. Meanwhile, average air temperature for the whole of Brazil was 1.5°C higher, and radiation was 1% below 15YA. Significant below average rainfall in combination with the above average temperature resulted in a 26% reduction in potential biomass. Dry and warm weather also accelerated soil moisture loss and worsened drought conditions. Most of Brazil has suffered from severe water shortages, resulting in significant negative departure of BIOMSS except for the Parana and East Coast region. Among the top nine major agricultural producing states, only Parana received close to average rainfall (+2%). It also had average temperatures compared to the 15-year average. All other major states experienced significantly below-average rainfall ranging from 12% to 94% below average, along with higher temperatures. The unfavorable weather conditions with shortage of rainfall and high temperature resulted in below-average biomass in all major agricultural producing states, except for Parana (+3%). As compared to the same period in 2022, only three major states, Ceara, Parana, and Santa Catarina, received more rainfall.

The prolonged precipitation deficit weather negatively affected crop growth, leading to an overall below average crop condition as reflected by the consistently below average vegetation greenness, tracking back to the start of the summer season in October 2022. Meanwhile, NDVI profiles show that the crop condition gradually recovered starting in mid-February and reached a close-to-average level by the end of April. Spatial distribution of NDVI departure from 5YA and NDVI departure profiles corresponding to the clusters illustrated the detailed spatial-temporal variation of the crop conditions. Average crop conditions were mostly distributed in the Parana River basin, while most other regions presented continuously below average conditions. Accordingly, the VCIx map also presented higher values in the Parana river basin, while other regions were normal except for the very south of Brazil, where VCIx values were lowest, mainly due to the irregular rainfall. At the national level, VCIx was 0.93, the same as in the January to April 2022 period. CALF was at 5YA, indicating overall limited effects from the dry weather on the sowing of the crops.

Despite the slightly below-average crop conditions in Brazil caused by the dry and warm weather, the success of second maize production largely depended on irrigation practices. The average yield of second maize is expected to surpass that of 2022. In addition, the expansion of the cultivated area for second maize compared to 2022 also played a crucial role in mitigating the impact of the drought, resulting in increased production of second maize. The crop production index of Brazil is 1.14, which is slightly higher than that of 2022, which was 1.10.

Regional analysis

Taking into account the variations in cropping systems, climatic zones, and topographic conditions, Brazil can be divided into eight distinct agro-ecological zones (AEZs). This bulletin focuses on six specific AEZs: Central Savanna (31), East coast (32), Mato Grosso zone (34), Nordeste (35), Parana River (36), and Southern subtropical rangelands (37). Across all AEZs, there was a notable deficiency in rainfall, ranging from -17% to -91% compared to the average, coupled with above-average temperatures ranging from +0.1°C to +3.7°C. The most significant temperature anomaly was observed in the Central Savanna zone, where temperatures were 3.7°C higher than the 15-year average . Photosynthetically Active Radiation (RADPAR) was generally close to the average, with a departure ranging from -4% to +3%. However, the unfavorable dry and hot weather conditions across all AEZs resulted in below-average biomass (-3% to -57%) compared to the 15-year average.

Among the AEZs, the Central Savanna (31), Nordeste (35), and Southern subtropical rangelands (37) were most severely affected by the drought. Central Savanna experienced the lowest rainfall levels during the monitoring period, receiving only 73 mm, which was 91% below the 15-year average. The significant water deficit led to well-below-average

Normalized Difference Vegetation Index (NDVI) values, particularly noticeable since February 2023. The Nordeste region also faced dry and hot weather conditions, receiving the second-lowest rainfall among the eight zones, totaling 191 mm. The substantial water deficit in January and February hindered crop development, resulting in consistently below-average crop conditions since February. However, rainfall recovered to near-average levels in March and April, potentially benefiting crop development until the maturity stage. The Southern subtropical rangelands exhibited below-average crop conditions with the lowest Crop Production Index (CPI) value (0.94) and Vegetation Condition Index (VCIx) value (0.79) compared to other AEZs. NDVI profiles indicated below-average crop growth conditions throughout the monitoring period. However, thanks to above-average rainfall in early and late March, the negative NDVI anomaly compared to the five-year average has diminished since March, despite reaching the harvest stage for summer crops in the region.

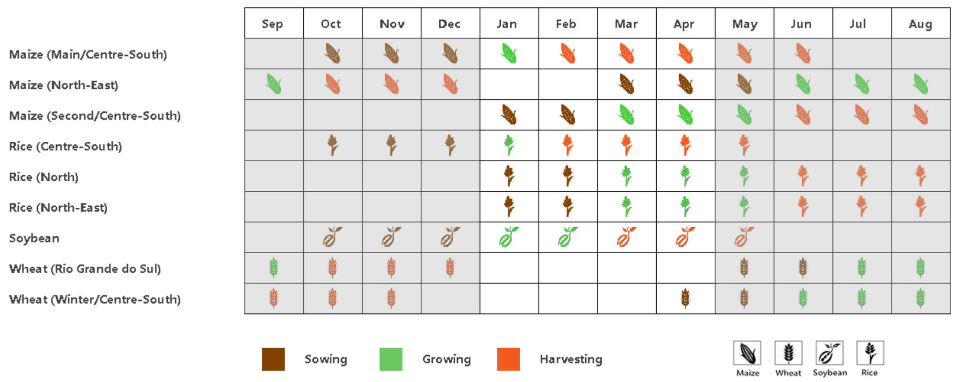
Dry and hot weather conditions also prevailed in Mato Grosso and the Parana River Basin, the two leading AEZs for agriculture. The impacts were more complex in Mato Grosso as the monitoring period covered the growth and harvest of first maize and soybean, as well as the sowing and growth of second maize. The drought reduced the yields of first maize and soybean compared to the 2022 season but they still exceeded the five-year average. For second maize, the crop phenology was delayed due to significantly below-average rainfall. Nevertheless, irrigation practices maintained favorable soil moisture conditions, resulting in second maize yields surpassing those of 2022, with a CPI value of 1.17. Both CALF and VCIx exhibited normal values compared to the five-year averages.

Similarly, the Parana River Basin presented overall normal crop conditions compared to the five-year average, as indicated by the average NDVI values in the crop development graph. During the peak growing period of first-season crops, NDVI values surpassed those of 2022 from late January to mid-February, despite below-average rainfall. The soil moisture conditions were favorable, primarily due to irrigation practices, benefiting crops, particularly second maize and soybean. Throughout the monitoring period, CALF values were average, VCIx reached 0.94, and the CPI value was 1.15, significantly higher than 2022 (1.08).

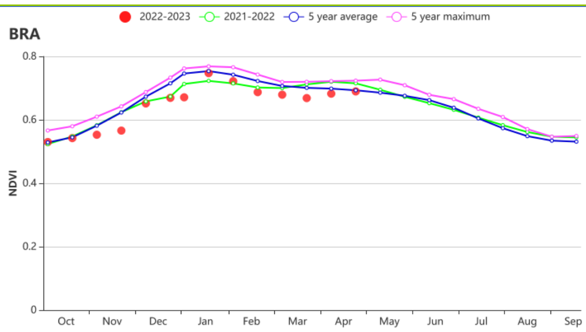
The East coast AEZ exhibited a large negative biomass departure, with overall below-average crop conditions as reflected by the NDVI-based crop development profile. Agricultural lands along the coastal line displayed a significant above-average potential biomass, while inland areas showed substantial below-average biomass. The rainfall deficit in February and early March was more pronounced than in other periods during the monitoring period, resulting in a well-below-average NDVI since early March. Rainfall recovered thereafter, accelerating crop development. However, by the end of the monitoring period, crop conditions remained below average. Overall, the production outlook for this AEZ is forecasted to be below average, with a CPI value of 1.04, considerably lower than that of 2022, which was 1.11.

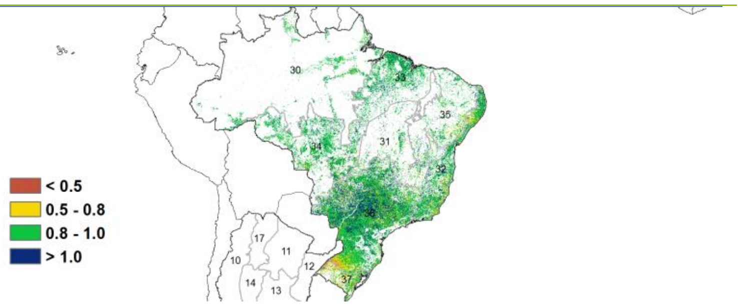
For more indicators and detailed information, it is recommended to visit CropWatch Explore (http://cropwatch.com.cn/newcropwatch/main.htm).

Figure 3.11 Brazil's crop condition, January -April 2023.

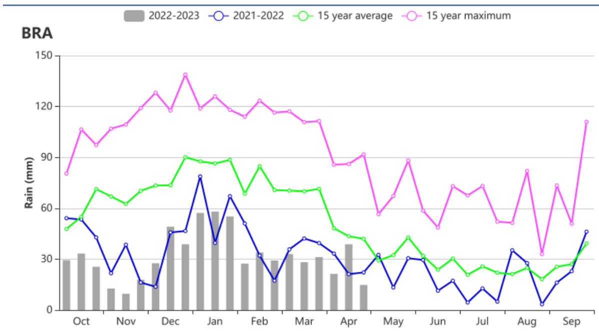


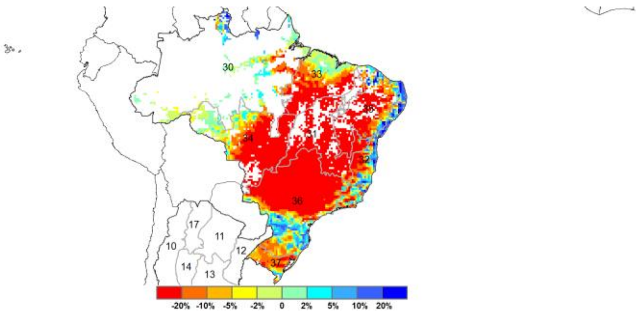
(a). Phenology of major crops



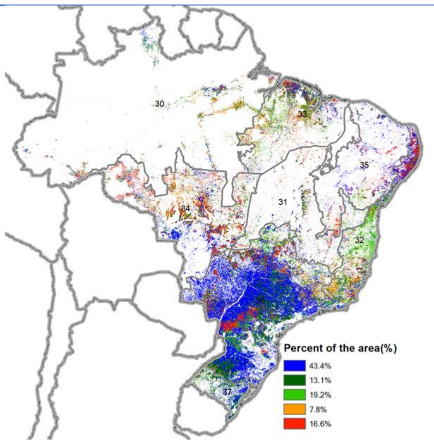


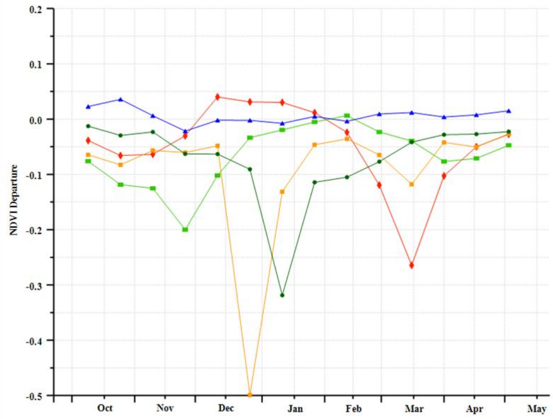
(b) Crop condition development graph based on NDVI (c) Maximum VCI



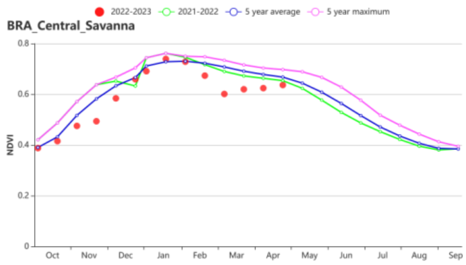


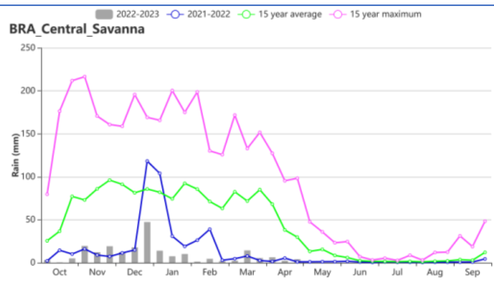
(d) Rainfall Index (e) Potential biomass departure from 15YA



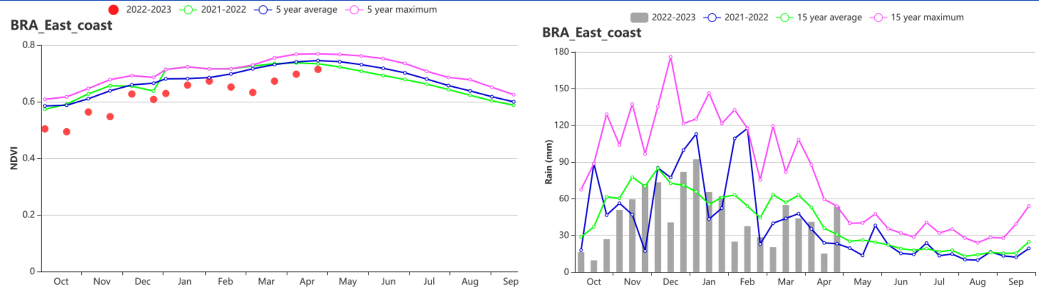


(f) Spatial NDVI patterns compared to 5YA (g) NDVI profiles

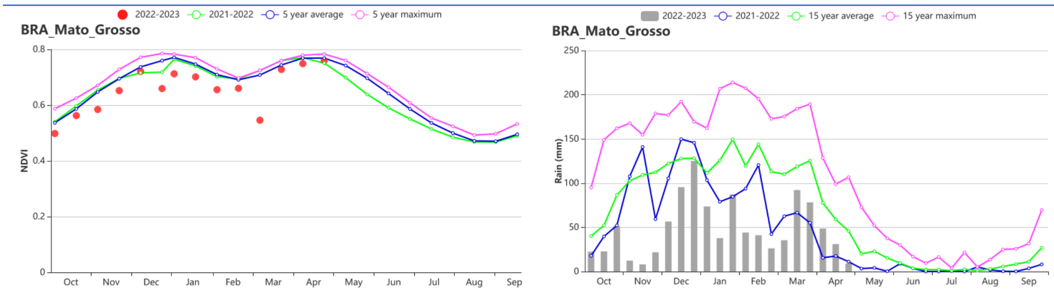




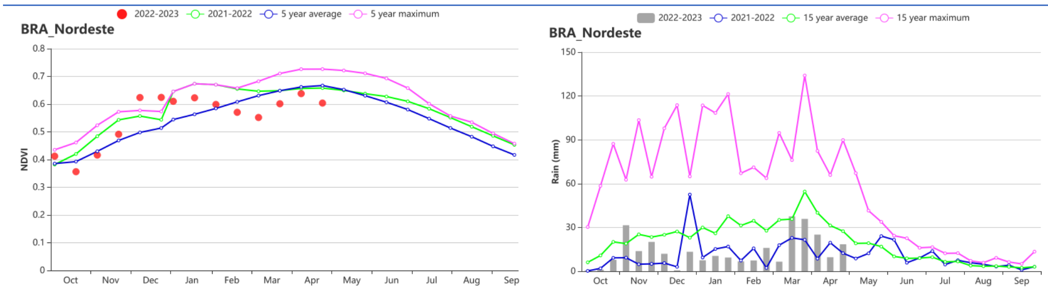
(h) Crop condition development graph based on NDVI (left) and rainfall profile (right) of Central Savanna



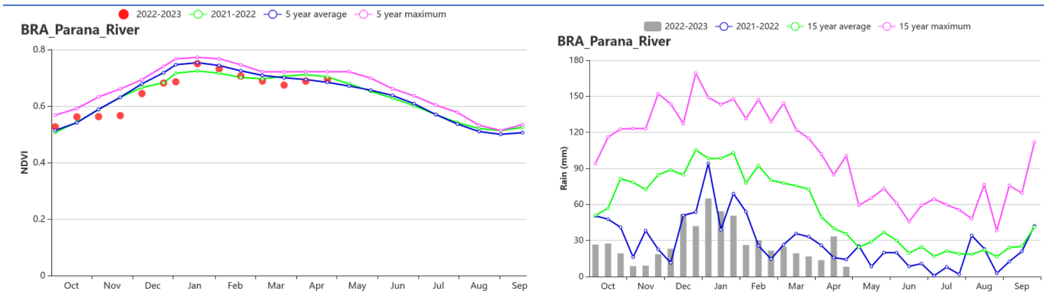
(i) Crop condition development graph based on NDVI (left) and rainfall profile (right) of Coast zone



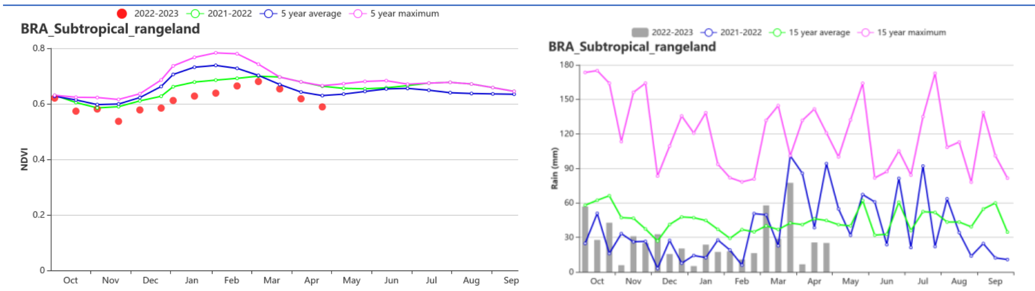
(j) Crop condition development graph based on NDVI (left) and rainfall profile (right) of Mato Grosso



(k) Crop condition development graph based on NDVI (left) and rainfall profile (right) of Nordeste



(L) Crop condition development graph based on NDVI (left) and rainfall profile (right) of Parana basin



(m) Crop condition development graph based on NDVI (left) and rainfall profile (right) of Southern subtropical rangelands

Table 3.13 Brazil's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, January-April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure from 15YA (%)	Current (°C)	Departure (°C)	Current (MJ/m2)	Departure from 15YA (%)	Current (gDM/m2)	Departure from 15YA (%)
Amazonas	1018	-24	25.1	0.1	1096	2	1422	-5
Central Savanna	73	-91	27.3	3.7	1216	-2	559	-57
Coast	540	-17	23.8	0.6	1282	3	1124	-3
Northeastern mixed forest and farmland	731	-44	25.9	1	1164	1	1285	-19
Mato Grosso	605	-54	25.8	1.6	1108	0	1075	-28
Nordeste	191	-54	26.7	1.1	1250	0	723	-27
Parana basin	364	-60	24	1.8	1140	-4	877	-34
Southern subtropical rangelands	313	-35	23.6	1.2	1165	-1	929	-12

Table 3.14 Brazil's agronomic indicators by sub-national regions, current season's values and departure from 5YA, January-April 2023

Region	CALF		Maximum VCI
	Current (%)	Departure from 5YA (%)	Current
Amazonas	100	0	0.93
Central Savanna	100	0	0.93
Coast	100	0	0.92
Northeastern mixed forest and farmland	100	0	0.96
Mato Grosso	100	0	0.95
Nordeste	100	2	0.91
Parana basin	100	0	0.94
Southern subtropical rangelands	99	-1	0.79

AFG AGO ARG AUS BGD BLR BRA **CAN** DEU DZA EGY ETH FRA GBR HUN IDN IND IRN ITA KAZ KEN KGZ KHM LKA MAR MEX MMR MNG MOZ NGA PAK PHL POL ROU RUS SYR THA TUR UKR USA UZB VNM ZAF ZMB

[CAN] Canada

During this monitoring period, winter cereals (wheat & barley) and canola were the main crops in the field. They are mainly grown in the region near Toronto, such as Ontario and Quebec. The winter wheat conditions were below the 5-year average at the beginning of this monitoring period but recovered to the average level at the end, according to the NDVI development graph.

The proportion of irrigated cropland in Canada is only 5% and agro-meteorological conditions play a decisive role in the growth of most crops. Below-average precipitation and above-average temperature occurred in this monitoring period. According to CropWatch Agroclimatic indicators, the precipitation and radiation were below the 15-year average by 5% and 7%, respectively, while temperatures were above average by 1.1℃. These agroclimatic conditions led to a close to average potential BIOMSS (+2%). According to the NDVI development graph, the spring green-up period was delayed, due to cool weather conditions. The NDVI development curve recovered to normal levels at the end of this monitoring period. The sowing of spring wheat crops will start in May, mainly distributed in the Prairies region, which is the major type of wheat grown in Canada.

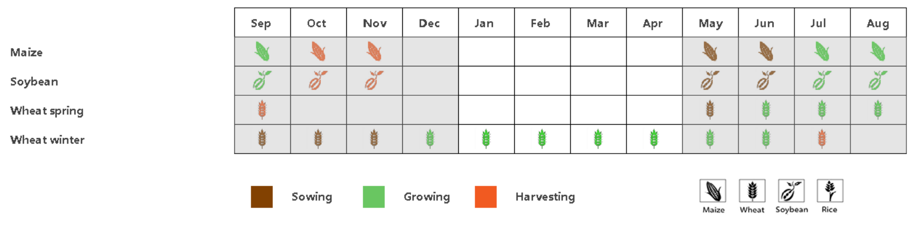
Regional analysis

The Prairies (area identified as 53 in the NDVI clustering map) and Saint Lawrence basin (49, covering Ontario and Quebec) are the major agricultural regions.

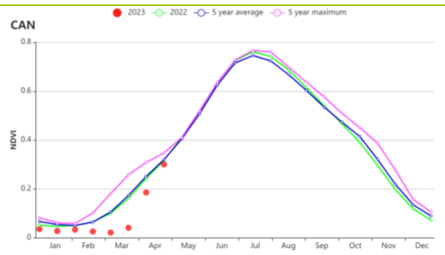
In the **Prairies**, the temperature was above average (TEMP +0.4°C), while the precipitation and radiation were lower than the 15-year average (RAIN -14%; RADPAR -5%, respectively). By the end of April, land preparation for the coming sowing season had started.

The **Saint Lawrence Basin** is the main winter wheat production area in Canada. Most winter wheat is grown in southeastern Ontario, near Toronto and Ottawa. The precipitation and radiation were below the 15-year average (RAIN -1%; RADPAR -9%), and the temperatures were significantly above average (TEMP +1.8℃). Despite the below-average trend of NDVI occurring at the beginning, the crop condition recovered at the end, and prospects for winter wheat production are normal.

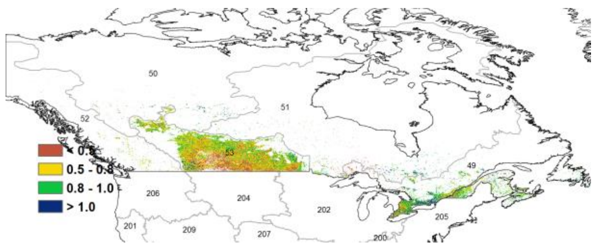
Figure 3.12 Canada's crop condition,January - April 2023



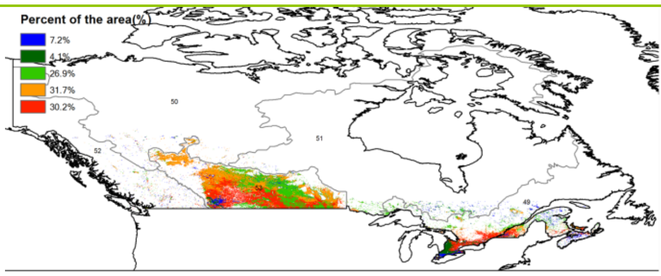
(a) Phenology of major crops



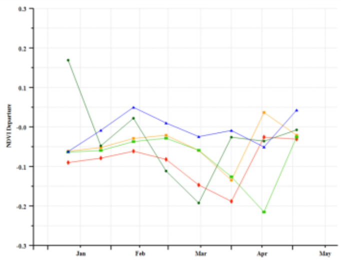
(b) Crop condition development graph based on NDVI



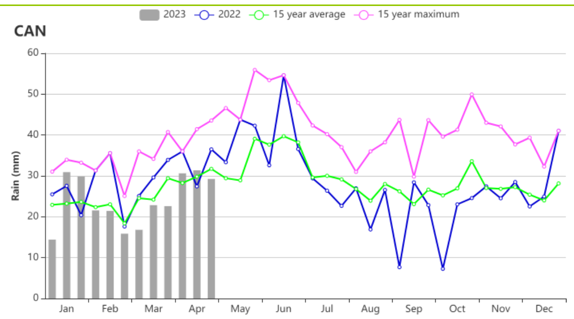
(c) Maximum VCI



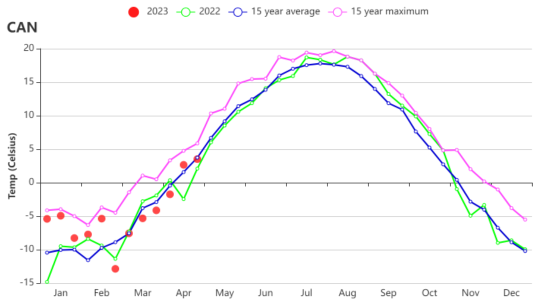
(d) Spatial NDVI patterns compared to 5YA



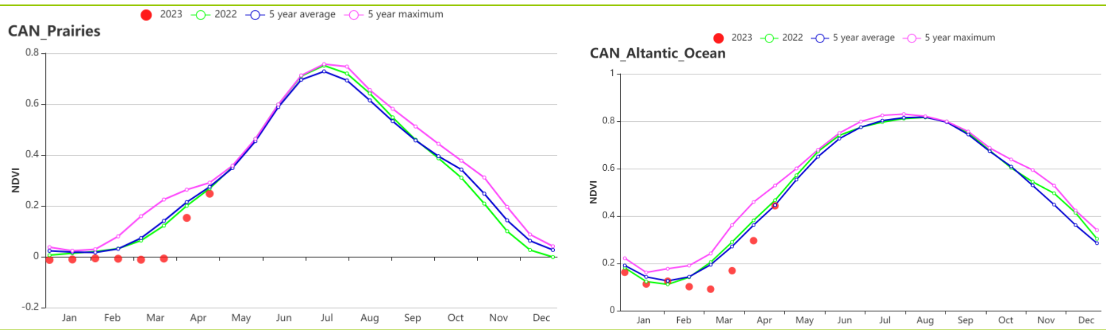
(e) NDVI profiles



(f) Rainfall profiles



(g) Temperature profiles



(h) Crop condition development graph based on NDVI (Canadian Prairies region (left) and Saint Lawrence basin region (right))

Table 3.15 Canada's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, January - April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Saint Lawrence basin	424	-1	-2.7	1.8	529	-9	293	12
Prairies	157	-14	-5.4	0.4	545	-5	237	-6

Table 3.16 Canada's agronomic indicators by sub-national regions, current season's values and departure from 5YA, January - April 2023

Region	Cropped arable land fraction		Maximum VCI
	Current (%)	Departure (%)	Current
Saint Lawrence basin	54	-2	0.83
Prairies	2	-49	0.67

AFG AGO ARG AUS BGD BLR BRA CAN **DEU** DZA EGY ETH FRA GBR HUN IDN IND IRN ITA KAZ KEN KGZ KHM LKA MAR MEX MMR MNG MOZ NGA PAK PHL POL ROU RUS SYR THA TUR UKR USA UZB VNM ZAF ZMB

[DEU] Germany

This reporting period covers the overwintering and spring green-up phases of the winter cereals. In late April, winter wheat and barley were at the late vegetative stages, and spring wheat and maize were being planted. Generally, the crop conditions in Germany were above average in most regions based on the agroclimatic and agronomic indicators.

CropWatch agroclimatic indicators show that both total precipitation (RAIN, +20%) and temperature (TEMP, +0.5°C) were above average, while radiation (RADPAR, -14%) was below the average of the past 15 years. As can be seen from the time series of the rainfall profile, Germany experienced above-average precipitation except for early January, late January and February. Most of the country experienced warmer conditions during the monitoring period, except for late January, February and April, which were cooler than average. Early January was even above the maximum of the past 15 years. Due to plenty of precipitation and warmer-than-usual temperatures, the biomass accumulation potential (BIOMSS) increased by 4% at the nationwide level as compared to the 15YA. Sufficient precipitation in March and April favored the growth of summer crops in Germany.

CropWatch agronomic indicators based on NDVI development graph at the national scale show that NDVI values were slightly above average in October and near the 5-year maximum level in April. Subsequent drops in NDVI can be attributed to either fog, cloud cover or snow on the ground. These factors also caused large negative departures in the spatial NDVI profiles. These observations were also confirmed by VCI values in the spatial distribution of maximum VCI map. It reached 0.91 at the national scale. Crop production index (CPI) was 1.17, higher than 1, further suggesting favorable crop conditions.

Overall, the agronomic and agroclimatic indicators show favorable conditions for most winter crops in Germany.

Regional analysis

Based on cropping systems, climatic zones, and topographic conditions, six sub-national agro-ecological regions are adopted for Germany. They include: the Wheat Zone of Schleswig-Holstein and the Baltic coast (56), Mixed Wheat and Sugar beet Zone of the Northwest (57), Central Wheat Zone of Saxony and Thuringia (55), Sparse Crop Area of the East-German Lake and Heathland area (54), Western Sparse Crop Area of the Rhenish Massif (59) and the Bavarian Plateau (58).

Schleswig-Holstein and the Baltic coast is the major winter wheat zone of Germany. Compared to the s average of the past 15 years, the CropWatch agroclimatic indicators RAIN (+26%) and temperature (TEMP, +0.9°C) were above average, while radiation (RADPAR, -12%) was below average. Due to favorable precipitation and temperature during the green-up period of wheat, biomass (BIOMSS) was increased by 6%. The area had a high CALF (99%) as well as a favorable VCIx (0.90), indicating favorable crop prospects. CPI was 1.06. The crop production in this region is expected to be above average.

Wheat and sugar-beets are major crops in the Mixed wheat and sugar-beets zone of the north-west. RAIN (+27%) and temperature (TEMP, +0.9°C) were significantly above average, while radiation (RADPAR, -13%) was below average. Due to favorable precipitation and temperature during the germination of wheat, biomass (BIOMSS) was 5% above average. As shown in the crop condition development graph based on NDVI, the values were above average except for January and mid-March, which were below the 5-year average. The area had a high CALF (99%) as well as a favorable VCIx (0.85). CPI was 1.06. The crop production in this region is expected to be above average.

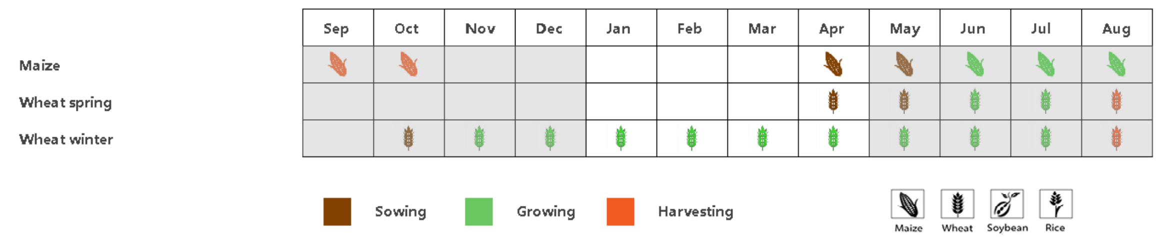
The Central wheat zone of Saxony and Thuringia is another major winter wheat zone. The CropWatch agroclimatic indicators show that this region experienced above average precipitation (+29%) with warmer weather (TEMP, +0.6°C), while radiation was below average (RADPAR, -16%), which led to above average biomass (BIOMSS, +7%). As shown in the crop condition development graph based on NDVI, the values were above or near average except in late January and mid-March. The area has a high CALF (100%) as well as a favorable VCIx (0.90). CPI was 1.12. The crop production in this region is expected to be above average.

In **the East-German Lake and Heathland Sparse Crop Area**, significantly above-average precipitation was recorded (RAIN, +25%). Temperatures (TEMP, +0.6°C) was higher than average, while radiation (RADPAR, -16%) was below average. As a result, BIOMSS is expected to increase by 4% as compared to the average. As shown in the crop condition development graph based on NDVI, the values were above or close to average except in late January and mid-March. The area has a high CALF (100%) and the VCIx was 0.97 for this region. CPI was 1.20. The crop production in this region is expected to be above average.

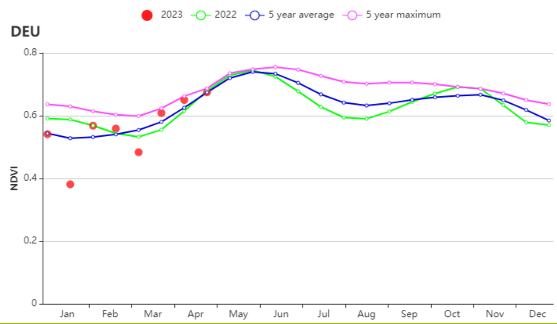
The cropland in **the Western sparse crop area of the Rhenish massif** also experienced above average precipitation (+23%) with warmer weather (TEMP, +0.9°C), while radiation was below average (RADPAR, -15%), which led to a biomass (BIOMSS) increase by 7%. As shown in the crop condition development graph based on NDVI, the values were above or close to average except in January and mid-March. The area had high CALF (99%) and a high VCIx (0.88). CPI was 1.08. The crop production in this region is expected to be above average.

Above average precipitation was recorded for the **Bavarian Plateau** (RAIN +11%), with above-average temperature (+0.2°C) and below-average radiation (RADPAR -15%). Compared to the fifteen-year average, BIOMSS decreased by 1%. As shown in the crop condition development graph based on NDVI, the values were above or close to average except in late January. The area had a high CALF (99%) as well as a favorable VCIx (0.94). CPI was 1.16. The crop production in this region is expected to be above average.

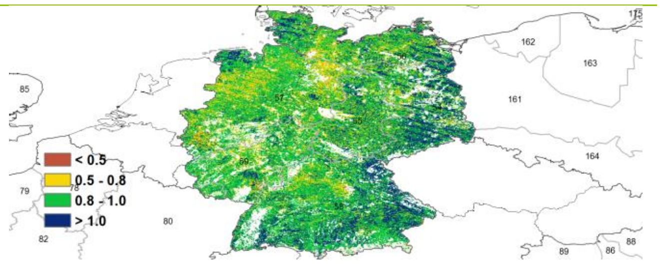
Figure 3.13 Germany's crop condition, January-April 2023



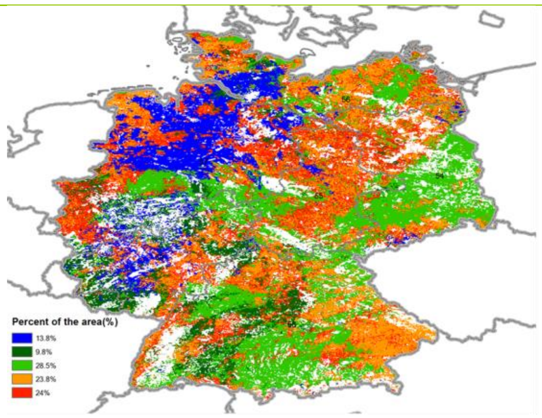
(a). Phenology of major crops



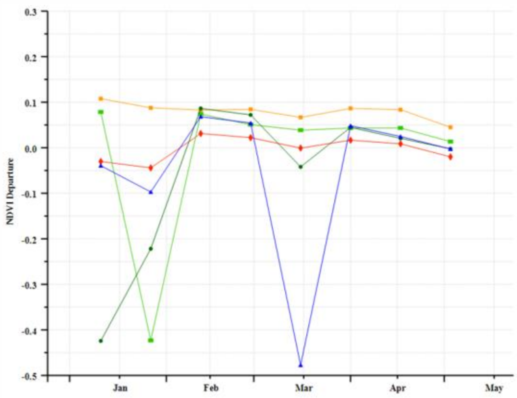
(b) Crop condition development graph based on NDVI



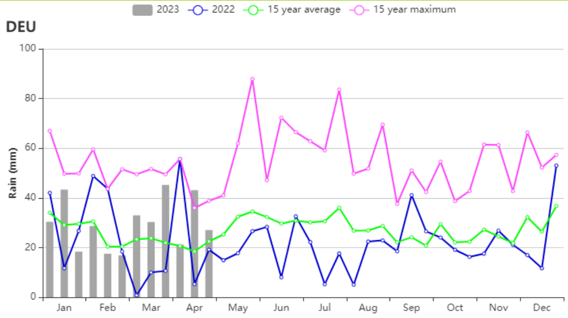
(c) Maximum VCI

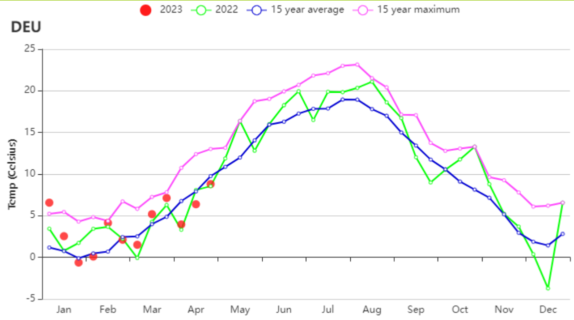


(d) Spatial NDVI patterns compared to 5YA



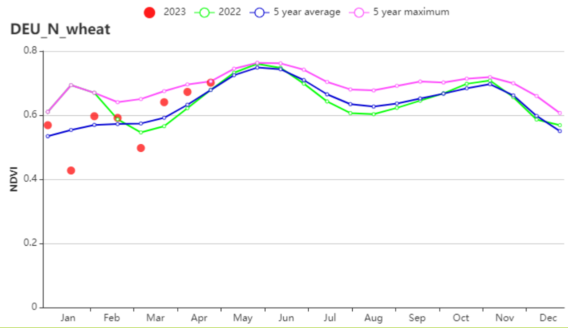
(e) NDVI profiles

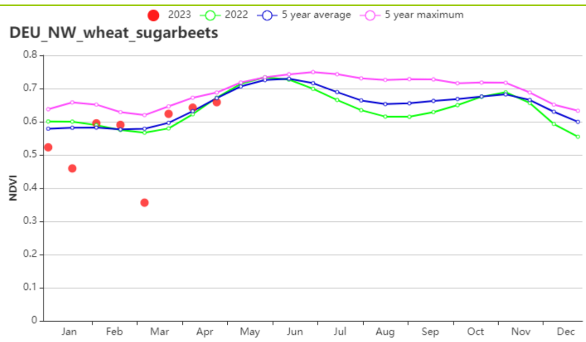




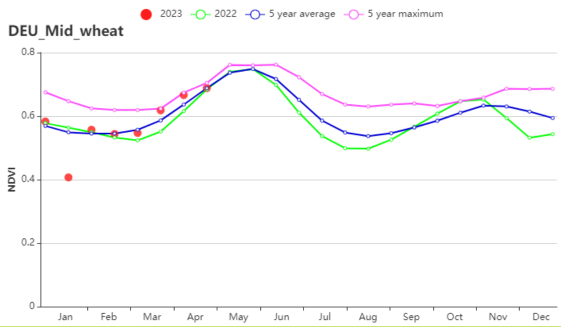
(f) Rainfall profiles

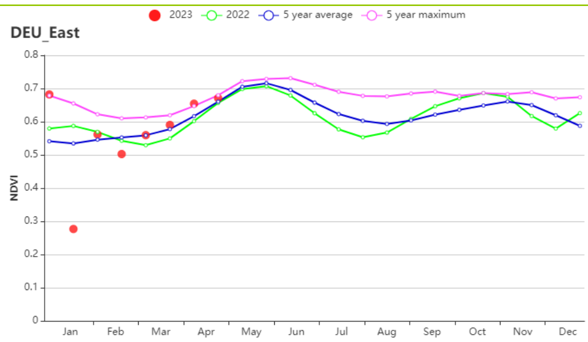
(g) Temperature profiles



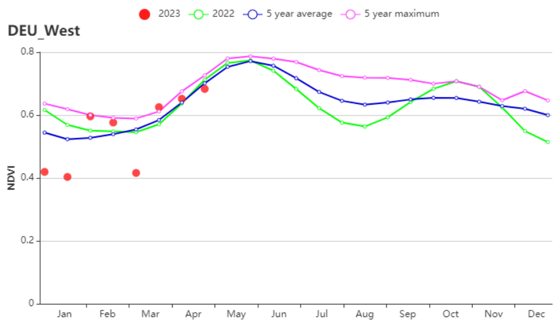


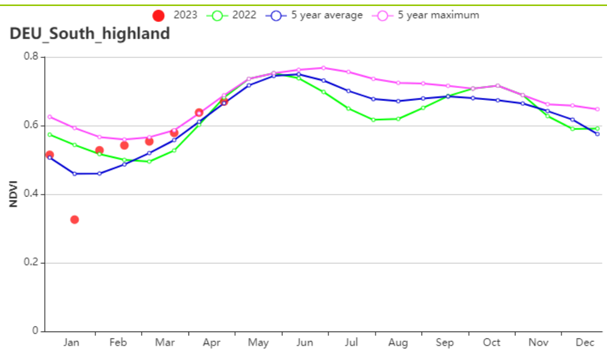
(h) Crop condition development graph based on NDVI (Wheat zone of Schleswig-Holstein and the Baltic coast (left) and Mixed wheat and sugar beets zone of the north-west(right))





(i) Crop condition development graph based on NDVI (Central wheat zone of Saxony and Thuringia(left) and Sparse crop area of the east-German lake and Heathland (right))





(j) Crop condition development graph based on NDVI (Western sparse crop area of the Rhenish massif (left) and Bavarian Plateau (right)

Table 3.17 Germany's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, January-April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Wheat zone of Schleswig-Holstein and the Baltic coast	335	26	4.9	0.9	410	-12	533	6
Mixed wheat and sugarbeets zone of the north-west	360	27	5.0	0.7	422	-13	541	5
Central wheat zone of Saxony and Thuringia	313	29	3.8	0.6	429	-16	496	7
East-German lake and Heathland sparse crop area	306	25	3.8	0.6	420	-16	496	4
Western sparse crop area of the Rhenish massif	340	23	4.5	0.9	438	-15	521	7
Bavarian Plateau	393	11	2.8	0.2	492	-15	460	-1

Table 3.18 Germany's agronomic indicators by sub-national regions, current season's values and departure from 5YA, January-April 2023

Region	Cropped arable land fraction		Maximum VCI	Crop Production Index(CPI)
	Current (%)	Departure (%)	Current	Current
Wheat zone of Schleswig-Holstein and the Baltic coast	99	0	0.90	1.06
Mixed wheat and sugarbeets zone of the north-west	99	0	0.85	1.06
Central wheat zone of Saxony and Thuringia	100	0	0.90	1.12
East-German lake and Heathland sparse crop area	100	0	0.97	1.20
Western sparse crop area of the Rhenish massif	99	0	0.88	1.08
Bavarian Plateau	99	0	0.94	1.16

AFG AGO ARG AUS BGD BLR BRA CAN DEU DZA **EGY** ETH FRA GBR HUN IDN IND IRN ITA KAZ KEN KGZ KHM LKA MAR MEX MMR MNG MOZ NGA PAK PHL POL ROU RUS SYR THA TUR UKR USA UZB VNM ZAF ZMB

[EGY] Egypt

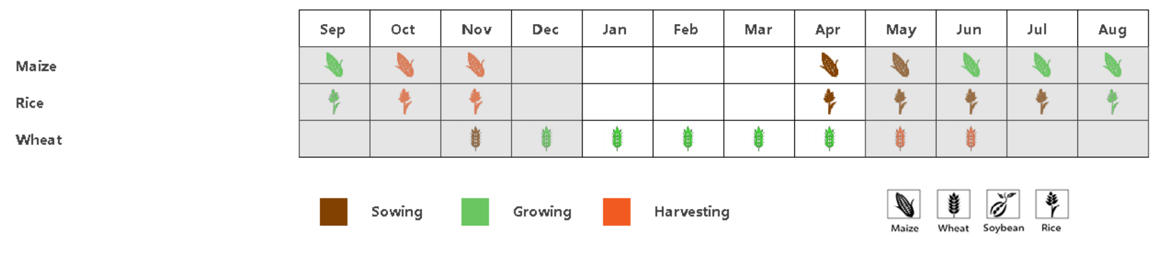
This report covers the primary growing season of winter wheat and the sowing of maize and rice. The CropWatch agro-climatic indicators show that the recorded rainfall was 52 mm, only 2% more than the average of the last 15 years (15YA). The rainfall index graph shows that most rainfall fluctuated around 15YA and exceeded 10 mm during the first decade of January and March. The average temperature was 15.6°C, just 0.1°C higher than the 15YA. The temperature index graph fluctuated around the 15YA. RADPAR and BIOMSS were lower than the 15YA, respectively, by 1.4% and 9%. The nationwide NDVI development graph shows that the crop conditions fluctuated around the 5-year average (5YA). The NDVI profile map indicates that 12.5% of the cultivated area was above the 5YA, 57.3% fluctuated around the 5YA, and 30.3% was below the 5YA. The country's VCIx value was 0.81, and the CALF exceeded the 5YA by 1%. Crop conditions in Egypt were average. The nationwide crop production index (CPI) was at 1.11, implying above-average crop production conditions.

Regional analysis

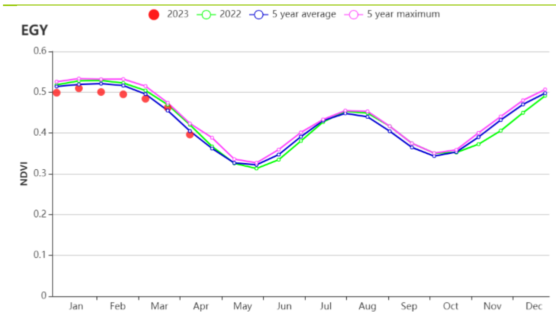
Based on the cropping systems, climatic zones, and topographic conditions, Egypt is subdivided into three agro-ecological zones (AEZ). Only two are relevant for crop production: **(1) the Nile Delta and the Mediterranean coastal strip (AEZ 60)**, as well as **(2) the Nile Valley (AEZ 61).**

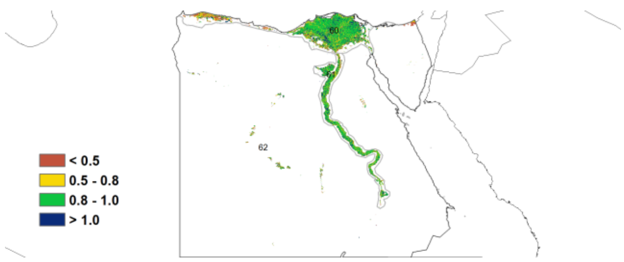
In the Nile Delta and Mediterranean coastal strip, the average rainfall was 54 mm, only 3% above the 15YA while in the Nile Valley zone, it was 8 mm, 56% below the 15YA. The temperature was at 15YA in the Nile Delta and the Mediterranean coastal strip and 0.2°C below the 15YA in the Nile Valley. In Egypt, most crops are irrigated, so rainfall has little impact on crop production. RADPAR was below the 15YA by 1.9% and 0.6% for the Nile Delta and the Mediterranean coastal strip and the Nile Valley, respectively. BIOMSS was higher than the 15YA in the Nile Delta and the Mediterranean coastal strip by 2% while it was below the 15YA in the Nile Valley by 36%. The NDVI-based crop condition development graphs show similar conditions for both zones following the national crop development NDVI graph. The VCIx was 0.86 and 0.82 for the Nile Delta and the Mediterranean coastal strip and the Nile Valley, respectively, while the CALF exceeded the 5YA by 1% for both zones, indicating average crop conditions. The nationwide crop production index (CPI) was at 1.07 and 1.13 for the Nile Delta and the Mediterranean coastal strip and the Nile Valley, respectively, implying above normal crop production situation following the nationwide CPI.

Figure 3.14 Egypt's crop condition, January-April 2023



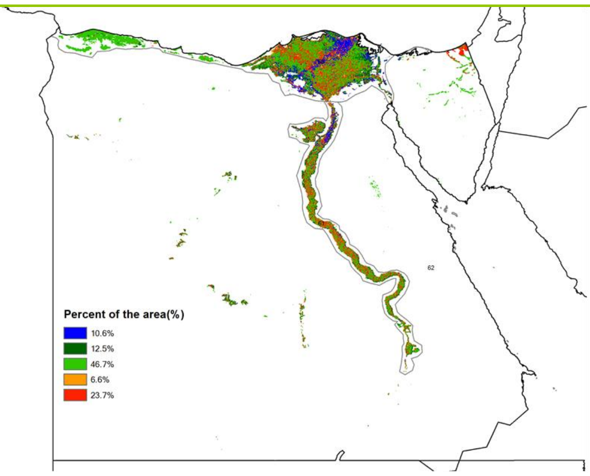
(a) Phenology of major crops



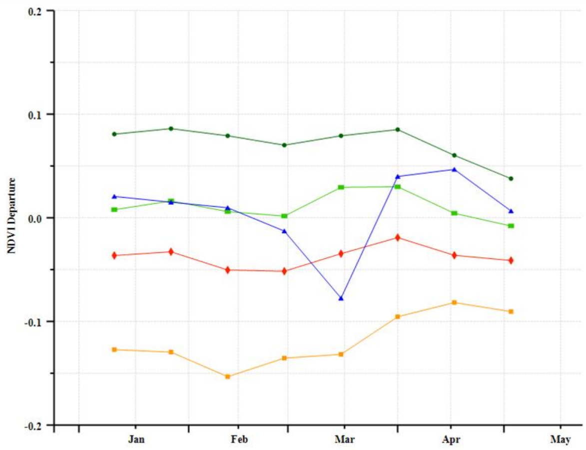


(b) Crop condition development graph based on NDVI

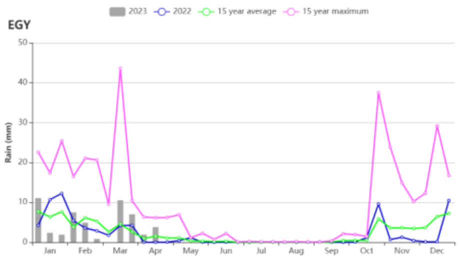
(c) Maximum VCI



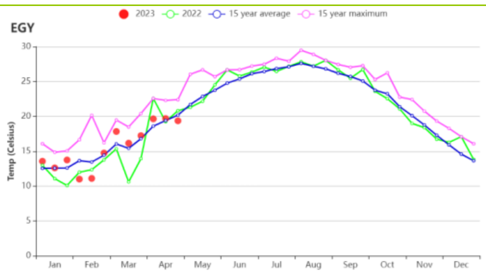
(d) Spatial NDVI patterns compared to 5YA



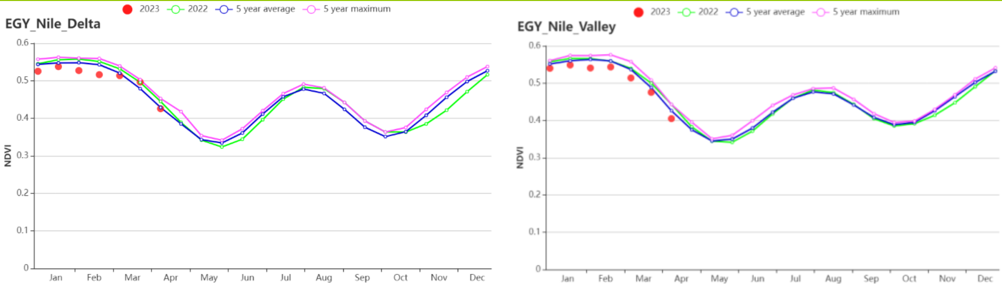
(e) NDVI profiles



(f) Rainfall profiles



(g) Temperature profiles



(h) Crop condition development graph based on NDVI (Nile Delta (left) and Nile Valley (right))

Table 3.19 Egypt's agroclimatic indicators by sub-national regions, current season's values, and departure from 15YA, January-April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Nile Delta and Mediterranean coastal strip	54	3	15.5	0.0	987	-1.9	329	2
Nile Valley	8	-56	16.1	-0.2	1106	-0.6	163	-36

Table 3.20 Egypt's agronomic indicators by sub-national regions, current season's values, and departure from 5YA, January-April 2023

Region	Cropped arable land fraction		Maximum VCI
	Current (%)	Departure (%)	Current
Nile Delta and Mediterranean coastal strip	71	1	0.86
Nile Valley	82	1	0.82

[ETH] Ethiopia

The monitoring period for this report spans from January to April, coinciding with the short rainy season (Belg) in central and southeastern Ethiopia. During this period, the sowing of Meher (main season) maize began in the central and southeastern Oromia regions. Nationally, agroclimatic indicators indicate favorable soil moisture conditions, with rainfall (+21%), temperature (-0.3°C), and biomass (0%) within desirable ranges. Agronomic indicators also show a smooth sowing of maize, with a significant increase in CALF (+37%). Adequate rainfall in March and April allowed farmers to initiate land preparation for the main season crops. Moreover, the NDVI and maximum VCI value of 1.02 were considerably above average, suggesting favorable conditions. Late April data based on NDVI clusters revealed that only 2% of cropland had slightly below-average conditions, while the remaining land exhibited above-average conditions. Overall, prospects for the Meher season are favorable.

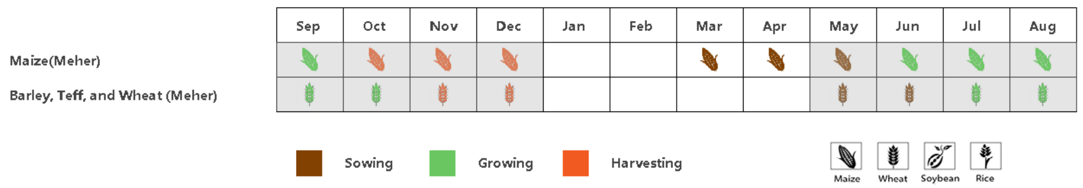
Regional analysis

This analysis focuses on five major cereal production regions: **Central-northern maize-teff highlands (63), Great Rift region (65), South-eastern Mendebo highlands (71), South-western coffee-enset highlands (73),** and **Western mixed maize zone (74)**.

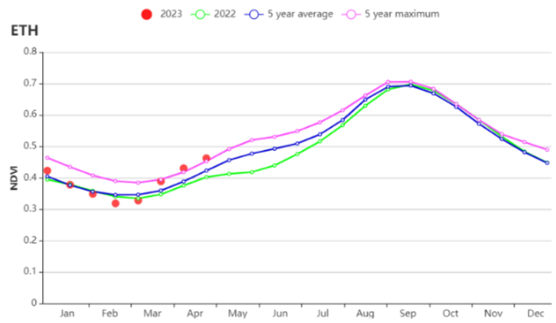
Agroclimatic conditions in the **Central-northern maize-teff highlands (63), Great Rift region (65),** and **South-eastern Mendebo highlands (71)** were similar, with cumulative precipitation levels above average (RAIN +41%, +28%, and +34%). Biomass also increased compared to the 15-year average (BIOMSS +8%, +7%, and +11%). The NDVI exhibited a favorable trend, and there was a substantial increase in cropped arable land fraction (CALF +63%, +70%, and +25%). VCIx values were 1.03, 1.09, and 0.97, indicating favorable conditions.

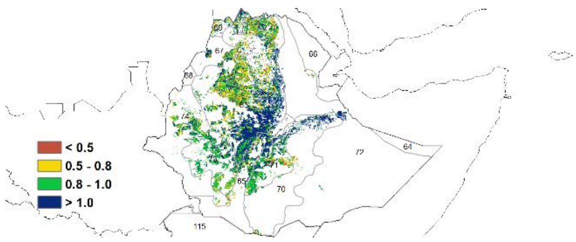
In the **South-western coffee-enset highlands (73)** and **Western mixed maize zone (74)**, precipitation levels were close to the 15-year average (RAIN -8% and +5%). However, biomass estimates were below average (BIOMSS -12% and -4%). The cropped arable land fraction remained mostly unchanged, and crop production in these two regions was normal.

Figure 3.15Ethiopia's crop condition, January - April 2023



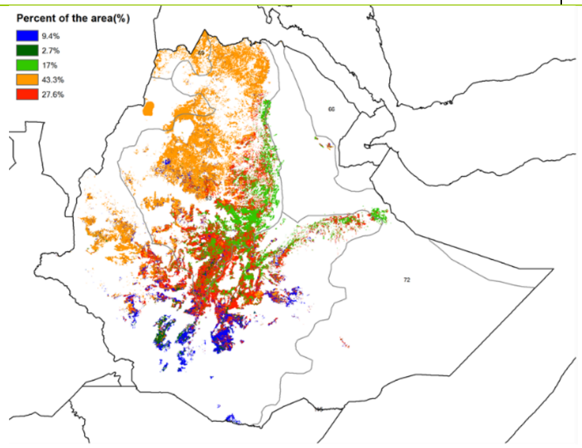
(a) Phenology of major crops

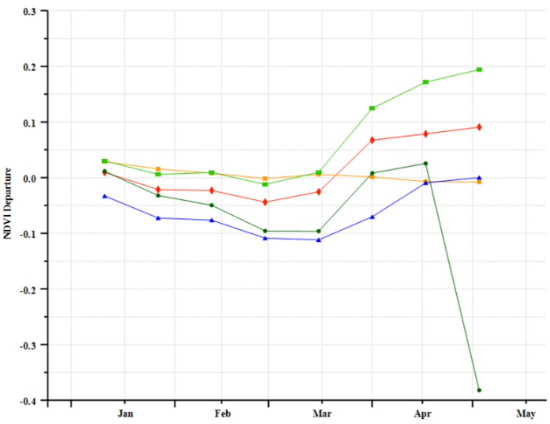




(b) Crop condition development graph based on NDVI

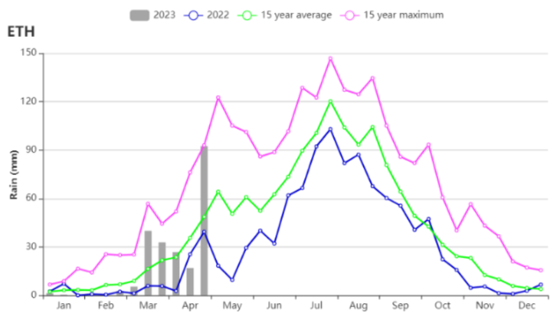
(c) Maximum VCI

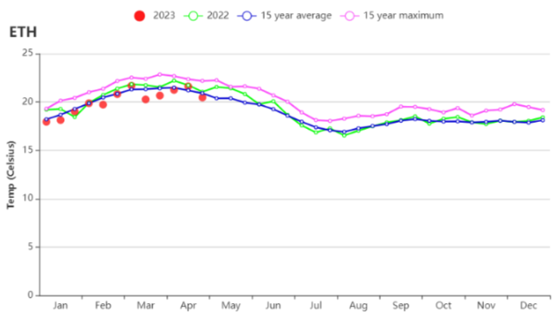




(d) Spatial NDVI patterns compared to 5YA

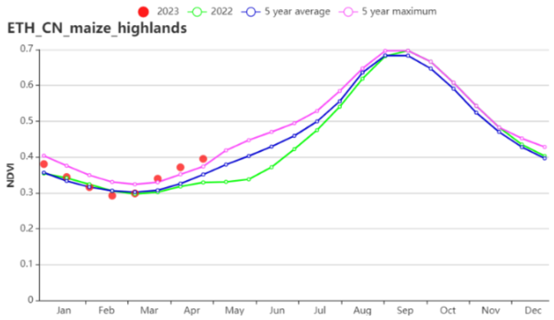
(e) NDVI profiles

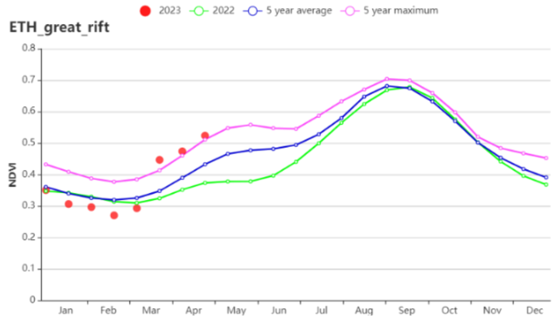




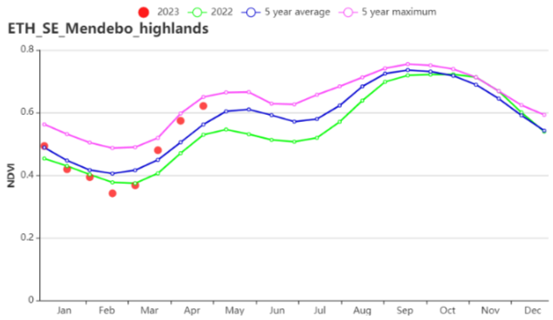
(f) Rainfall profiles

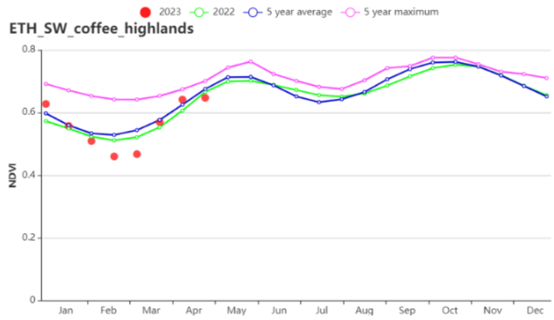
(g) Temperature profiles



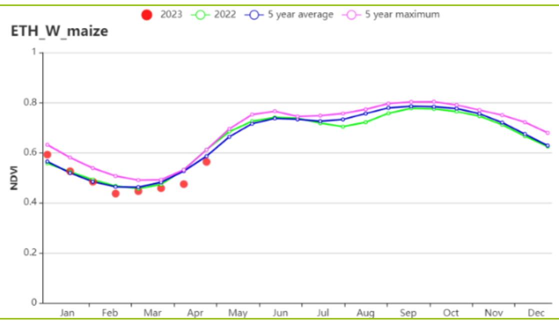


(h) Crop condition development graph based on NDVI (Central-northern maize-teff highlands (left) Great Rift region (right))





(i) Crop condition development graph based on NDVI (South-eastern Mendebo highlands (left) and South-western coffee-enset highlands (right))



(j) Crop condition development graph based on NDVI (Western mixed maize zone)

Table 3.21 Ethiopia’s agroclimatic indicators by sub−national regions, current season's values and departure from 15YA, January – April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m2)	Departure (%)	Current (gDM/m2)	Departure (%)
Central-northern maize-teff highlands	170	41	19.2	-0.3	1412	0	584	8
Great Rift region	212	28	19.4	-0.3	1358	-3	617	7
South-eastern Mendebo highlands	286	34	15.8	-0.3	1320	-3	622	11
South-western coffee-enset highlands	351	-8	19.9	-0.2	1302	0	713	-12
Western mixed maize zone	217	5	24.0	-0.4	1314	1	661	-4

Table 3.22 Ethiopia’ s agronomic indicators by sub −national regions, current season's values and departure from 5YA, January – April 2023

Region	Cropped arable land fraction		Maximum VCI
	Current (%)	Departure (%)	Current
Central-northern maize-teff highlands	50	63	1.03
Great Rift region	73	70	1.09
South-eastern Mendebo highlands	91	25	0.97
South-western coffee-enset highlands	100	1	0.94
Western mixed maize zone	96	1	0.89

[FRA] France

This report covers the growing period of winter wheat, as well as the sowing of spring wheat and maize in France. CropWatch agro-climatic indicators, when compared to the 15YA, show that RAIN was 14% lower than average, especially in late January and early February. Sunshine was also below average (RADPAR -5%). The temperature was slightly above the average level (TEMP +0.5°C), but below average in mid to late January. Due to unfavorable precipitation conditions, the biomass production potential (BIOMSS) is estimated to have decreased by 2% nationwide compared to the 15-year average. The national-scale NDVI development graph shows that the NDVI values were generally slightly lower than in the 2022 season and the 5YA. The sharp drop in NDVI in late January can be attributed to cloud cover, fog, or snow. Apart from that, NDVI was generally close to the 5-year average. The spatial distribution of maximum VCI (VCIx) ranged between 0.79 to 0.94. Overall, below-average rainfall caused slightly unfavorable, but close to average growth conditions for most of France.

Regional analysis

Considering cropping systems, climatic zones and topographic conditions, additional sub-national details are provided for eight agro-ecological zones. They are identified on the maps by the following numbers: (78) **Northern barley region**, (82) **Mixed maize/barley and rapeseed zone from the Center to the Atlantic Ocean**, (79) **Maize-barley and livestock zone along the English Channel**, (80) **Rapeseed zone of eastern France**, (75) **Massif Central dry zone**, (81) **Southwestern maize zone**, (76) **Eastern Alpes region** and (77) **the Mediterranean zone.**

In the Northern barley region, warmer weather was observed (TEMP +0.6°C) while RAIN was above average (+10%) but RADPAR was below average (-15%). The potential BIOMSS increased by 3% when compared to the 15-year average. The CALF was at the average level, and VCIx was 0.90. Crop condition development based on NDVI for this region was above the 5-year average for most of the monitoring period, especially in mid-January, early February, and mid-March, but lower than average in early January and late April.

In the Mixed maize/barley and rapeseed zone from the Center to the Atlantic Ocean, slightly warmer (TEMP +0.3°C) weather was observed, but precipitation was below average (RAIN -8%), and sunshine was also lower than 15YA (RADPAR -7%). The estimated BIOMSS was 3% higher than average, CALF was at the average level, and VCIx was at 0.92. The regional NDVI profile fluctuated around the average.

In the Maize-barley and livestock zone along the English Channel, RAIN and RADPAR were below average by 8% and 11%. TEMP was slightly higher than the average (+0.4°C). BIOMSS increased by 4%. CALF was average, and VCIx was relatively high at 0.92. The regional NDVI profile presented an undulating trend, which was generally close to average.

In the Rapeseed zone of eastern France, the NDVI profile indicated general close to and above-average conditions. RAIN was 1% below the 15YA, RADPAR also decreased by 11%, while TEMP increased by 0.5°C. BIOMSS was about 3% higher than average, while CALF was at the average level, and VCIx was 0.94.

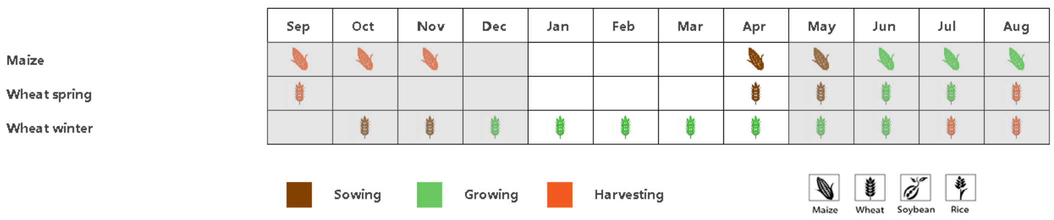
In the Massif Central dry zone, RAIN and RADPAR were 15% and 5% lower than the average, respectively, while TEMP was near the average level. The VCIx was 0.92. BIOMSS and CALF also stayed at the average level, which indicated a close to average cropping season in the region. Crop conditions based on the NDVI profile were also close to the average.

The Southwestern maize zone is one of the major irrigated regions in France. The regional NDVI profile presented a below-average trend, especially in mid-January. RAIN in the period was 21% lower than average, TEMP was also below the average by 0.2°C, while RADPAR slightly increased by 1%. The VCIx was recorded at 0.91, while CALF was 1% above average. BIOMSS was 4% lower than average, indicating below-average crop conditions.

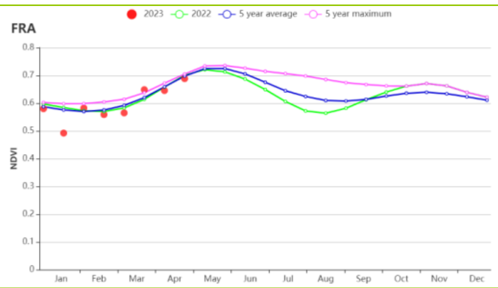
In the Eastern Alpes region, the NDVI profile also presented an overall close to average trend. RAIN in the region was 23% lower than average, and RADPAR was 1% lower than the 15YA, while TEMP was slightly higher than average level (+0.5°C). BIOMSS was 7% lower than the 15YA. VCIx for the region recorded a relatively low level (0.84), and CALF was 1% above average.

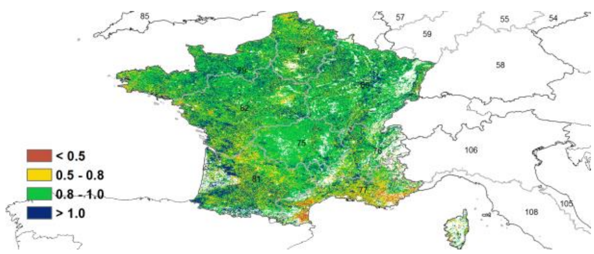
The Mediterranean zone presented an overall lower NDVI profile. The region recorded a low VCIx (0.79). TEMP and RADPAR were above average by 1.6 °C and 5%, respectively, while RAIN was lower than average by 45%. CALF was at average level, and BIOMSS decreased by 18%. This region is showing below-average crop conditions due to the low precipitation throughout the monitoring period.

Figure 3.16 France's crop condition, January 2023 – April 2023

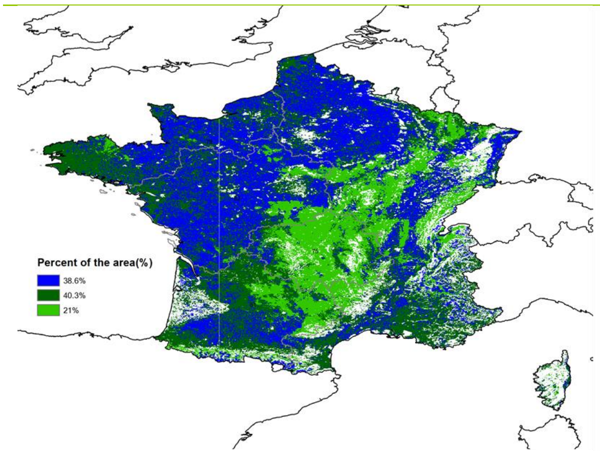


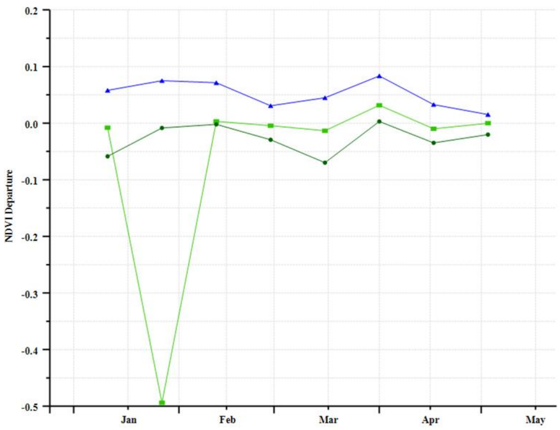
(a) Phenology of major crops



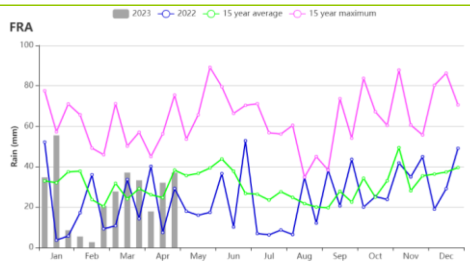


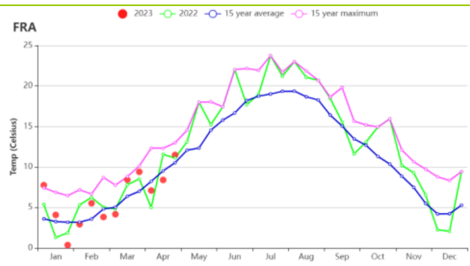
(b) Crop condition development graph based on NDVI (c) Maximum VCI



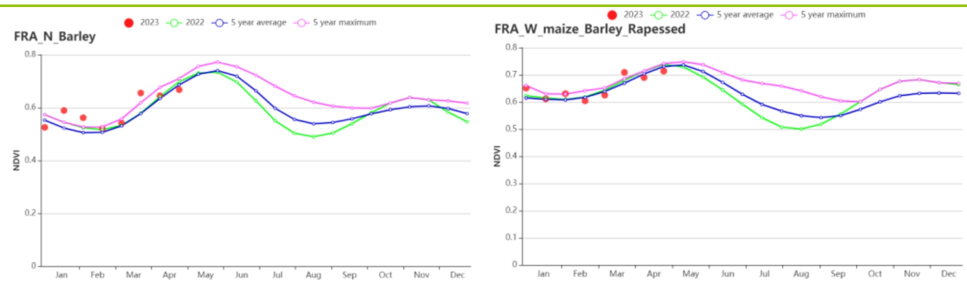


(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles

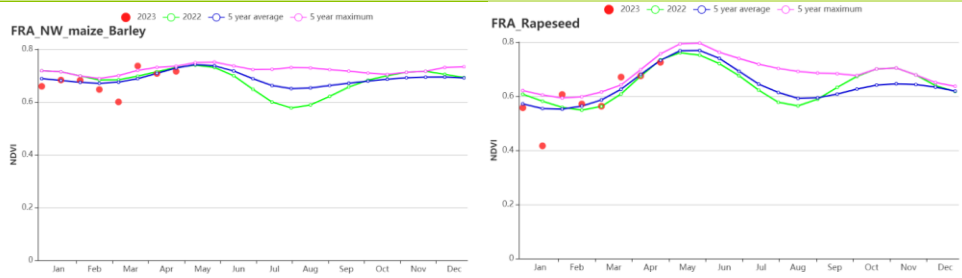




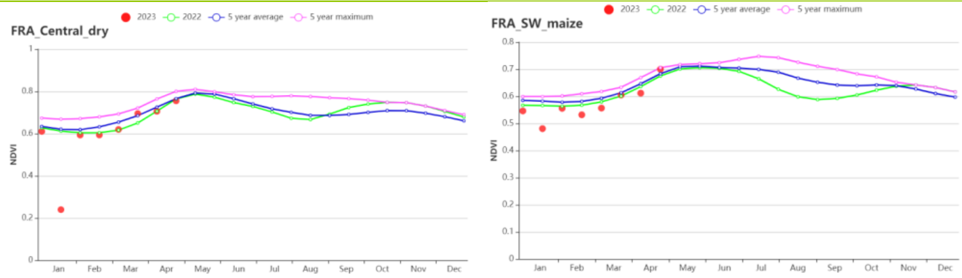
(f) Rainfall profiles (g) Temperature profiles



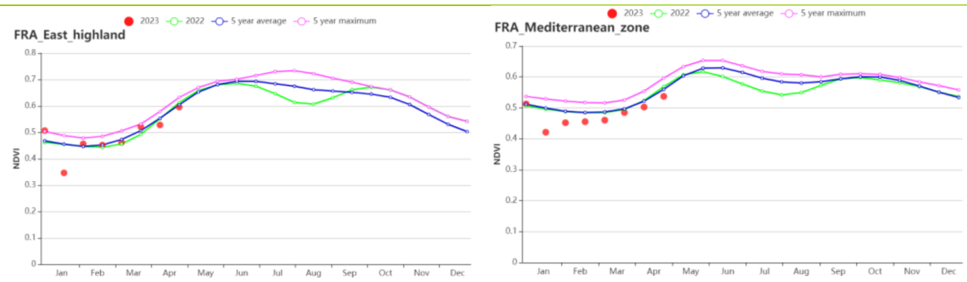
(h) Crop condition development graph based on NDVI (Northern barley region (left) and Mixed maize, Barley and Rapeseed zone (right))



(i) Crop condition development graph based on NDVI (Maize, barley and livestock zone (left) and Rapeseed zone (right))



(j) Crop condition development graph based on NDVI (Dry Massif Central zone (left) and Southwest maize zone (right))



(k) Crop condition development graph based on NDVI (Eastern Alpes region (left) and Mediterranean zone (right))

Table 3.23 France's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, January 2023 – April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Northern Barley zone	313	10	6.4	0.6	459	-15	582	3
Mixed maize/barley and rapessed zone from the Centre to the Atlantic Ocean	284	-8	7.3	0.3	548	-7	619	3
Maize barley and livestock zone along the English Channel	295	-8	7.4	0.4	497	-11	625	4

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Rapeseed zone of eastern France	355	-1	5.2	0.5	508	-11	553	3
Massif Central Dry zone	307	-15	4.7	0	588	-5	540	0
Southwest maize zone	347	-21	6.3	-0.2	662	1	581	-4
Alpes region	338	-23	3.7	0.5	666	-1	443	-7
Mediterranean zone	195	-45	7	1.6	772	5	425	-18

Table 3.24 France's agronomic indicators by sub-national regions, current season's values and departure from 5YA, January 2023 – April 2023

Region	Cropped arable land fraction		Maximum VCI
	Current (%)	Departure (%)	Current
Northern Barley zone	100	0	0.90
Mixed maize/barley and rapessed zone from the Centre to the Atlantic Ocean	100	0	0.92
Maize barley and livestock zone along the English Channel	100	0	0.92
Rapeseed zone of eastern France	100	0	0.94
Massif Central Dry zone	100	0	0.92
Southwest maize zone	99	1	0.91
Alpes region	88	1	0.84
Mediterranean zone	88	0	0.79

[GBR] United Kingdom

This report covers the vegetative growth period of winter wheat, winter barley and rapeseed. According to the crop condition development graph, NDVI values were close to average from January to April. Temperature was above average (TEMP +0.6°C), rainfall and radiation were below average （RAIN -5%, RADPAR -7%). The combined impact of these agroclimatic factors resulted in increased biomass (BIOMSS +5%). The seasonal RAIN profile shows that rainfall was below average in February and above in March. The temperature was above or close to average for most of the period.

The national average VCIx was 0.88. CALF (99%) was unchanged compared to its five-year average. Crop production index was 1.09. The NDVI departure cluster profiles indicate that: (1) 39.4% of arable land experienced average crop conditions, mainly in the south of the United Kingdom. (2) 30.7% of arable land experienced above-average crop conditions, mainly in the east of the United Kingdom. (3) 29.9% of arable land experienced average crop conditions in most of the monitoring period with a marked drop of crop conditions in the middle of January, middle of March and late April. Most likely, the large drops in NDVI can be attributed to cloud cover in the satellite images. Altogether, the conditions for wheat in the UK are assessed to be average.

Regional analysis

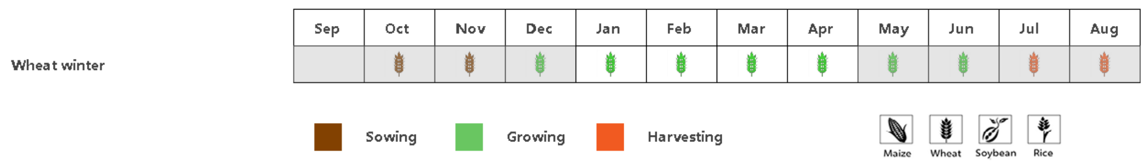
Based on cropping systems, climatic zones and topographic conditions, three sub-national regions can be distinguished: the **Northern barley region （84）**, **Central sparse crop region （83）** and **Southern mixed wheat and barley region (85)**. The fractions of cropped arable land (CALF) in all subregions are average compared to the 5-year average.

The **Northern barley region** experienced below-average rainfall and radiation (RAIN -10%; RADPAR -2%), while temperatures were significantly above average (TEMP +0.5°C). Biomass was above average (BIOMSS +4%). NDVI was below or close to average according to the crop condition graph. The VCIx was 0.87. Crop production index was 1.04. Altogether, the output of wheat is expected to be near average.

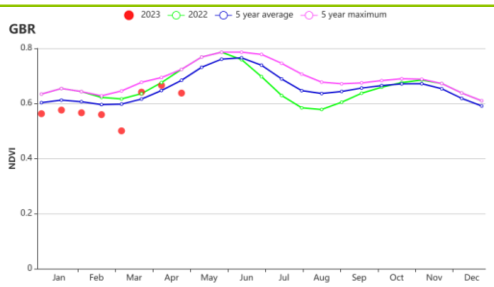
The **Central sparse crop region** is one of the major agricultural regions in terms of crop production. The rainfall and radiation were below average (RAIN -9%; RADPAR -9%), while temperature was above average (TEMP +0.7° C). This resulted in an above-average estimate for biomass（BIOMSS +5%). NDVI values were below or close to average. The VCIx was at 0.87. Crop production index was 1.08. Altogether, the conditions for wheat are expected to be near average.

Southern mixed wheat and barley zone experienced above-average rainfall and temperature (RAIN +2%; TEMP +0.7°C). Radiation was below average (RADPAR -9%). The higher temperatures and rainfall resulted in biomass estimates that were above average (BIOMSS +6%). NDVI was below or close to average according to the crop condition graph in this reporting period. The VCIx was 0.88. Crop production index was 1.10. Altogether, the output of wheat is expected to be near average.

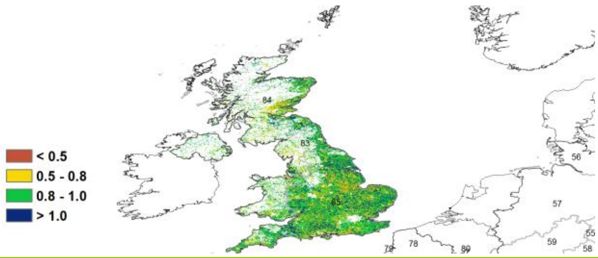
Figure 3.17 United Kingdom's crop condition, January - April 2023



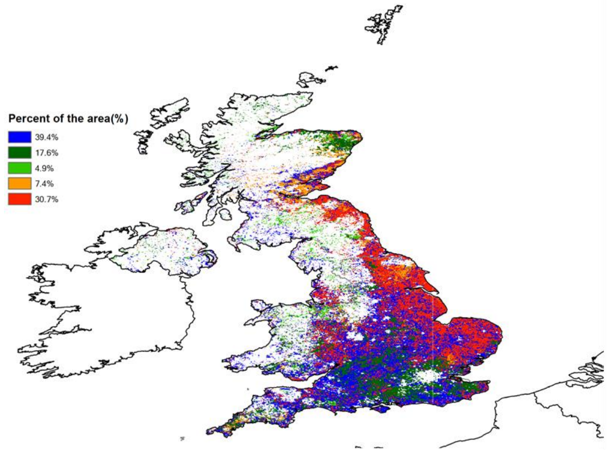
(a) Phenology of major crops



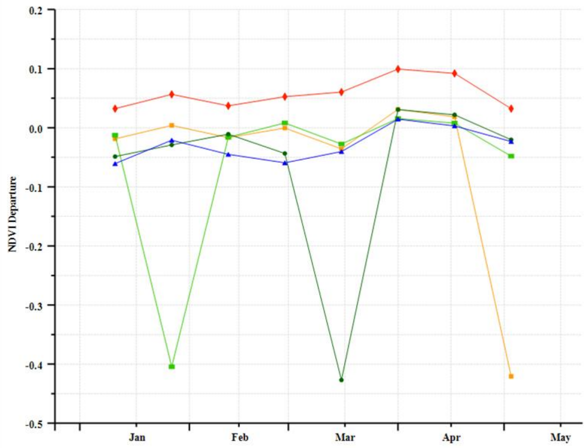
(b) Crop condition development graph based on NDVI



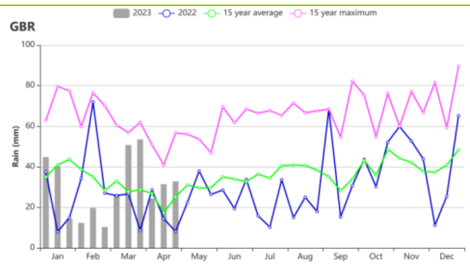
(c) Maximum VCI



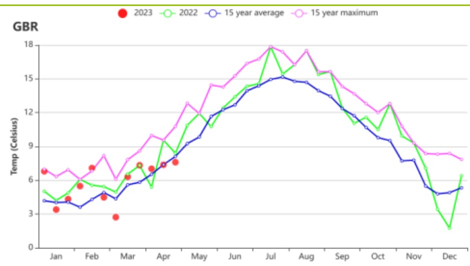
(d) Spatial NDVI patterns compared to 5YA



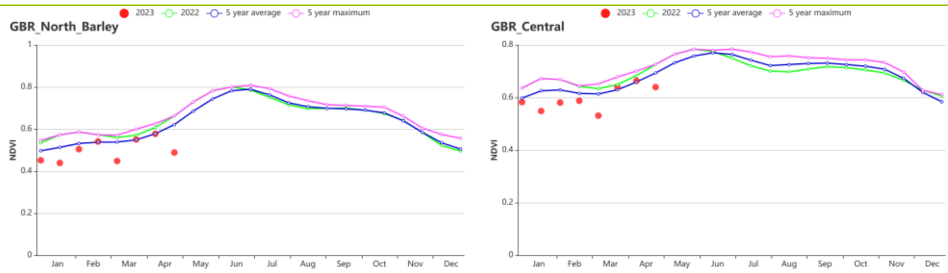
(e) NDVI profiles



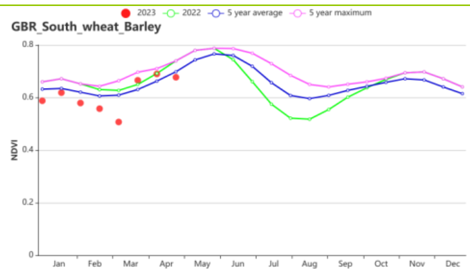
(f) Rainfall profiles



(g) Temperature profiles



(h) Crop condition development graph based on NDVI (Northern Barley region (left) and Central sparse crop region (right))



(i) Crop condition development graph based on NDVI (Southern mixed wheat and Barley zone)

Table 3.25 United Kingdom's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, January - April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m^2)	Departure (%)	Current (gDM/m^2)	Departure (%)
Northern Barley region(UK)	425	-10	4.7	0.5	375	-2	526	4
Central sparse crop region (UK)	360	-9	5.9	0.7	389	-9	569	5
Southern mixed wheat and Barley zone (UK)	303	2	6.5	0.7	431	-9	592	6

Table 3.26 United Kingdom's agronomic indicators by sub-national regions, current season's values and departure from 5YA, January - April 2023

Region	Cropped arable land fraction		Maximum VCI
	Current (%)	Departure (%)	Current
Northern Barley region(UK)	97	0	0.87
Central sparse crop region (UK)	98	0	0.87
Southern mixed wheat and Barley zone (UK)	99	0	0.88

[IDN] Indonesia

During the monitoring period, the main rice was harvested and completed. The rainy season maize in Java and Sumatra was still in the growth phase between January and February, and the harvest started in March. CropWatch agroclimatic indicators show that temperature was close to the 15YA (TEMP +0.0°C), the precipitation was below the average (RAIN -5%), and the radiation was above the 15YA (RADPAR +3%). This resulted in a potential biomass production increase (BIOMSS +1%).

According to the national NDVI development graph, crop conditions were below the 5YA during the monitoring period. However, this might be an artifact due to frequent cloud cover in the satellite images, which causes low NDVI values. Conditions had improved to close to the average in early April. NDVI clusters and profiles show that 69% of the cropland was significantly below the 5YA from January to March, and began to recover to average in April. Crop conditions for the 31% of cropland were close to average during the whole monitoring period, which was distributed in North Sumatra, Bengkulu, Java, North Sulawesi, and East Papua.

The area of cropped arable land (CALF 100%) in Indonesia was close to the 5YA and the VCIx value was 0.94. The Crop Production Index (CPI) in this country was 1.13, indicating above average conditions. Overall, crop conditions can be assessed as close to average or slightly above.

Regional analysis

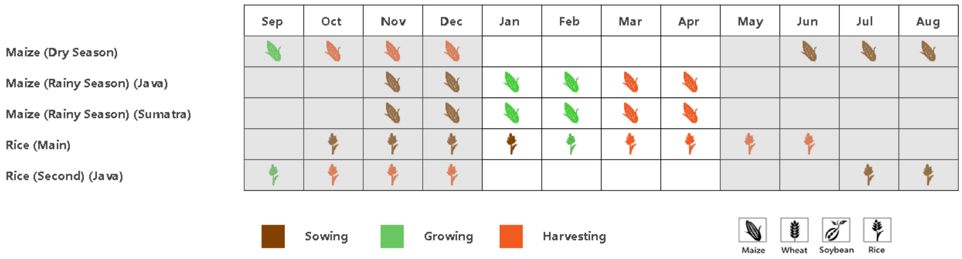
The analysis below focuses on four agro-ecological zones, namely **Sumatra** (92), **Java** (90， the main agricultural region in the country), **Kalimantan and Sulawesi** (91), and **West Papua** (93), among which the first three are relevant for crop production. The numbers correspond to the labels on the VCIx and NDVI profile maps.

According to the agroclimatic conditions of **Java**, radiation was above average (RADPAR +7%), but precipitation and temperature were below the 15YA (RAIN -3%, TEMP -0.2℃), the potential biomass production was close to the 15YA (BIOMSS +0%). The NDVI development graphs show that crop conditions were close to the 5YA in April, and other months were below the average. The Crop Production Index (CPI) in **Java** was 1.12, crop production could be assessed as normal.

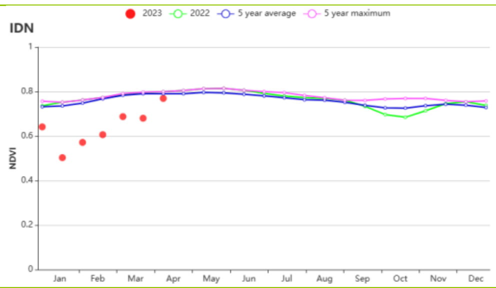
Precipitation was below the 15YA (RAIN, -6%), while temperature and radiation were slightly above the average in **Kalimantan and Sulawesi** (TEMP +0.2°C, RADPAR +4%). This resulted in an increase in the potential biomass production (BIOMSS +2%). According to the NDVI development graph, crop conditions were below the 5YA except for the middle of April. The Crop Production Index (CPI) in **Kalimantan and Sulawesi** was 1.15, and crop production in **Kalimantan and Sulawesi** is anticipated to be above average.

In **Sumatra**, precipitation and temperature were below the average (RAIN -1%， TEMP -0.1°C), but radiation was above the 15YA (RADPAR +1%), which led to a small increase of the potential biomass production (BIOMSS +1%). As shown in the NDVI development graph, crop conditions were significantly below the 5YA. This can be partly attributed to the floods that occurred in this region in January and February 2023. The Crop Production Index (CPI) in **Sumatra** was 1.14, and crop production in Sumatra Island could be expected to be above normal.

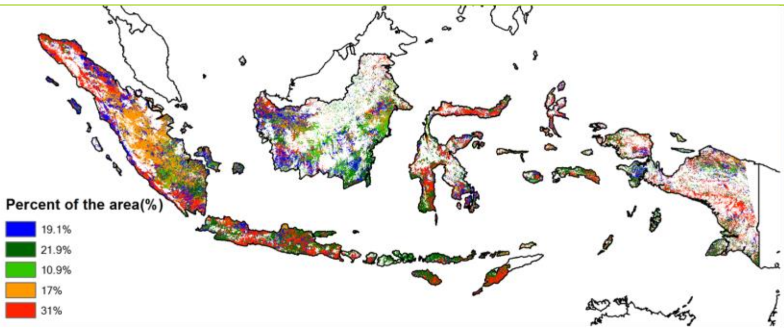
Figure 3.18 Indonesia's crop condition, January – April 2023

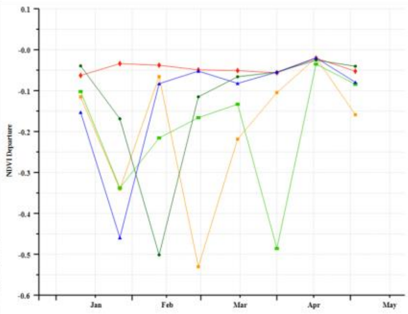


(a) Phenology of major crops

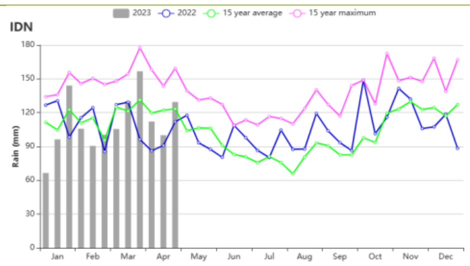


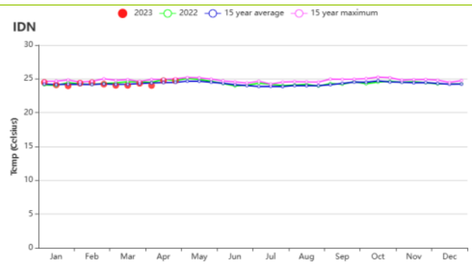
(b) Crop condition development graph based on NDVI (c) Maximum VCI



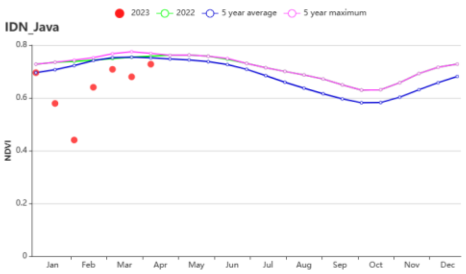


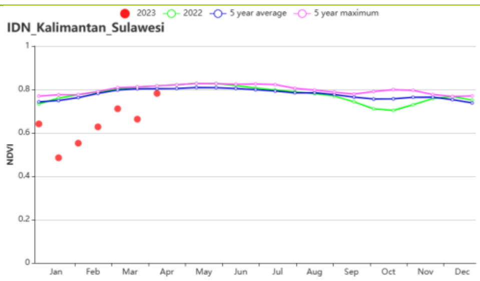
(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles



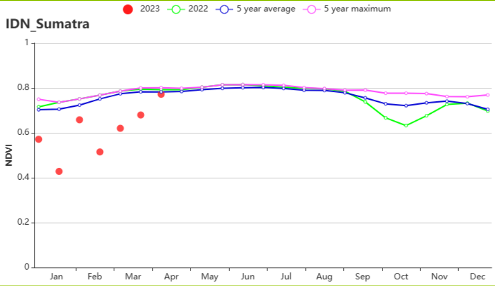


(f) Rainfall profiles (g) Temperature profiles





(h)Crop condition development graph based on NDVI (Java (left) and Kalimantan-Sulawesi (right))



(i) Crop condition development graph based on NDVI (Sumatra)

Table 3.27 Indonesia's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, January – April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Java	1292	-3	24.8	-0.2	1240	2	1472	0
Kalimantan and Sulawesi	1230	-6	24.6	0.2	1192	4	1508	2
Sumatra	1306	-1	24.3	-0.1	1146	1	1489	2
West Papua	1592	-6	23.6	0.1	1033	2	1409	-1

Table 3.28 Indonesia's agronomic indicators by sub-national regions, current season's values and departure from 5YA, January – April 2023

Region	Cropped arable land fraction		Maximum VCI
	Current (%)	Departure (%)	Current
Java	99	0	0.93
Kalimantan and Sulawesi	100	0	0.94
Sumatra	100	0	0.94
West Papua	100	0	0.95

[IND] India

The current monitoring period covers most of the wheat and winter (Rabi) rice growing periods. Harvest for both crops was mostly completed by the end of April, while maize and summer (Kharif) rice were harvested by January. The graph of NDVI development shows that the crop conditions were favorable.

The proportion of irrigated cropland in India is 50%. However, most crops grown during this monitoring period were irrigated. The CropWatch agroclimatic indicators show that nationwide, RAIN and RADPAR were slightly below average (-7% and -1%, respectively), whereas TEMP was near the 15 year-average (-0.2°C). The estimated BIOMSS increased by 3% compared with the 15YA. The overall VCIx was high, with a value of 0.83. As can be seen from the spatial distribution, only the Northwestern region recorded values below 0.80, and most of India had high VCIx values. These spatial patterns of VCIx were thus generally consistent with those of NDVI. The northern and central regions showed close to and above-average crop conditions, while the conditions were slightly below average in the eastern regions. The spatial distribution of NDVI profiles shows that 33.3% of the areas, mainly located in the northern and southwestern regions had below-average crop conditions throughout the monitoring period. From late February to April, 66.7% of the areas showed close to and above-average crop conditions in south-eastern and central regions. CALF increased by 5% compared to the 5YA. The CPI was 1.10, indicating that the crop conditions were generally normal.

Regional analysis

India is divided into eight agro-ecological zones: the Deccan Plateau (94), the Eastern coastal region (95), the Gangetic plain (96), the Assam and north-eastern regions (97), Agriculture areas in Rajasthan and Gujarat (98), the Western coastal region (99), the North-western dry region (100) and the Western Himalayan region (101).

The three agro-ecological zones of the Deccan Plateau, the Eastern coastal region and the Agriculture areas in Rajastan and Gujarat showed similar trends in agricultural indices. Compared to the same period of previous years, RAIN was above average, especially in the Deccan Plateau (+120%), whereas the RADPAR and TEMP were slightly below average. BIOMSS was above the 15-year average, benefitting from the abundant rainfall. CALF was above average in all three regions. The graph of NDVI development shows that the crop growth was close to or above the 5-year average for most of the period. The CPI was above 1.00, indicating that the crop production situation was expected to be near or above average.

The Assam and north-eastern regions and the Western coastal region showed similar trends in agricultural indices. Compared to the same period of previous years, RAIN was below average by 20%, but RADPAR was slightly above average, TEMP was near average. The BIOMSS was below the 15-year average due to the low rainfall. CALF was close to average. The graph of NDVI development shows that the crop growth of the two regions was below the 5-year average for most of the period. The CPI was below 1.00, indicating that the crop production situation was below average.

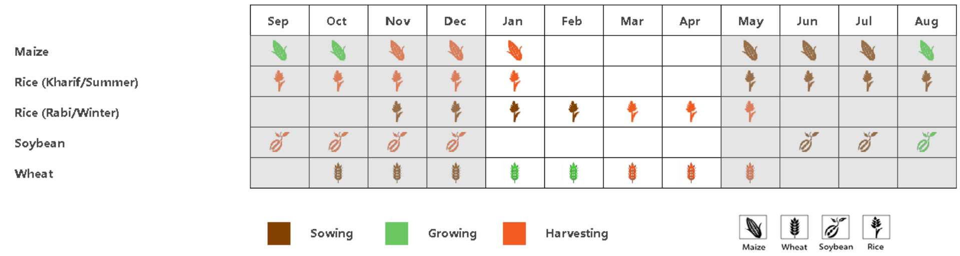
The Gangetic plain recorded 45 mm of RAIN, which was below average (-20%). TEMP was close to average (-0.1°C), and RADPAR was slightly below the 15YA (-2%). BIOMSS was below the 15YA (-5%) due to low rainfall and sunshine. CALF was 89% which was 1% lower than the 5-year average, and VCIx was 0.85. The graph of NDVI development shows that the crop growth of this region during the monitoring period was below, but very close to the 5-year average during the entire period. All in all, the conditions were average.

The North-western dry region recorded 32 mm of RAIN, an increase by 135%. TEMP was slightly above average (+0.2°C), whereas the RADPAR was below the 15YA (-4%). BIOMSS was significantly above the 15YA (+11%), benefitting from the abundant rainfall. CALF was 19% which was above average, and VCIx was 0.85. The graph of NDVI development shows that the crop growth of this region during the monitoring period was above the 5-year average in most months, and the CPI was 1.07, indicating that the crop conditions were favorable.

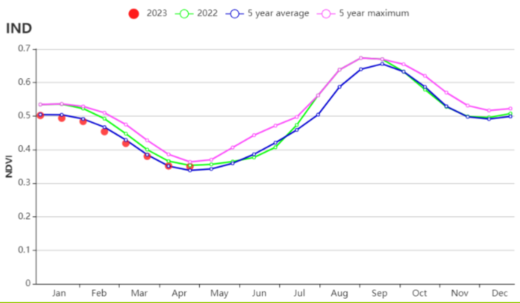
The Western Himalayan region recorded 300 mm of RAIN, which was below average (-13%), and TEMP was significantly above average (+0.9°C), whereas the RADPAR was slightly below average (-1%). Estimated BIOMSS was as the 15YA. CALF was 87% which was the same as the 5-year average, and VCIx was 0.78. The graph of

NDVI development shows that the crop growth of this region was close to or below the 5-year average. All in all, the overall crop production situation was close to average.

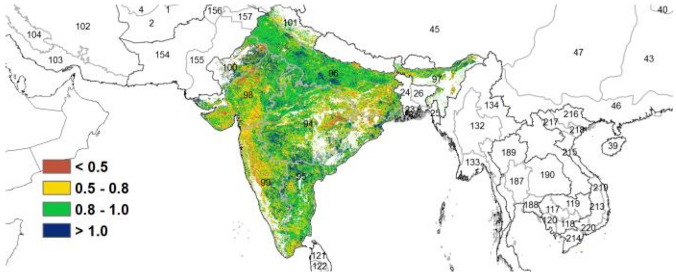
Figure 3.19 India's crop condition, January - April 2023



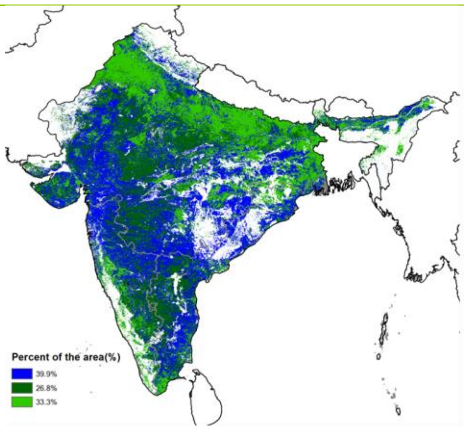
(a) Phenology of major crops



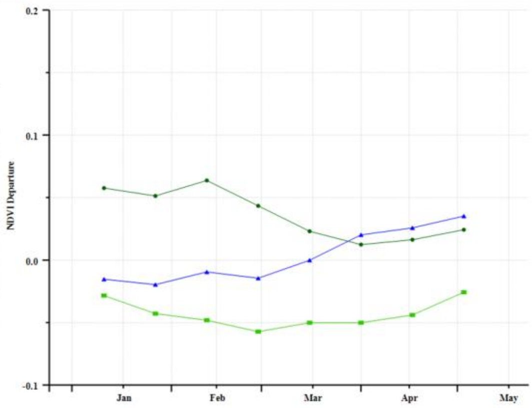
(b) Crop condition development graph based on NDVI



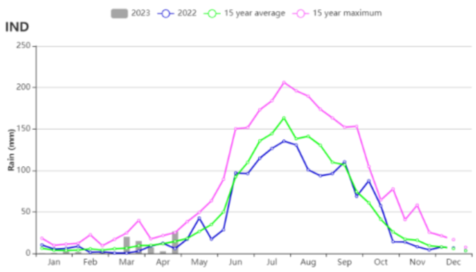
(c) Maximum VCI



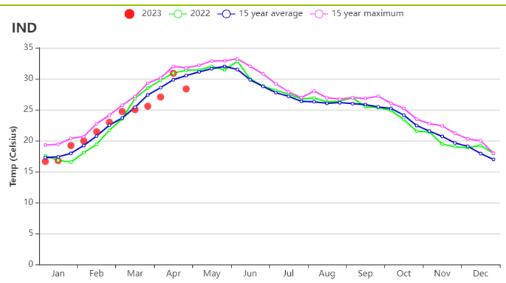
(d) Spatial NDVI patterns compared to 5YA



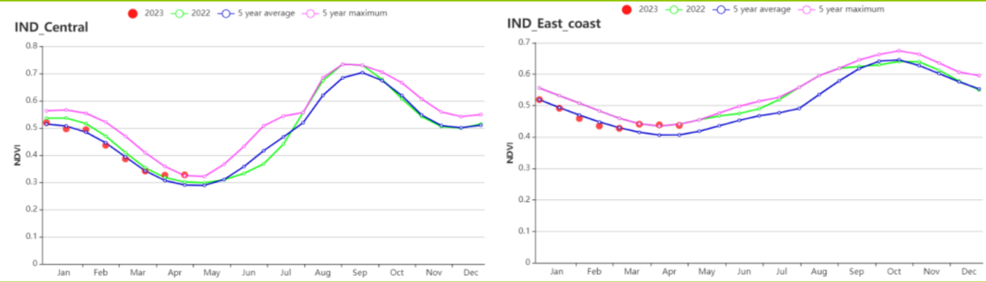
(e) NDVI profiles



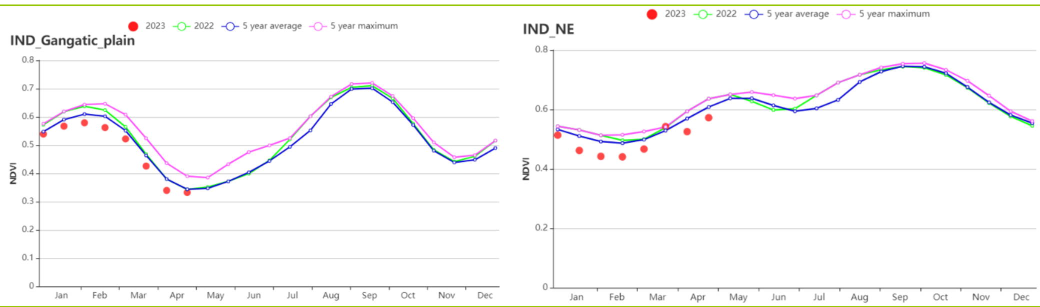
(f) Rainfall profiles



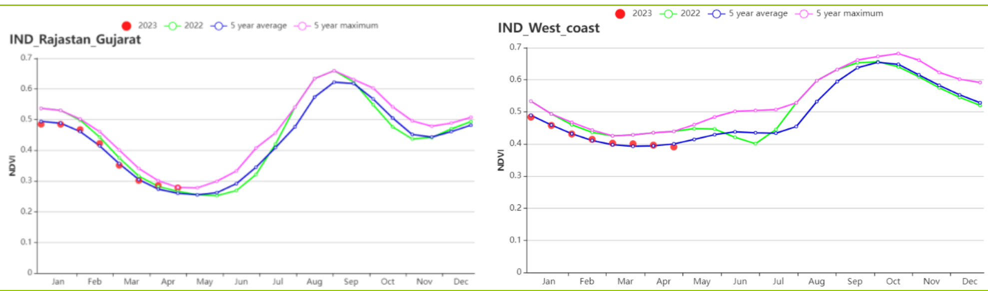
(g) Temperature profiles



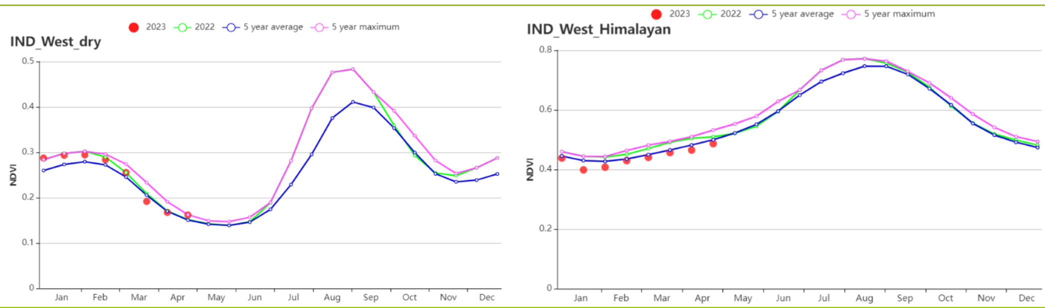
(h) Crop condition development graph based on NDVI (Deccan Plateau (left) and Eastern Coastal Region (right))



(i) Crop condition development graph based on NDVI (Gangetic Plains (left) and Assam and north-eastern regions (right))



(j) Crop condition development graph based on NDVI (Agriculture areas in Rajasthan and Gujarat (left) and Western Coastal Region (right))



(k) Crop condition development graph based on NDVI (North-western dry region (left) and Western Himalayan Region (right))

Table 3.29 India's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, January - April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Deccan Plateau	41	103	24.5	-0.5	1237	-3	478	4
Eastern coastal region	120	52	25.5	-0.2	1288	-1	636	14
Gangatic plain	45	-20	22.0	-0.1	1160	-2	440	-5
Assam and north-eastern regions	203	-37	18.3	0.1	1147	5	573	-11
Agriculture areas in Rajastan and Gujarat	17	62	24.5	-0.2	1224	-3	439	6

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m^2)	Departure (%)	Current (gDM/m^2)	Departure (%)
Western coastal region	65	-21	25.8	-0.2	1353	1	541	-2
North-western dry region	32	135	23.6	0.2	1174	-4	443	11
Western Himalayan region	300	-13	10.4	0.9	1037	-1	446	0

Table 3.30 India's agronomic indicators by sub-national regions, current season's values and departure from 5YA, January - April 2023

Region	Cropped arable land fraction		Maximum VCI
	Current (%)	Departure (%)	Current
Deccan Plateau	79	8	0.84
Eastern coastal region	86	11	0.86
Gangatic plain	89	-1	0.85
Assam and north-eastern regions	92	-1	0.82
Agriculture areas in Rajastan and Gujarat	65	3	0.79
Western coastal region	68	6	0.77
North-western dry region	19	15	0.85
Western Himalayan region	87	0	0.78

AFG AGO ARG AUS BGD BLR BRA CAN DEU DZA EGY ETH FRA GBR HUN IDN IND **IRN** ITA KAZ KEN KGZ KHM LKA MAR MEX MMR MNG MOZ NGA PAK PHL POL ROU RUS SYR THA TUR UKR USA UZB VNM ZAF ZMB

[IRN] Iran

This monitoring period covers the vegetative and early reproductive phases of winter wheat. Rice planting started in April. The proportion of irrigated cropland in Iran is more than 50%. Nevertheless, adequate rainfall is important for replenishing dams and groundwater. Nationwide, the accumulated rainfall was below average (RAIN -6%), while temperature and radiation were above average (TEMP +0.3°C, RADPAR +1%). The BIOMSS index was 3% below average. The national average of maximum VCI index was 0.64, and the Cropped Arable Land Fraction (CALF) decreased by 3% as compared to the recent five-year average. The national Crop Production Index (CPI) was 1.01, indicating normal crop production conditions.

According to the national NDVI development graphs, on about 8.6% of the cropland (marked in blue) crop conditions were above average throughout the monitoring period, while on about 60.6% of the cropland, they were around average throughout the monitoring period (marked in red and orange). 25.7% of the cropland showed below average crop conditions at the beginning of the monitoring period (marked in deep green), and then recovered gradually to around average, mainly distributed in Kordestan, Zanjan, Gilan, Qazvin, Hamadan, and Kermanshah. The remaining croplands had close-to-average crop conditions in January and then dropped to below average (marked in light green), mainly distributed in some parts of Ardebil, East Azarbaijan, and Golestan. The decreasing of crop conditions for the light green marked regions might be due to the cloud cover.

In general, the conditions for the winter crops were close-to-average

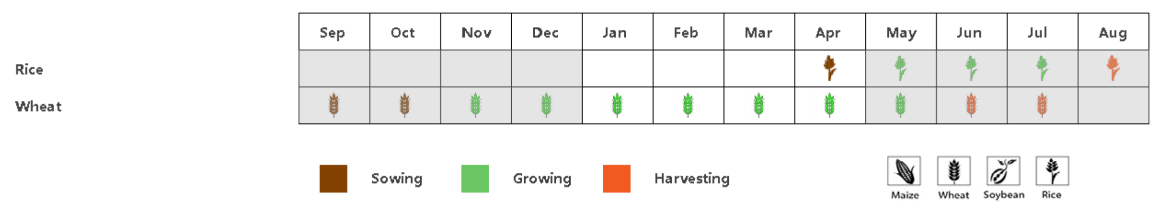
Regional analysis

Based on cropping systems, climatic zones, and topographic conditions, three sub-national agro-ecological regions can be distinguished for Iran, among which two are relevant for crop cultivation. The two regions are referred to as the **Semi-arid to sub-tropical hills of the west and north (104)**, and the **Arid Red Sea coastal low hills and plains (103)**.

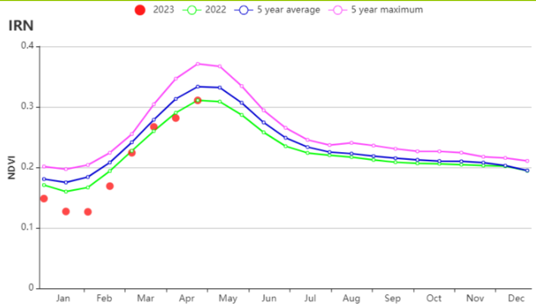
In the **Semi-arid to sub-tropical hills of the west and north (104)** region, NDVI profiles show a similar change of patterns as for the whole country. The accumulated rainfall was 216 mm (7% below average), while temperature and radiation were above average (TEMP +0.4°C, RADPAR +2%). The influence of rainfall exceeded that of radiation and temperature, which resulted in a decrease of BIOMSS by 4%. CALF declined by 8%. The average VCIx was (0.65). Conditions can be assessed as below, but close to average.

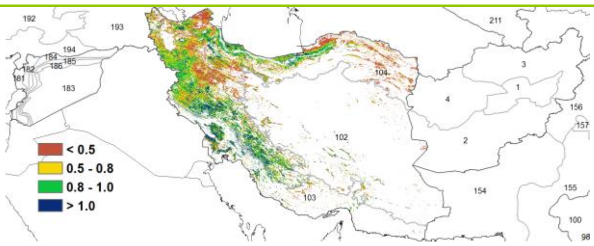
Crop conditions in the **Arid Red Sea coastal low hills and plains (103)** region were below the five-year average in early January only and were above average during the rest of the monitoring period. This region experienced above average rainfall (RAIN +36%) and received less sunshine (RADPAR -2%). The temperature was above average (TEMP +0.2°C). BIOMSS increased by 15%. The CALF increased by 39% compared to the five-year average, and the national VCIx (0.79) was quite fair, indicating the close-to-average and promising outlook for winter crops in this region.

Figure 3.20 Iran's crop condition, January - April 2023



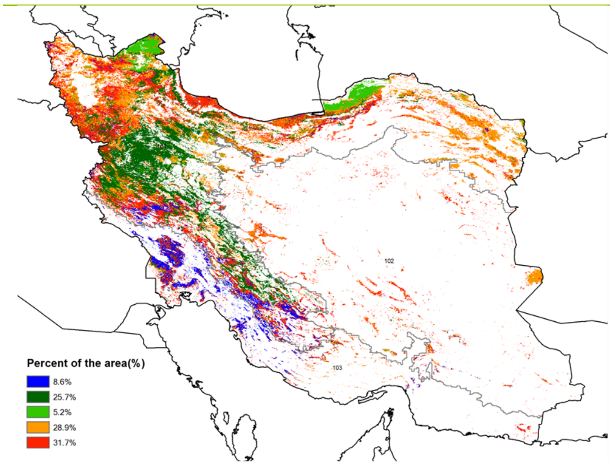
(a) Phenology of major crops

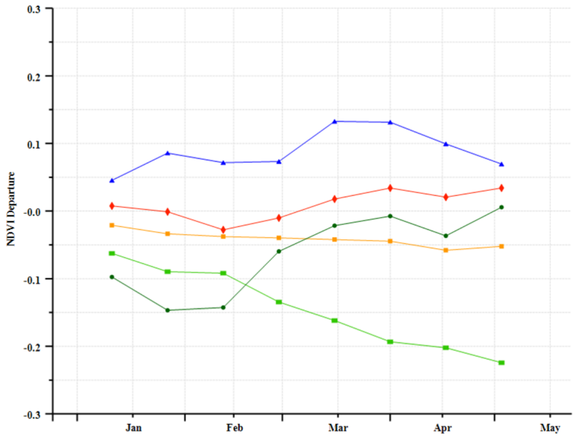




(b) Crop condition development graph based on NDVI

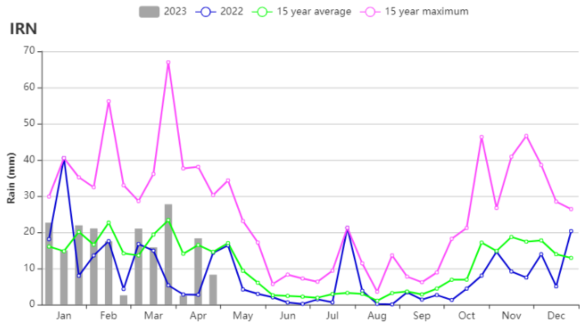
(c) Maximum VCI

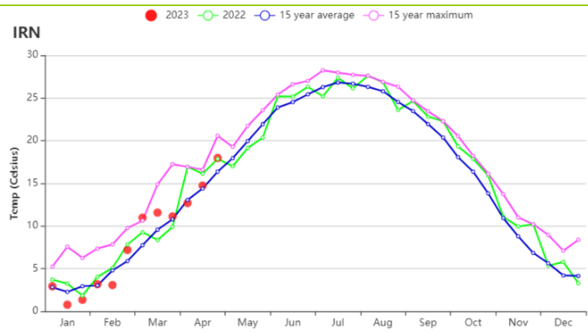




(d) Spatial NDVI patterns compared to 5YA

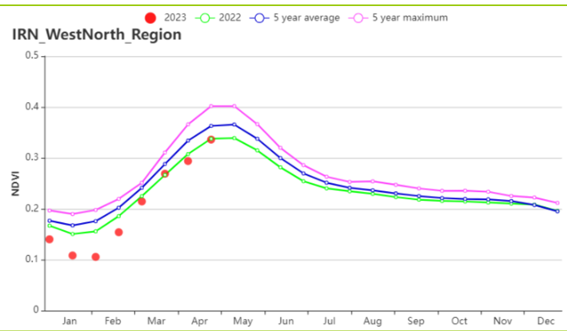
(e) NDVI profiles

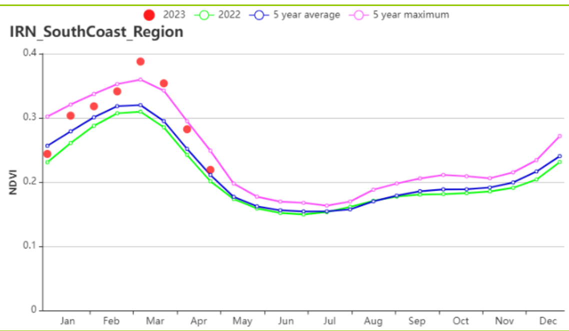




(f) Rainfall profiles

(g) Temperature profiles





(h) Crop condition development graph based on NDVI (Semi-arid to sub-tropical hills of the west and north region (left) and Arid Red Sea coastal low hills and plains region (right))

Table 3.31 Iran's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, January 2023 - April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m^2)	Departure (%)	Current (gDM/m^2)	Departure (%)
Arid Red Sea coastal low hills and plains	198	36	17.6	0.2	1041	-2	585	15
Semi-arid to sub-tropical western and northern hills	216	-7	6.4	0.4	994	2	445	-4

Table 3.32 Iran's agronomic indicators by sub-national regions, current season's values and departure from 5YA, January 2023 - April 2023

Region	Cropped arable land fraction		Maximum VCI
	Current (%)	Departure (%)	Current
Arid Red Sea coastal low hills and plains	44	39	0.79
Semi-arid to sub-tropical western and northern hills	26	-8	0.65

AFG AGO ARG AUS BGD BLR BRA CAN DEU EGY ETH FRA GBR HUN IDN IND IRN **ITA** KAZ KEN KGZ KHM LKA MAR MEX MMR MNG MOZ NGA PAK PHL POL ROU RUS THA TUR UKR USA UZB VNM ZAF ZMB

[ITA] Italy

The reporting period is from January to April 2023 and covers the main growing season for winter wheat. Based on the agroclimatic and agronomic indicators, the crop conditions in Italy were close to the 5-year average.

The total rainfall in this period was below 15YA (RAIN −19%). The proportion of irrigated arable land in Italy is 39.7%. However, the prolonged drought in the Po Valley has caused alarmingly low water levels and thus limited the availability of river water for irrigation. The temperature and RADPAR are slightly above average (TEMP +0.9°C, RADPAR +1%) and BIOMSS is unchanged. CALF was 98%. The national VCIx was even 0.92. The crop condition development graph indicates that NDVI was near 5YA in the reporting period.

The NDVI departure cluster profiles indicate that 34.6% (blue and deep green) of arable land experienced above-average crop conditions, scattered in the Piedmont, Lombardy, Veneto, Apulia and Sicily. 20.7% (light green) of arable land experienced slightly below average crop conditions, mostly in Lazio and Sicily. 2.9% (yellow) of the arable land had NDVI values well below the mean in January and February. This is consistent with the maximum VCI map, which shows a relatively high VCI of more than 0.8 (green and blue) in the Islands and Western Italy region. In the four sub-national zones, the VCIx was above 0.85. The crop production index was 1.20. All in all, the conditions were better than last year.

Regional analysis

Based on cropping systems, climatic zones, and topographic conditions, four sub-national zones can be distinguished for Italy. These four regions are East coast (108), Po Valley (105), Islands (107) and Western Italy (106).

East coast (mainly in Puglia, Marche, and Abruzzi) experienced slightly below-average rainfall (RAIN -9%), while temperature was slightly higher (+0.1°C) and RADPAR was above 15YA (1%). The potential biomass production was below average (BIOMSS -3%). VCIx was 0.94 and crop production index was 1.12. The crop condition development graph indicates that NDVI was close to average over the past five years. The above indicators suggest that the crops in the region are growing in a normal way.

Rainfall in **Po Valley** (mainly in Piemonte, Lombardia and Veneto) was 27% lower on average, the lowest of the four AEZs. But BIOMSS was above the 15YA by 7%. VCIx reached 0.96, which was the highest among the four AEZs in Italy. The Po Valley is the main wheat producing region in Italy, the high BIOMSS as well as VCIx indicate close to normal conditions for wheat, despite the rainfall deficit.

The Islands recorded below-average precipitation (RAIN -6%) and temperature (TEMP +0.4°C). RADPAR was above average (+5%). BIOMSS decreased by 11% compared with the 15YA. The maximum VCI was 0.92 and crop production index was 1.12. NDVI was very close to average. The crop production in this region is expected to be close to average.

In **Western Italy**, RAIN (-15%) was below average, while TEMP (+0.7°C) and RADPAR (+2%) were above average. The maximum VCI was 0.89 with unchanged BIOMSS. The NDVI was close to average. CropWatch expects a near −average production.

Figure 3.21 Italy's crop condition, January - April 2023

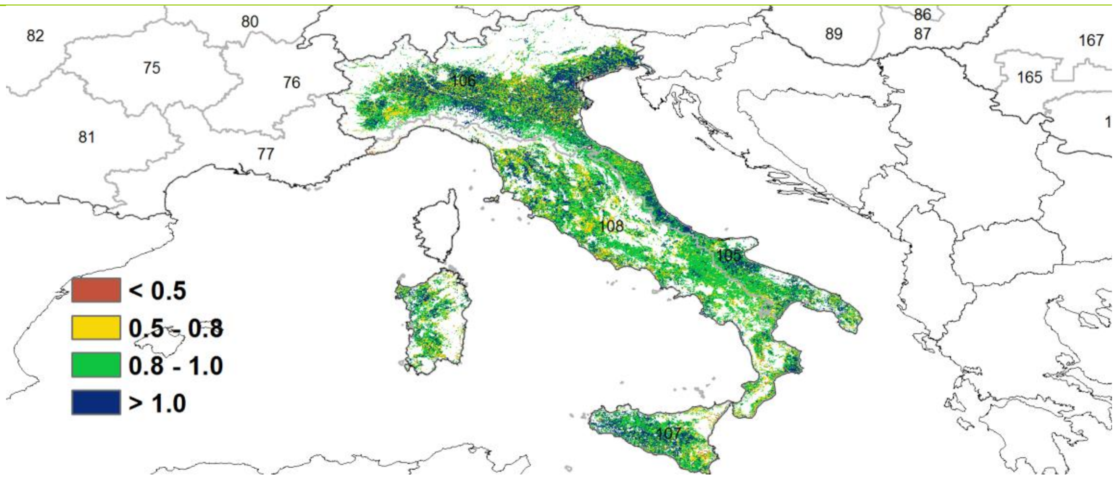
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Winter wheat												

Sowing Growing Harvesting

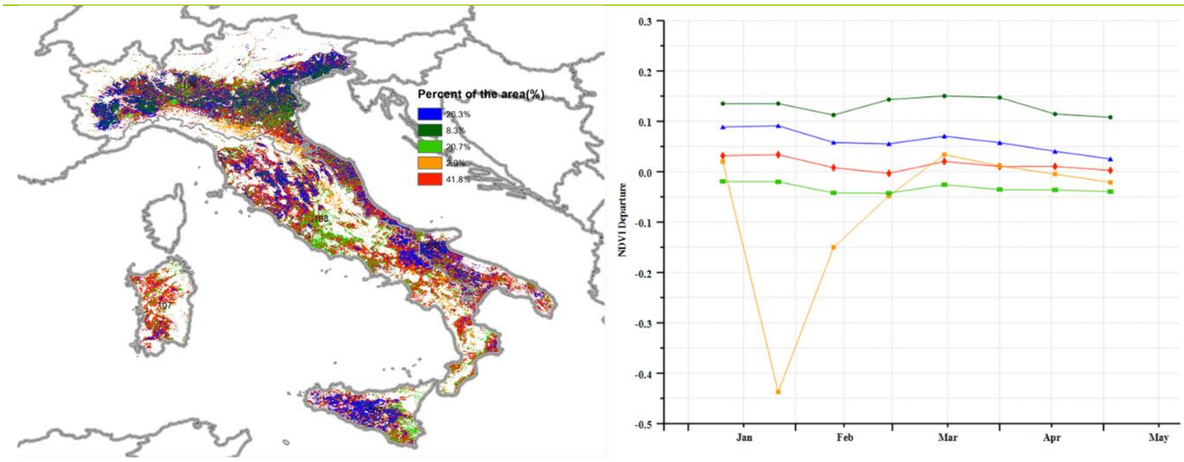
Maize Wheat Soybean Rice

(a) Phenology of major crops

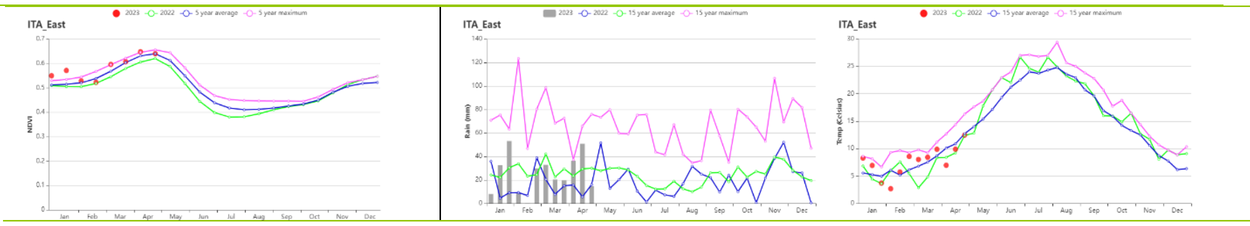
(b) Crop condition development graph based on NDVI, RAIN and TEMP (Italy).



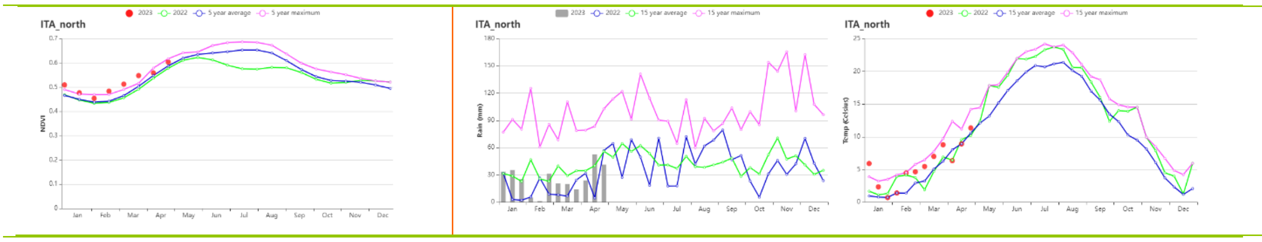
(c) Maximum VCI



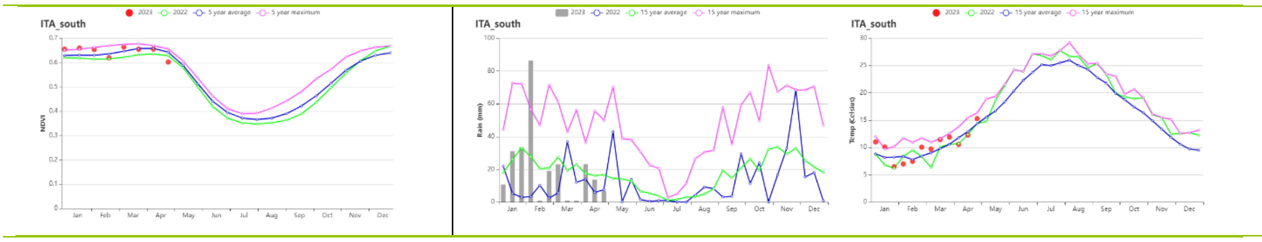
(d)Spatial distribution of NDVI profiles.



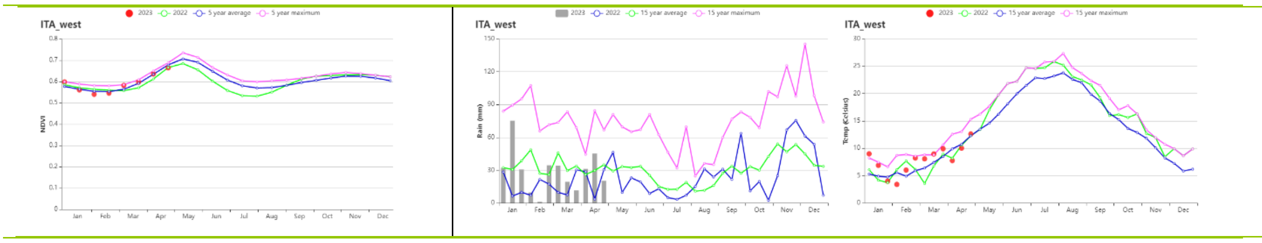
(e) Crop condition development graph based on NDVI, RAIN and TEMP (East Italy).



(f) Crop condition development graph based on NDVI, RAIN and TEMP (Po Valley).



(g) Crop condition development graph based on NDVI, RAIN and TEMP (Ialands).



(h) Crop condition development graph based on NDVI, RAIN and TEMP (West Italy).

Table 3.33 Italy's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, January - April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
East Coast	307	-9	7.6	0.1	761	1	577	-3
Po Valley	303	-27	5.6	1.4	668	-1	512	7
Islands	250	-6	10.3	0.4	898	5	532	-11
Western Italy	344	-15	7.9	0.7	754	2	616	0

Table 3.34 Italy's agronomic indicators by sub-national regions, current season's values and departure from 5YA, January - April 2023

Region	Cropped arable land fraction		Maximum VCI
	Current (%)	Departure (%)	Current
East Coast	100	0	0.94
Po Valley	95	5	0.96
Islands	100	0	0.92
Western Italy	100	0	0.89

[KAZ] Kazakhstan

No crops were cultivated in most of the country during this monitoring period. Only some minor winter crops were grown in the southern regions. Crop production in Kazakhstan is mostly rainfed, as only 3% of the cropland is under irrigation. According to the NDVI profiles, the national average NDVI values were generally below average from March to April.

Compared to the 15-year average, accumulated precipitation, temperature and radiation were above average (RAIN +2%, TEMP +1.6°C, RADPAR +2%). The dekadal precipitation was above the 15-year average from February to early March and exceeded the 15-year maximum in early January and mid-April. The dekadal temperature mostly was above average in the monitoring period except mid-January, early April and mid-April. The agro-climatic conditions resulted in an increase of potential biomass (BIOMSS +7%).

Overall, agro-climate conditions were favorable for the planting of spring wheat.

Regional analysis

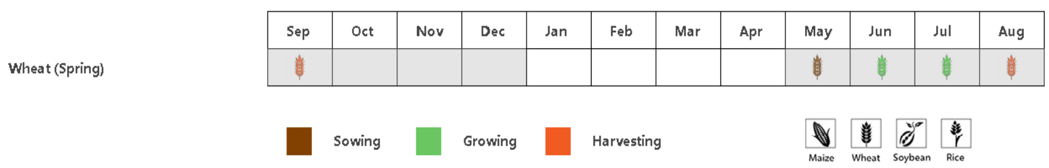
Based on cropping systems, climatic zones and topographic conditions, four sub-national agro-ecological regions can be distinguished for Kazakhstan, among which three are relevant for crop cultivation: the Northern region (112), the Eastern plateau and southeastern region (111) and the South region (110).

In the **Northern region**, the accumulated precipitation and RADPAR was close to average, while the temperature (TEMP +2.3°C) was above average, while RADPAR was at average. The warm weather conditions resulted in an increase of the BIOMSS index by 13%.

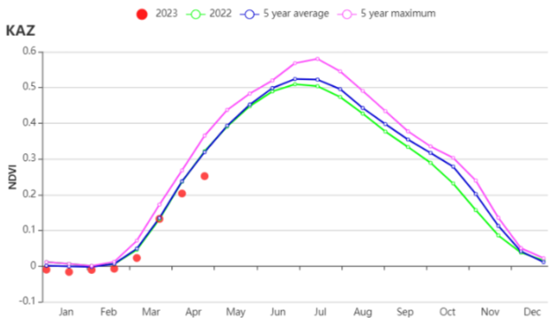
In the **Eastern plateau and southeastern region**, the accumulated precipitation, temperature and radiation were above average (RAIN +6%, TEMP +0.2°C, RADPAR +4%). Compared to the other regions, the higher CALF value (16%) indicated some agricultural activities in this region. The NDVI profiles showed that the NDVI value was below average during the whole monitoring period.

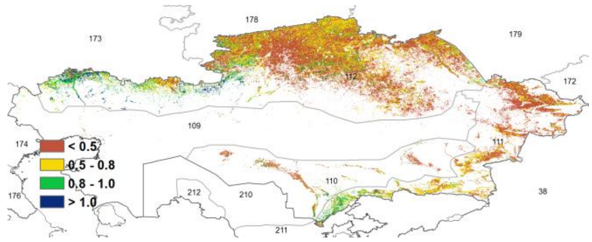
In the **South region,** the accumulated precipitation, temperature and radiation were above average (RAIN +3%, TEMP +0.5°C, RADPAR +5%). The agro-climate conditions were normal in the monitoring period.

Figure 3.22 Kazakhstan's crop condition, January – April 2023

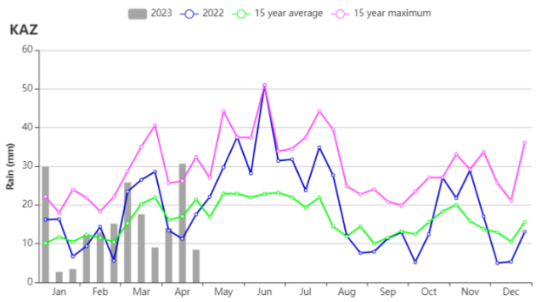


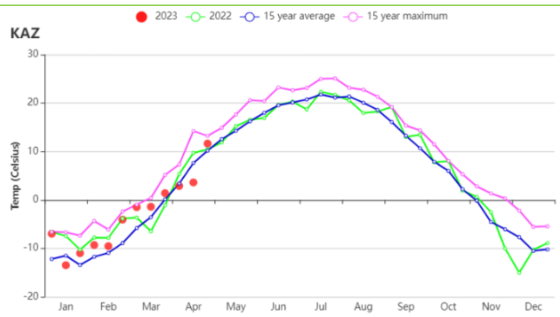
(a). Phenology of major crops



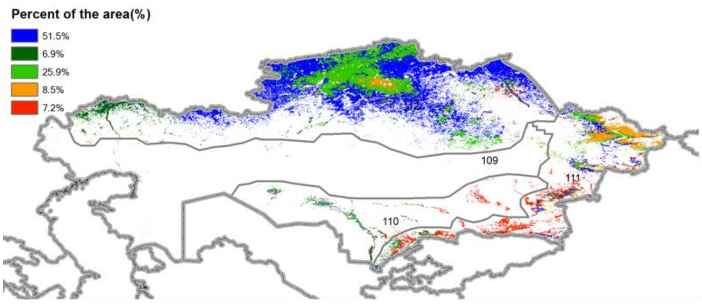


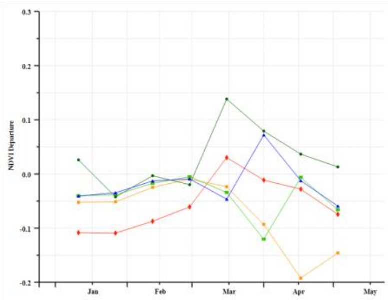
(b) Crop condition development graph based on NDVI (c) Maximum VCI



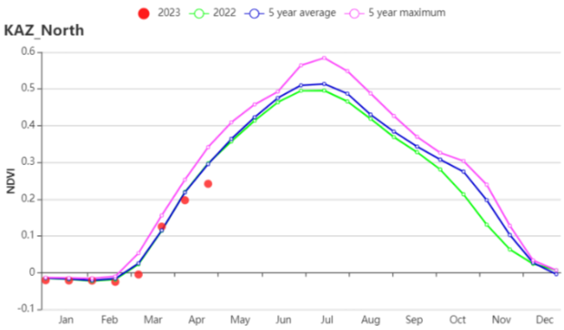


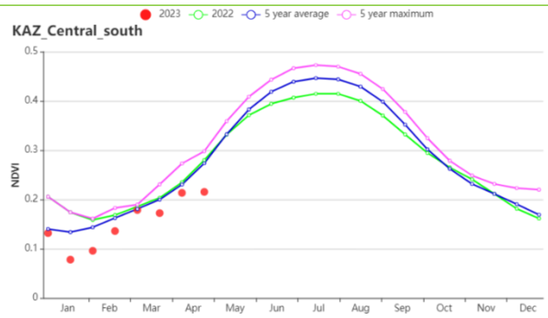
(d) Rainfall Index (e) Temperature Index



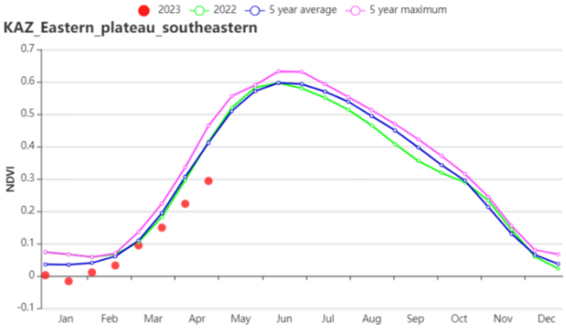


(f) Spatial NDVI patterns compared to 5YA (g) NDVI profiles





(h) Crop condition development graph based on NDVI (North region) (i) Crop condition development graph based on NDVI (South region)



(j) Crop condition development graph based on NDVI (Eastern plateau and southeastern region)

Table 3.35 Kazakhstan agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, January – April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
South zone	177	3	3.3	0.5	793	5	378	-3
Eastern plateau and southeastern zone	258	6	-2.9	0.2	785	4	296	-3
Northern zone	152	-1	-3.8	2.3	588	1	304	13

Table 3.36 Kazakhstan, agronomic indicators by sub-national regions, current season's values and departure from 5YA, January – April 2023

Region	Cropped arable land fraction		Maximum VCI
	Current (%)	Departure (%)	Current
South zone	6	-23	0.49
Eastern plateau and southeastern zone	16	-59	0.45
Northern zone	4	-40	0.52

AFG AGO ARG AUS BGD BLR BRA CAN DEU EGY ETH FRA GBR HUN IDN IND IRN ITA KAZ **KEN** KGZ KHM LKA MAR MEX MMR MNG MOZ NGA PAK PHL POL ROU RUS THA TUR UKR USA UZB VNM ZAF ZMB

[KEN] Kenya

Kenya has two rainy seasons. The long rains last from March to the end of May and the short rains last from the end of October to December. Maize is sown during both the long and short rains, while wheat is sown only during the long rains. This report covers the monitoring period from January to April 2023. The short rain maize got harvested and the long rain maize sowing has started, while the wheat sowing will start in May.

At the national level, precipitation was 24% below average at 337 mm. According to the national rainfall profiles, the 10-day cumulative rainfall was below the 15YA in almost all decades except in late March and late April. It was slightly warmer (TEMP +0.2°C) with RADPAR slightly above 15YA (+2%). Due to these conditions, the BIOMSS was 11% below average and the maximum VCI was 0.85.

The sowing and growth of short rainy season maize were affected by prolonged drought condions, which were prevalent during the entire growing season that had started in October. January and February were the harvesting phase for short rainy season maize. The NDVI values were below the 15YA, which indicates a significant reduction in yield. Based on NDVI clusters and corresponding NDVI departure profiles, western Kenya (blue area), which accounts for 47% of the country's cropland, had below average NDVI before March and recovered to above-average NDVI values in April. NDVI values in the dark green area of the eastern coastal region also were well below average. This is consistent with the maximum VCI map, which shows a relatively low VCI of less than 0.5 (red area) in the eastern coastal region. In general, yield of the short rainy season maize yield was reduced by drought. Long rainy season maize was sown in March and April, especially in western Kenya, when the precipition had improved to close to average levels.

Regional analysis

Based on cropping systems, climatic zones, and topographic conditions, four sub-national agro-ecological regions can be distinguished for kenya: the Eastern coastal region (113), the Highland agriculture zone (114) and Northern region (115) and the Southwest region (116).

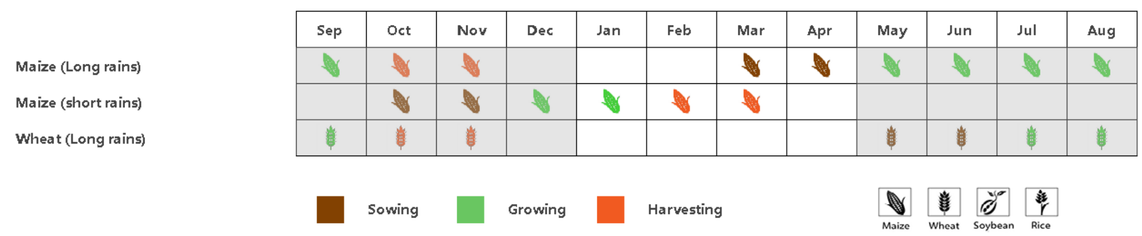
In the **Eastern coastal region**, the rainfall was above average (+37%). Biomass did not change, while temperatures (+0.2°C) and RADPAR (+3%) were moderately above average. However, as precipitation remained below 15YA in February and March, sowing of long rain maize sowing was affected. And the CALF decreased by 18% to 78%. The Crop Production Index was 0.66 and the maximum VCIx value was 0.63. The poorer CPI and VCIx may have been caused by the short rainy season maize harvest. Overall, crop conditions in the coastal areas were below average for both livestock and crop production, but the above average rainfall in April will be beneficial for long rain season maize development.

The **Highland agriculture zone** recorded 339 mm of rain, which was below the 15YA (-28%). Biomass decreased significantly (-13%) due to low precipitation. Temperature was near the 15YA (+0.3 °C), while RADPAR was slightly above average (+2%). Maximum VCI was 0.82. And the NDVI was below the 5YA before March. This means that the sowing of long rain maize was affected. Overall, crop growth was constrained by drought conditions, apart from April, when above rainfall occurred, improving crop development.

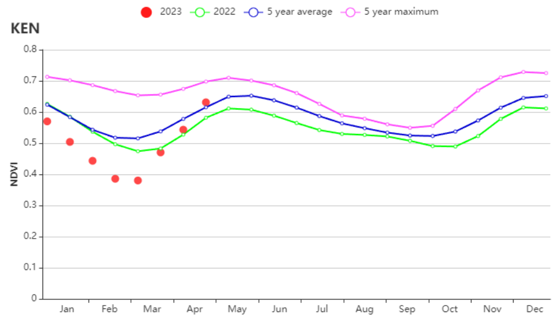
In the **Northern region**, precipitation was slightly above average at 344 mm (+8%). The 1% increase in BIOMSS was due to increased precipitation. But the maximum VCIx was only at 0.70. The significantly lower NDVI from January to March explains the poor output from short rain maize. Since late March, rainfall recovered to above average levels, resulting in high NDVI values compared with 5YA. In addition, CALF increased (+6%) to 86%. In general, perspectives for long rain season maize are godd as the region has seen an increase in rainfall, biomass, and CALF.

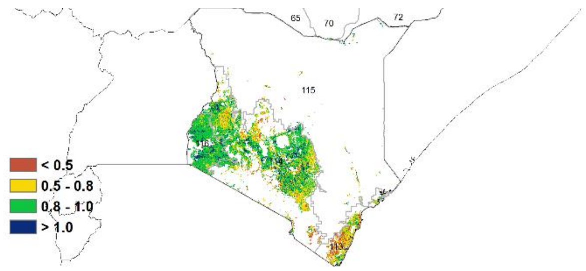
The **Southwest region** includes the areas of Narok, Kajiado, Kisumu, Nakuru and Embu. It had the largest negative deviation in RAIN (-63%). This resulted in a BIOMSS reduction by 30%. However, NDVI values were close to the 5YA except for February and March. The gradual increase in NDVI in April is signalling improved conditions for long rain maize. In addition, CALF was unchanged (100%). VCIx value remained at a high level (0.91). This indicates a return to normal vegetation conditions, thanks to the increased rainfall in March and April. All in all, the parameters indicate close to average conditions for this area.

Figure 3.23 Kenya's crop condition, January-April 2023



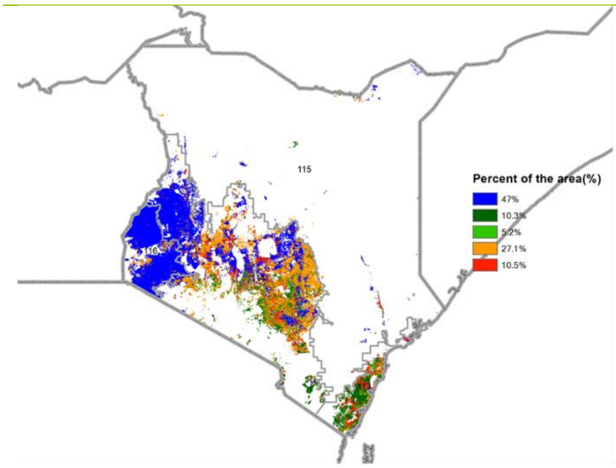
(a). Phenology of major crops

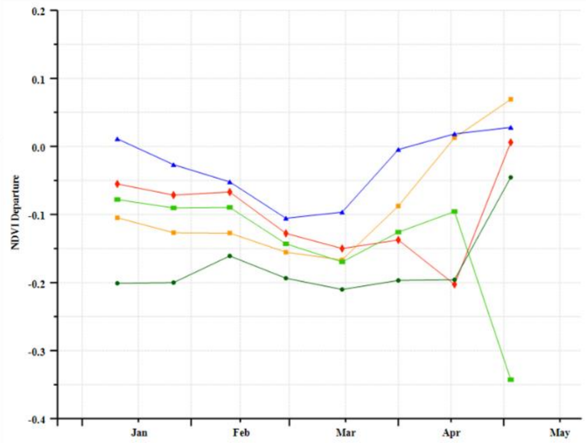




(b) Crop condition development graph based on NDVI

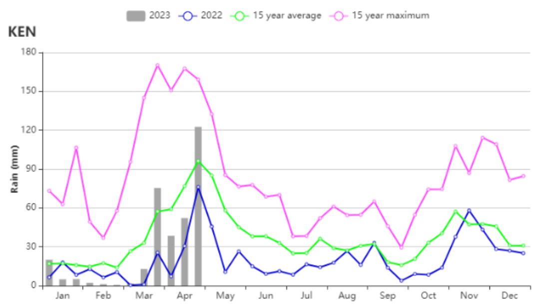
(c) Maximum VCI

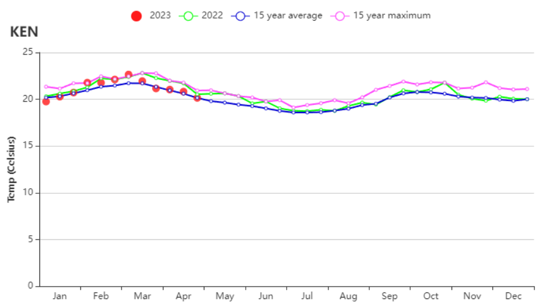




(d) Spatial NDVI patterns compared to 5YA

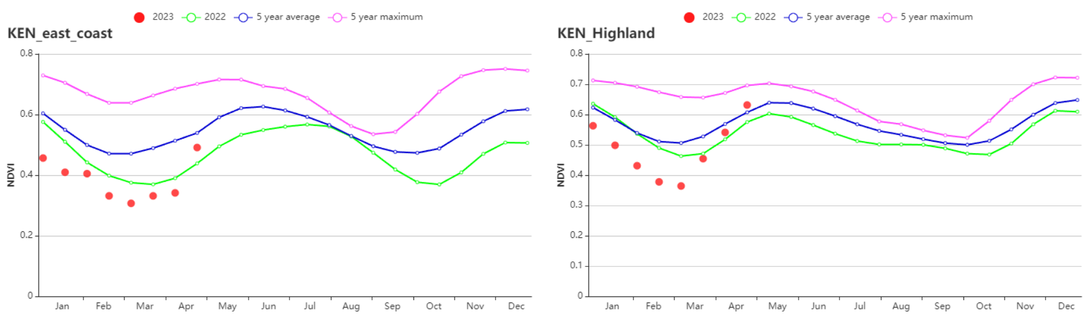
(e) NDVI profiles



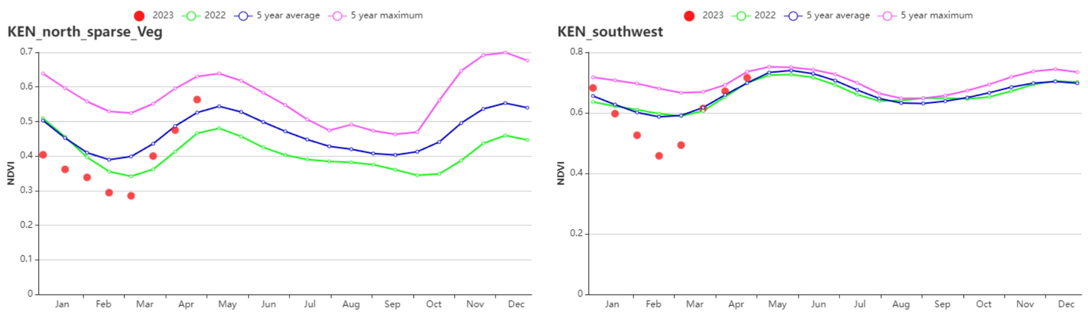


(f) Time series rainfall

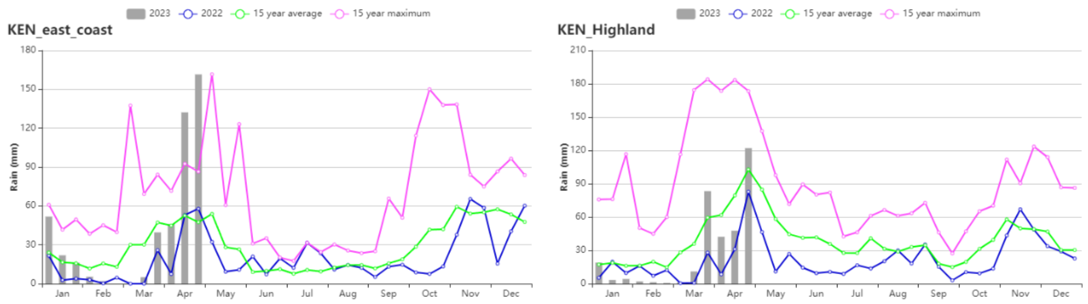
(g) Time series temperature



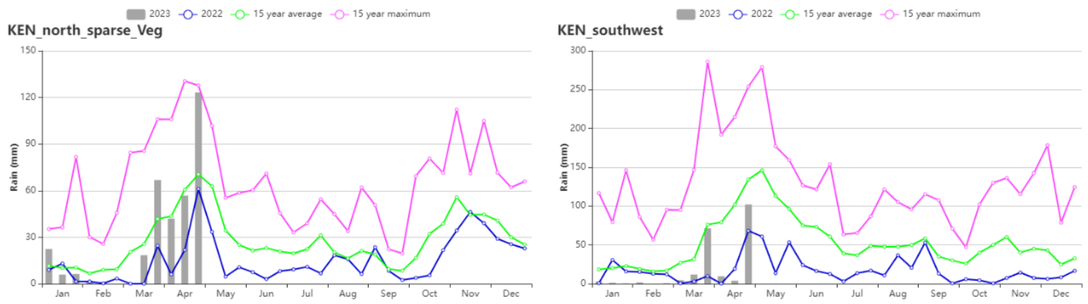
(h) Crop condition development graph based on NDVI, The eastern coastal region(left), The Highland agriculture zone(right)



(i) Crop condition development graph based on NDVI, the northern region with sparse vegetation (left), South-west (right)



(j) RAIN condition development graph based on NDVI, the eastern coastal region(left), The Highland agriculture zone(right)



(k) RAIN condition development graph based on NDVI, the northern region with sparse vegetation (left), South-west (right)

Table 3.37 Kenya's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, January-April 2023

Region	RAIN	TEMP	RADPAR	BIOMSS

	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m2)	Departure (%)	Current (gDM/m2)	Departure (%)
Coast	482	37	27.0	0.2	1402	3	1056	0
Highland agriculture zone	339	-28	19.8	0.3	1345	2	730	-13
northern rangelands	344	8	24.3	0.4	1385	2	862	1
South-west	211	-63	20.9	0.3	1352	2	659	-30

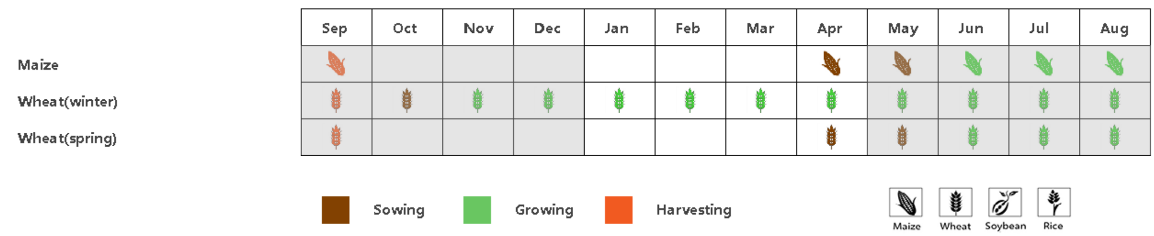
Table 3.38 Kenya's agronomic indicators by sub-national regions, current season's values and departure, January-April 2023

Region	Cropped arable land fraction		Maximum VCI
	Current (%)	Departure (%)	Current
Coast	78	-18	0.63
Highland agriculture zone	96	0	0.82
northern rangelands	86	6	0.78
South-west	100	0	0.91

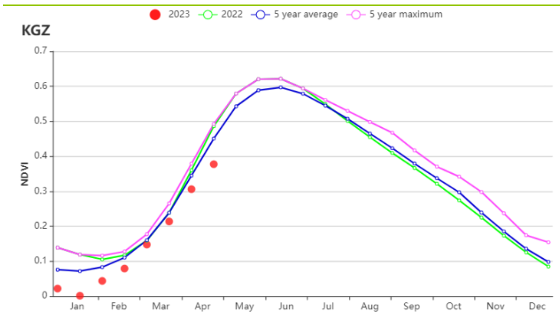
[KGZ] Kyrgyzstan

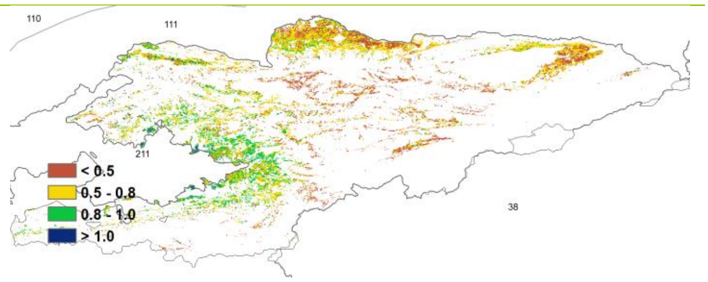
Only a small area of winter wheat is grown in Kyrgyzstan. Spring crops were planted in April in the southern part. Among the CropWatch agro-climatic indicators, RADPAR was above average (+5%), while TEMP (-0.9℃) and RAIN (-13%) were below average. The combination of these factors resulted in a below-average BIOMSS (-9%) compared to the recent fifteen-year average. As shown by the NDVI development graph, the winter vegetation conditions were generally below average, and experienced great negative anomalies in January, which can be attributed to the slower crop growth caused by the below average temperature from winter to spring. The spatial NDVI clustering profile shows that most of the cultivated regions had average or below average crop conditions. Only 18.5% of the cultivated regions (marked in orange) had slightly above average crop conditions throughout the monitoring period. The largest cluster, representing 32.9% of the area, had close-to-average crop conditions at first, and then gradually dropped to below-average from the beginning of March on, probably due to the below-average rainfall and temperature during this period. Other regions also experienced some fluctuations in crop conditions. Blue and dark green marked regions (mainly distributed in central Talas, northern and eastern Chuy, and some parts of Jalal-Abad and Osh) both suffered from low temperatures and had below-average crop conditions in January, then recovered gradually in February. This situation is confirmed by the VCIx map, which shows relatively low values (<0.8) distributed across the whole country. The national average VCIx was 0.59, indicating unfavorable crop conditions. The cropped arable land fraction decreased by 30%, mainly due to the lagging of spring sowing caused by the below average rainfall. Crop production prospect is unfavorable due to the lagging of spring sowing and below average rainfall, which is confirmed by the poor value of the Crop Production Index (CPI) at 0.65.

Figure 3.24 Kyrgyzstan's crop condition, January - April 2023

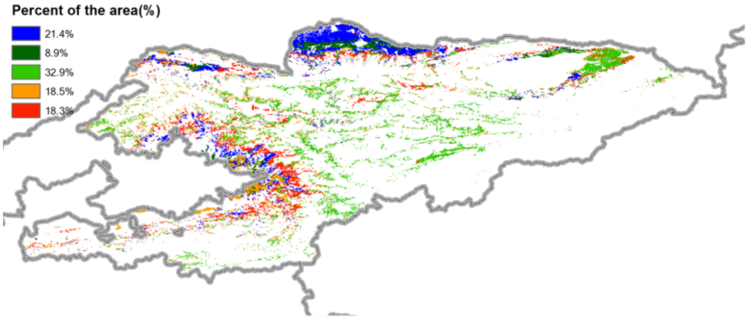


(a) Phenology of major crops

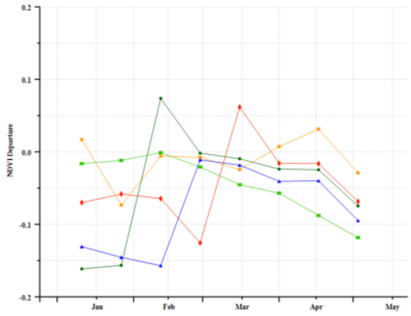




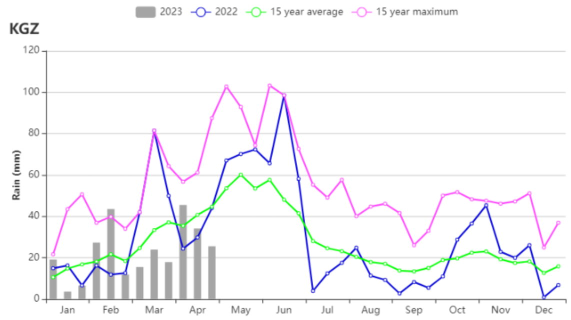
(b) Crop condition development graph based on NDVI (c) Maximum VCI



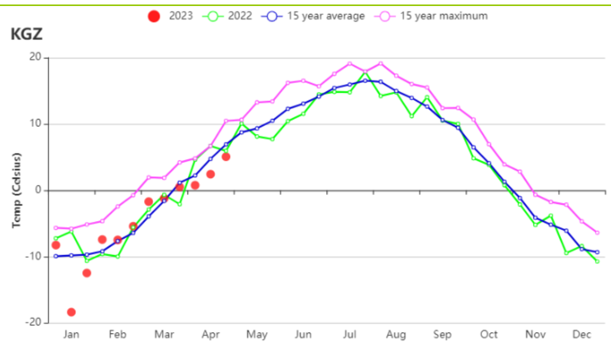
(d) Spatial NDVI patterns compared to 5YA



(e) NDVI profiles



(f) Rainfall profiles



(g) Temperature profiles

Table 3.39 Kyrgyzstan's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, January - April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Kyrgyzstan	275	-13	-4.5	-0.9	882	5	262	-9

Table 3.40 Kyrgyzstan's agronomic indicators by sub-national regions, current season's values and departure from 5YA, January - April 2023

Region	Cropped arable land fraction		Maximum VCI
	Current (%)	Departure (%)	Current
Kyrgyzstan	38	-30	0.59

[KHM] Cambodia

This report covers the major harvesting stages of the dry-season rice. The previous monitoring results showed that the expected yield of these crops will be slightly lower than average. This period of monitoring also covers the main growth stages of corn and soybeans. According to the monitoring by the CropWatch system, conditions for these crops are fair due to the impact of precipitation deficits.

During the monitoring period, Cambodia has experienced drier weather conditions. Compared to the same period in the last 15 years, cumulative precipitation (RAIN) in Cambodia was significantly lower by about 31%, while the radiation (RADPAR) was slightly higher by 3%, and average temperatures (TEMP) remained normal. The apparent lack of rainfall resulted in a below-average potential biomass (BIOMASS) of about 8%, indicating that the low rainfall had a negative impact on dry season crop growth, which is consistent with the description of the NDVI profiles. They show that starting from the end of February, NDVI was significantly lower than the average of the last five years. The spatial clustering results at the NDVI distance level show that about 20.5% of the cropland (light green) generally had slightly above-average NDVI, indicating normal crop growth conditions. These croplands are mainly located in the lower Mekong Valley. Approximately 75.3% of the cropland (red, blue, and dark green) had NDVI fall gradually below average starting in March, indicating unfavorable crop growth conditions. These croplands are widely distributed around Tonle Sap Lake and in the lower Mekong Valley. In contrast, 4.1% of cropland (orange) showed a rapid increase in NDVI to slightly below average in February, and these croplands are mainly located along the lower Mekong River.

Considering that the maximum vegetation condition index (VCIx) is only 0.78, and the CALF index remains average, conditions can be assessed as slightly below average.

Regional analysis

Based on cropping systems, climatic zones, and topographic conditions, four sub-national regions are described below: **The Tonle Sap Lake area**, a seasonally inundated freshwater lake which is influenced by the inflow and outflow from the Mekong River, **the Mekong valley** between Tonle Sap and Vietnam border, **Northern plain and northeast**, and the **Southwest Hilly region** along the Gulf of Thailand coast.

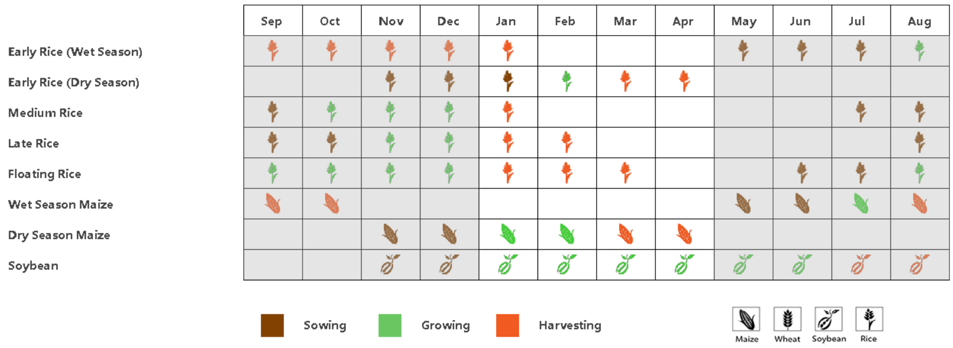
For the **Tonle-sap region** (agroecological subzone 117), cumulative precipitation (RAIN) was significantly lower by 43%, average temperature (TEMP) remained near the 15YA, and radiation (RADPAR) increased by 3%, resulting in a 14% reduction in potential biomass (BIOMASS). The NDVI in this zone was slightly above average until March, fell below average in March and remained below average thereafter. In addition, the CALF index in the zone was slightly higher by about 3%, but the VCIx index was only 0.79, indicating fair conditions.

For the **Mekong Valley region** (agroecological subzone 118), cumulative precipitation (RAIN) was significantly lower by 16%, average temperatures (TEMP) were close to average, and radiation (RADPAR) was 2% higher. The low precipitation resulted in a slight decrease of potential biomass (BIOMASS) by about 1%. Similar to the Tonle-sap region, NDVI in the zone fell below average in March and remained below average throughout the rest of the period. Considering that the CALF in the region fell by about 1%, and that the VCIx was only 0.79 and the CPI was 0.93, crop growth in the region was slightly below average.

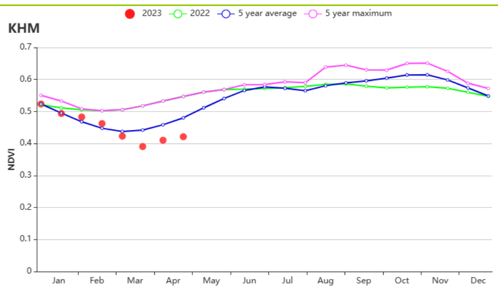
For the **Northern Plain and Northeast region** (agroecological subzone 119), the zone had significantly lower cumulative precipitation (RAIN) by 40%, higher average temperatures (TEMP) by about 0.1°C and higher radiation (RADPAR) by about 4%, resulting in lower potential biomass (BIOMASS) by about 9%. Crop NDVI in the zone remained at average levels until mid-February, when it dropped to below-average levels and remained below-average subsequently. The CALF in the zone was reduced by about 5% and the VCIx was only 0.69 and the CPI was only 0.86, both of which are the lowest value of four regions. It means that crop growth in this zone was poor.

For the **southwestern hilly region** (agroecological subzone 120), the cumulative precipitation (RAIN) in this area was 28% below average, the average temperature (TEMP) was 0.5°C lower and the radiation (RADPAR) was 2% higher, resulting in a decrease of potential biomass (BIOMASS) by about 7%. The NDVI curve shows that NDVI in the region also fell below average after mid-February and has remained below average since then. At the same time, the CALF was about 2% higher, with an VCIx of 0.80 and a CPI of 0.90. Although crop conditions were slightly better than in the other sub-regions, they were still below normal.

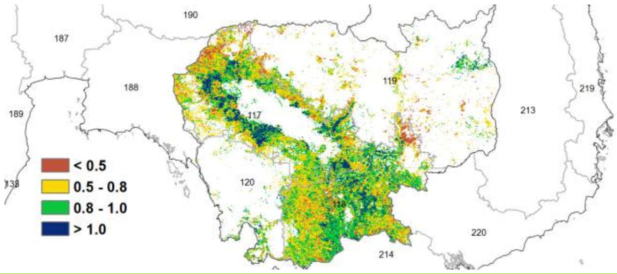
Figure 3.25 Cambodia's crop condition, January - April 2023



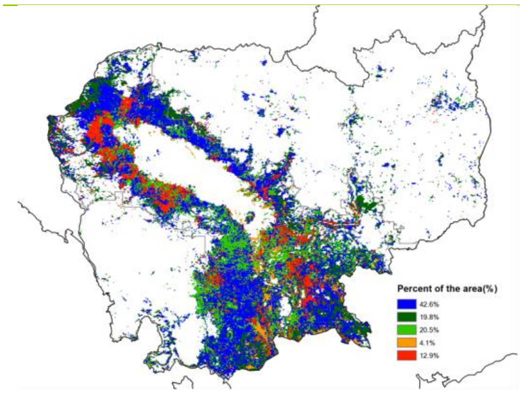
(a) Phenology of major crops



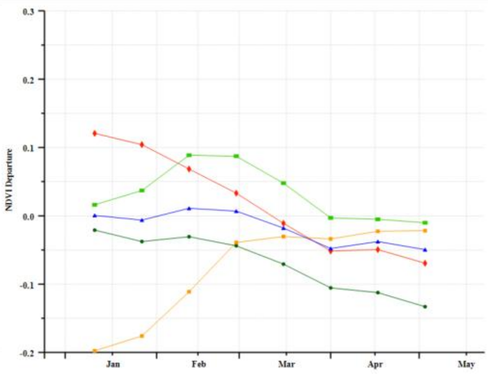
(b) Crop condition development graph based on NDVI



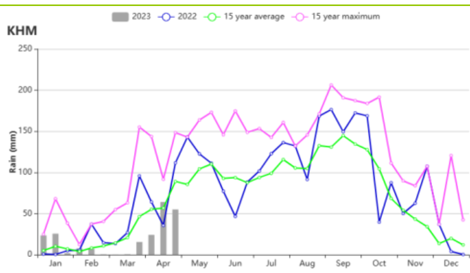
(c) Maximum VCI



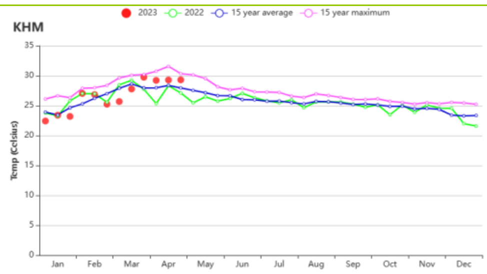
(d) Spatial NDVI patterns compared to 5YA



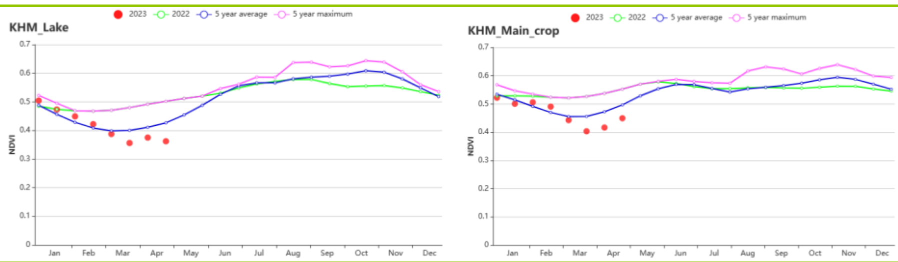
(e) NDVI profiles



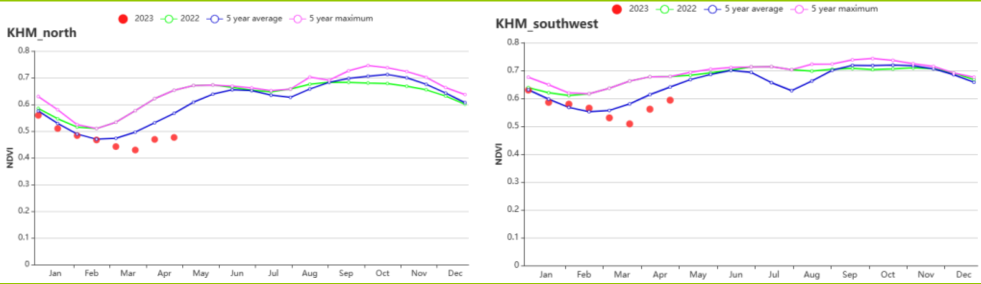
(f) Rainfall profiles



(g) Temperature profiles



(h) Crop condition development graph based on NDVI (Tonle-Sap region (left) and Mekong Valley region (right))



(i) Crop condition development graph based on NDVI (Northern Plain and northeast (left) and Southwest Hilly region (right))

Table 3.41 Cambodia's agroclimatic indicators by sub-national regions, current season's values, and departure from 15YA, January – April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Tonle-Sap region	185	-43	26.7	0.0	1220	3	747	-14
Mekong Valley region	291	-16	27.3	0.0	1212	2	876	-1
Northern Plain and northeast	171	-40	26.6	0.1	1244	4	720	-9
Southwestern Hilly region	316	-28	24.4	-0.5	1223	2	918	-7

Table 3.42 Cambodia's agronomic indicators by sub-national regions, current season's values, and departure from 5YA, January - April 2023

Region	Cropped arable land fraction		Maximum VCI
	Current (%)	Departure (%)	Current
Tonle-Sap region	72	3	0.79
Mekong Valley region	83	-1	0.79
Northern Plain and northeast	88	-5	0.69
Southwestern Hilly region	99	2	0.80

[LKA] Sri Lanka

This report covers the main and second cropping season of Sri Lanka. The main Maha season crops were harvested during February and March, while the sowing of second Yala season crops (maize and wheat) started in April. According to the CropWatch monitoring results, crop conditions were assessed as average for the monitoring period.

The country experienced the Northeast-Monsoon season during January and February and transformed into the First Inter-monsoon season in March and April. At the national level, precipitation was slightly below the 15YA (RAIN -2%), as well as the temperature (TEMP -0.1°C), while the radiation (RADPAR 1%) was slightly above the average. The fraction of cropped arable land (CALF) was similar to the 5YA, and BIOMSS was up by 5% compared to the 15YA due to the comprehensive effect of agroclimatic indicators. As shown in the NDVI development graph, NDVI was near average during most of the period. The maximum VCI for the whole country was 0.91. The CPI was 1.14, slightly higher than the last year, which indicating the normal agricultural production situation.

As shown by the NDVI clustering map and profiles, almost all of the country's cropland showed near-average crop conditions during the period. The crop condition of 8.2% of country's cropland apparently deviated from average, which was distributed in some clustered areas over east region. The maximum VCI showed high values almost all over the country.

Regional analysis

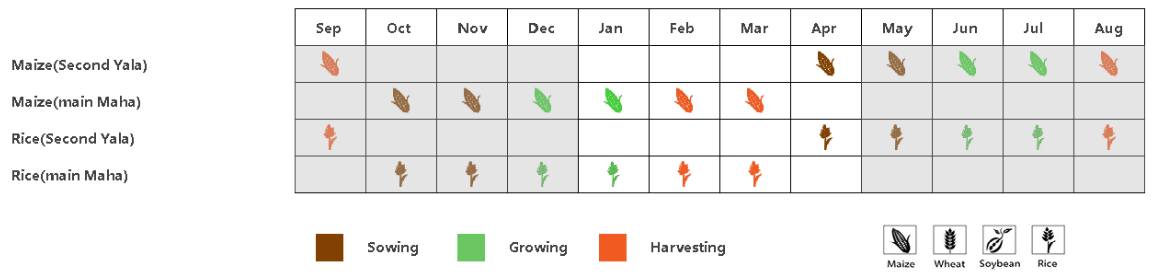
Based on the cropping system, climatic zones and topographic conditions, three sub-national agroecological regions can be distinguished for Sri Lanka. They are the Dry zone (121), the Wet zone (123), and the Intermediate zone (122).

In the **Dry zone**, the recorded RAIN (448 mm) was 2% below average. TEMP and RADPAR were 0.1°C and 1% above average. BIOMSS increased by 4% as compared to the 15YA. CALF was comparable to the 5YA level with 99% of cropland utilized. NDVI was similar to that of the whole country. The VCIx for the zone was 0.91. The CPI was 1.12. Overall, agricultural production situation was basically the same as last year for this zone.

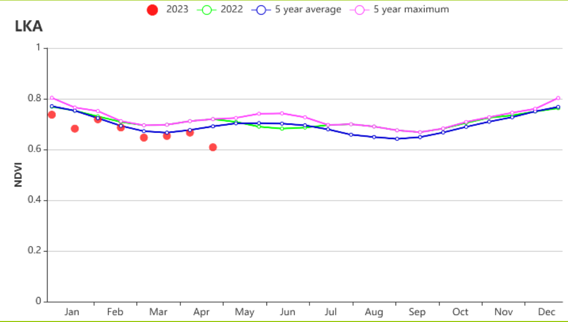
For the **Wet zone**, RAIN (795 mm) was 2% below average as compared to the 15YA. TEMP and RADPAR decreased by 0.5°C and 1% respectively. BIOMSS was 6% above the 15YA and cropland was almost fully utilized. NDVI values showed average levels during the whole period except for late April. The CPI was 1.12. Crop conditions were near average for this zone.

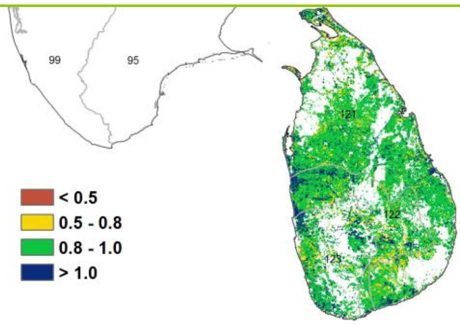
The **Intermediate zone** had the rainfall of 538 mm, which was 21% below average. TEMP and RADPAR were 0.3°C and 4% up compared to the 15YA. With full use of cropland, BIOMSS was 3% lower than the average. The crop condition was average and the VCIx value for this zone was 0.92. The CPI was 1.12.

Figure 3.26 Sri Lanka's crop condition, January - April 2023

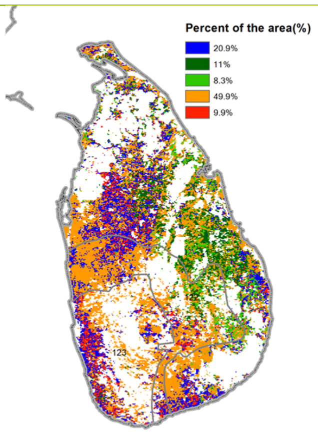


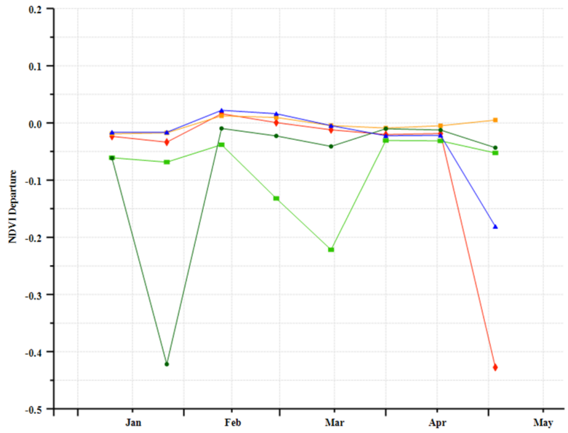
(a) Phenology of major crops



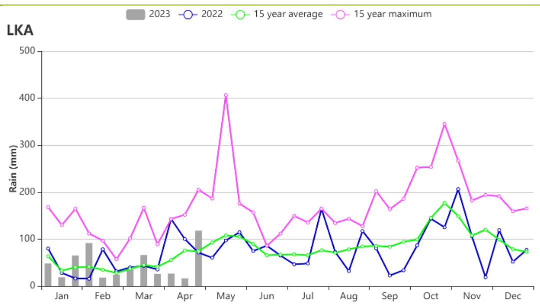


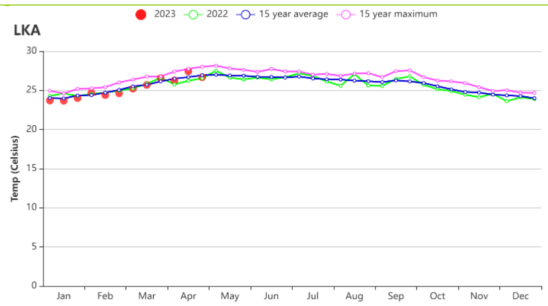
(b) Crop condition development graph based on NDVI (c) Maximum VCI



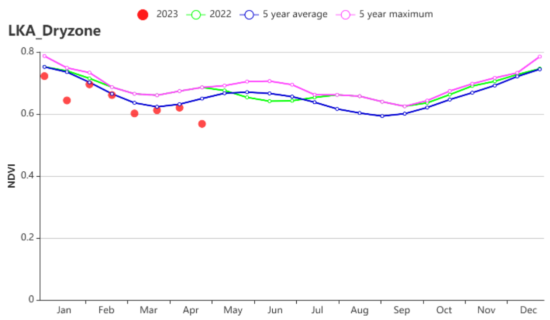


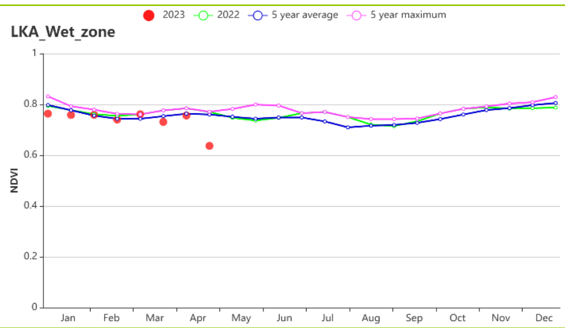
(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles



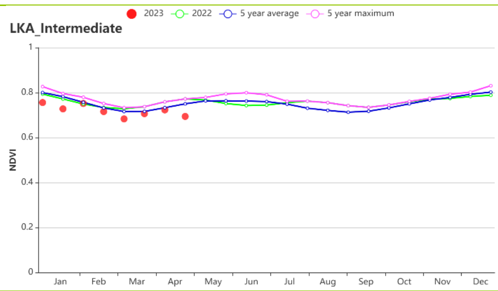


(f) Rainfall profiles (g) Temperature profiles





(h) Crop condition development graph based on NDVI (Dry zone (left) and Wet zone (right))



(i) Crop condition development graph based on NDVI (Intermediate zone)

Table 3.43 Sri Lanka's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, January - April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m^2)	Departure (%)	Current (gDM/m^2)	Departure (%)
Dry zone	448	-2	25.8	0.1	1309	2	1132	4
Intermediate zone	538	-21	24.3	0.3	1232	4	1122	-3
Wet zone	795	-2	24.2	-0.5	1185	-1	1336	6

Table 3.44 Sri Lanka's agronomic indicators by sub-national regions, current season's values and departure from 5YA, January - April 2023

Region	Cropped arable land fraction		Maximum VCI
	Current (%)	Departure (%)	Current
Dry zone	99	0	0.91
Intermediate zone	100	0	0.92
Wet zone	100	0	0.93

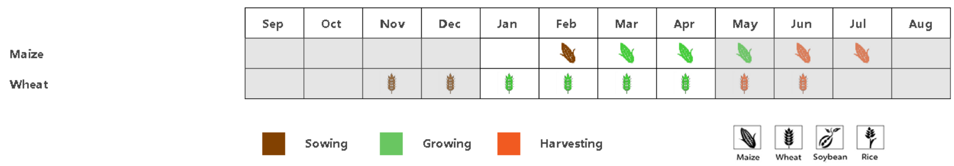
[MAR] Morocco

This reporting period covers the main growing stage of wheat, while maize planting started in February. Precipitation had been 51% below the 15YA during the previous monitoring period. The drought conditions continued during this monitoring period, as the CropWatch agro-climatic indicators show that the recorded rainfall was 114 mm, 48% below the 15-year average (15YA). The rainfall index graph shows that the rainfall was less than the 15YA except for in mid-to-late- February. The average temperature was only 0.7°C higher the 15YA. The temperature index graph shows that the temperature fluctuated around 15YA. RADPAR was higher than the 15YA by 2%, while BIOMSS was lower than the 15YA by 23%. The nationwide NDVI crop development graph shows that the crop conditions were far below the 5-year average (5YA) due to severe drought conditions. Nevertheless, crop growth is still significantly better than in 2022. The NDVI profile map indicates that about 15.9% of cultivated areas were better than the 5YA before April and then gradually fell back to around values below the 5YA, mainly in the North and Midwest (light green areas); the remaining 84.1% of cultivated areas were below the 5YA. The national VCIx was at 0.61, but significantly higher than the 0.51 of the same period last year. The CALF was below the 5YA by 16%. The nationwide crop production index (CPI) was at 0.86 implying below normal crop production situation, but significantly higher than the 0.62 in 2022.

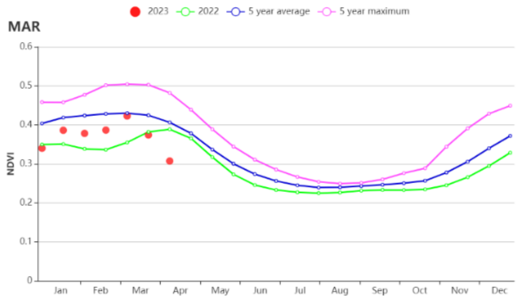
Regional analysis

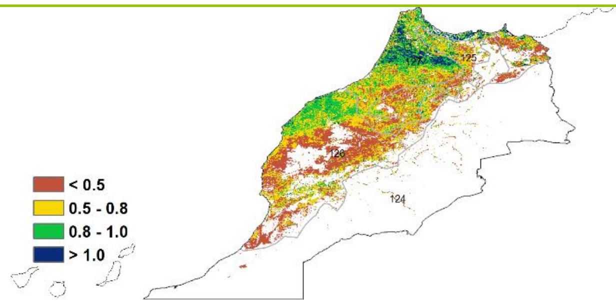
Based on the cropping system, climatic zones, and topographic conditions, Morocco is subdivided into four agro-ecological zones (AEZ). Only three are relevant for crop production: Sub-humid northern highlands (125), including the central Centre-Nord Region and northern Centre-Sud, Warm semiarid zone (126) covering the regions of North-Oriental and the broad Tensift Region, and Warm sub-humid zone (127) of the Nord-Ouest Region. The agroclimatic indicators show a decrease in rainfall at -51% for the Sub-humid northern highlands, -42% for the Warm semi-arid zone, and -51% for the Warm sub-humid zone, while the temperature was above 15YA by 0.7°C, 0.6°C, and 0.6°C in the Sub-humid northern highlands, the Warm semi-arid zone, and the Warm sub-humid zone, respectively. RADPAR was higher than the 15YA by 5%, 1%, and 3% while BIOMSS was below the 15YA by 28%, 21%, and 28% in the Sub-humid northern highlands, the Warm semi-arid zone, and the Warm sub-humid zone, respectively, due to significantly lower precipitation. The NDVI-based crop condition development graphs show similar conditions for the three zones following the national crop development NDVI graph, which are generally below average, but the peak crop growth period is still significantly better than the same period last year. The VCIx was 0.61, 0.52, and 0.74, and the CALF was below the 5YA by 22%, 28%, and 5% in the Sub-humid northern highlands, the Warm semi-arid zone, and the Warm sub-humid zone, respectively. The CPI was at 0.79, 0.79, and 0.98 in the Sub-humid northern highlands, the Warm semi-arid zone, and the Warm sub-humid zone, respectively, implying a below-normal crop production situation, but better than 2022.

Figure 3.27 Morocco's crop condition, January-April 2023

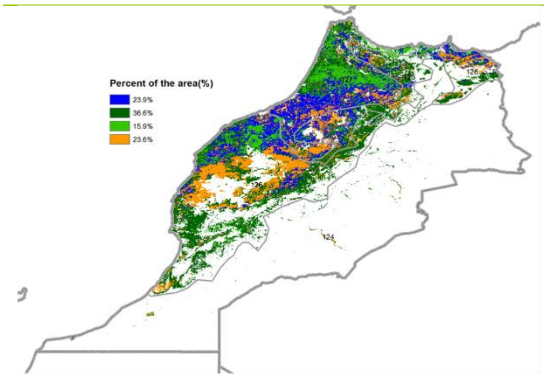


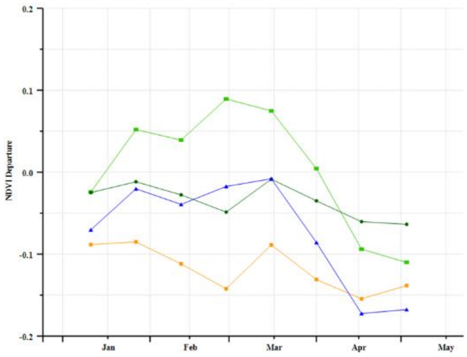
(a) Phenology of major crops



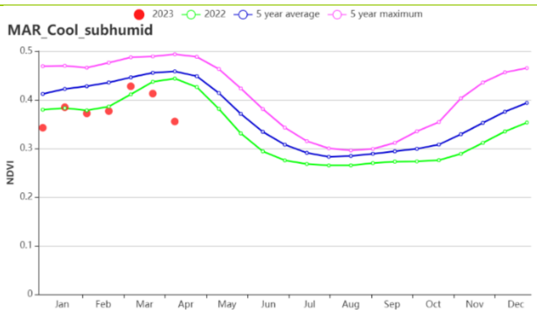


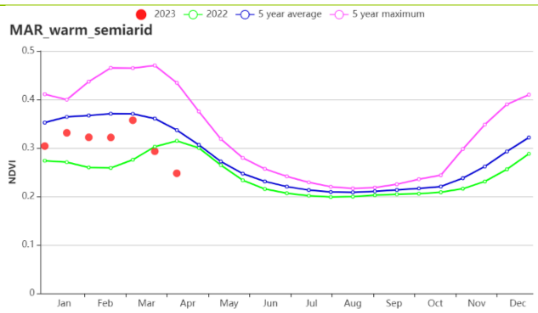
(b) Crop condition development graph based on NDVI (c) Maximum VCI



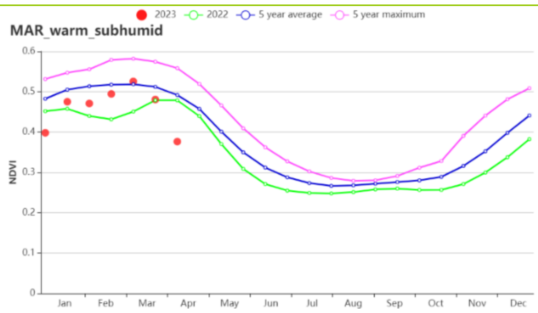


(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles

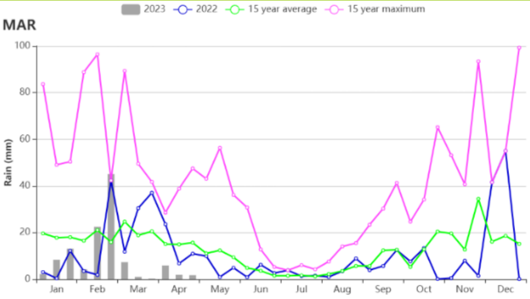


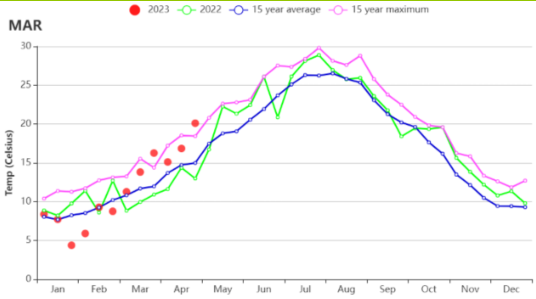


(f) crop condition development graph based on NDVI, Sub-humid northern highlands, and (g) Warm semiarid zones



(h) Crop condition development graph based on NDVI, Warm subhumid zones





(i) Time series profile of rainfall (j)Time series profile of temperature

Table 3.45 Morocco's agroclimatic indicators by sub-national regions, current season's values, and departure from 15YA, January-April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Sub-humid northern highlands	152	-51	10.0	0.7	1006	5	427	-28
Warm semi-arid zones	80	-42	13.0	0.6	1074	1	349	-21
Warm sub-humid zones	140	-51	11.0	0.6	996	3	426	-28

Table 3.46 Morocco's agronomic indicators by sub-national regions, current season's values, and departure from 5YA, January-April 2023

Region	Cropped arable land fraction		Maximum VCI
	Current (%)	Departure (%)	Current
Buzi basin	53	-22	0.61
Northern high-altitude areas	30	-28	0.52
Southern g region	76	-5	0.74

[MEX] Mexico

This report covers the main fertility periods of irrigated wheat, typically sown in November and December, and the mature harvest of irrigated winter maize, sown roughly one month earlier. Wheat has been coming into harvest since April. Rice and soybean sowing began in April.

Agro-climatic conditions showed that RAIN decreased by 24%, TEMP increased by 0.4°C, RADPAR was at the average level and BIOMSS decreased by 11%. The CALF decreased by 4%. According to the spatial distribution of NDVI profiles, overall crop growth in Mexico was slightly below average.

Based on the spatial NDVI profiles and distribution map, it can be observed that 50% of the total cropped areas had below-average crop condition throughout the monitoring period, primarily concentrated in the central part of Mexico, specifically in Veracruz. Approximately 32.7% of the total cropped areas exhibited average crop conditions, with notable concentrations in Chihuahua, Chiapas, and Tlaxcala. These regions experienced moderate crop growth, indicating that the agro-climatic conditions were more favorable compared to the central part of Mexico. Only 6.3% of the total cropped areas showed above-average crop conditions, predominantly found in Tamaulipas. This suggests that crops in these areas have benefited from relatively better agro-climatic conditions, resulting in improved growth and productivity. Finally, in 10.9% of the areas, the crop condition gradually improved towards the end of the monitoring period.

Overall, moisture stress occurred in Mexico due to insufficient precipitation in January. The crop production situation was slightly below average and a decline in crop yields is expected.

Regional analysis

Based on cropping systems, climatic zones and topographic conditions, Mexico is divided into four agro-ecological regions. They include the Arid and semi-arid region (128), Humid tropics with summer rainfall (129), Sub-humid temperate region with summer rains (130) and Sub-humid hot tropics with summer rains (131). Regional analyses of crop conditions provide more details for the production situation in Mexico.

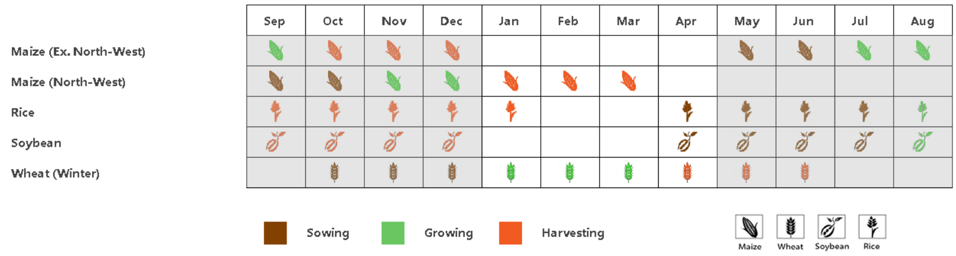
The Arid and semi-arid region, located in northern and central Mexico, accounts for about half of planted areas in the country. The agro-climatic condition indicated a 13% decrease in RAIN, with TEMP remaining near the average and a 4% decrease in RADPAR. According to the NDVI development graph, crop conditions in this region were close to the average. CALF decreased by 10% compared with the 5YA. The VCIx was 0.67.

The region of Humid tropics with summer rainfall is located in southeastern Mexico. RAIN was significantly decreased by 22%, TEMP was 0.7°C warmer, RADPAR increased by 3% and BIOMSS decreased by 9%. According to the NDVI-based crop condition development graph from January to April, the NDVI values were slightly below but close to the average level. CALF was 99%. The high CALF and VCIx of 0.89 indicated that crop growth in the region was generally normal.

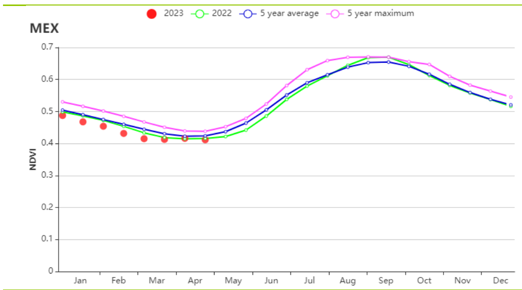
The Sub-humid temperate region with summer rains is situated in central Mexico. According to the NDVI development graph, crop conditions were below the average level. RAIN experienced a significant decrease of 48%, while TEMP increased by 0.7°C. RADPAR remained unchanged compared to the 15YA. BIOMSS decreased by 26% and CALF was recorded at 44%. The VCIx was 0.68.

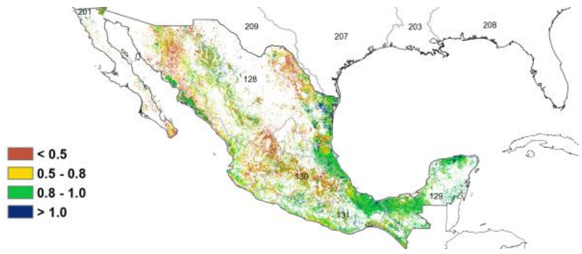
The region called Sub-humid hot tropics with summer rains is located in southern Mexico. During the monitoring period, crop conditions were slightly lower than the average in the four months, as shown by the NDVI time profiles. The agro-climatic conditions revealed a decrease in RAIN (-24%), a slight increase in TEMP (+0.5°C) and no change in RADPAR. CALF was 79%, and the VCIx for the region was 0.79.

Figure 3.28 Mexico's crop condition, January - April 2023



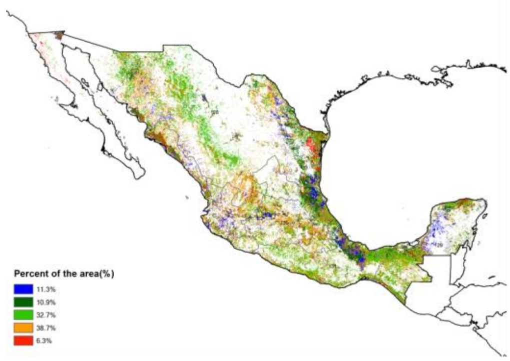
(a) Phenology of major crops

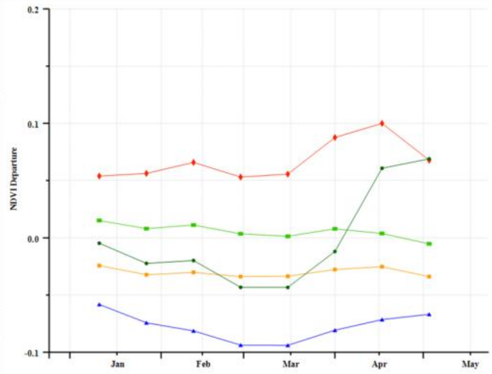




(b) Crop condition development graph based on NDVI

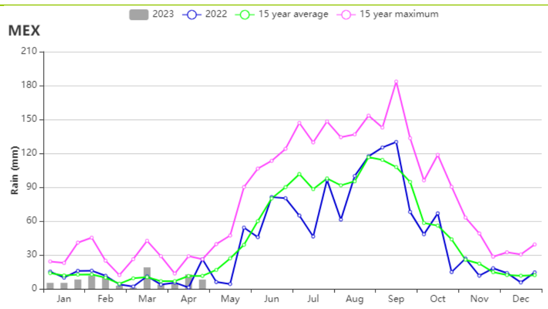
(c) Maximum VCI

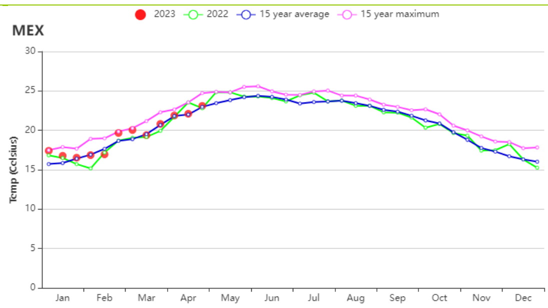




(d) Spatial NDVI patterns compared to 5YA

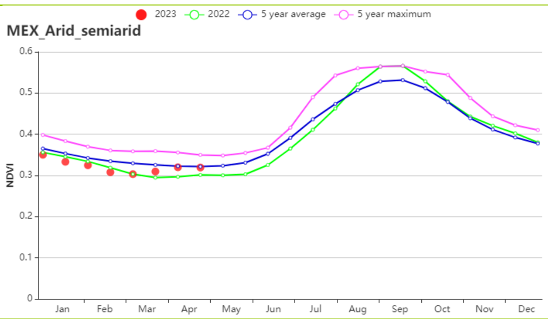
(e) NDVI profiles

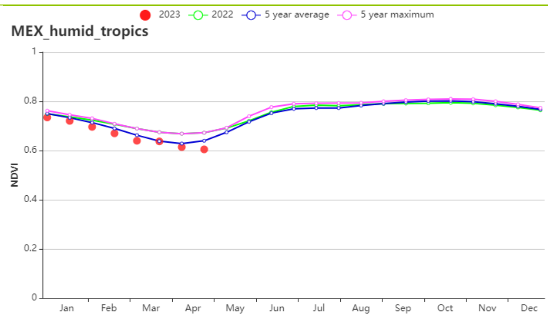




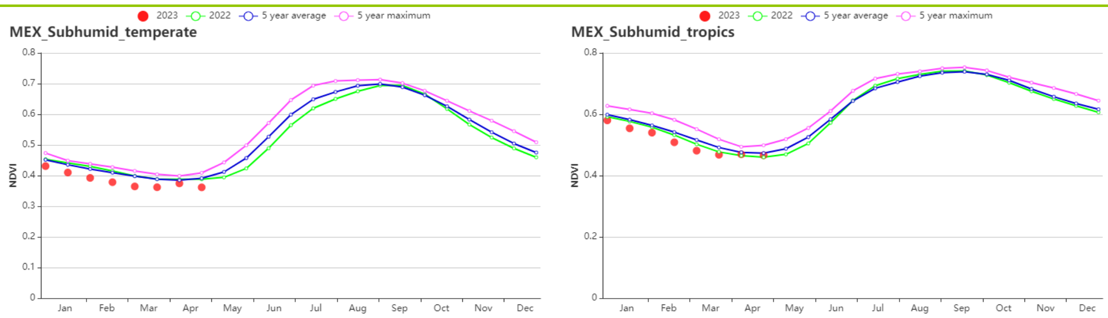
(f) Rainfall profiles

(g) Temperature profiles





(h) Crop condition development graph based on NDVI (Arid and semi-arid regions (left) and Humid tropics with summer rainfall (right))



(i) Crop condition development graph based on NDVI (Sub-humid temperate region with summer rains (left) and Sub-humid hot tropics with summer rains (right))

Table 3.47 Mexico's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, January - April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Arid and semi-arid regions	59	-13	15.9	0.0	1180	-4	365	-6
Humid tropics with summer rainfall	191	-22	23.9	0.7	1202	3	707	-9
Sub-humid temperate region with summer rains	55	-48	18.6	0.7	1312	0	354	-26
Sub-humid hot tropics with summer rains	91	-24	20.7	0.5	1253	0	450	-13

Table 3.48 Mexico's agronomic indicators by sub-national regions, current season's values and departure from 5YA, January - April 2023

Region	Cropped arable land fraction		Maximum VCI
	Current (%)	Departure (%)	Current
Arid and semi-arid regions	32	-10	0.67
Humid tropics with summer rainfall	99	0	0.89
Sub-humid temperate region with summer rains	44	-7	0.68
Sub-humid hot tropics with summer rains	79	-2	0.79

[MMR] Myanmar

During this reporting period, the maize was in the harvesting season. Production of the second rice crop started in January. It reached maturity in April. The harvest of wheat also fell into this monitoring period.

According to the agroclimatic indicators, the weather in Myanmar continues to be drier than normal. Compared to the 15YA, RAIN was much lower (-66%), while TEMP was higher (+0.6ºC) and RADPAR was up by 3%. As a result of the rainfall deficit, BIOMSS was markedly below the average (-18%). 25% of cropland was not utilized, 8% lower than the 5YA. NDVI values were below average during the whole monitoring period. The maximum VCI during this period was 0.72. The CPI value was 0.87, which represents a below-average agricultural production situation.

As shown by the NDVI clusters map and profiles, the crop conditions across the country ranged from average to below average. More than 70% of the country's cropland showed below-average crop conditions during the whole period. It was mainly distributed throughout the country except for the part of the Center Plain. 6.2% of the cropland, located in south region, including Bago, Yangon and Ayeyarwady, showed positive NDVI departure values in January, but below average values thereafter. 26.9% of the country's cropland, which was distributed around the Central Plain, was near average during the entire period. According to the CropWatch monitoring results, crop conditions were below average.

Regional analysis

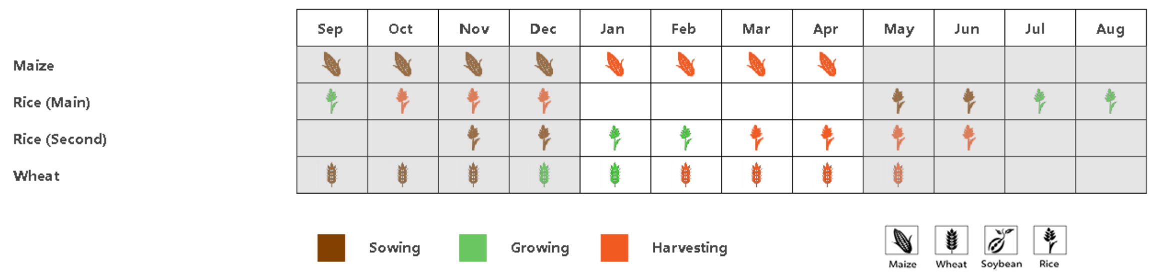
Three sub-national agro-ecological zones (AEZ) can be distinguished for Myanmar based on the cropping system, climatic zones and topographic conditions. They are the Central plain (132), the Hills (134) and the Delta and Southern Coast regions (133).

The **Central Plain** had a marked rainfall deficit (RAIN -84%), and RADPAR and TEMP were up by 3% and 0.9ºC compared to the 15YA. BIOMSS was 17% lower than the 15YA. CALF showed that 58% of the cropland was utilized. NDVI was below the level of the 5YA for the period. The VCIx was 0.65. The CPI was 0.73. Crop conditions for this region were below average.

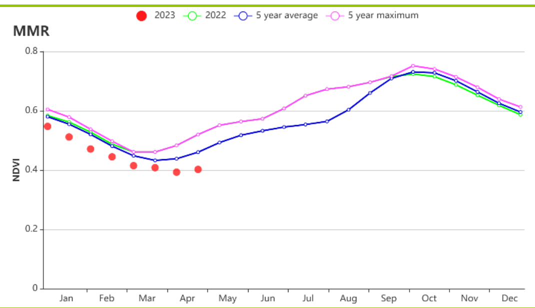
The **Hills region** also had below-average rainfall (RAIN -63%). RADPAR and TEMP increased by 4% and 0.6ºC. BIOMSS was 20% lower than the 15YA. The cropland was not fully utilized (CALF 91%). The NDVI values were similar to that of the whole country. The VCIx was 0.77. The CPI was 0.86. Crop conditions are assessed as below the 5YA level.

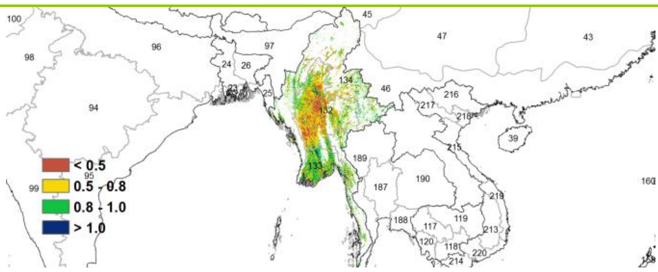
The **Delta and Southern Coast region** had a below-average rainfall (RAIN -69%), similar to the other two sub-national regions. RADPAR and TEMP were 3% and 0.4ºC above average. BIOMSS was 17% lower than the 15YA. The cropland was also not fully utilized (CALF 89%). The NDVI values were below the 5YA during the whole period. VCIx was 0.83. The CPI was 1.00. Crop conditions in this region were below average.

Figure 3.29 Myanmar's crop condition, January - April 2023



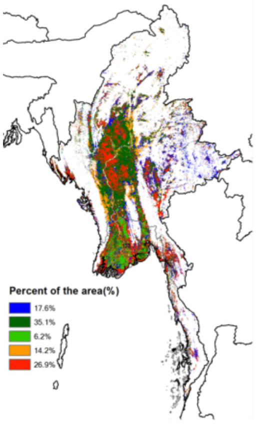
(a) Phenology of major crops

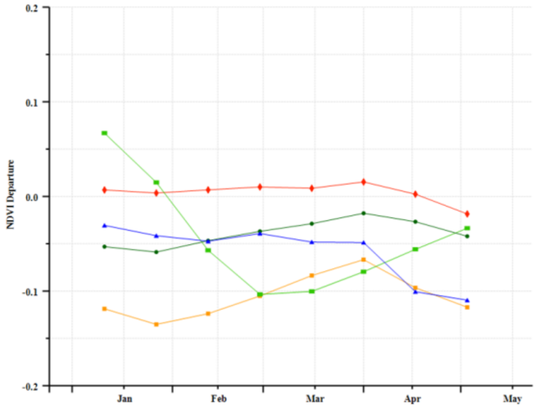




(b) Crop condition development graph based on NDVI

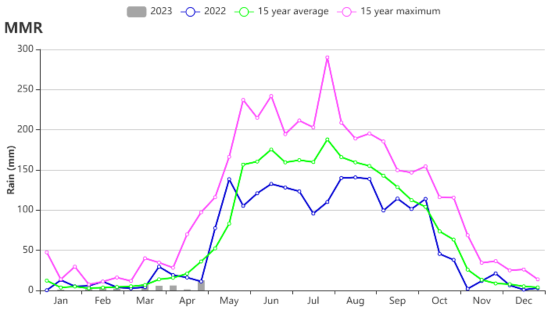
(c) Maximum VCI

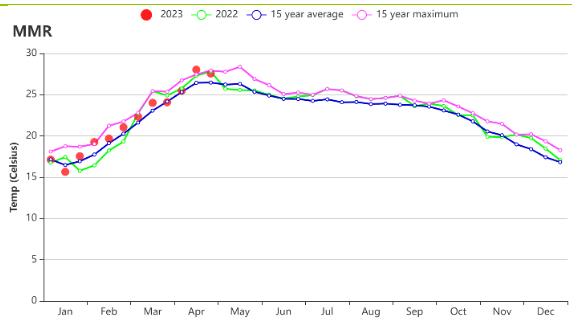




(d) Spatial NDVI patterns compared to 5YA

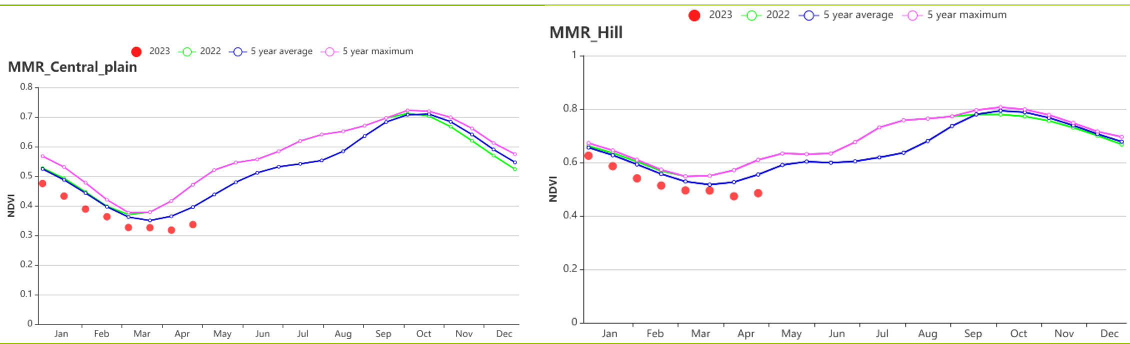
(e) NDVI profiles



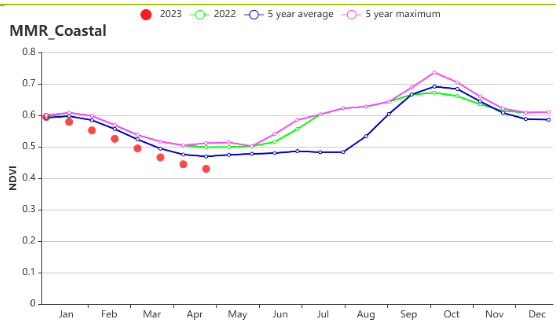


(f) Rainfall profiles

(g) Temperature profiles



(h) Crop condition development graph based on NDVI (Central plain region(left) and Hills region(right))



(i) Crop condition development graph based on NDVI (Delta and Southern Coast region)

Table 3.49 Myanmar's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, January - April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Central plain	11	-84	23.0	0.9	1307	3	409	-17
Delta and southern-coast	44	-69	26.4	0.4	1323	3	546	-17
Hills region	57	-63	19.4	0.6	1271	4	426	-20

Table 3.50 Myanmar's agronomic indicators by sub-national regions, current season's values and departure from 5YA, January - April 2023

Region	Cropped arable land fraction		Maximum VCI
	Current (%)	Departure (%)	Current
Central plain	58	-17	0.65
Delta and southern-coast	89	0	0.83
Hills region	91	-2	0.77

[MNG] Mongolia

Located at high latitudes, Mongolia cultivates crops mainly during the summer months (May-September), focusing on spring wheat and potatoes. During this reporting period (January-April 2023), no crops were grown in the region. Only 3% of Mongolia's cropland is irrigated, which means that agro-meteorological conditions have a decisive impact on almost all crop growth.

Among the CropWatch agro-climatic indicators, the average temperature in Mongolia was -11.7°C, slightly above the 15-year average (+0.6°C). precipitation was 67 mm, 3% less than the 15-year average. Solar radiation was the same as the 15-year average. The potential cumulative biomass was 3% less than the 15-year average.

It's worth noting that although the overall agroclimatic indicators for Mongolia showed normal conditions during this monitoring period, the country experienced a severe "Dzud" event in the winter of 2022-23. "Dzud" is a specific term in Mongolian to describe an extremely cold winter climate phenomenon that often results in large numbers of livestock starving or freezing to death due to the harsh weather conditions. This climate phenomenon is unique to the Mongolian plateau and has caused massive livestock deaths. This Dzud event has a direct impact on the livelihoods of farmers.

Overall, although agro-meteorological conditions in Mongolia were generally normal during this period, it requires close attention during the next monitoring period as crops have not yet been planted.

Regional analysis

Based on cropping systems, climatic zones, and topographic conditions, Mongolia can be divided into five agro-ecological zones (AEZ): **Altai (135), Gobi Desert (136), Hangai Khuvsgul Region (137), Selenge-Onon Region (138) and Central and Eastern Steppe (139). Altai** and **Gobi Desert** have no cultivated land, so we are mainly concerned with the three regions of **Hangai Khuvsgul Region, Selenge-Onon Region and Central and Eastern Steppe**.

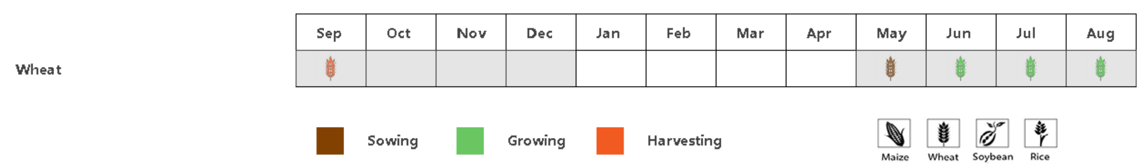
In **the Hangai Khuvsgul Region**, accumulated precipitation was 53 mm, 21% less than the 15-year average for the same period. The average temperature was -13.3°C, increased by 0.4°C. Solar radiation increased by 1%. Significantly low precipitation resulted in a 13% decrease in BIOASS, indicating generally unfavorable meteorological conditions that will affect subsequent crop planting.

In **the Selenge-Onon Region**, accumulated precipitation was 71 mm, an increase of 3% over the 15-year average for the same period. The average temperature was -11.0°C, increased by 0.5°C. Solar radiation increased by 1%. The combined effect leads to a 3% decrease in BIOMSS. The emergence and early growth of the subsequent crop will depend on the subsequent agroclimatic conditions.

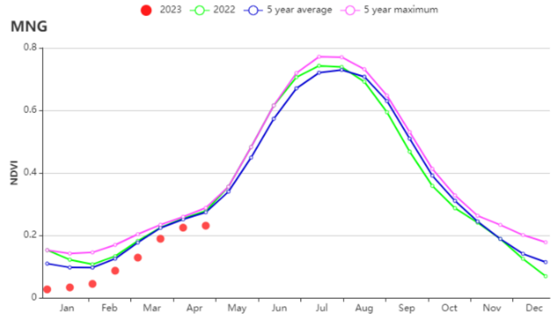
In **the Central and Eastern Steppe**, accumulated precipitation was 67 mm, an increase of 3% over the 15-year average for the same period. The average temperature was -10.7°C, increased by 1.0°C. Solar radiation was the same as the 15-year average. The combined effect leads to an increase of 12% in BIOMSS. It indicates that the agroclimatic conditions are favorable for subsequent crop sowing, seedling emergence and early growth and development.

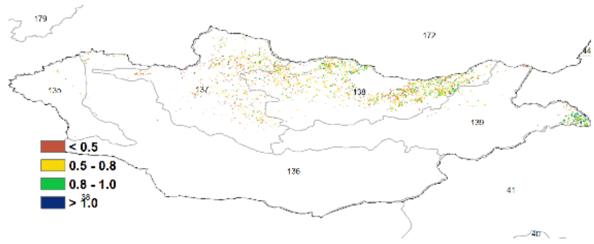
Subsequent crop sowing expected to be near normal due to near-average winter precipitation.

Figure 3.30 Mongolia's crop condition, January - April 2023

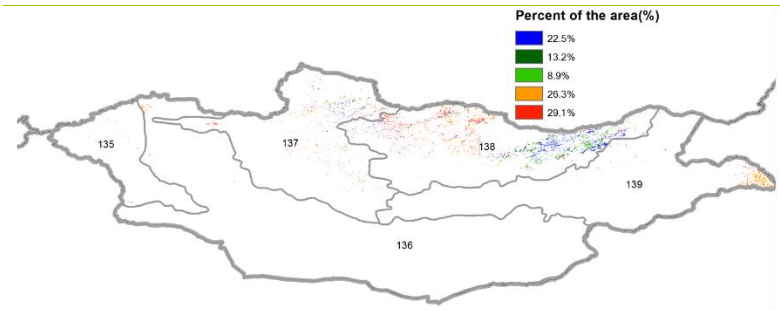


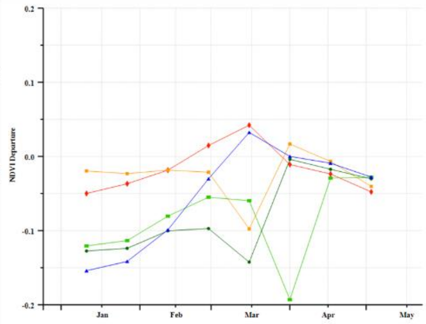
(a). Phenology of major crops



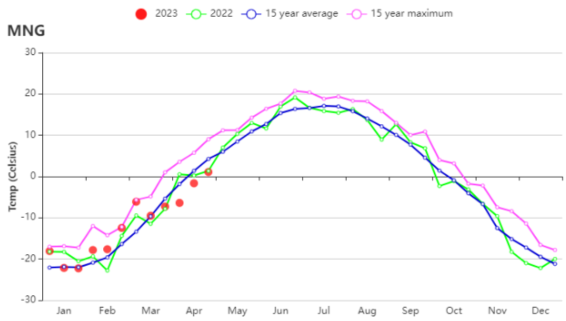


(b) Crop condition development graph based on NDVI (c) Maximum VCI

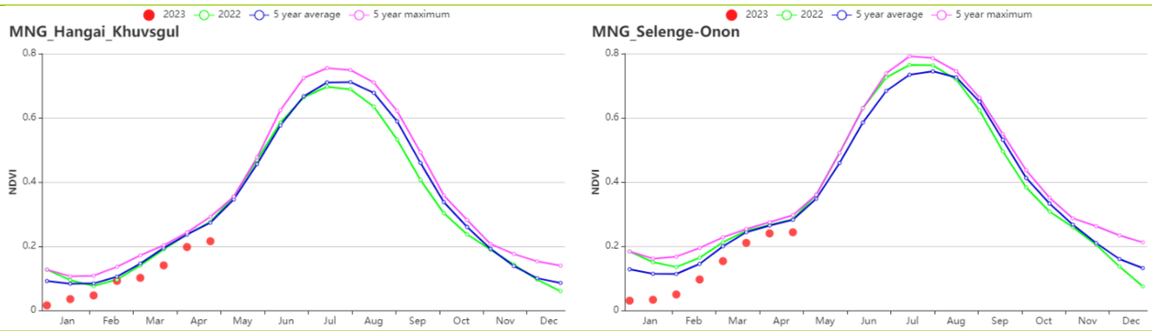




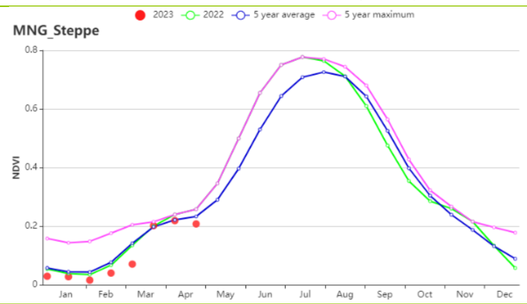
(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles



(f) Rainfall profiles (g) Temperature profiles



(h) Crop condition development graph based on NDVI (Hangai Khuvsgul Region (left) and Selenge-Onon Region (right))



(i) Crop condition development graph based on NDVI (Central and Eastern Steppe)

Table 3.51 Mongolia's agroclimatic indicators by sub-national regions, current season's values, and departure from 15YA, January - April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m2)	Departure (%)	Current (gDM/m2)	Departure (%)
Hangai Khuvsgul Region	53	-21	-13.3	0.4	806	1	117	-13
Selenge-Onon Region	71	3	-11.0	0.5	791	1	159	-3
Central and Eastern Steppe Region	67	3	-10.7	1.0	812	0	179	12
Altai Region	72	-39	-11.6	0.8	757	2	138	-2
Gobi Desert Region	50	-18	-10.3	1.7	766	2	124	1

Table 3.52 Mongolia's agronomic indicators by sub-national regions, current season's values, and departure from 5YA, January - April 2023

Region	Cropped arable land fraction		Maximum VCI
	Current (%)	Departure (%)	Current
Hangai Khuvsgul Region	1	-65	0.57
Selenge-Onon Region	1	-61	0.67
Central and Eastern Steppe Region	0	21	0.83
Altai Region	0	-100	0.36
Gobi Desert Region	0	59	0.43

[MOZ] Mozambique

The monitoring period from January to April focuses on tracking the key growth stages of crops, such as maize and rice, in the central and northern regions of the country. In contrast, both crops have already been fully harvested in the southern region during this period. Wheat sowing commenced in late January, and its harvesting is projected to begin in late May and continues until late June.

During this period, which aligns with the rainy and cyclone season across the country, the agroclimatic indicators show an increase in the total amount of rainfall (+16), while both temperature and photosynthetic active radiation experienced decreases of 0.2ºC and 2% respectively. These combined factors led to a 3% increase in total biomass production. However, despite these favorable agroclimatic indicators, the NDVI based crop condition development graph indicates crop growth was close to or slightly below average during most of the monitoring period, especially from mid-February to early April when NDVI was relatively more low. The severe floods that occurred in February, primarily affected the southern region, including Maputo city and the districts of Boane, Matola, Namaacha, and Magude in the Maputo province. These regions exhibited low values of the maximum vegetation index. Another contributing factor to the poor crop conditions during this period was Tropical Cyclone Freddy, which struck the country, impacting the provinces of Zambezia, Nampula, Sofala, and Niassa in February. This timing coincided with the peak growth period of most crops. The Spatial NDVI patterns and the NDVI profiles reveal that approximately 49.3% of crop conditions were below the average of the past five years, with a notable emphasis on the provinces of Zambezia, Tete, Nampula, Sofala, and Maputo. The remaining about half of the arable land has slightly above average crop growth (light green areas). The cropped arable land fraction being consistent with the average of the past five years, and a recorded maximum VCIx of 0.95. and the crop production index in the country stands at 1.17, the anticipated yields during this period are not promising, especially in the regions affected by tropical cyclones can still not be ignored.

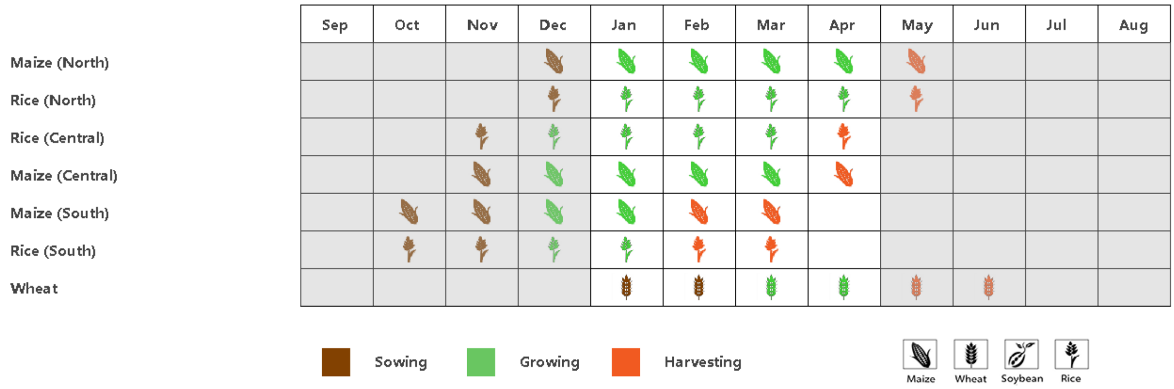
Regional analysis

Based on the national cropping system, topography, and climate, CropWatch has subdivided Mozambique into five agroecological zones (AEZs) including the Buzi basin (140), Northern High-altitude areas (141), Low Zambezi River basin (142), Northern coast (143), and the Southern region (144).

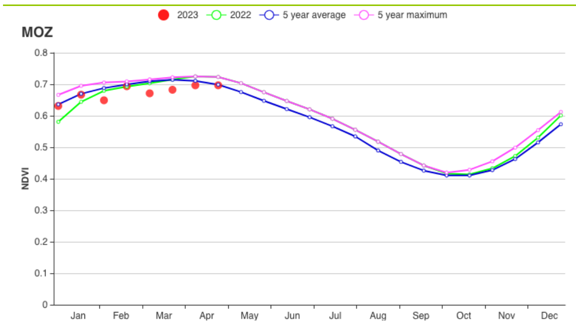
Att the regional level, the agroclimatic indicators reveal increases in rainfall in most of the agroecological zones, except for the Buzi basin (RAIN -5). The most significant increase in rainfall was recorded in the southern region (RAIN +68%), while the remaining regions experienced rainfall increases of 13% on the Northern coast, 12% in the Low Zambezia River basin, and 1% in the Northern-high altitude areas. Temperatures were generally close to average for all regions, decreased by 0.3ºC in the Northern-high altitude areas and the Low Zambezia River basin, 0.2ºC in the Northern coast, and 0.1ºC in the southern region. In the Buzi basin, the temperature increased by 0.2ºC. Except for the Buzi basin and the southern region, radiation decreased in all remaining zones, with the highest decrease of 4% recorded in the Northern-high altitude areas. The total biomass production decreased by 2% in the Buzi basin which was affected by low precipitation, while the remaining regions experienced increases, with the highest being recorded in the southern region (BIOMSS +8%).

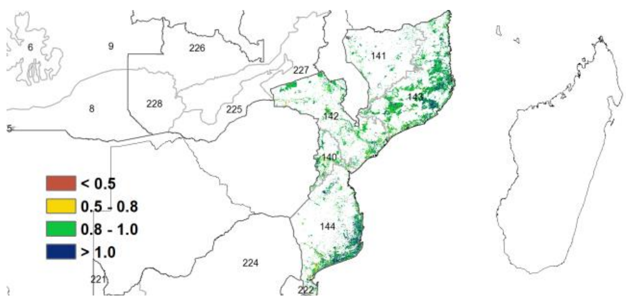
The regional crop condition development graphs indicate that, except for the southern region, all other regions experienced unfavorable crop conditions throughout the monitoring period. Despite the significant increases in rainfall and the occurrence of floods in Maputo city and the Maputo province, the crop conditions in the southern region were favorable, likely influenced by the favorable conditions recorded in other provinces such as Inhambane and Gaza. With CALF around the average in all the agroecological zones, the maximum VCIx recorded during the monitoring period varied from 0.92 to 0.97, and the CPI also exhibited higher values ranging from 1.12 to 1.17, which is generally similar to last year.

Figure 3.31 Mozambique's crop condition, January - April 2023



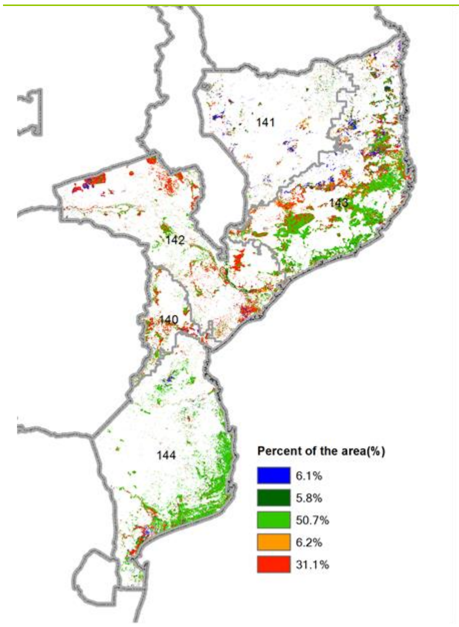
(a) Phenology of major crops

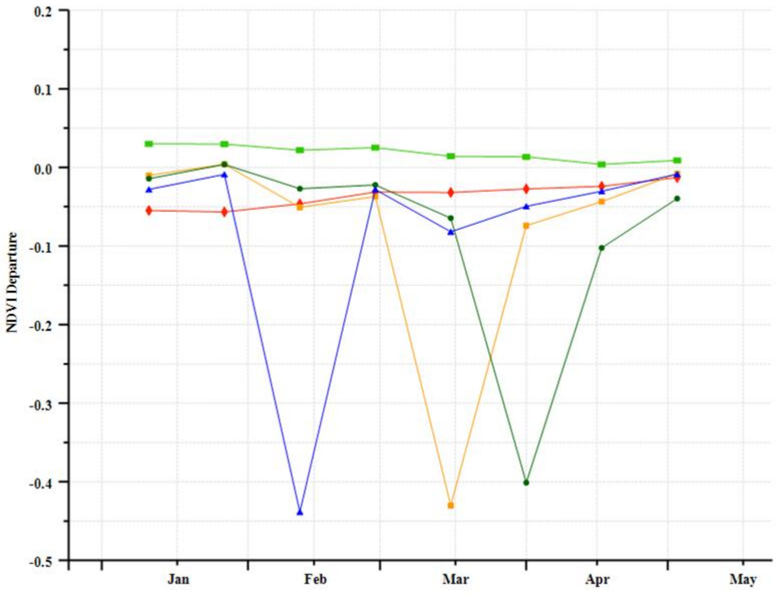




(b) Crop condition development graph based on NDVI

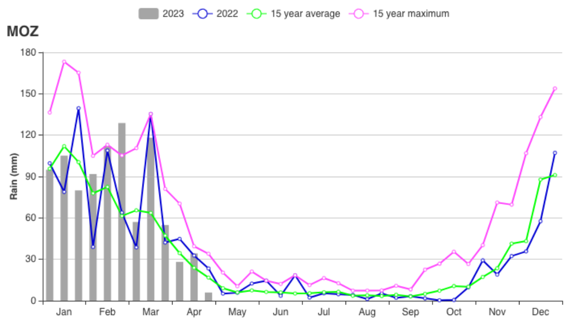
(c) Maximum VCI

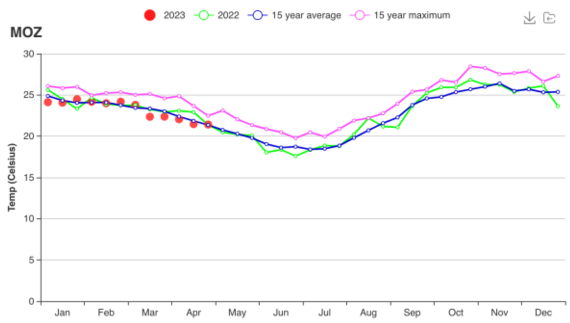




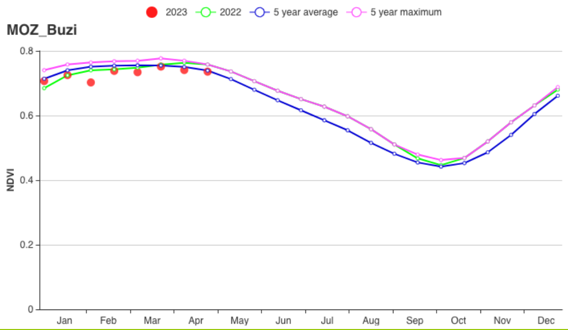
(d) Spatial NDVI patterns compared to 5YA

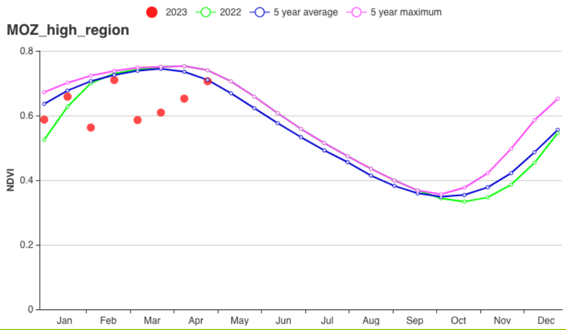
(e) NDVI profiles



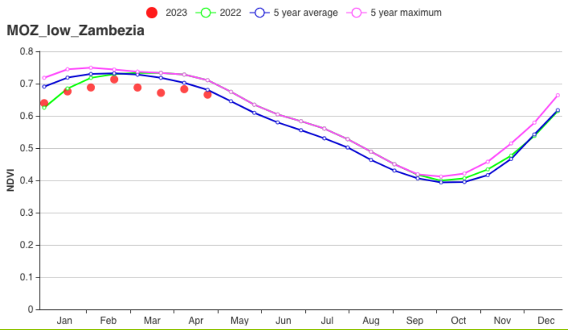


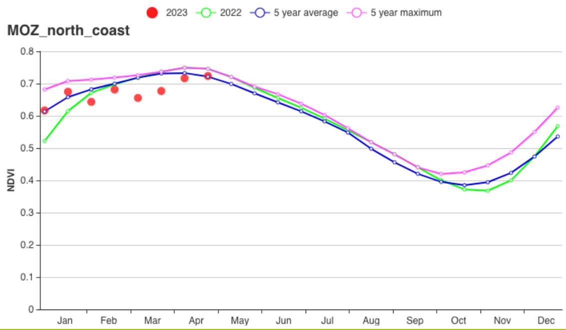
(f) National time-series rainfall profiles (g) National time-series temperature profiles



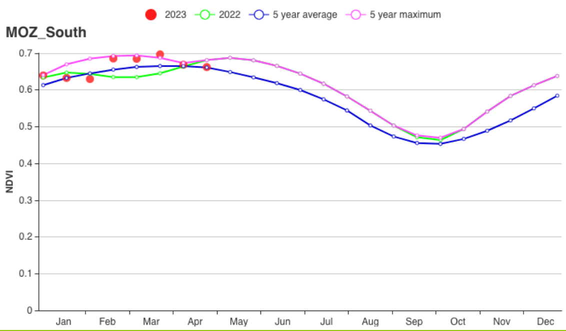


(h) Crop condition development graph based on NDVI-Buzi basin (left), and Northern high-altitude areas (right)





(i) Crop condition development graph based on NDVI-Lower Zambezi River basin (left), and Northern coast region (right)



(j) Crop condition development graph based on NDVI-Southern region

Table 3.53 Mozambique's agroclimatic indicators by sub-national regions, current season's values, and departure from 15YA, January - April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Buzi basin	670	-5	21,7	0,2	1243	0	1134	-2
Northern high-altitude areas	1034	1	21,6	-0,3	1092	-4	1384	2
Low Zambezia River basin	892	12	23,0	-0,3	1168	-2	1265	1
Northern coast	1002	13	23,6	-0,2	1178	-3	1467	3
Southern region	800	68	24,6	-0,1	1215	0	1148	8

Table 3.54 Mozambique's agronomic indicators by sub-national regions, current season's values, and departure from 15YA, January - April 2023

Region	Cropped arable land fraction		Maximum VCI
	Current (%)	Departure (%)	Current
Buzi basin	100	0	0,93
Northern high-altitude areas	100	0	0,95
Low Zambezia River basin	99	0	0,92
Northern coast	100	0	0,95
Southern region	100	0	0,97

[NGA] Nigeria

This report covers crop conditions for maize, wheat, and soybean in Nigeria between the months of January to April 2023. In this period, farmers completed the harvest of last year's crops and started with the land preparation for the new crops. Normally, the rains are expected to start fully by late March into early April. However, there was a late onset of rainfall across the country. Rainfall recorded during this period was below average (RAIN -41%). Rainfall in almost all the tendays was below average. Solar radiation did not deviate from the average (RADPAR 0%), but the temperature decreased (TEMP -0.5ºC). The temperatures fluctuated around the long-term trend. The combination of these indicators led to a decrease in potential biomass (BIOMSS -9%).

According to the NDVI development graph, crop conditions were fluctuating around the 5-year average for most of the monitoring period. According to the NDVI departure clustering map, 51.4% of the cropland was below average throughout the monitoring period, 37.2% predominantly in the Sahel and Sudan Savannah was slightly above average, while the coastal areas in southern of the area were unstable, but still above the average. These fluctuations are most likely artifacts, caused by cloud cover in the satellite images. The dry season saw a decline in the cropped arable land (CALF -2%), but with a favorable maximum VCI value of around 0.83. The crop Production Index (CPI) was 1.10. All in all, conditions were near average during this dry period, but still below the last year. However, the rainy season started with a delay, which impacts the land preparation and sowing of the crops.

Regional Analysis

The analysis focuses on nine(9) agro-ecological zones in the country transiting from North to South, i.e., Sahel Savannah(153), Sudan Savannah(154), Guinea Savannah(148), Derived Savannah(146), Jos Plateau(149), Mountain Forest(152), Lowland Rainforest(150), Freshwater Swamp Forest(147) and Mangrove Forest(151).

The Sahel Savanah is found in the north-eastern part of the country, followed by the Sudan Savanah, which stretches across the entire northern region. The Guinea savannah is the largest, which is a transition between the Sudan Savanah and the Derived Savanah, covering a large portion of the central part of the country. The Derived Savanah, Fresh Water Swamp, Rain Forest and Mangrove Forest are all located in the southern part of the country. While the Jos Plateau and the Mountain Forest are also located in the central part of the country.

In the **Sahel Savanah** zone, the agro-climatic indicators showed unfavorable crop conditions. Rainfall (RAIN -93%) and the average temperature were below average (TEMP -1.0°C), radiation also decreased (RADPAR -1%), leading to decrease in potential biomass (BIOMSS -27%). There was almost no rainfall during this period, so the cropping activities was few.

In the **Sudan Savannah**, the region adopts similar agricultural practices as the Sahel Savanah zone. The agro-climatic condition also showed a drastic decline in rainfall (RAIN -78%). The temperature and radiation were also below average (TEMP -0.7°C, RADPAR -1%). Potential biomass was close to average (BIOMSS -1%) and CALF increased by 49%. Due to the extreme drought, there was almost not any cropping activities during this period.

The **Guinea Savannah** zone also recorded below average rainfall and temperature (RAIN -73%, TEMP -0.5°C), while radiation did not deviate from average (RADPAR 0%), potential biomass also decreased (BIOMSS -12%). The CALF was lower than average by -6% and the maximum VCI was 0.77. The NDVI development graph also shows that crop conditions in the area were on average for the most part of the period with a crop production index (CPI 1.21) above normal.

The **Mountain Forest** which covers a very small portion in the central part of the country, recorded below average rainfall and temperature of (RAIN -75%, TEMP -0.8°C), while radiation increased to (RADPAR 1%), and biomass dropped down to (BIOMSS -24%). The CALF was -1% and the maximum VCI was 0.84.

The **Jos Plateau**, also located in the central region recorded below average rainfall (RAIN -80%), temperature (TEMP -0.5°C), while the radiation was average (RADPAR 0%) and potential biomass was below average

(BIOMSS -14%). The CALF was reduced by -7% and the maximum VCI was 0.72. The crop conditions were also average for the most part of the period with crop production index being slightly below normal (CPI 0.94).

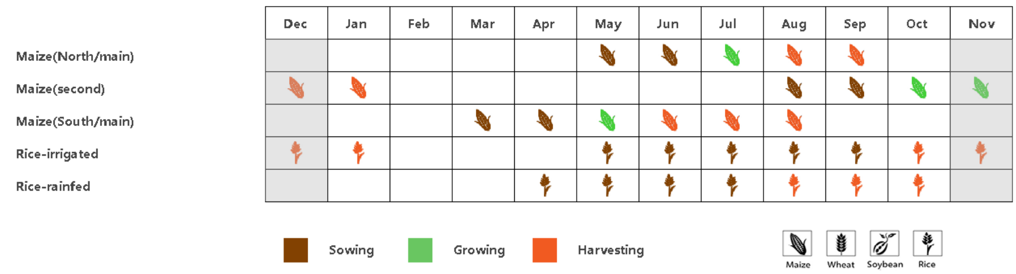
The **Derived Savanah** region also recorded a decreased rainfall and temperature (RAIN -54%, TEMP -0.2°C), with radiation unchanged (RADPAR 0%) and potential biomass was below average (BIOMSS of -14%). CALF was -3% and the maximum VCI was at 0.90, while the crop production index (CPI 1.03) was near normal.

The **Lowland Rain Forest** also recorded a decrease in rainfall at (RAIN -31%), and temperature was below average (TEMP -0.2°C). The radiation was unchanged (RADPAR 0%) and the biomass was lower (BIOMSS -12%). The CALF was unchanged and the maximum VCI was 0.97. The crop production index (CPI 1.16) was above normal, while the NDVI crop conditions were below average.

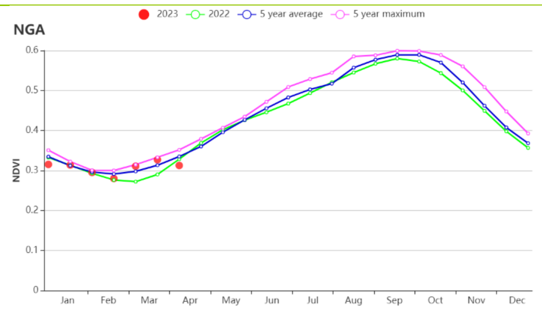
The **Fresh Water Swamp Forest** is located in the southern region of the country covering a small area. Rainfall in this area was below average (RAIN -22%). Temperatures were slightly lower as well (TEMP -1°C), while radiation fell by -1%, and biomass also dropped (BIOMSS -10%). The CALF was below average by -1% and the maximum VCI was 0.86. The crop conditions in this flooded region were fluctuating. The flood caused by the phased heavy rainfall from April impacted the crop condition, which was below the average.

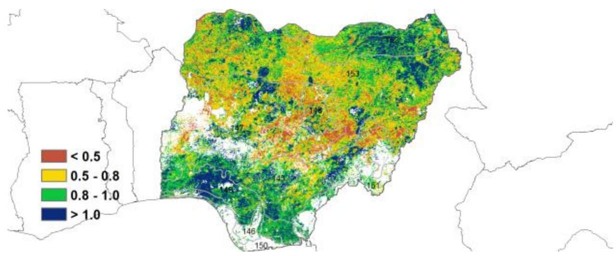
The **Mangroove Forest**, also located in the southern region of the country, recorded below average rainfall (RAIN -21%), the temperature was lower (TEMP -0.3°C) and radiation was unchanged (RADPAR 0%) which resulted in a decrease in biomass (BIOMSS -10%). The CALF was 1% above average, and the maximum VCI was 0.94.

Figure 3.32 Nigeria's crop condition, January-April 2023



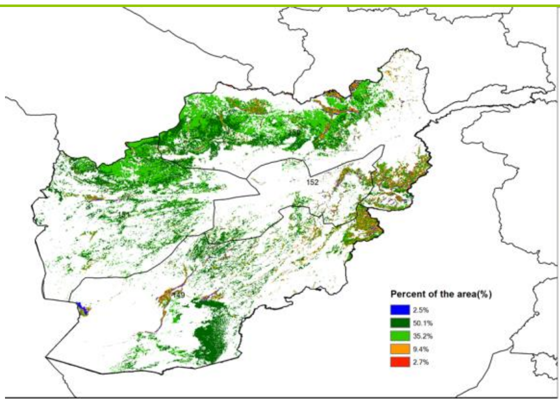
(a) Phenology of major crops

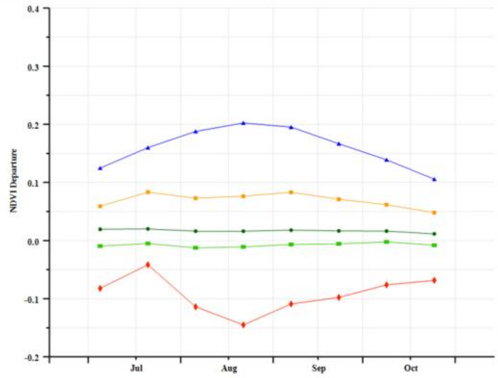




(b) Crop condition development graph based on NDVI

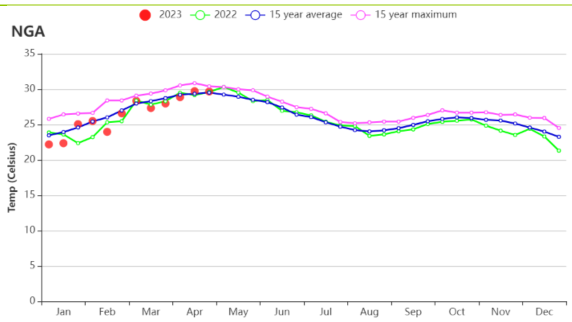
(c) Maximum VCI

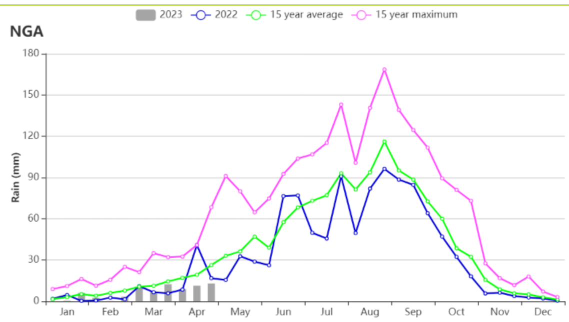




(d) Spatial NDVI patterns compared to 5YA

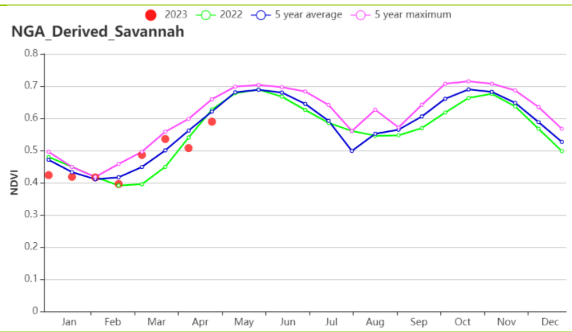
(e) NDVI profiles

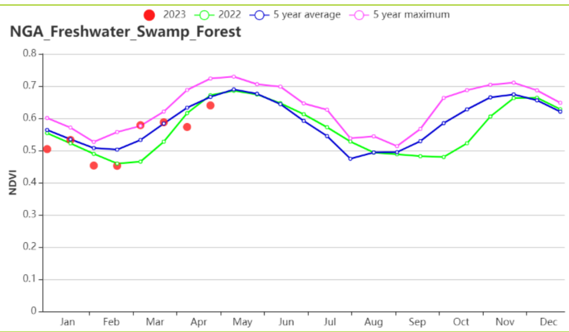




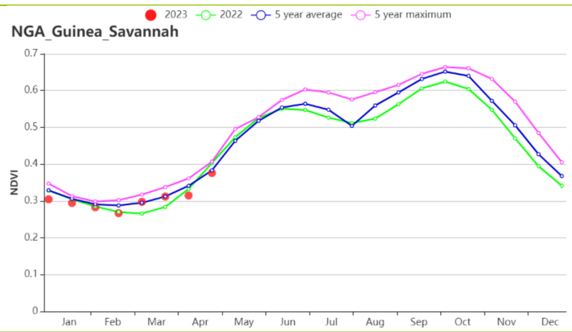
(f) Time series temperature profile

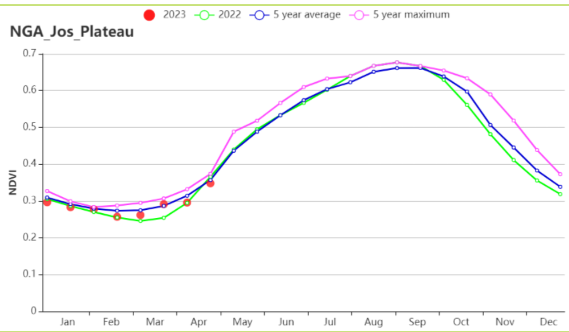
(g) Time series rainfall profile



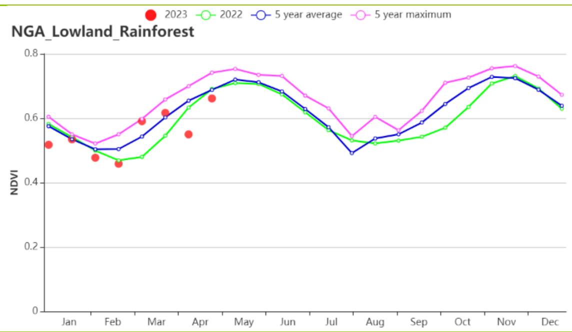


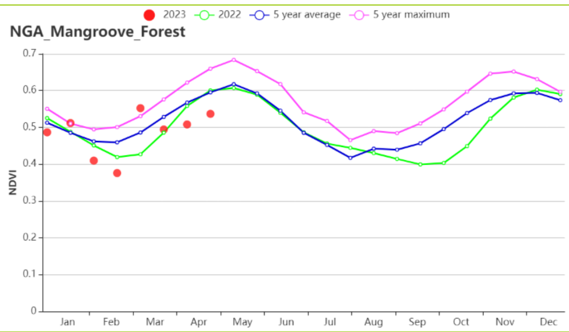
(h) Crop condition development graph based on NDVI(Left:Derived Savannah(146), Right:Freshwater Swamp(147))



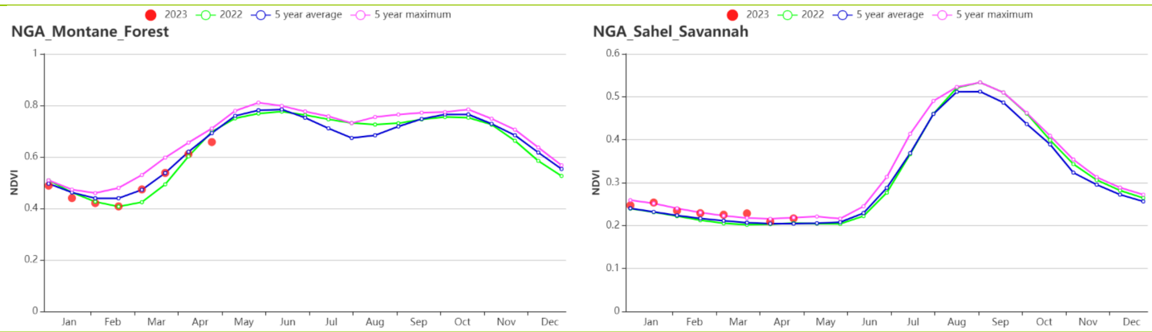


(i) Crop condition development graph based on NDVI(Left:Guinea savannah(148), Right:Jos Plateau(149))

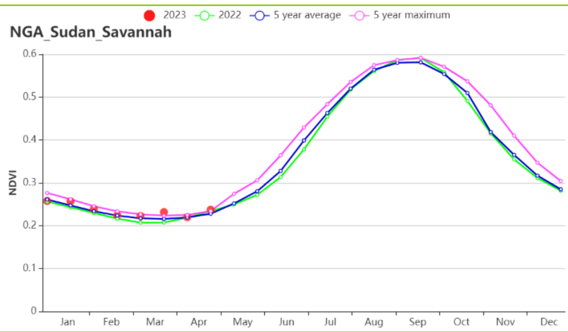




(j) Crop condition development graph based on NDVI(Left:Low Land Rainforest(150), Right:Mountain Forest(151))



(k) Crop condition development graph based on NDVI(Left:Mangroove Forest(152), Right:Sahel savannah(153))



(l) Crop condition development graph based on NDVI:Sudan Savannah(154)

Table 3. 55 Nigeria's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, January - April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Derived Savannah	70	-54	28.1	-0.2	1270	0	584	-14
Freshwater Swamp Forest	398	-23	26.9	-0.2	1293	1	1038	-10
Guinea Savannah	15	-73	26.8	-0.5	1350	0	481	-12
Jos Plateau	7	-80	23.5	-0.5	1399	0	427	-14
Lowland Rainforest	256	-31	26.9	-0.2	1272	0	860	-12
Mangroove Forest	538	-21	26.7	-0.3	1308	0	1134	-10
Montane Forest	49	-75	22.6	-0.8	1389	1	513	-24
Sahel Savannah	0	-93	25.1	-1.0	1360	-1	167	-27
Sudan Savannah	4	-78	25.7	-0.7	1372	-1	400	-1

Table 3. 56 Nigeria's agronomic indicators by sub-national regions, current season's values and departure from 5YA, January - April 2023

Region	Cropped arable land fraction		Maximum VCI
	Current (%)	Departure (%)	Current
Derived Savannah	92	-3	0.90
Freshwater Swamp Forest	96	0	0.97
Guinea Savannah	29	-6	0.77
Jos Plateau	18	-7	0.72
Lowland Rainforest	98	0	0.97
Mangroove Forest	92	1	0.94

Region	Cropped arable land fraction		Maximum VCI
	Current (%)	Departure (%)	Current
Montane Forest	98	-1	0.84
Sahel Savannah	5	13	0.93
Sudan Savannah	2	49	0.80

[PAK] Pakistan

The monitoring period encompasses the majority of the winter wheat cycle, starting from the vegetative stage and extending up to harvest. It also encompasses field preparation and maize sowing. Agroclimatic and agronomic indicators indicated favorable crop conditions between January and April as a whole.

Rainfall is not the major factor influencing crop production in Pakistan, primarily due to the high proportion of irrigated cropland, which accounts for 80% of the total. In comparison to the average from the past 15 years (15YA), the recent rainfall was 11% below average, while the photosynthetically active radiation (RADPAR) was 2% below average. However, the air temperature (TEMP) during this period was above average, with an increase of 0.7℃. The combined effect of these agroclimatic indicators resulted in an above-average biomass (BIOMSS) production by 2%. At the national level, the rainfall during the period from mid-February to mid-March remained consistently below average. TEMP during the same period reached or exceeded the maximum values observed in the past 15 years. The combination of drier and warmer weather conditions led to below-average development of NDVI. However, TEMP has dropped below the average level and significantly lower than the extreme high temperatures of last year starting in mid March, it caused a delay in senescence, which in turned helped sustain relatively high grain yields.

The spatial distribution of NDVI patterns and profiles revealed that 46.9% of the cropped areas were below average, particularly in the Northern Highlands, most parts of Punjab, and Sindh from late January to early April. Despite experiencing relatively warm weather in early March, conditions for high grain yields were rather favorable for Punjab, the most important wheat production region of Pakistan. The fraction of cropped arable land (CALF) slightly decreased by 2%. Overall, crop conditions were average and normal wheat production levels can be expected, and the production is better than last year.

Regional analysis

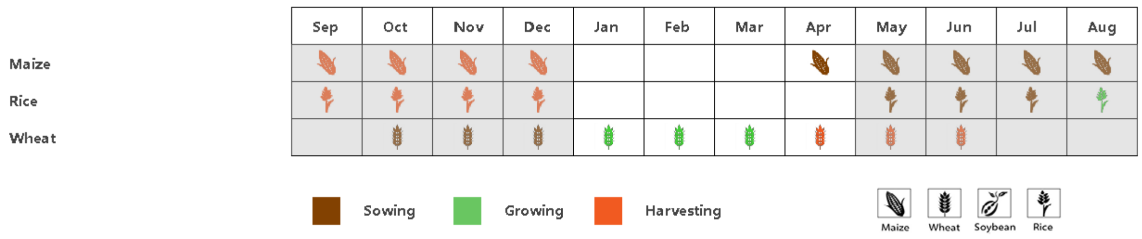
For a more detailed spatial analysis, CropWatch divides Pakistan into three agroecological regions based on geography and agroclimatic conditions: the Lower Indus river basin in South Punjab and Sindh(155), the Northern Highlands(156) and the Northern Punjab(157).

In the Lower Indus River basin in South Punjab and Sindh, RAIN was above average by 45% and TEMP was above by 0.2℃, while RADPAR was below average by 2%. The estimated BIOMSS departure was +7%. Crop conditions based on NDVI were below average from late January to early March, indicating unfavorable conditions, but improved to above average during the subsequent critical growth period. It was aided by adequate rainfall. The CALF of 65% was below average by 2%. Overall, the prospects were satisfactory.

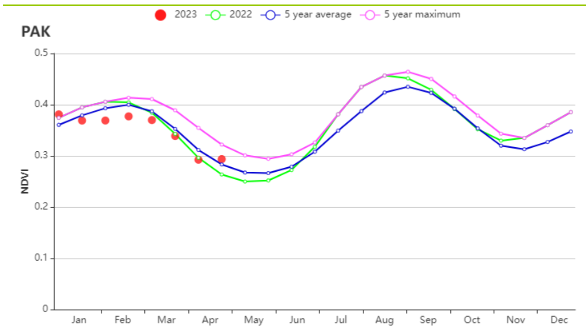
RAIN (-19%) and RADPAR (-2%) of Northern Highlands were both below average, TEMP was above average by 1.2℃. The region experienced warmer and drier weather, and the estimated BIOMSS departure was -3%. The NDVI development graph shows below-average crop conditions except for early January and late April, especially in the north. This region had the lowest CALF of 48% among the three AEZs. It was below the 5YA by 4%. Crop conditions were below average.

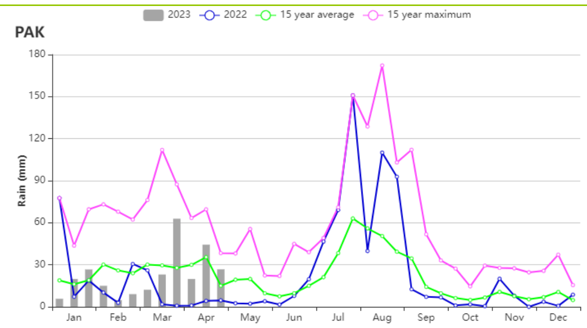
Northern Punjab is the main agricultural region in Pakistan. It recorded more rainfall than usual (RAIN +16%). TEMP (+0.1℃) was slightly above average and RADPAR (-3%) was below average. The combination of these factors resulted in above-average estimates of BIOMSS by 7% compared to the recent fifteen-year average. The NDVI development graph shows above average crop conditions in January and late March to April. The region had a CALF of 86%, which was slightly below the 5YA by 1%. Favorable crop conditions during the critical grain filling period caused an increase in wheat production as compared to last year.

Figure 3.33 Pakistan crop condition, January - April 2023



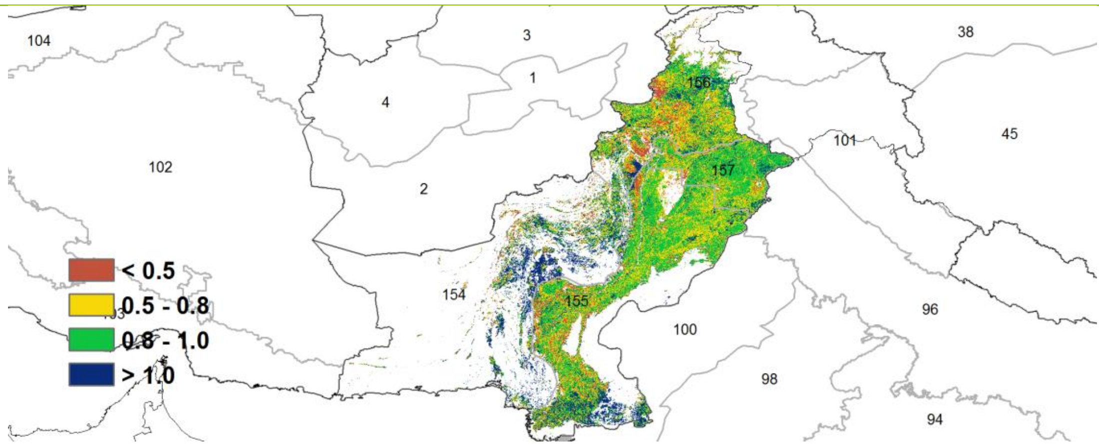
(a) Phenology of major crops



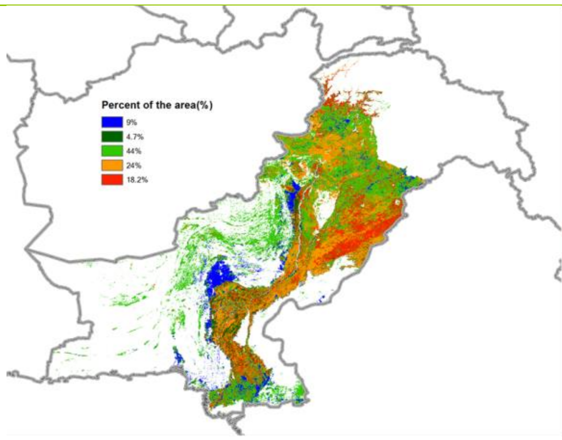


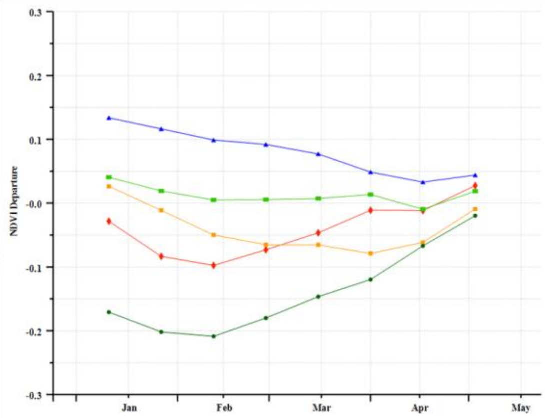
(b) Crop condition development graph based on NDVI

(c) Time series precipitation profile



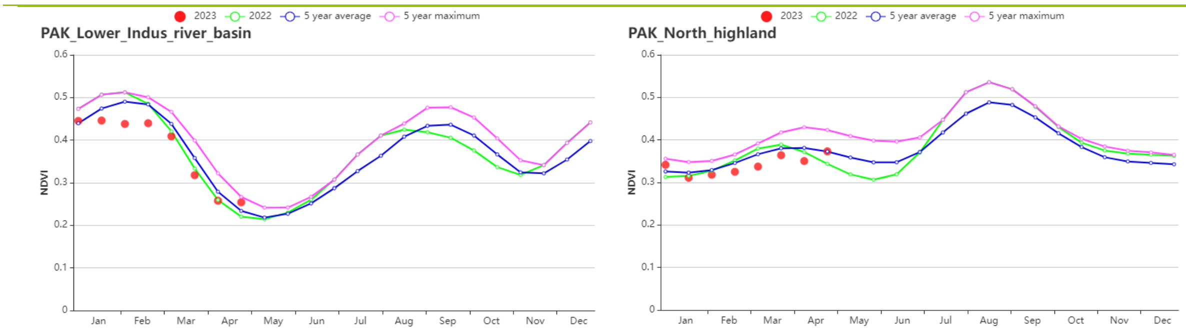
(d) Maximum VCI



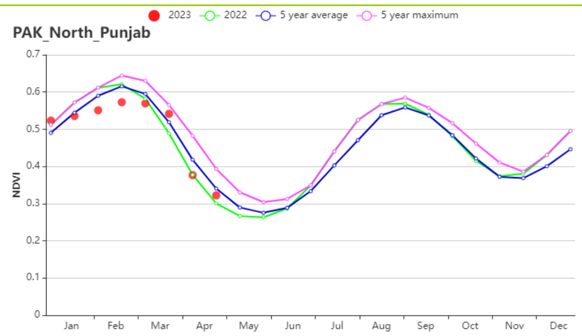


(e) Spatial NDVI patterns compared to 5YA

(f) NDVI profiles



(g) Crop condition development graph based on NDVI in Lower Indus river basin in south Punjab and Sind (left) and Northern Highland(right)



(h) Crop condition development graph based on NDVI in Northern Punjab

Table 3.57 Pakistan's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, January - April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (℃)	Departure (℃)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Lower Indus river basin	74	45	22.5	0.2	1141	-2	477	7
Northern highlands	360	-19	9.2	1.2	930	-2	495	-3
Northern Punjab	237	16	18.4	0.1	987	-3	630	7

Table 3.58 Pakistan's agronomic indicators by sub-national regions, current season's values and departure from 5YA, January - April 2023

Region	Cropped arable land fraction		Maximum VCI
	Current (%)	Departure (%)	Current
Lower Indus river basin	65	-2	0.83
Northern highlands	48	-4	0.76
Northern Punjab	86	-1	0.83

AFG AGO ARG AUS BGD BLR BRA CAN DEU DZA EGY ETH FRA GBR HUN IDN IND IRN ITA KAZ KEN KGZ KHM LKA MAR MEX MMR MNG MOZ NGA PAK **PHL** POL ROU RUS SYR THA TUR UKR USA UZB VNM ZAF ZMB

[PHL] Philippines

This report covers the second season rice and maize planting and harvesting periods, while the main season maize and rice sowing started in April. The Philippines experienced significantly wetter weather conditions during this monitoring period. Compared to the same period in the past 15 years, cumulative precipitation (RAIN) was higher (+41%), while average temperatures (TEMP) were about 0.3°C cooler and radiation (RADPAR) slightly lower (-3%). Abundant precipitation resulted in above-average potential biomass (BIOMASS) (+9%). However, more rainfall does not seem to have led to better crop conditions. The NDVI curve shows that the national NDVI was well below average until March, when the conditions started to improve. The significantly higher rainfall in January and February was associated with numerous typhoons in the Philippines, which brought heavy rainfall and flooding that adversely affected crop growth in the early part of the reporting period. Starting in March, conditions gradually improved. About 35.6% of the croplands (light green, dark green and orange) had varying NDVI levels in January or February. They were mainly located in the eastern Mindoro and Samar. Some of these fluctuations might have been due to cloud cover in the satellite images and flooding. Considering that the CALF is close to 100% and that the VCIx is as high as 0.94, and the CPI is 1.16, it is estimated that the second season maize and second season rice production in the Philippines is normal.

Regional analysis

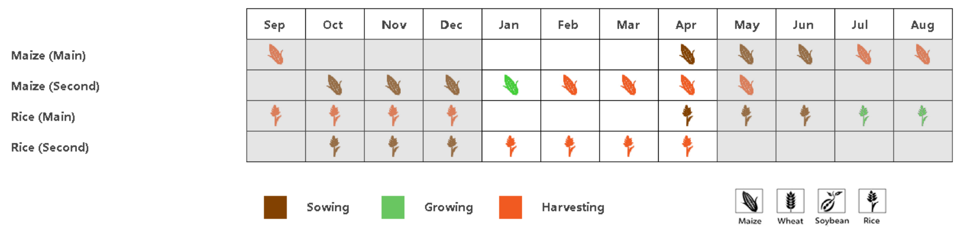
Based on the cropping systems, climatic zones, and topographic conditions, three main agro-ecological regions can be distinguished for the Philippines. They are **the Lowlands region** (northern islands), **the Hilly region** (Island of Bohol, Sebu, and Negros), and **the Forest region** (mostly southern and western islands).

In the **Lowland region** (agroecological subzone 155), cumulative precipitation (RAIN) was 26% higher, while the temperature (TEMP) and radiation (RADPAR) were 0.4°C and 4% lower, respectively. Sufficient rainfall resulted in an above-average potential biomass (BIOMASS) of about 7%. The NDVI trend line was well below average. After March, the situation was much better than before, although NDVI was still below average. In addition, the district had a 100% cropped area (CALF), an VCIx of 0.92 and a CPI of 1.14, indicating generally normal crop growth in the area.

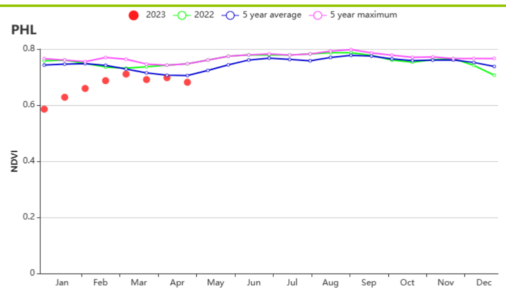
In the **Hilly region** (agroecological subzone 154), cumulative precipitation (RAIN) increased by 57%, average temperatures (TEMP) were 0.6°C cooler and radiation (RADPAR) decreased by 3%. Despite the high rainfall, which resulted in an increase in potential biomass (BIOMASS) of about 17%, the NDVI of crops in this zone was also well below average until March, after which it improved to average levels. The district has 100% arable land (CALF), a VCIx of 0.97 and a CPI of 1.18, indicating generally normal crop growth.

In **Forest region** (agroecological subzone 153), cumulative precipitation (RAIN) increased by about 46%, resulting in a 9% bias in potential biomass (BIOMASS). Average temperatures (TEMP) in this zone were 0.1°C lower and radiation (RADPAR) was also 3% lower. Despite the significant increase in precipitation, NDVI in this zone was also significantly below average until March. It returned to normal levels after March. With almost 100% (CALF) of the area under cultivation, a VCIx of 0.96 and a high CPI of 1.14, crop growth in the area is expected to be generally normal.

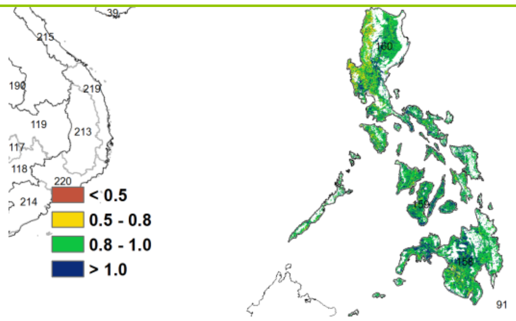
Figure 3.34 Philippines' crop condition, January – April 2023



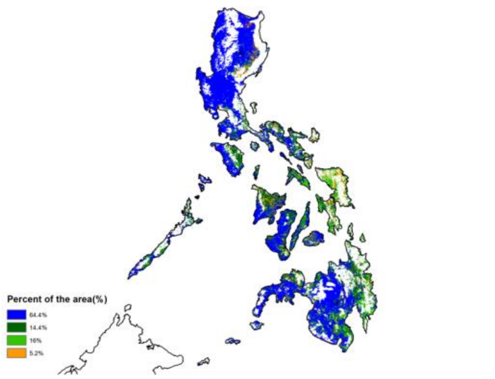
(a) Phenology of major crops



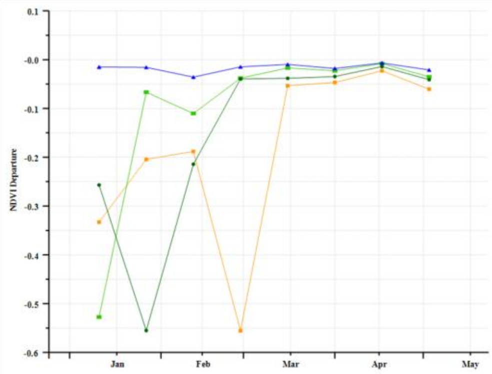
(b) Crop condition development graph based on NDVI



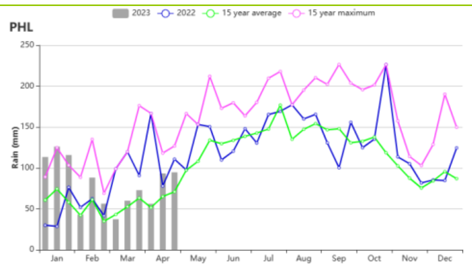
(c) Maximum VCI



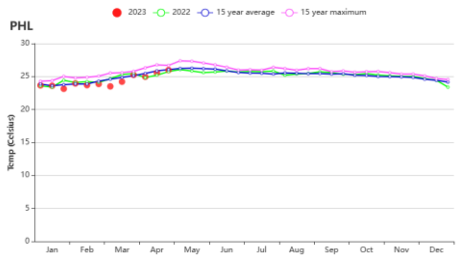
(d) Spatial NDVI patterns compared to 5YA



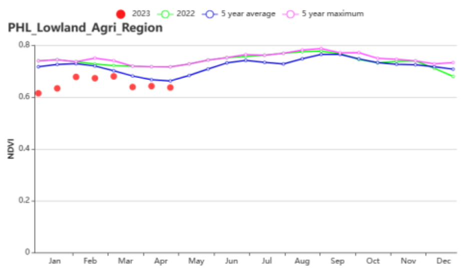
(e) NDVI profiles

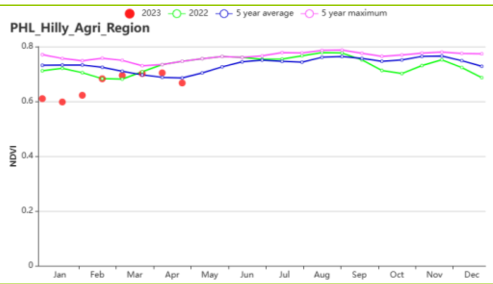


(f) Rainfall profiles

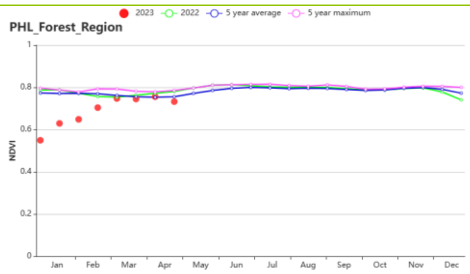


(g) Temperature profiles





(h) Crop condition development graph based on NDVI (Lowland Region (left) and Hilly Region (right))



(i) Crop condition development graph based on NDVI (Forest Region)

Table 3.59 Philippines' agroclimatic indicators by sub-national regions, current season's values, and departure from 15YA, January – April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m^2)	Departure (%)	Current (gDM/m^2)	Departure (%)
Forest region	1319	46	24.5	-0.1	1144	-3	1400	9
Hilly region	1055	57	25.7	-0.6	1218	-3	1434	17
Lowland region	573	26	23.9	-0.4	1075	-4	1044	7

Table 3.60 Philippines' agronomic indicators by sub-national regions, current season's values, and departure from 5YA, January – April 2023

Region	Cropped arable land fraction		Maximum VCI
	Current (%)	Departure (%)	Current
Forest region	100	0	0.96
Hilly region	100	0	0.97
Lowland region	100	0	0.92

[POL] Poland

Winter wheat, barley and rye are the main crops that were grown in Poland during this monitoring period. The planting of summer crops started in April. Compared to the average of the last 15 years, RAIN was 19% higher, TEMP was 1.0°C higher, and RADPAR was 14% lower. The potential biomass was 5% above average. The low values of NDVI in January can be attributed to snow or cloud cover in the satellite images. Sufficient precipitation and warmer-than-usual temperatures helped NDVI reach close to the 5-year average level in late February and surpass it in April. VCIx at the national scale was 0.91. Areas with a VCI below 0.8 were mainly distributed in the northwest, east and southeast regions. CALF reached 99%, which was 1% higher than the average of the last 5 years, and CPI was 1.16, indicating favorable crop growth conditions.

In general, benefiting from above average precipitation and temperatures, crop growth conditions were favorable and above average yield can be expected for the winter crops.

Regional analysis

Four agro-ecological zones (AEZ) are examined more closely below. They include the **Northern oats and potatoes areas** (163, the northern half of west Pomerania, eastern Pomerania and Warmia-Masuria), the **Northern-central wheat and sugar-beet area** (162, Kuyavia-Pomerania to the Baltic Sea), the **Central rye and potatoes area** (161, Lubusz to South Podlaskie and northern Lublin), and the **Southern wheat and sugar-beet area** (164) from southern Lower Silesia to southern Lublin and Subcarpathia along the Czech and Slovak borders. The listed administrative units correspond to the Voivodeships.

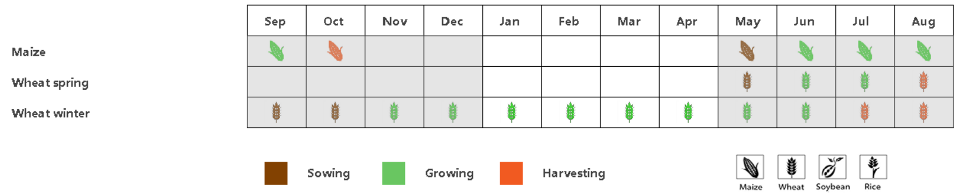
Precipitation and average temperature in the **Northern oats and potatoes areas** were above the average of the last 15 years (RAIN, +18%; TEMP, +1.3°C), RADPAR was 19% lower. These conditions resulted in a 6% increase in potential biomass. NDVI recovered to the 5-year average in late February but fell slightly below average again in early March and early April, then rising to the 5-year maximum in late April. CALF was 98%, which was 1% above the 5-year average. VCIx was 0.91, and CPI was 1.18, indicating good crop growth in this subregion.

Compared to 15-year average, RAIN and TEMP in the **Northern-central wheat and sugar-beet area** were 21% and 1.1°C higher, respectively, while RADPAR was 19% lower. BIOMSS increated by 6%. NDVI returned to the average for the same period in late February, but was significantly lower in early March, then slowly returned to the average again, and rose to 5-year maximum level in late April. CALF in this region reached 98%, which was 1% higher than the 5-year average. VCIx was 0.91 and CPI was 1.16, indicating that the crop growth conditions in this region were favorable and the yield was well expected.

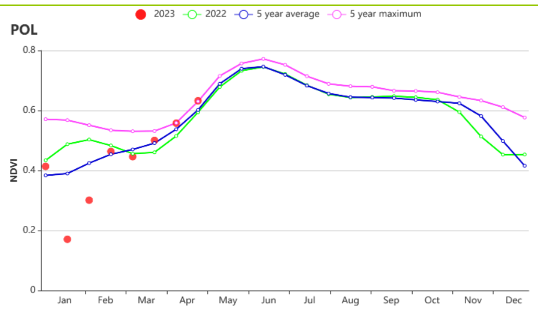
In the **Central rye and potatoes area**, rainfall was 19% above the 15-year average, TEMP was 1.1°C higher, RADPAR was 15% lower, and potential biomass was 6% higher. NDVI recovered to the 5-year average in late February and even reached the 5-year maximum level in April. CALF was 99%, close to the 5-year average. VCIx reached 0.91 and CPI was 1.11, indicating good crop growth in this region.

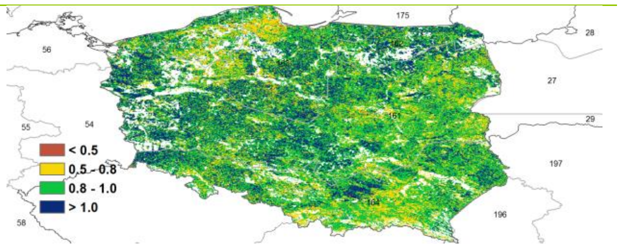
Precipitation in the **Southern wheat and sugar-beet area** was 19% above the average of the last 15 years, TEMP was 0.8°C higher, RADPAR was 10% lower, and potential biomass was 4% higher. NDVI recovered to the level of the previous year in late February, approached the 5-year average in March, rose above the 5-year maximum in early April, and was close to the 5-year average in late April. CALF in this subregion reached 99%, which was 1% higher than the 5-year average. VCIx was 0.89, and CPI was 1.17. The crop conditions in this subregion were favorable.

Figure 3.35 Poland's crop condition, January - April 2023

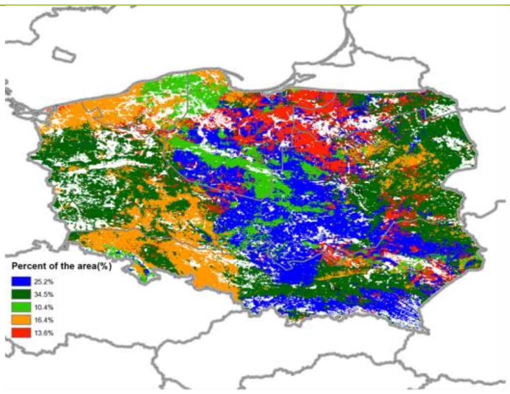


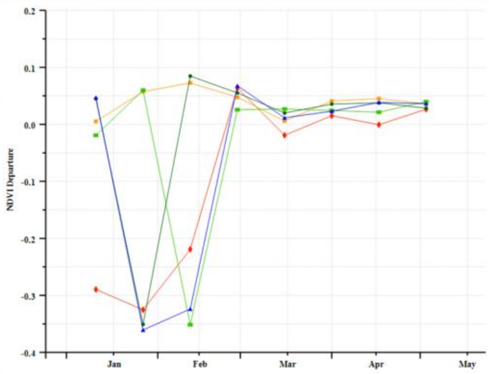
(a). Phenology of major crops



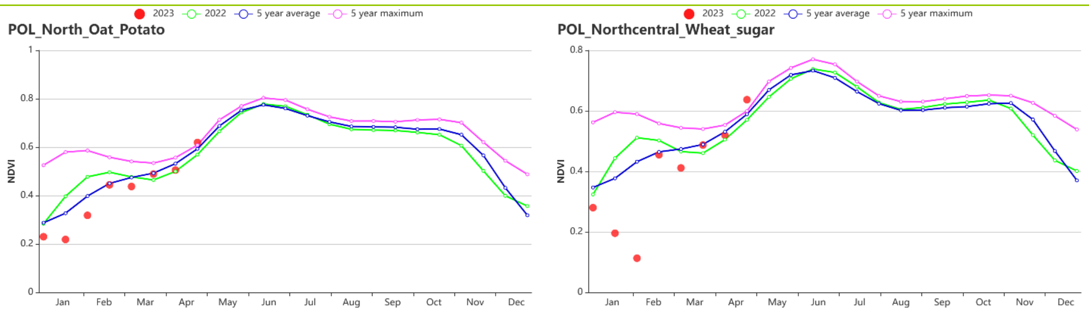


(b) Crop condition development graph based on NDVI (c) Maximum VCI

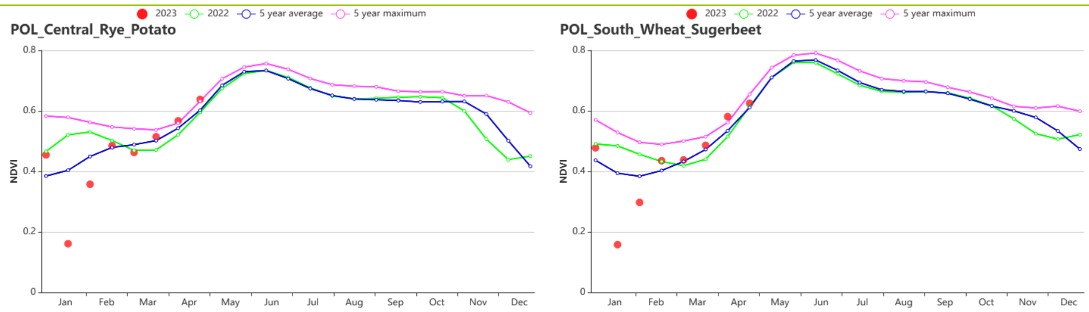




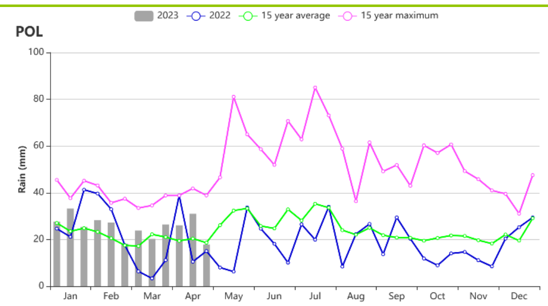
(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles



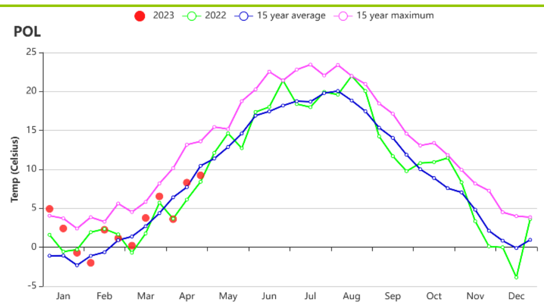
(f) Crop condition development graph based on NDVI, Northern oats and potatoes area (left) and Northern-central wheat and sugar beet area (right).



(g) Crop condition development graph based on NDVI, Central rye and potatoes area (left) and Southern wheat and sugar beet area (right)



(h) Rainfall index



(i) Temperature Index

Table 3.61 Poland's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, January - April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Northern oats and potatoes areas	313	18	3.2	1.3	359	-19	468	6
Northern-central wheat and sugarbeet area	287	21	3.6	1.1	373	-19	485	6
Central rye and potatoes area	301	19	3.7	1.1	395	-15	491	6
Southern wheat and sugarbeet area	314	19	2.7	0.8	461	-10	458	4

Table 3.62 Poland's agronomic indicators by sub-national regions, current season's values and departure from 5YA, January - April 2023

Region	Cropped arable land fraction		Maximum VCI
	Current	Departure (%)	Current
Northern oats and potatoes areas	98	1	0.91
Northern-central wheat and sugarbeet area	98	1	0.91
Central rye and potatoes area	99	0	0.91
Southern wheat and sugarbeet area	99	1	0.89

[ROU] Romania

Winter wheat is the main crop that is grown in Romania during this reporting period. It was sown last October. Sowing of maize and spring wheat started in April. During the reporting period, rainfall increased 13%, temperature increased 1.2℃, and solar radiation (RADPAR) decreased by 7%. The warm temperatures and increased rainfall helped increase the biomass by 7% above the 15YA. CALF increased by 4%, and the maximum VCI was 0.92. The NDVI temporal development shows that, except for early February, crop conditions were above the 5YA and close to the 5 year maximum. All in all, the conditions in Romania were above average..

Regional analysis

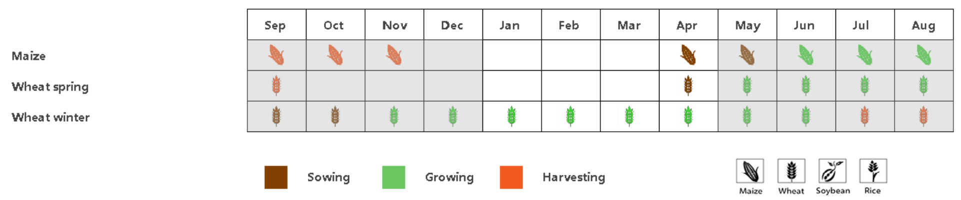
More spatial detail is provided below for the three main agro-ecological zones: the Central mixed farming and pasture Carpathian hills (165), the Eastern and southern maize, wheat and sugar beet plains (166) and the Western and central maize, wheat and sugar beet plateau (167).

For the Central mixed farming and pasture Carpathian hills, compared to the 15YA, radiation decreased by 7%, rainfall increased by 15% and temperature increased 1.2℃. BIOMSS increased by 7%. According to the NDVI development graph, crop conditions were above average until March and subsequently stayed close to the average trend. The regional average maximum VCI was 0.92. Regional CALF was 99%, which was 3% higher than average. The NDVI spatial distribution shows that NDVI was good throughout the reporting period. The CPI of this region is 1.19.

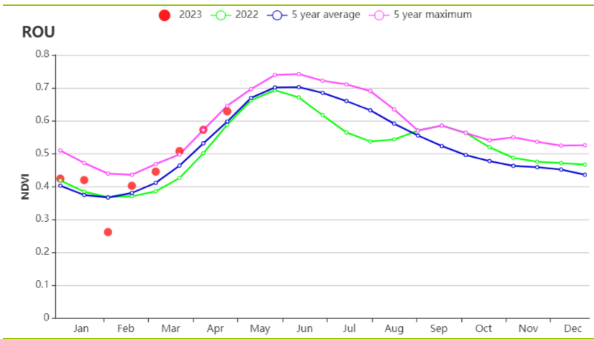
For the Eastern and Southern maize, wheat and sugar beet plains, rainfall increased by 9%, temperature increased by 1.7℃, radiation decreased by 7% and biomass increased by 8% as compared to the 15YA. The NDVI development graph shows that crop conditions were below average starting in January and above average after February. Regional CALF was 94% and 5% lower than average. Maximum VCI value of this region was 0.92. VCI values were above 0.80 in the southeast area of this sub-region (counties of Tulcea and Constanta), representing about 14.3% of the national cropland. The CPI of this region is 1.15. All in all, crop conditions can be assessed as slightly above average.

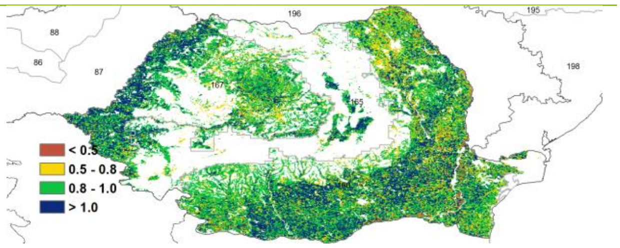
For the Western and central maize, wheat and sugar beet plateau, radiation was lower than average by 6%, temperature was 0.6℃ higher and rainfall was 16% higher and biomass increased by 6%. Spatial NDVI profiles show that crop conditions were above average throughout the reporting period. Regional CALF was 99%, 2% higher than average. Maximum VCI of this region was 0.93, and the spatial distribution was above 1.0 in most of the areas. The CPI of this region is 1.18. Crop conditions can be assessed as favorable.

Figure 3.36 Romania's crop condition, January - April 2023

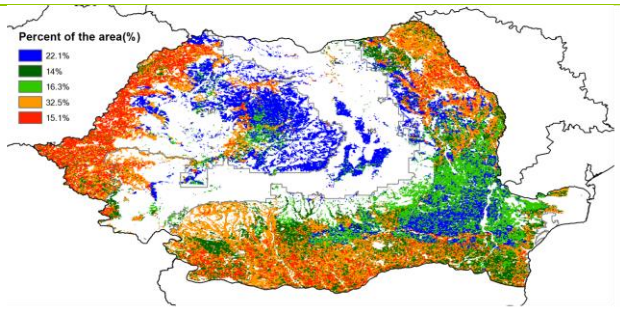


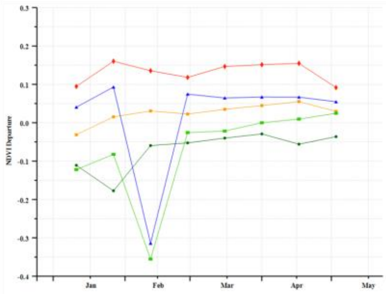
(a). Phenology of major crops



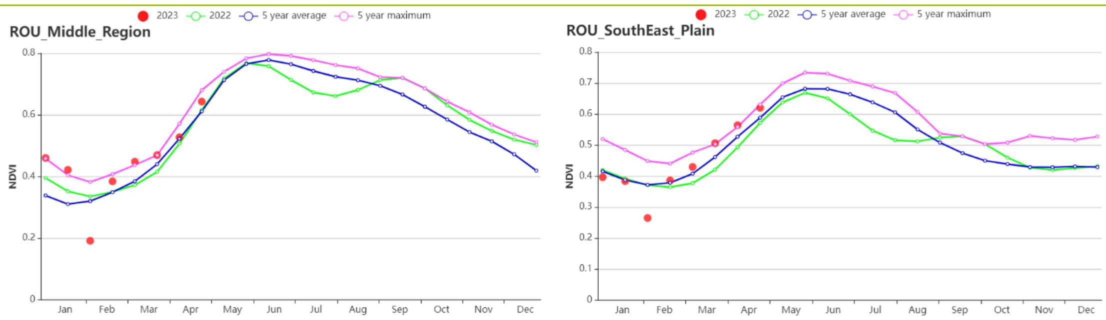


(b) Crop condition development graph based on NDVI (c) Maximum VCI

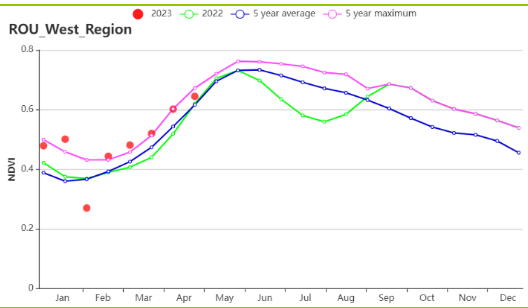




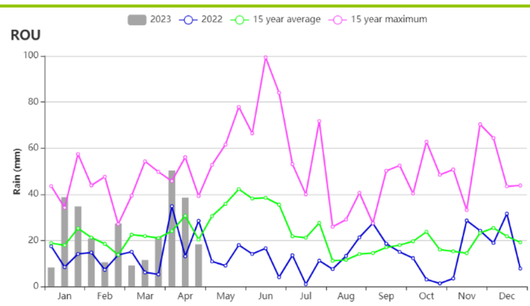
(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles

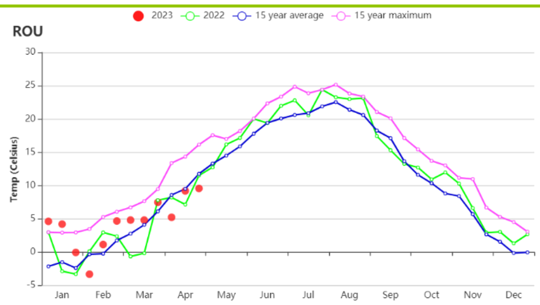


(f) Crop condition development graph based on NDVI (Central mixed farming and pasture Carpathian hills (left) and Eastern and southern maize, wheat and sugarbeet plains (right))



(g) Crop condition development graph based on NDVI (Western and central maize, wheat and sugar beet plateau)





(h) Rainfall index (i) Temperature Index

Table 3.63 Romania's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, January - April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Central mixed farming and pasture Carpathian hills	329	15	2.8	1.2	591	-7	452	7
Eastern and southern maize wheat and sugarbeet plains	260	9	5.4	1.7	611	-7	523	8
Western and central maize wheat and sugarbeet plateau	306	16	3.7	0.6	607	-6	495	6

Table 3.64 Romania's agronomic indicators by sub-national regions, current season's values and departure from 5YA, January - April 2023

Region	Cropped arable land fraction		Maximum VCI
	Current	Departure (%)	Current
Central mixed farming and pasture Carpathian hills	99	3	0.92
Eastern and southern maize wheat and sugarbeet plains	94	5	0.92
Western and central maize wheat and sugarbeet plateau	99	2	0.93

[RUS] Russia

In the Russian Federation, the snow starts to melt between February to May, depending on the region. Accordingly, the time of spring green-up and sowing of the summer crops varies from region to region as well.

At the national level, NDVI was mainly close to the 5-year average and the level of the previous year. Precipitation in January as well as at the beginning of February and April was mainly below the 15-year average and the level of the previous year, while in March and at the end of April it was mainly above both those levels. The air temperature mainly remained above the 15-year average values. RADPAR was by 5 % below the 15-year average. Biomass exceeded the 15-year average by 10 %. CPI was 1.28.

Most major regions of winter crop production showed positive NDVI departures since March with VCIx varying from below 0.5 to above 1. Winter crop yields are expected to be close to the level of the previous year or slightly above it. However, the agroclimatic conditions of the rest of the growing period are important and may still affect the yield of winter crops.

Regional analysis

Precipitation in Southern Caucasus (176) was by 6% below the 15-year average. Temperatures were 0.5°C above the 15-year average. RADPAR was by 2% below the 15-year average. Biomass was equal to the 15-year average. VCIx was 0.85. The cropped area was equal to the 5-year average. CPI was 1.12. NDVI was below the 5-year average and the level of the previous year until the end of March, when it reached average levels. As the general situation was close to the average, we expect winter crop yields to be close to the level of the 5-year average.

In **North Caucasus** (174) atmospheric precipitation and temperatures were above the 15-year average by 3% and by 1.3°C respectively. RADPAR was 10% below the 15-year average. Biomass was by 9% above the 15-year average. VCIx was 0.89. The cropped area was by 15% above the 5-year average. CPI was 1.24. NDVI was below the 5-year average and the level of the previous year until the beginning of March when it reached average levels due to favorable temperature and precipitation. In April, NDVI increased significantly, exceeding the 5-year maximum. As agroclimatic conditions for winter crops in this region were favorable, we can expect winter crop yields to be higher than the 5-year average and close to the 5-year maximum.

In **Central Russia** (169) atmospheric precipitation and air temperatures were above the 15-year average by 5% and by 1.8°C respectively. RADPAR was by 9% below the 15-year average. Biomass was 13% above the 15-year average. VCIx was 0.99. The cropped area was 1% above the 5-year average. CPI was 1.23. NDVI was mostly at the level of the previous year until the middle of March when it exceeded the 5-year average. Generally, agroclimatic conditions were favorable for winter crops, so we expect winter crop yields to be at the level of the 5-year average or above it.

In **Central Black soils region** (170), the amount of precipitation and air temperature were above the 15-year average by 2% and by 1.6°C respectively. RADPAR was by 12% below the 15-year average. Biomass was 11% above the 15-year average. VCIx was 0.84. The cropped area was 10% below the 5-year average. CPI was 0.97. NDVI was close to the level of the previous year until March when it exceeded the 5-year average. It subsequently dropped back to average levels. As agroclimatic conditions were generally favorable, we expect winter crop yields to be at the level of the 5-year average.

In **Middle Volga** (173) precipitation was 13% below the 15-year average. Air temperatures were 2.4°C above the 15-year average. RADPAR was 5% below the 15-year average. Biomass was 21% above the 15-year average. VCIx was 0.83. The cropped area was 14% below the 5-year average. CPI was 1.12. NDVI stayed mostly at the previous year's level and the 5-year average except in the middle of March when it exceeded the 5-year maximum. We expect winter crop yields to be close to the level of the previous year.

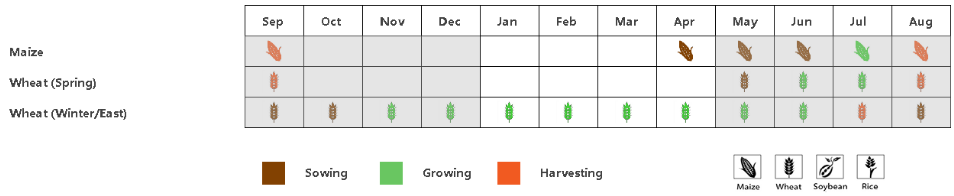
In **Ural and western Volga** (178) atmospheric precipitation was by 22% below the 15-year average. Temperatures, RADPAR and biomass were above the 15-year average by 2.5°C, 2% and 16%, respectively. VCIx was 0.63. The cropped area was 79% below the 5-year average. However, CALF was only 3%, since winter crop production is not important in this region. CPI was 0.45. NDVI stayed close to the 5-year average and the previous year's level except at the end of April when it dropped below average. Due to the decrease in cropped area and the lack of precipitation, we expect winter crop yields to be below the 5-year average. However, winter crop production is irrelevant in this region.

In **Eastern Siberia** (171), atmospheric precipitation and temperatures were above the 15-year average by 5% and 1.3°C respectively. RADPAR was by 3% below the 15-year average. Biomass was 10% above the 15-year average. VCIx was 0.74. The cropped area was 23% below the 5-year average. CPI was 0.32. NDVI was at the level of the previous year till March when it reached the 5-year average. The decrease in cropped area can result in lower winter crop production. However, as the area of winter crops in this region is insignificant, it will not affect the production of winter crops in the Russian Federation.

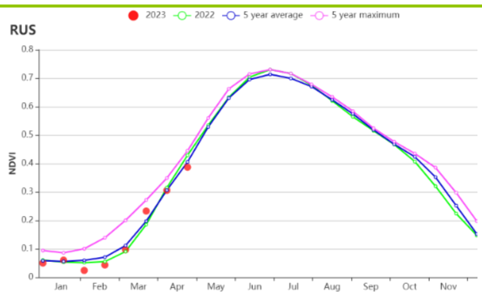
In **Middle Siberia** (172), precipitation and temperature were above the 15-year average by 25% and 0.9°C respectively. RADPAR was close to the 15-year average. Biomass was 4% below the 15-year average. VCIx was 0.62. The cropped area was 48% below the 5-year average. CPI was 0.67. NDVI was mostly below the 5-year average and the previous year's level. As a result, winter crop production may decrease. But as the area of winter crops in this region is insignificant, the decrease in winter crop production will have little effect on the production of winter crops in the Russian Federation.

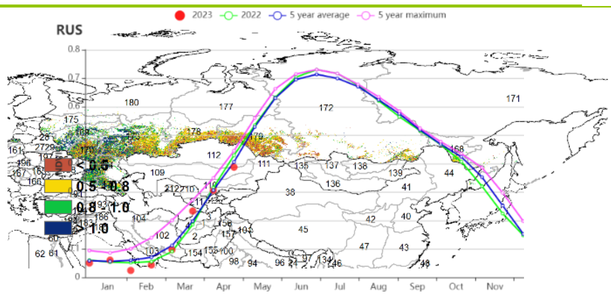
In **Western Siberia** (179), precipitation, temperature, RADPAR and biomass were above the 15-year average by 8%, 2.1°C, 1% and 3%, respectively. VCIx was 0.57. The cropped area was 93% below 5-year average. CPI was 0.40. Until March, NDVI was at the 5-year average and the previous year's level. It was subsequently below average. However, as the area of winter crops in this region is insignificant, it will not affect the production of winter crops in the Russian Federation.

Figure 3.37 Russia's crop condition, January – April 2023

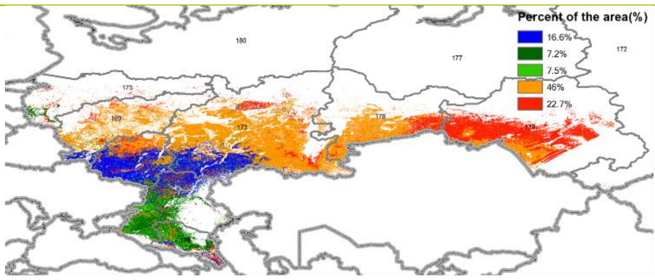


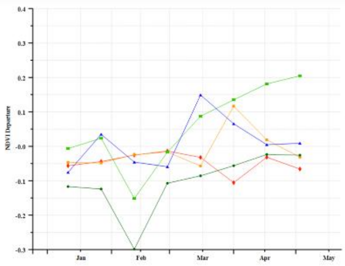
(a) Phenology of major crops



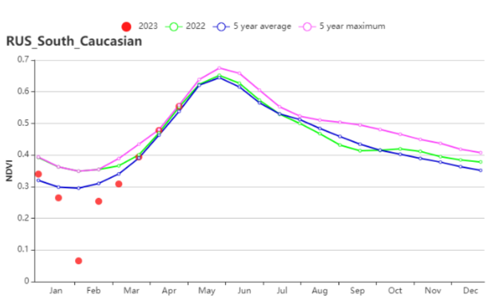


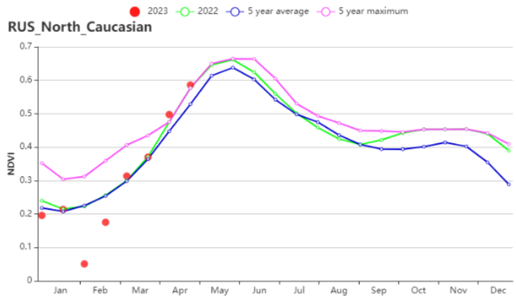
(b) Crop condition development graph based on NDVI (c) Maximum VCI



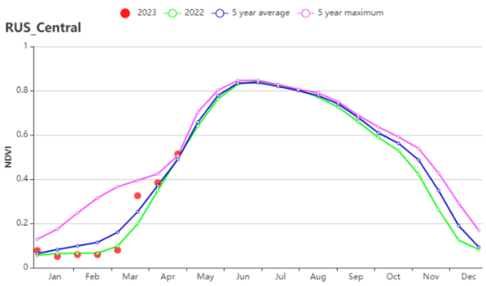


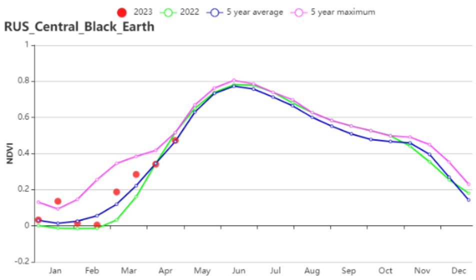
(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles



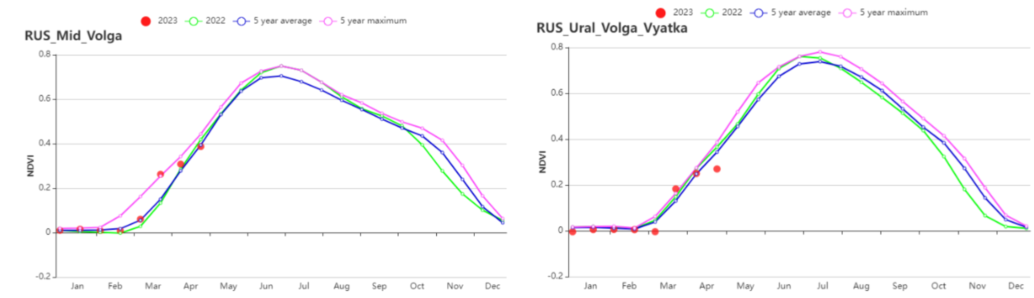


(f) Crop condition development graph based on NDVI, Southern Caucasus (left) and Northen Caucasus (right).

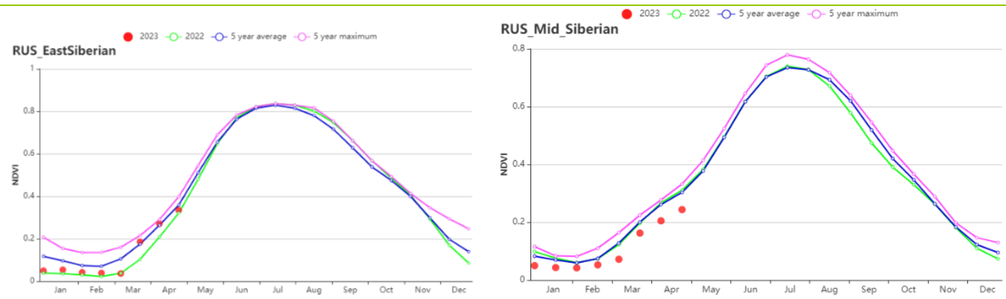




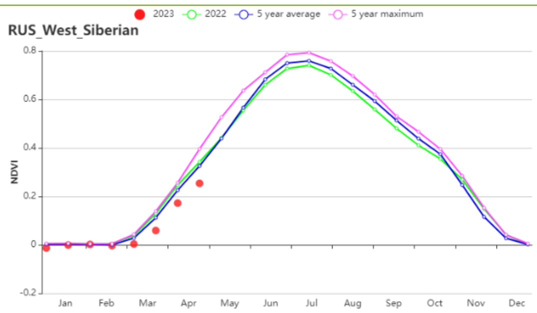
(g) Crop condition development graph based on NDVI, Central Russia (left) and Central black soils area (right).



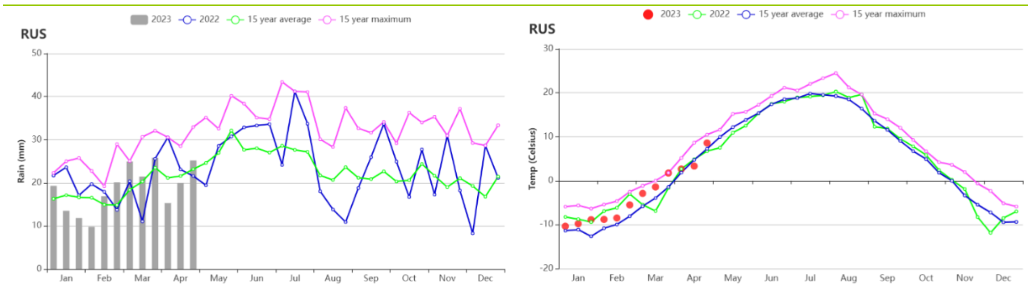
(h) Crop condition development graph based on NDVI, Middle Volga (left) and Ural and western Volga region (right).



(i) Crop condition development graph based on NDVI, Eastern Siberia (left) and Middle Siberia (right).



(j) Crop condition development graph based on NDVI, Western Siberia.



(k) Rainfall index (l) Temperature Index

Table 3.65 Russia's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, January – April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Central Russia	284	5	-1.1	1.8	340	-9	338	13
Central black soils area	272	2	-0.2	1.6	391	-12	376	11

Eastern Siberia	202	5	-8.5	1.3	630	-3	218	10
Middle Siberia	153	25	-10.7	0.9	633	0	152	-4
Middle Volga	224	-13	-2.5	2.4	403	-5	321	21
Northern Caucasus	265	3	2.8	1.3	526	-10	470	9
Southern Caucasus	259	-6	2.0	0.5	665	-2	404	0
Ural and western Volga region	143	-22	-4.7	2.5	445	2	264	16
Western Siberia	203	8	-5.8	2.1	484	1	232	3

Table 3.66 Russia's agronomic indicators by sub-national regions, current season's values and departure from 5YA, January – April 2023

Region	Cropped arable land fraction		Maximum VCI
	Current (%)	Departure (%)	Current
Central Russia	73	1	0.99
Central black soils area	53	-10	0.84
Eastern Siberia	21	-23	0.74
Middle Siberia	4	-48	0.62
Middle Volga	29	-14	0.83
Northern Caucasus	80	15	0.89
Southern Caucasus	74	0	0.85
Ural and western Volga region	3	-79	0.63
Western Siberia	1	-93	0.57

AFG AGO ARG AUS BGD BLR BRA CAN DEU DZA EGY ETH FRA GBR HUN IDN IND IRN ITA KAZ KEN KGZ KHM LKA MAR MEX MMR MNG MOZ NGA PAK PHL POL ROU RUS SYR **THA** TUR UKR USA UZB VNM ZAF ZMB

[THA] Thailand

The period from January to April falls into the dry season in Thailand. It is the growing and harvest season for the second rice crop. Maize planting started in April. According to the agroclimatic indicators, Thailand experienced dryer and hotter weather than usual in this monitoring period with below-average rainfall (RAIN -45%), above-average temperature (TEMP +0.2°C) and radiation (RADPAR 5%). As a result of these indicators, a severe decrease in crop biomass production potential was estimated (BIOMSS -15%).

Maximum temperatures had averaged around 40°C in April, when the national weather service alerted of an upcoming drought, more severe than the big droughts of 2019 and 2020. The government has requested farmers to limit the use of agricultural water during March and April and has issued warnings regarding potential drought damage in late June and early July. The Cropped Arable Land Fraction (CALF) decreased by 3% as compared to the recent five-year average. The ratio of irrigated cropland in Thailand is approximately 22.5%. It is located in the central region of Thailand, where crop conditions worsened due to restrictions on agricultural water use in March and April.

The NDVI development graph shows that the crop conditions were generally below the 5-year average during the whole monitoring period. The temperature was mainly above the 15-year average, although the temperatures in late January and early March were lower than unusual. The overall temperature trended upwards, approaching the 15-year maximum in April. The rainfall was high from January to early February and then consistently below the 15-year average. According to the NDVI departure cluster profiles, crop conditions were generally close to average on 32.7% of total arable land, located in the northeast, eastern, and central areas. The 3.1% of total arable land was affected by cloud cover in the satellite images. In the other regions, crop conditions were generally below average and steadily declining.

At the national level, the cropped arable land fraction was 3% below average (CALF 81%). VCIx values were around 0.73. The Crop Production Index (CPI) in Thailand was 0.86. CropWatch estimates that the crop conditions were below average.

Regional analysis

The regional analysis below focuses on the major agro-ecological zones of Thailand, which are mostly defined by the rice cultivation typology. Agro-ecological zones include **Central double and triple-cropped rice lowlands (187), the South-eastern horticulture area (188), the Western and southern hill areas (189), and the Single-cropped rice north-eastern region (190)**.

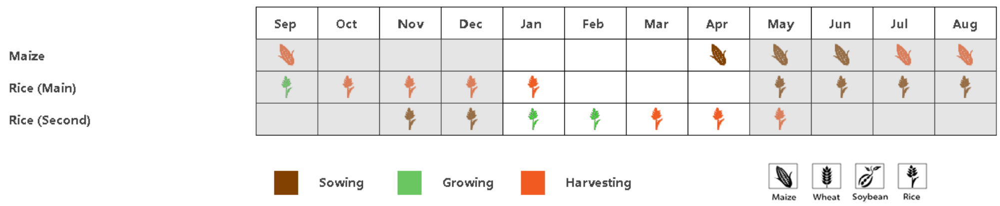
Compared to the 15YA, the **Central double and triple-cropped rice lowlands** experienced hotter and dryer conditions. Radiation (RADPAR +7%) was significantly above average, accompanied by higher temperatures (TEMP +0.2°C) and lower rainfall (RAIN -63%). These conditions led to a below-average estimate for BIOMSS (BIOMSS -18%). The NDVI development graph shows that crop conditions were below the five-year average for most of the monitoring period except for January and February. VCIx was 0.76. Overall, crop conditions were below average.

Indicators for the **South-eastern horticulture area** show that temperature (TEMP -0.1°C) and rainfall (RAIN -26%) were below average accompanied by higher radiation (RADPAR +3%). This led to a below-average estimate for BIOMSS (BIOMSS -15%). According to the NDVI development graph, the crop conditions were below average during this monitoring period except in early January and early February. The VCIx was at 0.72. All in all, the conditions were unfavorable.

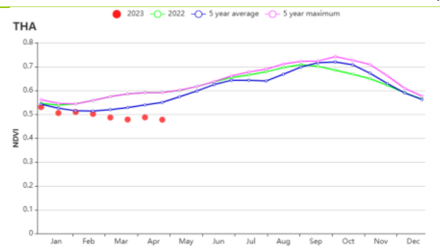
Agroclimatic indicators show that the conditions in the **Western and Southern Hills** were slightly below average: radiation (RADPAR +4%) and temperature (TEMP +0.2°C) were above average, while the rainfall (RAIN, -38%) was below average. These weather conditions led to a 12% decrease in BIOMSS. According to the NDVI development graph, the crop conditions were below average during the whole monitoring period. The VCIx value was 0.79. Crop conditions are assessed as below average.

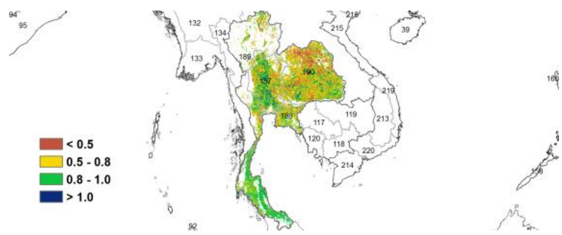
In the **Single-cropped rice north-eastern region**, the rainfall (RAIN, -58%) was below average, while radiation (RADPAR +3%) and temperature (TEMP +0.3°C) were above average. All these agroclimatic indicators led to a decrease in potential biomass (BIOMSS -17%). According to the NDVI development graph, the crop conditions were close to average in January and February and subsequently dropped to below average. Considering the moderate VCIx value of 0.67, the crop conditions were unfavorable.

Figure 3.38 Thailand's crop condition, crop calendar from January-April 2023

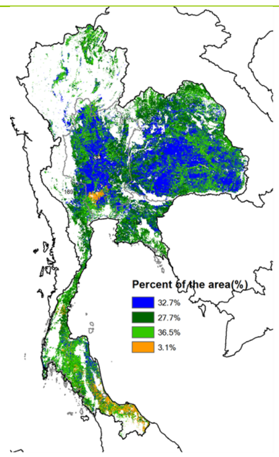


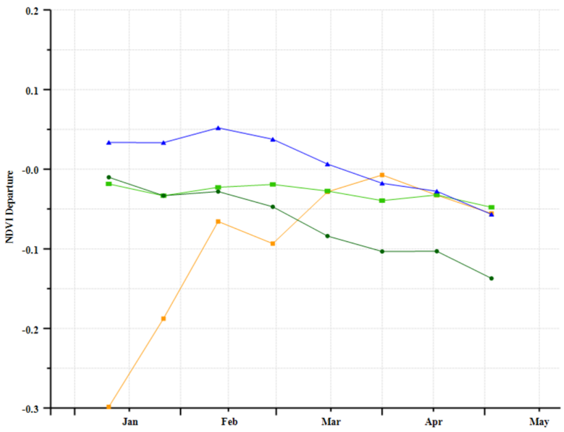
(a) Phenology of major crops



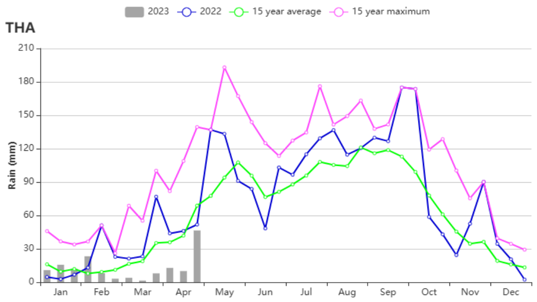


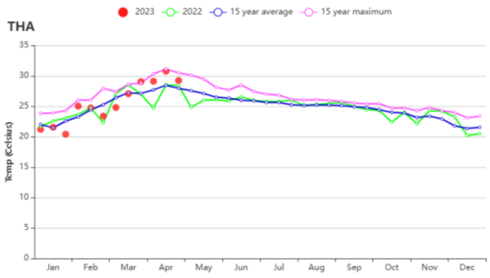
(b) Crop condition development graph based on NDVI (c) Maximum VCI



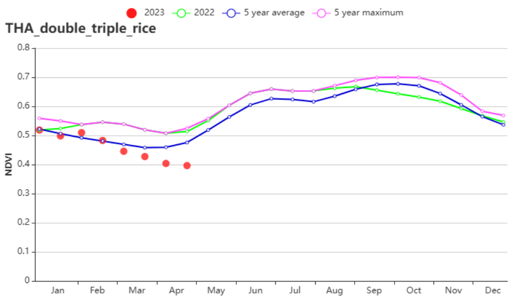


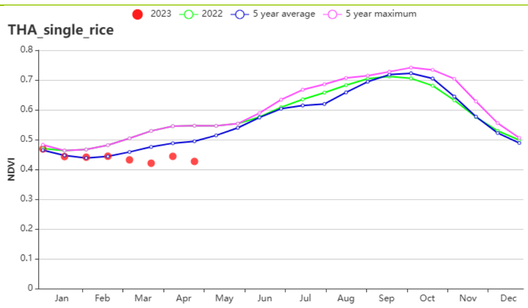
(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles



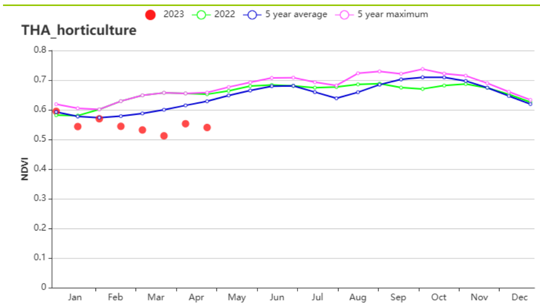


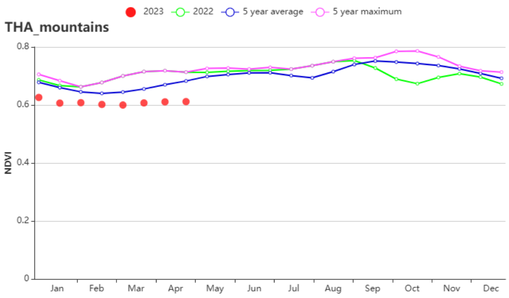
(f) Rainfall profiles (g) Temperature profiles





(h) Crop condition development graph based on NDVI in the double and triple-cropped rice lowlands (left) and single-cropped rice North-eastern region (right)





(i) Crop condition development graph based on NDVI in the South-eastern horticulture area (left) and Western and southern hill areas (right)

Table 3.67 Thailand's agroclimatic indicators by sub-national regions, current values and departure of 15YA, January-April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Central double and triple-cropped rice lowlands	82	-63	27.1	0.2	1263	7	591	-18
South-eastern horticulture area	255	-26	26.5	-0.1	1246	3	797	-15
Western and southern hill areas	196	-38	24.5	0.2	1282	4	723	-12

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m^2)	Departure (%)	Current (gDM/m^2)	Departure (%)
Single-cropped rice north-eastern region	105	-58	26.0	0.3	1184	5	604	-17

Table 3.68 Thailand's cropped arable land fraction (CALF) and current maximum VCI values, January-April 2023

Region	Cropped arable land fraction		Maximum VCI
	Current (%)	Departure (%)	Current
Central double and triple-cropped rice lowlands	88	3	0.76
South-eastern horticulture area	93	-3	0.72
Western and southern hill areas	97	0	0.79
Single-cropped rice north-eastern region	67	-8	0.67

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[TUR] Türkiye

During this monitoring period, the main crop grown in Türkiye is winter wheat. Maize and rice sowing starts in April. The NDVI-based time series process line shows that crop growth in Türkiye was better in January, deteriorated suddenly in February and then recovered in March and April. According to news reports, south-eastern Türkiye was hit by a major earthquake on 6 February, which damaged the infrastructure. Thanks to above average rainfall in March and April, crop growth conditions were in line with previous years.

Nationally, cumulative rainfall (RAIN) was 6% below average, temperature (TEMP) was 0.4°C above average, and photosynthetically active radiation (RADPAR) was 1% below average. The share of irrigated land in Türkiye is 19.8%. The cumulative potential biomass (BIOMSS) was 3% lower than the 15YA, the cropped arable land fraction (CALF) was 7% higher and the national optimum vegetation condition index (VCIx) was 0.85. The national crop production index (CPI) was 1.23.

The spatial distribution map of NDVI shows that it was close to or slightly above average in 20.6% of the cultivated areas (marked by the blue line), mainly in the eastern region. The NDVI was below average (marked by the yellow line table) in 28.2% of the areas monitored during the monitoring period, mainly in the central region. The sharp drops in NDVI can most likely be attributed to snow or cloud cover in the satellite images. It is worth noting that the NDVI trend line at the national level showed a clear upward trend in March, in line with the long-term average.

Regional analysis

Türkiye includes four agro-ecological regions: **the Black Sea region (191), the Central Anatolia region (192), the Eastern Anatolia region (193) and the Marmara, Aegean, and Mediterranean regions (194).**

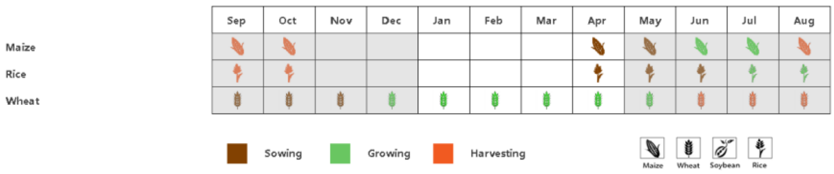
Crop growth in **the Black Sea region** was better in January, deteriorated suddenly in early February and returned to normal levels in early March. Photosynthetically active radiation (RADPAR) in the region was 3% lower than average, average temperature (TEMP) was 0.3°C lower, precipitation (RAIN) was 4% higher and final accumulated potential biomass (BIOMSS) was 3% lower. The optimum vegetation condition index (VCIx) was 0.89, the cropped arable land fraction (CALF) was 4% higher than the average and the crop production index (CPI) was 1.13, indicating a slightly higher than average level of crop production in this region.

Crop growth in **the Central Anatolian region** was better in January, deteriorated suddenly in early February and returned to normal levels in early March. Photosynthetically active radiation (RADPAR) in this region was 2% lower than average, average temperature (TEMP) was 0.1°C higher, rainfall (RAIN) was 6% higher and cumulative potential biomass (BIOMSS) was at the same level as average. The cropped arable land fraction (CALF) was 10% higher, the optimum vegetation condition index (VCIx) was 0.82 and the crop production situation index (CPI) was 1.25, indicating an agricultural production situation that is slightly above average for the region.

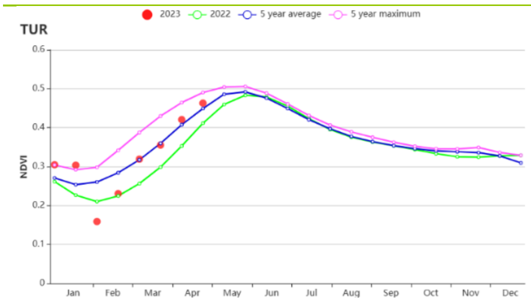
Crop growth in **the Eastern Anatolia region** reached its highest level in January, deteriorated suddenly in early February and returned to normal levels in early March. Precipitation (RAIN) in this region was 11% below average, average temperature (TEMP) was 0.9°C higher, photosynthetically active radiation (RADPAR) was 1% lower and cumulative potential biomass (BIOMSS) was 3% higher than average. The cropped arable land fraction (CALF) was 12 points higher than the average, the optimum vegetation condition index (VCIx) was 0.75, and the crop production index (CPI) was 1.3, which is expected to be above average for the agricultural production situation in the region.

Crop growth in **the Marmara, Aegean and Mediterranean regions** was better in January, deteriorated suddenly in early February and returned to normal levels in early March. Precipitation (RAIN) in this region was 13% below average, photosynthetically active radiation (RADPAR) average, average temperature (TEMP) was 0.7°C higher and cumulative potential biomass (BIOMSS) was 6% lower. The cropped arable land fraction (CALF) was 3% higher. The optimum vegetation condition index (VCIx) was 0.84 and the crop production index (CPI) was 1.19, resulting in above-average crop production conditions.

Figure 3.39 Türkiye's crop condition, January - April 2023

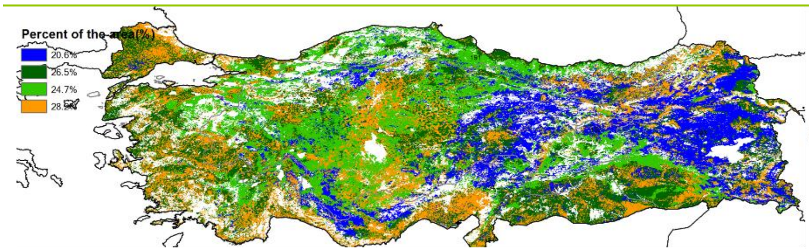


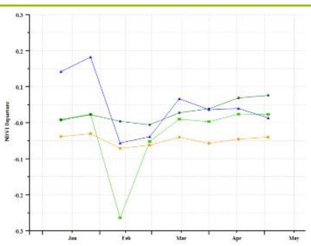
(a). Phenology of major crops



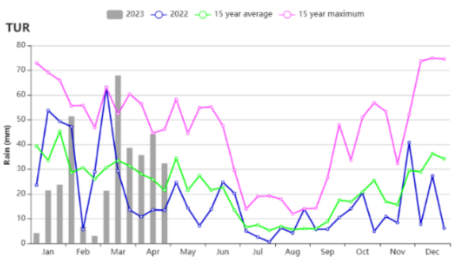
(b) Crop condition development graph based on NDVI

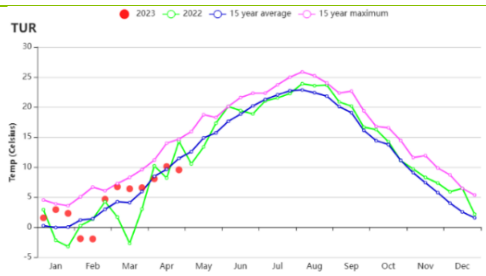
(c) Maximum VCI



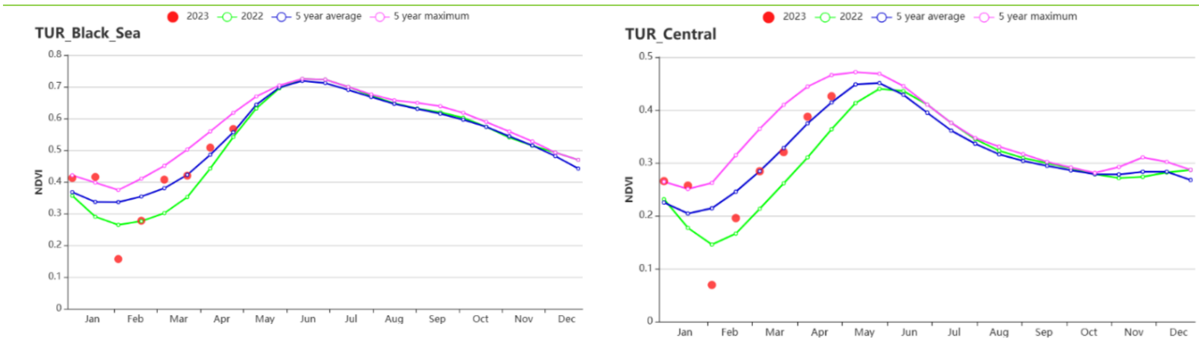


(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles

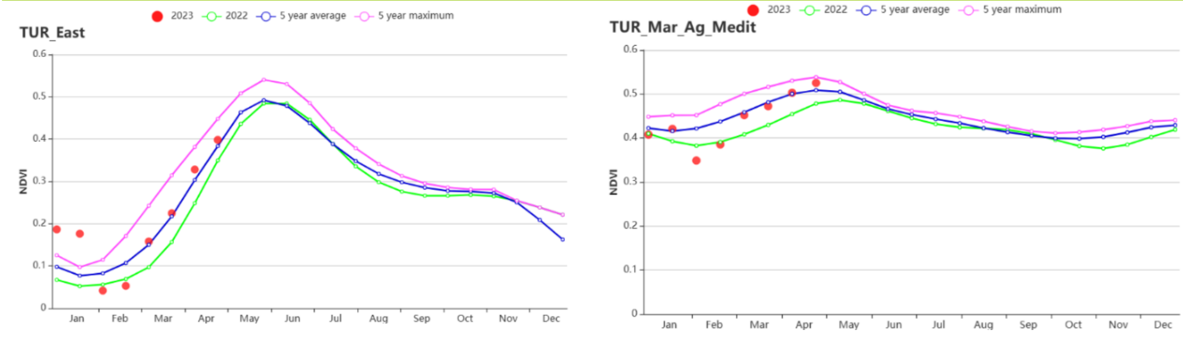




(f) Time series rainfall profile (g) Time series temperature profile



(h) Crop condition development graph based on NDVI (Black Sea region (left) and Central Anatolia region (right))



(i) Crop condition development graph based on NDVI (Eastern Anatolia region (left) and Marmara_Agean_Mediterranean lowland region (right))

Table 3.69Türkiye's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, January 2023 - April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current(mm)	Departure from 15YA(%)	Current(°C)	Departure from 15YA(°C)	Current(MJ/m2)	Departure from 15YA(%)	Current(gDM/m2)	Departure from 15YA(%)
Black Sea region	454	4	2.0	-0.3	686	-4	457	-3
Central Anatolia region	315	6	3.2	0.1	809	-2	476	0
Eastern Anatolia region	380	-11	1.3	0.9	817	-1	420	3
Marmara Agean Mediterranean lowland region	346	-13	8.0	0.7	838	0	587	-6

Table 3.70 Türkiye's agronomic indicators by sub-national regions, current season's values and departure from 5YA, January 2023 - April 2023

Region	CALF		Maximum VCI
	Current(%)	Departure from 5YA(%)	Current
Black Sea region	78	4	0.89
Central Anatolia region	47	10	0.82
Eastern Anatolia region	43	12	0.75
Marmara Agean Mediterranean lowland region	77	3	0.84

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[UKR] Ukraine

The main crop in Ukraine being monitored for this period (January to April, 2023) is winter wheat.

The Russia - Ukraine war has entered its second year. It has contributed to acute global food and nutrition insecurity. In this monitoring period, the overall situation of agroclimatic indicators showed generally favorable conditions for crop development in Ukraine. Rainfall (264 mm, +9%) was sufficient and temperature (2.8°C, +1.3°C) was warmer as compared to 15YA level. Solar radiation (442 MJ/m2, -16%) was significantly lower than usual. Based on the above agroclimatic situation, Cropwatch predicted the potential crop biomass would reach 451 gDM/m2 at the national level, which was 5% higher than 5YA. For agronomic aspects, about 82% (CALF=0.82) of cropland was cropped in this season, which was 7% higher than 5YA. Meanwhile, the maximum VCI reached a favorable value of 0.86, and cropland in the southern area even reached an average of 0.9. The national crop production Index also reached 1.11, which suggested favorable crop conditions in this season.

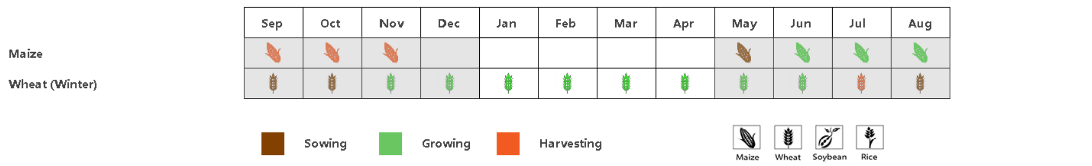
In line with agroclimatic and agronomic conditions, the remote sensing based NDVI crop condition development graph confirmed the favorable conditions. NDVI was generally higher than 5YA in this period, exceeding the 5 year maximum in late April. Spatial distribution of NDVI showed NDVI in about 72.8% of the cropped area was close to or higher than 5YA in this period. The lower values were concentrated around the frontline near Kherson and Zaporizhia. In summary, favorable weather conditions caused good prospects for the production of winter cereals.

Regional analysis

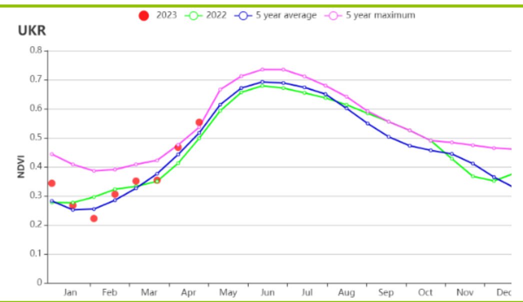
Regional analyses are provided for four agro-ecological zones (AEZ) defined by their cropping systems, climatic zones and topographic conditions. They are referred to as **Central wheat area** (195) with the Poltava, Cherkasy, Dnipropetrovsk and Kirovohrad Oblasts; **Eastern Carpathian hills** (196) with Lviv, Zakarpattia and Ivano-Frankivsk Oblasts; **Northern wheat area** (197) with Rivne and **Southern wheat and maize area** (198) with Mykolaiv, Kherson and Zaporizhia Oblasts.

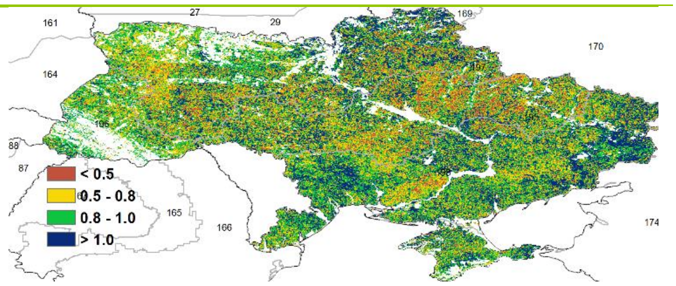
During this monitoring period, all four AEZs shared generally similar patterns in agroclimatic and agronomic conditions, as well as crop development curves. Rainfall was 8 to 18% higher than the 15YA in the **Southern wheat and maize area** / **Northern wheat area** to **Eastern Carpathian hills**. Temperatures were warmer by 1.1°C (**Eastern Carpathian hills**) to 1.4°C (**Southern wheat and maize area**), while radiation significantly decreased by 9% (**Eastern Carpathian hills**) to 20% (**Central wheat area**). Similar to the national level, potential biomass in all four AEZs was estimated at 5 to 6% above the 5YA. Cropped area (CALF) in this season was up to 14% above average, and VCIx values were around 0.81 to 0.9. In addition, the AEZs had a crop production index ranging from 1.01 to 1.23, which suggested a better agricultural production situation in the current monitoring period. NDVI based crop condition development also presented a favorable situation, NDVI values of all AEZs were above 5YA, even higher than the 5 year maximum in late April. All in all, current crop conditions indicated good prospects for winter wheat.

Figure 3.40 Ukraine's crop condition, January – April 2023

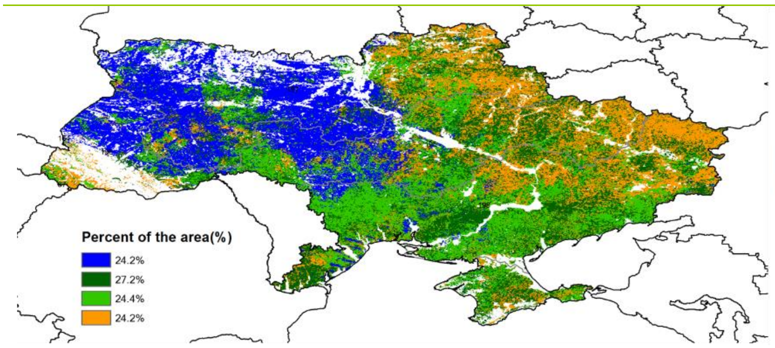


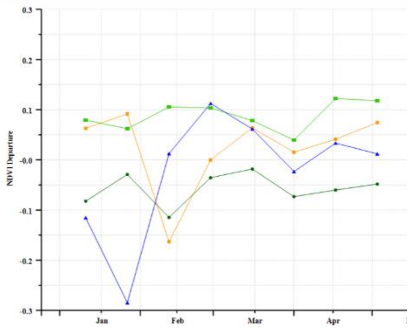
(a). Phenology of major crops



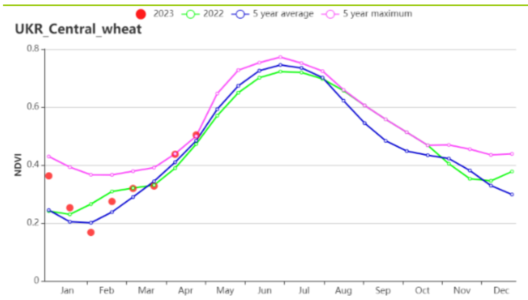


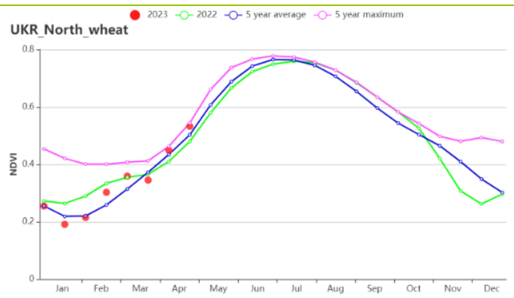
(b) Crop condition development graph based on NDVI (c) Maximum VCI



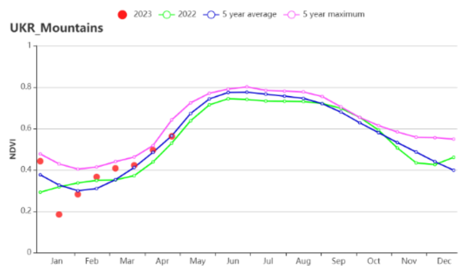


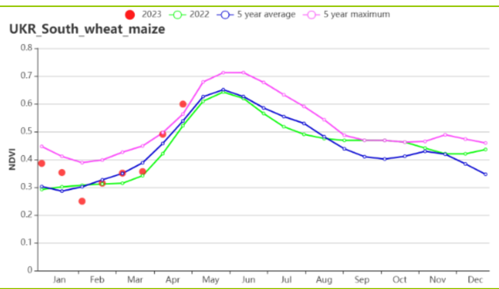
(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles



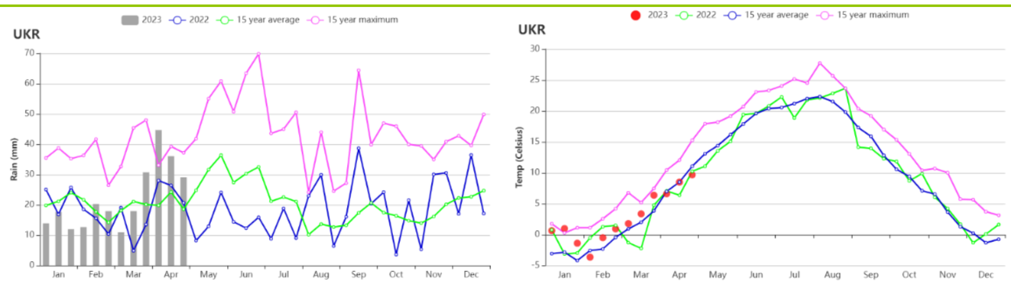


(e) Crop condition development graph based on NDVI (Central wheat area(left) Northern wheat area(right))





(f) Crop condition development graph based on NDVI (Eastern Carpathian hills(left) Southern wheat and maize area(right))



(g) Rainfall profile (left) and temperature profile (right)

Table 3.71 Ukraine's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, January – April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Central wheat area	256	9	2.2	1.3	412	-20	443	6
Eastern Carpathian hills	330	18	2.4	1.1	500	-9	452	5
Northern wheat area	272	8	2.2	1.3	393	-17	438	6
Southern wheat and maize area	239	8	3.5	1.4	477	-16	471	6

Table 3.72 Ukraine's agronomic indicators by sub-national regions, current season's values and departure from 5YA, January – April 2023

Region	Cropped arable land fraction		Maximum VCI
	Current (%)	Departure (%)	Current
Central wheat area	71	6	0.81
Eastern Carpathian hills	90	0	0.84
Northern wheat area	78	3	0.85
Southern wheat and maize area	90	14	0.90

[USA] United States

Winter wheat was the main crop that was grown during this monitoring period. It went through the tillering, greening, jointing and heading stages. Land preparation and planting of maize, rice and soya bean began in April. Overall, conditions for winter crops were below the five-year average due to a drought in the major winter wheat production areas.

The marked heterogeneity of agro-climatic conditions and phenology led to significant differences in crop growing conditions between regions. Rainfall and temperatures were 5% and 1.0°C above the 15-year average, respectively, and radiation was 5% below, resulting in potential biomass 4% above the 15-year average. Kansas, the leading winter wheat producing state, suffered from rainfall deficits (RAIN -23%). The resulting drought conditions impacted growth and yield formation. Cold temperatures and slightly below average rainfall in Idaho (RAIN -6%), Washington (RAIN: -6%) and Oregon (RAIN -4%) hampered the growth of winter crops and the planting of spring crops. Rainfall in California was well above average (RAIN +60%) and the VCIx of 0.75 was close to average.

The national cropped arable land fraction (CALF) was 46%, 11% below the five-year average. The national VCIx value was 0.71 and the crop production index (CPI) was 1.04, indicating average crop conditions for the observation period. VCIx values below 0.5 indicated that poor crop conditions were widespread in the southern high plains and the Northwest. Drought caused by lack of rainfall led to poor crop conditions in the winter wheat production area in the Southern Highplains, while cooler than usual temperatures in the northwest delayed the growth of winter wheat in the Northwest.

In short, CropWatch, conditions for winter wheat in the Southern Plains were unfavorable, whereas in the Northwest, below average temperatures caused slow crop growth.

Regional Analysis

Winter crops are grown mainly in the Southern Plains (No. 207), Northwest (No. 206) and California (No. 201). Winter wheat growth conditions are highly spatially heterogeneous due to different agroclimatic, agronomic and irrigation infrastructure conditions.

(1) Southern Plains (207)

The Southern Plains is the main winter wheat producing region in the United States. It includes the states of Kansas, Oklahoma and Texas. Overall, crop conditions in the region were poor, as indicated by below average CALF (-10%), low VCIx (0.68) and low CPI (0.89).

Conditions varied greatly within this region. On average, the Southern Plains experienced wet and warm weather, characterized by above average rainfall (RAIN +11%) and temperature (TEMP +0.9℃), and low RADPAR (-6%), resulting in average potential biomass (0%). Kansas, a major winter wheat producing state, experienced dry and warm weather with below average rainfall (RAIN -23%) and above average temperatures (0.6°C), which accelerated soil moisture loss. The VCIx of 0.54 and CALF of 49% were below the 5-year average and the crop production index (CPI) of 0.89 indicates poor crop conditions. Oklahoma (RAIN +14%, TEMP 0.8℃) and Texas(RAIN +15%, TEMP 1℃) experienced wet and warm weather, and the crop condition was near normal. CropWatch assesses the crop situation in the Southern Plains as below average due to poor winter wheat performance in Kansas.

According to the weather forecast by FGOALS-f2 weather and the subseasonal to seasonal Ensemble Prediction System, air temperature in the Southern Plains at the grain-filling to maturity stage will be above average, which might further lower the wheat yield expectation.

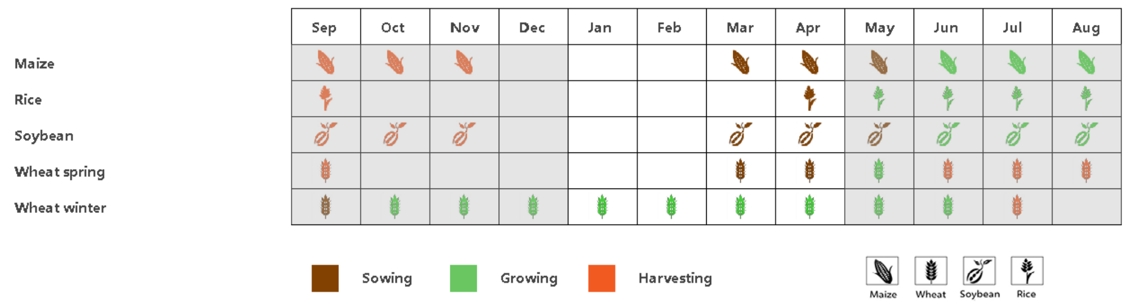
(2) Northwest (206)

The Northwest is another important winter wheat production region. It includes the states of Washington and Oregon. Growing conditions in this region were well below average due to poor agro-climatic conditions. The Northwest experienced below 15-year average rainfall (RAIN -7%), temperature (TEMP -1.5℃) and radiation (-5%), resulting in below average potential biomass (BIOMSS -10%). It is worth noting that the CALF was 42% below the 5-year average, the VCIx was 0.52 and the crop production index (CPI) was only 0.52, all confirming poor growth conditions for winter wheat in the region. In short, CropWatch assessed the crop growth in the Northwest as below average, and crop production is expected to be below average.

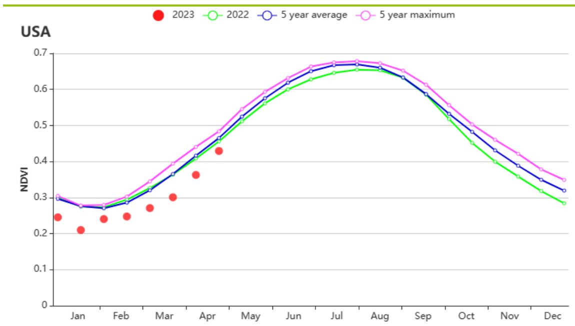
(3) California (201)

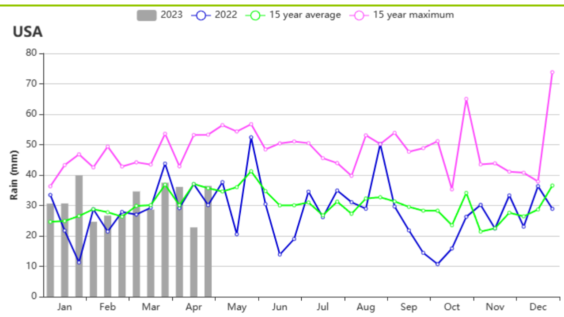
California is a major producer of winter wheat, and the most important producer of vegetables and fruits in the United States. The winter wheat reached the maturity stage by late April. According to the NDVI profile, the crop conditions were close to the 5-year average. Wet weather dominated in California with significantly above average rainfall (RAIN +60%), below average temperature (TEMP -2.1°C), and below average RADPAR (-8%). The significantly above average precipitation provided abundant soil moisture for crop growth, resulting in an increase in potential biomass (+18%). The cropped arable land fraction (CALF, -1%) was near average. The VCIx reached 0.78, and the crop production index (CPI) reached 1.03, close to the average. Agro-climatic conditions in California were favourable, and CropWatch predicts average yield for winter wheat in California.

Figure 3.41 United States crop condition, January to April 2023



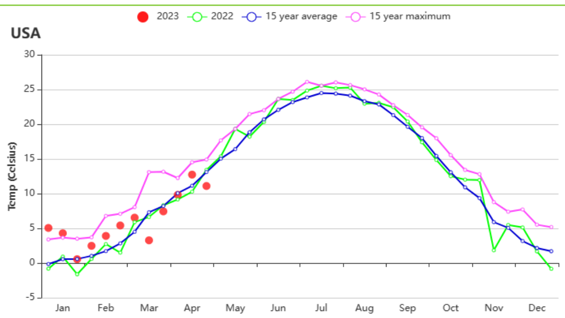
(a). Phenology of United States from January to April 2023

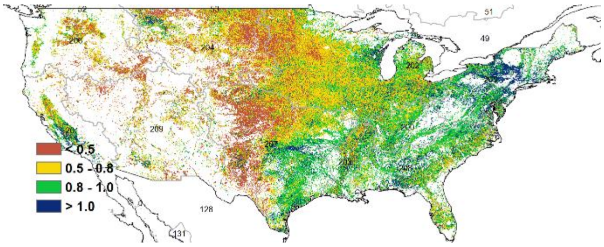




(b). Crop condition development graph based on NDVI

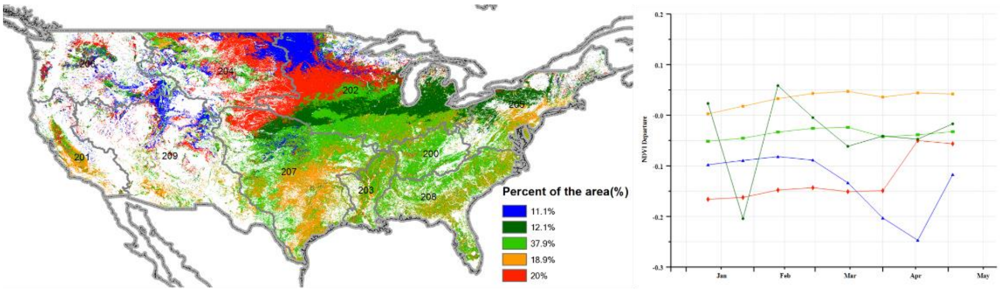
(c). Time series rainfall profile



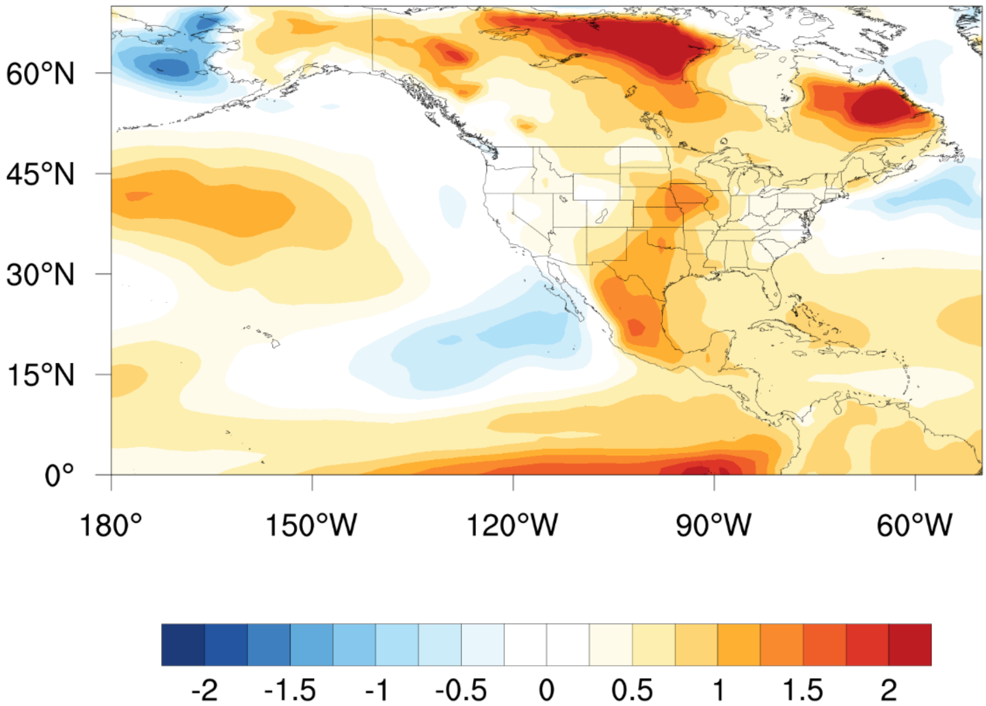


(d). Time series temperature profile

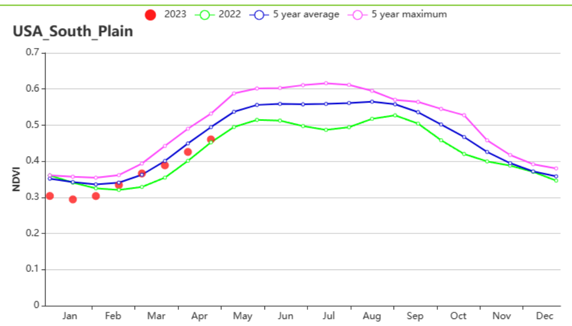
(e). Maximum VCI



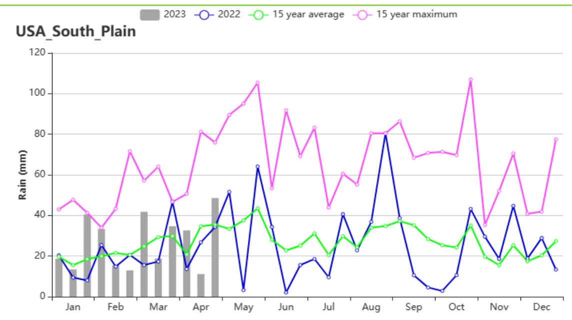
(f). Spatial distribution of NDVI profiles



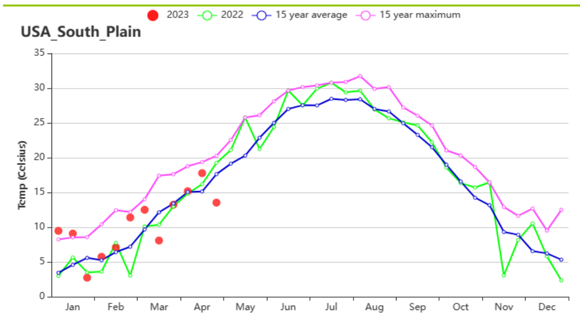
(g) Forecasted anomaly of air temperature (2m) in June 2023 by FGOALS-f2 system



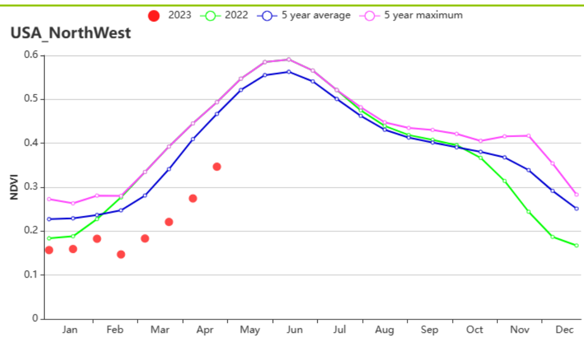
(h). Crop condition development graph based on NDVI for the Southern Plains from January - April 2023



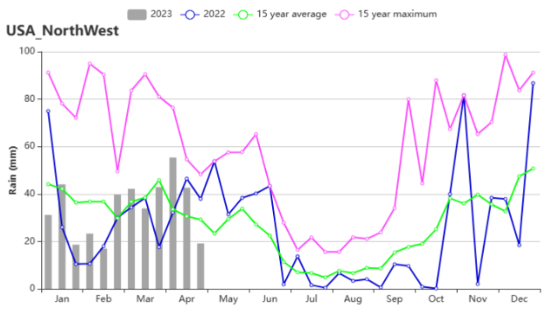
(i). Time series rainfall profile for the Southern Plains from January - April 2023



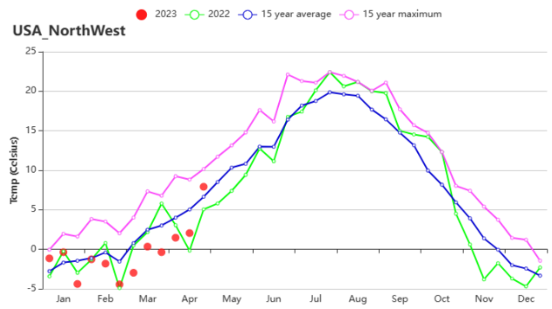
(j). Time series temperature profile for the Southern Plains from January - April 2023



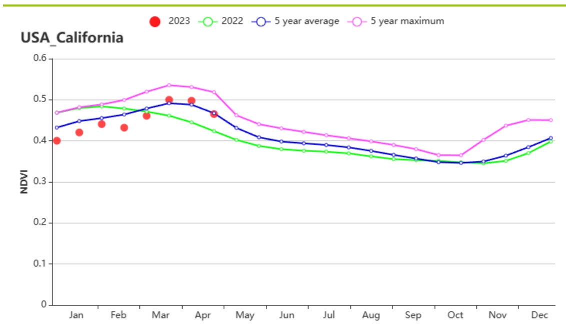
(k). Crop condition development graph based on NDVI for the Northwest from January - April 2023



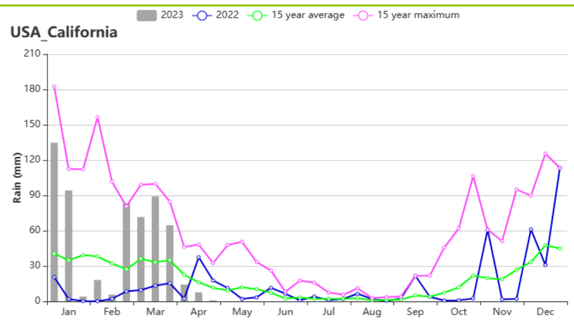
(l). Time series rainfall profile for the Northwest from January - April 2023



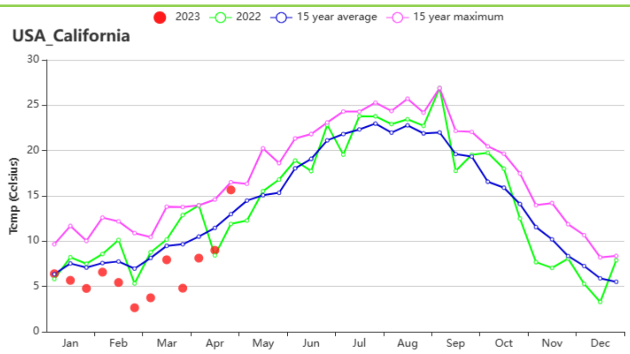
(m). Time series temperature profile for the Northwest from January - April 2023



(n). Crop condition development graph based on NDVI for the California from January - April 2023



(o). Time series rainfall profile for the California from January - April 2023



(p). Time series temperature profile for the California from January - April 2023

Table 3.73 United States' agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, January - April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departu (%)
Blue Grass region	524	-2	8.7	2.2	742	-1	744	14
California	588	60	6.7	-2.1	830	-8	614	18
Corn Belt	359	8	1.4	1.3	646	-5	423	5
Lower Mississippi	627	13	13.1	2.0	746	-8	913	9
North-eastern areas	382	-9	3.9	2.5	667	-2	508	15
Northwest	410	-7	-0.4	-1.5	627	-5	357	-10
Northern Plains	203	-5	-2.7	-1.1	728	-3	310	-10
Southeast	441	-2	14.6	2.5	852	-4	874	7
Southwest	209	31	4.3	-1.1	961	-6	366	3
Southern Plains	322	11	10.5	0.9	826	-6	545	0

Table 3.74 United States'agronomic indicators by sub-national regions, current season's values and departure, October January - April 2023

Region	Cropped arable land fraction		Maximum VCI
	Current (%)	Departure (%)	Current
Blue Grass region	97	0	0.87
California	74	-1	0.78
Corn Belt	27	-22	0.72
Lower Mississippi	76	0	0.85
North-eastern areas	97	4	0.99
Northwest	31	-42	0.52
Northern Plains	1	-85	0.57
Southeast	99	0	0.87
Southwest	5	-64	0.49
Southern Plains	53	-10	0.68

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[UZB] Uzbekistan

The monitoring period from January to April 2023 covers the main growth stages of winter wheat and the planting of maize in Uzbekistan. Among the CropWatch agroclimatic indicators, the radiation (RADPAR) and temperature (TEMP) were slightly above average (+6% and 0.6°C), while rainfall (RAIN) was below average (-5%) compared to the 15-year average (15YA). The precipitation was significantly below the 15YA, except for the beginning of January, February and beginning of April. The temperature in January was below the 15YA, but was close to or higher than the 15YA in the following months, especially in March. The biomass accumulation (BIOMSS) decreased by 18% compared to the 15YA. At the national level, the NDVI development graph indicates that besides the beginning of February (slightly above the 5YA), the crop conditions were below the five-year average in this monitoring period, especially for late January and late April. However, the drop in late January most likely can be attributed to cloud cover in the satellite images or snow on the ground.

The maximum Vegetation Condition Index (VCIx) was 0.71. The cropped arable land fraction (CALF, 38%) decreased by 10% compared to its five-year average. The NDVI departure cluster profiles indicate that: (1) 52.6% of arable land (light green and blue) showed unfavorable conditions in this monitoring period, mainly in the west and south of the country. (2) 11.9% of arable land (dark green), mainly in the central area of the Eastern hilly cereals, had much better crop conditions than average in this monitoring period, except in late January. (3) 24.2% of arable land (orange) had unfavorable conditions in late January and late April, while better crop conditions than average in February and March. (4) 11.3% of arable land (red) had unfavorable conditions in January, better conditions than average in February and March and returned to the average level in April. Prospects for the production of winter cereals are slightly unfavorable.

Regional analysis

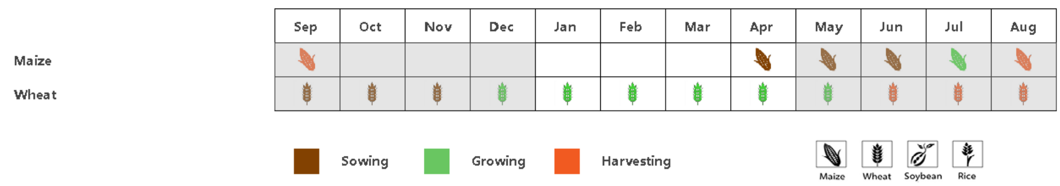
Based on cropping systems, climatic zones and topographic conditions, three sub-national agro-ecological regions (AEZ) can be distinguished for Uzbekistan: Central region with sparse crops (210), Eastern hilly cereals zone (211), and Aral Sea cotton zone (212).

In the Central region with sparse crops, the NDVI development graph shows that the crop conditions were generally below average, except for the beginning of April. RAIN was below average (-28%), while RADPAR and TEMP were slightly above average (+7% and +1.4°C). The VCIx was 0.61 and BIOMSS decreased by 22% compared to the 15YA. The agro-climatic conditions of this region were unfavorable.

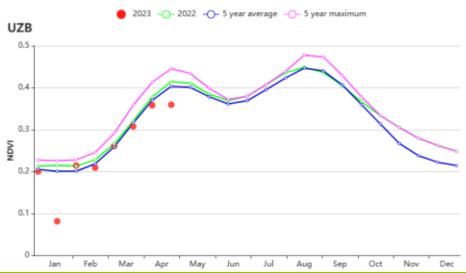
In the Eastern hilly cereals zone, RAIN was below average (-23%), while RADPAR and TEMP were slightly above average (+6% and +0.5°C). The CALF was 49%. It had decreased by 10% compared to the 5YA and the VCIx index was 0.72. The NDVI-based crop condition development graph shows a similar pattern as the national average state. The NDVI values were lower than 0.1 at the end of January, probably due to the cloud or snow and the crop conditions were below the five-year average in this monitoring period, especially in late April. The BIOMSS decreased by 17%. The prospects for winter wheat are unfavorable.

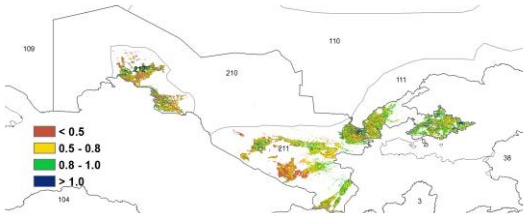
In the Aral Sea cotton zone, RAIN was below average (-46%), while RADPAR and TEMP were slightly above average (+5% and +1.4°C). These factors resulted in a decrease in BIOMSS (-25%). The CALF(0%) decreased by 61% compared to the 5YA and the maximum VCI index was 0.67. The agro-climatic conditions of this region were unfavorable.

Figure 3.42 Uzbekistan's crop condition, January - April 2023

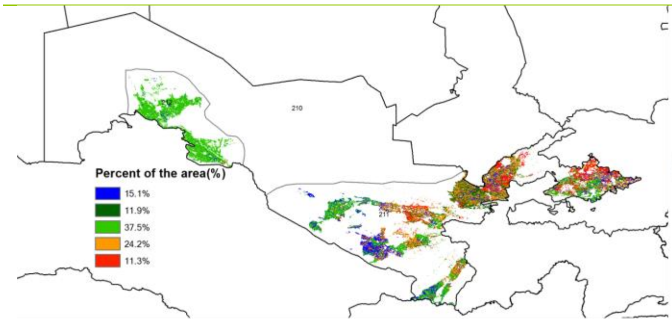


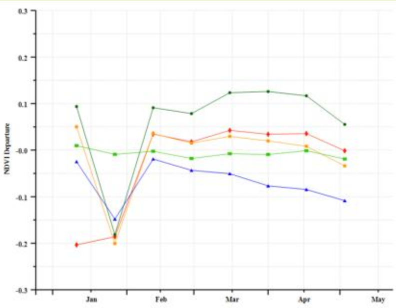
(a) Phenology of major crops



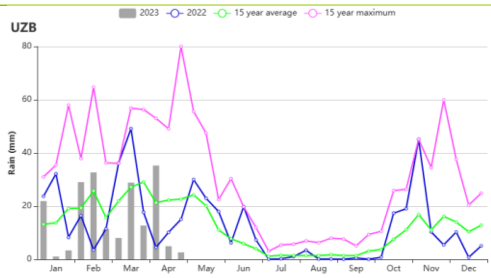


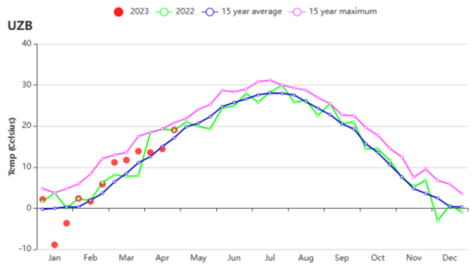
(b) Crop condition development graph based on NDVI (c) Maximum VCI



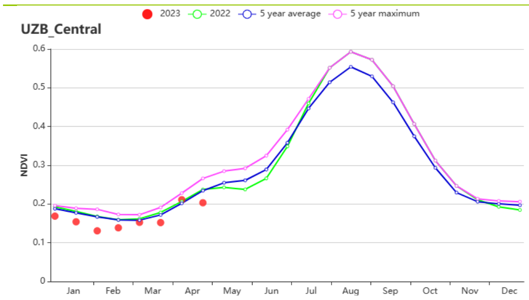


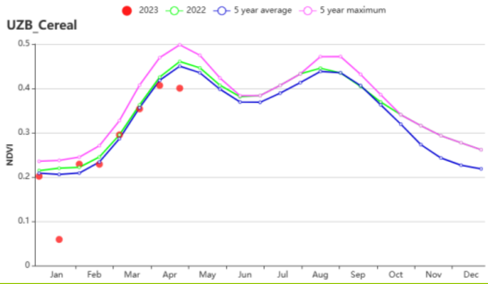
(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles



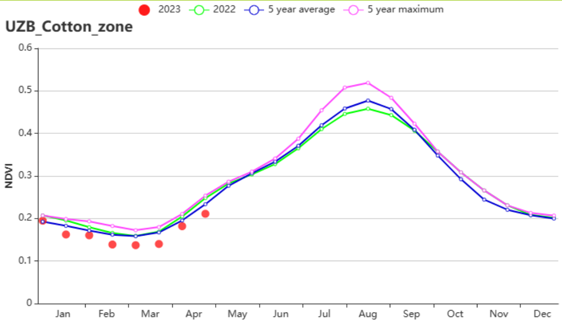


(f) Rainfall profiles (g) Temperature profiles





(h) Crop condition development graph based on NDVI of Central region with sparse crops (left) and Eastern hilly cereals region (right)



(i) Crop condition development graph based on NDVI of Aral Sea cotton region

Table 3.75 Uzbekistan's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, January - April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Central region with sparse crops	88	-28	8.3	1.4	882	7	260	-22
Eastern hilly cereals zone	210	-23	6.9	0.5	892	6	402	-17
Aral Sea cotton zone	35	-46	7.1	1.4	852	5	192	-25

Table 3.76 Uzbekistan's agronomic indicators by sub-national regions, current season's values and departure from 5YA, January - April 2023

Region	Cropped arable land fraction		Maximum VCI
	Current (%)	Departure (%)	Current
Central region with sparse crops		-100	0.61
Eastern hilly cereals zone	49	-10	0.72
Aral Sea cotton zone	0	-61	0.67

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[VNM] Vietnam

This report covers the grainfilling period and harvest of winter-spring rice, followed by planting of summer-autumn rice in the Mekong Delta and the southeast of Vietnam. In the central part, winter rice was also followed by summer rice, but planting took place in April only. In the north, winter-spring rice was planted in January. It will be ready for harvest in May.

The proportion of irrigated cropland in Vietnam is 32%, which means that precipitation is vital to the production of most crops in Vietnam. The agro-climatic condition showed the TEMP (21.2°C, +0.5°C) and the RADPAR (1022 MJ/m², +5%) were both above the average. But due to the decreased precipitation (241 mm, -23%), the BIOMASS (726 gDM/m², -8%) dropped below the 15YA. The VCIx was 0.89, and the CALF (96%, 0%) was at the 5YA. The CPI in this monitoring period was 1.10, which represents a normal crop production situation.

Based on the NDVI development graph, the crop conditions were below the 5YA throughout the whole monitoring period except at the beginning of January, but the NDVI value was always above 0.5 throughout the monitoring period. In most of January and February, the precipitation was generally near or surpassed the 15YA . While in March and April, the precipitation was below the average. The temperature fluctuated around the average throughout the monitoring period. Especially in late March and all of April, the temperatures surpassed the average. As to the spatial distribution of NDVI profiles, the crop conditions in most of the country were near the average. Due to the significant decrease in precipitation during the monitoring period, the crop conditions in Vietnam are fair.

Regional analysis

Based on cropping systems, climatic zones, and topographic conditions, the following agro-ecological zones (AEZ) can be distinguished for Vietnam: **Central Highlands (213), Mekong River Delta (214), North Central Coast (215), North East (216), North West (217), Red River Delta (218), South Central Coast (219) and South East (220) .**

In the **Central Highlands**, the RAIN (224 mm, -14%) and the TEMP (21.9°C, -0.2°C) were both below the average, but the RADPAR (1149 MJ/m², 1%) had a slight increase. The resulting BIOMASS (737 gDM/m², 0%) was at the level of the 15YA. According to the NDVI development graph, crop conditions were generally near the 5YA during the whole monitoring period. The CALF was 97% and VCIx was 0.80. The CPI was 1.00, which indicates that the crop production situation was normal. The crop conditions in this region are expected to be near the average.

In the **Mekong River Delta region**, the TEMP (27.2°C, -0.2°C) was below the average. The RAIN (315 mm, 0%) and RADPAR (1228 MJ/m², 2%) were at the level of 15YA. The BIOMASS (950 gDM/m², 6%) was above average. The CALF was 87% and the VCIx was 0.89. The crop condition development graph showed that the crop conditions were close to the 5YA. The CPI was 1.12, which indicates that the crop productions were slightly better than the average. Overall, the crop conditions in this region are expected to be average.

In the **North Central Coast**, although the TEMP (19.7°C, 0.4°C) and the RADPAR (941 MJ/m², 6%) were above the average, due to the sharp decrease of

RAIN (280 mm, -24%), the BIOMASS (760 gDM/m², -9%) was below the average. CALF was 99% and the VCIx was 0.93. According to the crop condition development graph, the NDVI was below the average in most of the monitoring period, and there was a sharp drop in February, which may have been caused by the cloud cover in the satellite images. The CPI was 1.10. The crop conditions in this region are expected to be below the average due to the impacts of rainfall deficit.

In the **North East region**, the TEMP (18.0°C, 1.2°C) increased by 1.2°C and the RADPAR (785 MJ/m², 11%) increased by 11%. However, similar to the situation in the North Central Coast, the RAIN (191 mm, -44%) showed a sharp decrease which caused a drop in BIOMASS (599 gDM/m², -21%). The CALF was 99% and the VCIx was 0.95. According to the NDVI development graph, crop conditions fluctuated greatly. The NDVI was above the average in January and the late February. At the rest of the monitoring time, the NDVI was below the average. The CPI was 1.08. The crop conditions were expected to be lower than the average.

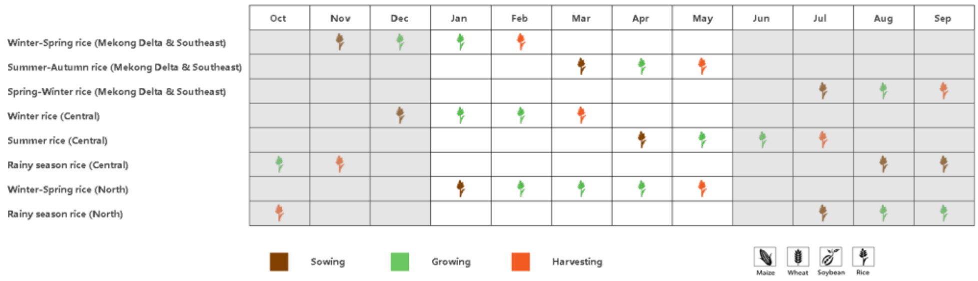
In the **North West region**, the TEMP (18.3°C, 1.0°C) was above the average. Although the RADPAR (1034 MJ/m², 8%) increased by 8%, the BIOMASS (493 gDM/m², -28%) dropped by 28%, which was due to the decrease of RAIN (115 mm, -56%). The VCIx was 0.88 and the CALF was 100%. The CPI was 0.99. The crop condition development graph showed that NDVI was below average. The crop conditions in this region are expected to be unfavorable due to the drought.

In the region of the **Red River Delta**, the TEMP (19.9°C, 0.7°C) increased by 0.7°C and the RADPAR (714 MJ/m², 11%) increased by 11%. With the heavy decrease of RAIN (194 mm, -39%), the BIOMASS (634 gDM/m², -18%) dropped by 18%. The CALF was 95% and the VCIx was 0.88. As shown by the crop condition development graph, the NDVI fluctuated greatly. In early January and late February, the NDVI was at or surpassed the maximum of the past 5 years. The CPI was 1.10. The crop conditions in this region were estimated to be below average due to the rainfall deficit.

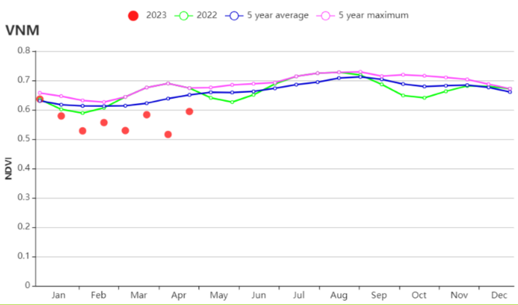
In the **South Central Coast**, the RAIN (406 mm, -4%) was lower than the 15YA. But with the RADPAR (1060 MJ/m², 2%) close to the average and the TEMP (21.0°C, 0.6°C) increased by 0.6°C, the resulting BIOMASS (903 gDM/m², 2%) showed a slight increase by 2%. The CALF was 98% and the VCIx was 0.91. The crop condition development graph showed that during the whole monitoring period, the NDVI was close to the average except in late January and February. There were two sharp drops during this period, which may have been due to cloud cover in the satellite images. The CPI was 1.10. Overall, the crop conditions in this region were normal.

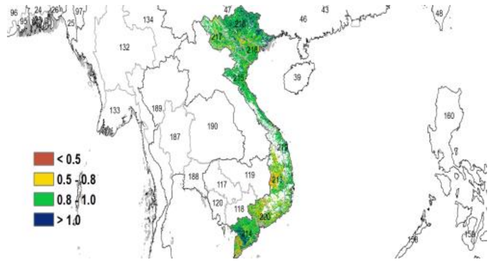
In the **South East region**, TEMP (26.0°C, 0.0°C) was at the level of 5YA and RADPAR (1253 MJ/m², 5%) increased by 5%. With a significant increase of RAIN (278 mm, 11%), the BIOMASS (795 gDM/m², 3%) increased by 3%. The CALF was 94% and the VCIx was 0.80. The crop condition development graph indicates that NDVI was a slightly lower than the average. The CPI was 1.02. The crop conditions in this region are expected to be comparable to the five-years average.

Figure 3.43 Vietnam's crop conditions, January -April 2023

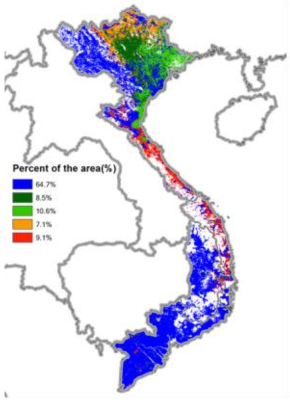


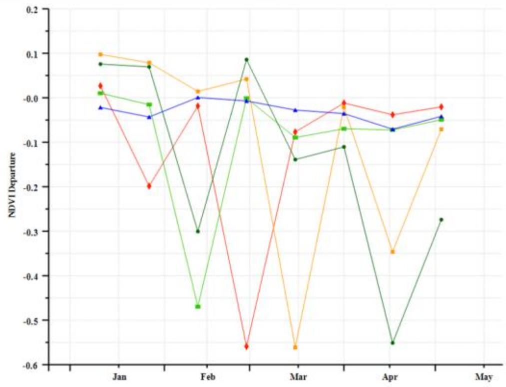
(a) Phenology of major crops



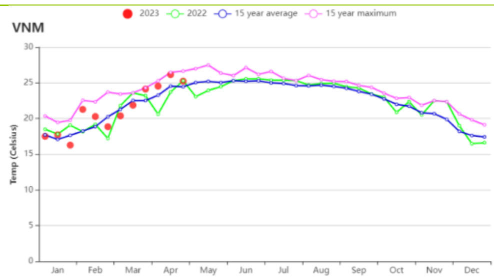


(b) Crop condition development graph based on NDVI (c) Maximum VCI

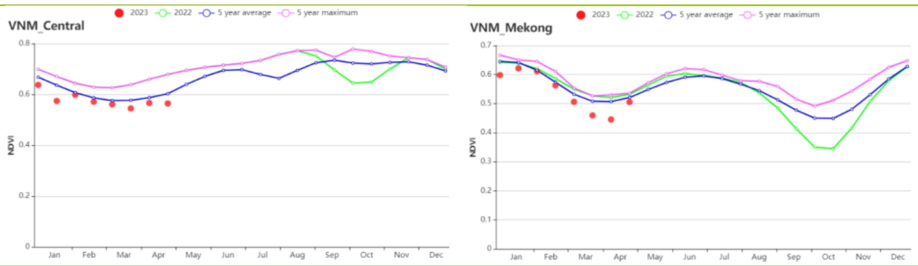




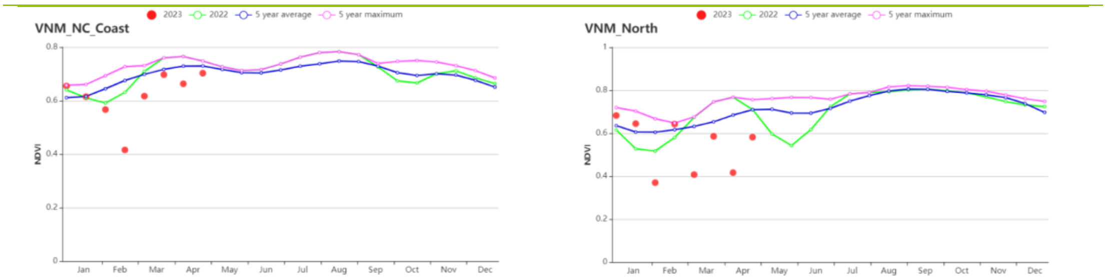
(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles



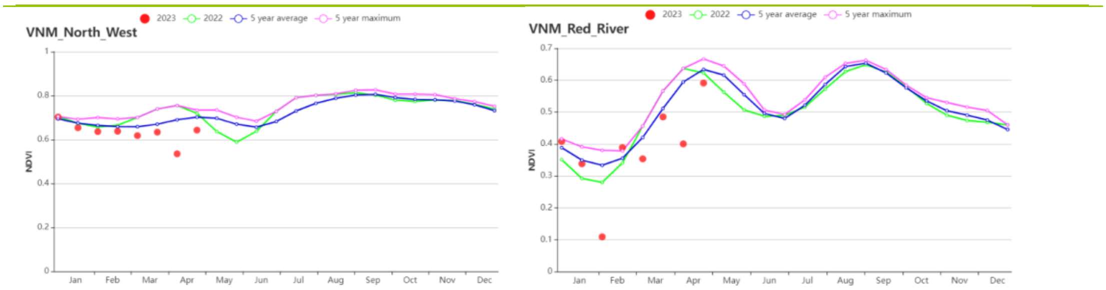
(f) Rainfall profiles (g) Temperature profiles



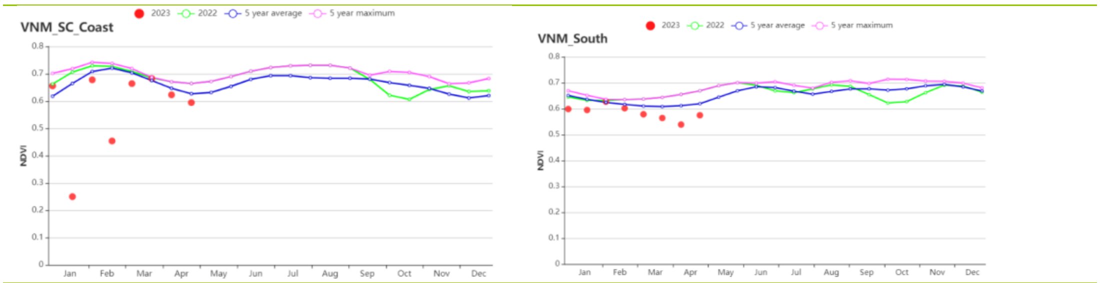
(h) Crop condition development graph based on NDVI Central Highlands Vietnam (left), and Mekong River Delta (right)



(i) Crop condition development graph based on NDVI North Central Coast Vietnam (left), and North East Vietnam (right)



(j) Crop condition development graph based on NDVI North West Vietnam (left), and Red River Delta (right)



(k) Crop condition development graph based on NDVI South Central Coast Vietnam (left), and South East Vietnam (right)

Table 3.77 Vietnam's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, January-April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure from 15YA (%)	Current (°C)	Departure from 15YA (°C)	Current (MJ/m^2)	Departure from 15YA (%)	Current (gDM/m^2)	Departure from 15YA (%)
Central Highlands	224	-14	21.9	-0.2	1149	1	737	0
Mekong River Delta	315	0	27.2	-0.2	1228	2	950	6
North Central Coast	280	-24	19.7	0.4	941	6	760	-9
North East	191	-44	18.0	1.2	785	11	599	-21
North West	115	-56	18.3	1.0	1034	8	493	-28
Red River Delta	194	-39	19.9	0.7	714	11	634	-18
South Central Coast	406	-4	21.0	0.6	1060	2	903	2
South East	278	11	26.0	0.0	1253	5	795	3

Table 3.78 Vietnam's agronomic indicators by sub-national regions, current season's values and departure from 5YA, January-April 2023

Region	Cropped arable land fraction		Maximum VCI
	Current (%)	Departure from 5YA (%)	Current
Central Highlands	97	0	0.80
Mekong River Delta	87	1	0.89
North Central Coast	99	0	0.93
North East	99	0	0.95
North West	100	0	0.88
Red River Delta	95	1	0.88
South Central Coast	98	1	0.91
South East	94	1	0.80

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[ZAF] South Africa

In South Africa, soybean and maize are the main crops being produced during this monitoring period. In the west, maize planting finished in January and harvest will start in June. In the east, maize harvest started in April. Soybean was grown from January to March and harvest began in April. The proportion of irrigated cropland in South Africa is 9% and agro-meteorological conditions play an important role in the growth of most crops. Water is generally limiting crop production in South Africa. Based on the NDVI development graph, the crop conditions were near or above the 5-year average until the end of March. In April, they dropped to below-average conditions, due to the precipitation deficit. At the national level, the CropWatch agroclimatic indicators show that TEMP and RADPAR were above the 15-year average (+0.4°C, +5%). Due to the rainfall large deficit (-44%), the BIOMSS decreased significantly by 21% compared to the 15-year average. The VCIx was 0.91. CALF increased slightly (+5%) compared with the last 5 years, indicating good progress with sowing and establishment of the new crops. As to the spatial distribution of NDVI profiles, before April, crop conditions on about 78.7% of the cropland were close to and above average mainly in the central and eastern parts, and on about 21.3%, they were below average. The areas with negative departures were mainly in the western region, located in Gauteng, Mpumalanga, North West and Orange Free State Province. The rainfall deficit started to impact growth in April, when NDVI levels dropped to below-average levels, but the drier weather in April helped with crop harvesting. Overall, crop conditions in South Africa were favorable.

Regional analysis

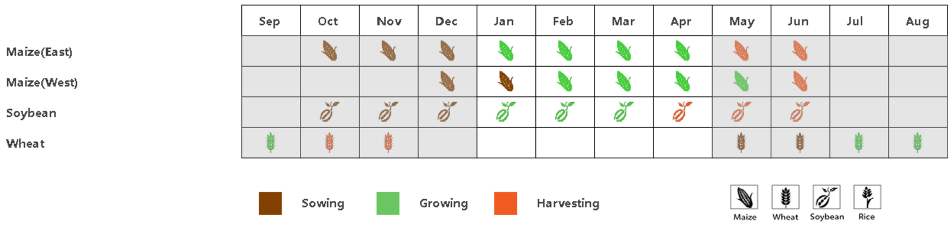
In the Arid and desert zones (221), RAIN was significantly below average (-42%), whereas RADPAR and TEMP were slightly above average (+2%, +0.2°C). BIOMSS decreased by 13% due to the shortage of rainfall. CALF increased (+9%) and VCIx was 0.86. The crop condition development graph based on NDVI indicates that the crop conditions were generally above and close to the 5-year average in most months. Crop production is expected to be favorable.

In the Humid Cape Fold mountains (222), the TEMP (+0.5°C) and RADPAR (+4%) were above average. Due to insufficient rainfall (-19%), BIOMSS was below the 15-year average (-12%). CALF was 98% and VCIx was 0.93. The crop condition development graph based on NDVI also indicates favorable crop conditions, but the large rainfall deficit started to impact growth in April, when NDVI levels dropped to below-average levels.

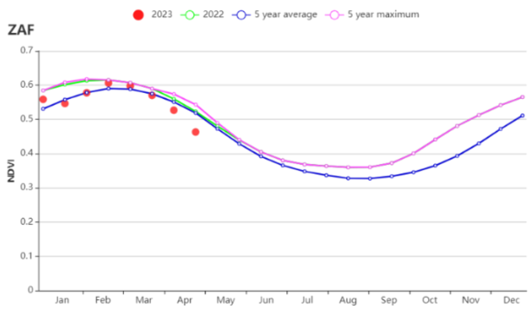
In the Mediterranean zone (223), the TEMP and RADPAR were below average (-0.5°C, -4%). The BIOMSS was increased by 4% benefiting from the sufficient rainfall (+21%). CALF was increased significantly (47%, +98%) and VCIx was 1.30. According to the crop condition development graph, the NDVI was above the 5-year average in the entire period and even above 5-year maximum after Feburary, the CPI was 2.43, indicating that crop conditions were generally favorable.

In the Dry Highveld and Bushveld maize areas (224), RAIN (-56%) was significantly below the 15-year average, whereas TEMP and RADPAR were above average (+0.6°C, +7%). The BIOMSS was decreased significantly by 26% due to the insufficient rainfall. CALF increased slightly (99%, +2%) and VCIx was 0.87. The crop condition development graph based on NDVI shows that the NDVI was close to and above the 5-year average for most of the period, and the CPI was 1.06. All in all, the crop conditions were favorable, but the large rainfall deficit started to impact growth in April, when NDVI levels dropped to below-average levels.

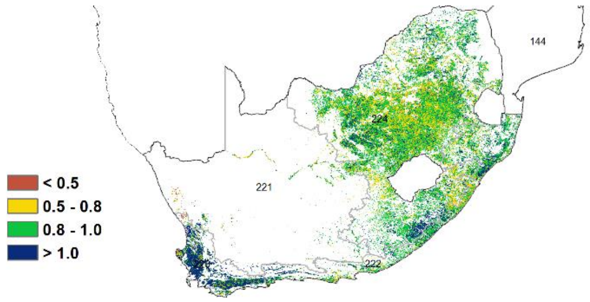
Figure 3.44 South Africa's crop condition, January - April 2023



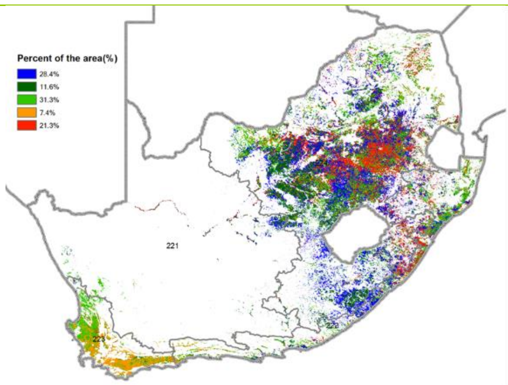
(a) Phenology of major crops



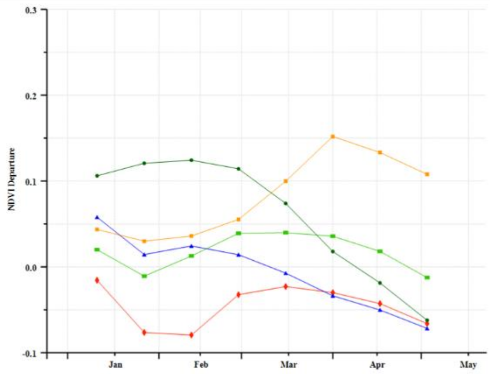
(b) Crop condition development graph based on NDVI



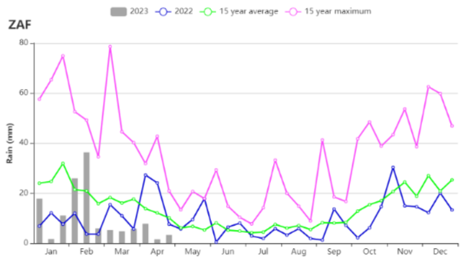
(c) Maximum VCI



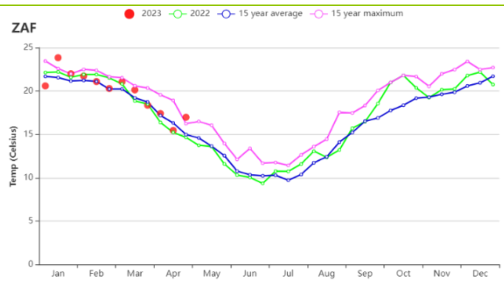
(d) Spatial NDVI patterns compared to 5YA



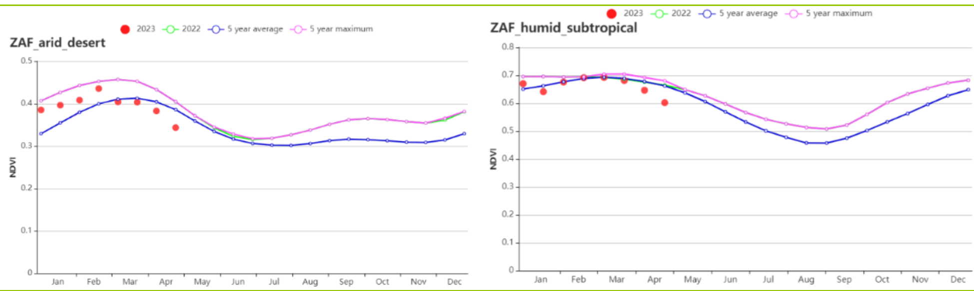
(e) NDVI profiles



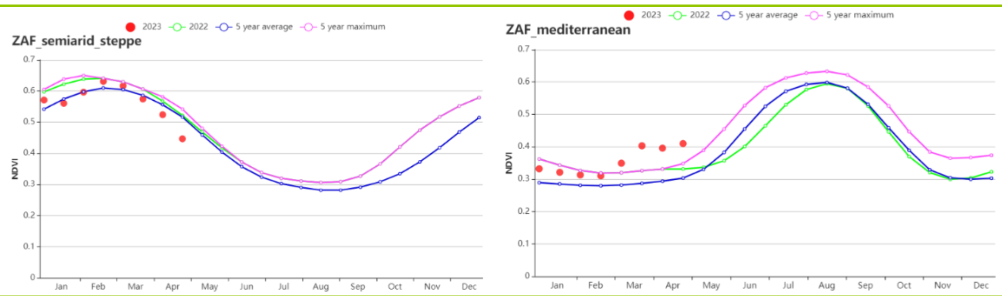
(f) Rainfall profiles



(g) Temperature profiles



(h) Crop condition development graph based on NDVI Arid desert (left) and Humid sub-tropical (right)



(i) Crop condition development graph based on NDVI semiarid steppe (left) and Mediterranean (right)

Table 3.79 South Africa's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, January - April 2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Arid and desert zones	66	-42	20.8	0.2	1353	2	517	-13
Humid Cape Fold mountains	272	-19	20.1	0.5	1186	4	762	-12
Mediterranean zone	118	21	18.8	-0.5	1246	-4	572	4
Dry Highveld and Bushveld maize areas	99	-56	20.0	0.6	1350	7	540	-26

Table 3.80 South Africa's agronomic indicators by sub-national regions, current season's values and departure from 5YA, January - April 2023

Region	Cropped arable land fraction		Maximum VCI
	Current (%)	Departure (%)	Current
Arid and desert zones	61	9	0.86
Humid Cape Fold mountains	98	2	0.93
Mediterranean zone	47	98	1.30
Dry Highveld and Bushveld maize areas	99	2	0.87

AFG AGO ARG AUS BGD BLR BRA CAN DEU DZA EGY ETH FRA GBR HUN IDN IND IRN ITA KAZ KEN KGZ KHM LKA MAR MEX MMR MNG MOZ NGA PAK PHL POL ROU RUS SYR THA TUR UKR USA UZB VNM ZAF **ZMB**

[ZMB] Zambia

The report covers the period from January to April as part of the rainfed crop production in Zambia, dominated by major cereal crops (maize, sorghum, and millet), legumes, and pulses. These crops are planted from mid-November to early January, depending on the agro-ecological region.

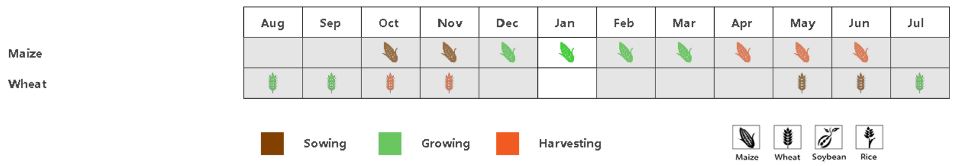
Based on the CropWatch agronomic indicators at the national level, a nationwide decrease in rainfall (860 mm, -14%) was observed while the temperature was unchanged (20.8ºC, +0%). There was an increase in radiation potential (1184 MJ/m2, +2%) and a decrease in potential biomass production (1189 gDM/m2, -5%) while CALF was 100%. The reduction in biomass production can be attributed to decreased rainfall and flooding between January and February. The NDVI profile indicated below 5-year average conditions from January to April, while the low NDVI of late January may be attributed to the flooding experienced in most parts of the country. However, the VCIx was 0.94 varying from 0.92 to 0.95, with the lowest VCIx experienced in the Western Semi-arid plain 228 (0.92) and highest in the Northern High rainfall zone 226 (0.95).

Total cereal production was estimated at a below-average level, reflecting the impact of widespread seasonal rainfall deficits and incidences of flooding of some cultivated fields.

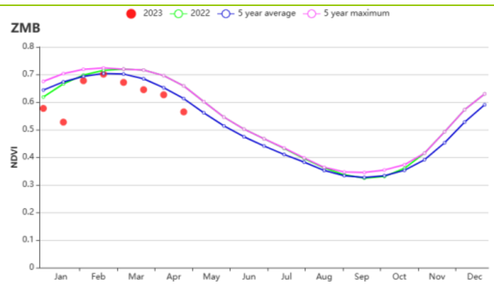
Regional Analysis

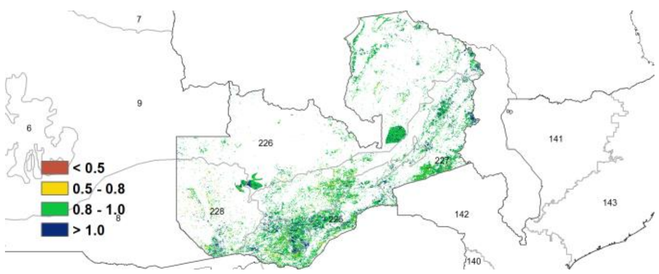
Zambia has 4 distinctive agro-ecological zones: Western Semi-arid plain (AEZ 227), Luangwa-Zambezi valley (AEZ 225), Northern high rainfall region (AEZ) 226, and Central Eastern and Southern plateau (AEZ 228). The regional analysis of rainfall showed a reduction across all regions, namely in the Western Semi-arid plain (-32%), Luangwa-Zambezi valley (-24%), Northern high rainfall region (-12%), and Central Eastern and Southern plateau (-9%). A slight reduction in potential solar radiation (-0.4%) was observed in the Western semi-arid plain, and other regions recorded an increase in solar radiation. Biomass production decreased across all the zones, reflected in the widespread seasonal rainfall deficits and flooding events of critically affected lowland areas. The VCIx varied from 0.92 to 0.94 across the regions, with the lowest recorded in the Western semi-arid plain (0.92) and the highest in the Northern high rainfall zone (0.95). However, the area under cultivation remained at 100% in all the regions. The reported period was critical for the plant growth development of rainfed cereal crops, and moisture stress and low input availability largely caused crop yield reduction nationwide.

Figure 3.45 Zambia's crop condition, January - April 2023



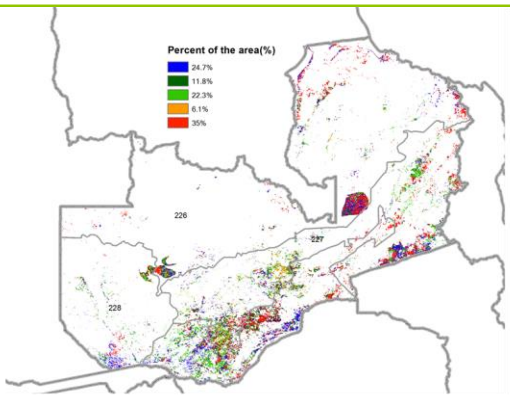
(a) Phenology of major crops

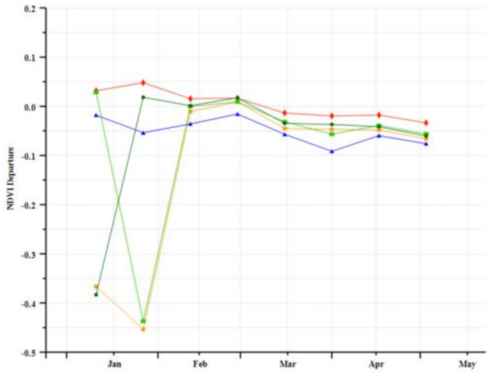




(b) Crop condition development graph based on NDVI

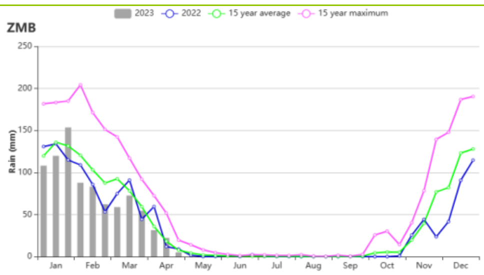
(c) Maximum VCI

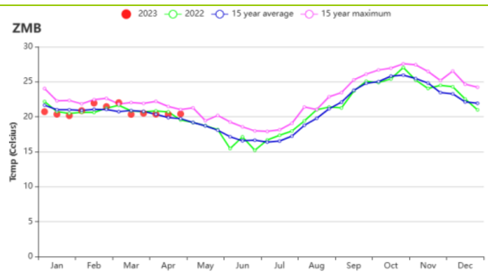




(d) Spatial NDVI patterns compared to 5YA

(e) NDVI profiles





(f) Rainfall profiles

(g) Temperature profiles

Table 3.81 Zambia's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, January - April2023

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Luangwa Zambezi rift valley	649	-23.5	22.0	0.2	1243	0.3	1037	-12.2
Western semi-arid plain	522	-32.2	22.7	0.4	1214	-0.4	1083	-11.2
Central-eastern and southern plateau	892	-8.6	20.7	-0.1	1176	1.2	1228	-2.9
Northen high rainfall zone	1011	-12.2	19.6	0.0	1149	4.6	1290	-1.3

Table 3.82 Zambia's agronomic indicators by sub-national regions, current season's values and departure from 5YA, January - April2023

Region	Cropped arable land fraction		Maximum VCI
	Current (%)	Departure (%)	Current
Luangwa Zambezi rift valley	99.9	0.0	0.94
Western semi-arid plain	99.8	-0.1	0.92
Central-eastern and southern plateau	100.0	0.0	0.94
Northen high rainfall zone	99.9	0.1	0.95

Chapter 4. China

After a brief overview of the agro-climatic and agronomic conditions in China over the reporting period (section 4.1), Chapter 4 presents an updated estimate of major cereals and soybean production at provincial and national level as well as summer crops production and total annual outputs (4.2) and describes the situation by region, focusing on the seven most productive agro-ecological regions of the east and south: Northeast China, Inner Mongolia, Huanghuaihai, Loess region, Lower Yangtze, Southwest China, and Southern China (4.3). Additional information on the agro-climatic indicators for agriculturally important Chinese provinces are listed in table A.11 in Annex A.

4.1 Overview

This report covers the main growing period of winter wheat and rapeseed. The sowing of the first summer crops, such as spring maize and early rice started in March. Half of cropland in China is irrigated and agro-meteorological conditions play important role for the rest crops. Rainfall is not the major influential factor on irrigated cropland.

Generally speaking, agroclimatic conditions over the major winter crops producing regions were normal. For China, RADPAR and TEMP increased by 4% and 1.1℃, respectively, as compared to the 15-year average, whereas RAIN decreased by 12%. Consequently, BIOMSS was at average compared to the 15-year average. During the monitoring period, rainfall in China's main winter crop producing area (Huanghuaihai) was 21% above average and the temperature was 1.4℃ higher. The favorable hydrothermal conditions contributed to the good crop growth state, as confirmed by the VCIx value at 0.86. National CALF decreased by 4% and VCIx was quite fair, with a value of 0.79. National Crop Production Index (CPI) was 1.11, indicating slightly better-than-normal crop production conditions. All in all, the conditions for winter crop production in China were fair, apart from Southern- and South-West China, which was affected by a rainfall deficit.

Spatially, most of the arable land (marked in dark green and blue, taking up 92.2% of the arable land) experienced average precipitation throughout the monitoring period, with the absolute value of departure was less than 30 mm/dekad. Arable land in the remaining 7.8% of the regions (marked by light green) went through some rainfall fluctuations, mainly distributed in Guangdong, Fujian, Jiangxi, and some parts of Guangxi, Hunan, and Jiangsu. Negative rainfall anomalies (more than 60 mm/dekad below average) occurred in early March, and positive rainfall anomalies (more than 120 mm/dekad above average) occurred in late March. With respect to temperature, the clustered regions all had anomalies with similar changing patterns over time across the whole country. The dark green marked areas, including most parts of Northeast China, Huanghuaihai, and some parts of Lower Yangtze and Southwest China, had the biggest positive temperature departure (more than 6.5℃ above average) in early March. The light green marked areas, including some parts of Inner Mongolia, Loess region and Southwest China, had the biggest negative temperature departure (more than 4.0℃ below average) in late April. The uncropped areas were mainly located in the Northwest and Northeast regions and some parts in Inner Mongolia, Gansu, Ningxia, Shaanxi, Shanxi, and Hebei. Cold temperatures during the winter months make them unsuitable for crop production.

According to the spatial VCIx patterns, favorable crop conditions (VCIx larger than 0.8) occurred widely across China; values between 0.5 and 0.8 were observed for some parts in Inner Mongolia, Gansu, Ningxia, Shaanxi, Shanxi, Hebei, Sichuan, Hubei, Jiangxi, and Guizhou. The potential biomass showed significant variability across regions. Positive anomalies (more than 20%, marked in blue) mainly occurred in eastern

Northeast China, southern Inner Mongolia, eastern Loess region, and western Huanghuaihai, while negative anomalies (-20% or more) were mainly observed in some parts of Inner Mongolia, Liaoning, Yunnan, Guangxi, Guizhou, Hunan, and Sichuan. With regard to VHIn, high values (above 35%) were widespread in China, indicating limited water deficit effects on most of the winter crops.

As for the main producing regions at the sub-national level, rainfall was above average in Inner Mongolia, Huanghuaihai and Loess region by 5%, 21%, and 35%, respectively, while rainfall in other regions was below average, ranging from -31% (Southern China) to -4% (Northeast China and Southwest China). TEMP was all above average, and the range of temperature departures varied from +0.8°C (Southwest China and Loess region) to +1.5°C (Northeast China). RADPAR was above average, except for Inner Mongolia (-1%), Loess region (-1%) and Northeast China (-1%). BIOMSS increased in almost all of the regions compared to average, with the anomalies ranging from +1% (Lower Yangtze) to +20% (Loess region), except for Southern China (-18%) and Southwest China (-2%). CALF in almost all of the regions was all below average to average, and only CALF in Lower Yangtze (+1%) and Huanghuaihai (+3%) was slightly above average. As for VCIx, the values were quite varying for all the regions, ranging between 0.74 (Loess region) and 0.90 (Lower Yangtze region).

Table 4.1 CropWatch agroclimatic and agronomic indicators for China, January - April 2023, departure from 5YA and 15YA

Region	Agroclimatic indicators				Agronomic indicators	
	Departure from 15YA				Departure from 5YA	Current period
	RAIN (%)	TEMP (°C)	RADPAR (%)	BIOMSS (%)	CALF (%)	Maximum VCI
Huanghuaihai	21	1.4	0	12	3	0.86
Inner Mongolia	5	1.1	-1	5	/	/
Loess region	35	0.8	-1	20	-10	0.74
Lower Yangtze	-11	1.2	9	1	1	0.90
Northeast China	-4	1.5	-1	8	/	/
Southern China	-31	1.1	9	-18	0	0.89
Southwest China	-4	0.8	3	-2	-3	0.84

Figure 4. 1 China crop calendar

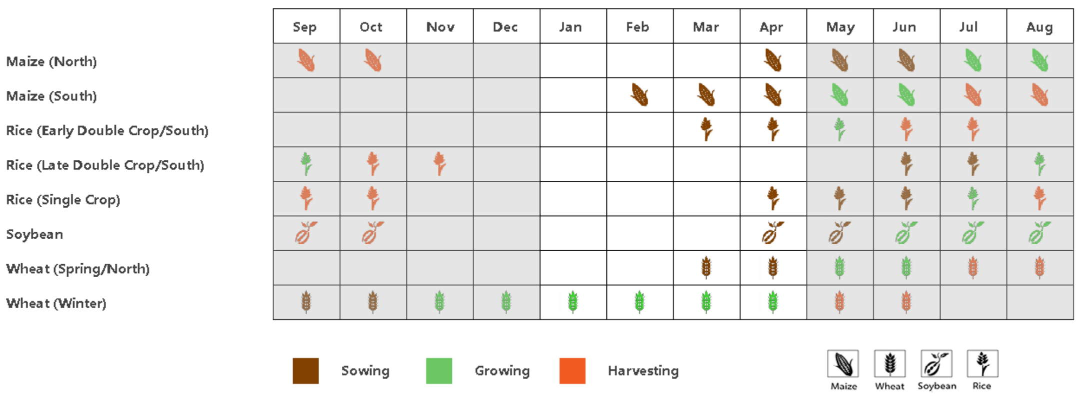


Figure 4.2 China spatial distribution of rainfall profiles, Jan to Apr 2023

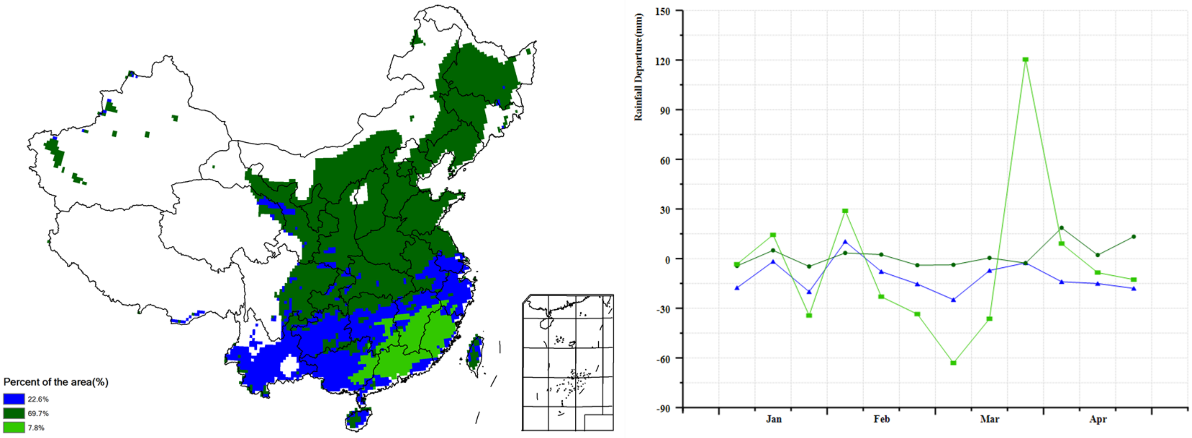


Figure 4.3 China spatial distribution of temperature profiles, Jan to Apr 2023

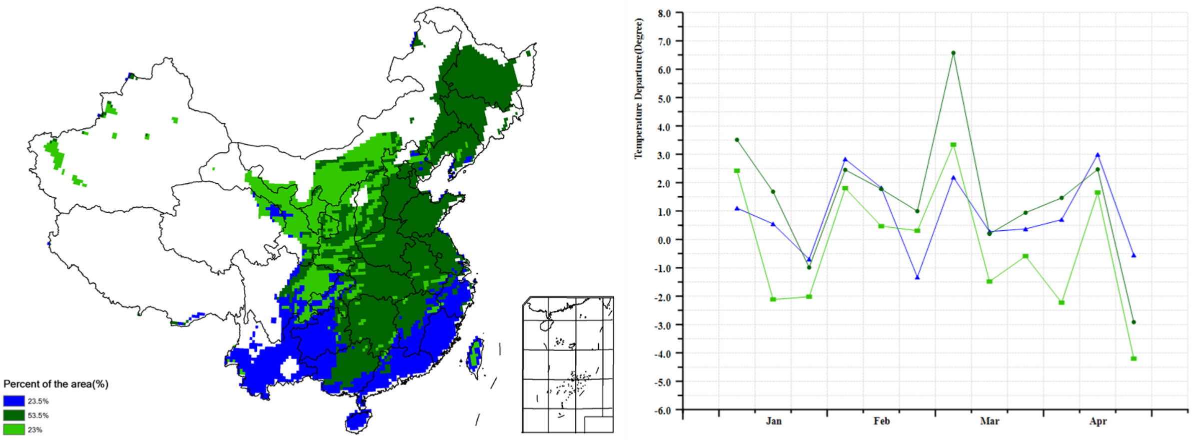


Figure 4.4 China cropped and uncropped arable land, by pixel, Jan to Apr 2023

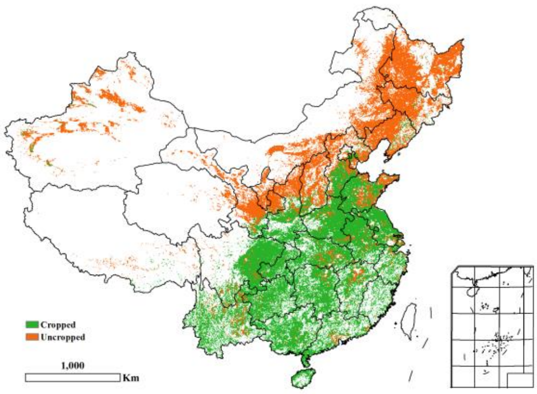


Figure 4.5 China maximum Vegetation Condition Index (VCIx), by pixel, Jan to Apr 2023

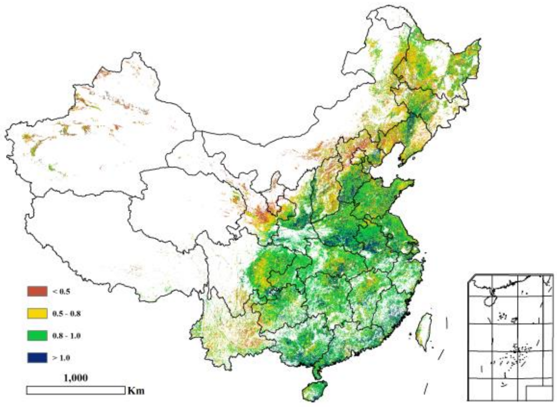
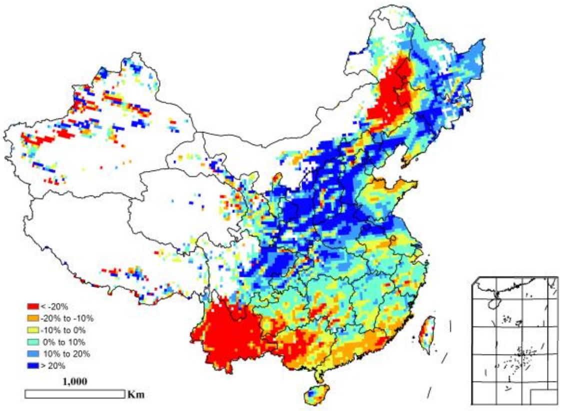
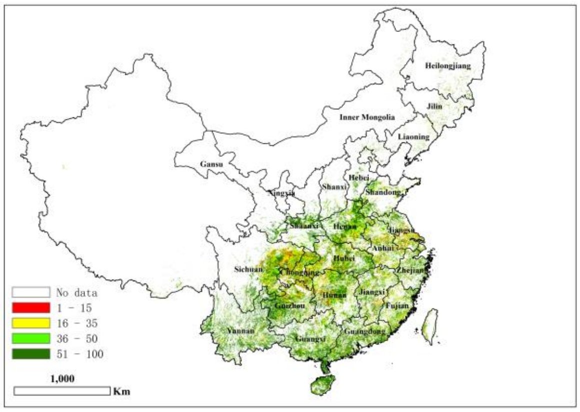


Figure 4.6 China biomass departure map from 15YA, by pixel, Jan to Apr 2023

Figure 4. 7 China minimum Vegetation Health Index (VHIn), by pixel, Jan to Apr 2023


< -20%
-20% to -10%
-10% to 0%
0% to 10%
10% to 20%
> 20%
1,000
Km


Heilongjiang
Jilin
Inner Mongolia
Liaoning
Gansu
Hebei
Shanxi
Shandong
Shaanxi
Jiangsu
Sichuan
Hubei
Anhui
Zhejiang
Hunan
Jiangxi
Guizhou
Fujian
Yunnan
Guangxi
Guangdong
No data
1 - 15
16 - 35
36 - 50
51 - 100
1,000
Km

4.2 China's crop production

(1) Winter grain production forecast

The main winter grain producing areas in China experienced abundant precipitation during the overwintering to spring green-up and flowering period. The accumulated rainfall and average temperature were higher than the 15YA for the same period. In March-April, temperatures were cooler than average, which delayed canopy growth. Starting in late April, the weather conditions returned to normal levels. The total winter grain production in China is expected to be 144.14 million tons in 2023, an increase of 1.91 million tons or 1.3% year-on-year (Table 4.2).

Table 4.2 China's winter crop production

City	Production (million tons)	Area variation (%)	Yield variation (%)	production Variation (%)	Summer grain production (million tons)
Hebei	12.51	2.4	-0.3	2.1	12.77
Shanxi	2.34	0.8	-3.9	-3.2	2.27
Jiangsu	13.99	0.5	-0.6	-0.1	13.97
Anhui	14.66	2.5	0.4	3.0	15.09
Shandong	27.15	2.8	-2.3	0.5	27.28
Henan	32.65	2.2	2.0	4.2	34.04
Hubei	6.19	-0.9	-3.8	-4.7	5.90
Sichuan	5.96	-2.7	-0.4	-3.1	5.77
Shaanxi	4.07	-2.2	2.4	0.2	4.07
Gansu	3.56	-2.5	-2.0	-4.4	3.41
Xinjiang	5.12	2.2	-0.3	1.9	5.21
Subtotal	128.19			1.2	129.77
National*	142.23	1.6	-0.2	1.3	144.14

*Note: Summer grains from Taiwan Province are not included in the total production of other provinces and the country.

Fall planting in the North China Plain in 2022 was normal, and the area planted with winter grains increased by 1.6%. For the 2021-22 season, the area had been reduced due to local flooding, which had prevented planting. In Henan, Shandong, Anhui, Hebei, the four major winter grain producing provinces, the planted area increased by 2.2%, 2.8%, 2.5% and 2.4%. Xinjiang's winter grain area increased by 2.2%. Shanxi's and Jiangsu's areas also increased slightly by 0.8% and 0.5%, respectively. This contributed to an increase in the national area of winter cereals and a return to the 2020-21 level.

There was a wide variation in winter grain yield among the regions. Henan benefited from good agro-meteorological conditions, and its winter grain yield increased by 2.0% year on year. Combined with the increase in area, Henan's winter grain production increased by 1.39 million tons to 34.04 million tons. Although the winter grain area in Shaanxi decreased by 2.2%, meteorological conditions were generally good and conducive for winter wheat growth and yield formation. The forecasted winter grain yield in Shaanxi increased by 2.4%, offsetting the impact of the area decrease. Most winter grain producing areas in northern China experienced strong cold air in late April. Rain and snow in central Shanxi, western Hubei, and eastern Gansu caused frost damage to winter wheat during the flowering and grainfilling periods, reducing winter grain yields by 3.2%, 4.7%, and 4.4%.

(2) Winter wheat production forecast

This report estimates the winter wheat yield in China for the 2022-23 season. It is based on remote sensing data from ESA Sentinel-1 and 2 and US Landsat 8 satellites, as well as a large survey. We applied machine learning and crop yield forecasting models in conjunction with the satellilte data, agro-meteorological information and crop survey data to generate the production forecasts. Winter wheat production in China in 2023 is estimated at 130.56 million tons, an increase of 2.05 million tons or 1.6% (Table 4.3). The area planted with winter wheat reached 23,72 million hectares, recovering to the level of 2020-21. The area planted with winter wheat in 2023 increased by 422 thousand hectares or 1.8% compared with 2022; the average yield of winter wheat was 5505 kg/ha. It had slightly decreased by 0.2% year on year, and the small decrease was mainly due to frost damage in some regions.

The area planted with winter wheat had increased in most provinces, more than offsetting the slight decrease in yield. In the 2021/22 season, the area had been reduced to flooding. During the current season, planting resumed to average levels. Henan, Anhui, Hebei, Shandong and other major winter wheat producing provinces in North China increased the winter wheat planting area in 2022 by 2.2%, 2.5%, 1.9% and 2.5%. This resulted in an increase of the winter wheat production by 1.38 million tons, 0.41 million tons, 0.2 million tons and 0.09 million tons. Xinjiang, Shanxi, Gansu, Hubei and Jiangsu provinces and regions also increased their winter wheat area year on year to varying degrees, offsetting the impact of lower yields. Shaanxi and Sichuan winter wheat area decreased by 3.0% and 1.7% year-on-year, respectively, and production decreased by 0.02 million tons and 0.05 million tons.

However, in late May, continuous rainy weather occurred in the major winter wheat production areas of North China, affecting the harvest and drying of wheat in provinces such as Henan. This has led to the emergence of sprouted wheat and mold in some production areas, which may result in a decrease in both the quality and yield of wheat.

Table 4.3 China's winter wheat production

City	Area		Yield		Production		
	2023 (thousand ha)	Variation (%)	2023 (kg/ha)	Variation (%)	2023 (million tons)	Variation (%)	Increment/Decrement (million tons)
Hebei	2130	1.9	5822	-0.3	12.40	1.7	0.2
Shanxi	430	3.1	5217	-3.9	2.24	-1.0	-0.02
Jiangsu	2713	1.3	5037	-0.6	13.67	0.7	0.09
Anhui	3054	2.5	4777	0.3	14.59	2.9	0.41
Shandong	4196	2.5	6422	-2.3	26.95	0.1	0.04
Henan	5402	2.2	6273	2.0	33.88	4.2	1.38
Hubei	1123	2.6	3932	-3.7	4.42	-1.2	-0.05
Sichuan	484	-1.7	3982	-0.6	1.93	-2.3	-0.05
Shaanxi	773	-3.0	3989	2.5	3.08	-0.5	-0.02
Gansu	544	2.8	4105	-0.6	2.23	2.2	0.05
XInjiang	619	5.3	5492	-2.1	3.40	3.1	0.1
Subtotal	21468	2.0	5534	-0.2	118.79	1.8	2.13
National*	23715	1.8	5505	-0.2	130.56	1.6	2.05

*Note: Winter wheat in Taiwan Province is not included.

4.3 Regional analysis

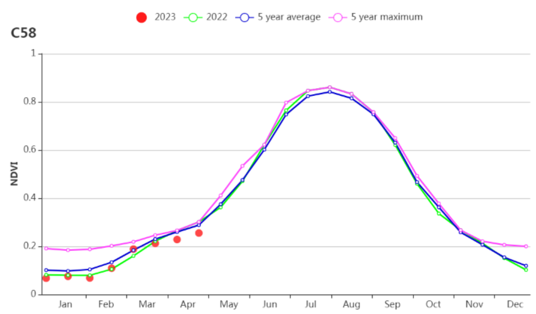
Figures 4.8 through 4.14 present crop condition information for each of China's seven agricultural regions. The provided information is as follows: (a) Phenology of major crops; (b) Crop condition development graph based on NDVI, comparing the current season from January to April 2023 to the previous season, to the five-year average (5YA), and to the five-year maximum; (c) Spatial NDVI patterns for January to April 2023 (compared to the (5YA)); (d) NDVI profiles associated with the spatial patterns under (c); (e) maximum VCI (over arable land mask); and (f) biomass for January to April 2023. Additional information about agro-climatic indicators and BIOMSS for China is provided in Annex A.

Northeast region

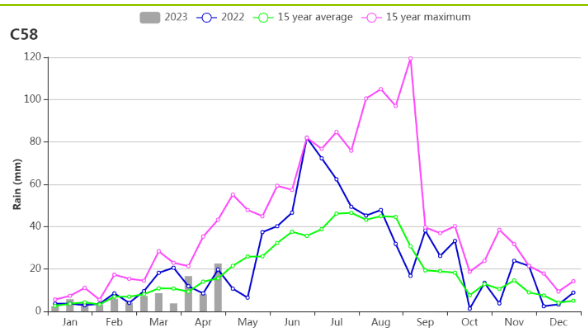
Due to the cold winter weather, no crops were grown in the northeast region of China during this monitoring season (January to April 2023). CropWatch Agroclimatic Indicators (CWAIs) show that the total precipitation decreased by 4%. It was below average in March and it returned to above average in April. The photosynthetically active radiation was below average (RADPAR - 1%), and the temperatures were above average (TEMP +1.5°C). Altogether, the potential biomass was 8% above the fifteen-year average level.

The increase of precipitation in April and the gradual recovery of temperature are beneficial for the spring sowing in the northeast region of China. However, the low precipitation in western part of Heilongjiang province and Jilin province lead to poor soil moisture, which may affect spring sowing and early crop growth to a certain extent. Warmer temperatures and abundant precipitation in May facilitate the germination and good establishment of the summer crops.

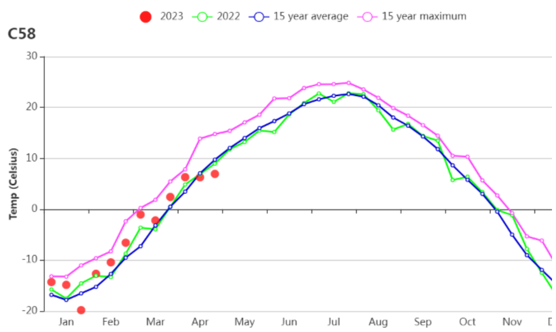
Figure 4. 8 Crop condition China Northeast region, January - April 2023



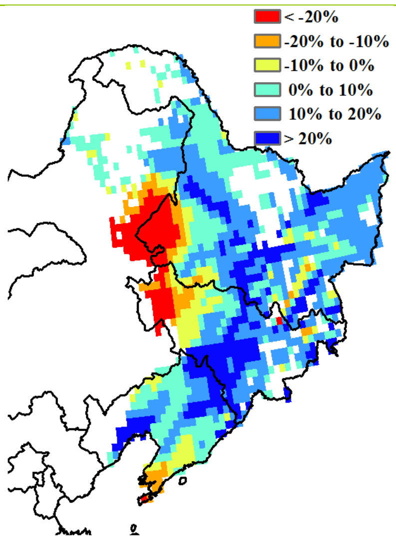
(a) Crop condition development graph based on NDVI



(b) Time series rainfall profile



(c) Time series temperature profile

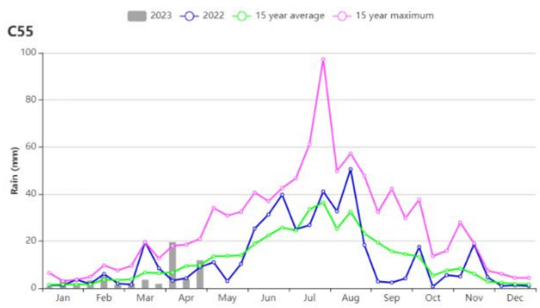


(d) Potential biomass departure from 15YA

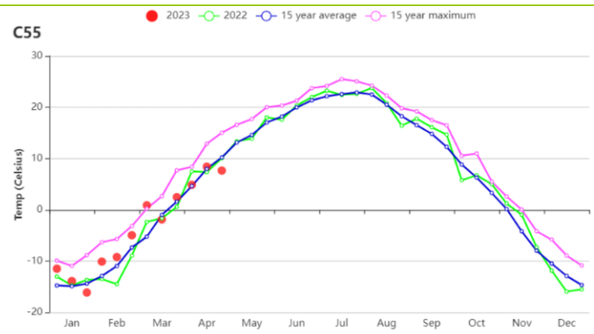
Inner Mongolia

During the first three months of this year, no crops were grown in Inner Mongolia due to the cold temperatures. Sowing activities gradually started in late April. Agro-climatic indicators of the reporting period show that both rainfall and temperature were above average (RAIN +5%, TEMP +1.1°C), while RADPAR was slightly below average (-1%). The resulting BIOMSS was above average (+5%). Higher precipitation and warmer temperatures were beneficial to the spring sowing in the region. Weather conditions in the following months are very critical.

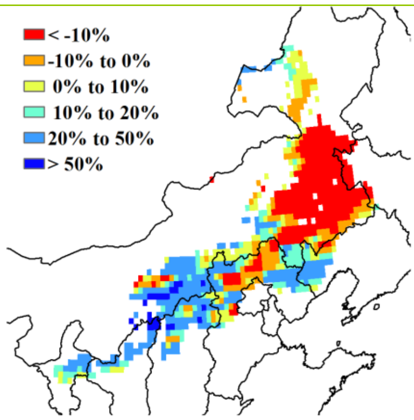
Figure 4. 9 Crop condition China Inner Mongolia, January - April 2023



(a) Time series rainfall profile



(b) Time series temperature profile



(c) Biomass departure

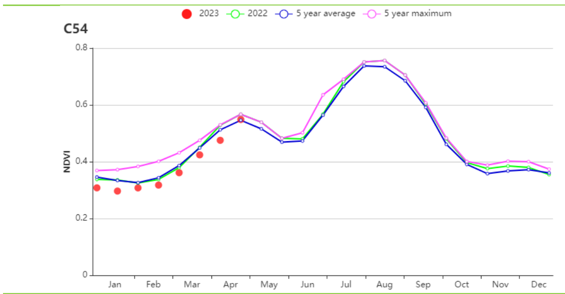
Huanghuaihai

The monitoring period (January to April 2023) covers the early growth to flowering stages of winter wheat in Huanghuaihai. Agro-climatic indicators showed that precipitation (+21%) and temperature (+1.4°C) in this area were above the 15YA, but radiation was unchanged. As a result of these indicators, an increase in crop biomass production potential was estimated (BIOMSS +12%). The CALF exceeded the 5YA by 3%, indicating an increased cropping area. Below-average BIOMSS was located in northern Shandong.

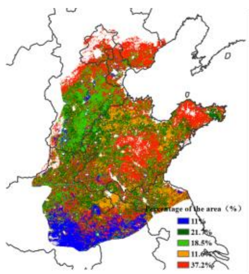
According to the NDVI development graph, crop growth was below average due to the late spring cold. Sufficient rainfall and above-average temperatures caused an increase in NDVI, even above the average level since April. As the NDVI departure clustering map shows, 11% of the cropland exceeded the average before early April, mainly located in central Henan and northeastern Anhui. Crops in the areas of Shandong, northeastern Henan, northern Jiangsu, and the Bohai Bay area (yellow, red, and dark green colors in the NDVI departure clustering map) presented below-average conditions until mid-April but recovered quickly thereafter.

The maximum VCI value was 0.86, and the Crop Production Index (CPI) is 1.10. Generally, the crop conditions in this important winter wheat production region were normal.

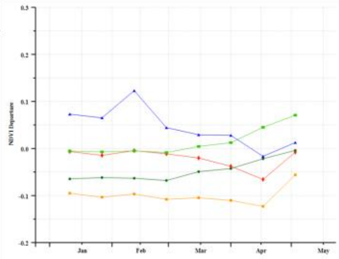
Figure 4. 10 Crop condition China Huanghuaihai, January - April 2023



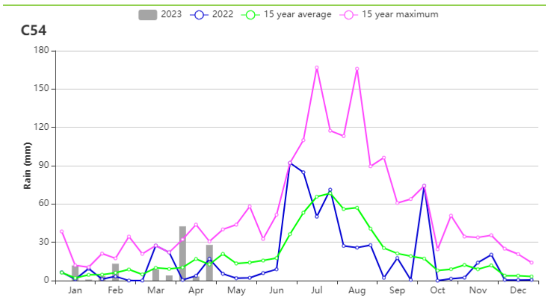
(a) Crop condition development graph based on NDVI



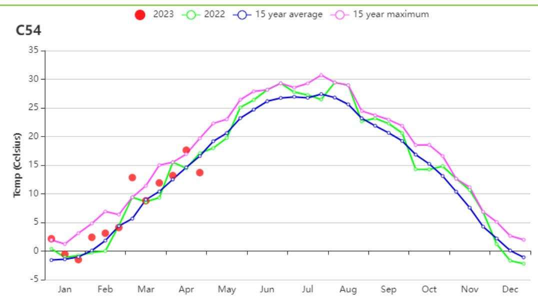
(b) Spatial NDVI patterns compared to 5YA



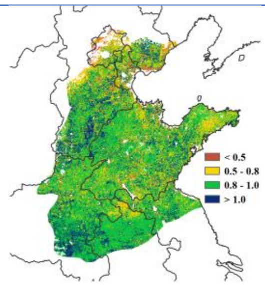
(c) NDVI profiles



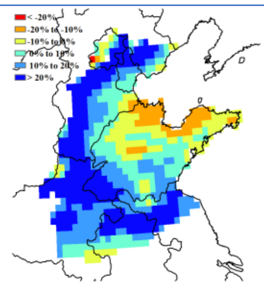
(d)Time series rainfall profile



(e)Time series temperature profile



(f) Maximum VCI



(g) Biomass departure

Loess region

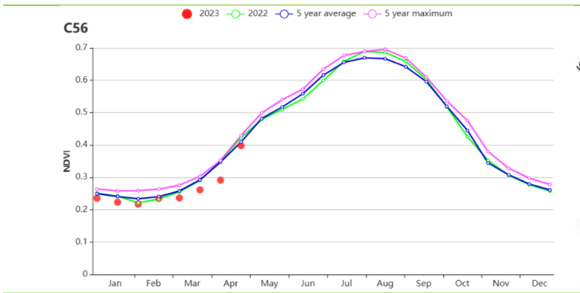
During this reporting period, winter wheat, spring wheat, and spring maize were the predominant crops grown in Loess region. Winter wheat sowing started from late September to mid-October and will be harvested in mid-June. Spring wheat and spring maize were sown from late March to April.

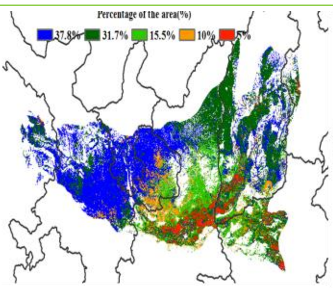
The CropWatch Agroclimatic Indicators (CWAIs) show that radiation in this area was slightly lower by 1% (RADPAR -1%), but precipitation was obviously higher by 35% (RAIN +35%), and temperature was higher by 0.8℃ (TEMP +0.8℃), which brought the potential biomass higher than the 15YA by 20%. Precipitation during most of the monitoring period was close to the average, but in early and late April, the maximum precipitation in 15 years (local snowstorm) exceeded, resulting in low temperature freezing damage in parts of Shanxi and Gansu. According to the regional NDVI development map, the overall crop condition in the Loess region was below the 5YA and recovered to average by April.

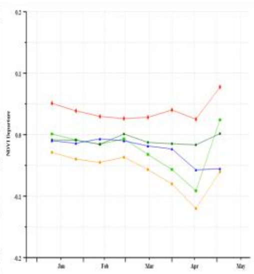
The NDVI departure cluster profiles indicate that about 63.3% of the areas were below average from mid-March to mid-April, and gradually recovered afterward in most areas. In addition, about 5% of the areas were above average, mainly in central Henan, southwestern Shanxi, and southeastern Shaanxi Province. The Maximum VCI map shows a relatively low value of VCIx (0.74), and in southern Ningxia, central Gansu, and parts of Shanxi Province, VCIx was even below 0.5. According to the CALF map, 36% of the farmland was cultivated, which was 10% below the 5YA.

In conclusion, the CPIx in the region was greater than 1, and the crop production situation was expected to be generally normal. The agricultural conditions in the Loess region were close to average.

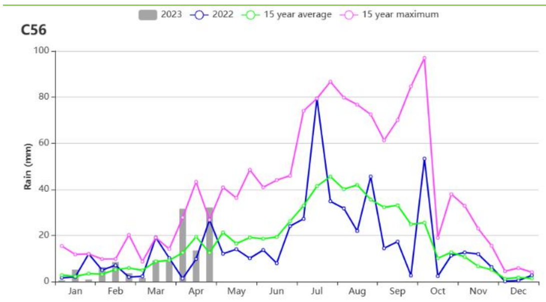
Figure 4.11 Crop condition China Loess region, January - April 2023

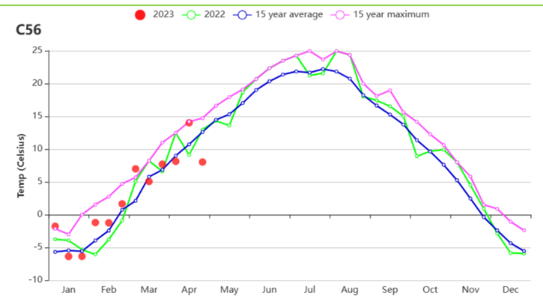




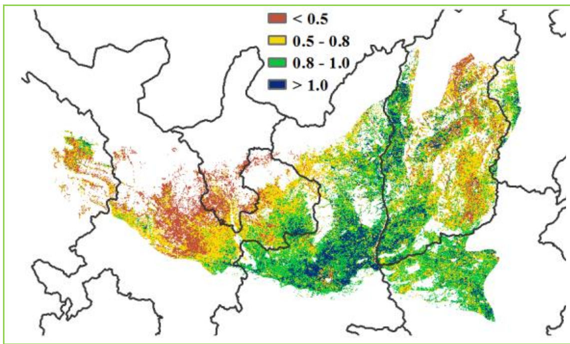


(a) Crop condition development graph based on NDVI (b) Spatial NDVI patterns compared to 5YA (c) NDVI profiles

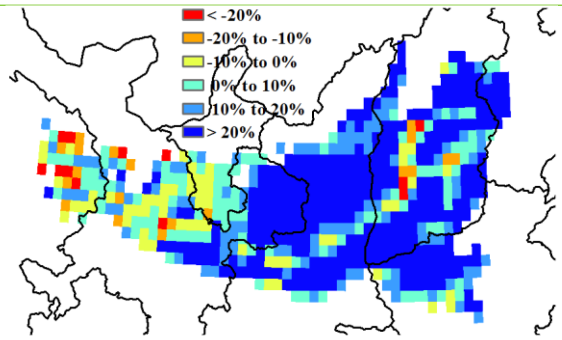




(d)Time series rainfall profile (e)Time series temperature profile



(f) Maximum VCI



(g) Biomass departure

Lower Yangtze region

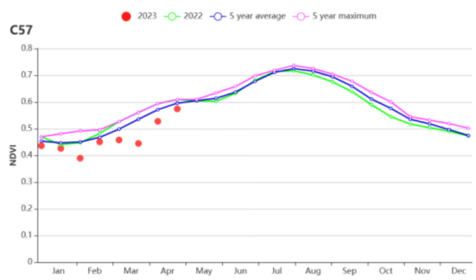
During this monitoring period, only winter crops like wheat and rapeseed were in the field, mostly in the north of the region, including parts of Hubei, Henan, Anhui and Jiangsu provinces. Limited winter crops were planted in Fujian, the southern Jiangxi and Hunan provinces.

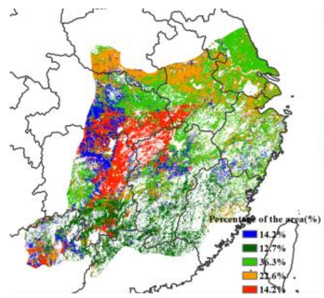
According to the CropWatch agro-climatic indicators, the accumulated precipitation was 11% below the average. Temperature and photosynthetically active radiation were 1.0℃ and 9% higher than the 15-year averages, respectively. The agro-climatic condition with abundant sunlight resulted in an increase of biomass potential production by 1%. The rainfall profile indicates that the decadal precipitation was at or above average from late March.

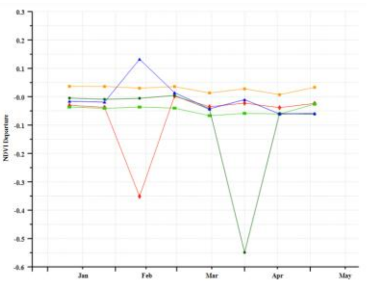
As shown in the NDVI development graph, crop conditions were slightly below the 5-year average. 22.6% of the region, mainly in the northern part, including Anhui, Henan and northern Zhejiang, had above-average crop growth. The crop conditions in other parts were slightly below average. The potential biomass departure indicates that the agro-climatic conditions were generally normal in most areas, with potential biomass departure values mostly between ±10%. The potential biomass in the northern part of this region was higher than 20%, and the NDVI values in the corresponding areas were higher than the 5-year average.. The average VCIx of this region was 0.90, and most of the area had VCIx values ranging from 0.8 to 1.

In general, the crop conditions in the Lower Yangtze region were close to average.

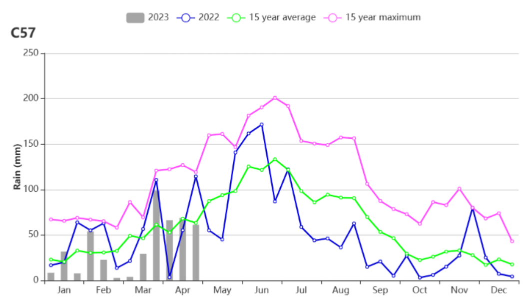
Figure 4.12 Crop condition China Lower Yangtze region, January - April 2023

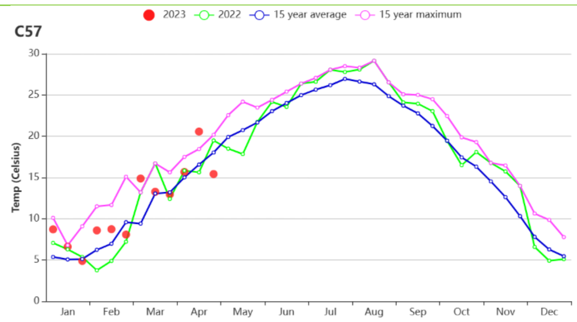




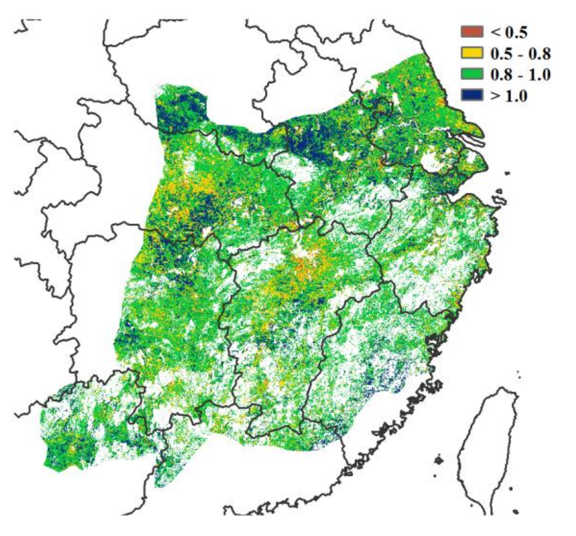


(a) Crop condition development graph based on NDVI (b) Spatial NDVI patterns compared to 5YA (c) NDVI profiles

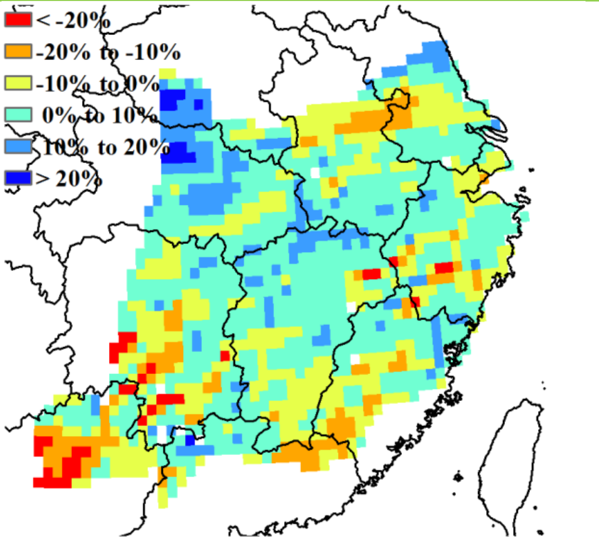




(d)Time series rainfall profile (e)Time series temperature profile



(f) Maximum VCI



(g) Biomass departure

Southwest region

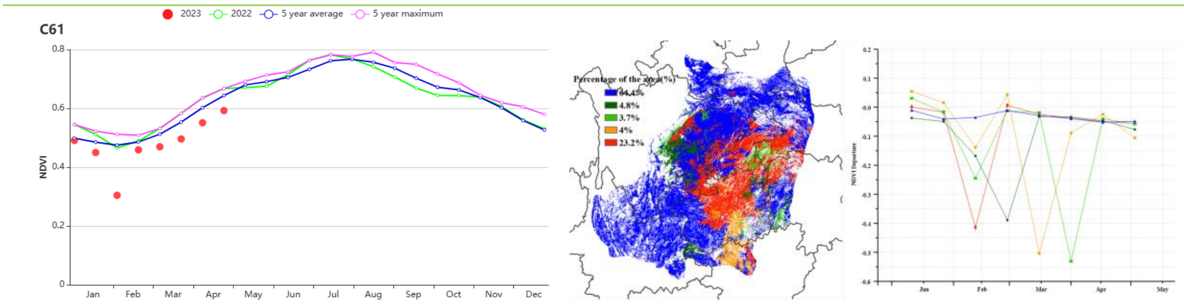
This reporting period covered the overwintering to ripening stage of winter wheat in Southwest China. Based on the NDVI profile, the overall crop conditions during this monitoring period were slightly below the 5-year average.

Agroclimatic indicators indicated a predominance of drier and warmer weather as compared to the 15YA. The RAIN was 304 mm, which was 4.0% below the 15-year average, and the TEMP was 0.8℃ higher than the 15-year average. Solar radiation was slightly higher than the 15YA (RADPAR, +3.3%).

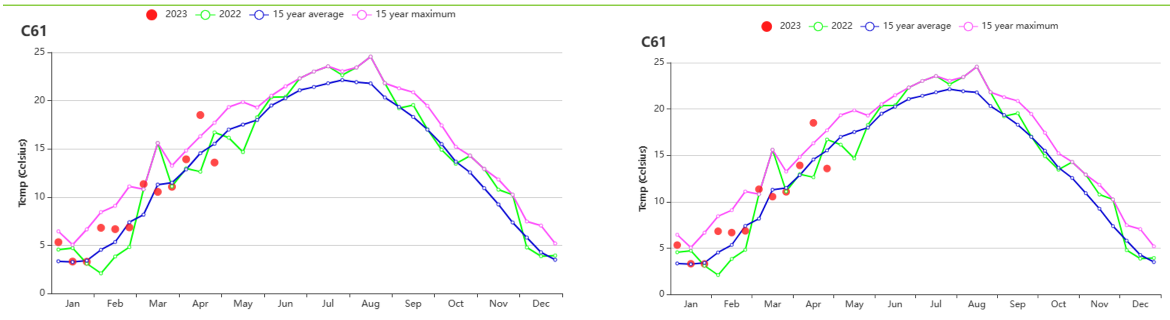
The vegetation condition index (VCI) showed that the optimal vegetation condition reached 0.84, lower than the same period last year (0.89), indicating that the crop condition did not reach the same level as the same period last yea. Based on the VCI map, the affected areas were mainly in the southern and eastern parts of Sichuan and the northern part of Yunnan, with significantly lower VCIx values in these regions.

Overall, the crop conditions in the Southwest region were slightly below the five-year average due to reduced precipitation. However, this region is not the core production area for winter wheat, so the impact on winter wheat production in China is relatively small.

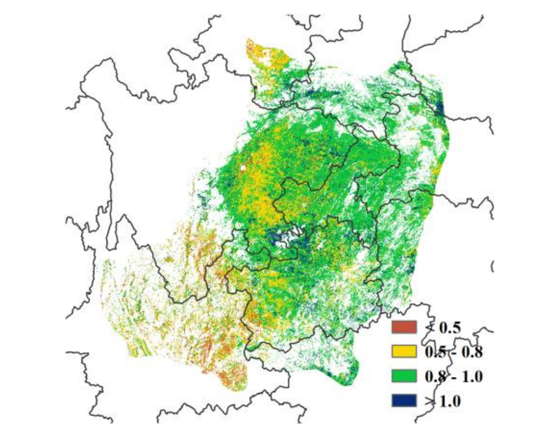
Figure 4.13 Crop condition China Southwest region, January - April 2023



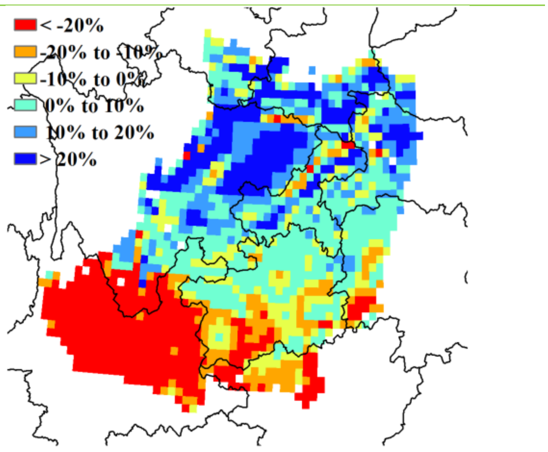
(a) Crop condition development graph based on NDVI (b) Spatial NDVI patterns compared to 5YA(c) NDVI profiles



(d)Time series rainfall profile (e)Time series temperature profile



(f) Maximum VCI



(g) Biomass departure

Southern China

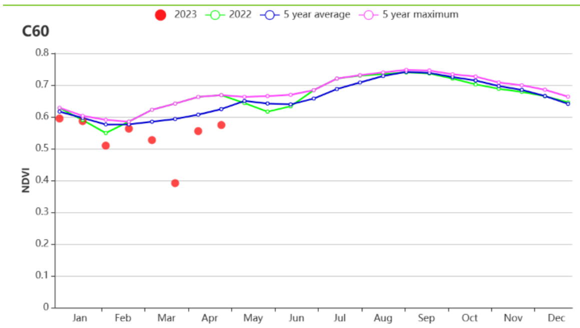
This reporting period covers the seedling and transplanting phases of early rice in Southern China. Based on the regional NDVI profile, crop conditions were below average.

According to the CropWatch agro-climatic indicators, Temperature (+1.1°C) and radiation (+9%) in this area were above average, but rainfall was below the 15-year average (RAIN, -31%), which resulted in below-average BIOMSS (-18%). The cropped arable land fraction remained at the same level as in the last five years.

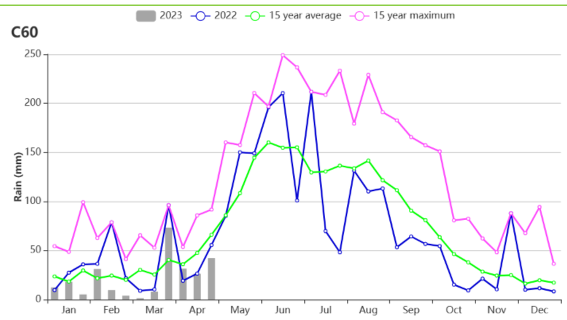
Based on the NDVI departure clustering map and profiles, it was found that most parts of southern China had NDVI values slightly below the average level during the monitoring period. Affected by insufficient precipitation, approximately 28.8% of the region had NDVI values lower than average throughout the monitoring period, and these areas were mainly located in Yunnan, Guangxi, and southwestern Guangdong. Crop conditions in most other areas was slightly lower than the average level. In central Guangxi, the deviation of NDVI started to widen from March, while the growth of crops in most parts of Guangdong returned to the average level by the end of April. The same crop growth pattern was also reflected by the potential biomass departure map, with Yunnan and Guangxi showing a greater decrease in BIOMSS, while Guangdong province showing a relatively smaller decrease.. The average VCIx of this region was 0.89, and most of the area had VCIx values ranging from 0.8 to 1.

In general, the crop conditions were below average.

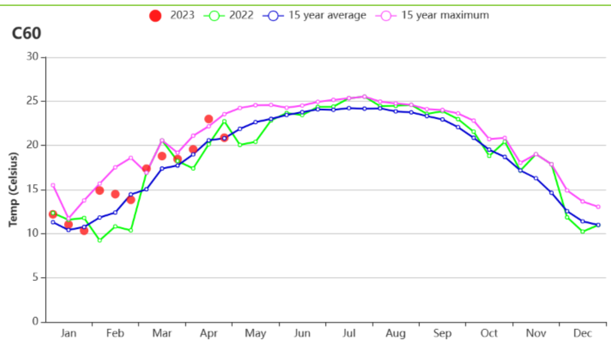
Figure 4.14 Crop condition Southern China, January - April 2023



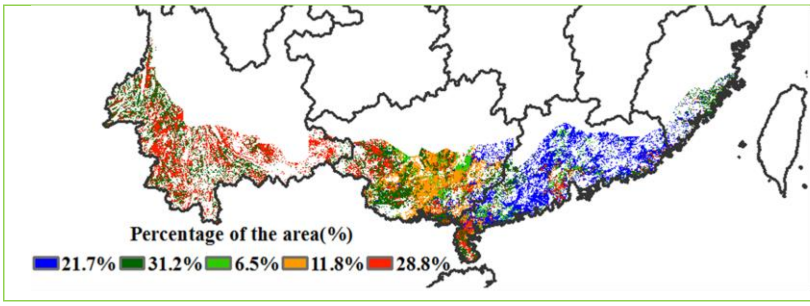
(a) Crop condition development graph based on NDVI



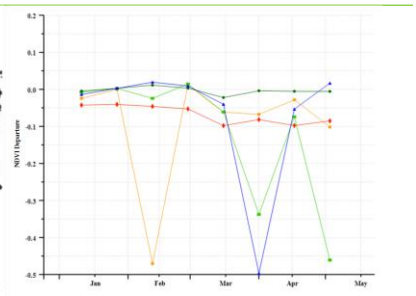
(b) Time series rainfall profile



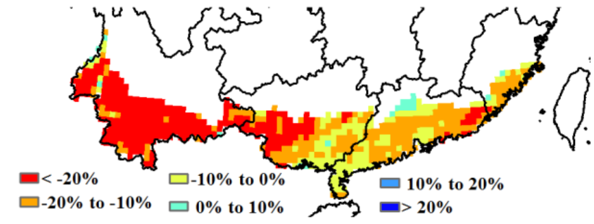
(c)Time series temperature profile



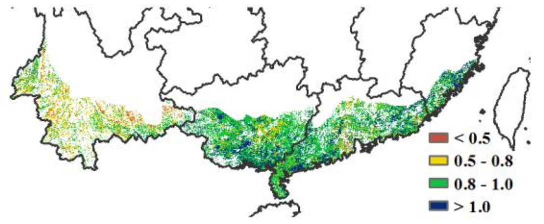
(d) Spatial NDVI patterns compared to 5YA



(e) NDVI profiles



(f) Maximum VCI



(g) Biomass departure

4.4 Major crops trade prospects

(1) International trade prospects for major cereals and oil crop in China

Maize

In the first quarter, China imported 7.52 million tonnes of maize, an increase of 6% over the previous year. The main sources of maize imports were the United States, Brazil, and Ukraine, accounting for 37.8%, 28.8%, and 27.7% of the total import, respectively.

Rice

In the first quarter, China imported 1.004 million tonnes of rice, a decrease of 39.4% over the previous year. The main sources of rice imports were Myanmar, Vietnam, Thailand, India, and Pakistan, accounting for 29.2%, 26.8%, 13.7%, 13.3%, and 8.8% of the total import, respectively.

Wheat

In the first quarter, China imported 4.35 million tonnes of wheat and wheat products, a growth of 42.6% over the previous year. The main sources of wheat imports were Australia, Canada, and France, accounting for 58.2%, 18%, and 17.8% of the total import, respectively.

Soybean

In the first quarter, China imported 23.02 million tonnes of soybeans, an increase of 13.5% over the previous year. The main sources of soybean imports were the United States, Brazil, and Argentina, accounting for 71.3%, 17%, and 6.2% of the total import, respectively.

(2) Trade prospects for major cereals and oil crop in China for 2022

On the basis of remote sensing-based production prediction in major agricultural producing countries in 2023 and the Major Agricultural Shocks and Policy Simulation Model, it is predicted that the import of major grain crops will decrease in 2023. The details are as follows:

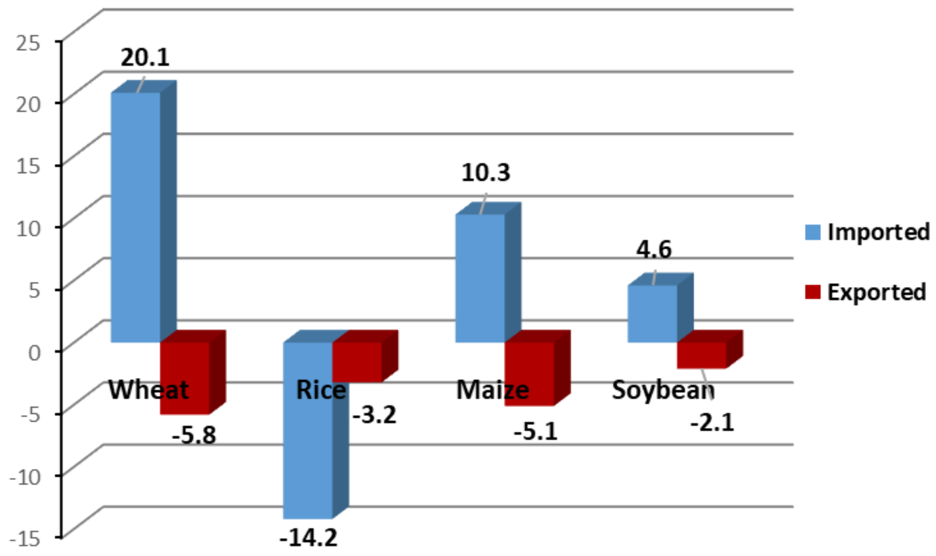
In 2023, China's maize import will increase by 10.3%, and exports will decrease by 5.1%. With the recovery of domestic demand for feed grains and the downward trend of international maize prices, China's maize imports are expected to increase. In particular, the opening of channels for maize imports from Brazil contributes to the anticipated increase in maize imports in 2023.

In 2023, China's rice import will decrease by 14.2%, and exports will decrease by 3.2%. Factors such as the uncertainty of policies, such as increased tariffs by the Indian government, and reduced production due to disasters, contribute to weakened rice import demand in China. It is expected that rice imports in China will decrease in 2023.

In 2023, China's wheat import will increase by 20.1%, and exports will decrease by 5.8% in 2023. The main driving factors for wheat imports are strong domestic demand for high-quality special-purpose wheat and the price advantage of foreign wheat. Considering the economic complexities following the COVID-19 pandemic, wheat imports in 2023 are expected to remain at a relatively high level.

In 2023, China's soybean import will increase by 4.6%, while exports will remain relatively stable. Despite domestic efforts to increase soybean oilseed production capacity, imported soybeans remain the main raw material for soybean crushing. Brazil and the United States will continue to be the main sources of soybean imports. It is expected that soybean imports in China will increase in 2023.

Figure 4.15 Rate of change of imports and exports for rice, wheat, maize, and soybean in China in 2023 (%)



Chapter 5. Focus and perspectives

Building on the CropWatch analyses presented in chapters 1 through 4, this chapter presents first early outlook of crop production for 2020 (section 5.1), as well as sections on recent disaster events (section 5.2), and an update on El Niño (5.3).

The unprecedented "triple" La Niña event ended in the spring of this year. The likelihood of a strong El Niño event in the summer is increasing, raising the risk of extreme weather events. As a result, global agricultural production may continue to face significant challenges.

5.1 CropWatch food production estimates

Methodological introduction

CropWatch production estimates are based on a combination of remote-sensing models combined with CropWatch global agro-climatic and agronomic indicators as well as meteorological data from over 20,000 meteorological weather stations around the world. The major grain crops (maize, rice, wheat) and soybean production of 47 major producers and exporters are estimated and predicted for 2021. The results are as follows.

Production estimates

Based on the global agro-climatic conditions and agricultural indicators, global wheat production is forecast to be 746 million tonnes with an increase of 5.47 million tonnes (+0.7%); global soybean production is 327 million tonnes with an increase of 7.13 million tonnes (+2.2%); global corn production is 1049 million tonnes with an increase of 0.4%; global rice production is 751 million tonnes with a decrease of 0.5%. From January to April 2023, agro-climatic conditions were generally normal in the wheat-producing countries in the northern hemisphere, and the wheat production is good. Drought-season rice in South and Southeast Asia, which is largely dependent on irrigation, experiences a slight change in yields. All in all, the global food production is expected to be normal.

Wheat: In 2022-2023, global wheat production is estimated to be 746 million tonnes with an increase of 5.47 million tonnes over 2021-2022. Most European countries, Morocco and other wheat producing countries experienced a relatively large recovery and production increase. The most noteworthy improvements were estimated for Romania, Hungary, Morocco and Belarus, resulting in increases in production by 18.1%, 16.7%, 14.8% and 11.6%, respectively. Turkey suffered from a strong earthquake and a rainfall deficit in February, but the earthquake had a more limited effect on crops. The abundant rainfall since March has eased the drought conditions, leading to an increase in wheat production by 12.7%. In India and Pakistan, wheat yields and total production increased slightly to 94.99 million tonnes and 25.89 million tonnes, respectively, due to generally normal agro-climatic conditions and the absence of extreme heat which had caused yield losses in March 2022. Wheat cultivation area increased by 1.8% in China, leading to a recovery in wheat production to 136.33 million tonnes with an increase of 2.14 million tonnes (+1.6%). In Afghanistan, Uzbekistan and the main production areas in USA, wheat production was affected by drougth conditions, causing a reduction in area and yield. This led to a decrease in production by 14.6% in Afghanistan, by 12.4% in Uzbekistand and 5.2% in the USA. In Russia, wheat cultivation area fell by 4.9%, with total wheat production falling by 5.4%. Global wheat production is good, but global wheat supply and demand will remain tight due to the Ukraine crisis.

Soybean: Soybean production in Brazil and Argentina, two major agricultural countries in South America, reached 150.41 million tonnes, with an increase of 3.5 million tonnes by 2.4%. Although neighbors, Brazil and Argentina have very different agro-climatic conditions and soybean production. In Argentina, the major soybean production areas experienced prolonged dry weather throughout the growing season, with drought conditions not only affecting soybean planting but also leading to a substantial reduction in soybean yields. As a result, soybean production in Argentina fell by as much as 9.77 million tonnes to 42.01 million tonnes, which is the biggest drop in five years. In contrast, rainfall was basically the same as last year in main Brazilian soybean production areas. Rainfall was normal during the flowering period, resulting in significantly higher yields than in 2022. Coupled with a small increase in soybean cultivation area, soybean production in Brazil recovered to 108.4 million tonnes. This is an increase of 13.9%, reversing the momentum of two consecutive years of declining yields.

Maize: Total maize production in the countries of the Southern Hemisphere and Equatorial region was 201.25 million tonnes, with an increase of 4.16 million tonnes or 2.1%. Maize production increases or decreases in the major producing countries vary. The first maize production in Brazil decreased, while the cultivation area of second maize increased and irrigated yields increased, so that second maize production is expected to increase substantially, bringing Brazilian maize production to 100.68 million tonnes, with an increase of 10.3%. In Kenya, an increase of maize cultivation area in the long rainy season compensated for the impact of the short rainy season and the reduction in maize production due to drought. Thus, the national maize production increased by 5.3%. In Argentina, the main maize producing areas suffered from a prolonged drought and maize production fell sharply by 9.6%. The rest of the countries experienced relatively small changes in maize production.

Early monitoring indicators of crop cultivation area based on remote sensing indicate that the progress of maize planting in the United States and Canada is slower, lagging behind by 8% and 10%， respectively. However, maize planting in most European countries is progressing much faster.

Rice: In 2023, irrigated rice production in the dry winter-season was generally normal in South and Southeast Asia, with small increases in rice production in Indonesia, Thailand, Vietnam and Sri Lanka, but small decreases in rice cultivation area in Bangladesh, Cambodia, Myanmar, India and the Philippines, with rice production in each country decreasing by 3.0%, 2.2%, 1.7%, 1.4% and 0.8%, respectively. As a result, global rice production decreased by 3.71 million tonnes. Angola, Argentina and Brazil, the countries of the Southern Hemisphere, experienced varying degrees of decline in rice cultivation area, with rice production falling by 4.5%, 3.0% and 0.6%, respectively..

Table 5.1 2023 cereal and soybean production estimates in thousand tonnes. Δ is the percentage of change of 2023 production when compared with corresponding 2022 values.

	Maize		Rice		Wheat		Soybean	
	2023	Δ%	2023	Δ%	2023	Δ%	2023	Δ%
Afghanistan					3,090	-14.6		
Angola	2,730	-0.2	50	-4.5				

	Maize		Rice		Wheat		Soybean	
	2023	**Δ%**	**2023**	**Δ%**	**2023**	**Δ%**	**2023**	**Δ%**
Argentina	49,690	-9.6	1,790	-3			42,010	-18.9
Bangladesh			46,540	-3				
Belarus					3,340	11.6		
Brazil	100,680	10.3	11,280	-0.6			108,400	13.9
Cambodia			9,580	-2.2				
China					136,330	1.6		
Egypt					11,410	1.5		
France					33,610	0.7		
Germany					25,680	2.3		
Hungary					5,200	16.7		
India			173,620	-1.4	94,990	1.9		
Indonesia	19,250	0.5	65,460	0.3				
Iran					12,040	9.7		
Italy					7,730	4.9		
Kenya	2,040	5.3						
Morocco					6,940	14.8		
Mozambique	2,190	-0.5	420	4.4				
Myanmar	1,980	2.4	24,200	-1.7				
Pakistan					25,890	1.2		
Philippines	7,470	0.6	21,120	-0.8				
Poland					11,060	7.5		
Romania					8,200	18.1		
Russia					81,540	-5.4		
South Africa	11,710	-1.3						
Sri Lanka			2,520	1.3				
Thailand			39,080	0.6				
Turkey					18,990	12.7		
Ukraine					23,340	8.9		
United Kingdom					12,360	-2.3		
United States					48,870	-5.2		
Uzbekistan					7,300	-12.4		
Vietnam			47,380	1.5				
Zambia	3,510	-1.3						
Sub-total	**201,250**	**2.1**	**443,040**	**-0.8**	**577,920**	**1**	**150,410**	**2.4**
Global	**1,049,340**	**0.4**	**750,870**	**-0.5**	**745,530**	**0.7**	**327,170**	**2.2**

5.2 Disaster events

Introduction

This section covers the January-April 2023 disaster events worldwide. Apart from floods, cyclones, and droughts, this section also highlights the current situation of the Desert locust across the globe as well as the current food production situation in war-torn Ukraine.

Extreme conditions by type

Russia-Ukraine conflict

Ukraine and Russia collectively supply around one-third of the wheat that is traded globally. They are also significant providers of fertilizer, cooking oil, and feed grains like maize. These nations play a vital role as suppliers to numerous countries in the Middle East and Africa. However, the Russian invasion of Ukraine caused a severe disruption in the wheat supply. This disruption has led to a surge in prices and far-reaching consequences, affecting various agricultural products such as maize, vegetable oil, and fertilizer on a global scale. Nevertheless, a year after the invasion, some positive developments in crop production can be observed. According to the Remote Sensing CropWatch monitoring system, agronomic indicators show that between January and April 2023, the national cropped arable land fraction (CALF) increased by 7% compared to the average of the past five years. The southern wheat and maize regions experienced even higher increases in CALF, with respective growth rates of 14% and 6%. Moreover, despite a decrease in photosynthetic active radiation (RADPAR) by 16%, the country recorded an overall increase in biomass production by 5% due to above-average rainfall.

If the grain exports from Ukraine can be sustained in the coming months, supply and demand on the international grain market may become better balanced, resulting in lower food prices for those who are suffering from hunger.

Desert Locust situation

The desert locust is a grasshopper found in the desert and semi-arid regions of Africa, the Middle East, and Asia. They form swarms and can cause significant crop damage and they have been a threat to food security for centuries and remain a concern for affected countries. This section highlights the desert situation during the period of January to March 2023. The spatial distribution of the desert locust thought the reporting period is shown in Figure 1. At the beginning of the reporting period, the Desert Locust situation remained calm. In the southern Western Sahara of Morocco, scattered hoppers and adults were observed, including a few adult groups. Similarly, in nearby Mauritania, there was a decline in locust numbers. Ground teams treated a total area of 467 hectares in Morocco and 35 hectares in Mauritania. Sudan's Red Sea coast had hoppers and adults present, and a few hopper groups began to form. In Sudan, a total of 204 hectares were treated. Yemen's coast had low numbers of adults, and a few adults were seen in Saudi Arabia, Eritrea, and northwest Somalia. In February, the Desert Locust situation remained relatively stable. However, like in January, there were sightings of small groups of adult locusts in scattered locations, particularly in the southern Western Sahara region of Morocco, where some mating behavior was observed. To address this issue, a total of 606 hectares were treated. In Sudan, adult locust groups increased along the Red Sea coast and subcoastal areas as vegetation began to dry out. A total of 3,826 hectares were treated to control the population. In Saudi Arabia, a few mature groups of adult locusts were observed mating on the northern Red Sea coast, and 410 hectares were treated to address this issue. Only a small number of adult locusts were present in southeast Egypt and the Red Sea coast of Yemen.

Throughout March, the Desert Locust situation remained relatively calm, with breeding occurring in Saudi Arabia. At the end of the winter season, small numbers of solitary adult locusts and a few groups were observed in various regions, including southern Western Sahara, south of the Atlas Mountains in Morocco, and the Red Sea coasts of Sudan and southeast Egypt. In Saudi Arabia, adult locust groups had been laying eggs since the end of February in two small areas along the northern coast. By March, these eggs had hatched, resulting in new hoppers that had formed small groups and some bands. Meanwhile, in Yemen, only a small number of adult locusts were observed along the Red Sea and Gulf of Aden coast. During the month of April, the Desert Locust situation remained calm. However, the small outbreak that developed from the spring breeding in March increased in Saudi Arabia in April. By the end of April, some late hopper groups, bands, and new immature adult groups were observed. Furthermore, in Northwest Africa, there were small hopper groups and bands present in the south of the Atlas Mountains in Morocco, as well as further south in Western Sahara, and control measures were carried out.

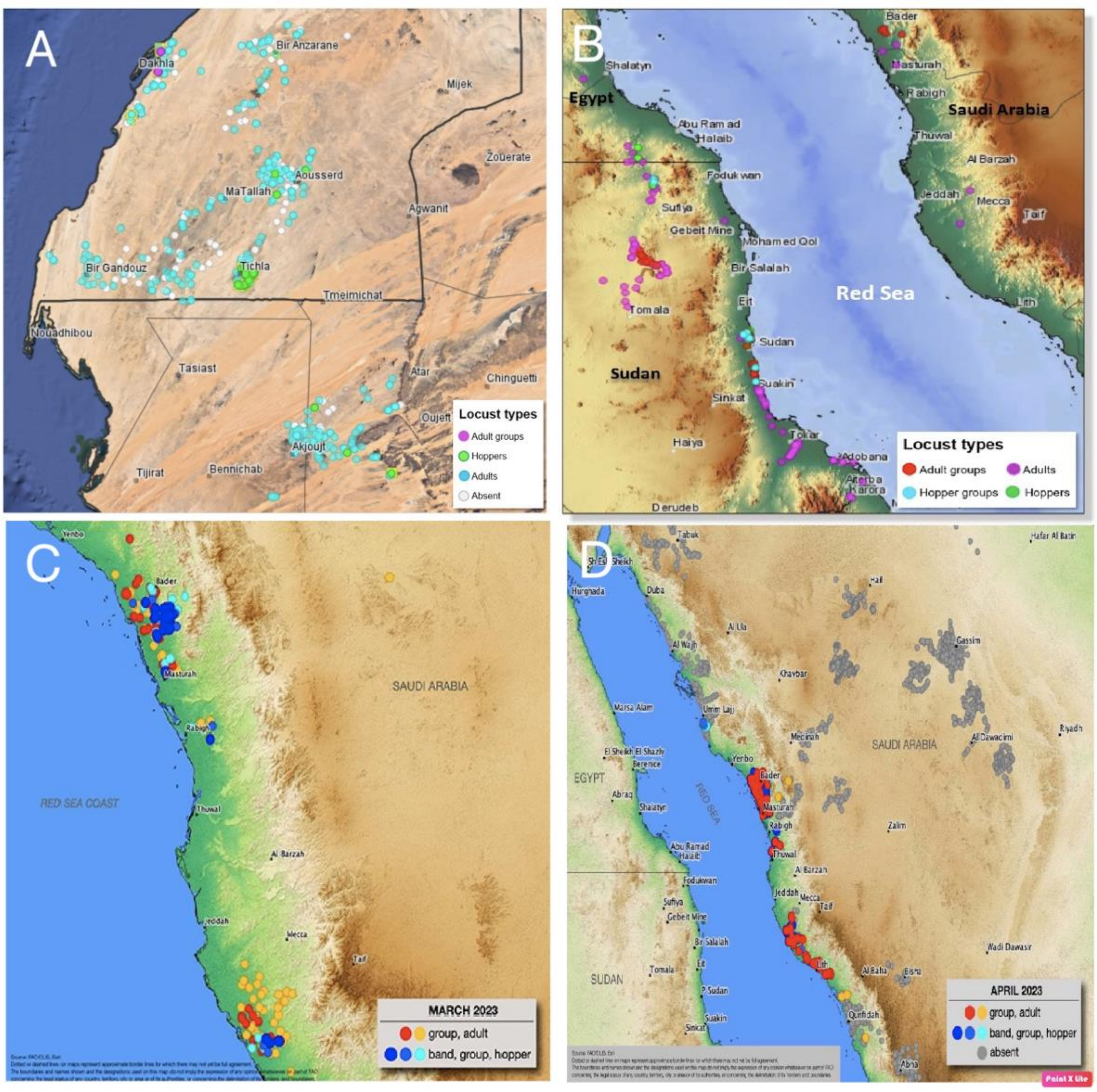


Figure 5.1 Desert locust situation during January-April 2023 (A-January, B-February, C-March, and D-April)

Cyclones, floods, and landslides

Cyclone Freddy's effects in Madagascar, Mozambique, and Malawi: On February 21, 2023, Tropical Cyclone Freddy struck the eastern coast of Madagascar. Initially a category 3 cyclone, Freddy then proceeded to impact Mozambique and Malawi. Its impact on the precipitation in Mozambique is shown in Figure 2.

The aftermath of this cyclone brought about widespread devastation, including extensive destruction, flooding, and relentless downpours, affecting over 1.4 million individuals across the three countries of Mozambique, Malawi, and Madagascar. This catastrophic event has pushed the capacities of healthcare facilities to their limits. Countless homes, schools, roads, and various forms of infrastructure have been either destroyed or severely damaged, while vast stretches of farmland have become inundated.

The devastating Tropical Cyclone Freddy, which made landfall in the Inhambane district of Vilanculos, Mozambique, on the 24th of February 2023, unleashed its fury upon the region, causing widespread destruction and upheaval. The National Institute for Risk and Disasters Management reported that the cyclone brought with it torrential rainfall, affecting nearly 166,600 people residing in the area. The impact was swift and severe, leaving a trail of devastation in its wake. According to the report, the agricultural sector bore the brunt of the cyclone's wrath, with approximately 38,100 hectares of cropland feeling the full force of its destructive power. The loss was further compounded by the destruction of over 18,700 hectares of land that had been cropped with diverse crops, a blow to the livelihoods and food security of the affected communities.

But the tale of destruction did not end there. After ravaging the Inhambane district, Cyclone Freddy continued its tumultuous journey across Mozambique. Unrelenting, it made a harrowing return and once again made landfall in Quelimane city, Zambezia province, between the 11th and 12th of March 2023. This time, the cyclone unleashed its fury with winds ranging from 106 to 170 kilometers per hour. The provinces of Sofala, Nampula, and Tete, in addition to Zambezia province, experienced the ferocity of Freddy's return. These regions, already reeling from the aftermath of weeks of intensive rainfall and flooding, found themselves subjected to further devastation and suffering. The southern and central parts of the country had already been significantly impacted, but Freddy's return intensified the scale of the disaster in the country, exuberating the current food shortages and the increasing international food prices. The consequences of Tropical Cyclone Freddy's reappearance were staggering. The lives of at least 9,369 people were directly affected, plunging them into a state of despair and uncertainty.

The occurrence of Cyclone Freddy in Malawi caused an outbreak of Cholera, further exacerbating the existing emergency in the country. The southern region of the country experienced the heaviest rainfall, particularly in districts such as Blantyre, Phalombe, Mulanje, Chikhwawa, and Nsanje. Devastating flash floods wreaked havoc in numerous areas, sweeping away homes, and people, and causing extensive damage to infrastructure. The impact of Freddy resulted in a tragic loss of life, with at least 1,216 people reported dead and 537 individuals still missing and presumed deceased. In addition, 1,332 injuries were reported. According to Médecins Sans Frontières, Blantyre alone accounted for at least 192 deaths, including 40 children, while Mulanje recorded 135 fatalities. The disaster forced approximately 180,000 people to evacuate their homes, affecting a total of 500,000 individuals across the country.

The floodwaters submerged over 430 km^2 of land in Malawi, causing significant losses for smallholder farmers. Crops and fields were destroyed, with approximately 204,833 hectares of cropland being inundated. Of this total, 84,930 hectares were submerged, while 119,930 hectares were washed away. The timing of the storm's arrival was particularly devastating as it occurred just as farmers were preparing for harvest, compounding the nation's existing food insecurities. In addition to the agricultural damage, the storm also inflicted significant harm on farms, many of which were damaged or completely destroyed. Livestock suffered greatly as well, with 194,500 animals perishing and an additional 91,000 sustaining injuries. The overall impact of Cyclone Freddy was immense, causing widespread displacement, loss of life, destruction of infrastructure, and severe setbacks to the agricultural sector and local food security.

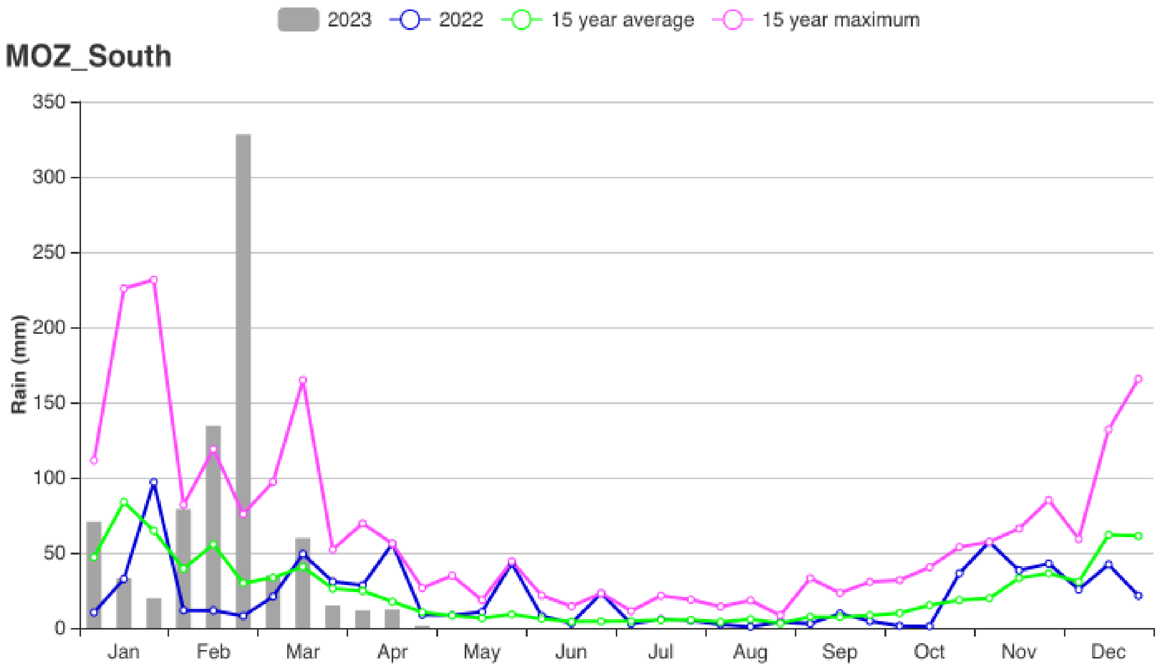


Figure 5.2 CropWatch's rainfall profile in the southern region of Mozambique (January-April 2023)

Türkiye: On 14-15 March 2023, Türkiye experienced heavy rainfall in the provinces of Adyaman and Sanliurfa in the southern region, resulting in devastating floods. In a span of 24 hours, Adyaman received approximately 136 mm of rainfall, while Sanliurfa witnessed around 111 mm of rainfall. Unfortunately, these intense floods have resulted in the loss of 14 lives, according to reports. This flood event occurred at a particularly challenging time for Turkey, as the country was already dealing with the aftermath of a recent earthquake. The combination of these natural disasters has further exacerbated the situation, leaving thousands of people in a state of emergency and in desperate need of food assistance.

California - USA: Since early January 2023, a sequence of nine powerful atmospheric river storms has relentlessly battered the state of California in the United States. These storms have brought heavy rains, snowfall, isolated thunderstorms, and gusty winds. The impact of the storms extends beyond residential areas, as agricultural land in the state has also been affected, posing a threat to California's agricultural production.

With flooded farm fields and the looming prospect of additional rainfall, the prices of food are expected to rise. California is responsible for producing approximately one-third of the vegetables and three-quarters of the fruits and nuts consumed in the US, according to the California Department of Food and Agriculture. Moreover, California holds the distinction of being America's largest agricultural exporter, with exclusive exports of various products such as almonds, artichokes, dates, and garlic, among others, as indicated by the California Agricultural Statistics Review 2020-2021. The losses incurred in crops due to this series of storms could have repercussions on exports. While grocery prices have remained stable thus far, there is a possibility of an increase in the upcoming weeks if the situation deteriorates, as reported.

Earthquake

The devastating earthquake that occurred on February 6, 2023, in the southern part of Türkiye and the northern part of Syria had severe consequences for agriculture in both countries. In Türkiye, the earthquake had a significant impact on 11 key agricultural provinces, affecting approximately 15.73 million people and more than 20% of food production. Of the affected population, about one-third reside in rural communities and heavily rely on agriculture for their livelihoods, making their situation even more challenging.

In Syria, where an estimated 12.1 million people (over 50% of the country's population) already face food insecurity due to the civil war, the earthquake further exacerbated the situation. Additionally, more than 2.9 million people are at risk of slipping into hunger. The earthquake struck at a time when food prices were already soaring in the country. Agriculture remains a major source of livelihood in several parts of Syria, and the damage to agricultural infrastructure caused by the earthquake could jeopardize food production.

The earthquake's effects on agriculture can also be assessed through Copwatch's national crop development graph, which utilizes the Normalized Difference Vegetation Index (NDVI). During the reported period of the earthquake, the graph indicates below-average crop conditions in both Türkiye and Syria. These unfavorable conditions can have a detrimental impact on crop production, further worsening the existing food insecurity situation in both countries.

Drought

East Africa: Eastern Africa, particularly Somalia, has been teetering on the brink of famine for several months due to a combination of consecutive poor rainy seasons, escalating international food prices, and the rise of conflicts and displacement. The monitoring period has revealed a concerning drought situation in East Africa, characterized by vegetation stress caused by insufficient rainfall or soil moisture deficit, especially in southern Ethiopia and Somalia. Other regions experienced a watch condition due to the lack of rainfall (Figure 3).

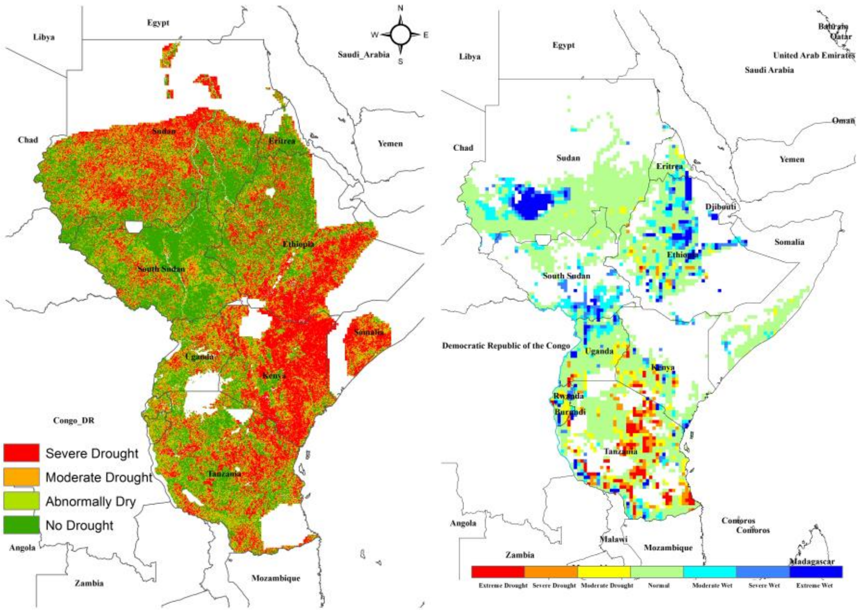


Figure 5.3 Cmbined drought indicator for West Africa from January-April 2023 (left: VHI, right: SPI)

During February, an alert situation persisted in Ethiopia, Somalia, and southern Kenya, with vegetation stress intensifying following inadequate rainfall or soil moisture. By March, the situation further deteriorated in southern Tanzania. The severity of the drought has resulted in a dire food insecurity crisis in the affected areas. Unfortunately, this crisis is expected to persist, leading to elevated humanitarian needs throughout 2023. Forecasts indicate the likelihood of a sixth consecutive failed rainy season extending until May 2023, exacerbating the ongoing food shortage.

South America: South America is currently experiencing a prolonged and extensive drought, resulting from a combination of multi-annual rainfall deficits, above-average temperatures, and a series of heatwaves. The severe drought initially affected Brazil and later spread to the southwest region, currently impacting Uruguay, northern Argentina, and southern Patagonia. This phenomenon is significantly affecting hydrology, river flow, and energy production, consequently leading to vegetation stress and hindering crop development throughout the region. As a consequence, crop yields have significantly decreased. In Argentina, soybean production in 2023 is anticipated to be 44% lower than the average of the previous five years, marking the lowest soy harvest since 1988/89. Figure 4 highlights the drought situation in South America as of April 2023 based on the Standardized Precipitation Index with 4 years accumulation period.

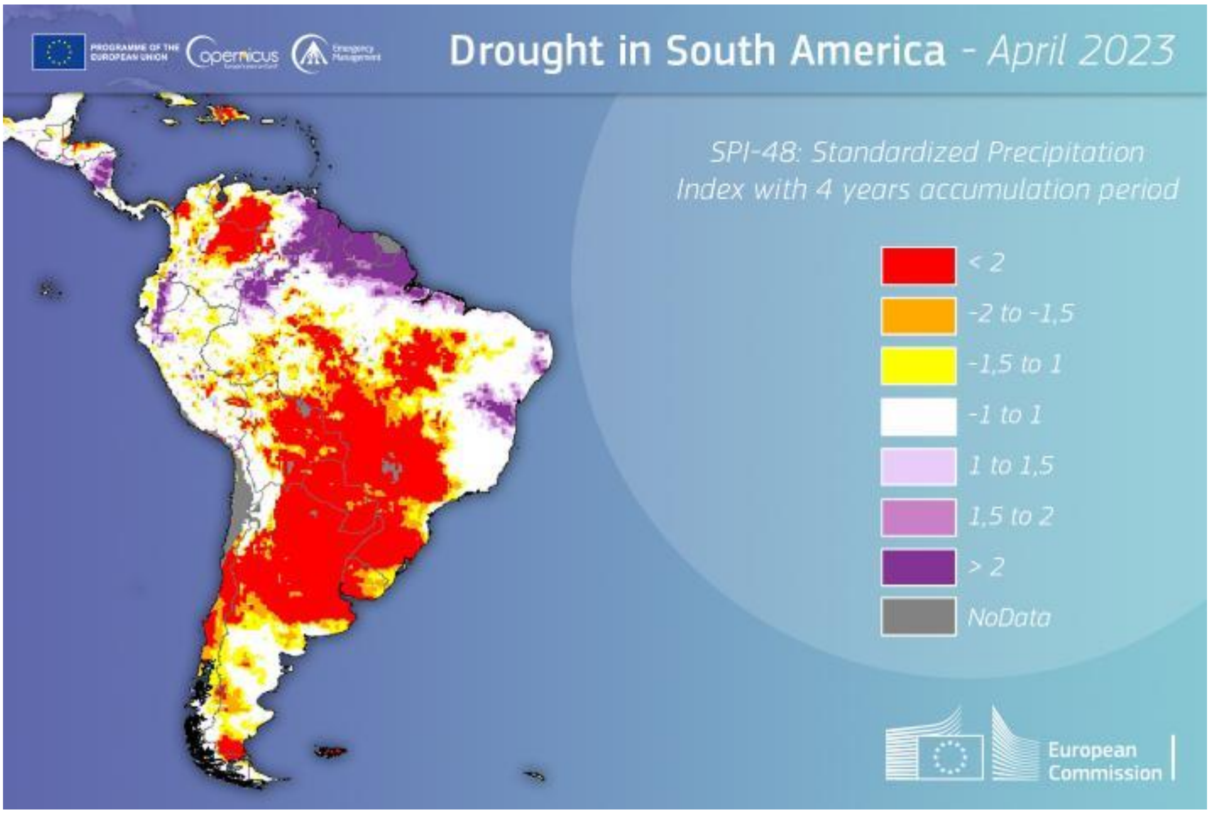


Figure 5.4 Drought situation in South America as of April 2023 based on the Standardized Precipitation Index with 4 years accumulation period.

As South America prepares for the shift to El Niño conditions, seasonal forecasts indicate warmer temperatures and fluctuating precipitation levels. Dryer-than-average conditions are expected in northern Argentina and Uruguay from May to June 2023. Brazil is projected to have average conditions, while central and coastal Peru may experience slightly wetter conditions. It is crucial to closely monitor the situation to gain a better understanding of the precise impacts during the upcoming months. Nevertheless, the prolonged absence of rainfall, severe heatwaves, and the forecasted above-average temperatures are highly likely to further reduce river flows, directly impacting agriculture, ecosystems, and energy production.

Spain: Since the start of the hydrological year, Spain has experienced a significant decrease in rainfall, with current reports indicating a reduction of 28%. This lack of rain has had various consequences, including depleted reservoirs, withered olive groves, and the implementation of water restrictions nationwide. A recent report by Copernicus Climate Change Services highlights that soil moisture levels throughout Europe in 2022 were the second lowest in the past 50 years.

The prolonged drought was further intensified by unseasonable heat. On April 26, a hot air mass from North Africa swept over southern Spain, causing the temperature at Córdoba airport to reach 38.8°C, the highest recorded April temperature in Spain. The effects of the drought are also visible through vegetation stress. Figure 5 presents a map of satellite-derived normalized vegetation conditions across the country. Based on MODIS data, figure 5 displays the anomalies in NDVI (Normalized Difference Vegetation Index) from March 25 to April 23, 2023, compared to the long-term average (2000-2010) for the same period. Southern Spain, being a crucial agricultural region, exhibits negative anomalies, indicating poor vegetation conditions. This is further supported by Figure 6, which depicts the CropWatch National NDVI-based crop conditions development, revealing below-average crop conditions throughout the entire reporting period (2022). These conditions may result in below-average crop production in the country.

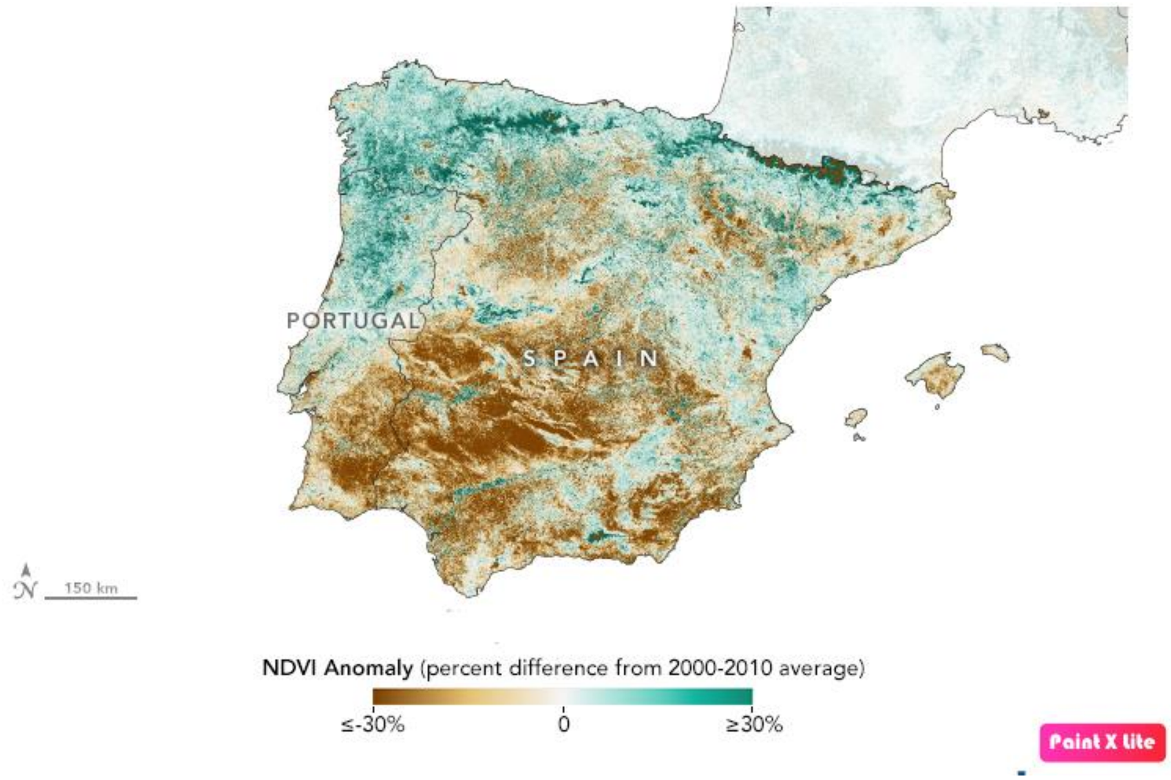


Figure 5.5 Spatial distribution of vegetation conditions based on the NDVI across Spain (March-April 2023) source: https://eoimages.gsfc.nasa.gov/images/imagerecords/151000/151366/iberianndvi_tmo_2023084_2023113_lrg.jpg)

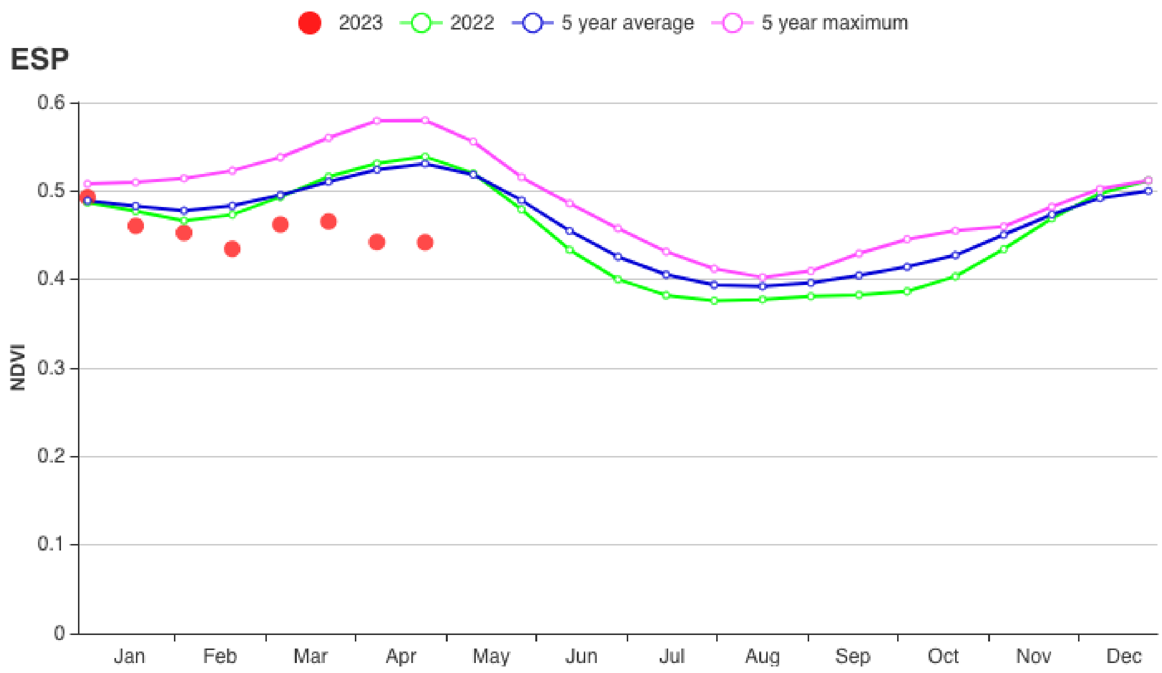


Figure 5.6 Spain crop conditions development graph based on NDVI (January-April 2023)

Maghreb region: The cereal production in the Maghreb region, stretching from Mauritania in the west to the western parts of Libya in the east, is severely affected by drought caused by a lack of rainfall. Cumulative NDVI (Normalized Difference Vegetation Index) anomalies for Morocco, Algeria, and Tunisia, compared to the medium-term period of 2013-2022, indicate unfavorable vegetation conditions and lower crop potential this year in North Africa (see Figure 7).

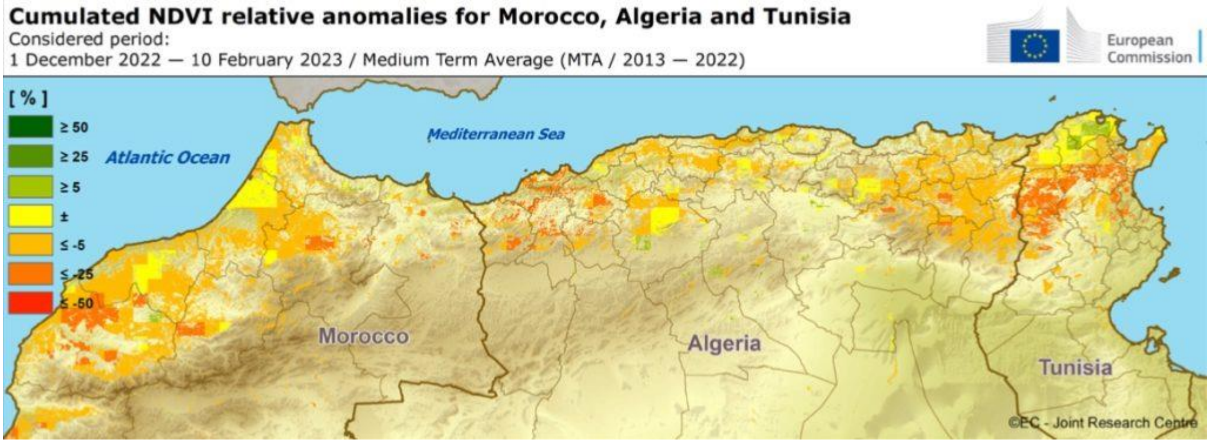


Figure 5.7 NDVI anomalies for Morocco, Algeria, and Tunisia, compared to the medium-term period of 2013-2022(source: https://www.graincentral.com/markets/maghreb-cereal-production-troubled-by-drought/)

Morocco experiences the most severe drought conditions, resulting in a significant loss of production potential. Rainfall levels recorded since September 2022 are the lowest in over 30 years. Consequently, the autumn sowing activity has been delayed by up to 30 days, and some farmlands are too dry for planting. Reports suggest that the wheat area planted in Morocco this season covers 2.38 million hectares, which is 11% lower than the average of the past five years. The expected harvest of 1.49 metric tonnes per hectare is 23% below the five-year average of 1.94 tonnes per hectare.

Tunisia has also been impacted by reduced rainfall, which has directly affected soil moisture levels, surpassing the growth rate of wheat and barley plants, except in irrigated areas. Wheat production is forecasted to be 0.99 million tonnes, 14% lower than the five-year average, considering an average planted area. Barley's output is expected to decrease by 29% compared to the five-year average, reaching 0.37 million tonnes.

The decline in cereal production throughout North Africa will inevitably lead to increased demand for European exports, which are already surpassing the levels seen in the 2021/22 marketing year.

Reference

https://reliefweb.int/report/mozambique/mozambique-i-protection-needs-assessment-boane-accommodation-centers-february-2023

https://www.voaportugues.com/a/inunda%C3%A7%C3%B5es-deixam-dezenas-de-milhar-de-fam%C3%ADlias-%C3%A0-beira-da-fome-na-prov%C3%ADncia-de-maputo/6979657.html

http://m.desertlocust-crc.org/Pages/NewsDetails.aspx?ID=2407051&lang=EN&I=0&DId=0&CId=0&CMSId=800362

https://www.fao.org/ag/locusts/en/info/info/index.html

https://reliefweb.int/report/mauritania/desert-locust-bulletin-533-9-march-2023

http://desertlocust-crc.org/Pages/Bulletin.aspx?DomainId=58&lang=EN&DId=0&I=0&CId=0&CMSId=800347

https://reliefweb.int/disaster/fl-2023-000040-tur

https://www.reuters.com/business/environment/floods-kills-least-10-southeast-turkey-anadolu-says-2023-03-15/

https://droughtwatch.icpac.net/mapviewer/

https://www.firstpost.com/explainers/california-floods-could-drive-up-food-prices-in-the-us-12371742.html#:~:text=Amid%20flooded%20farm%20fields%20and,Department%20of%20Food%20and%20Agriculture.

https://www.cbsnews.com/news/lettuce-cherries-produce-prices-going-up-california-storms/

https://reliefweb.int/report/mozambique/unhcr-mozambique-cyclone-freddy-flash-update-15-march-2023

https://dtm.iom.int/reports/mozambique-floods-tropical-cyclone-freddy-accommodation-centres-dashboard-30-march-2023

https://reliefweb.int/report/madagascar/cyclone-freddy-deepens-health-risks-worst-hit-countries#:~:text=The%20extensive%20destruction%2C%20flooding%20and,and%20swathes%20of%20farmland%20inundated.

https://reliefweb.int/report/madagascar/madagascar-tropical-cyclone-freddy-operational-update-2-mdrmg020-23-march-2023

https://reliefweb.int/report/mozambique/southern-africa-tropical-cyclone-freddy-flash-update-no-7-14-march-2023

https://www.barrons.com/news/cyclone-freddy-affects-500-000-people-in-malawi-un-1255d4fb

https://reliefweb.int/report/malawi/malawi-ifrc-launches-emergency-appeal-respond-effects-tropical-storm-freddy-malawi

https://www.wfp.org/news/half-syrias-population-faces-hunger-conflict-passes-12-year-milestone-and-earthquakes-deepen

https://reliefweb.int/report/syrian-arab-republic/syria-arab-republic-post-earthquake-rapid-needs-assessment-agricultural-livelihoods-and-production-northwest-data-emergencies-impact-report-april-2023#:~:text=Winter%20crops%2C%20orchards%20and%20agricultural,and%20orchard%20production%20this%20season

https://joint-research-centre.ec.europa.eu/jrc-news-and-updates/drought-conditions-threaten-economy-and-ecosystems-south-america-2023-05-22_en#:~:text=A%20multi%2Dannual%20drought%20event,largest%20droughts%20in%20recent%20decades.

https://earthobservatory.nasa.gov/images/151366/spain-browned-by-drought#:~:text=Since%20the%20start%20of%20the,water%20restrictions%20across%20the%20country.

https://edo.jrc.ec.europa.eu/documents/news/GDODroughtNews202304_South_America.pdf

5.3 Update on El Niño

According to the Australian Government Bureau of Meteorology, The Pacific Ocean is currently ENSO- neutral (neither La Niña nor El Niño), with anomalous warmth in both the east and west of the basin. While oceanic ENSO indicators have continued to warm and are forecast to reach El Niño thresholds during winter, there has been little to no shift towards El Niño in atmospheric ENSO indicators. As a result, the ENSO Outlook remains at El Niño WATCH. This means there is approximately a 50% chance of El Niño developing in 2023 [1].

Figure 5.7 depicts the standard Southern Oscillation Index (SOI) behavior from April 2022 to April 2023. The SOI has been positive and high (greater than +7) in January and February 2023. However, there has been a significant weakening trend, with the SOI declining to -2 and +0.3 in March and April 2023, respectively. This indicates that the La Niña event has concluded.

The Oceanic Niño Index (ONI) is another widely-used measure of El Niño. Figure 5.8 displays several ONIs and their respective locations. The data analysis in Table 5.1 shows a transition from cooler conditions towards a warming trend in the central and eastern equatorial Pacific Ocean during the first four months of 2023. The NINO3, NINO4, and NINO3.4 indices consistently demonstrate this shift, with sea surface temperatures progressively approaching or surpassing average values.

Sea surface temperature (SSTs) (Figure 5.9) for April 2023 were warmer than average over the eastern, southern, and far west of the tropical Pacific Ocean. Warm anomalies up to 2 °C warmer than average were present over these regions, increasing to more than 4 °C warmer than average off parts of the South American coast.

In conclusion, the recent La Niña event in winter has concluded, and the tropical Pacific is currently experiencing a warming phase. However, the atmospheric response to this warming trend remains minimal. It remains to be seen whether an El Niño event will occur in the future.

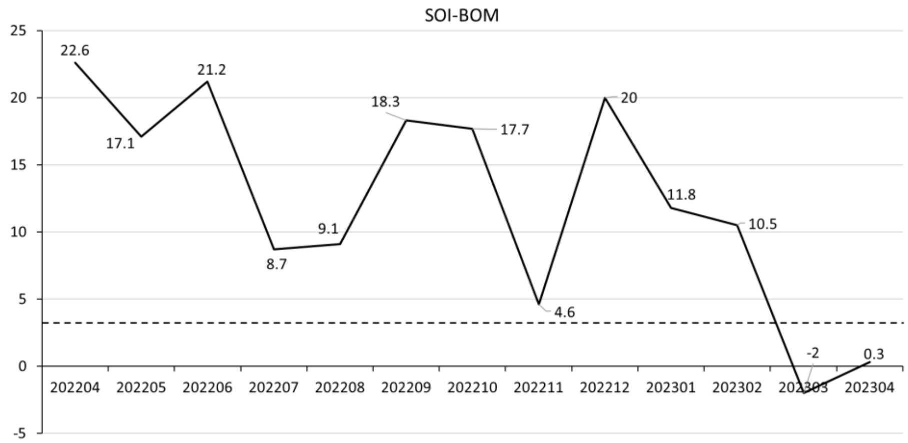


Figure 5.8 Monthly SOI-BOM time series from April 2022 to April 2023

(Source: http://www.bom.gov.au/climate/enso/soi/)

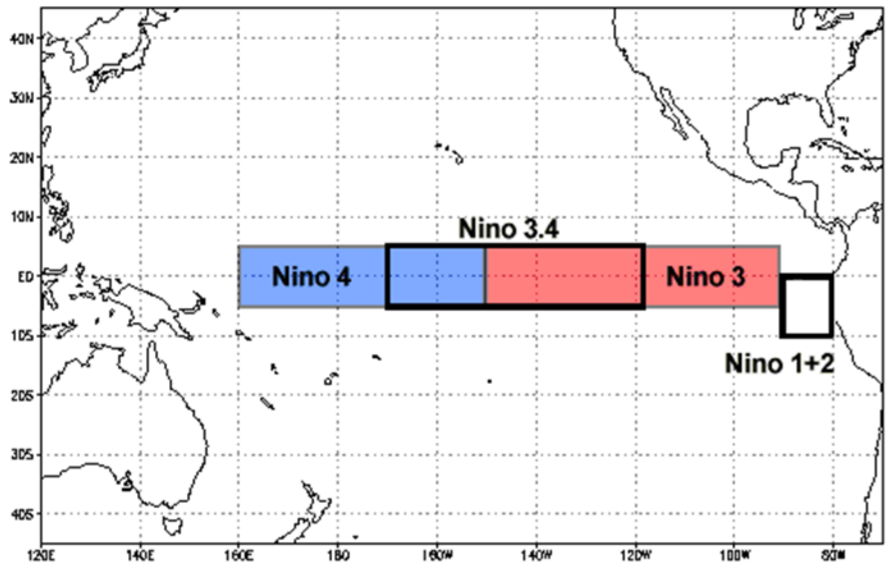


Figure 5.9 Map of NINO Region

(Source: https://www.ncdc.noaa.gov/teleconnections/enso/sst)

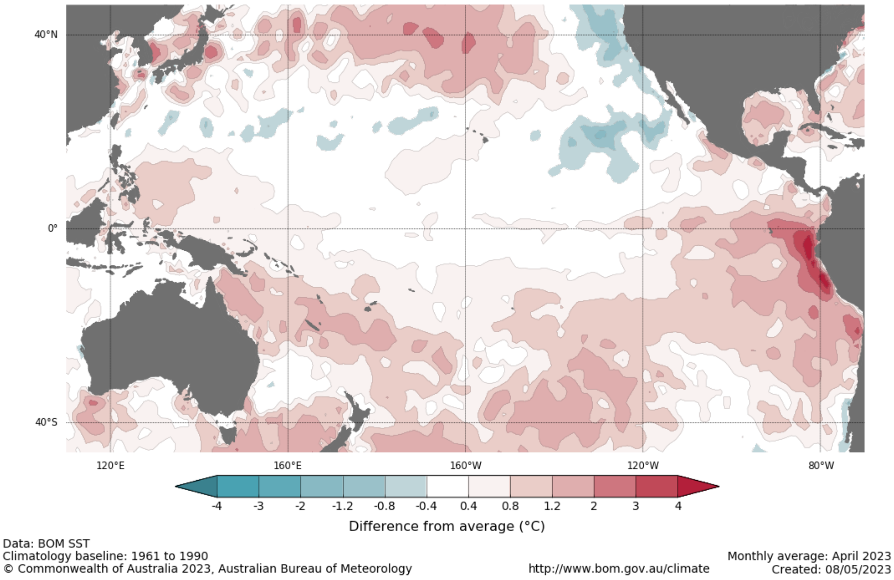


Figure 5.10 Monthly temperature anomalies for April 2023

(Source: http://www.bom.gov.au/climate/enso/index.shtml#tabs=Pacific-Ocean)

Table 5.2Anomalies of ONIs (°C), January to April 2023

(Source: https://www.cpc.ncep.noaa.gov/data/indices/sstoi.indices)

Year	Month	NINO3	NINO4	NINO3.4
2023	1	-0.50	-0.60	-0.69
2023	2	-0.13	-0.52	-0.44
2023	3	+0.36	-0.14	-0.01
2023	4	+0.44	+0.30	+0.19

Main Sources:

[1] http://www.bom.gov.au/climate/enso/index.shtml#tabs=Overview

Annex A. Agroclimatic indicators and BIOMSS

Table A.1 January - April 2023 agroclimatic indicators and biomass by global Monitoring and Reporting Unit (MRU)

105 Global MRUs		RAIN Current(mm)	RAIN 15YA dep.(%)	TEMP Current (°C)	TEMP 15YA dep.(°C)	RADPAR Current (MJ/m2)	RADPAR 15YA dep. (%)	BIOMSS Current (gDM/m2)	BIOMSS 15YA dep. (%)
C01	Equatorial central Africa_zone1 (Cameron, Central African Republic, and South Sudan)	266	4	25.5	-0.3	1289	-1	753	-3
C02	Equatorial central Africa_zone2 (North DRC, Equatorial Guinea, Uganda, Republic of Congo)	739	2	23.9	-0.4	1173	-2	1186	-4
C03	Equatorial central Africa_zone3 (South DRC, Rwanda, Burundi, Gabon)	879	-11	22.3	-0.2	1174	-1	1356	-4
C04	Equatorial central Africa_zone4 (Angola, Zambia, and Malawi)	886	-16	20.2	0.1	1141	3	1197	-4
C05	East African highlands	258	-4	19.7	-0.2	1354	0	640	-3
C06	Gulf of Guinea zone1 (Nigeria, Benin, Togo, Ghana, Cote d'Ivoire, Guinea, and Guinea_Bissau)	52	-33	27.3	-0.2	1304	-1	519	-9
C07	Gulf of Guinea zone2 (South Nigeria, Liberia, Sierra Leone, south Ghana, south Cote d'Ivoire, and west Genua)	271	-6	26.4	-0.1	1282	-1	867	-5
C08	Horn of Africa	354	-26	21.9	0.4	1313	2	859	-6
C09	Madagascar(main)	1189	1	22.1	-0.2	1166	-1	1394	0
C10	SW Madagascar	741	42	24.1	-1.0	1188	-5	1196	12
C11	North Africa Mediterranean	91	-57	11.0	0.4	1009	5	337	-30
C12	Sahel	29	24	27.2	-0.3	1349	-2	397	1
C13	Southern Africa_zone1 (West Angolan coast)	699	-7	23.7	-0.3	1181	-2	1205	0
C14	Southern Africa_zone10 (Middle part of South Africa)	51	-62	21.2	0.3	1368	6	514	-21
C15	Southern Africa_zone2 (southeastern Kenya, East Tanzania, and Mozambique)	918	8	23.4	0.0	1202	0	1320	1
C16	Southern Africa_zone3 (South Zambia)	610	-27	21.6	0.3	1242	1	1060	-12
C17	Southern Africa_zone4 (Zimbabwe)	551	-15	21.2	0.1	1226	0	960	-10
C18	Southern Africa_zone5 (Northeast of Namibia, Botswana, and south Zimbabwe and Mozambique)	300	-30	23.2	0.7	1233	0	795	-17
C19	Southern Africa_zone6 (West Namibia coast)	368	-14	23.7	0.6	1215	-5	854	-12
C20	Southern Africa_zone7 (Southeast Namibia, Southwest Botswana, and northeast of South Africa)	14	-78	23.9	-0.2	1436	2	501	-16
C21	Southern Africa_zone8 (South Africa and southwest Namibia)	55	-11	20.1	0.0	1341	-3	483	-5

C22	Southern Africa_zone9 (western part of South Africa, Lesotho, and Eswatini)	145	-44	19.4	0.6	1320	6	583	-24
C23	S. Africa Western Cape	115	-3	18.8	-0.3	1226	-3	570	-2
C24	British Columbia To Colorado	349	-4	-3.4	-0.9	675	-5	277	-9
C25	America northern great plains_canada	147	-15	-5.0	0.1	582	-4	247	-9
C26	America northeastern great plains	294	3	1.4	0.8	682	-4	422	1
C27	America northwestern great plains	185	-5	-1.9	-1.0	726	-3	331	-9
C28	Nnorth of high plain	170	-18	6.3	0.3	870	-2	413	-10
C29	America corn belt	442	4	2.2	1.9	624	-5	440	12
C30	America cotton belt_Mexican coastal plain	344	18	13.9	1.1	833	-9	601	3
C31	America cotton belt_lower Mississippi	630	14	13.4	2.0	747	-8	925	9
C32	America cotton belt_high plain	422	-4	12.9	2.5	828	-3	813	8
C33	Sub_boreal North America	203	-7	-6.6	1.3	484	-8	208	2
C34	America West Coast	614	25	5.3	-1.9	713	-8	579	9
C35	Sierra Madre	49	-41	16.7	0.1	1279	-1	352	-16
C36	SW Mexico and N. Mexico highlands	147	22	8.3	-0.9	1013	-5	373	-1
C37	Northern South and Central America	342	-20	23.5	0.2	1174	1	725	-8
C38	Caribbean	138	-32	23.9	0.4	1180	2	653	-13
C39	Central_Northern Andes	904	60	16.1	-1.3	1050	-9	793	9
C40	Central_Northern Andes	901	-11	15.2	0.1	1021	-1	829	-3
C41	Brazil Nordeste	223	-45	26.5	1.0	1264	0	765	-24
C42	Central_Eastern Brazil	359	-61	25.5	2.0	1159	-3	888	-33
C43	Amazon	921	-28	24.7	0.4	1091	1	1319	-9
C44	Central_North Argentina	888	65	23.1	-0.1	1090	-5	1275	23
C45	SE Brazil_Concepcion_Bahia Blanca	450	-7	23.0	0.8	1155	-3	977	-2
C46	SW Southern Cone	217	-16	14.0	0.4	1199	0	541	-7
C47	Semi_arid Southern Cone	455	131	18.7	0.4	1219	-6	656	10
C48	Caucasus	322	-3	3.6	0.5	798	-1	464	1
C49	Central Asia Pamir mountains	327	-20	3.8	0.6	921	2	411	-5
C50	Western Asia (Kazakhstan,Uzbekistan,Turkmenistan,Iran et.al)	163	-10	7.8	1.0	908	1	409	-4
C51	Western Asia(Syrian, Jordan,Israel, et.al)	202	-22	11.2	0.5	939	2	464	-11
C52	Gansu-Xinjiang (China)	121	16	-2.7	-0.4	886	0	212	2
C53	Hainan (China)	262	-9	21.4	0.2	1012	5	736	-5
C54	Huanghuaihai (China)	117	21	7.3	1.4	910	0	340	12
C55	Inner Mongolia (China)	58	5	-3.6	1.1	895	-1	190	5
C56	Loess region (China)	122	35	2.9	0.8	964	-1	338	20

C57	Lower Yangtze (China)	456	-11	11.5	1.2	779	9	760	1
C58	Northeast China	92	-4	-5.0	1.5	781	-1	231	8
C59	Qinghai-Tibet (China)	267	-30	1.6	1.1	1077	3	310	-2
C60	Southern China	263	-31	16.2	1.1	912	9	606	-18
C61	Southwest China	304	-4	9.3	0.8	814	3	569	-2
C62	Taiwan (China)	197	-33	18.8	-0.5	1087	11	599	-16
C63	East Asia	255	-12	-0.5	1.5	780	0	352	11
C64	Southern Himalayas_zone111 (Vietnam, Laos, Myanmar)	142	-49	18.5	1.0	973	10	539	-24
C65	Southern Himalayas_zone112 (Myanmar)	21	-82	18.6	0.7	1286	4	361	-27
C66	Southern Himalayas_zone12 (India, Myanmar, Bangladesh,Bhutan)	163	-39	18.2	0.3	1180	5	520	-11
C67	Southern Himalayas_zone222 (Nepal, India)	74	-24	19.6	0.2	1158	-1	412	-6
C68	Southern Asia	102	22	25.4	-0.2	1278	-1	590	7
C69	Southern Japan and Korea	486	-2	8.4	2.0	829	2	712	12
C70	Mongolia region (Western of Mongolia)	75	26	-11.4	0.9	801	-3	120	-3
C71	S. Asia Punjab to Gujarat	70	11	22.7	0.1	1157	-4	478	7
C72	SE Asia islands_zone1 (Indonesia, Malaysia)	1280	0	24.3	-0.1	1159	1	1490	2
C73	SE Asia islands_zone2 (Indonesia, Malaysia)	1178	2	24.4	0.0	1161	3	1439	4
C74	SE Asia islands_zone3 (Indonesia, Papua New Guinea)	1429	-10	23.8	0.2	1097	4	1389	-1
C75	SE Asia mainland_zone1 (Myanmar, Bangladesh)	23	-72	25.0	0.6	1322	2	467	-13
C76	SE Asia mainland_zone2 (Thailand, Myanmar, Laos)	167	-40	25.0	0.1	1279	4	683	-14
C77	SE Asia mainland_zone3 (Cambodia, Vietnam, Thailand, Laos)	203	-31	24.7	0.1	1180	4	719	-9
C78	Eastern Siberia	197	-5	-9.1	0.8	563	0	184	0
C79	Eastern Central Asia (Eastern of Mongolia)	103	18	-11.7	0.9	699	-1	151	0
C80	North Australia_zone1 (Timor_Leste, Indonesia, Papua New Guinea)	1204	4	25.8	0.0	1278	0	1488	0
C81	North Australia_zone2 (Northern Australia)	839	5	25.7	0.2	1228	2	1240	8
C82	Australia Queensland to Victoria _zone1 (Southeast Australia_coast)	255	-18	19.6	0.1	1164	1	769	-4
C83	Australia Queensland to Victoria _zone21 (Southeast Australia Marrin Darling)	112	-33	23.2	0.2	1264	1	620	-8
C84	Australia Queensland to Victoria _zone22 (Southeast Australia Adeleid)	176	14	17.9	-0.3	1052	-3	647	9
C85	Australia Nullarbor_Darling_zone1 (Southwest Australia)	77	-27	20.7	-0.8	1283	4	530	-10
C86	Australia Nullarbor_Darling_zone2 (Southwest Australia)	94	-10	20.3	-0.6	1293	3	554	-5
C87	New Zealand	519	72	14.3	-0.2	905	-11	905	23
C88	Boreal Eurasia	336	10	-3.6	0.8	365	-6	251	0
C89	Ukraine to URAL Mountains	273	5	0.0	1.8	387	-11	375	12

C90	Mediterranean Europe and Turkey	257	-29	7.6	0.6	836	6	478	-17
C91	W. Europe _zone1 (Germany, Poland, Switzerland, Czechia, Hungary, Austria, and Balkans countries)	332	13	3.8	0.8	518	-9	496	6
C92	W. Europe_ zone10 (Northwestern Greece and southwestern of Albania)	564	0	7.4	0.2	816	5	681	2
C93	W. Europe_zone2 (Southeastern of Romania, Moldova, and southwestern Urania)	211	-2	5.7	1.6	572	-10	508	6
C94	W. Europe__zone3 (Ebro River, Zaragoza, Spain)	68	-68	7.4	0.8	875	11	271	-45
C95	W. Europe_zone4 (Northeastern of Italy and southwestern coast of France)	202	-42	8.4	1.6	752	4	451	-19
C96	W. Europe_zone5 (North Italy)	284	-28	7.0	0.9	668	-2	568	3
C97	W. Europe_zone6 (Switzerland, North Italy and west Austria)	392	-13	0.3	1.1	662	-2	362	5
C98	W. Europe_zone7 (Ireland, United Kingdom, France, Belgium, Netherland)	338	-6	6.0	0.5	498	-7	565	2
C99	W. Europe_zone8 (Northwest of turkey and northeast of Greece)	283	-27	8.5	1.8	737	1	613	-1
C100	W. Europe_zone9 (North Greece and North Macedonia)	294	-18	6.6	1.3	792	5	548	-3
C101	Boreal North America	280	-12	-7.1	0.5	433	-1	186	-1
C102	URAL to Altai Mountains	182	-2	-4.7	1.8	563	2	266	7
C103	Australian Desert (Central Australia)	111	-9	23.2	-0.3	1321	1	595	-4
C104	Old World Deserts	78	4	17.1	0.2	1130	-2	399	2
C105	Sub Arctic America (IceLand)	69	-10	-21.8	1.0	297	-7	40	14

Table A.2 January - April 2023 agroclimatic indicators and biomass by country

Country code	Country name	RAIN Current (mm)	RAIN 15YA Departure (%)	TEMP Current (°C)	TEMP 15YA Departure(°C)	RADPAR Current (MJ/m²)	RADPAR 15YA Departure (%)	BIOMSS Current (gDM/m²)	BIOMSS 15YA Departure (%)
AFG	Argentina	461	14	23.0	1.1	1152	-3	933	5
AUS	Australia	246	-13	21.4	0.0	1215	1	697	-4
BGD	Bangladesh	109	-16	23.6	0.2	1208	1	579	1
BRA	Brazil	505	-49	25.2	1.5	1159	-1	988	-26
KHM	Cambodia	225	-31	26.6	0.0	1226	3	794	-8
CAN	Canada	287	-5	-4.8	1.1	520	-7	231	2
CHN	China	266	-12	7.5	1.1	851	4	430	0
EGY	Egypt	52	2	15.6	0.1	1005	-1	268	-9
ETH	Ethiopia	219	21	20.1	-0.3	1365	0	624	5
FRA	France	312	-13	6.1	0.4	584	-5	555	-1
DEU	Germany	355	20	4.0	0.5	446	-14	504	4
IND	India	79	-7	23.2	-0.2	1229	-1	503	3
IDN	Indonesia	1337	-5	24.3	0.0	1150	3	1480	1
IRN	Iran	194	-6	8.1	0.3	1012	1	440	-3
KAZ	Kazakhstan	182	2	-3.1	1.6	654	2	307	7
MEX	Mexico	93	-24	19.3	0.4	1223	-1	430	-11
MMR	Myanmar	44	-66	21.8	0.6	1290	3	443	-18
NGA	Nigeria	75	-41	26.5	-0.5	1334	0	491	-9

PAK	**Pakistan**	270	-11	13.7	0.7	1017	-2	478	2
PHL	**Philippines**	957	41	24.3	-0.3	1117	-3	1249	9
POL	**Poland**	305	19	3.3	1.0	409	-14	477	5
ROU	**Romania**	290	13	4.4	1.2	604	-7	503	7
RUS	**Russia**	224	0	-3.3	1.8	462	-5	288	10
SYR	**Syria**	127	-44	19.9	0.4	1320	5	572	-21
ZAF	**South Africa**	156	-45	25.5	0.2	1244	5	670	-15
THA	**Thailand**	351	-6	4.6	0.4	809	-1	504	-3
TUR	**Turkey**	361	-5	5.8	0.6	403	-7	568	5
GBR	**United Kingdom**	264	9	2.8	1.3	442	-16	451	5
UKR	**Ukraine**	376	5	6.1	1.0	747	-5	489	4
USA	**United States**	192	-24	6.9	0.6	888	6	359	-18
UZB	**Uzbekistan**	241	-23	21.2	0.5	1022	5	726	-8
VNM	**Vietnam**	186	-38	6.4	0.9	998	3	381	-19
AFG	**Afghanistan**	664	-19	22.2	0.3	1171	-1	1140	-8
AGO	**Angola**	326	24	1.6	1.7	348	-15	415	9
BLR	**Belarus**	263	18	5.4	1.0	596	-6	561	15
HUN	**Hungary**	310	-19	7.4	0.9	743	1	561	0
ITA	**Italy**	337	-24	21.2	0.2	1359	2	778	-11
KEN	**Kenya**	556	-2	25.2	-0.1	1269	1	1185	5
LKA	**Sri_Lanka**	114	-48	11.5	0.7	1033	2	377	-23
MAR	**Morocco**	67	-3	-11.7	0.6	795	1	145	-3
MNG	**Mongolia**	911	16	23.2	-0.2	1177	-2	1310	3
MOZ	**Mozambique**	860	-14	20.8	0.0	1184	2	1189	-5
ZMB	**Zambia**	275	-13	-4.5	-0.9	882	5	262	-9
KGZ	**Kyrgyzstan**	189	-22	11.5	0.4	948	3	464	-13
	85	-65	9.4	0.3	995	10	314	-41	

*Note: Departures are expressed in relative terms (percentage) forall variables, except for temperature, for which absolute departure in degrees Celsius is given. Zero means no change from the average value; relative departures are calculated as (C-R)/R*100, with C=current value and R=reference value, which is the fifteen-year average (15YA) for the same period between Oct- Jan.*

Table A.3 January - April 2023 agroclimatic indicators and biomass (by province)

	RAIN Current (mm)	RAIN 15YA Departure (%)	TEMP Current (°C)	TEMP 15YA Departure(°C)	RADPAR Current (MJ/m²)	RADPAR 15YA Departure (%)	BIOMSS Current (gDM/m²)	BIOMSS 15YA Departure (%)
Buenos Aires	134	-46	22.6	1.9	1191	-2	640	-16
Chaco	706	43	25.0	0.2	1106	-3	1253	17
Cordoba	415	44	23.1	1.0	1148	-6	981	16
Corrientes	485	-6	25.1	1.2	1165	-1	1105	3
Entre Rios	350	-11	24.6	1.8	1173	-2	905	-3
La Pampa	120	-33	23.3	1.5	1229	-2	645	-9
Misiones	570	-10	22.7	-0.1	1183	-2	1245	3
Santiago Del Estero	838	69	24.4	0.6	1082	-3	1302	25
San Luis	301	44	21.8	0.5	1177	-5	884	16
Salta	1270	35	20.5	0.4	1077	1	1307	12
Santa Fe	391	2	25.2	1.6	1155	-2	967	3
Tucuman	1121	72	19.8	0.6	1099	-3	1218	19

Table A.4 January - April 2023 agroclimatic indicators and biomass (by state)

	RAIN Current (mm)	RAIN 15YA Departure (%)	TEMP Current (°C)	TEMP 15YA Departure(°C)	RADPAR Current (MJ/m²)	RADPAR 15YA Departure (%)	BIOMSS Current (gDM/m²)	BIOMSS 15YA Departure (%)
New South Wales	206	-18	21.6	0.0	1252	3	700	-7
South Australia	118	6	20.1	-0.3	1174	-1	590	3
Victoria	178	-7	18.2	-0.3	1105	-2	627	-3
W. Australia	168	-4	21.3	-0.6	1292	3	597	-4

Table A.5 January - April 2023 agroclimatic indicators and biomass (by state)

	RAIN Current (mm)	RAIN 15YA Departure (%)	TEMP Current (°C)	TEMP 15YA Departure (°C)	RADPAR Current (MJ/m²)	RADPAR 15YA Departure (%)	BIOMSS Current (gDM/m²)	BIOMSS 15YA Departure (%)
Ceara	523	-15	26.3	0.3	1213	-3	1141	-7
Goias	60	-94	27.4	4.3	1200	-2	512	-63
Mato Grosso Do Sul	291	-65	26.2	1.6	1079	-11	830	-39
Mato Grosso	457	-64	26.1	2.0	1132	0	993	-33
Minas Gerais	269	-70	24.3	2.4	1208	0	777	-39
Parana	727	-12	21.6	0.2	1128	-4	1218	-6
Rio Grande Do Sul	369	-32	22.6	0.9	1171	-1	993	-9
Santa Catarina	777	2	19.7	0.0	1122	0	1255	3
Sao Paulo	282	-72	24.4	2.0	1126	-3	790	-42

Table A.6 Canada, January - April 2023 agroclimatic indicators and biomass (by province)

	RAIN Current (mm)	RAIN 15YA Departure (%)	TEMP Current (°C)	TEMP 15YA Departure (°C)	RADPAR Current (MJ/m²)	RADPAR 15YA Departure (%)	BIOMSS Current (gDM/m²)	BIOMSS 15YA Departure (%)
Alberta	146	-19	-4.7	0.8	545	-3	250	0
Manitoba	183	-7	-6.9	0.4	506	-11	202	-10
Saskatchewan	151	-13	-6.1	0.4	547	-4	224	-8

Table A.7 India, January - April 2023 agroclimatic indicators and biomass (by state)

	RAIN Current (mm)	RAIN 15YA Departure (%)	TEMP Current (°C)	TEMP 15YA Departure (°C)	RADPAR Current (MJ/m²)	RADPAR 15YA Departure (%)	BIOMSS Current (gDM/m²)	BIOMSS 15YA Departure (%)
Andhra Pradesh	147	255	26.1	-0.7	1300	-1	658	27
Assam	275	-32	18.3	-0.3	1096	5	659	-9
Bihar	22	-43	22.4	-0.2	1205	0	420	-8
Chhattisgarh	48	78	23.8	-0.4	1242	-2	484	4

Daman and Diu	3	109	26.7	0.4	1345	-2	467	44
Delhi	112	104	20.1	-0.4	1114	-2	538	25
Gujarat	6	74	26.2	0.1	1274	-4	448	11
Goa	1	-91	27.1	0.5	1427	2	445	-10
Himachal Pradesh	278	-13	11.0	0.7	1045	0	505	1
Haryana	106	59	20.1	-0.1	1095	-2	519	19
Jharkhand	18	-48	23.0	0.1	1202	-2	418	-8
Kerala	237	-21	25.7	-0.2	1339	2	722	-15
Karnataka	53	-14	25.5	-0.5	1373	3	550	2
Meghalaya	274	-3	18.5	-0.7	1129	3	647	-1
Maharashtra	33	156	26.3	-0.3	1301	-3	509	9
Manipur	140	-43	15.6	0.1	1208	4	490	-18
Madhya Pradesh	14	-17	23.5	-0.4	1218	-3	417	-4
Mizoram	95	-46	17.7	-0.6	1264	3	460	-17
Nagaland	283	-37	13.5	-1.1	1107	3	609	-18
Orissa	41	15	24.4	0.0	1230	-2	488	1
Puducherry	146	21	27.1	0.0	1392	1	747	10
Punjab	163	14	19.2	0.1	1040	-1	584	13
Rajasthan	31	85	23.0	-0.1	1170	-4	436	6
Sikkim	12	-83	14.0	3.9	1267	1	255	-16
Tamil Nadu	209	-1	25.8	-0.1	1334	1	764	6
Tripura	136	-41	22.0	0.1	1209	4	599	-7
Uttarakhand	92	-25	14.4	1.1	1129	-1	395	-4
Uttar Pradesh	17	-59	21.6	-0.3	1158	-2	381	-14
West Bengal	43	-32	24.3	0.6	1195	-1	485	-4

Table A.8 Kazakhstan, January - April 2023 agroclimatic indicators and biomass (by oblast)

	RAIN Current (mm)	RAIN 15YA Departure (%)	TEMP Current (°C)	TEMP 15YA Departure (°C)	RADPAR Current (MJ/m²)	RADPAR 15YA Departure (%)	BIOMSS Current (gDM/m²)	BIOMSS 15YA Departure (%)
Akmolinskaya	151	3	-4.5	2.0	626	4	284	9
Karagandinskaya	123	-3	-5.0	1.5	704	2	276	5
Kustanayskaya	163	0	-3.6	2.7	546	-2	309	18
Pavlodarskaya	113	-4	-4.7	2.1	612	3	276	8
Severo kazachstanskaya	132	-15	-4.6	2.3	549	5	274	12
Vostochno kazachstanskaya	237	29	-5.0	1.2	719	1	265	3
Zapadno kazachstanskaya	211	3	-0.2	2.5	518	-9	407	20

Table A.9 Russia, January - April 2023 agroclimatic indicators and biomass (by oblast, kray and republic)

	RAIN Current (mm)	RAIN 15YA Departure (%)	TEMP Current (°C)	TEMP 15YA Departure (°C)	RADPAR Current (MJ/m²)	RADPAR 15YA Departure (%)	BIOMSS Current (gDM/m²)	BIOMSS 15YA Departure (%)
Bashkortostan Rep.	197	-18	-4.0	2.3	457	1	289	20

Chelyabinskaya Oblast	122	-27	-4.5	2.4	487	-1	277	18
Gorodovikovsk	275	17	4.1	1.3	553	-7	531	11
Krasnodarskiy Kray	289	13	-1.4	0.9	542	-4	334	1
Kurganskaya Oblast	129	-25	-4.6	2.5	469	5	269	16
Kirovskaya Oblast	265	-7	-3.3	2.6	299	-10	282	23
Kurskaya Oblast	276	3	0.3	1.4	378	-14	384	8
Lipetskaya Oblast	260	-1	-0.4	1.6	392	-11	371	11
Mordoviya Rep.	224	-17	-1.4	2.3	387	-5	349	21
Novosibirskaya Oblast	181	-4	-6.1	2.1	461	2	228	4
Nizhegorodskaya O.	239	-13	-1.8	2.4	350	-6	328	21
Orenburgskaya Oblast	213	-6	-2.8	2.4	508	-3	331	19
Omskaya Oblast	156	-15	-5.3	2.5	461	7	248	12
Permskaya Oblast	224	-19	-4.3	2.5	339	-3	266	22
Penzenskaya Oblast	237	-13	-1.4	2.1	397	-8	352	18
Rostovskaya Oblast	273	9	2.9	1.5	491	-13	482	10
Ryazanskaya Oblast	243	-12	-0.7	2.0	379	-6	361	16
Stavropolskiy Kray	242	-5	3.5	0.8	590	-6	492	5
Sverdlovskaya Oblast	159	-23	-4.9	2.4	390	2	256	18
Samarskaya Oblast	216	-14	-1.8	2.6	435	-6	351	23
Saratovskaya Oblast	237	-6	-0.6	2.3	445	-10	384	19
Tambovskaya Oblast	267	-2	-0.5	1.8	389	-13	371	14
Tyumenskaya Oblast	165	-14	-5.0	2.5	420	6	250	14
Tatarstan Rep.	204	-22	-2.4	2.7	373	-5	322	26
Ulyanovskaya Oblast	213	-14	-1.7	2.5	411	-4	346	23
Udmurtiya Rep.	220	-21	-3.3	2.8	328	-6	289	26
Volgogradskaya O.	229	-1	0.9	1.9	463	-14	424	13
Voronezhskaya Oblast	295	13	0.1	1.5	416	-16	390	8

Table A.10 United States, January - April 2023 agroclimatic indicators and biomass (by state)

	RAIN Current (mm)	RAIN 15YA Departure (%)	TEMP Current (°C)	TEMP 15YA Departure (°C)	RADPAR Current (MJ/m²)	RADPAR 15YA Departure (%)	BIOMSS Current (gDM/m²)	BIOMSS 15YA Departure (%)
Arkansas	689	27	10.7	1.7	704	-9	839	10
California	597	63	7.0	-2.1	835	-8	615	18
Idaho	339	-6	-2.3	-1.5	683	-5	316	-12
Indiana	459	-2	5.3	2.1	677	-1	586	13
Illinois	443	4	5.1	2.0	690	-1	578	11
Iowa	332	9	1.4	1.2	657	-5	440	4

Kansas	161	-23	6.5	0.6	853	-1	428	-10
Michigan	397	11	0.1	1.7	559	-7	377	11
Minnesota	341	31	-3.4	0.7	549	-11	281	-6
Missouri	430	5	6.7	1.6	753	0	657	11
Montana	219	-6	-3.3	-1.2	699	-2	295	-12
Nebraska	177	-11	2.0	-0.4	806	-1	423	-4
North Dakota	203	7	-4.3	-0.5	604	-9	264	-14
Ohio	405	-8	5.0	2.4	670	0	571	16
Oklahoma	339	14	10.0	0.8	819	-6	585	0
Oregon	463	-4	1.4	-2.0	630	-4	402	-13
South Dakota	209	-1	-1.4	-0.7	705	-4	350	-7
Texas	291	15	14.6	1.0	842	-9	567	1
Washington	472	-6	1.7	-1.1	545	-7	421	-5
Wisconsin	410	31	-1.2	1.7	572	-9	342	7

Table A.11 China, January - April 2023 agroclimatic indicators and biomass (by province)

	RAIN Current (mm)	RAIN 15YA Departure (%)	TEMP Current (°C)	TEMP 15YA Departure (°C)	RADPAR Current (MJ/m²)	RADPAR 15YA Departure (%)	BIOMSS Current (gDM/m²)	BIOMSS 15YA Departure (%)
Anhui	325	-5	9.6	1.2	822	2	632	5
Chongqing	431	18	9.6	0.5	700	-2	696	8
Fujian	509	-16	13.2	1.1	801	11	815	-3
Gansu	159	21	0.8	0.4	952	-2	331	12
Guangdong	470	-14	17.1	1.2	807	12	806	-8
Guangxi	353	-24	15.6	1.4	697	12	704	-13
Guizhou	317	-23	10.0	0.7	665	8	670	-5
Hebei	65	25	2.0	1.2	911	-2	233	15
Heilongjiang	92	-9	-6.8	1.5	737	-1	230	9
Henan	182	25	8.7	1.3	903	1	456	17
Hubei	389	10	9.4	1.2	796	2	679	8
Hunan	456	-15	11.1	1.3	728	13	765	-1
Jiangsu	224	-5	9.2	1.3	873	2	574	6
Jiangxi	587	-6	11.9	1.1	763	13	850	3
Jilin	100	-2	-3.7	1.8	818	-1	243	9
Liaoning	84	8	-0.8	1.2	865	-1	245	10
Inner Mongolia	54	-8	-5.5	1.3	859	0	168	-1
Ningxia	76	14	0.7	0.1	991	-1	257	10
Shaanxi	178	28	4.9	0.8	916	-1	410	23
Shandong	86	4	7.1	1.5	929	1	300	3
Shanxi	99	51	1.8	1.0	939	-1	300	27
Sichuan	376	26	7.7	0.8	845	-1	565	8
Yunnan	102	-55	12.1	0.8	1108	7	384	-29
Zhejiang	405	-22	10.3	1.2	803	9	764	1

Annex B. Quick reference to CropWatch indicators, spatial units and methodologies

The following sections give a brief overview of CropWatch indicators and spatial units, along with a description of the CropWatch production estimation methodology. For more information about CropWatch methodologies, visit CropWatch online at www.cropwatch.com.cn**.**

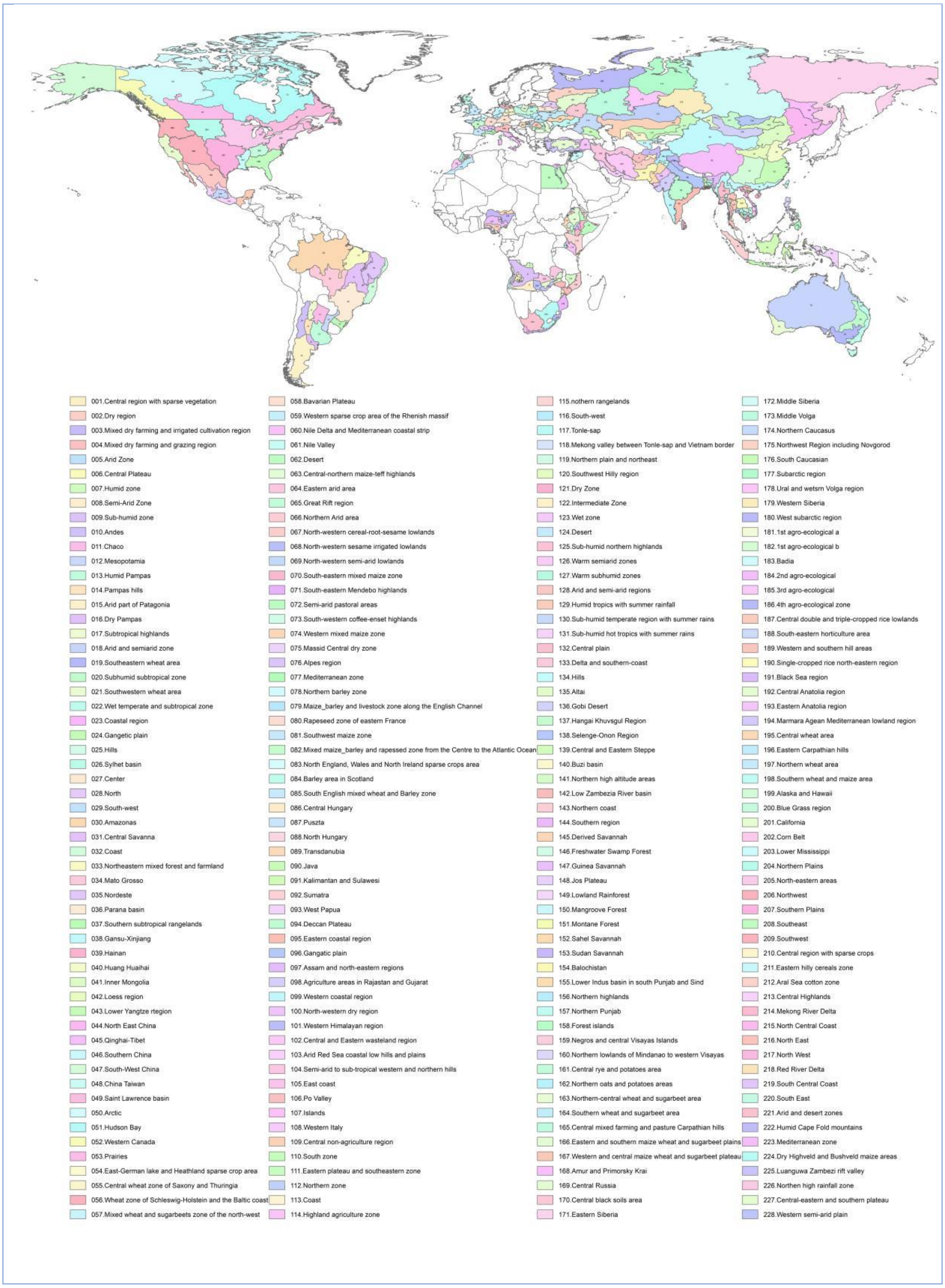
Agroecological zones for 45 key countries

Overview

228 agroecological zones for the 45 key countries across the globe

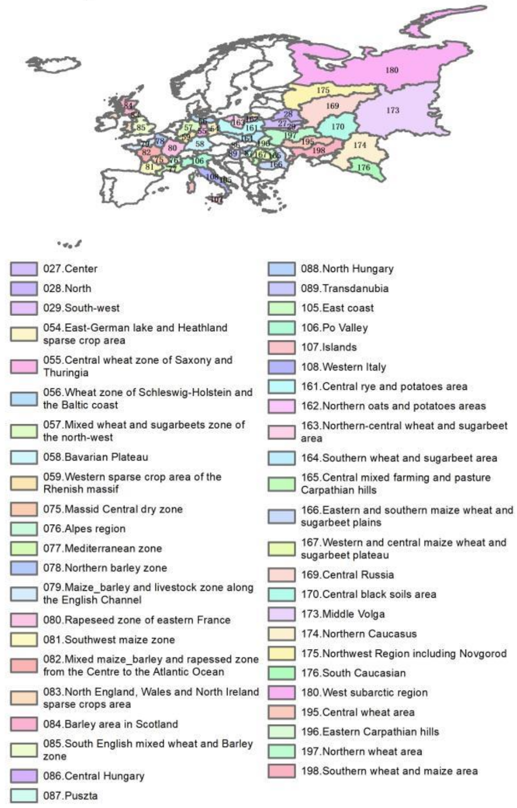
Description

45 key agricultural countries are divided into 228 agro-ecological zones based on cropping systems, climatic zones, and topographic conditions. Each country is considered separately. A limited number of regions (e.g., region 001, region 027, and region 127) are not relevant for the crops currently monitored by CropWatch but are included to allow for more complete coverage of the 45 key countries. Some regions are more relevant for rangeland and livestock monitoring, which is also essential for food security.

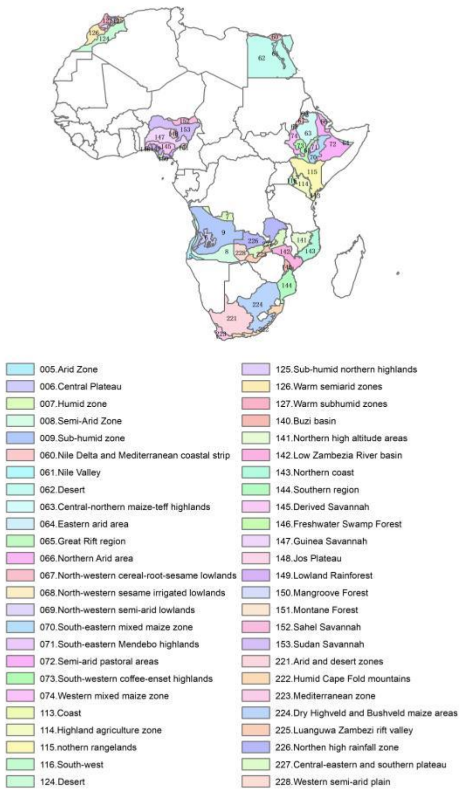

001.Central region with sparse vegetation
002.Dry region
003.Mixed dry farming and irrigated cultivation region
004.Mixed dry farming and grazing region
005.Arid Zone
006.Central Plateau
007.Humid zone
008.Semi-Arid Zone
009.Sub-humid zone
010.Andes
011.Chaco
012.Mesopotamia
013.Humid Pampas
014.Pampas hills
015.Arid part of Patagonia
016.Dry Pampas
017.Subtropical highlands
018.Arid and semiarid zone
019.Southeastern wheat area
020.Subhumid subtropical zone
021.Southwestern wheat area
022.Wet temperate and subtropical zone
023.Coastal region
024.Gangetic plain
025.Hills
026.Sylhet basin
027.Center
028.North
029.South-west
030.Amazonas
031.Central Savanna
032.Coast
033.Northeastern mixed forest and farmland
034.Mato Grosso
035.Nordeste
036.Parana basin
037.Southern subtropical rangelands
038.Gansu-Xinjiang
039.Hainan
040.Huang Huaihai
041.Inner Mongolia
042.Loess region
043.Lower Yangtze rtegion
044.North East China
045.Qinghai-Tibet
046.Southern China
047.South-West China
048.China Taiwan
049.Saint Lawrence basin
050.Arctic
051.Hudson Bay
052.Western Canada
053.Prairies
054.East-German lake and Heathland sparse crop area
055.Central wheat zone of Saxony and Thuringia
056.Wheat zone of Schleswig-Holstein and the Baltic coast
057.Mixed wheat and sugarbeets zone of the north-west
058.Bavarian Plateau
059.Western sparse crop area of the Rhenish massif
060.Nile Delta and Mediterranean coastal strip
061.Nile Valley
062.Desert
063.Central-northern maize-teff highlands
064.Eastern arid area
065.Great Rift region
066.Northern Arid area
067.North-western cereal-root-sesame lowlands
068.North-western sesame irrigated lowlands
069.North-western semi-arid lowlands
070.South-eastern mixed maize zone
071.South-eastern Mendebo highlands
072.Semi-arid pastoral areas
073.South-western coffee-enset highlands
074.Western mixed maize zone
075.Massid Central dry zone
076.Alpes region
077.Mediterranean zone
078.Northern barley zone
079.Maize_barley and livestock zone along the English Channel
080.Rapeseed zone of eastern France
081.Southwest maize zone
082.Mixed maize_barley and rapessed zone from the Centre to the Atlantic Ocean
083.North England, Wales and North Ireland sparse crops area
084.Barley area in Scotland
085.South English mixed wheat and Barley zone
086.Central Hungary
087.Puszta
088.North Hungary
089.Transdanubia
090.Java
091.Kalimantan and Sulawesi
092.Sumatra
093.West Papua
094.Deccan Plateau
095.Eastern coastal region
096.Gangatic plain
097.Assam and north-eastern regions
098.Agriculture areas in Rajastan and Gujarat
099.Western coastal region
100.North-western dry region
101.Western Himalayan region
102.Central and Eastern wasteland region
103.Arid Red Sea coastal low hills and plains
104.Semi-arid to sub-tropical western and northern hills
105.East coast
106.Po Valley
107.Islands
108.Western Italy
109.Central non-agriculture region
110.South zone
111.Eastern plateau and southeastern zone
112.Northern zone
113.Coast
114.Highland agriculture zone
115.nothern rangelands
116.South-west
117.Tonle-sap
118.Mekong valley between Tonle-sap and Vietnam border
119.Northern plain and northeast
120.Southwest Hilly region
121.Dry Zone
122.Intermediate Zone
123.Wet zone
124.Desert
125.Sub-humid northern highlands
126.Warm semiarid zones
127.Warm subhumid zones
128.Arid and semi-arid regions
129.Humid tropics with summer rainfall
130.Sub-humid temperate region with summer rains
131.Sub-humid hot tropics with summer rains
132.Central plain
133.Delta and southern-coast
134.Hills
135.Altai
136.Gobi Desert
137.Hangai Khuvsgul Region
138.Selenge-Onon Region
139.Central and Eastern Steppe
140.Buzi basin
141.Northern high altitude areas
142.Low Zambezia River basin
143.Northern coast
144.Southern region
145.Derived Savannah
146.Freshwater Swamp Forest
147.Guinea Savannah
148.Jos Plateau
149.Lowland Rainforest
150.Mangroove Forest
151.Montane Forest
152.Sahel Savannah
153.Sudan Savannah
154.Balochistan
155.Lower Indus basin in south Punjab and Sind
156.Northern highlands
157.Northern Punjab
158.Forest islands
159.Negros and central Visayas Islands
160.Northern lowlands of Mindanao to western Visayas
161.Central rye and potatoes area
162.Northern oats and potatoes areas
163.Northern-central wheat and sugarbeet area
164.Southern wheat and sugarbeet area
165.Central mixed farming and pasture Carpathian hills
166.Eastern and southern maize wheat and sugarbeet plains
167.Western and central maize wheat and sugarbeet plateau
168.Amur and Primorsky Krai
169.Central Russia
170.Central black soils area
171.Eastern Siberia
172.Middle Siberia
173.Middle Volga
174.Northern Caucasus
175.Northwest Region including Novgorod
176.South Caucasian
177.Subarctic region
178.Ural and wetsrn Volga region
179.Western Siberia
180.West subarctic region
181.1st agro-ecological a
182.1st agro-ecological b
183.Badia
184.2nd agro-ecological
185.3rd agro-ecological
186.4th agro-ecological zone
187.Central double and triple-cropped rice lowlands
188.South-eastern horticulture area
189.Western and southern hill areas
190.Single-cropped rice north-eastern region
191.Black Sea region
192.Central Anatolia region
193.Eastern Anatolia region
194.Marmara Agean Mediterranean lowland region
195.Central wheat area
196.Eastern Carpathian hills
197.Northern wheat area
198.Southern wheat and maize area
199.Alaska and Hawaii
200.Blue Grass region
201.California
202.Corn Belt
203.Lower Mississippi
204.Northern Plains
205.North-eastern areas
206.Northwest
207.Southern Plains
208.Southeast
209.Southwest
210.Central region with sparse crops
211.Eastern hilly cereals zone
212.Aral Sea cotton zone
213.Central Highlands
214.Mekong River Delta
215.North Central Coast
216.North East
217.North West
218.Red River Delta
219.South Central Coast
220.South East
221.Arid and desert zones
222.Humid Cape Fold mountains
223.Mediterranean zone
224.Dry Highveld and Bushveld maize areas
225.Luanguwa Zambezi rift valley
226.Northen high rainfall zone
227.Central-eastern and southern plateau
228.Western semi-arid plain

Asia

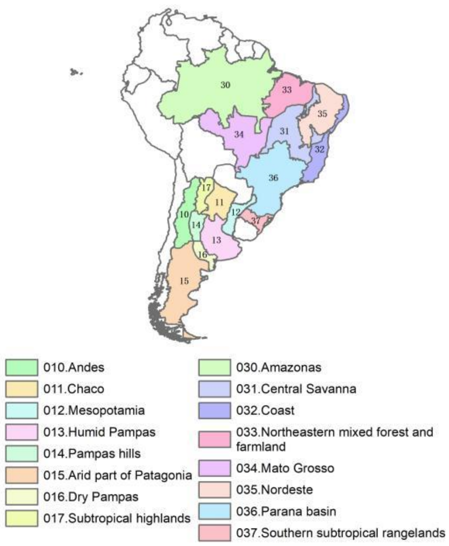
Europe

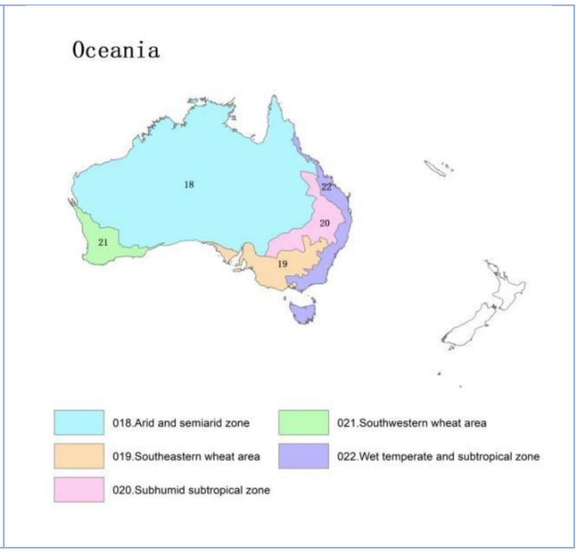


Africa



South America





CropWatch indicators

The CropWatch indicators are designed to assess the condition of crops and the environment in which they grow and develop; the indicators—RAIN (for rainfall), TEMP (temperature), and RADPAR (photosynthetically active radiation, PAR)—are not identical to the weather variables, but instead are value-added indicators computed only over crop growing areas (thus for example excluding deserts and rangelands) and spatially weighted according to the agricultural production potential, with marginal areas receiving less weight than productive ones. The indicators are expressed using the usual physical units (e.g., mm for rainfall) and were thoroughly tested for their coherence over space and time. CWSU are the CropWatch Spatial Units, including MRUs, MPZ, and countries (including first-level administrative districts in select large countries). For all indicators, high values indicate "good" or "positive."

INDICATOR			
BIOMSS			
Biomass accumulation potential			
Crop/ satellite	Grams dry matter/m^2, pixel or CWSU	An estimate of biomass that could potentially be accumulated over the reference period given the prevailing rainfall and temperature conditions.	Biomass is presented as maps by pixels, maps showing average pixels values over CropWatch spatial units (CWSU), or tables giving average values for the CWSU. Values are compared to the average value for the recent fifteen years (2007-2021), with departures expressed in percentage.
CALF			
Cropped arable land and cropped arable land fraction			
Crop/ Satellite	[0,1] number, pixel or CWSU average	The area of cropped arable land as fraction of total (cropped and uncropped) arable land. Whether a pixel is cropped or not is decided based on NDVI twice a month. (For each four-month reporting period, each pixel thus has 8 cropped/ uncropped values).	The value shown in tables is the maximum value of the 8 values available for each pixel; maps show an area as cropped if at least one of the 8 observations is categorized as "cropped." Uncropped means that no crops were detected over the whole reporting period. Values are compared to the average value for the last five years (2017-2021), with departures expressed in percentage.
CROPPING INTENSITY			
Cropping intensity Index			
Crop/ Satellite	0, 1, 2, or 3; Number of	Cropping intensity index describes the extent to which arable land is used over	Cropping intensity is presented as maps by pixels or spatial average pixels values for MPZs, 45

INDICATOR			
	crops growing over a year for each pixel	a year. It is the ratio of the total crop area of all planting seasons in a year to the total area of arable land.	countries, and 7 regions for China. Values are compared to the average of the previous five years, with departures expressed in percentage.
NDVI			
Normalized Difference Vegetation Index			
Crop/ Satellite	[0.12-0.90] number, pixel or CWSU average	An estimate of the density of living green biomass.	NDVI is shown as average profiles over time at the national level (cropland only) in crop condition development graphs, compared with previous year and recent five-year average (2017-2021), and as spatial patterns compared to the average showing the time profiles, where they occur, and the percentage of pixels concerned by each profile.
RADPAR			
CropWatch indicator for Photosynthetically Active Radiation (PAR), based on pixel based PAR			
Weather /Satellite	W/m^2, CWSU	The spatial average (for a CWSU) of PAR accumulation over agricultural pixels, weighted by the production potential.	RADPAR is shown as the percent departure of the RADPAR value for the reporting period compared to the recent fifteen-year average (2007-2021), per CWSU. For the MPZs, regular PAR is shown as typical time profiles over the spatial unit, with a map showing where the profiles occur and the percentage of pixels concerned by each profile.
RAIN			
CropWatch indicator for rainfall, based on pixel-based rainfall			
Weather / satellite	$Liters/m^2$, CWSU	The spatial average (for a CWSU) of rainfall accumulation over agricultural pixels, weighted by the production potential.	RAIN is shown as the percent departure of the RAIN value for the reporting period, compared to the recent fifteen-year average (2007-2021), per CWSU. For the MPZs, regular rainfall is shown as typical time profiles over the spatial unit, with a map showing where the profiles occur and the percentage of pixels concerned by each profile.
TEMP			
CropWatch indicator for air temperature, based on pixel-based temperature			
Weather / satellite	°C, CWSU	The spatial average (for a CWSU) of the temperature time average over agricultural pixels, weighted by the production potential.	TEMP is shown as the departure of the average TEMP value (in degrees Centigrade) over the reporting period compared with the average of the recent fifteen years (2007-2021), per CWSU. For the MPZs, regular temperature is illustrated as typical time profiles over the spatial unit, with a map showing where the profiles occur and the percentage of pixels concerned by each profile.
VCIx			
Maximum vegetation condition index			
Crop/ Satellite	Number, pixel to CWSU	Vegetation condition of the current season compared with historical data. Values usually are [0, 1], where 0 is "NDVI as bad as the worst recent year" and 1 is "NDVI as good as the best recent year." Values can exceed the range if the current year is the best or the worst.	VCIx is based on NDVI and two VCI values are computed every month. VCIx is the highest VCI value recorded for every pixel over the reporting period. A low value of VCIx means that no VCI value was high over the reporting period. A high value means that at least one VCI value was high. VCI is shown as pixel-based maps and as average value by CWSU.
VHI			
Vegetation health index			

INDICATOR			
Crop/ Satellite	Number, pixel to CWSU	The average of VCI and the temperature condition index (TCI), with TCI defined like VCI but for temperature. VHI is based on the assumption that "high temperature is bad" (due to moisture stress), but ignores the fact that low temperature may be equally "bad" (crops develop and grow slowly, or even suffer from frost).	Low VHI values indicate unusually poor crop condition, but high values, when due to low temperature, may be difficult to interpret. VHI is shown as typical time profiles over Major Production Zones (MPZ), where they occur, and the percentage of pixels concerned by each profile.
VHIn			
Minimum Vegetation health index			
Crop/ Satellite	Number, pixel to CWSU	VHIn is the lowest VHI value for every pixel over the reporting period. Values usually are [0, 100]. Normally, values lower than 35 indicate poor crop condition.	Low VHIn values indicate the occurrence of water stress in the monitoring period, often combined with lower than average rainfall. The spatial/time resolution of CropWatch VHIn is 16km/week for MPZs and 1km/dekad for China.
CPI			
Crop Production Index			
Crop/ Satellite	Number, pixel to CWSU	The average crop production situation for the same period in the past five years was used as a benchmark to make an overall estimate of the current season's agricultural production situation.	Based on the VCIx, CALF, land productivity and area of irrigated and rainfed cropland in the current monitoring period and the same period in the past five years for the spatial unit, a mathematical model proposed by CropWatch is used to calculate the index expressed as a normalized value. A value of 1.0 represents the basic normal crop production situation in the current period for the spatial unit, and the higher the value, the better the crop production situation in the current period. Conversely, the lower the value, the worse the crop production situation for the spatial unit in the current period.

Note: Type is either "Weather" or "Crop"; source specifies if the indicator is obtained from ground data, satellite readings, or a combination; units: in the case of ratios, no unit is used; scale is either pixels or large scale CropWatch spatial units (CWSU). Many indicators are computed for pixels but represented in the CropWatch bulletin at the CWSU scale.

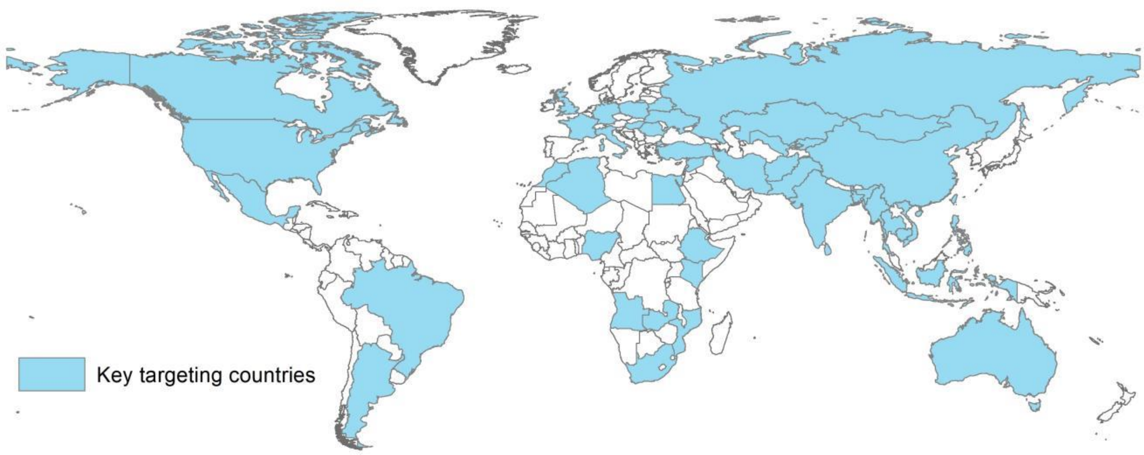
CropWatch spatial units (CWSU)

CropWatch analyses are applied to four kinds of CropWatch spatial units (CWSU): Countries, China, Major Production Zones (MPZ), and global crop Monitoring and Reporting Units (MRU). The tables below summarize the key aspects of each spatial unit and show their relation to each other. For more details about these spatial units and their boundaries, see the CropWatch bulletin online resources.

SPATIAL LUNITS	
CHINA	
Overview	*Description*
Seven monitoring regions	The seven regions in China are agro-economic/agro-ecological regions that together cover the bulk of national maize, rice, wheat, and soybean production. Provinces that are entirely or partially included in one of the monitoring regions are indicated in color on the map below.

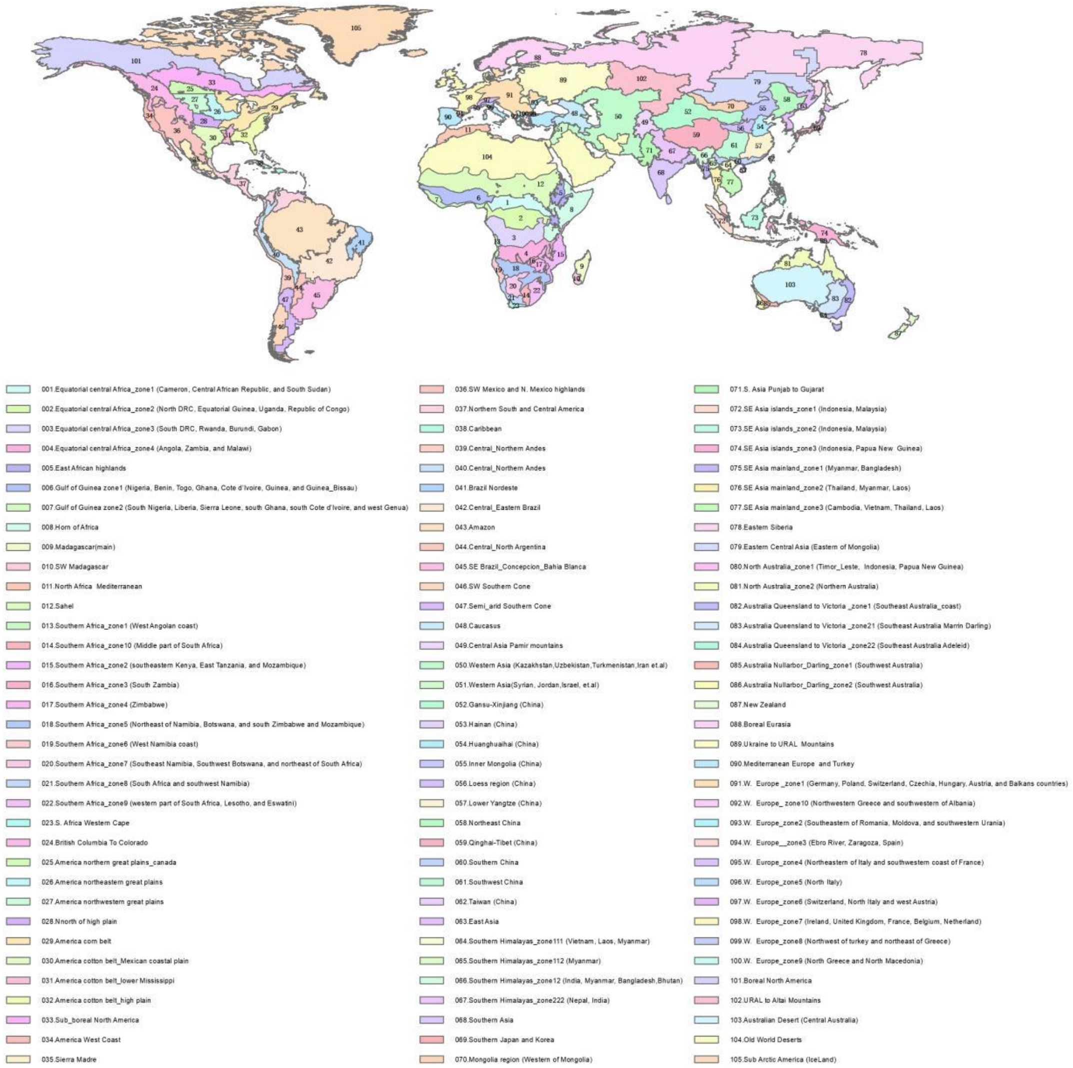

Heilongjiang
North East China
Inner Mongolia
Jilin
Inner Mongolia
Liaoning
Gansu
Ningxia
Shanxi
Hebei
Loess region
Shandong
Huang Huaihai
Shaanxi
Jiangsu
Anhui
Sichuan
Hubei
Chongqing
South-West China
Lower Yangtze
Zhejiang
Jiangxi
Guizhou
Hunan
Fujian
Yunnan
Guangxi
Guangdong
Southern China

Countries (and first-level administrative districts, e.g., states and provinces)	
Overview	*Description*
"Forty four plus one" countries to represent main producers/exporters and other key countries.	CropWatch monitored countries together represent more than 80% of the production of maize, rice, wheat and soybean, as well as 80% of exports. Some countries were included in the list based on criteria of proximity to China (Uzbekistan, Cambodia), regional importance, or global geopolitical relevance (e.g., four of five most populous countries in Africa). The total number of countries monitored is "44 + 1," referring to 44 and China itself. For the nine largest countries—, United States, Brazil, Argentina, Russia, Kazakhstan, India, China, and Australia, maps and analyses may also present results for the first-level administrative subdivision. The CropWatch agroclimatic indicators are computed for all countries and included in the analyses when abnormal conditions occur. Background information about the countries' agriculture and trade is available on the CropWatch Website, **www.cropwatch.com.cn**.



Major Production Zones (MPZ)	
Overview	*Description*
Six globally important areas of agricultural production	The six MPZs include West Africa, South America, North America, South and Southeast Asia, Western Europe and Central Europe to Western Russia. The MPZs are not necessarily the main production zones for the four crops (maize, rice, soybean, wheat) currently monitored by CropWatch, but they are globally or regionally important areas of agricultural production. The seven zones were identified based mainly on production statistics and distribution of the combined cultivation area of maize, rice, wheat and soybean.

Global Monitoring and Reporting Unit (MRU)	
Overview	*Description*
105agro-ecological/agro-economic units across the world	MRUs are reasonably homogeneous agro-ecological/agro-economic units spanning the globe, selected to capture major variations in worldwide farming and crops patterns while at the same time providing a manageable (limited) number of spatial units to be used as the basis for the analysis of environmental factors affecting crops. Unit numbers and names are shown in the figure below. A limited number of units are not relevant for the crops currently monitored by CropWatch but are included to allow for more complete coverage of global production. Additional information about the MRUs is provided online under **www.cropwatch.com.cn** .



Production estimation methodology

The main concept of the CropWatch methodology for estimating production is the calculation of current year production based on information about last year's production and the variations in crop yield and cultivated area compared with the previous year. The equation for production estimation is as follows:

$$Production_i = Production_{i-1} * (1 + \Delta Yield_i) * (1 + \Delta Area_i)$$

Where i is the current year, $\Delta Yield_i$ and $\Delta Area_i$ are the variations in crop yield and cultivated area compared with the previous year; the values of $\Delta Yield_i$ and $\Delta Area_i$ can be above or below zero.

For the 45 countries monitored by CropWatch, yield variation for each crop is calibrated against NDVI time series, using the following equation:

$$\Delta Yield_i = f(NDVI_i, NDVI_{i-1})$$

Where $NDVI_i$ and $NDVI_{i-1}$ are taken from the time series of the spatial average of NDVI over the crop specific mask for the current year and the previous year. For NDVI values that correspond to periods after the current monitoring period, average NDVI values of the previous five years are used as an average expectation. $\Delta Yield_i$ is calculated by regression against average or peak NDVI (whichever yields the best regression), considering the crop phenology of each crop for each individual country.

A different method is used for areas. For China, CropWatch combines remote-sensing based estimates of the crop planting proportion (cropped area to arable land) with a crop type proportion (specific type area to total cropped area). The planting proportion is estimated based on an unsupervised classification of high resolution satellite images from HJ-1 CCD and GF-1 images. The crop-type proportion for China is obtained by the GVG instrument from field transects. The area of a specific crop is computed by multiplying farmland area, planting proportion, and crop-type proportion of the crop.

To estimate crop area for wheat, soybean, maize, and rice outside China, CropWatch relies on the regression of crop area against cropped arable land fraction of each individual country (paying due attention to phenology):

$$Area_i = a + b * CALF_i$$

Where, a and b are the coefficients generated by linear regression with area from FAOSTAT or national sources and CALF (Cropped Arable Land Fraction) from CropWatch estimates.

Data notes and bibliography

Notes

[1] Although Yemen is not part of the Horn of Africa (HoA), it is geographically close and maintains close links to the region. The countries of the HoA are grouped in the regional development association IGAD (Inter-governmental Authority on Development, with headquarters in Djibouti). IGAD has recently established the IGAD Drought Disaster Resilience and Sustainability Initiative (IDDRSI, 2016).

[2] Under-investment in agriculture was one of the main drivers of the 2008 crisis of high food prices (Mittal 2009, ATV 2010), even if several other local and global triggering factors can be identified (Evans 2008).

[3] Previous large humanitarian crises were those of the West African Sahel (from the early sixties to the mid eighties), the Ethiopian droughts of the mid-eighties, the Indian Ocean tsunami of 2004, several large earthquakes (for example, Haiti, 2010), and floods and medical emergencies (such as the West African Ebola outbreak, 2013-16).

[4] http://www.agrhymet.ne/eng/index.html

[5] http://www.icpac.net/

[6] Belg is harvested before or during October.

[7] "Purely man-made disasters" is, however, a concept that deserves a closer look, as many wars and insurgencies are partially triggered by shortages of natural resources, including land. As such, most "man-made disasters" do have an environmental component.

References

ACT 2014 Condensed Papers of the First Africa Congress on Conservation Agriculture, 2014, Lusaka. http://www.act-africa.org/lib.php?com=5&com2=20&com3=63&com4=30&res_id=219

Agada O O 2016 Agricultural Water Management in Sub – Sahara Africa: Options for Sustainable Crop Production. Greener Journal of Agricultural Sciences, 6 (4):151-158. https://www.researchgate.net/publication/308208940_Agricultural_Water_Management_in_Sub_-_Sahara_Africa_Options_for_Sustainable_Crop_Production

Akroyd S, L Smith 2007 Public Spending to Agriculture A joint DFID / World Bank study. Main Study & Country Case-Studies. Oxford Policy Management, Oxford, UK. http://www1.worldbank.org/publicsector/pe/pfma07/OPMReview.pdf

ATV 2010 Recommendation report: food for all forever. Danish academy of technical sciences (ATV), Copenhagen,

Bloomberg 2018 South Africa Plans to Declare Drought a National Disaster https://www.bloomberg.com/news/articles/2018-02-08/south-africa-plans-to-declare-drought-a-national-disaster

Buckley L, Chen Ruijian, Yin Yanfei, Zhu Zidong 2017 Chinese agriculture in Africa, Perspectives of Chinese agronomists on agricultural aid. International Institute for Environment and Development IIED and Foreign Economic Cooperation Centre (FECC) of the of the Chinese Ministry of Agriculture, http://pubs.iied.org/pdfs/17603IIED.pdf

Christiaansen L, L Demery 2018 Agriculture in Africa : Telling Myths from Facts. Directions in Development—Agriculture and Rural Development;. Washington, DC: World Bank. © World Bank. https://openknowledge.worldbank.org/handle/10986/28543 License: CC BY 3.0 IGO.

CropWatch 2015 New optimism for African agriculture? February 2015 CropWatch bulletin available from http://www.cropwatch.com.cn/htm/en/files/201531010955561.pdf

CropWatch 2017a The specter of famine is back in the Horn of Africa. August 2017 CropWatch bulletin available from http://www.cropwatch.com.cn/htm/en/files/20170805en.pdf

CropWatch 2017b Rangeland management and issues in Africa. July 2017 CropWatch bulletin available from http://www.cropwatch.com.cn/htm/en/files/20170405EN.pdf

Deininger K, D Byerlee 2011 Rising global interest in farmland. Can it yield sustainable equitable benefits. World Bank, Washington http://siteresources.worldbank.org/INTARD/Resources/ESW_Sept7_final_final.pdf

ECA 2009 Agricultural Input Business Development in Africa: Opportunities, Issues and Challenges, Economic Commission for Africa, southern-Africa Office. https://www.uneca.org/sites/default/files/PublicationFiles/sro-sa-agri-iputs-business-opportunities.pdf

FAO. 2011. The state of the world's land and water resources for food and agriculture (SOLAW) – Managing systems at risk. FAO Rome and Earthscan, London. http://www.fao.org/docrep/017/i1688e/i1688e00.htm

Feed Africa 2016 Strategy for agricultural transformation in Africa. African development Bank, Tunis, Tunisia. https://www.afdb.org/fileadmin/uploads/afdb/Documents/Generic-Documents/Feed_Africa-_Strategy_for_Agricultural_Transformation_in_Africa_2016-2025.pdf

Ferguson, R., D. Krishna, Y. Mhango, A. Alexander, R. Kuzviwanza, A. Oliver, O. Mfune,

I. Pretorius & J. Lutzweiler. 2011. African agriculture, this other Eden. Renaissance, Moscow, Russia. 220 pp. http://www.fastestbillion.com/res/Research/This_other_Eden-211111.pdf

Fritz S, L See, I McCallum, Liangzhi You, A Bun and 42 others 2015 Mapping global cropland and field size Global Change Biology 21(5)1980-1992

GrowAfrica 2018 https://www.growafrica.com/

Hopkins R Agriculture in Africa http://ruperthopkins.com/pdf/Agriculture%20in%20Africa%20002.pdf

IRI 2015 2015 El Niño: Notes for the East African Malaria Community.

IFPRI 2016 El Niño and the Outlook for 2016. http://www.foodsecurityportal.org/el-ni%C3%B1o-and-outlook-2016

Livingston G, S Schonberger, S Delaney 2011 Sub-Saharan Africa: The state of smallholders in agriculture, Paper presented at the IFAD Conference on New Directions for Smallholder Agriculture 24-25 January, 2011, IFAD, Rome

Mittal A 2009 The 2008 Food price crisis: rethinking food security policies. G-24 Discussion Paper No. 56.

Nakweya G 2017 Africa needs to invest in agricultural censuses. https://www.scidev.net/sub-saharan-africa/agriculture/news/africa-invest-agricultural-censuses.html#

NEPAD 2013 Agriculture in Africa, Transformation and outlook. https://www.un.org/en/africa/osaa/pdf/pubs/2013africanagricultures.pdf

OECD-FAO 2016 Agricultural Outlook 2016-2025. INCOMPLETE

Peel M C, B L Finlayson, T A McMahon 2007 Updated world map of the Köppen-Geiger climate classification. Hydrol. Earth Syst. Sci., 11, 1633–1644.

Reuters 2018 Commentary: In drought-hit South Africa, the politics of water. https://www.reuters.com/article/us-saundersonmeyer-drought-commentary/commentary-in-drought-hit-south-africa-the-politics-of-water-idUSKBN1FP226

RISCURA 2015 The high-level impact and ongoing effects of El Niño http://www.riscura.com/brightafrica/el-nino/impact-effects/

Siebert S, V Henrich, K Frenken, J Burke 2013 GMIA version 5, Global map or irrigated agriculture. FAO and University of Bonn. http://www.fao.org/nr/water/aquastat/irrigationmap/gmia_v5_highres.pdf

SOLAW 2011. The state of the world's land and water resources for food and agriculture. Managing systems at risk. FAO, Rome. http://www.fao.org/docrep/015/i1688e/i1688e00.pdf

UNEP-UNCTAD 2008 Organic Agriculture and Food Security in Africa, UN New-York and Geneva http://www3.weforum.org/docs/WEF_ACR_2015/Africa_Competitiveness_Report_2015.pdf

Vargas-Hill R 2010 Agricultural insurance in Sub-Saharan Africa: can it work? Paper prepared for the Fourth African Agricultural Markets Program (AAMP) policy symposium, Agricultural Risks Management in Africa: Taking Stock of What Has and Hasn't Worked, organized by the Alliance for Commodity Trade in Eastern and Southern Africa (ACTESA) and by the Common Market for Eastern and Southern Africa (COMESA). Lilongwe, Malawi, September 6-10, 2010. http://www.fsg.afre.msu.edu/aamp/sept_2010/aamp_lilongwe-vargas_hill-agricultural_insurance.pdf

Ward Christopher, R Torquebiau, Hua Xie 2016 Improved Agricultural Water Management for Africa's Drylands. World Bank Studies. Washington, DC: World Bank. doi: 10.1596/978-1-4648-0832-6. License: Creative Commons Attribution CC BY 3.0 IGO

WEC 2015 "Africa competitiveness Report 2015, chapter 2.1 Africa" WEC, Geneva Switzerland http://www3.weforum.org/docs/WEF_ACR_2015/Africa_Competitiveness_Report_2015.pdf

WB 2018 https://data.worldbank.org/indicator/NV.AGR.TOTL.ZS, https://data.worldbank.org/indicator/SL.AGR.EMPL.ZS

WEF 2016 African farmers need investment – but these 6 factors stand in the way. https://www.weforum.org/agenda/2016/05/6-challenges-to-investing-in-african-farmers

WHO 2016 El Niño and health, Global overview. http://www.who.int/hac/crises/el-nino/who_el_nino_and_health_global_report_21jan2016.pdf

World Bank 2009. Awakening Africa's Sleeping Giant. Prospects for Commercial Agriculture in the Guinea Savannah Zone and Beyond. Directions in development, Agriculture and Rural Development. World Bank, Italian Ministry fo Foreign Affairs and FAO, Rome. 219 pp

https://reliefweb.int/report/lesotho/lesotho-key-message-update-november-2017

http://www.bbc.com/news/av/world-africa-42866178/why-cape-town-is-shutting-off-its-water-supply

https://reliefweb.int/report/zimbabwe/zimbabwe-key-message-update-january-2018

https://www.acaps.org/country/dominica/special-reports#container-955

https://en.wikipedia.org/wiki/Hurricane_Irma

https://en.wikipedia.org/wiki/Hurricane_Maria

https://www.acaps.org/country/vietnam/special-reports#container-957

https://en.wikipedia.org/wiki/Hurricane_Nate_(2017)

https://reliefweb.int/report/viet-nam/aha-centre-flash-update-4-typhoon-damrey-28

https://reliefweb.int/sites/reliefweb.int/files/resources/AHA__6_Flash_Update_Typhoon_Damrey.pdf

https://en.wikipedia.org/wiki/Cyclone_Ockhi

https://reliefweb.int/sites/reliefweb.int/files/resources/DSWD%20DROMIC%20Report%20%2310A%20on%20TD%20URDUJA%20as%20of%2020%20December%202117%2C%208AM.pdf

https://reliefweb.int/sites/reliefweb.int/files/resources/Summary%20of%20Response%20Clusters%20SitRep%20No.%2007%20on%20TS%20Urduja.pdf

https://reliefweb.int/report/viet-nam/viet-nam-typhoon-damrey-dref-operation-update-n-1-mdrvn017

https://www.acaps.org/sites/acaps/files/products/files/171228_start_acaps_briefing_note_philippines_tropical_storm.pdf

https://reliefweb.int/sites/reliefweb.int/files/resources/ROSEA_180110_FlashUpdate5_TropicalCyclone_Madagascar.pdf

https://reliefweb.int/sites/reliefweb.int/files/resources/MDRPH026_OU1.pdf

https://reliefweb.int/sites/reliefweb.int/files/resources/171109_flash_update_inundacion_corinto-noviembre_vf.pdf

https://reliefweb.int/sites/reliefweb.int/files/resources/Peru%20deslizamiento%20en%20el%20distrito%20de%20%20Cholon.pdf

https://reliefweb.int/report/colombia/colombia-desplazamiento-masivo-en-alto-baud-choc-flash-update-no-2-15112017

https://reliefweb.int/sites/reliefweb.int/files/resources/MDRPA012dfr.pdf

https://reliefweb.int/sites/reliefweb.int/files/resources/BOLETIN%20INFORMATIVO%20N%20607.pdf

https://ec.europa.eu/jrc/sites/jrcsh/files/jrc-mars-bulletin-vol25-no11.pdf

https://reliefweb.int/sites/reliefweb.int/files/resources/Children-on-the-Move-v.2.pdf

https://reliefweb.int/sites/reliefweb.int/files/resources/55971.pdf

https://reliefweb.int/sites/reliefweb.int/files/resources/WCD_Data_analysis.pdf

https://www.acaps.org/sites/acaps/files/products/files/acaps_humanitarian_overview_analysis_of_key_crises_into_2018.pdf

https://reliefweb.int/report/guatemala/autoridades-atienden-m-s-de-2700-desamparados-por-fr-o-en-guatemala

https://reliefweb.int/sites/reliefweb.int/files/resources/MDRMA009EPOA.pdf

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Online resources

Online Resources posted on **www.cropwatch.com.cn** , **http://cloud.cropwatch.com.cn/**

This bulletin is only part of the CropWatch resources available. Visit **www.cropwatch.com.cn** for access to additional resources, including the methods behind CropWatch, country profiles, and other CropWatch publications. For additional information or to access specific data or high-resolution graphs, simply contact the CropWatch team at **cropwatch@radi.ac.cn**.

CropWatch bulletins introduce the use of several new and experimental indicators. We would be very interested in receiving feedback about their performance in other countries. With feedback on the contents of this report and the applicability of the new indicators to global areas, please contact:

Professor Bingfang Wu
Institute of Remote Sensing and Digital Earth
Chinese Academy of Sciences, Beijing, China
E-mail: cropwatch@radi.ac.cn,
wubf@aircas.ac.cn