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中国科学院空天信息创新研究院
Aerospace Information Research Institute, Chinese Academy of Sciences

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), Jose Bofana (Mozambique), Sheng Chang, Shuping Cheng (Hubei, China), Abdelrazek Elnashar (Egypt), Li Fu, Zhijun Fu, Wenwen Gao (Shanxi, China), Yueran Hu, Kangjian Jing, Mengxiao Li, Yuanchao Li, Zhongyuan Li (Hubei, China), Wenjun Liu (Yunnan, China), Yuming Lu, Wenwen Ma (Hubei, China), Zonghan Ma, Linghua Meng (Jilin, China), Elijah Phiri (Zambia), Elena Proudnikova (Russia), Xingli Qin, Mohsen N. Ramadan (Egypt), Igor Savin (Russia), Urs Christoph Schulthess (CIMMYT, Netherlands), Binfeng Sun (Jiangxi, China), Fuyou Tian, Huanfang Wang, Linjiang Wang, Qiang Wang (Anhui, China), Yixuan Wang, Yuandong Wang (Jiangxi, China), Zhengdong Wang, Bingfang Wu, Cong Xu, Jiaming Xu (Zhejiang, China), Nana Yan, Leidong Yang, Min Yang (Hubei, China), Zhishan Ye (Anhui, China), Hongwei Zeng, Miao Zhang, Xiwang Zhang (Henan, China), Dan Zhao, Hang Zhao, Xinfeng Zhao, Yifan Zhao, Liang Zhu, Weiwei Zhu, and Qifeng Zhuang (Jiangsu, China).

Editor: Liang Zhu

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: This bulletin along with additional resources is also available on the CropWatch Website at http://www.cropwatch.cn and http://cloud.cropwatch.cn/.

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Abbreviations

5YA	Five-year average, the average for the four-month period from July to October for 2016-2020; one of the standard reference periods.
15YA	Fifteen-year average, the average for the four-month period from July to October for 2006-2020; 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
CWAI	CropWatch Agroclimatic Indicator
CWSU	CropWatch Spatial Units
DM	Dry matter
EC/JRC	European Commission Joint Research Centre
ENSO	El 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

Bulletin overview and reporting period

This CropWatch bulletin presents a global overview of crop stage and condition between July and October 2021, a period referred to in this bulletin as the JASO (July, August, September and October) period or just the "reporting period." The bulletin is the 123th 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 crop condition and development. (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, 42 major agricultural countries, and 217 Agro-Ecological Zones (AEZs).

This bulletin is organized as follows:

Chapter	Spatial coverage	Key indicators
Chapter 1	World, using Mapping and Reporting Units (MRU), 65 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	42 key countries (main producers and exporters) and 210 AEZs	As above plus NDVI and GVG survey
Chapter 4	China and regions	As above plus high-resolution images; Pest and crops trade prospects
Chapter 5	Production outlook, and updates on disaster events and El Niño.	

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 **www.cropwatch.cn**, **http://cloud.cropwatch.cn/**

Executive summary

The current CropWatch bulletin describes world-wide crop condition and food production as appraised by data up to the end of October 2021. It is prepared by an international team coordinated by the Aerospace Information Research Institute, Chinese Academy of Sciences.

Special attention is paid to the major producers of maize, rice, wheat and soybean throughout the bulletin. The assessment is based mainly on remotely sensed data. It covers prevailing weather conditions, including extreme factors, at different spatial scales, starting with global patterns in Chapter 1. Chapter 2 focuses on agro-climatic 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. Each is the object of a detailed analysis. Chapter 4 zooms into China. The bulletin also presents this year's fouth CropWatch production estimates for selected countries and reviews the disasters in chapter 5.

This report for the period from July to October 2021 covers wheat, maize, soybean and rice production in the Northern Hemisphere. Winter wheat reached maturity in June/July. The harvest of the summer crops (spring wheat, maize, single-season rice/middle-season rice and soybean) started in August and was mostly finished by the end of October, then the harvest of late rice was finished in November. In the Southern Hemisphere, wheat is the only major crop that was grown during this monitoring period. It reaches maturity in October (Southern Brazil) or in November and December (Argentina, South Africa and Australia).

While COVID-19 keeps impacting the lives of the entire world population, it has generally had very limited effects on the production of the key staple crops, which are maize, rice, wheat and soybean. The outbreak of desert locusts in East Africa and Middle East is getting under control, although efforts are hampered by conflicts in the Horn of Africa. Harm to crops, while devastating for the affected farmers, has been limited to some pockets.

Agro-climatic conditions

Global temperatures continue to set alarming records in 2021. July 2021 was the Earth's hottest month on record. It was also the hottest month for Asia. August to October also ranked at the very top of hottest months ever recorded.

Climate change not only impacts the temperatures, it also affects precipitation and wind. It causes prolonged and more severe droughts, such as the one that occurred in the West of the USA. On the other hand, rainfall intensities tend to increase. On July 20, more than 200 mm of rainfall were recorded over the city of Zhengzhou between 4 and 5 pm. This was the heaviest hour of rainfall ever reliably recorded in China. Many other parts of the world were also affected by floods during this monitoring period. Fertile agricultural land is often located in flood plains. Thus, not only droughts, but also floods, amplified by climate change, can pose a major threat to food security.

Overall, conditions for the production of maize, rice and soybean were favorable during this monitoring period. Conditions for wheat were highly variable. In 2021, total production of major cereal and oil crops globally is estimated to be at 2,882 million tonnes, a decrease by 0.4%, equivalent to 10.3 million tonnes. Maize production is estimated at 1,077 million tonnes, an increase of 0.6% or equivalent to 6.9 million tonnes; global rice production is at 764 million tonnes， an increase of 0.5% or an increase of 3.5 million tonnes; global wheat production is 720 million tonnes, a 2.4% decrease or 17.7 million tonnes drop from

2020, due to the consistent drought impact in South America, Western Africa and Western Asia. The global soybean production is estimated to be at 320.3million tonnes, a decrease by 0.9%.

The following is a summary of the conditions in the key production regions:

- North America: In the USA, production conditions were generally favorable for maize (+1.8%), and soybean (+0.2%). Rice (-3.0%) was negatively impacted by the drought conditions in California. Conditions were mixed for wheat. Especially the Pacific Northwest and the Northern Plains were unfavorable, due to drought conditions and high temperatures. This resulted in a decline of wheat production by 2.7%. Wheat in the Canadian Prairies was also severely impacted by the drought. Canada's wheat production is estimated to have declined by 15.2% as compared to last year. Rainfed maize production in Mexico (+3.9%) benefitted from abundant rainfall during the summer months.

- South America: Wheat production in Argentina (+12.3%) and Brazil (+17.7%) is estimated to be higher than last year. Conditions in Brazil were mixed, as wheat in Parana was affected by drought and several freezes. But production increased due to an expanded area. The soybean crop in Brazil is off to a good start. Dry weather in the first half of October provided good conditions for sowing. Subsequent heavy rains in late October helped with germination and crop establishment.

- Europe: This summer was rather wet in most of western and northern Europe. Harvest of wheat was negatively impacted by frequent rains and quality suffered due to lodging and sprouting. France, Europe's largest producer, saw an increase in wheat production by 2.4%, whereas in Germany, it declined by 1.6%. Conditions in Hungary were drier than usual, causing a decline in maize (-10.3%) and wheat (-5.2%) production.

- Eastern Europe to the Ural: In the Ukraine, a top exporter of wheat and maize, conditions were favorable. Wheat production increased by 9% and maize by 28.7%. In Russia, conditions were mixed. Irregular rainfall caused a decline in wheat production in the southern Ural and Volga region.

- Africa: Rainfall was generally below average, by as much as 30% and more in Western Africa. The only region with average rainfall was Ethiopia, but crop production declined in its conflict regions. Maize production is estimated to decline by 2.6% and wheat by 2.3%. Wheat production is up by 16.4% in Zambia and by 6.2% in South Africa.

- Central Asia: Prolonged drought conditions caused a decline in crop production in this region. Slightly below average rainfall could not compensate for the drought conditions that had been observed in Kazakhstan during the previous monitoring period, and yields declined by 12.7%. Afghanistan has been negatively affected by the severe drought and the food crisis got exacerbated by the conflict and subsequent change of government.

- South Asia: Rice production in India (+0.9%), Pakistan (-1.1%) and Bangladesh (+4.5%) stayed near average levels, aided by regular monsoon rains.

- Southeast Asia: Rice production stayed near average. It slightly declined in Thailand (-0.7%), Vietnam (-0.5%), Cambodia (-1.8%), Myanmar (-2.8%) and Philippines (-1%), whereas it increased in Indonesia (+2.2%).

- Australia: Rainfall was generally favorable in Australia. Wheat yields are forecasted slightly below last year's record levels (-2.1%).

- China: The country generally benefitted from abundant, though occasionally excessive, rains. Especially the regions along the Yellow River received above-average rainfall, causing flooding conditions. Late rains in October also delayed the harvest of maize and the sowing of the subsequent winter wheat crops in some areas. Overall crop production is estimated to have increased by 0.9% over the same period of last year. Conditions were much more favorable than last year in the Northeast, resulting in an increase in crop production by more than 5 million tonnes in that region. At the country level, maize production is estimated at 229.7 million tonnes (+1.6%), rice production increased to 202.96 million tonnes (+0.9%) and soybean production decreased slightly by -1.6% to 14.3 million tonnes. Wheat production increased by 0.7% to 128 million tonnes.

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 sixty-five 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.cn**.

1.1 Introduction to CropWatch agroclimatic indicators (CWAIs)

This bulletin describes environmental and crop conditions over the period from July 2021 to October 2021, JASO, referred to as "reporting period". In this chapter, we focus on 65 spatial "Mapping and Reporting Units"(MRU) which cover the globe, but CWAIs are averages of climatic variables over agricultural areas only inside each MRU. For instance, in the "Sahara to Afghan desert" MRU, only the Nile Valley and other cropped areas are considered. MRUs are listed in Annex C and serve the purpose of identifying global climatic patterns. Refer to Annex A for definitions and to table A.1 for 2021 JASO 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 2006 to 2020. Although departures from the 2006-2020 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. 2016-2020) but the BIOMSS indicator is nevertheless compared against the longer 15YA (fifteen-year average). This makes provision for the fast response of markets to changes in supply but also to the fact that in spite of the long warming trend, some recent years (e.g. 2008 or 2010-13) were below the trend.

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. The improved approach includes sunshine (RADPAR), TEMP and RAIN.

1.2 Global overview

July 2021 was the Earth's hottest month on record. It was also the hottest month for Asia. August to October also ranked at the very top of hottest months every recorded. Considering only land area, October was the warmest October recorded since 142 years, mainly due to unusual warmth across the Northern Hemisphere's land area.

Climate change not only impacts the temperatures, it also affects precipitation and wind. It causes prolonged and more severe droughts, such as the one that occurred in the West of the USA. On the other hand, rainfall intensities tend to increase. On July 20, more than 200 mm of rainfall were recorded over the city of Zhengzhou between 4 and 5 pm. This was the heaviest hour of rainfall ever reliably recorded in China. Many other parts of the world were also affected by floods during this monitoring period. Some of them are described in more details in Chapter 5.2. DISASTER EVENTS. Fertile agricultural land is often located in flood plains. Thus, not only droughts, but also floods, amplified by climate change, can pose a major threat to food security.

Figure 1.1 shows unweighted averages of the CropWatch Agroclimatic Indicators (CWAIs), i.e. the arithmetic means of all 65 MRUs, which are relatively close to average. CWAIs are computed only over agricultural areas, and they display a relatively average situation, globally.

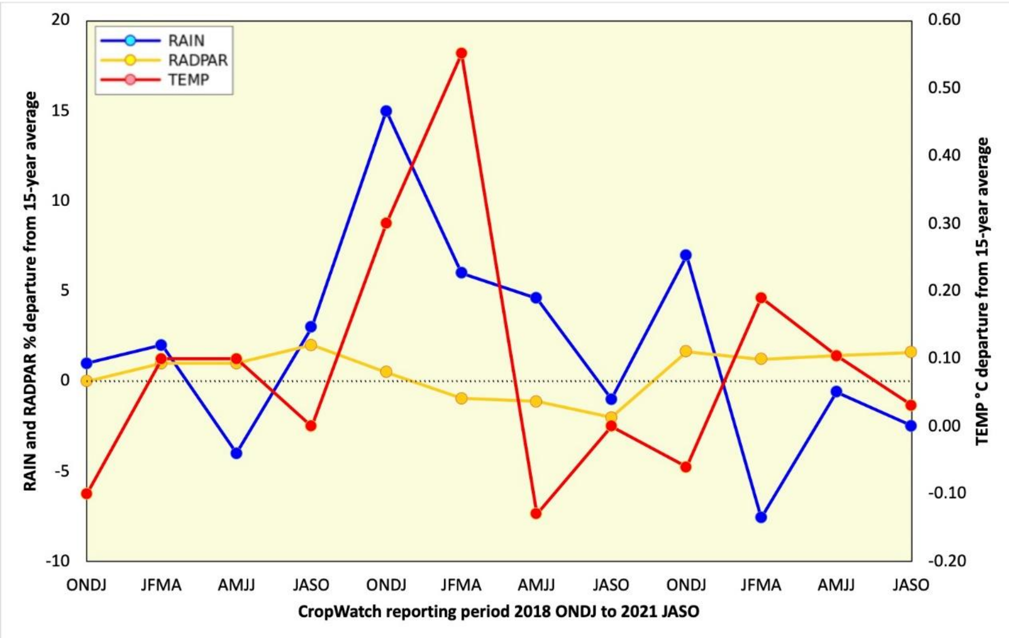


Figure 1.1 global departure from recent 15 year average of the RAIN, TEMP and RADPAR indicators. The last period covers July to October (JASO) 2021 (average of 65 MRUs, unweighted) .

1.3 Rainfall

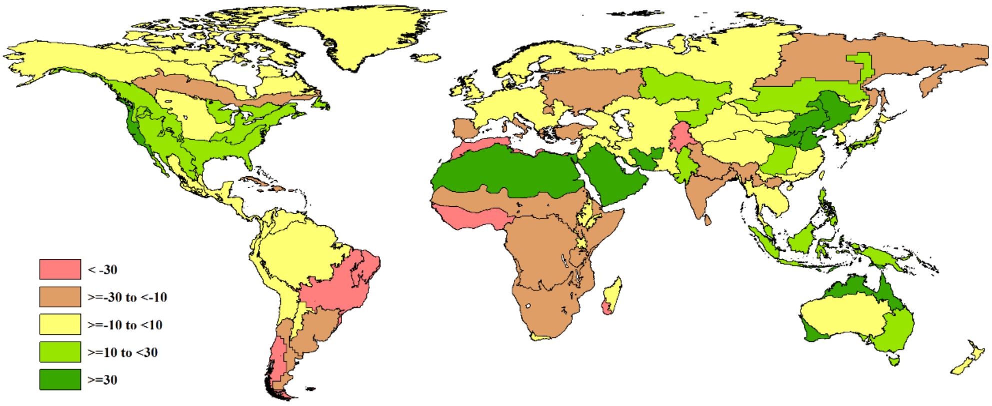


Figure 1.2 Global map of rainfall anomaly (as indicated by the RAIN indicator) by CropWatch Mapping and Reporting Unit: departure of July to October 2021 total from 2006-2020 average (15YA), in percent.

Below average rainfall conditions persisted for most of Brazil, Argentina, the south of Madagascar and California. A heavy storm caused flooding conditions in some parts of California on October 26 and brought rainfall levels up to average. However, most of the state is still under exceptional or extreme drought. A significant negative departure in rainfall was also observed for Westafrica and the Maghreb. Most of Sub-Saharan Africa received below average rainfall as well. The severe drought also continued in the Hindukush, causing a food crisis in Afghanistan. The entire Mediterranean region was also plagued by drought conditions. Rainfall was below average in Eastern Europe, Russia west of the Ural, the Himalayas and most of India. Eastern China as well as Australia received above average rainfall.

1.4 Temperatures

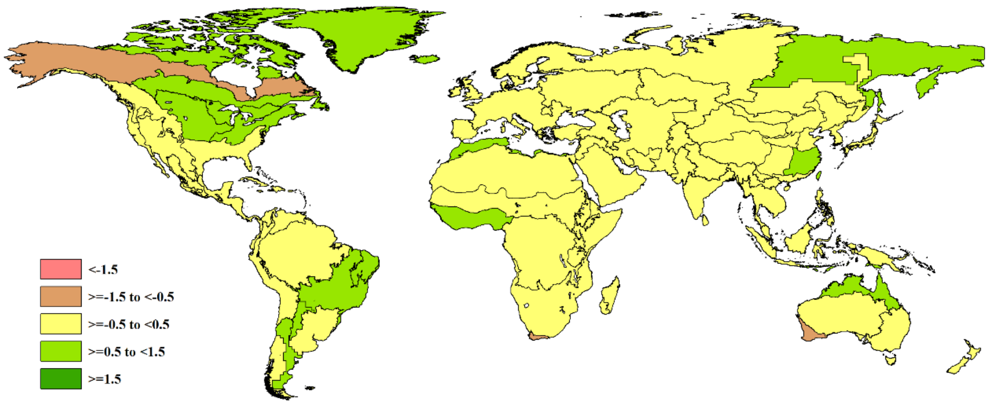


Figure 1.3 Global map of temperature anomaly (as indicated by the TEMP indicator) by CropWatch Mapping and Reporting Unit: departure of July to October 2021 average from 2006-2020 average (15YA), in °C.

In the monitoring period, the average temperatures in most MRUs did not depart much from the long-term averages except Arctic regions The Mid-west of the USA and the Canadian Prairies experienced slightly warmer than average temperatures. The average temperature in the Boreal America region from Alaska to northern Canada was below average. Similarly, temperatures in the crop production regions of Brazil and Southeast of China were also above average.

1.5 RADPAR

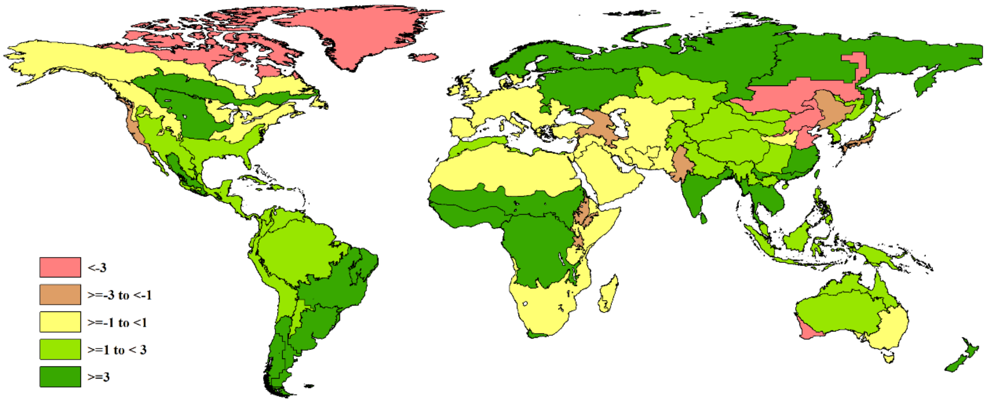


Figure 1.4 Global map of photosynthetically active radiation anomaly (as indicated by the RADPAR indicator) by CropWatch Mapping and Reporting Unit: departure of departure of July to October 2021 total from 2006-2020 average (15YA), in percent.

Radiation was above average for all of South America, Central America, the South and Great Plains of the USA and Sub-boreal America in the Canadian Prairies, the European region from Ukraine to Ural mountains, Boreal Eurasia to Eastern Siberia, the Asian region from Pamir area, Ural to Altai mountains, Southern Himalayas, Gansu-Xinjiang (China), Qinghai-Tibet (China) to Southern China, Mainland Southeast Asia and Maritime Southeast Asia. Most of central Africa also received higher solar radiation. Strong negative departures were observed for Inner Mongolia (China) and Huanghuaihai (China), as well as Nullarbor to Darling in the South West of Australia, where rainfall exceeded the average by more than 30%.

1.6 BIOMSS

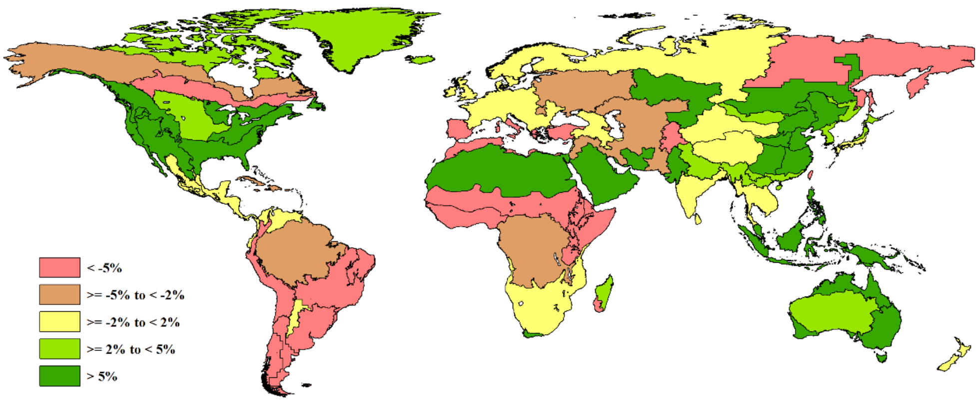


Figure 1.5 Global map of biomass accumulation (as indicated by the BIOMSS indicator) by CropWatch Mapping and Reporting Unit: departure of July to October 2021 from 2006-2020 average (15YA), in percent.

The Biomass product is calculated as a function of temperatures, rainfall and solar radiation. The map shows a strong positive departure for most of the USA, Eastern Asia and Australia. Apart from the western regions of the USA, the increase in biomass was fueled by positive rainfall departures. Biomass production was estimated to be below average in most of South America, South of the Sahara Desert in Africa, Ukraine to Ural mountains and Eastern Siberia in Eurasia, where rainfall was also below average.

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 production 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.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 (July to October 2021)

	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m^2)	Departure (%)	Current (gDM/m^2)	Departure (%)
West Africa	643	-33	25.8	1.0	1149	6	1083	-17
North America	405	17	21.1	0.6	1170	3	924	8
South America	243	-29	19.3	-0.4	1038	1	566	-20
S. and SE Asia	1259	-7	25.6	0.2	1095	2	1369	3
Western Europe	354	16	15.2	-0.6	946	-1	789	5
C. Europe and W. Russia	229	-11	15.1	-0.1	910	4	668	-5

*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 (July-October) for 2006-2020.*

Table 2.2 Agronomic indicators by Major Production Zone, current season values and departure from 5YA (July to October 2021)

	CALF (Cropped arable land fraction)		Maximum VCI	Cropping Intensity	
	Current	**5A Departure (%)**	**Current**	**Current**	**5A Departure (%)**
West Africa	97	0	0.94	125	-6
North America	92	-2	0.86	103	2

	CALF (Cropped arable land fraction)		Maximum VCI	Cropping Intensity	
	Current	5A Departure (%)	Current	Current	5A Departure (%)
South America	86	-5	0.77	133	7
S. and SE Asia	97	1	0.93	139	6
Western Europe	90	0	0.97	118	10
Central Europe and W Russia	96	1	0.87	108	5

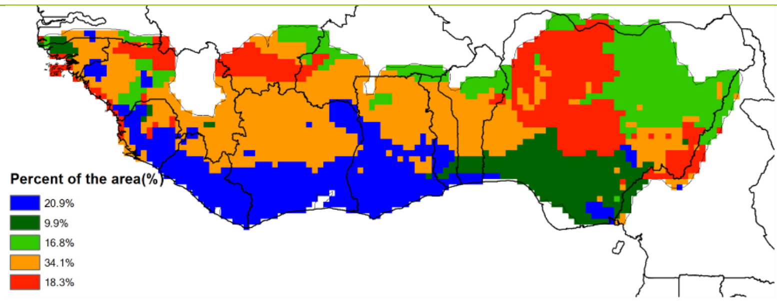
Note: See note for Table 2.1, with reference value R defined as the five-year average (5YA) for the same period (July-October) for 2016-2020.

2.2 West Africa

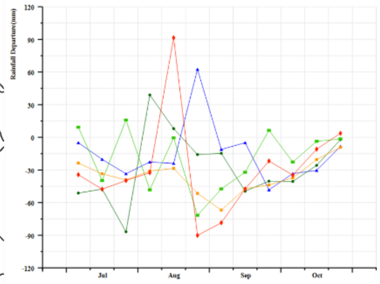
The reporting period covers the onset of the main rainy season throughout the south of the MPZ and the end of the rainy season in the northern Sahelian areas. The main cropping activities during this period included the sowing of main cereals (maize, sorghum, millet, and rice) under both rainfed and irrigated conditions. In addition, tuber crops (yam and cassava) were also being harvested. In the southern parts of the region with bimodal rainfall, the first maize crop was harvested by October while cassava was still growing. The harvest of the main maize crop was completed in August in the south, while it was ongoing in the rest of the MPZ for other cereal crops (rice, millet and sorghum). The cumulative rainfall in the MPZ was below average in most areas leading to below normal vegetation conditions.

Climatic indicators for the MPZ show a below-average rainfall of 643 mm (-33%) with the highest rainfall of over 1000 mm recorded in Equatorial Guinea (1454 mm, +10%), Sierra Leone (1414 mm, -19%) and Liberia (1043 mm, -16%). The average temperature for the MPZ was recorded as 25.8°C (+1°C) with the coastal areas experiencing around 0.5ºC temperature increase and the central areas of the region experiencing increases of over 1.5ºC as compared to the 15YA. The northern parts of Nigeria experienced negative temperature departures, affecting 8.5% of the region. The average potential solar radiation of the region was 1149 MJ/m^2 (+6%) indicating positive increase over the 15YA. However, the resulting potential biomass production was below average (-17%), though more than 1000 g DM/m^2 in most of areas of the region except for the coastal areas of the region were estimated. The cropped arable land fraction (CALF) was above 94% (+0%) in most areas of the region except for extreme northern parts of Nigeria which may be attributed to conflicts. The maximum VCI (VCIx) map shows an average value of 0.94 covering most of the region indicating favorable conditions for crop growth, and the cropping intensity increased by 10% indicating that the total cultivated crop area was at an above-average level. Moderate to severe drought was experienced throughout the region as also reflected in the rainfall deficits. All in all, conditions were below average due to a rainfall deficit.

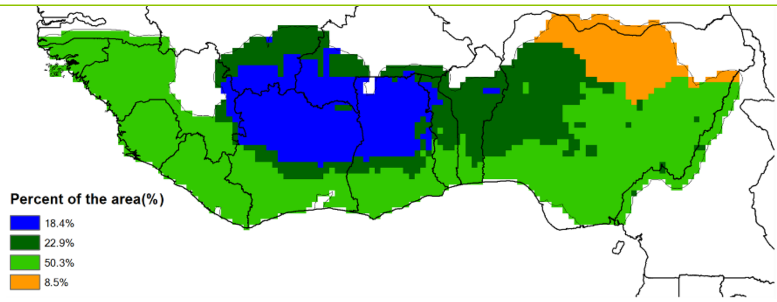
Figure 2.1 West Africa MPZ: Agroclimatic and agronomic indicators, July to October 2021.



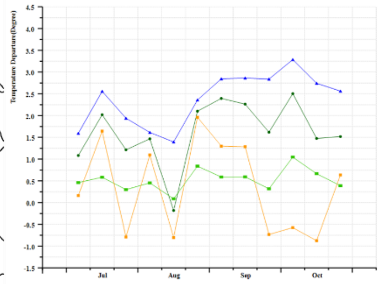
a. Spatial distribution of rainfall profiles



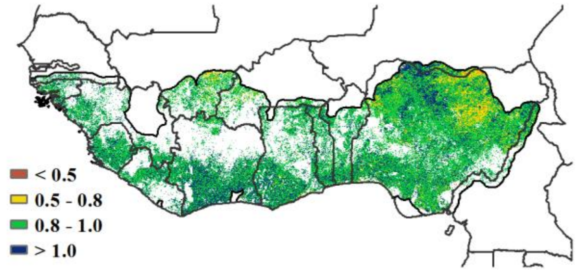
b. Profiles of rainfall departure from average (mm)



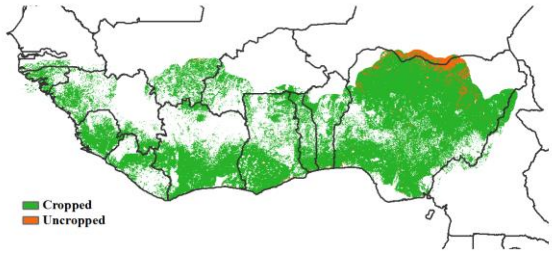
c. Spatial distribution of temperature profiles



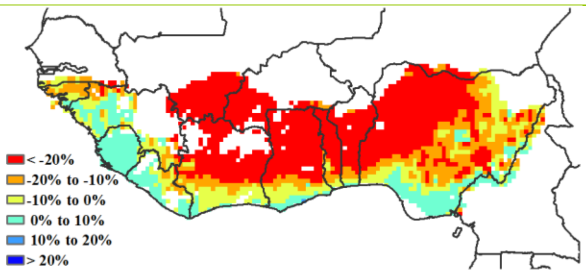
d. Profiles of temperature departure from average (°C)



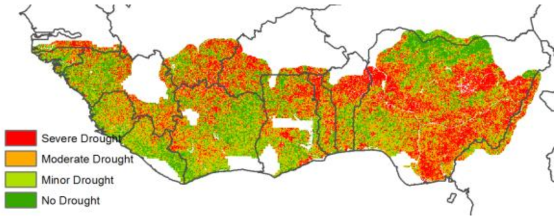
e. Maximum VCI



f. Cropped arable land



g. Potential biomass departure from 15YA



h. VHI minimum

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

2.3 North America

This reporting period covers the middle to late stages of spring wheat, which reached maturity in August. Rice, soybean and maize entered the harvest period in September. Unfavorable crop conditions occurred in the northern plains and prairies, with above-average crop conditions prevailing in other areas.

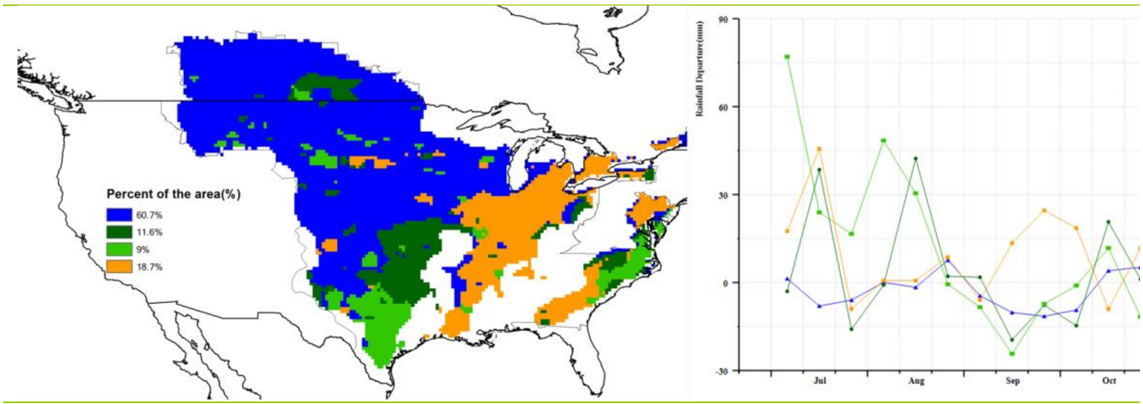
Agro-climatic conditions were dominated by warm, wet and sunny weather throughout the region, with rainfall, temperature and RADPAR 17%, 0.6°C and 3% above average, respectively, resulting in a potential biomass estimate that was 8% higher than the average. However, there were large differences within this region.

During this period, rainfall showed strong spatial and temporal differences across the region, with rainfall in the northern plains and prairies below the average and rainfall in other areas significantly above the average. Compared with the variation of rainfall, the temperature fluctuated more, especially in the northern plains and prairies, where the temperature dropped significantly at the end of August and then returned to significantly above average in mid-September.

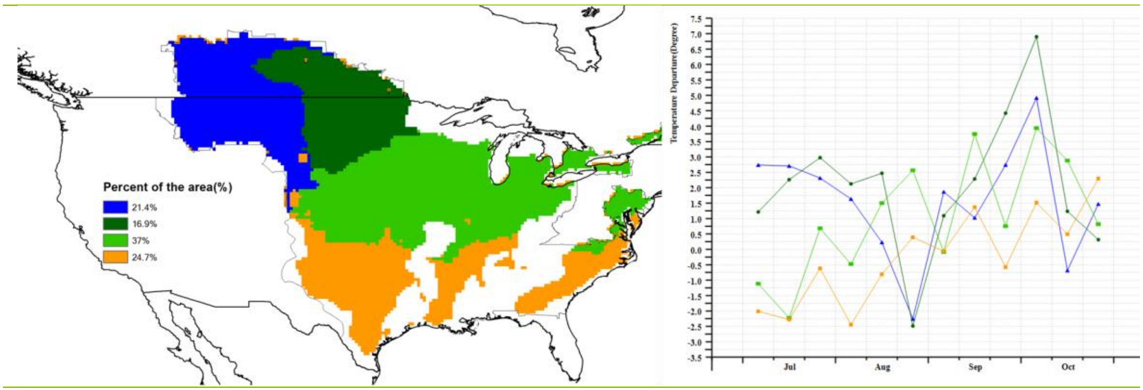
The effects of the drought that occurred in the previous period in the northern plains and prairie areas continued into the current period. The potential biomass was significantly below average, mainly in the prairies. The spatial distribution of potential biomass that was below average was consistent with the drought that occurred in the region, indicating the prolonged negative impact of drought on crop condition. The prolonged effects of the drought resulted in a 2% decrease in CALF compared to the 5-year average. Overall, the VCIx (0.86) indicated acceptable crop conditions, though poor crop conditions were widely observed in the northern plains and prairies. Areas with above-average potential biomass and high VCIx were mainly distributed in the southeastern part of the North American region, including the Corn Belt, Southern Plains, Lower Mississippi and major areas of the Southeast in the United States. The cropland utilization intensity increased compared to the 5YA, with a cropping intensity of 103%, 2% higher than the 5YA, contributing to crop production improvement.

In summary, mixed crop conditions was assessed by CropWatch in North America, with crop production tending to decline in north plains and prairies, resulting in lower-than-average wheat production. Above-average production can be expected for maize, soybeans and rice.

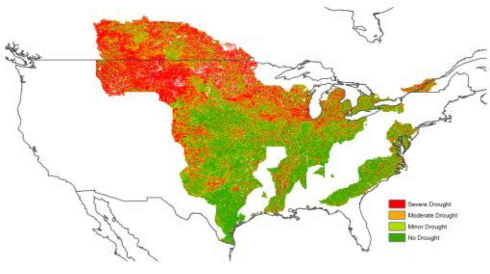
Figure 2.2North America MPZ: Agroclimatic and agronomic indicators, July to October 2021



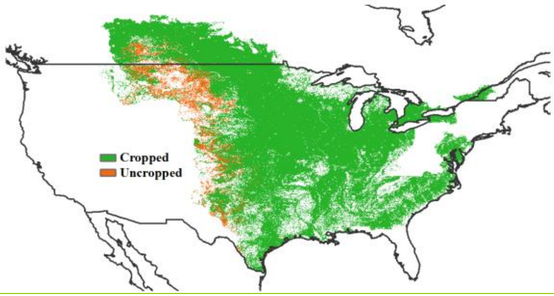
a. Spatial distribution of rainfall profiles b. Profiles of rainfall departure from average (mm)



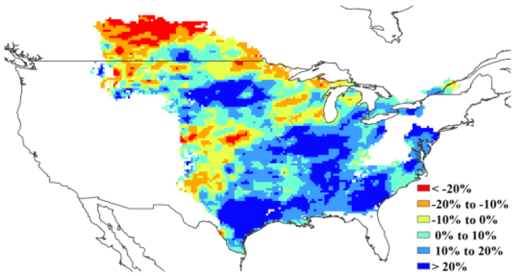
c. Spatial distribution of temperature profiles d. Profiles of temperature departure from average (°C)



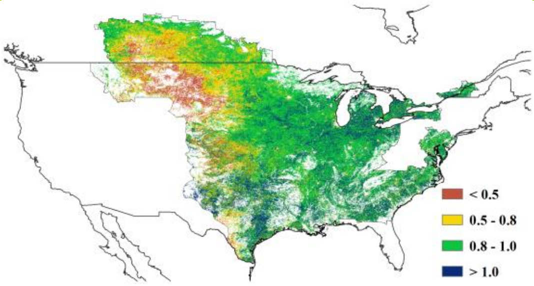
e. VHI Minimum



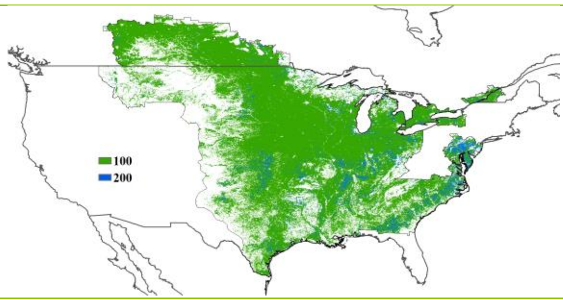
f. Cropped and uncropped arable land



g. Potential biomass departure from 15YA



h. Maximum VCI



i.Cropping intensity

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

2.4 South America

The reporting period covers the main growing period of wheat and the planting of early maize and rice. Part of the area is not left fallow during the dry winter months. The situation in South America is regular to poor. The Central area was dominated by normal conditions, while for the North of the MPZ in Brazil and West Argentinian agricultural areas, several indices reflected poor conditions.

Spatial distribution of rainfall profiles showed five different patterns. A pattern with no anomalies from July to mid-September, and with negative anomalies since then to the end of the reporting period, was observed in the North of the MPZ, as well as in North Chaco in Argentina (blue areas). A stable pattern with almost no anomalies (red areas) was observed in the Central area, as well as in Subtropical highlands, West and South-West Pampas. A pattern with slight negative anomalies during July and August and strong positive anomalies during October was observed in South Brazil, Paraguay and North Mesopotamia in Argentina (dark green). The rest of the area including most of the Pampas, Uruguay and Brazilian southern border area were dominated by either a pattern with almost no anomalies or a pattern with positive anomalies since mid-September to mid-October.

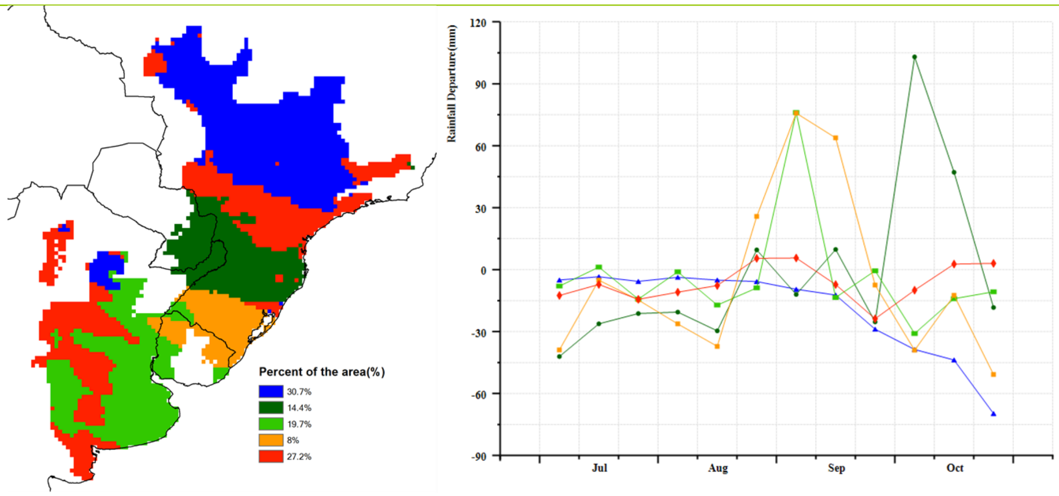
Temperature profiles showed five homogeneous patterns located in a South-North gradient (Figure 2.3c/d). All profiles showed variability between positive and negative anomalies with smaller changes during July and the beginning of August. Areas located more in the South, including Argentina, Uruguay and South of Brazil (orange areas), showed low variation in anomalies during the reporting period, except for a strong positive anomaly at the end of October. Red areas showed stronger anomalies (near +2.5°C) and mid-October (near -2°C). Blue areas showed positive anomalies from mid-August to the beginning of October reaching a peak of near +4°C, followed by a strong negative anomaly of -2°C at mid-October. Dark and light green areas showed positive anomalies since mid-August, showing higher values for the dark green areas.

CALF index showed uncropped areas in North West Pampas, West Chaco and North Subtropical Highlands in Argentina, and in some regions of the Northern Brazilian agricultural area. Strong BIOMSS negative anomalies were observed in the North of Brazilian agricultural area. Argentine Pampas, Chaco, South Mesopotamia, Paraguay and Uruguay were dominated by situations with no anomalies or lower than 20% positive anomalies. Central and South Brazilian agricultural area showed in part slight positive anomalies and in part slight negative anomalies. Average cropping intensity for the region was 133%, 7% above average. Double cropping practices were commonly found in Brazil, including Southern Brazil, Parana Basin and part of Mato Grosso and Mato Grosso Du Sol.

Maximum VCI showed mostly poor conditions (lower than 0.8). North West Pampas and Subtropical highlands in Argentina showed very poor conditions (lower than 0.5). Quite good conditions in VCIx were observed in Paraguay, Uruguay, South Brazil and part of South East Pampas.

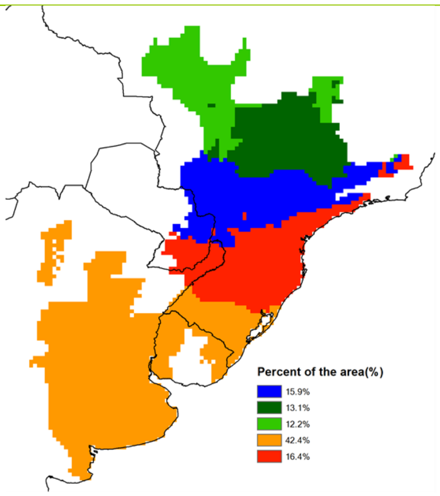
Meteorological drought showed normal conditions in most of the region but severe to moderate conditions in North of Brazilian agricultural areas. Some areas located in North West Pampas, West Subtropical Highlands and North Mesopotamia in Argentina, West Paraguay and its border area with Brazil, showed moderate to severe wet conditions.

Figure 2.3 South America MPZ: Agroclimatic and agronomic indicators, July to October 2021

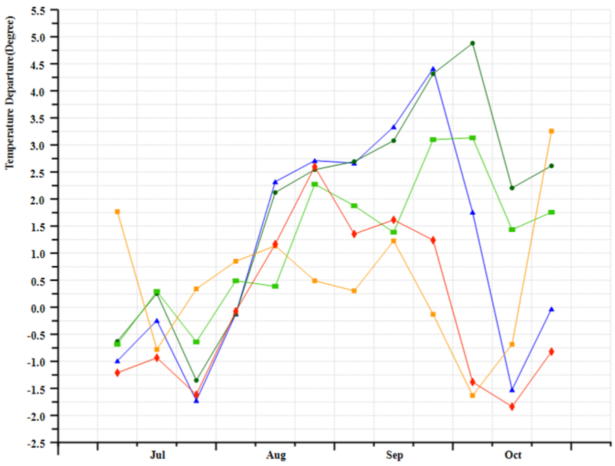


a. Spatial distribution of rainfall profiles

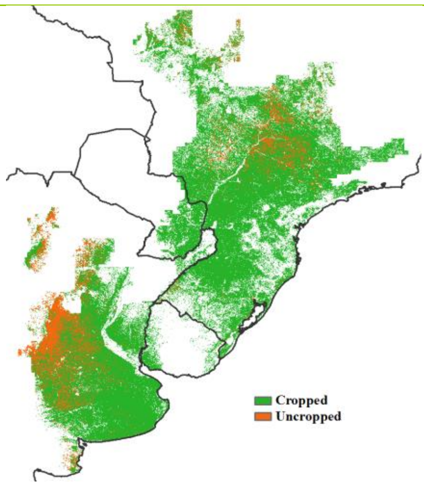
b. Profiles of rainfall departure from average (mm)



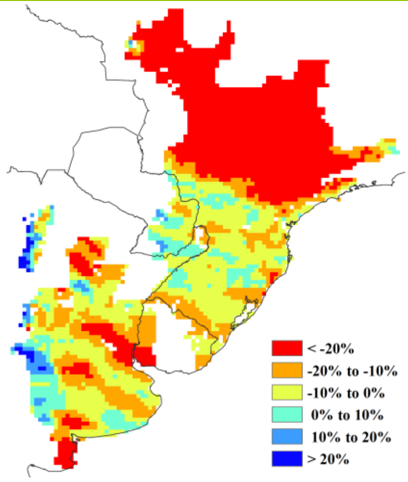
c. Spatial distribution of temperature profiles



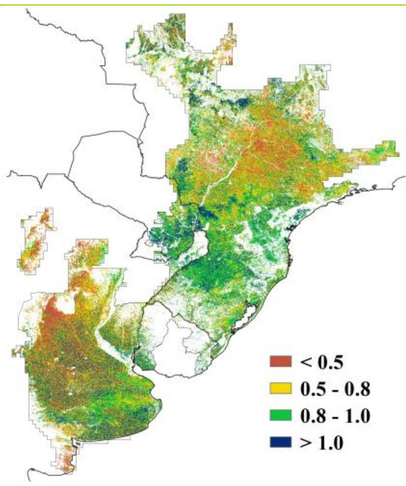
d. Profiles of temperature departure from average (°C)



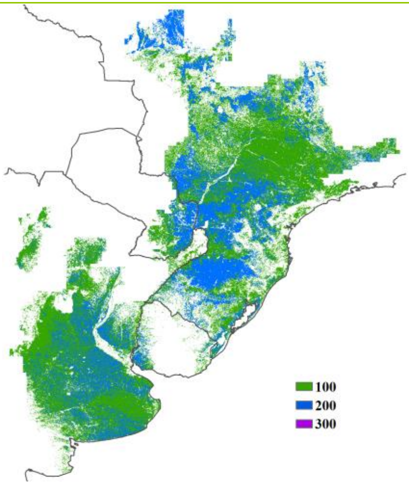
e. Cropped and uncropped arable land



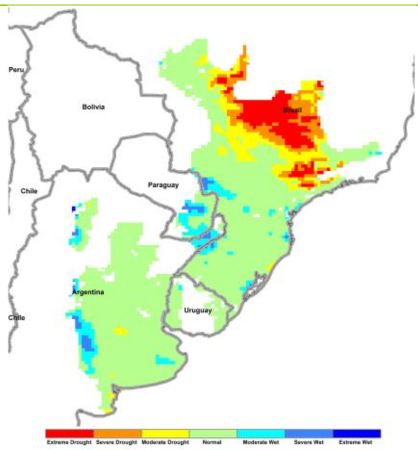
f. Potential biomass departure from 15YA



g. Maximum VCI



h. Cropping intensity November 2020 to October 2021



i. Meteorological drought measured by standard precipitation index, August–October, 2021

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

2.5 South and Southeast Asia

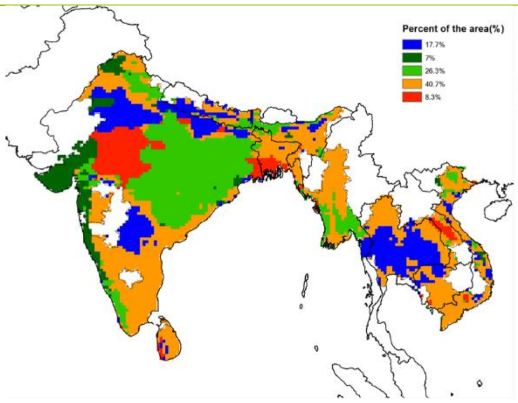
The South and Southeast Asia MPZ includes India, Bangladesh, Cambodia, Myanmar, Nepal, Thailand, Laos and Vietnam. This reporting period covers the growth period of maize and the growth and harvest period of summer rice and soybean. At the MPZ level, compared to the 15YA, TEMP was 0.2°C higher and RADPAR was 2% above, which led to a 3% increase in BIOMSS, though RAIN was 7% below. Meanwhile, CALF was 1% higher compared with the last 5YA, reaching 97% and VCIx was 0.93. Rainfall-deficit conditions persisted before early September in central India and southern Myanmar. It affected the growth of summer crops in those regions.

The spatial distribution of rainfall profiles reveals that precipitation in 40.7% of this MPZ (mainly in southern India, eastern India, Bangladesh, Myanmar, northern Thailand, Cambodia, Laos and Vietnam) was slightly below the average from mid-June to early October, reaching above-average levels in mid-October. Other regions showed rainfall conditions with strong fluctuations before October, followed by above-average rainfall in mid-October. The spatial distribution of temperature profiles reveals that temperature in 60.1% of this MPZ was slightly above average, mainly in Southeast Asia, southern Bangladesh, eastern India and northern India. TEMP conditions in northern and northwestern India were fluctuating above or below the average during the entire monitoring period. The prolonged dry weather conditions in central India, a small area of northern India and southern Myanmar hampered the growth of summer crops and resulted in lower BIOMSS.

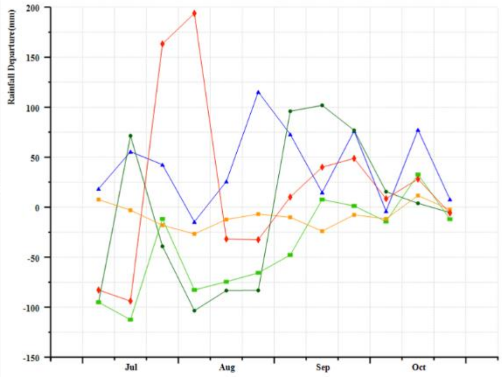
The BIOMSS departure map reveals that high values (above 20%) mainly occurred in northwestern India, and above-average values for the whole MPZ indicate generally favorable crops conditions. The Maximum VCI showed that high values (more than 0.8) mainly occurred in Southeast Asia, Bangladesh, Nepal and eastern India. The Minimum VHI showed severe drought conditions in eastern India, central India, central Myanmar, northern Thailand, Cambodia and spread areas of Vietnam, which may have affected the growth of crops.

In summary, crops conditions in most of this MPZ are expected to be generally favorable except for some pockets that were affected by severe drought.

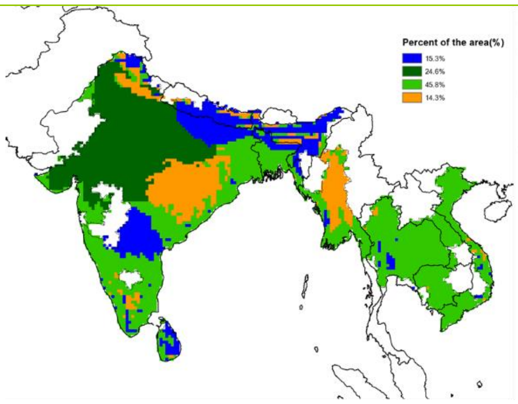
Figure 2.4 South and Southeast Asia MPZ: Agroclimatic and agronomic indicators, July to October 2021



a. Spatial distribution of rainfall profiles

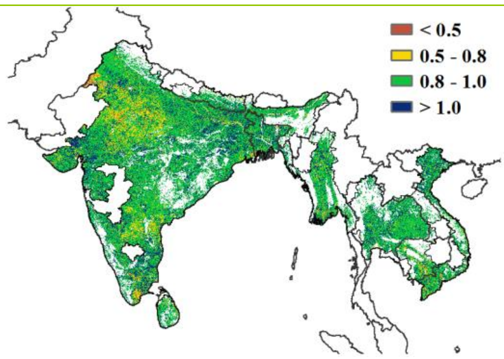


b. Profiles of rainfall departure from average (mm)

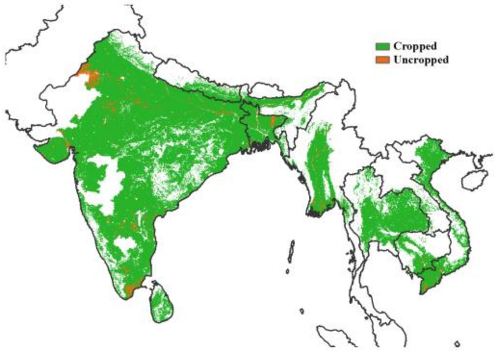


c. Spatial distribution of temperature profiles

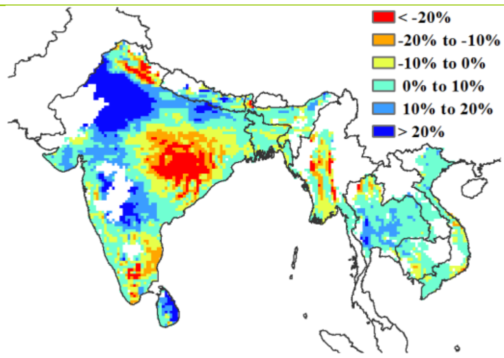
d. Profiles of temperature departure from average (°C)



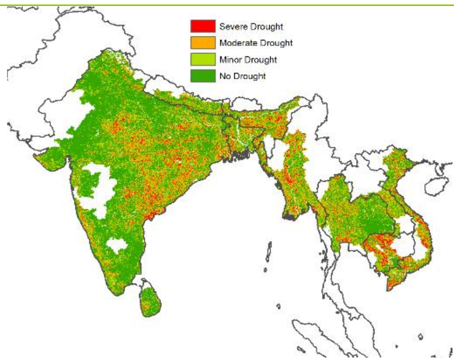
e. Maximum VCI



f. Cropped arable land



g. Potential biomass departure from 15YA



h. VHI minimum

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

2.6 Western Europe

The monitoring period covered the vegetative and reproductive periods of the summer crops and sowing of winter crops in the major production zone (MPZ) of Western Europe. Generally, crop conditions were above average in most parts of the Western European MPZ based on the integration of agroclimatic and agronomic indicators (Figure 2.5).

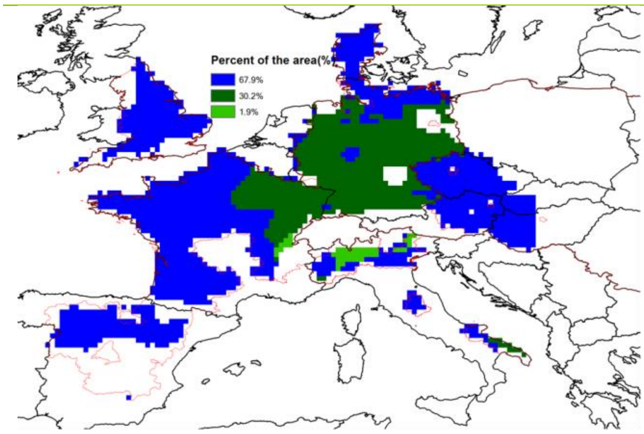
CropWatch agroclimatic indicators show that the whole MPZ showed a significant increase in RAIN (16% above average). Rainfall patterns can be characterized as follows: (1) above-average precipitation throughout the whole MPZ until early August; (2) precipitation hovered around the average in 67.9 percent of the MPZ areas (most parts of Spain, UK, northern Germany, Denmark, North-west and north-east and central Italy, southern Mid-West and northern France, the Czech Republic, south-western Slovakia, eastern Austria and western Hungary) from mid-August to late-October; (3) Precipitation was below average from mid-August to late October, with the exception of late August, in 30.2% of the MPZ areas (north-eastern France and most part of Germany); (4) precipitation in northern Italy and northeastern Rhône-Alpes in France was significantly above average during the monitoring period, except between mid-August and early September and in mid-late October. Countries with the most severe precipitation departures included Hungary (RAIN -35%), Slovakia (RAIN -13%), Spain (RAIN -9%) and Italy (RAIN -6%). Due to persistent and significantly precipitation deficit, flowering and grain filling for the summer crops in the countries with precipitation deficits mentioned above were negatively impacted. The persistent precipitation deficit in October may affect the sowing and germination of winter wheat in those regions.

CropWatch agroclimatic indicators also show that both temperature (TEMP -0.6°C) and sunshine (RADPAR, -1%) for the MPZ as a whole were below average. As shown in the spatial distribution of rainfall profiles that 46.7 percent of the MPZ areas (most parts of France and central and southern Germany) experienced colder-than-usual conditions throughout the monitoring period, except for late-August and early-September; 27.6 percent of the MPZ areas (Spain, central and south-eastern Italy, the Czech Republic, south-western Slovakia, eastern Austria and western Hungary) experienced temperatures hovering around average throughout the monitoring period; 25.7 percent of the MPZ areas (UK, Denmark and northern Germany) experienced warmer-than-usual conditions during the monitoring period, except for the period from late July to late August. The spatial distribution of temperature profiles indicates that the first warm spells swept across the UK, Denmark and northern Germany in mid-July, and the second warm spells swept across most of Europe in early-September.

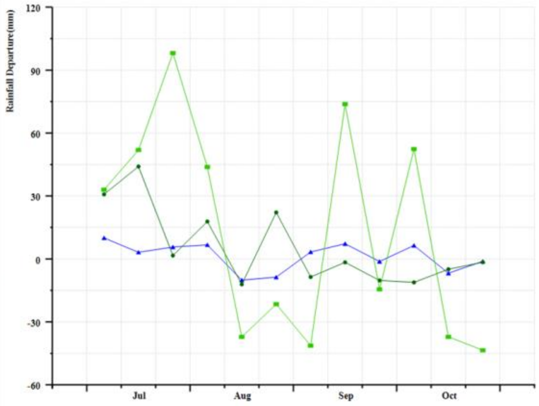
Due to adequate precipitation and overall suitable temperatures, the biomass accumulation potential was 5% above average. Significant BIOMSS departures (-20% and less) occurred in Central France, northern and central Italy, south-western Germany, northern and eastern Spain. In contrast, BIOMSS was above average (sometimes exceeding a 20% departure) over the Western and north-eastern France, southern UK, northern Germany and southern Spain. The average maximum VCI for the MPZ reached 0.97. More than 90% of arable land was cropped, which is the same as the recent five-year average. Most uncropped arable land was concentrated in Spain and southeastern Italy, with patchy distribution in Central France, Western Germany, Western Austria, Northern and Central Italy. The VHI minimum map shows that Spain and Italy were most affected by severe drought conditions that are consistent with the presence of precipitation deficits in these two countries during the monitoring period. Cropping intensity reached 118%, which was up by 10% compared to the five-year-average across the MPZ.

Generally, crop conditions were above average in most parts of this MPZ. Crop yields in some countries need do be paid attention to due to persistent and significantly precipitation deficits in the second half of the monitoring period.

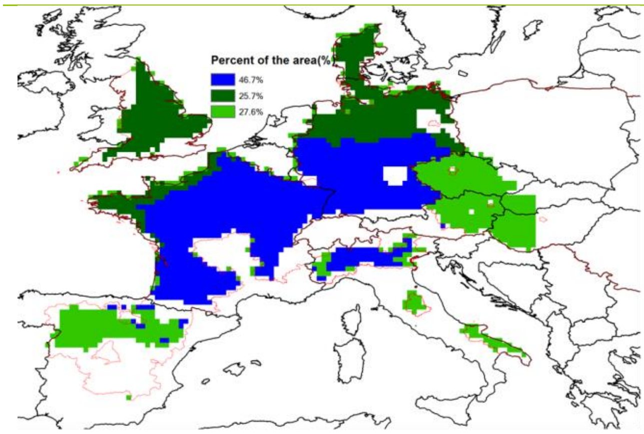
Figure 2.5 Western Europe MPZ: Agroclimatic and agronomic indicators, July to October 2021



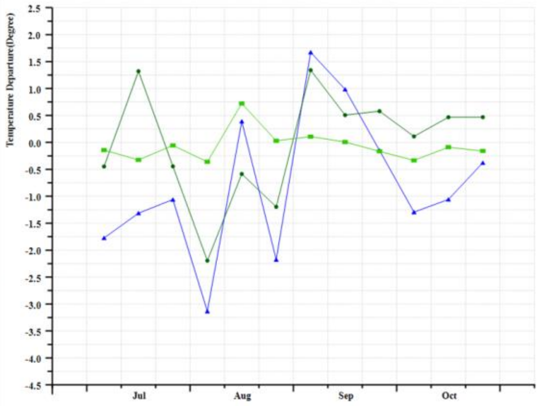
a. Spatial distribution of rainfall profiles



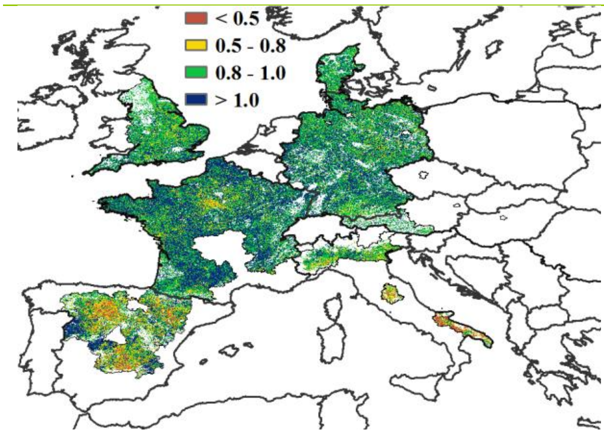
b. Profiles of rainfall departure from average (mm)



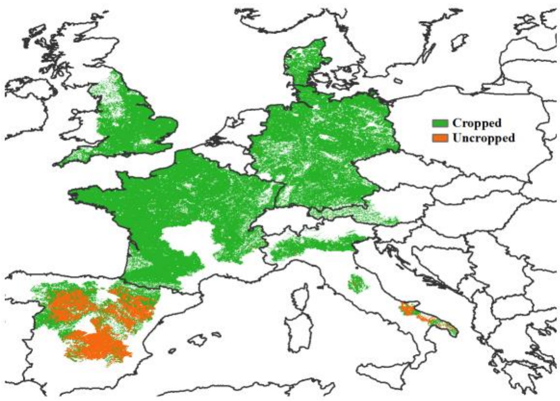
c. Spatial distribution of temperature profiles



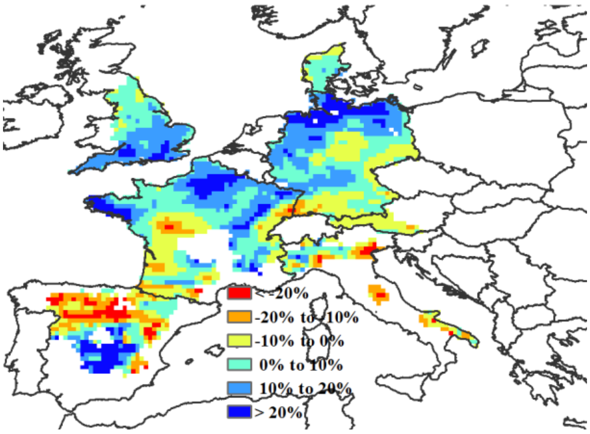
d. Profiles of temperature departure from average (°C)



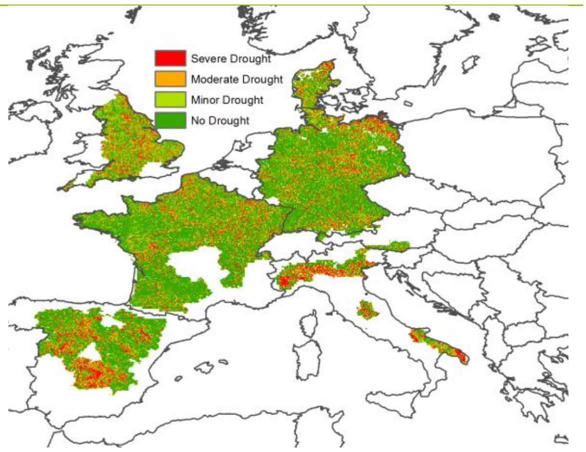
e. Maximum VCI



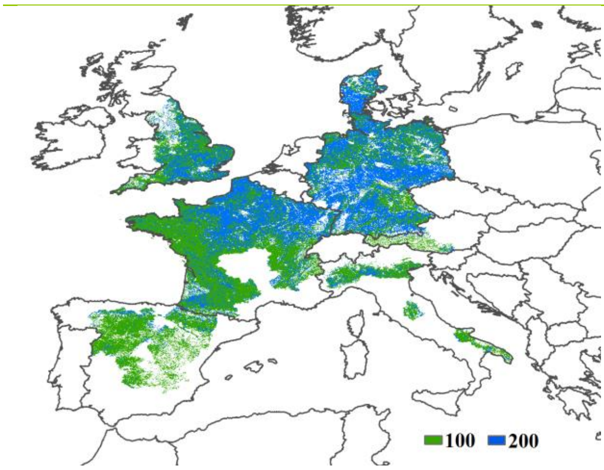
f. Cropped arable land



g. Potential biomass departure from 15YA



h. VHI minimum



i. Cropping intensity

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

2.7 Central Europe to Western Russia

The monitoring period covered the harvest period of summer crops and the sowing period of winter crops. In general, the agroclimatic indicators in this MPZ were close to average, including 11% lower precipitation, temperature near average and 3.8% higher photosynthetic active radiation.

According to the spatial distribution map of rainfall departure, the spatial and temporal differences of accumulated precipitation in different regions within this MPZ were considerable, and the rainfall in most areas was below the average from July to October. The specific spatial and temporal distribution characteristics were as follows.

(1) In early July and mid-August, 31.1% of the regions received above-average precipitation and reached the highest positive departure level of 97mm. These regions were mainly located in the eastern, central and southern parts of MPZ. This included the southeastern and central regions of Russia, eastern and southern Ukraine, Moldova and eastern Romania. (2) In late August and mid-September, 34.6% of the regions received above-average precipitation. These regions were mainly distributed in the northern Ukraine, northwestern Russia, southern Belarus, Poland and Romania. (3) During the completely monitoring period, 34.3% of the regions the precipitation remained at the average level, mainly in the eastern part of Russia.

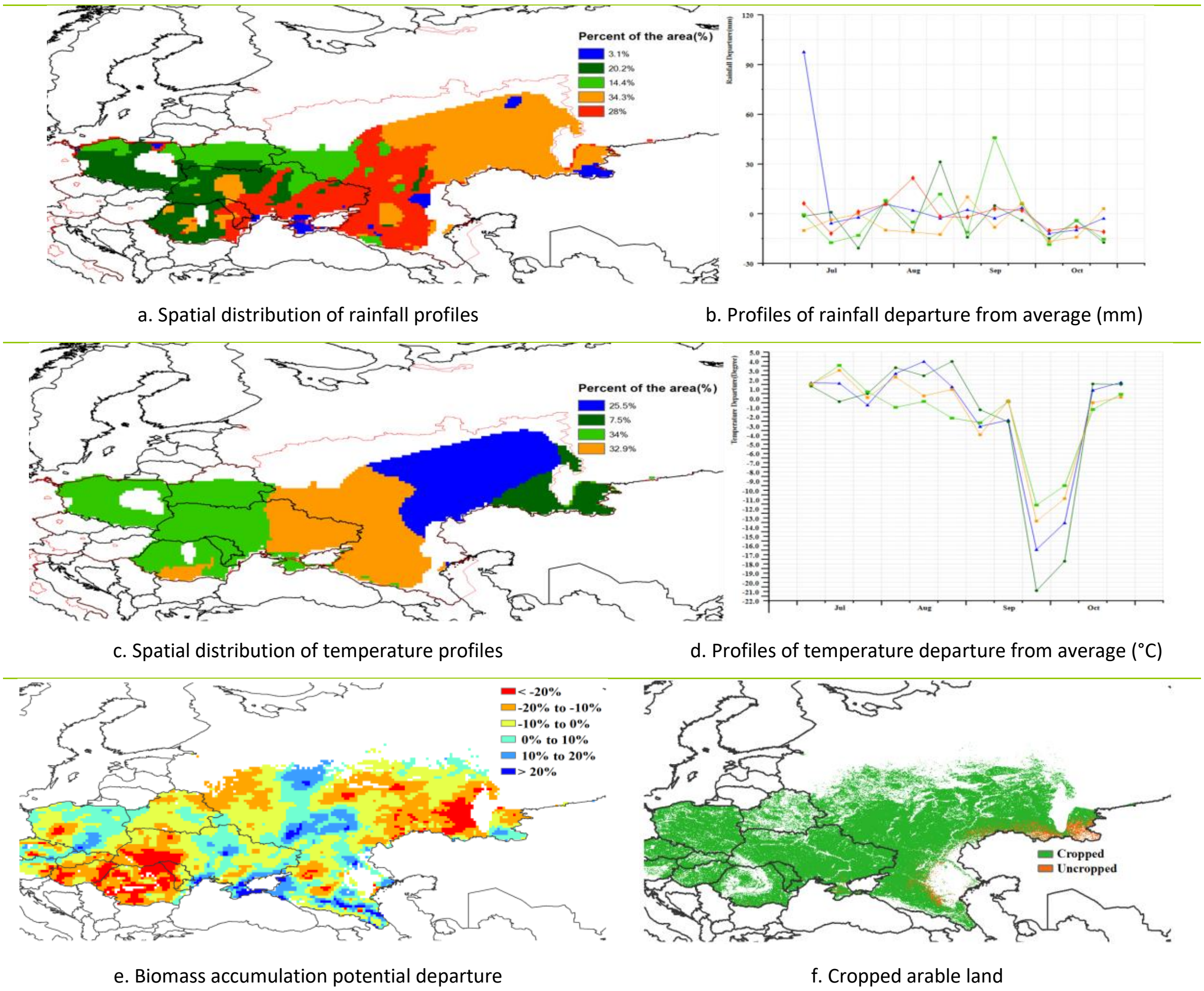
The temperature departure distribution map shows that the temperature varies strongly within MPZ. The specific spatial and temporal distribution characteristics were as follows.

(1) In late July, temperatures were below average in 25.5% of the MPZ in the northeast. (2) In August, temperatures were above average in 66%, mainly in the southern Romania, eastern Ukraine and Russia. (3) Temperatures were well below average from mid-September to early October, in 7.5% of the MPZ, located in southeastern Russia, where temperatures dropped to 21°C below zero (-21°C). However, by that time, most crops had reached maturity.

CropWatch monitoring results show that potential biomass in MPZ was 5% below the average of the last 5 years. Potential cumulative biomass was below 20% in eastern Russia, western Ukraine, western Moldova, most of Romania and a small part of Hungary. Western Russia, most of Belarus and parts of western Poland were below 10%. The areas with high potential biomass are mainly located in central and small parts of southern Russia and the central Ukraine.

During this monitoring period, most of the arable land in MPZ was cultivated, with a CALF value of 96% (slightly higher than 1%), the uncultivated arable land mainly distributed in the southeast. The replanting index was 5% above average. The VCIx showed a significant spatial variation, with an average value of 0.87. The regions below 0.8 were mainly in the Hungary and small parts of northwestern and southern Romania. The minimum healthy vegetation index is similar to the distribution of the best vegetation condition, with severe drought areas mainly in the southeast and small parts of the central and eastern Ukraine, Hungary, and southern Romania. Overall, CropWatch agroclimatic and agronomic indicators indicate that crop growth was expected to be below average during this monitoring period.

Figure 2.6 Central Europe to Western Russia MPZ: Agroclimatic and agronomic indicators, July to October 2021



a. Spatial distribution of rainfall profiles

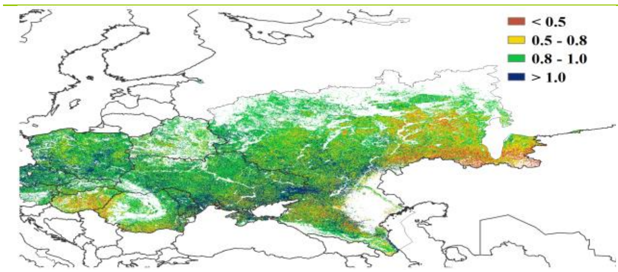
b. Profiles of rainfall departure from average (mm)

c. Spatial distribution of temperature profiles

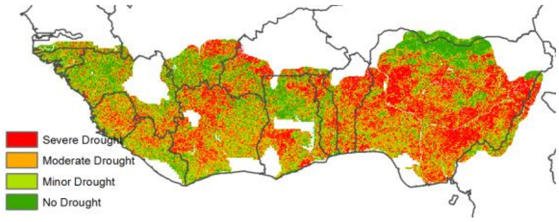
d. Profiles of temperature departure from average (°C)

e. Biomass accumulation potential departure

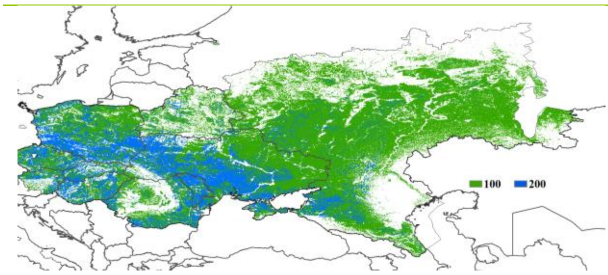
f. Cropped arable land



g. Maximum VCI



h. VHI minimum



i. 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 42 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.

Introduction

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.

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 tonnes 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 are dominated by just 4 countries: USA, Brazil, Argentina and the Ukraine. Together, they supply almost 90% of the maize being traded internationally. During this monitoring period, maize planting had started in late September in southern Brazil. Conditions were generally on the dry side, due to the continuing La Niña conditions, which may further constrain production in southern Brazil and Argentina. In the USA, the largest exporter, conditions were generally favorable. During the previous monitoring period, conditions were reported to be on the dry side for the northern parts of Iowa. However, they returned to normal in August. Combined with the favorable conditions in the key maize producing states, high production levels can be expected for the USA. Weather conditions for maize production were also favorable in the Ukraine, where record yields have been forecasted as well. Conditions in West Africa were less favorable, as rain was about 30% below average. Rain was normal in Ethiopia. In China, moisture was abundant and parts of the North China Plain experienced flooding conditions. Harvest was also hampered in parts of area by rains that lasted well into October.

Rice: Four out of the 5 top rice exporting countries are located in South and Southeast Asia: India supplies about 1/3 of the rice that is internationally traded, followed by Thailand with 1/5. The USA, number 3, supplies less than 10%. Vietnam contributes about 7% and Pakistan close to 6%. The southern rice producing regions of the USA had received plenty of rainfall, whereas California, the second most important production region, was affected by an extreme drought. Weather conditions in Southeast Asia, with a combined market share of slightly more than 25%, were close to normal. In China, rice benefitted from normal to above normal rainfall. In South Asia, conditions were also favorable for rice production and Indian farmers harvested a record setting rice crop.

Wheat: Conditions for wheat production in Argentina and Brazil were generally favorable, although some regions within those two countries had been affected by drought conditions. Especially in Parana (Brazil) conditions were not so favorable due to drier than normal weather and frosts in July and August. Wheat production in the northern and western states of the USA and in the Canadian Prairies was negatively affected by extreme heat and drought conditions. Conditions for wheat were generally favorable for most of Europe and the Ukraine. They were less favorable in the Urals and Volga region of Russia and neighboring Kazakhstan, causing a drop in production as compared to last year. Conditions for spring wheat in China were generally favorable. Similarly, wheat in Australia also benefitted from good rainfall.

Soybean: Similar to maize, the soybean market is dominated by few countries: Brazil, the USA and Argentina account for more than 80% of total production. Brazil's share is more than half of the soybean traded on the international market, followed by the USA (30%), Argentina (5%), Paraguay (4%) and Canada (3%). Soybean planting for the 2021/22 season started in October in Brazil. Dry weather in the first half of October provided good conditions for sowing. Subsequent heavy rains in late October helped with germination and crop establishment. Weather conditions in most of the soybean producing region of the USA were favorable and high yields can be expected.

Weather anomalies and biomass production potential changes

(1) Rainfall

Rainfall anomalies depict the average departure of rainfall from the 15YA. The map shows average rainfall departures for the 4-month period. They do not show short term water deficits. Nevertheless, they indicate where rainfall was generally favorable or not for crop production.

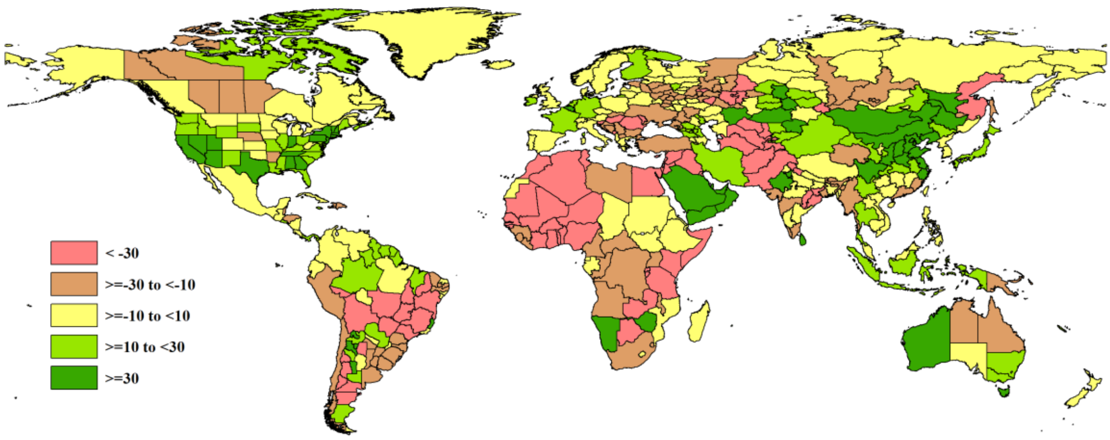


Figure 3. 1 National and subnational rainfall anomaly (as indicated by the RAIN indicator) of July to October 2021 total relative to the 2006-2020 average (15YA), in percentage.

Heavy rains in late October brought a welcome relief for the West Coast of the USA. On average, rainfall was above average for most of the USA, although crop production in the West, Northwest and Northern Plains, as well as in the Canadian Prairies had been severely impacted by the drought conditions in July and August. In South America, wheat was the main crop that was grown in the Pampas of Argentina and southern Brazil. In parts of Argentina, conditions were favorable, whereas most of Brazil had been impacted by drought conditions. In South Africa, the Cape Province received normal to above normal rainfall, whereas most of the other regions of the continent received below average rainfall. In West- and East Africa, rainfall was more than 30% below average. Western and northern Europe received above average rainfall, whereas it was below average in Hungary and parts of Romania. Summer is generally a dry period for the countries bordering the eastern Mediterranean basin. Nevertheless, rainfall was below average in that region. Dry conditions were also recorded for Irak, Iran, Afghanistan, Central Asia, the Volga and southern Ural region of Russia. In neighboring Kazakhstan, rainfall was near average. But it could not compensate for the rainfall deficit that had been recorded during the previous monitoring period. Rainfall in India was mixed, but conditions were generally favorable for rice production. In Southeast Asia, as well as China, rice also benefitted from an ample supply of moisture. Rainfall in the North China Plain was above average. Rains lasted until October, negatively impacting the harvest season of the maize crop and subsequent sowing of the winter wheat crop. Conditions were favorable for wheat production in Australia due to average to above average rainfall.

(2) Temperature anomalies

Average and warmer than average temperatures were recorded for all regions south of the equator, except for the southern tip of Africa. In the USA and Canada, temperatures were above average average, except for Arizona, and the Southeast. The Midwest and the Canadian Prairies experienced above average temperatures. Westafrica also experienced warmer than usual temperatures. Cooler temperatures occurred in regions with above average rainfall, such as Western Europe, Mongolia and the north of China. A severe cold spell in late September caused below average temperatures in Kazakhstan and the southern Ural. Apart from the aforementioned regions, temperatures where mostly near average in most of Asia. In the import winter crop production regions of Australia, temperatures were near average.

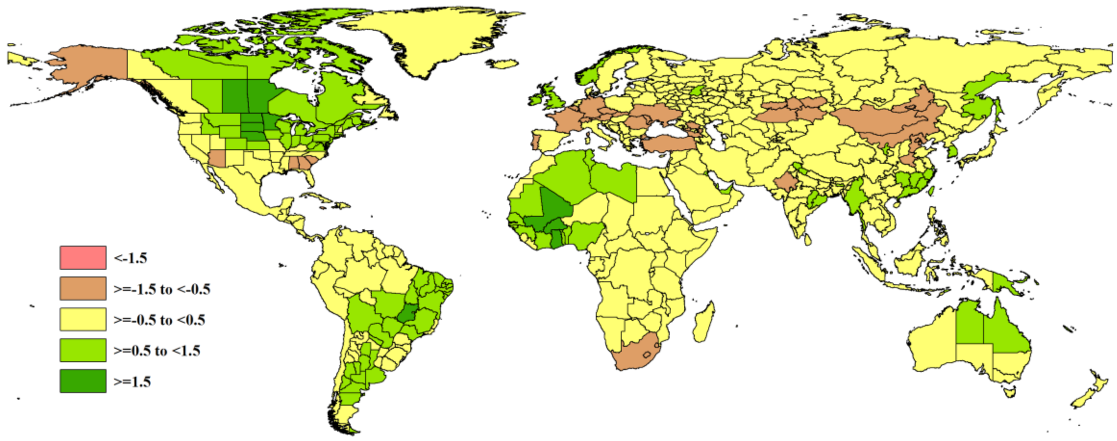


Figure 3. 2 National and subnational temperature anomaly (as indicated by the TEMP indicator) of July to October 2021 average relative to the 2006-2020 average (15YA), in °C

(3) RADPAR anomalies

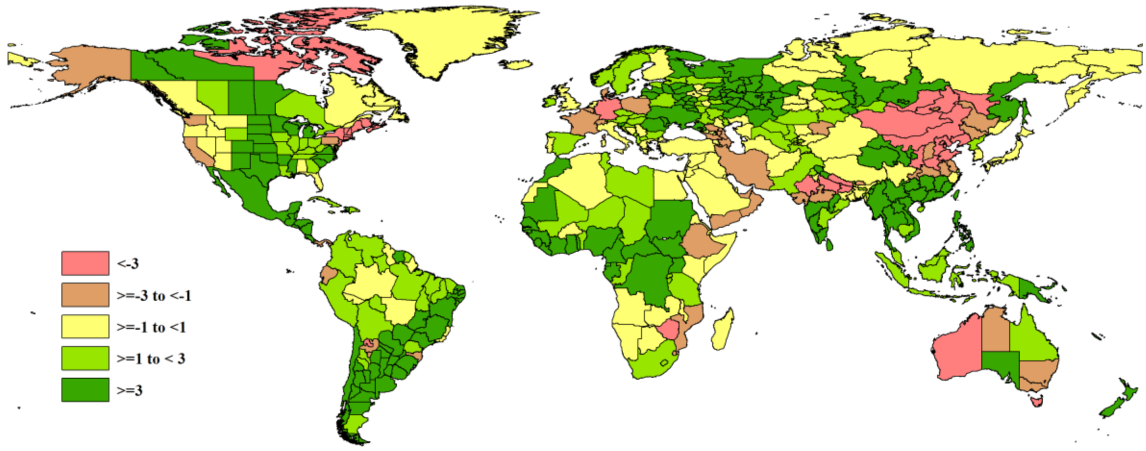


Figure 3. 3 National and subnational sunshine anomaly (as indicated by the RADPAR indicator) of July to October 2021 total relative to the 2006-2020 average (15YA), in percentage

Similar to the temperatures, solar radiation was predominantly above average in most regions south of the equator. Zimbabwe, Mozambique, as well as Western and Southeastern Australia are the notable exceptions. In California and Washington State in the USA, which were plagued by wild fires and smog, radiation levels were more than 1% below average. The Northeast of the USA experienced solar radiation levels that were more than 3% below average. For the other regions in Central and North America, solar radiation was around or above average. Solar radiation was below average in France, Germany and Poland. For the other European countries, it was around or above average. Most of Eastern Europe and Russia experienced above average solar radiation. Ethiopia, Oman, Iran, Georgia, the Indo-Gangetic Plain, Mongolia and most of China, except the south, experienced below average solar radiation. Solar radiation was in general more than 3% above the 15YA in southern India and the rice producing countries in Southeast Asia.

(4) Biomass accumulation potential

The map depicting potential biomass production shows more variability than the other three maps. It shows mostly negative departures for most of South America, except some provinces in Argentina at the foothill of the Andes and for the heart of the Amazon basin. A positive departure is also shown for the USA. Below average production is estimated for the Canadian Prairies, mostly due to the drought conditions. A strong negative departure is also shown for most of West, North and East Africa. Estimates for Central Africa and Ethiopia hovered around the average. Average to above average production was estimated for western Europe. In Russia, the conditions were highly variable. For Turkey, Irak, Central Asia and Afghanistan a strong negative departure was estimated. In India, conditions were mixed, although generally positive. Average conditions to a strong positive departure was estimated for all of China and Australia. In Southeast Asia, conditions were generally on average.

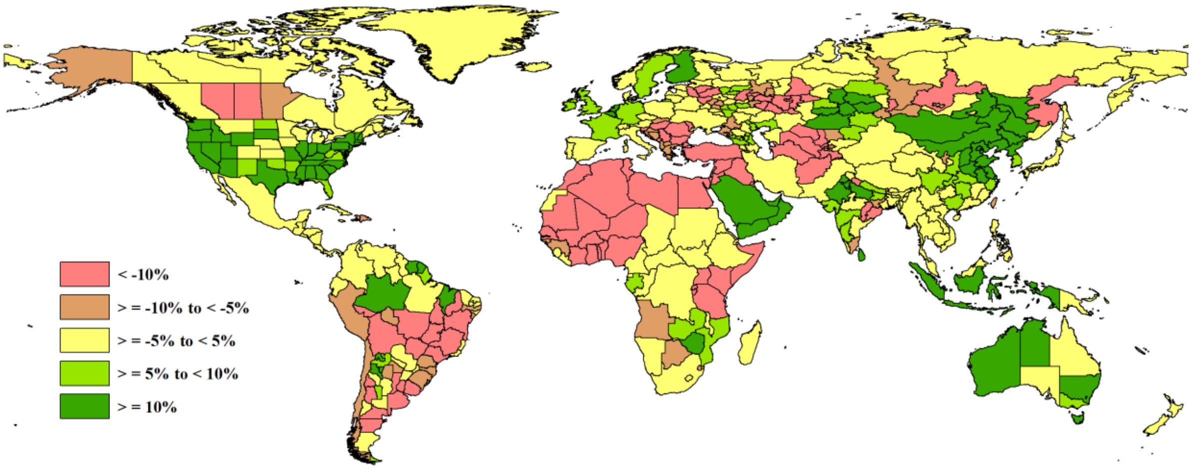


Figure 3. 4 National and subnational biomass production potential anomaly (as indicated by the BIOMSS indicator) of July to October 2021 total relative to the 2006-2020 average (15YA), in percentage

Table 3.1 July- October 2021 agro-climatic and Agronomic indicators by country, current value and departure from average.

Code	Country	Agro-climatic indicators				Agronomic indicators		
		Departure from 15YA (2006-2020)				Departure from 5YA (2016-2020)		Current
		RAIN (%)	TEMP(°C)	PAR(%)	BIOMSS (%)	CALF (%)	CI (%)	VCIx
AFG	Afghanistan	-38	-0.1	1	-17	3	9	0.23
AGO	Angola	-15	0.2	0	-6	11	11	0.84
ARG	Argentina	-11	0.5	5	-6	-5	3	0.74
AUS	Australia	16	-0.1	-1	9	5	3	0.85
BGD	Bangladesh	-8	0.2	0	0	2	1	0.94
BLR	Belarus	-8	-0.1	3	-5	0	-1	0.89
BRA	Brazil	-27	0.8	3	-16	-2	7	0.81
KHM	Cambodia	-8	1.2	1	-5	-3	3	0.84
CAN	Canada	21	-0.7	-4	8	0	13	0.99
CHN	China	-60	0.5	0	-25	3	17	0.71
EGY	Egypt	-5	-0.2	-2	-3	1	1	0.95
ETH	Ethiopia	15	-0.6	-1	6	1	11	1.00
FRA	France	2	0.6	1	7	0	2	0.95
DEU	Germany	-35	-0.2	3	-17	0	20	0.73
HUN	Hungary	20	0.2	2	12	0	-1	0.95
IND	India	-11	0.1	1	5	1	10	0.91
IDN	Indonesia	21	0.1	-1	2	-6	3	0.45
IRN	Iran	-6	0.0	-1	-5	-5	4	0.71
ITA	Italy	21	-0.3	1	8	-26	-1	0.64
KAZ	Kazakhstan	-34	0.1	0	-13	-11	1	0.72
KEN	Kenya	24	-0.2	1	-1	-11	-1	0.73
MEX	Mexico	6	0.1	1	2	1	-7	0.90
MNG	Mongolia	33	-0.1	4	12	1	0	0.93
MAR	Morocco	-56	0.2	3	-27	-9	1	0.58
MOZ	Mozambique	1	0.1	3	1	2	-3	0.92
MMR	Myanmar	-13	0.6	7	-2	1	-6	0.94
NGA	Nigeria	36	-0.6	-4	12	2	2	1.02
PAK	Pakistan	7	-0.3	-2	6	3	0	0.87
PHL	Philippines	-32	0.7	5	-15	0	-6	0.91
POL	Poland	-35	0.3	2	4	1	13	0.70
ROU	Romania	-5	0.4	7	1	0	1	0.96
RUS	Russia	4	-0.2	-3	0	0	4	0.94
ZAF	South Africa	-38	-0.5	3	-18	1	15	0.84
LKA	Sri_Lanka	-6	0.0	3	-1	0	-1	0.87
THA	Thailand	11	0.2	5	4	0	-8	0.95

TUR	Turkey	-20	-0.6	0	-14	-16	3	0.63
UKR	Ukraine	-15	-0.6	4	-4	4	19	0.95
GBR	United Kingdom	22	0.4	2	11	-2	1	0.87
USA	United States	-48	0.2	1	-27	-11	2	0.73
UZB	Uzbekistan	3	0.2	5	2	1	2	0.95
VNM	Vietnam	-15	-0.7	2	-3	22	0	0.91
ZMB	Zambia	-35	0.2	-1	9	11	0	0.81

3.2 Country analysis

This section presents CropWatch analyses for each of 42 key countries (China is addressed in Chapter 4). The maps refer to crop growing areas only and include several graphs: (a) Phenology of major crops; (b) Crop condition development based on NDVI over crop areas at national scale, comparing the July - October 2020 period to the previous season and the five-year average (5YA) and maximum; (c) Maximum VCI (over arable land) for July - October 2020 by pixel; (d) Spatial NDVI patterns up to July - October 2020 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 regions within the country, again comparing the July - October 2020 period to the previous season and the five-year average (5YA) and maximum.

Refer to Annexes A for additional information about indicator values by country. Country agricultural profiles are posted on **www.cropwatch.cn** or **cloud.cropwatch.cn**

Figures 3.5 - 3.45 are Crop condition for individual countries ([AFG] Afghanistan - [ZMB] Zambia) including sub-national regions during July – October 2021.

[AFG] Afghanistan

Wheat, maize and rice are the main cereals that are grown in Afghanistan. The sowing of spring wheat starts in March and April and harvest is in August and September. Maize sowing starts in May and harvest is in August. Likewise, rice sowing starts in May/June and harvest is in October/November.

The agro-climatic condition showed that RAIN decreased by 38%, and TEMP and RADPAR were close to the average level. The decrease in rainfall resulted in significantly lower biomass (-17%). The cropped arable land fraction (CALF) increased by 3%. VCIx was low, it reached only 0.23. It is worth noting that the rainfall was very low in northern Afghanistan. The hardest hit provinces were Badghis Province and Faryab Province. But drought conditions were observed for the other regions as well.

According to the spatial distribution of NDVI profiles, the overall crop growth in Afghanistan was below the average level. The growth of crops in 58.4% of the crop land area was lower than the average level and mainly distributed in northern Afghanistan, which may be related to the decrease of rainfall. Additionally, about 37.4% of total cropped areas were near average, mainly distributed in southern Afghanistan, and only 4.3% of the total cropped areas were positive during the entire monitoring period. The VCIx diagram represents the same conditions.

During the monitoring period, Afghanistan has suffered a severe drought, and the prospect for crop production is far below normal. Its effects were exacerbated by the war and the change in the Government, resulting in a shortage of food supply. According to relevant reports, more than half of Afghans are experiencing a food crisis.

Regional analysis

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

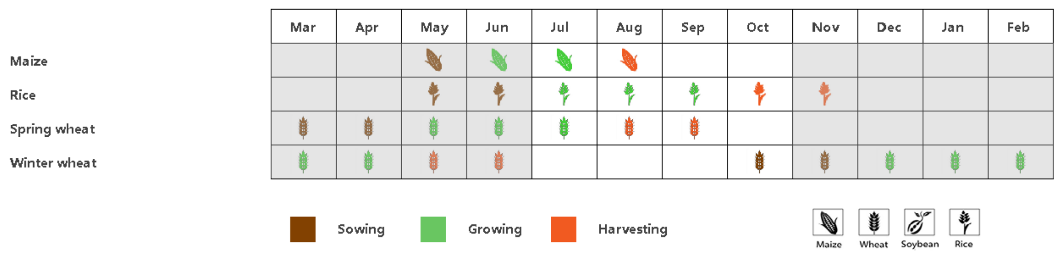
The RAIN in the Central region with sparse vegetation was 17 mm (-38%). The TEMP was 15°C, and the RADPAR was 1469 MJ/m2, at an average level. According to the NDVI-based crop condition development graph, the NDVI was slightly lower than the average level between July and October. BIOMSS decreased by 15%, CALF had increased by 7% and VCIx was 0.38.

The Dry region recorded 22 mm of rainfall (RAIN -10%), TEMP was higher than average at 21.5°C, and RADPAR was 1484 MJ/m2. According to the NDVI-based development graph, crop conditions were lower than the five-year average in the monitoring period. CALF in this region was only 4% and VCIx was 0.2.

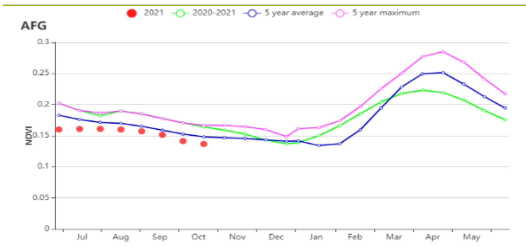
In the Mixed dry farming and irrigated cultivation region, the following indicator values were observed: RAIN 41 mm (-41%); TEMP 17.5°C (-0.1°C); RADPAR 1446 MJ/m2 (+2%). BIOMSS was 153 g DM/m2 (-26%) and CALF was 2% above average. According to the NDVI-based crop condition development graph, NDVI was lower than the average level and VCIx was 0.32.

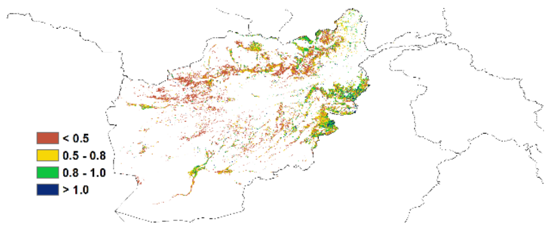
The Mixed dry farming and grazing region recorded 1 mm of rainfall (RAIN -92%). TEMP was 20.1°C (-0.2°C) and RADPAR was 1478 MJ/m2, at an average level. CALF was 13% above the 5YA. VCIx was 0.09 and BIOMSS decreased by 23%. According to the crop condition development graph, the NDVI was much lower than the 5YA throughout the monitoring period.

Figure 3. 5 Afghanistan's crop condition, July- October 2021

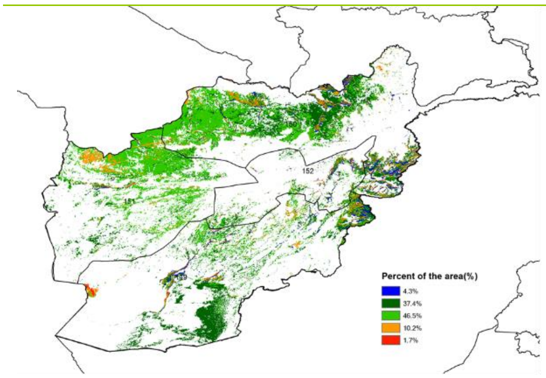


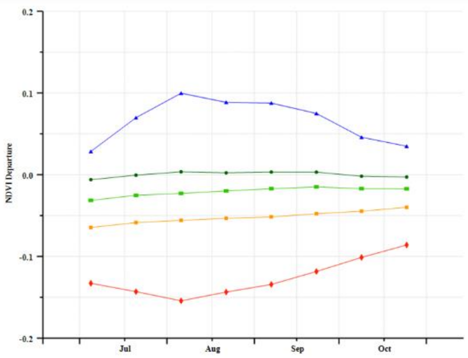
(a). Phenology of major crops



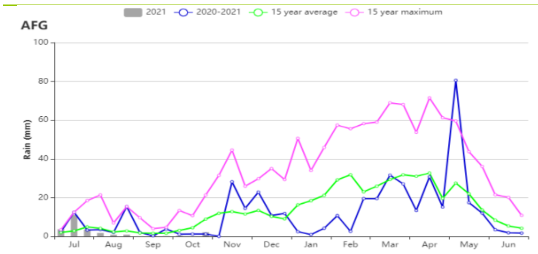


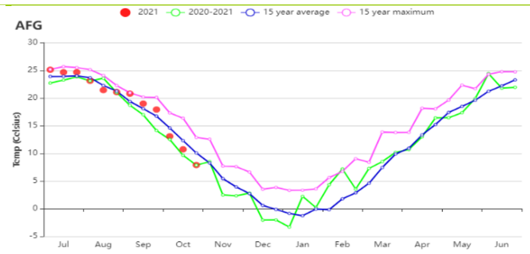
(b) Crop condition development graph based on NDVI (c) Maximum VCI



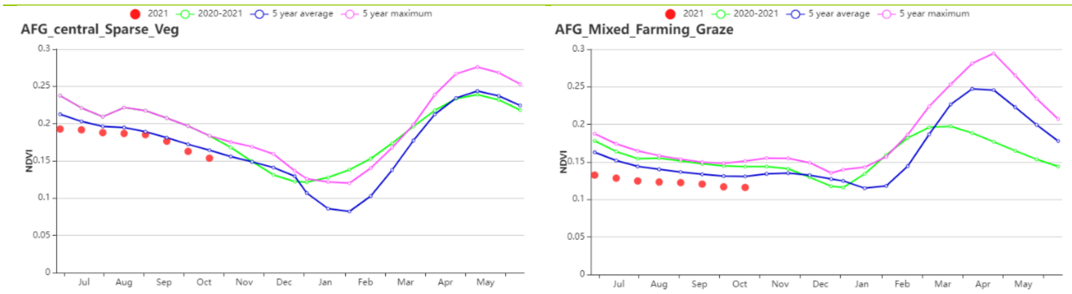


(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles

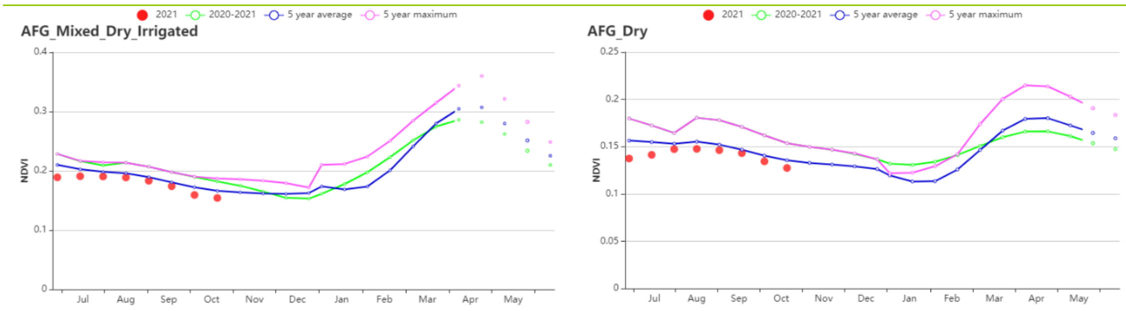




(f) Rainfall profiles (g) Temperature profiles



(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 3.2 Afghanistan's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July – October 2021

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Central region with sparse vegetation	17	-38	15	0	1469	1	133	-15
Dry region	22	-10	21.5	0	1484	0	113	1
Mixed dry farming and irrigated cultivation region	41	-41	17.5	-0.1	1446	2	153	-26
Mixed dry farming and grazing region	1	-92	20.1	-0.2	1478	0	47	-23

Table 3.3 Afghanistan's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July – October 2021

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Central region with sparse vegetation	7	7	106	1	0.38
Dry region	4	0	—	—	0.2
Mixed dry farming and irrigated cultivation region	11	2	115	8	0.32
Mixed dry farming and grazing region	0	13	113	10	0.09

[AGO] Angola

The current monitoring period covers the growing and harvesting stages of rainfed wheat in the provinces of Bengela, Kuanza Sul, Luanda, Bengo and Kuanza Norte. The planting of maize and rice began in late September and it is expected to last until late November. Estimated biomass dropped by 6%, due to below-average rainfall by (RAIN -15%). The temperature increased by 0.2ºC, while the radiation was near the average of the past fifteen years. The NDVI development graph indicates that nationwide, crop conditions were near the average of the past five years from July to September, deteriorating in early October till the end of the monitoring period, when the harvesting period of wheat was completed.

At the country level, the overall VCIx was acceptable, with a value of 0.84. According to its spatial distribution, the best VCIx values were recorded in the province of Cuando Cubango, Benguela, Cuanza Sul and Bengo. The VCIx spatial distribution was generally consistent with those of NDVI, according to the NDVI departures, in almost 46.9% of the arable land in these regions. The crop conditions were favourable from mid-July (when wheat started to develop) till late September.

Regional Analysis

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

In the Arid Zone, the agroclimatic indicators reveal that rainfall decreased significantly (RAIN -29%). Meanwhile, temperature and radiation increased by 0.5ºC and 1% respectively. The potential biomass for this region decreased by 15% compared to the 15-year average. In the region, crop conditions were favourable during almost the entire monitoring period, except for late October. Both the cropping intensity and CALF are higher than 5YA (111% and 34%, respectively), the maximum VCI in the arid zone was 0.76. Crop conditions were close to the average.

With crop conditions below the average of the past five years, the rainfall in the Central Plateau region decreased by 20%. The temperature recorded an increase of 0.1ºC while radiation decreased by about 1%. Following these conditions, the potential biomass production decreased by 6%. The significant drop in the total rainfall may have led to a decrease in CALF (-15%). But the cropping intensity increased by 22%, indicating that the annual crop area was above average. The maximum VCI for this region was 0.70. Crop conditions in this region were negative.

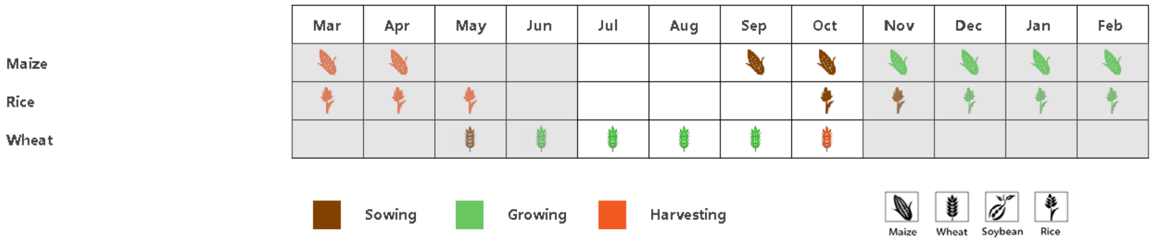
With both rainfall and temperature decreasing (RAIN -11% and TEMP -0.3ºC), and radiation increasing (RADPAR +3%), the Humid zone registered a drop in the potential biomass (BIOMSS -5%). However, the agroclimatic indicators had less impact on crop conditions, as the NDVI development graph revealed mixed crop conditions during the entire monitoring period. In this region, CALF was about the average of the past five years and he recorded VCIx was 0.92, indicating positive crop conditions during the growing period. The cropping intensity increased by 24%, indicating that the annual crop area was above average

Although the Semi-arid zone recorded an increase in rainfall (RAIN +1%) and radiation (RADPAR +3%), the potential biomass production in this region had decreased by 8%. The crop conditions development graph based on NDVI reveals generally above-average crop conditions during the entire monitoring period. The cropping intensity in this region increased in 4% while CALF increased by 39%. The VCIx observed in this region was of 0.89.

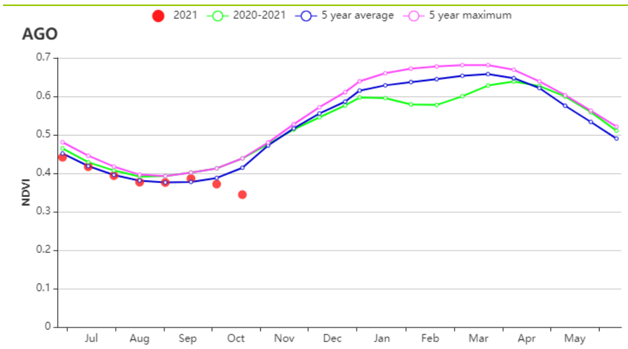
In the Sub-humid zone, rainfall decreased by 17%. Both temperature and radiation increased by 0.2ºC and 1%, respectively. The potential biomass production decreased by 5%. The NDVI development graph shows that crop conditions were generally below the average of the past five years during almost the entire monitoring period. With an increase of 1% in CALF, the Cropping Intensity had increased by 15%. The maximum VCI observed in this region was 0.81.

In general, based on the agroclimatic and agronomic indicator herein reported, the crop condition in the Central Plateau, Arid and Subhumid zones were less favorable, while crop conditions of Semi-arid zone and Sub-humid zone were favourable for the growing of wheat.

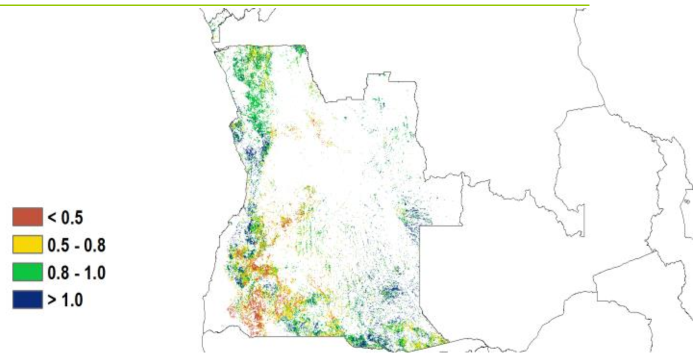
Figure 3. 6 Angola's crop condition, July – October 2021



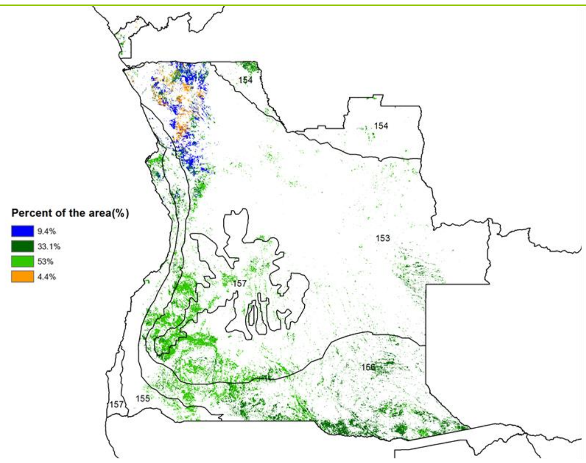
(a). Phenology of major crops



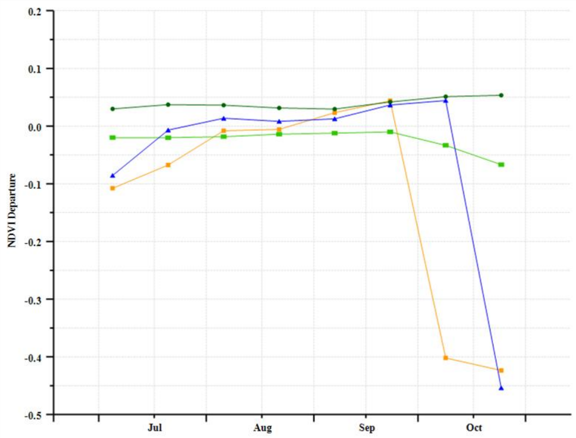
(b) Crop condition development graph based on NDVI



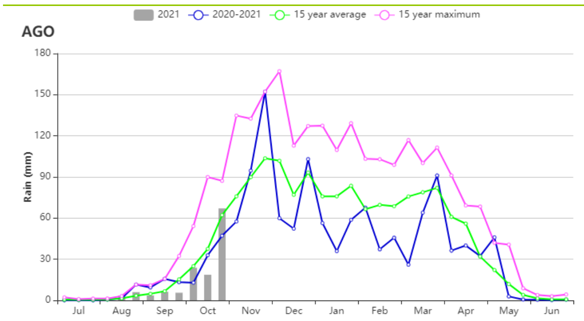
(c) Maximum VCI



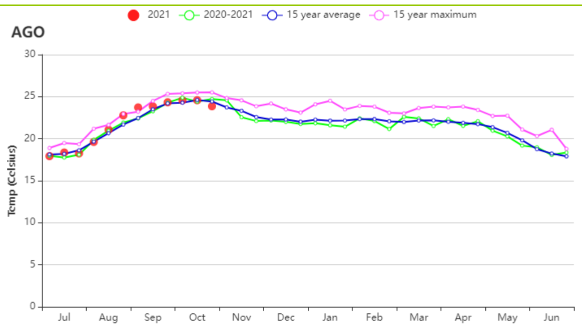
(d) Spatial NDVI patterns compared to 5YA



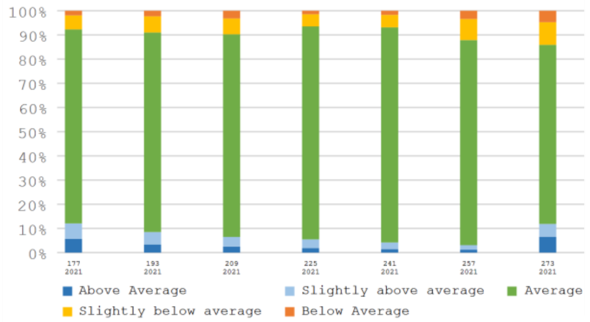
(e) NDVI profiles



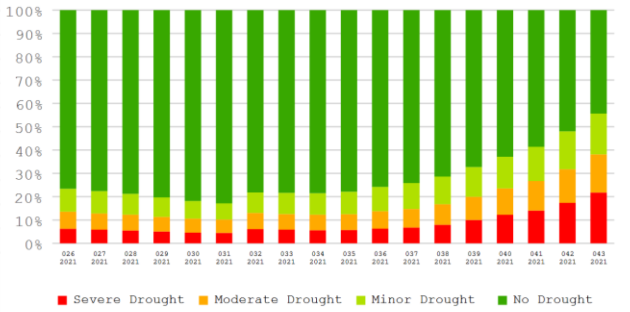
(f) National time-series rainfall profiles



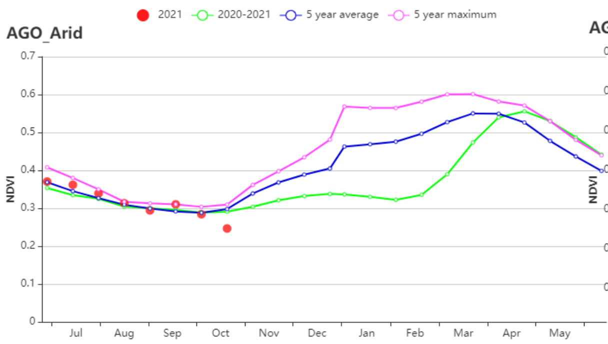
(g) National time-series temperature profiles



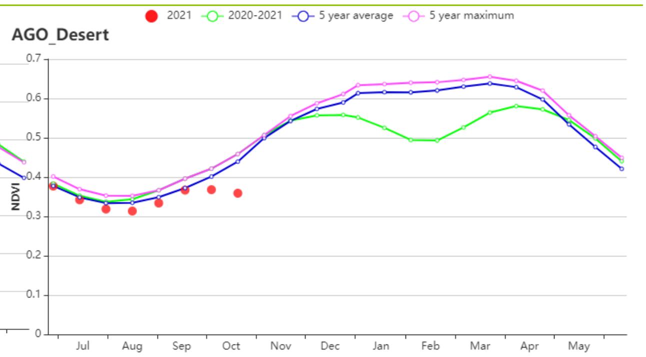
(h) Proportion of NDVI anomaly categories compared with 5YA



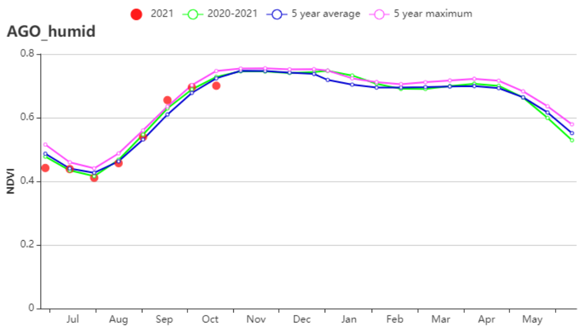
(i) Proportion of VHIm categories compared with 5YA



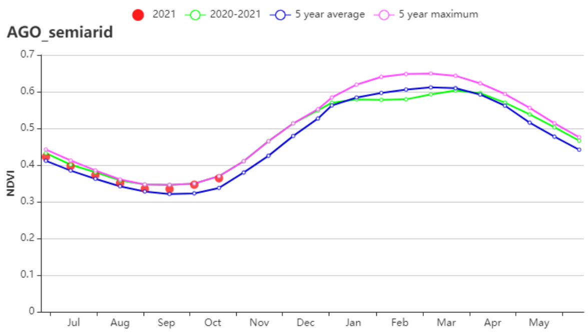
(j) Crop condition development graph based on NDVI- Arid zone



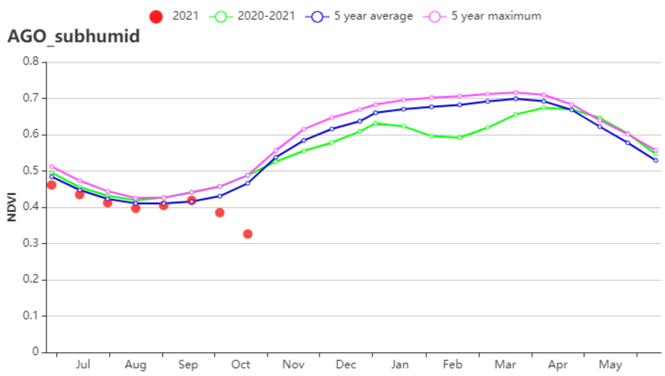
(k) Crop condition development graph based on NDVI - Central Plateau



(l) Crop condition development graph based on NDVI- Humid zone



(m) Crop condition development graph based on NDVI - Semi-arid zone



(n) Crop condition development graph based on NDVI- Sub-humid zone

Table 3.4 Angola's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July–October 2021

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/m2)	Departure from 15YA (%)
Arid Zone	64	-29	22.3	0.5	1355	1	395	-15
Central Plateau	120	-20	19.2	0.1	1352	-1	352	-6
Humid zone	476	-11	23.7	-0.3	1299	3	906	-5
Semi-Arid Zone	41	1	21.5	0.3	1377	-1	228	-8
Sub-humid zone	164	-17	22.0	0.2	1315	1	457	-5

Table 3.5 Angola's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July – October 2021

Region	Cropped arable land fraction		Cropping Intensity		Maximum VCI
	Current (%)	Departure from 5YA (%)	Current (%)	Departure from 5YA (%)	Current
Arid Zone	34	56	111	5	0.76
Central Plateau	37	-15	122	22	0.70
Humid zone	100	0	157	24	0.92
Semi-Arid Zone	44	39	105	4	0.89
Sub-humid zone	62	1	119	15	0.81

[ARG] Argentina

The reporting period covers the main growing period of winter crops and the sowing of early maize and rice. Part of the period is a fallow period for the summer crops. The overall crop conditions in Argentina varied between regular and poor.

For the whole country, rainfall showed a 11% negative anomaly, TEMP showed a positive anomaly (+0.5°), RADPAR showed positive anomalies by +5%. Due to the shortage of rainfall, BIOMSS was negatively affected at 6% below 15YA. Rainfall profiles showed slightly negative anomalies during most of the period, except for a strong rain event at the beginning of September. Overall, weather conditions were variable.

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, Mesopotamia, Humid Pampas, and Subtropical Highlands. The other agro-ecological zones are less relevant for this period.

Except for the Subtropical Highlands that showed positive anomalies in RAIN (+31 %), negative anomalies were observed in Chaco (-20 %), Humid Pampas (-13 %) and Mesopotamia (-11 %). TEMP showed positive anomalies for the four AEZs: Humid Pampas (+0.6°), Chaco (+0.4°), Subtropical Highlands (+0.4°) and Mesopotamia (+0.3°). RADPAR showed positive anomalies in Humid Pampas (+6 %), Mesopotamia (+6 %) and Chaco (+5 %), while Subtropical Highlands showed negative anomaly (-1 %). Thanks to the sufficient rainfall in Subtropical Highlands, BIOMSS showed positive anomalies by +9%. In contrast, it was below 15YA for the other three AEZs: Humid Pampas (-7%), Mesopotamia (-9%), and Chaco (-8%) mainly due to the shortage of rainfall.

CALF was almost complete in Mesopotamia (98%). The other AEZs showed low CALF values: Subtropical Highlands (53 %), Humid Pampas (77%), the major winter crops growing region, and Chaco (80 %). Cropping Intensity index showed positive anomaly in Humid Pampas (+5 %) and in Subtropical Highlands (+1 %). No anomalies were observed for Chaco and a slightly negative one for Mesopotamia (-2 %). Maximum VCI showed average conditions for Mesopotamia (0.81), and lower values for Humid Pampas (0.76), Chaco (0.67) and Subtropical Highlands (0.58).

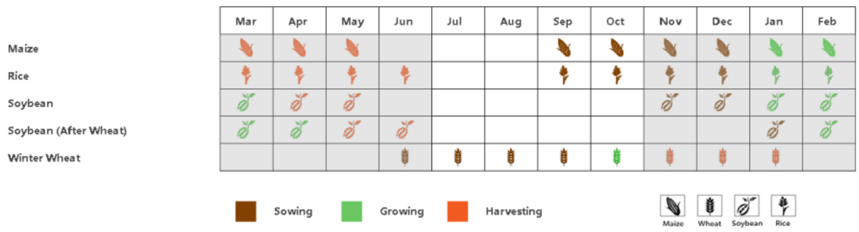
For the whole country, crop condition development graph based on NDVI showed negative anomalies during July and August. Starting in September, NDVI values were near the 5 year average and above the 2020 values for the same period. Several differences were observed among regions. Humid Pampas showed almost no anomalies during July and August, and positive anomalies starting in September. The peak NDVI in Humid Pampas was well above those of the 5YA and the 2020 winter crops growing season, reflecting an increase signal of winter crops. Chaco and Subtropical Highlands showed negative anomalies during almost the entire reporting period. NDVI in Mesopotamia remained at average levels during the whole period although sufficient rainfall provided favorable soil moisture conditions.

Spatial distribution of NDVI profiles showed some homogeneous patterns. Two profiles showed negative anomalies during the entire reporting period: the green profile showed stronger negative anomalies than the red profile. These profiles were located in North West Pampas, Subtropical Highlands and Chaco, as well as in a small region in Center East Pampas. Another homogeneous pattern showed slight negative anomalies during July and August and positive anomalies since September (blue profile) and was observed in Center and West Pampas. A pattern with high positive anomalies since August was observed in East Chaco (orange pattern). The dark green pattern, with slight positive anomalies, was sparsely scattered over the country.

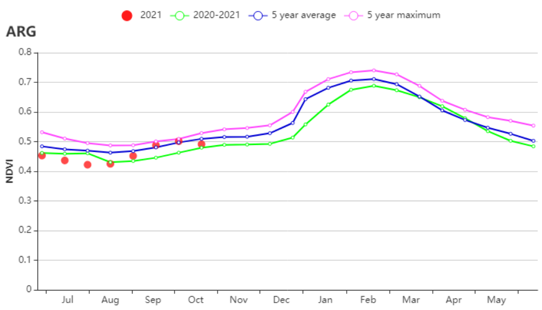
Maximum VCI showed similar spatial patterns as the crop condition presented by the NDVI departure clusters. Below-average conditions (lower than 0.8) were mainly located in northern, northwest, and central Argentina. Poor conditions (lower than 0.5) were observed in North West Pampas and Subtropical Highlands, where crops might have suffered from drought. On the contrary, quite good conditions were observed in parts of the South East Pampas.

In general, Argentina showed regular and poor conditions. Below-average crop conditions were found all along the reporting period in Chaco and Subtropical Highlands as well as in North West and West Pampas with low VCIx values.

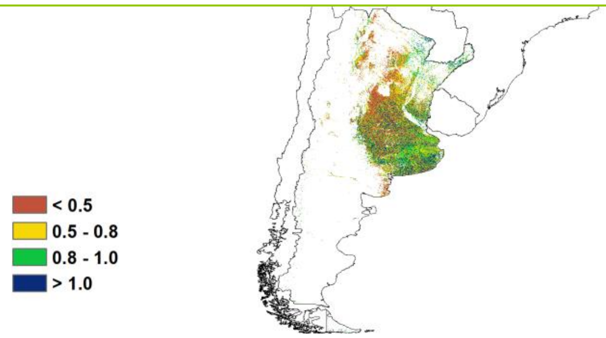
Figure 3.7 Argentina 's crop condition, July -October 2021



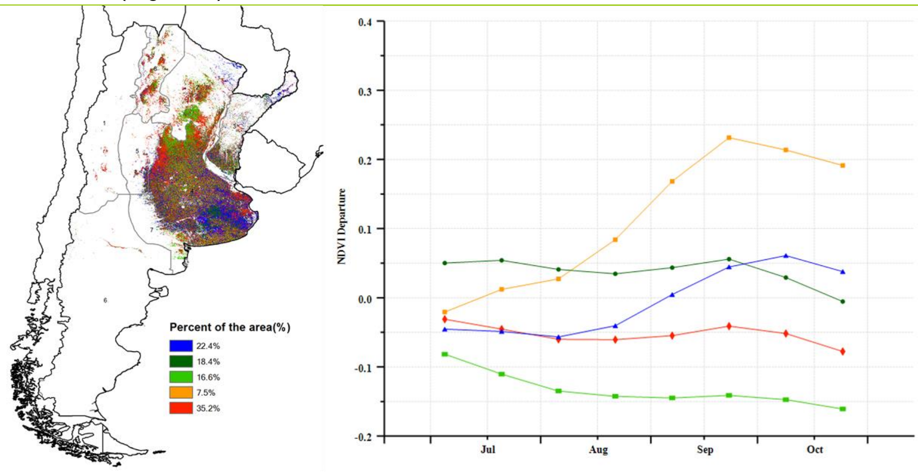
(a). Phenology of major crops



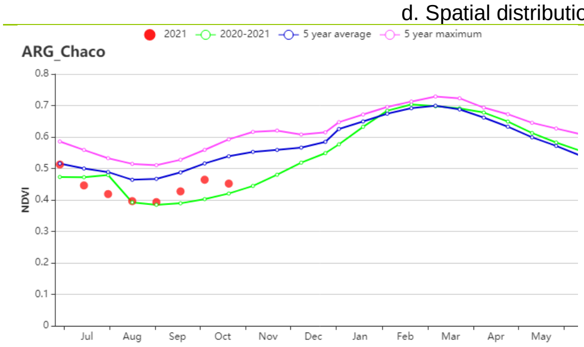
b. Crop condition development graph based on NDVI (Argentina).



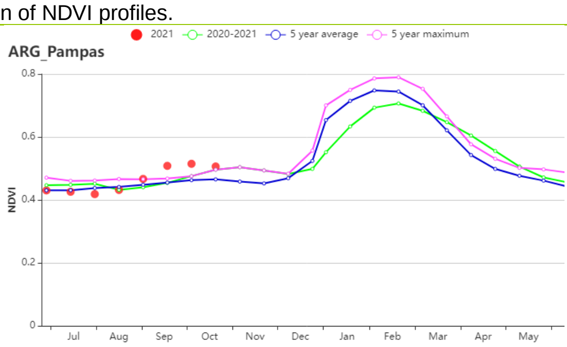
c. Maximum VCI.



d. Spatial distribution of NDVI profiles.



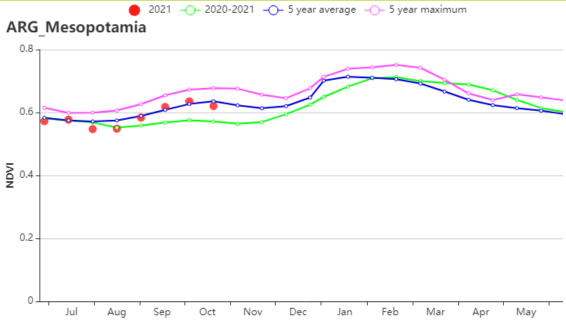
e. Crop condition development graph based on NDVI



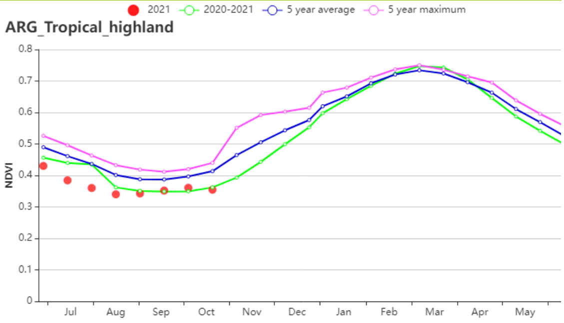
f. Crop condition development graph based on NDVI

(Chaco).

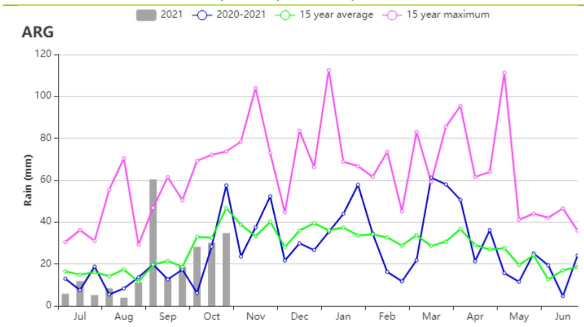
(Pampas).



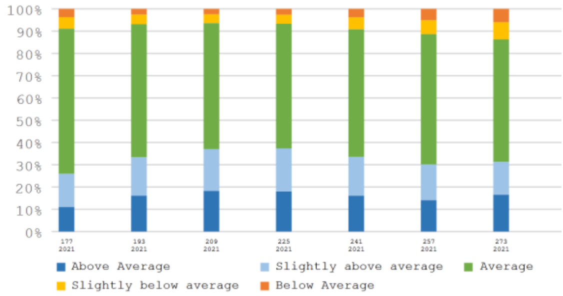
g. Crop condition development graph based on NDVI (Mesopotamia).



h. Crop condition development graph based on NDVI (Subtropical Highlands).



i. Time series rainfall profile (Argentina).



j. Proportion of NDVI anomaly categories compared with 5YA.

Table 3.6 Argentina 's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July -October 2021

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 (%)
Chaco	197	-20	18.3	0.4	982	5	577	-8
Mesopotamia	400	-11	16.2	0.3	918	6	763	-9
Humid Pampas	192	-13	13.3	0.6	945	6	513	-7
Subtropical highlands	177	31	16.2	0.4	1118	-1	482	9

Table 3.7 Argentina 's agronomic indicators by sub-national regions, current season's value and departure from 5YA, July -October 2021

Region	Cropped arable land fraction		Cropping Intensity		Maximum VCI
	Current (%)	Departure from 5YA (%)	Current (%)	Departure from 5YA (%)	Current
Chaco	80	-9	109	0	0.67
Mesopotamia	98	-1	114	-2	0.81
Humid Pampas	77	-4	116	5	0.76
Subtropical highlands	53	-26	105	1	0.58

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

[AUS] Australia

The current monitoring period covers the end of the sowing, main growth and early harvest periods of wheat and barley, which are the main cereal crops of Australia. The national NDVI profile was much better than the average of the last 5 years, nearly reaching the maximum levels.

In the current period, rainfall was higher than the 15-year average (RAIN +16%). The average temperature was normal while the sunshine was slightly below average (-1%). Abundant rainfall led to an increasing biomass (BIOMSS, +9%). The agronomic indicators were also positive, with a VCIx of 0.85 and an increased CALF (+5%).

The conditions in the four main wheat production states (New South Wales, South Australia, Victoria, and Western Australia) were similar, with above-average rainfall (ranging from +8% to +34%), slightly cooler temperature (ranging from -0.2°C to -0.5°C), average sunshine (ranging from -3% to +4%). Like the national indicators, the sufficient rainfall brought above average biomass (ranging from +2% to +15%). Spatially, the VCI map shows that the overall conditions in Australia were favorable, and the low values only appeared in New South Wales and north Victoria. The spatial NDVI profiles show the same pattern. The NDVI values for 16.1% of the crop areas were below average during this period and 39.4% were near average. The other areas were above average. Overall, the crop conditions for Australia were very favorable.

Regional analysis

This analysis adopts five agro-ecological regions for Australia, namely the Arid and Semi-arid Zone, Southeastern Wheat Zone, Subhumid Subtropical Zone, Southwestern Wheat Zone, Wet Temperate and Subtropical Zone. The Arid and Semi-arid Zone, in which hardly any crop production takes place, was not analyzed.

During the current period, the four main AEZs had similar indicator departures: above-average rainfall and biomass. The conditions in these regions were all favorable.

The rainfall in the Southeastern wheat area was 17% above average, while the temperature (-0.4°C) and RADPAR (-1%) were slightly below average. Due to the sufficient rainfall, the biomass was also above average (BIOMSS, +8%). The CALF was average, CI was 108%, and the VCIx was 0.81.

The agroclimatic indicators in the Subhumid subtropical zone were stable, with a slightly increased rainfall (RAIN, +4%), average temperature and sunshine. The biomass (+8%), CALF (+29%), and CI (113%, +8%) were above average. VCIx was also favorable (0.78).

The largest rainfall departure appeared in Southwestern wheat area (+36%), which resulted in a decreased temperature (-0.6°C) and sunshine (-5%). However, the sufficient rain caused an above average estimate of the biomass (+17%). The agronomic indicators were favorable (CALF +8%, CI 0%, VCIx 0.99).

The rainfall in Wet temperate and subtropical zone was also above average (+16%), which led to an increased biomass (+7%). Unlike the other 3 regions, the temperature was slightly above average (+0.2 °C), while the sunshine was still below average (-1%). The CALF was 0.95, which was average, CI was 102% (decreased by 4%), and VCIx was 0.84.

Overall, combining the agro-climatic and agronomic indicators, the crop conditions in the JASO period were favorable, and an above-average production is estimated.

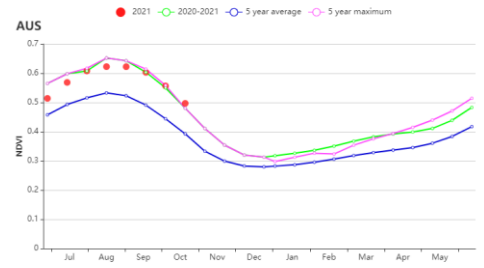
Figure 3.8 Australia's crop condition, July - October 2021

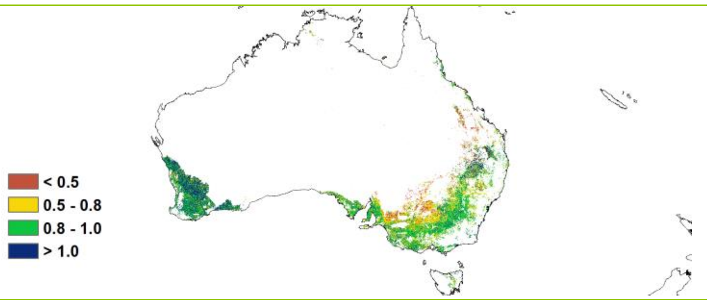
	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Wheat												

Sowing Growing Harvesting

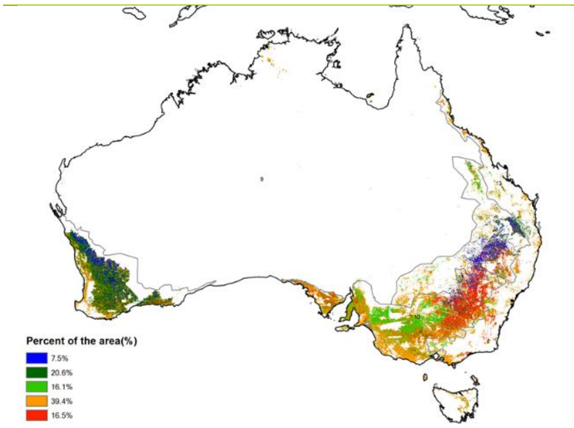
Maize Wheat Soybean Rice

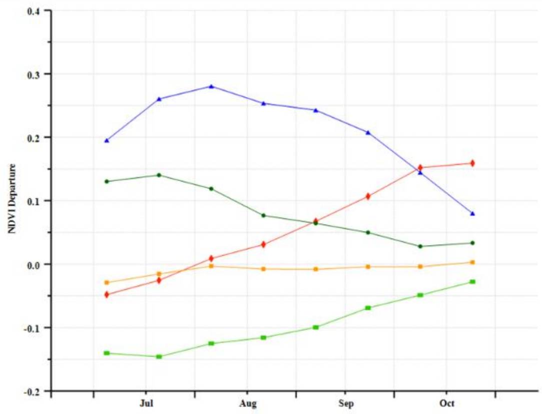
(a). Phenology of major crops



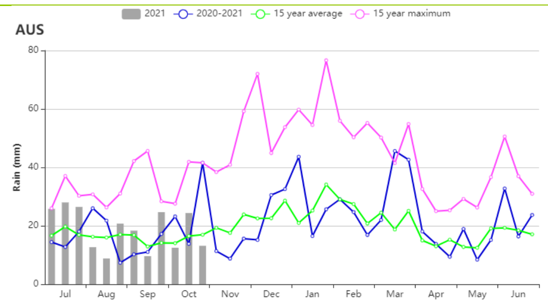


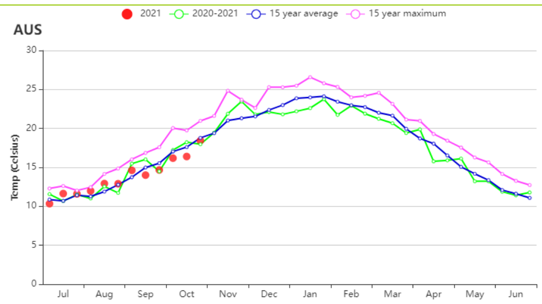
(b) Crop condition development graph based on NDVI (c) Maximum VCI



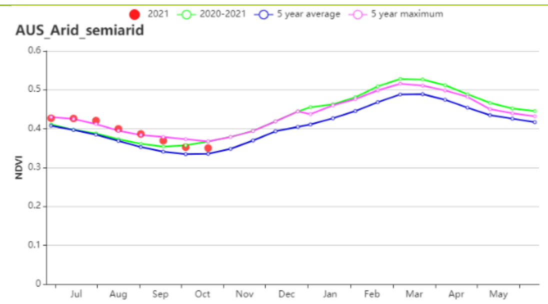


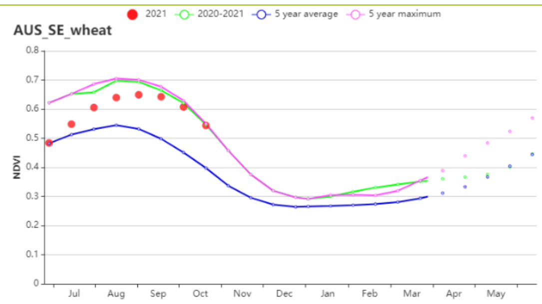
(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles



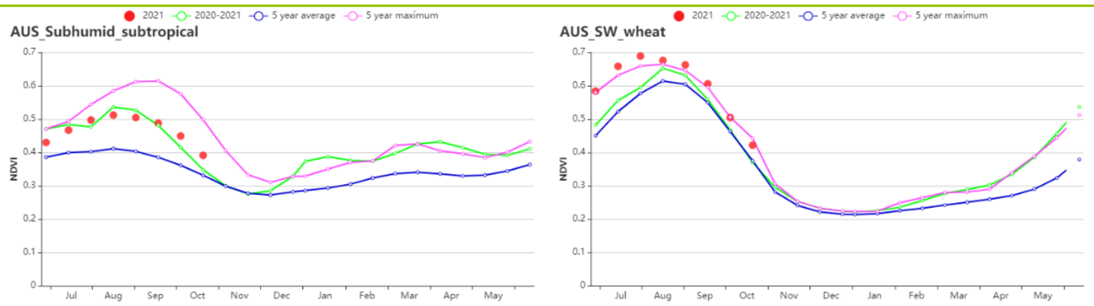


(f) Rainfall profiles (g) Temperature profiles

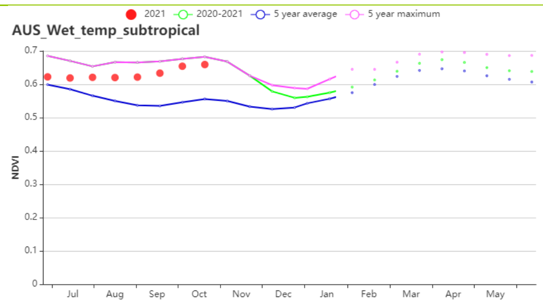




(h) Crop condition development graph based on NDVI (Arid and semiarid zone (left) and Southeastern wheat area (right))



(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 3.8 Australia's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July 2021 - October 2021

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Arid and semiarid zone	57	-14	23.4	0.9	1248	1	326	-4
Southeastern wheat area	241	17	11.7	-0.4	833	-1	591	8
Subhumid subtropical zone	153	4	15.3	0.0	1065	0	525	8
Southwestern wheat area	316	36	12.5	-0.6	817	-5	700	17
Wet temperate and subtropical zone	259	16	13.2	0.2	931	-1	626	7

Table 3.9 Australia's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2021

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Arid and semiarid zone	60	16	102	1	0.83
Southeastern wheat area	93	0	108	7	0.81
Subhumid subtropical zone	71	29	113	8	0.78
Southwestern wheat area	97	8	100	0	0.99
Wet temperate and subtropical zone	95	0	102	-4	0.84

[BGD] Bangladesh

During the reporting period, near 15YA rainfall and TEMP in July and August allowed the sowing of the main rice crop (Aman) and the harvesting of Aus rice to be completed in August. September and October covered the main growth period of Aman rice, the rainfall was near average and TEMP was slightly above average. For the whole reporting period, rainfall was below average (-8%) and TEMP was above average (+0.2℃). Both RADPAR and BIOMSS were close to the 15-year average. The national NDVI development graph showed that overall crop conditions were below the 5-year average in July and August and returned to the 5-year average in September and October. These drops in August might have been due to cloud cover in the satellite images. The spatial NDVI pattern showed that 26.2% of the cultivated area were close to average and 24.6% were below average during the whole period. 49.3% had a big drop in August and recovered to average in September, mainly distributed in Gangetic Plain and the Sylhet basin. The maximum Vegetation Condition Index (VCIx) was 0.94, with most areas showing values higher than 0.8 and CALF had increased by 2%. Overall, the conditions were favorable for the Aman rice production in Bangladesh.

Regional analysis

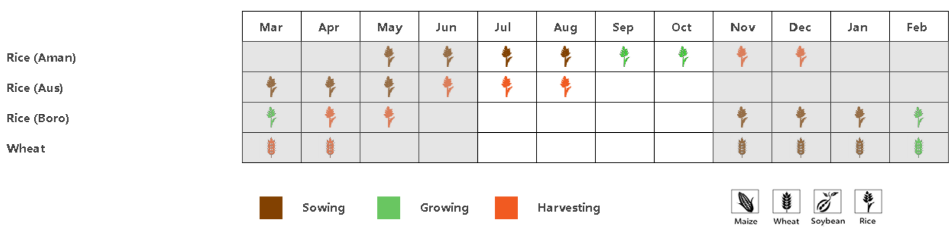
Bangladesh can be divided into four agro-ecological zones (AEZ): Coastal region, the Gangetic Plain, the Hills, and the Sylhet basin.

In the Coastal region, both RAIN and TEMP were above average (+6% and +0.2°C, respectively) while RADPAR was below average (-1%). The potential biomass was average. The crop condition development graph based on NDVI showed that crop conditions were below the 5-year average and returned to average in the end of October. The excessive rainfall in July might have delayed the sowing of Aman rice. Cropping intensity (CI 145%) was lower than the 5YA by 8%. CALF was 91% and VCIx was 0.90. Overall, crop conditions were close to the average for this zone.

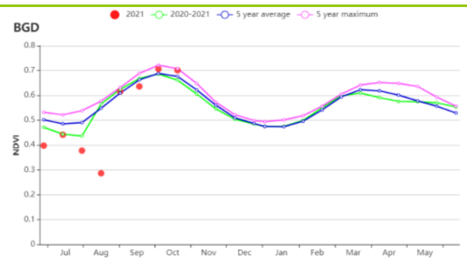
Both RAIN and RADPAR were below average (-11% and -1%, respectively) in the Gangetic Plain. TEMP and BIOMSS were above average (+0.1°C and 2%, respectively). The crop condition development graph based on NDVI showed that crop conditions were close to the 5-year average in September and October. During the monitoring period, CALF (96%) and CI (188%) were above average (+1% and +2%, respectively) and VCIx was 0.95. Crop conditions of this region were close to the average.

The Hills and the Sylhet basin experienced similar conditions in this period. They recorded less rainfall (-10% and -9%, respectively). Both had warmer temperature (+0.3℃) and more sunshine (+1%) as compared to the 15YA, which were beneficial for the growth of rice in September and October. Potential biomass for the Hills was estimated 2% lower than the 15YA average and and the Sylhet basin was close to average. For the hills, CALF and CI were 98% (+1%) and 135% (+6%) with a favorable VCIx (0.98). CALF and CI were higher than the 5YA by 4% and 2% (91% and 171%, respectively) and VCIx was 0.95 for the Sylhet basin. Crop development based on NDVI also showed near or above average levels in September and Octorber in the Hills and the Sylhet basin. Based on the above information, favorable prospects for rice in these two zones can be expected.

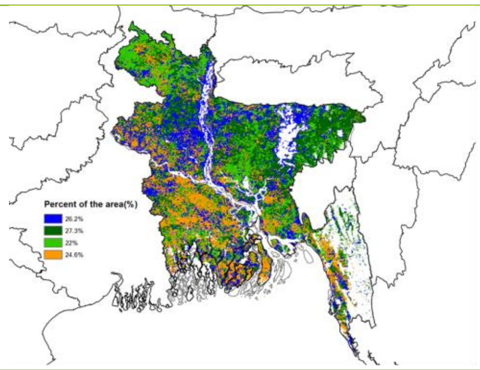
Figure 3.9 Bangladesh's crop condition, July - October 2021

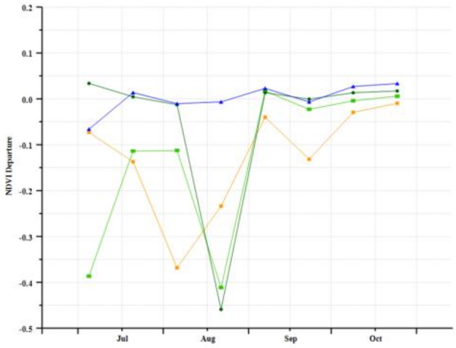


(a). Phenology of major crops

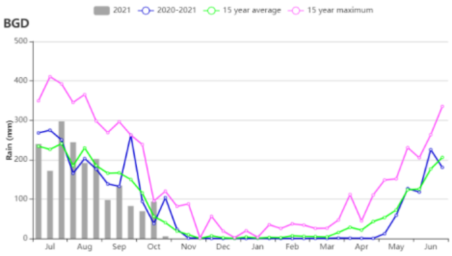


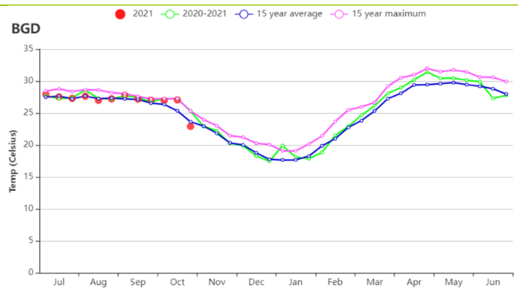
(b) Crop condition development graph based on NDVI (c) Maximum VCI



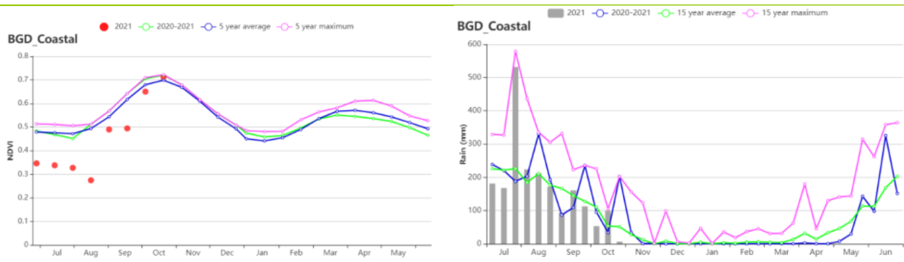


(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles

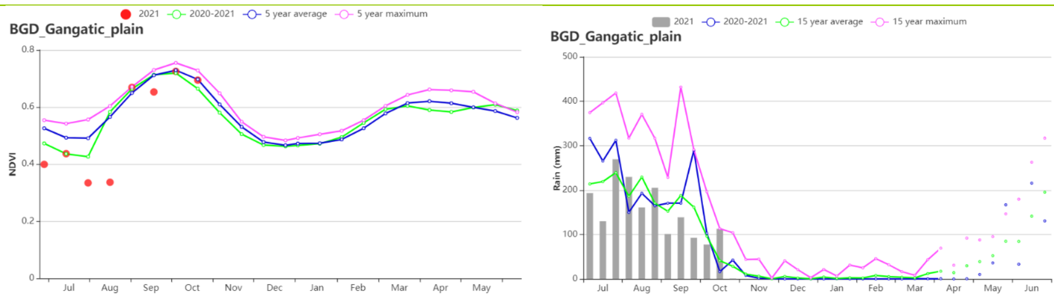




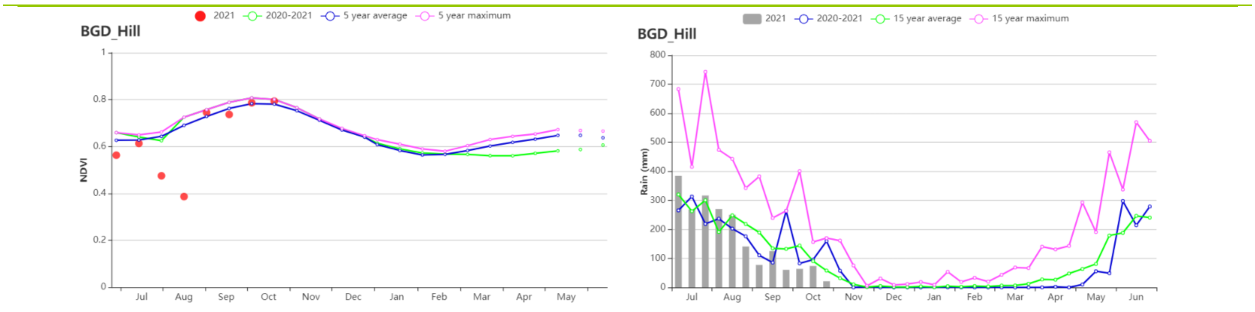
(f) Rainfall profiles (g) Temperature profiles



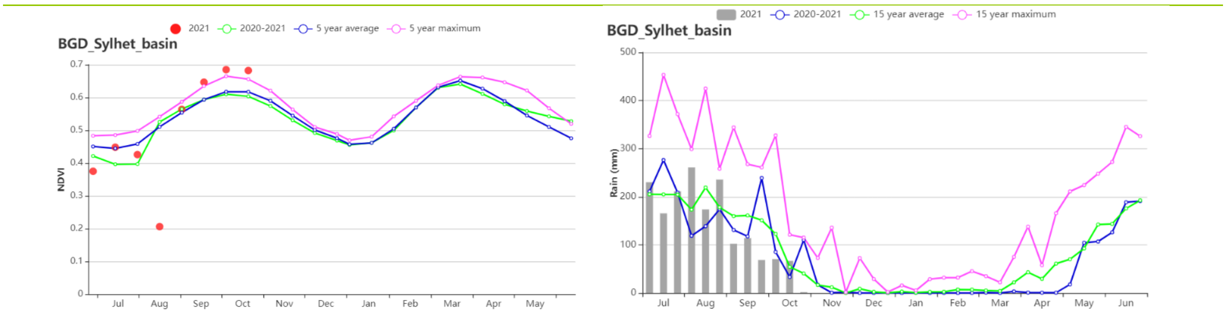
(h) Crop condition development graph based on NDVI (left) and rainfall profile (right) of Coastal region



(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 3.10 Bangladesh's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2021

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Coastal region	2014	6	27.5	0.2	1164	-1	794	0
Gangetic plain	1720	-11	27.1	0.1	1080	-1	723	2
Hills	2052	-10	26.3	0.3	1089	1	749	-2
Sylhet basin	1700	-9	26.9	0.3	1063	1	714	0

Table 3.11 Bangladesh's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2021

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Coastal region	91	0	145	-8	0.90
Gangetic plain	96	1	188	2	0.95
Hills	98	1	135	6	0.98
Sylhet basin	91	4	171	2	0.95

[BLR] Belarus

The reporting period includes the harvesting of spring wheat from August to September and the planting of winter wheat in October. The nationwide rainfall amount was 260 mm, 8% below the 15YA average. Temperature decreased slightly (14°C, -0.1°C) while radiation was somewhat above average (RADPAR, 812MJ/m², 3%). The potential biomass was below average (-5%). Agronomic conditions were generally favorable: good values of VCIx (0.89) and cropped arable land fraction (CALF, 100%) were observed. However, due to the decrease of rainfall in north and south Belarus during the period of winter wheat sowing, crop prospects for the next season in these areas might be affected.

The NDVI development graph indicates that crop condition had gradually recovered to the level of the 5-year average starting in August. Crop condition in about 90.2% cropped area was close to or above the 5-year average, in agreement with the national VCIx map. There was an apparent drop in NDVI profiles in some of the areas from August to September, the reason for this might be the shortage of rainfall during this period. According to the VCIx distribution map, VCIx was satisfactory in most cropped areas of the country (above 0.8), indicating fair crop prospects, while low values were scattered in the southern area.

Although agronomic indicators were generally favorable starting in August, below average rainfall in the northern and southern area caused low soil moisture conditions and may have negatively impact on germination of winter wheat. Crop conditions in most areas of the country during the past months were generally close to the 5-year average, indicating favorable crop prospects.

Regional analysis

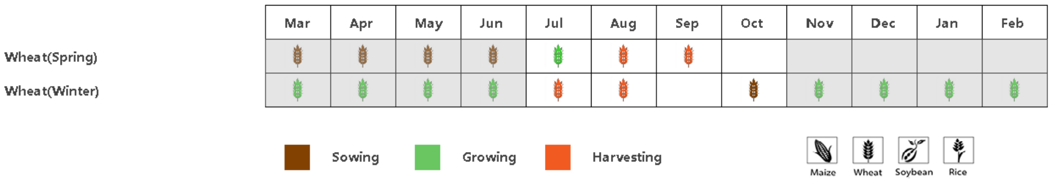
Regional analyses are provided for three agro-ecological zones (AEZ) defined by their cropping systems, climatic zones, and topographic conditions, including Northern Belarus (028, Vitebsk, the northern area of Grodno, Minsk and Mogilev), Central Belarus (027, Grodno, Minsk and Mogilev and Southern Belarus (029) which includes the southern halves of Brest and Gomel regions.

North Belarus recorded a radiation increase (+5%) combined with slightly higher temperatures (+0.1°C) and lower rainfall (-12%). And potential biomass decreased by 7% below average. The VCIx had reached 0.91, and CALF had reached 100%. The NDVI development curve was generally near average level. Winter wheat may grow normally based on agro-climatic indicators in this area but the impact of lower soil moisture in this period on winter wheat germination and early establishment requires close attention.

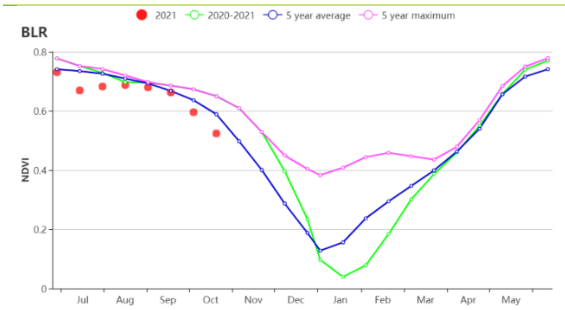
Central Belarus also experienced more sunshine (+1%) and slightly lower temperature (-0.2°C) and increased rainfall (+1%). Similar to northern Belarus, high CALF (100%) and VCIx (0.88) were also recorded. The NDVI growth curve was generally near the average trend from July to October. The potential biomass decreased by about 3%, and cropping intensity was also 4% below average, therefore winter wheat conditions in this area might also need close monitoring.

Precipitation in **Southern Belarus** was below the 15YA average level (-10%), and the temperature was slightly lower by -0.2°C and radiation was increased by 3%. Potential biomass was expected to decrease by 6%. The CALF and the VCIx were 100% and 0.89 respectively. The water shortage in the previous period might have caused a negative impact on the production of spring wheat and the impact of lower soil moisture in this period on winter wheat also requires close attention.

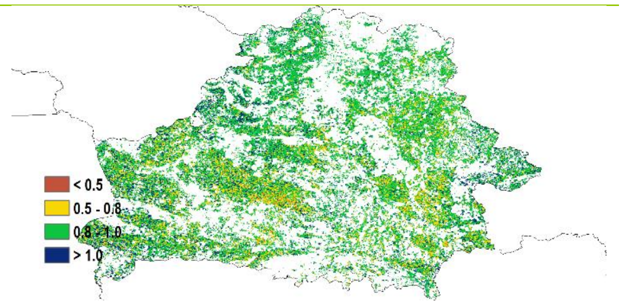
Figure 3.10 Belarus's crop condition, July - October 2021.



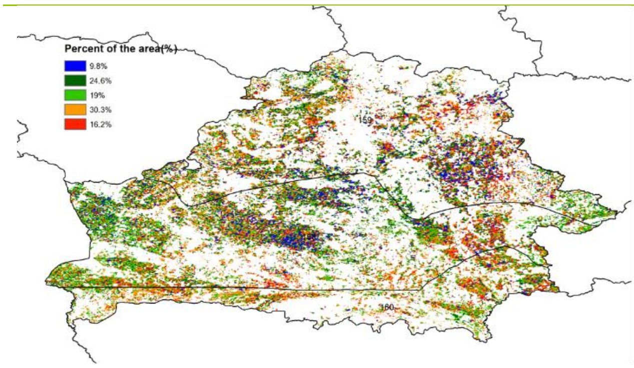
(a). Phenology of major crops



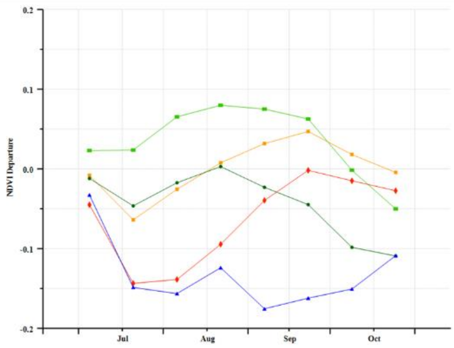
(b) Crop condition development graph based on NDVI



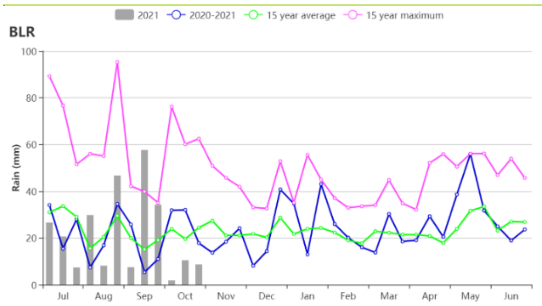
(c) Maximum VCI



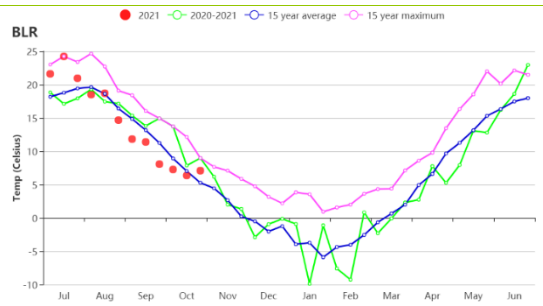
(d) Spatial NDVI patterns compared to 5YA



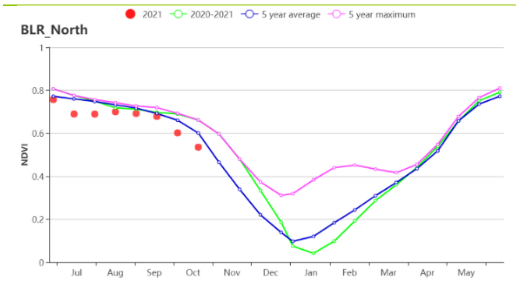
(e) NDVI profiles



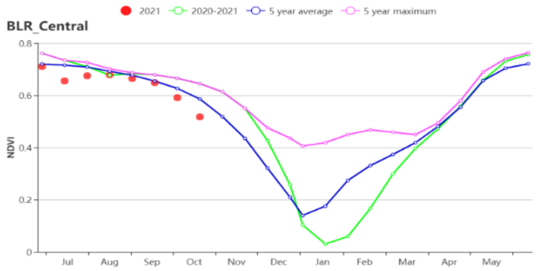
(f)Rainfall time series



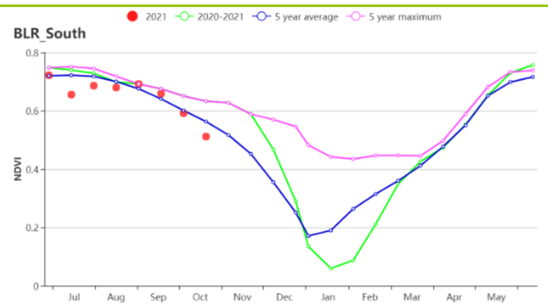
(g) Temperature time series



(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 3.12 Belarus's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2021.

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Center	273	1	14	-0.2	810	1	700	-3
North	266	-12	14	0.1	794	5	707	-7
South-west	223	-10	15	-0.2	862	3	645	-6

Table 3.13 Belarus's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2021.

Region	Cropped arable land fraction		Cropping Intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Center	100	0	97	-4	0.88
North	100	0	102	2	0.91
South-west	100	0	101	1	0.89

[BRA] Brazil

This reporting period (July to October) covers the main growing period of wheat. Its harvest is still ongoing and will conclude by December. The harvest of maize in the North-east is also ongoing while the harvest of rice in north and northeast and the second maize in central and southern Brazil had concluded by August. The planting of the summer crops (maize, soybean, and rice) in Central and Southern Brazil started in October.

The 2020-2021 summer crops growing season was dominated by overall dry and warmer-than-usual weather in Brazil. The prolonged dry weather continued during the recent four months from July to October. CropWatch Agro-climatic Indicators (CWAIs) present below-average conditions with 27% lower rainfall, 0.8°C higher temperature and 3% above average radiation compared with the 15YA. Although the temperature and radiation were in general favorable for crops, the significantly below-average rainfall resulted in a 16% reduction of potential biomass. Dry weather conditions were widespread across central and southern Brazil. In contrast, most states in north and northwest Brazil received close-to-average rainfall. The extreme dry weather was observed in some major agricultural producing states such as Goias, Sao Paulo, Mato Grosso, Mato Grosso Do Sul and Minas Gerais with over 50% negative rainfall anomalies. Accordingly, temperatures in those five major states were all well above average with more than 1.0ºC higher than the 15YA. Positive anomalies of radiation were observed in most states except for the Acre, Santa Catarina, and Rio de Janeiro where RADPAR was slightly below average. The largest positive departure of RADPAR occurred in Pernambuco and Sergipe at 8% above average. Low rainfall, high temperature and radiation resulted in severe water stress in central Brazil which is clearly indicated by the significant below average BIOMSS on the BIOMSS departure map. The meteorological drought conditions illustrated by the standard precipitation index map also confirmed the severe to extreme drought in most of central Brazil.

As reflected by the national rainfall profiles, the current monitoring period covers the end of the dry season and the start of the rainy season. During the dry season period from June to mid-September, the rainfall was close to average while it was below average in late-September and October. This indicates a late start of the wet season which might delay the sowing, emergence and early development of summer crops.

The crop condition development graph based on NDVI for Brazil presents below average values throughout the monitoring period due to water stress. The chart showing proportions of different crop condition categories from July to October 2021 presented increasing proportions of below-average crop condition from 9% in early September to 16% in late October which indicated the adverse effect of dry weather in Brazil. Spatially, crops in the north and northwest presented above-average NDVI as they benefited from the normal or above-average rainfall while NDVI in most other regions stayed at or below average according to the NDVI departure clustering maps and profiles. This pattern coincided with the abnormal weather pattern with wet condition in the north and northwest and extreme dry and hot weather in the center. Mato Grosso, Parana, Sao Paulo and Mato Grosso Do Sul suffered from prolonged dry weather conditions resulting in significant negative NDVI departures (light green color in figure f). Accordingly, the VCIx map also presents low values (< 0.8) in central Brazil covering vast areas in Mato Grosso, Mato Grosso Do Sul, Goias, Minus Gerias to Sao Paulo (figure b). It is noteworthy that the top wheat producing state Rio Grande do Sul presented above-average crop conditions, an indication of favorable wheat outputs in the state. At the national level, VCIx was 0.81 and CALF was 2% below the 5YA. At the annual base, cropping intensity increased by 7% indicating that the total cultivated crop area was at an above-average level.

All in all, crop conditions in Brazil were below average and the establishment of the summer crops was delayed due to the late start of the wet season. Wheat production in Parana was affected by drought, while Rio Grande do Sul benefitted from normal conditions and an above-average wheat production is estimated for the latter. Currently, the early summer crops suffered from a considerable soil moisture deficit. As it is still at early stage of the summer crops, their establishment will mainly depend on the weather conditions in the coming months.

Regional analysis

Considering the differences of cropping systems, climatic zones and topographic conditions, eight agro-ecological zones (AEZ) are identified for Brazil. These include the Central Savanna, the East coast, Parana River, Amazon zone, Mato Grosso zone, Southern subtropical rangelands, mixed forest, and farmland, and the Nordeste. Four AEZs including Central Savanna, Mato Grosso, Nordeste and Parana basin received significantly below-average rainfall (-43% to -81%) which was similar to the dry weather pattern at the national scale. Central Savanna and Nordeste received less than 50 mm rainfall during the last four months. Both temperature and radiation in each zone was higher than average with the largest temperature departure in Central Savanna by +1.5ºC and the largest radiation anomaly at +5% in Coast Zone. The overall dry and hot weather resulted in below-average BIOMSS in most zones except for Amazonas (5% above average) and Northeastern mixed forest and farmland (7% above average) where rainfall was slightly above average.

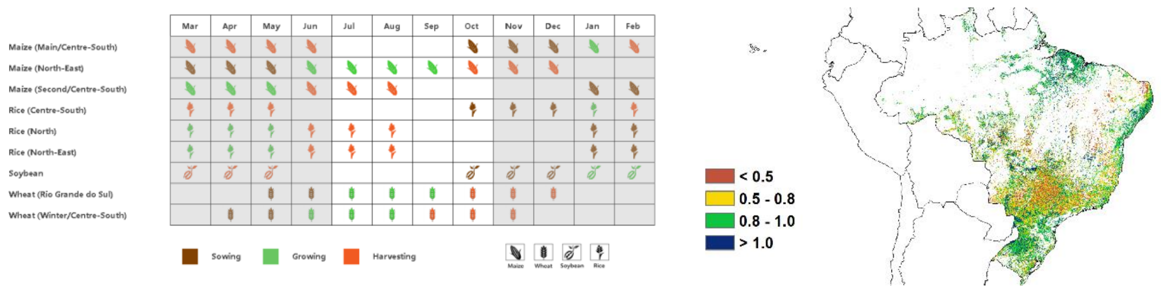
Maize in Northeastern mixed forest and farmland was at harvesting stage which almost concluded by the end October. Overall average weather conditions with 3% above average rainfall, 0.4 degree higher temperature and 1% above average RADPAR were observed in the zone, resulting in a 7% positive departure in BIOMSS. Thanks to the normal weather conditions, the highest VCIx value was observed in Northeastern mixed forest and farmland at 0.95. NDVI profile also presented overall average crop condition during the monitoring period. CALF in the region was 99%, close to the 5YA. Maize production in the region is estimated at average level.

Wheat is mostly cultivated in southern subtropical rangelands and the Parana basin. Located in the south of Brazil, the southern subtropical rangelands zone received the highest rainfall among the eight AEZs at 515 mm, but still at 15% below average level. Significantly above-average rainfall in August to September benefited wheat development and grain-filling, indicating a promising wheat yield in the region. The average VCIx in the region was 0.84 which was above average. Although the CALF in the regions was 1% below the 5YA, wheat production was still at above average levels estimated by CropWatch. Overall unfavorable conditions in the Parana basin hampered the wheat development although most wheat in the region was irrigated. Less farmland was used for wheat cultivation as reflected by the 5% below average CALF during the wheat growing period. Average VCIx value in the region was 0.77. CropWatch puts the wheat production in the region at below-average level.

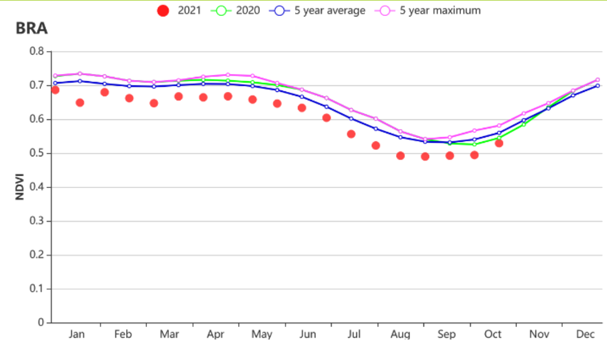
Central savanna also produces some wheat, mostly distributed in eastern Goias and southerwestern Minas Gerais. As the region received only 33 mm precipitation during the four months, all wheat in the region is definitely irrigated. It was shown by the CALF indicator that wheat area in the region was 9% above average. High resolution satellite image also confirmed the expansion of wheat sown area in 2021 compared with 2020 (figure q). CropWatch estimates a favorable wheat production in the region.

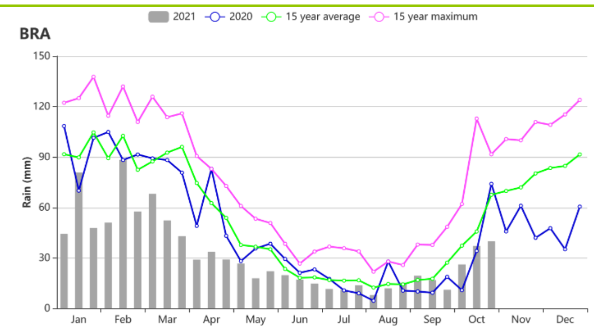
For more indicators and detailed information, it is recommended to visit CropWatch Explore (http://cropwatch.cn/newcropwatch/main.htm).

Figure 3. 11 Brazil's crop condition, July - October 2021

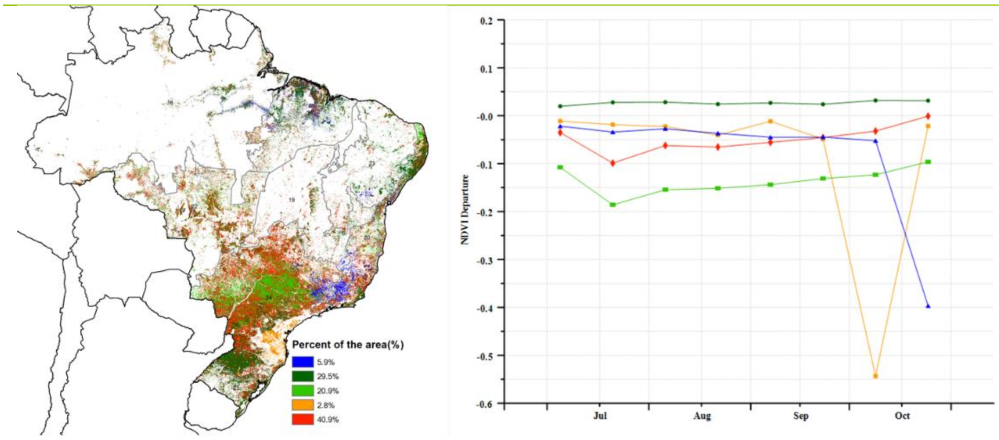


(a) Phenology of major crops (b) Maximum VCI

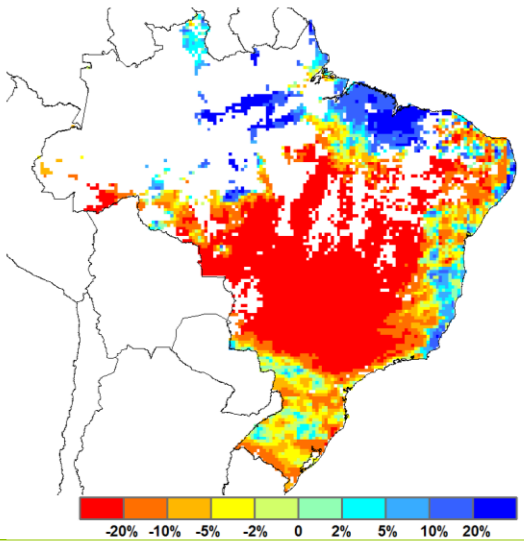


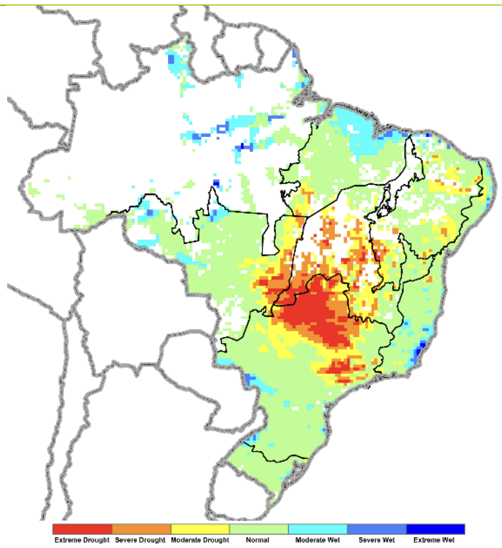


(c) Crop condition development graph based on NDVI of Brazil (d) Time series rainfall profile of Brazil

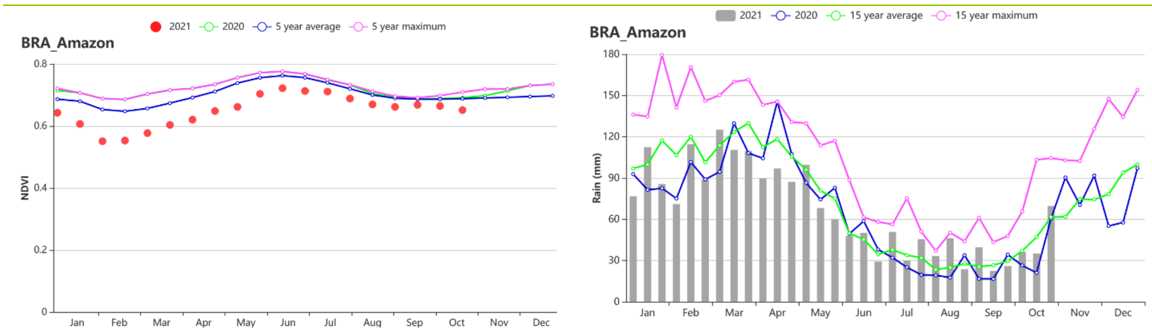


(e) Spatial distribution of NDVI departure from 5YA and NDVI departure profiles corresponding to the clusters

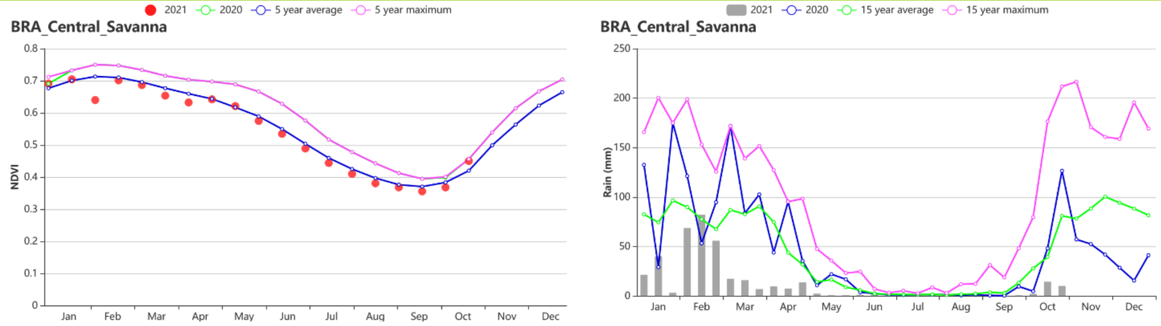




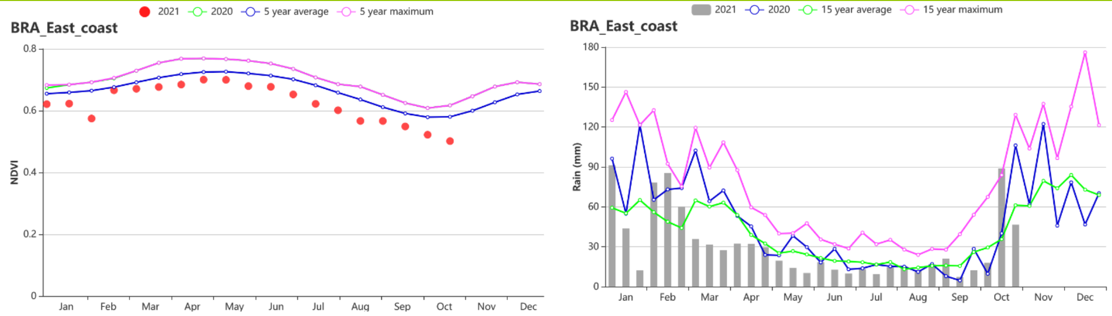
(f) Potential biomass departure from 15YA (g) Meteorological drought measured by standard precipitation index



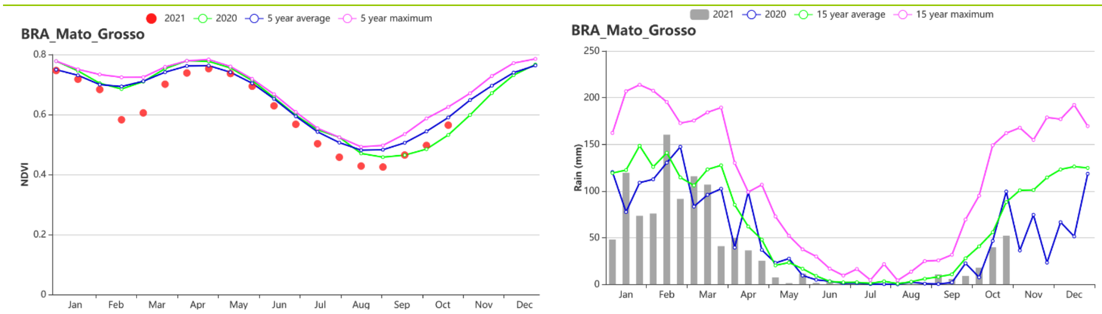
(h) Crop condition development graph based on NDVI (left) and rainfall profile (right) of Amazon



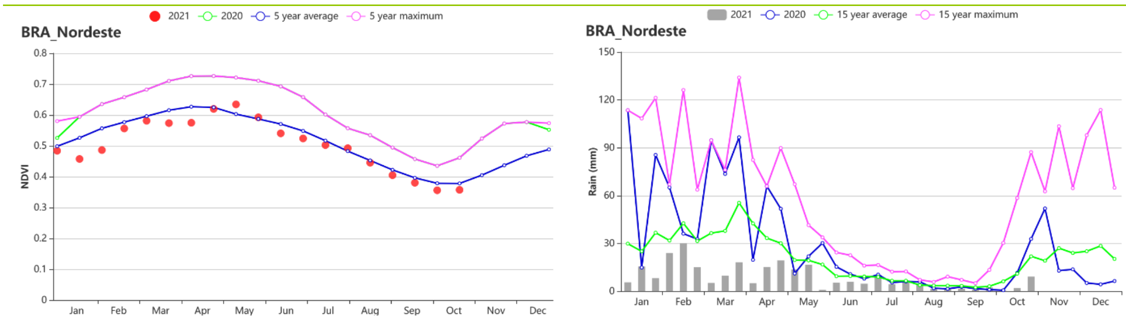
(i) Crop condition development graph based on NDVI (left) and rainfall profile (right) of Central Savanna



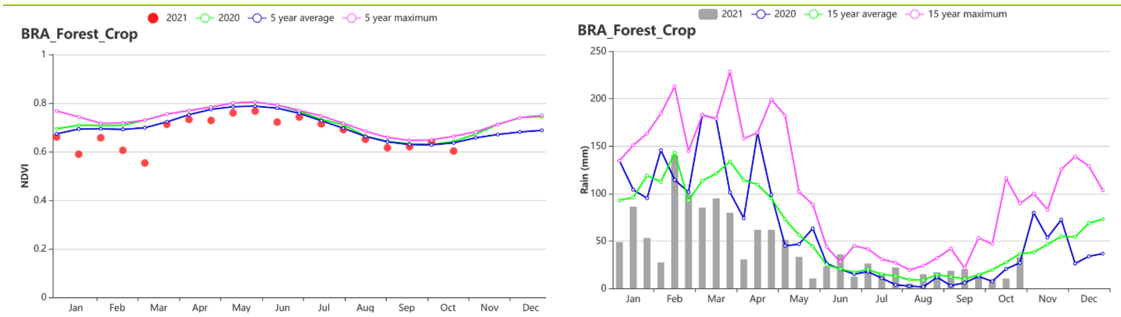
(j) Crop condition development graph based on NDVI (left) and rainfall profile (right) of Coast zone



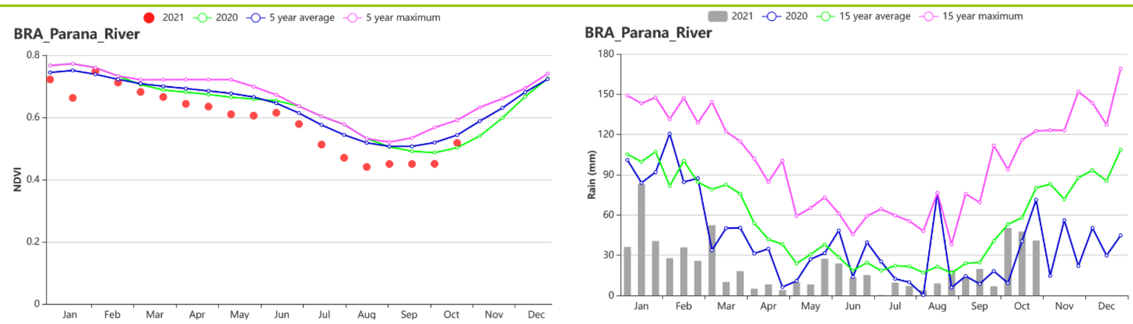
(k) Crop condition development graph based on NDVI (left) and rainfall profile (right) of Mato Grosso



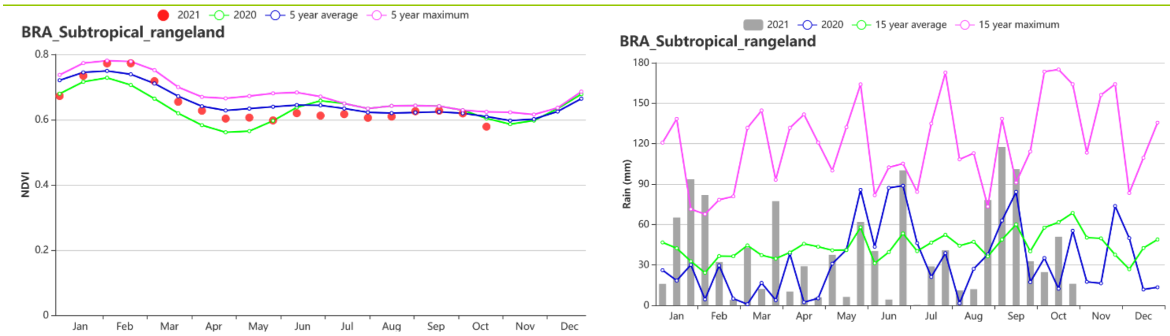
(L) Crop condition development graph based on NDVI (left) and rainfall profile (right) of Nordeste



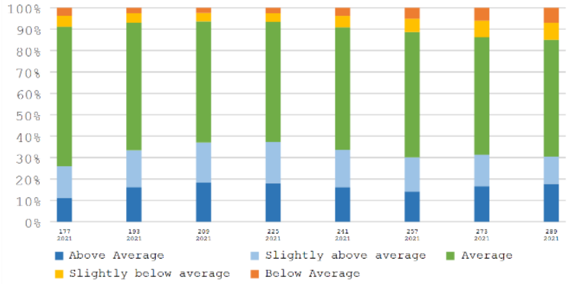
(m) Crop condition development graph based on NDVI (left) and rainfall profile (right) of Northeastern mixed forest and farmland



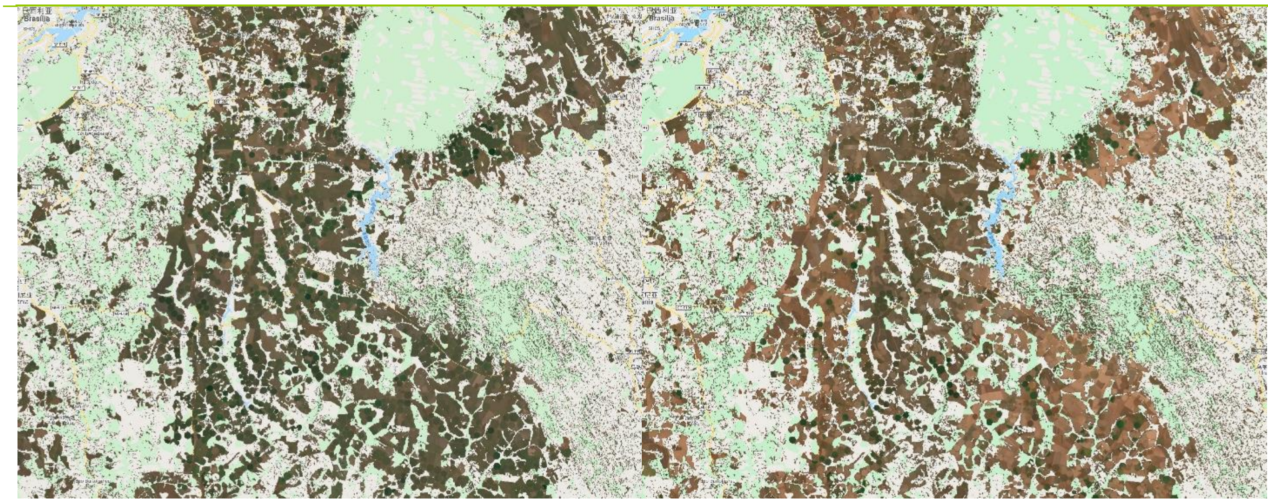
(n) Crop condition development graph based on NDVI (left) and rainfall profile (right) of Parana basin



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



(p) Proportion of different crop condition categories, July - October 2021



(q) More central pivot fields were cultivated with wheat in 2021 (left) compared with 2020 (right)

(Satellite data: Planet imageries in June to August during the two years)

Table 3.14 Brazil's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2021

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure from 15YA	Current (°C)	Departure from 15YA	Current (MJ/m²)	Departure from 15YA	Current (gDM/m²)	Departure from 15YA

		(%)		(°C)		(%)		(%)
Amazonas	459	13	26.7	0.1	1244	1	1025	4
Central Savanna	33	-81	25.9	1.5	1284	4	272	-42
Coast	275	-2	21.2	0.4	1055	5	735	-2
Northeastern mixed forest and farmland	207	3	27.5	0.4	1289	1	775	7
Mato Grosso	137	-45	27	0.9	1169	1	427	-30
Nordeste	46	-44	25.5	0.9	1293	4	399	-16
Parana basin	228	-43	21.3	1	1095	4	558	-28
Southern subtropical rangelands	515	-15	15.4	0.2	856	3	899	-8

Table 3.15 Brazil’s agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2021

Region	Cropped arable land fraction		Maximum VCI	Cropping intensity	
	Current (%)	Departure from 5YA (%)	Current	Current (%)	Departure from 5YA (%)
Amazonas	100	0	0.91	124	5
Central Savanna	73	9	0.81	119	5
Coast	98	-1	0.80	120	7
Northeastern mixed forest and farmland	99	0	0.95	112	-5
Mato Grosso	91	0	0.80	163	9
Nordeste	69	1	0.75	112	6
Parana basin	91	-5	0.77	141	10
Southern subtropical rangelands	96	-1	0.84	136	11

[CAN] Canada

During this monitoring period, the harvest of spring wheat was complete while the harvests of maize and soybean were underway. The sowing of winter wheat takes place in September and October. According to agroclimatic indicators, Canada experienced warmer weather in this period. The overall conditions in this region were below average until September. In the Prairies, conditions were unfavorable whereas in the Saint Lawrence basin, they were close to the five-year average. Overall, crop conditions were unfavorable.

Compared with the 15-year average, the temperature and radiation were above average by 1.2°C and 1%, respectively. Nevertheless, the significant drop of rainfall (RAIN -8%) led to a decrease of potential biomass (BIOMSS -5%). The rainfall profile indicates that the deficit of precipitation mainly occured in July and early August, which is the major growing season of summer crops. Accordingly, the crop conditions were below average in that period as shown in the NDVI development graph, after which precipitation gradually recovered to above-average levels, but yield reductions in wheat-producing areas were unavoidable. Spatially, the crop condition was always below average in middle and north of Saskatchewan and Alberta, which accounted for 39.0% of cropped land, as shown in the NDVI cluster map. For 35.6% of total cropped land (marked as yellow and deep green), the crop was below average before September and improved to be close to average at the end of the monitoring period. In other regions, accounting for 25.4% of total cropped area, the crop condition was above but close to average, mainly in Quebec and Ontario (Saint Lawrence basin). For the whole year, the crop intensity is 103%, an increase by 3% when compared with the 5YA. The national maximum VCI value was 0.84, while CALF was slightly below average (CALF -3%). The overall conditions of the summer crops in Canada are assessed as below average.

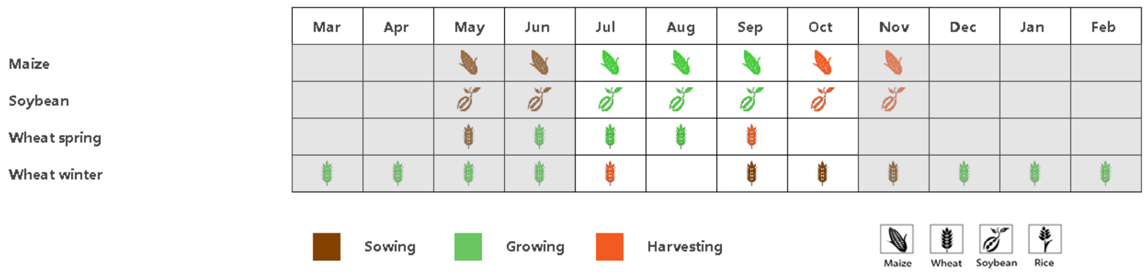
Regional analysis

The **Prairies** (area identified as 53 in the crop condition clusters map) and **Saint Lawrence basin** (49) are the major agricultural regions in Canada.

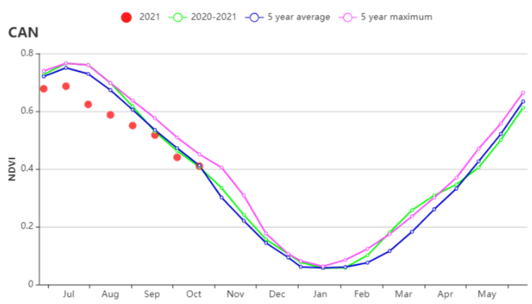
The **Prairies** is the main food production area in Canada. However, it suffered from dry weather conditions in this reporting period. The rainfall was significantly below average (RAIN 187, -24%) , while the temperature and radiation were slightly above average (TEMP +1.6℃; RADPAR +3%). According to the rainfall profile in the Prairies, rainfall was significantly below average in July and September. The deficit of rainfall led to a below-average potential production (BIOMSS -11%). The major crops in this region are winter wheat and spring wheat. According to the NDVI development graph and NDVI profile, crop conditions were below average before September and improved to be close to average by the end of the monitoring period. The negative departures during the growing season may have been caused by a rainfall deficit and they may also affect wheat yields. So, the crop condition in this region is unfavorable.

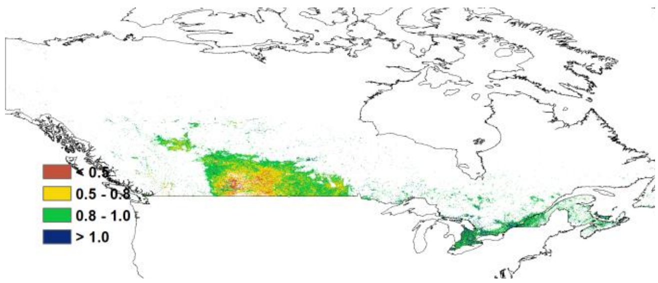
The conditions in the **Saint Lawrence basin** were slightly warmer (TEMP +0.9°C) and more humid (RAIN +2%) than the 15YA, while radiation was slightly below average (RADPAR -1%). This led to a close-to-average estimate for potential biomass (BIOMSS +2%). According to the NDVI development graph, crop conditions were close to average during the whole monitoring season. All in all, crop conditions were close to the five-year average.

Figure 3.12 Canada's crop condition, July - October 2021

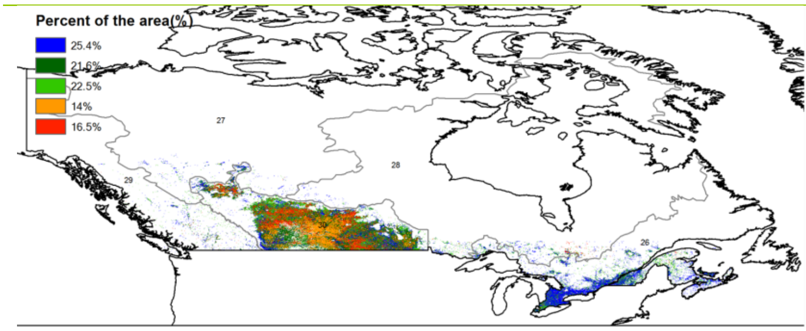


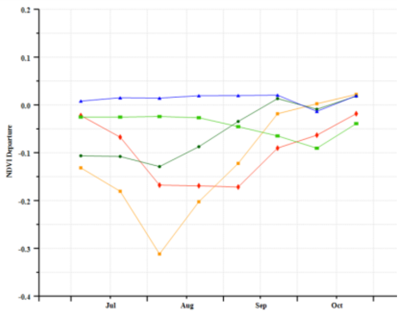
(a). Phenology of major crops



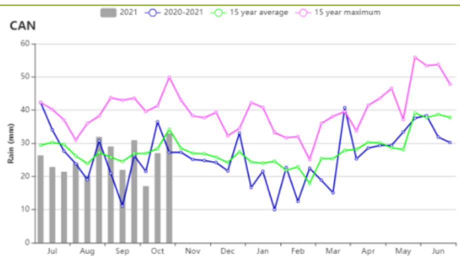


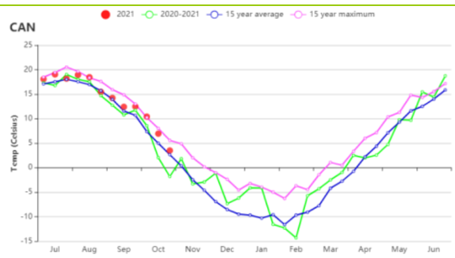
(b) Crop condition development graph based on NDVI (c) Maximum VCI



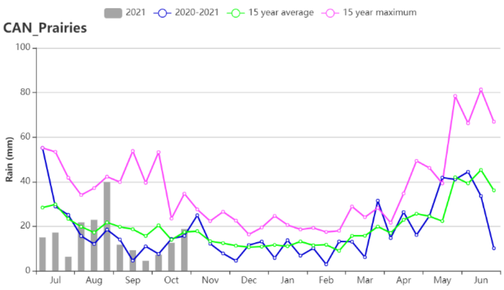


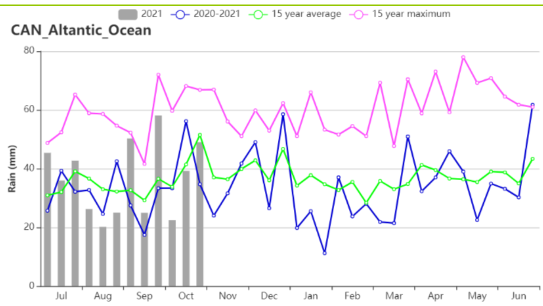
(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles



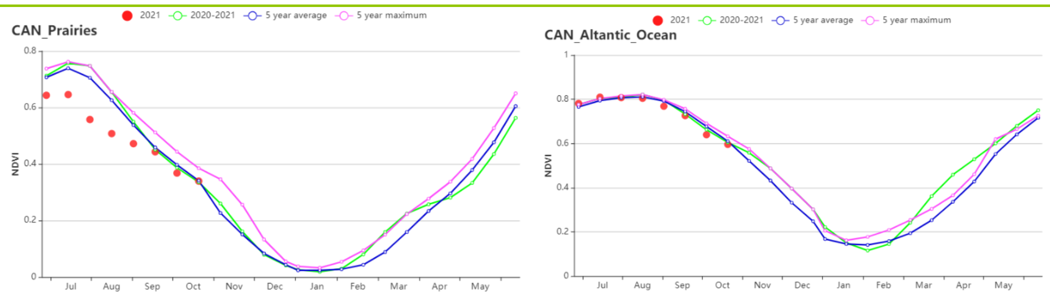


(f) Rainfall profiles (g) Temperature profiles





(h) Rainfall profiles (Prairies region (left) and Saint Lawrence basin region (right))



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

Table 3.16 Canada's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2021

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Saint Lawrence basin	440	2	15.2	0.9	892	-1	948	2
Prairies	187	-24	14.7	1.6	996	3	611	-11

Table 3.17 Canada's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2021

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Saint Lawrence basin	100	0	105	5	0.96
Prairies	95	-4	102	2	0.79

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[DEU] Germany

During this monitoring period, the harvest of summer crops was mostly completed by the end of October, whereas the sowing of canola and winter wheat had started in September. Based on the agroclimatic and agronomic indicators, the crop conditions in Germany were generally above the 5-year average between July and early October in most regions, and then below average in mid-October.

At the national level, total precipitation was significantly above average (RAIN +21%), temperature was below average (TEMP -0.7°C) and radiation was also below average (RADPAR -4%). As can be seen from the time series of the rainfall profile, Germany experienced above-average precipitation from July to August, and then significantly below-average precipitation from September to October. Most of the country experienced cooler-than-usual conditions during this reporting period, except for September. Benefitting from adequate moisture conditions early in the summer growing season, the biomass accumulation potential (BIOMSS) was increased by 8% at the nationwide level as compared to the 15YA. Due to persistent and significantly precipitation deficits from September to October in some regions, grain filling for the summer crops may have been negatively impacted. On the other hand, this provided good conditions for harvest of the summer crops. This persistent precipitation deficit may also result in the delayed emergence of winter crops.

As shown by the NDVI development graph at the national scale, NDVI values were above average, even close to the 5-year maximum level from early July to early October, and then below average in mid-October. These observations are confirmed by the spatial NDVI profiles. Before mid-August, crop conditions were above average on 81.9% of the cropland. The proportion of cropland with above-average conditions was up to 87.2% from mid-August to mid-September. Due to persistent precipitation deficits starting in September, only 56.4% of the cropland from mid-September to mid-October and 39.2% of the cropland after mid-October were above average. These observations were also confirmed by higher VCI values in the spatial distribution of maximum VCI map. It reached 0.99 at the national scale. CALF during the reporting period was the same as for the recent five-year average.

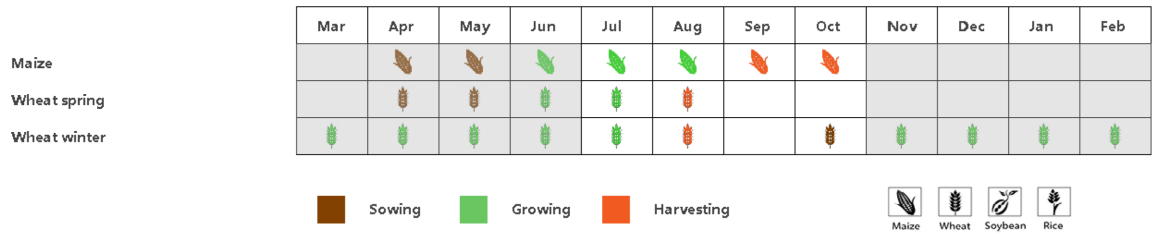
Generally, the agronomic indicators show favorable conditions for most summer crops in Germany. Persistently and significantly below-average precipitation in October may have delayed the germination of winter wheat in the north and east of the country.

Regional analysis

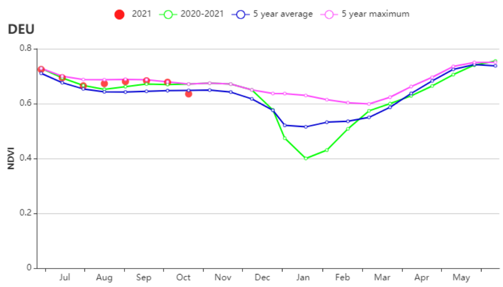
According to the CropWatch agroclimatic and agronomic indicators, three sub-national agro-ecological regions, i.e., Wheat Zone of Schleswig-Holstein and the Baltic coast, Mixed Wheat and Sugar beet Zone of the North-west and western sparse crop area of the Rhenish massif experienced the same trend of precipitation, temperature and RADPAR, where precipitation was all significantly above average between +21% and +32%, temperature was all below average between -0.2°C and -0.8°C, PAR was all below average between -3% and -6% as compared to the average of the past 15 years. Since precipitation was above average during the entire monitoring period, the biomass accumulation potential (BIOMSS) in these three sub-national agro-ecological regions was above average between +8% and +19%. As shown by the time series rainfall profile of each agro-ecological region, precipitation in these three regions was also significantly above average from July to August, and close to average after mid-October. This provided favorable conditions for the growth of summer crops and establishment of the winter crops. As shown in the crop condition development graph based on NDVI, NDVI values were all above average, even close to the 5-year maximum level throughout the monitoring period. CALF of these three regions all reached 100%, with a zero departure from their 5YA. The cropping intensity (CI) of these three regions was all above the 5YA between +9% and +27%, and these three regions also recorded favorable VCIx value from 0.96 to 1.02, which indicates a high cropping intensity and favorable conditions for most summer crops.

The other three sub-national agro-ecological regions of Central Wheat Zone of Saxony and Thuringia, Sparse Crop Area of the East-German Lake and Heathland area and Bavarian Plateau also experienced above-average precipitation, ranging from +15% and +19%. Temperature was below average between -0.7°C and -0.9°C and PAR was also below average between -2% and -5% compared to the 15YA. As shown by the time series rainfall profile of each agro-ecological regions, precipitation in these three regions and the biomass accumulation potential (BIOMSS) were also above average between +1 % and +5% during entire monitoring period. But the magnitude of increased BIOMSS was significantly lower than in the other three sub-regions. Due to persistent and significant precipitation deficits from September to October, grain filling for the summer crops in these three regions was negatively impacted. The persistent precipitation deficit may have affected the establishment of the winter crops. As shown in the crop condition development graph based on NDVI, NDVI values were all above average, even close to or exceeding the 5-year maximum level from early July to early October, and then below average in mid-October, presumably due to persistent precipitation deficits. CALF of these three regions all reached 100%, with a zero departure from their 5YA. The cropping intensity (CI) of these three regions was above the 5YA between +9% and +14%, and these three regions also recorded favorable VCIx value from 0.97 to 0.99.

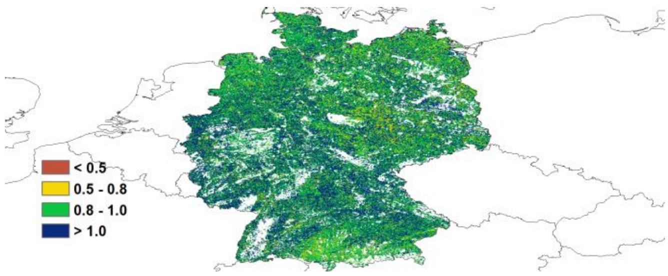
Figure 3.13 Germany's crop condition, July - October 2021



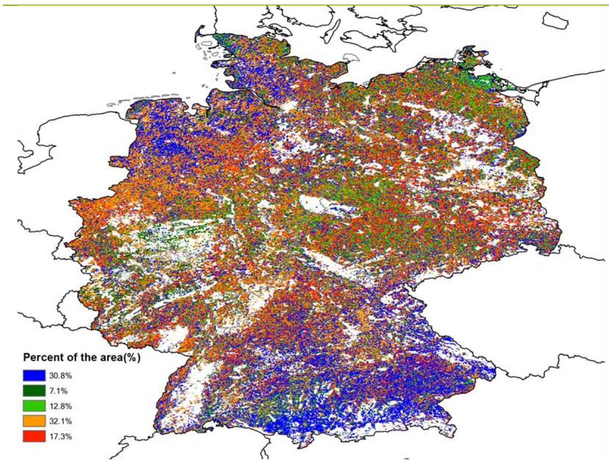
(a). Phenology of major crops



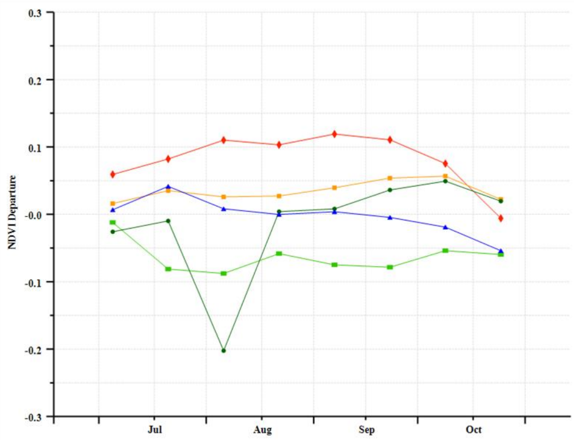
(b) Crop condition development graph based on NDVI



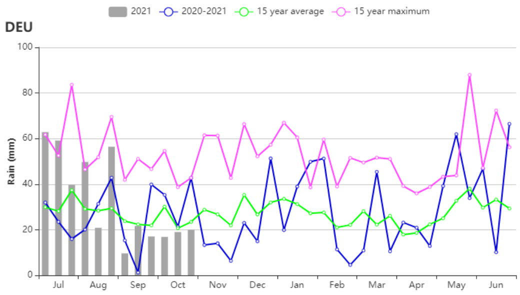
(c) Maximum VCI



(d) Spatial NDVI patterns compared to 5YA

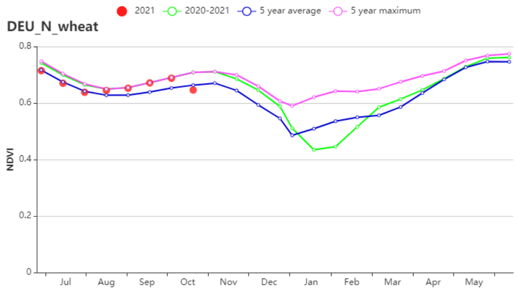


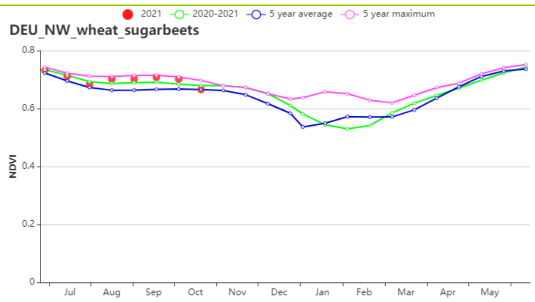
(e) NDVI profiles



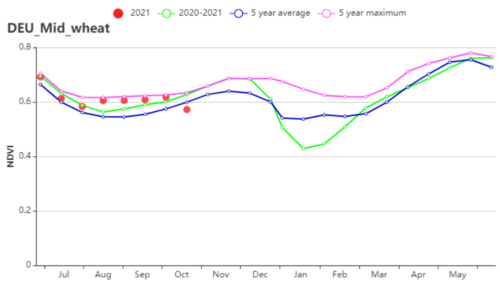
(f) Rainfall profiles

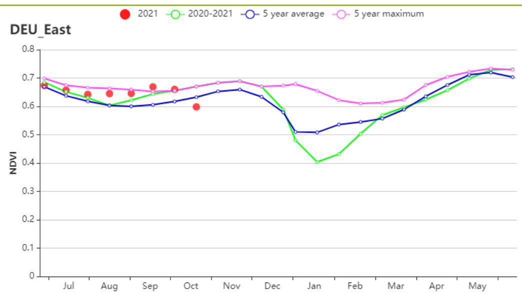
(g) Temperature profiles



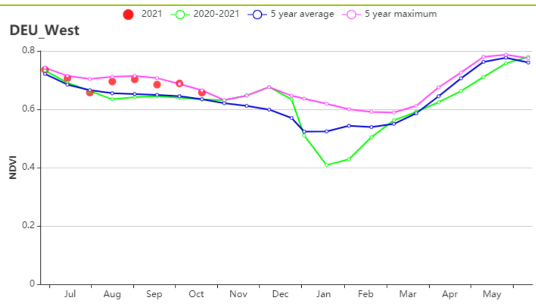


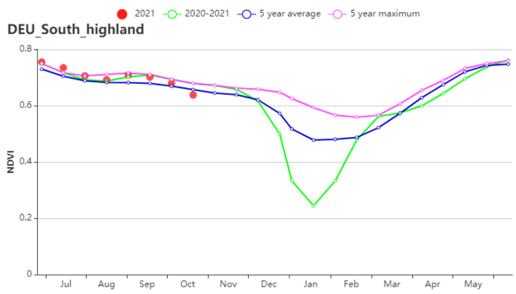
(h) Crop condition development graph based on NDVI (Wheat zone of Schleswig-Holstein and the Baltic coast (left) and Mixed wheat and sugar beets zone of the north-west(right))





(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 3.18 Germany's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2021

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	**433**	**32**	**15.2**	**-0.2**	**747**	**-6**	**951**	**19**
Mixed wheat and sugarbeets zone of the north-west	**385**	**29**	**14.5**	**-0.4**	**778**	**-5**	**881**	**14**
Central wheat zone of Saxony and Thuringia	**312**	**15**	**14.1**	**-0.7**	**823**	**-5**	**751**	**2**
East-German lake and Heathland sparse crop area	**345**	**19**	**14.6**	**-0.7**	**813**	**-5**	**799**	**5**
Western sparse crop area of the Rhenish massif	**323**	**21**	**13.6**	**-0.8**	**852**	**-3**	**790**	**8**
Bavarian Plateau	**446**	**15**	**13.1**	**-0.9**	**918**	**-2**	**856**	**1**

Table 3.19 Germany's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2021

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Wheat zone of Schleswig-Holstein and the Baltic coast	**100**	**0**	**117**	**9**	**0.96**
Mixed wheat and sugarbeets zone of the north-west	**100**	**0**	**122**	**10**	**0.99**
Central wheat zone of Saxony and Thuringia	**100**	**0**	**127**	**14**	**0.97**
East-German lake and Heathland sparse crop area	**100**	**0**	**127**	**13**	**0.98**
Western sparse crop area of the Rhenish massif	**100**	**0**	**132**	**27**	**1.02**
Bavarian Plateau	**100**	**0**	**116**	**9**	**0.99**

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

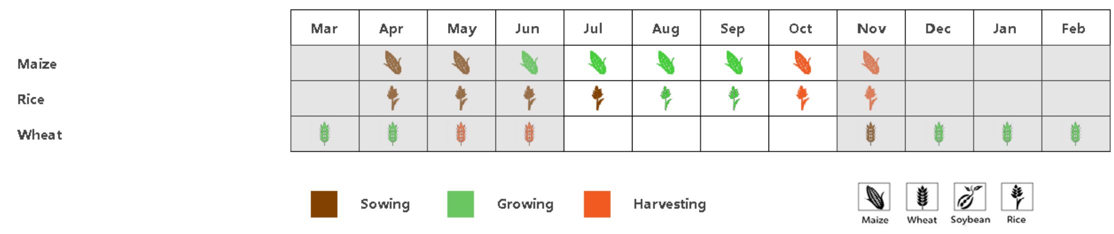
[EGY] Egypt

The reporting period (July - October) covers the growth and harvest of the main summer crops: maize and rice. Winter wheat sowing is about to start in early November. The current monitoring period is the dry season in Egypt, and the average rainfall was just 3 mm, 60% lower than the 15-year average (15YA). The average temperature was higher than the 15YA by 0.5°C; generally, the temperature profile shows slightly warmer conditions than the 15YA. The RADPAR was slightly higher than 15YA by only 0.4%, while the BIOMSS was below the 15YA by 25%. The nationwide NDVI profile was below the 5-year average (5YA) except for the end of July and the beginning of August. The NDVI spatial pattern shows that 11% of the cultivated area was above the 5YA, 59.9% fluctuated around the 5YA, and 29.1% was below. The Maximum Vegetation Condition Index (VCIx) map shows that the condition of the current crops was near average. The dominant VCIx values ranged between 0.50 and 1. This finding agrees with the whole country's VCIx value at 0.71. CALF exceeded the 5YA by only 3%. General, the crop conditions were favorable.

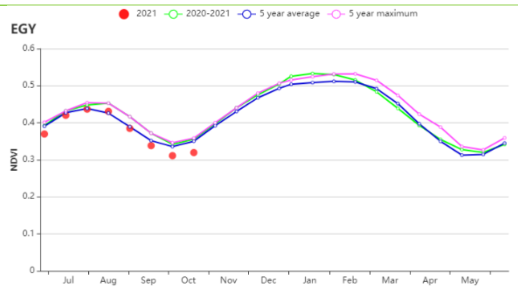
Regional Analysis

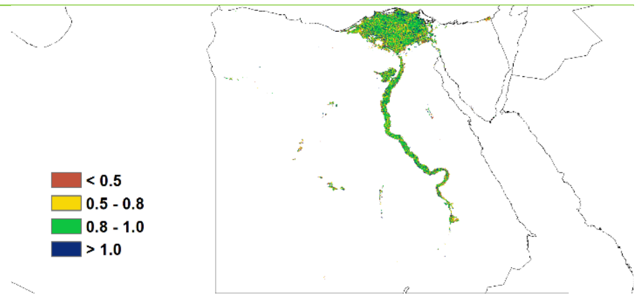
Based on crop planting systems, climate zones, and topographical conditions, Egypt can be divided into three agro-ecological zones (AEZs), two of which are suitable for crop cultivation. These are the Nile Delta and the southern coast of the Mediterranean and the Nile Valley. The average rainfall was 3 mm (-60%) in the Nile Delta and Mediterranean coast, while the Nile Valley recorded only 1 mm (-17%). Since virtually all crops in Egypt are irrigated, the impact of precipitation on crop yield is limited, but additional precipitation is nevertheless always beneficial. In both regions, the temperature was higher than the 15YA by 0.5 °C. The RADPAR was higher than the 15YA by 0.4% in the first zone and lower by 0.1% in the second zone. BIOMSS fell by 23% and 34% in the Nile Delta and Nile Valley, respectively. The NDVI development graph shows that crop conditions fluctuated around the average in both zones, with below-average values close to the harvesting stage in October. In both zones, CALF exceeded the 5YA by 3%. They also registered good VCIx values at 0.72 and 0.79 for the Nile Dela and Nile Valley, respectively, confirming proper crop conditions. Cropping Intensity estimates were at 182% and 158% for the Nile Delta and Nile Valley, respectively, indicating both regions had a mixture of single and double-cropping during the reporting period.

Figure 3.14 Egypt's crop condition, July - October 2021

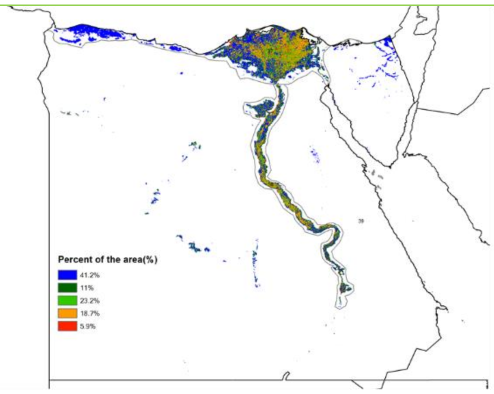


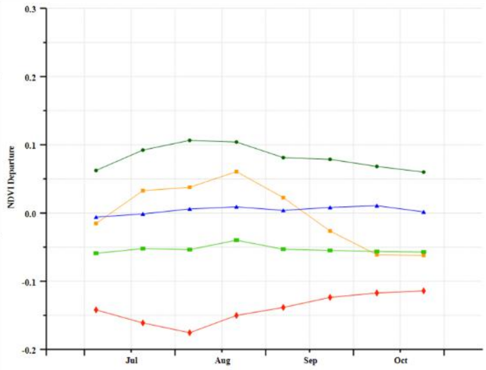
(a) Phenology of major crops



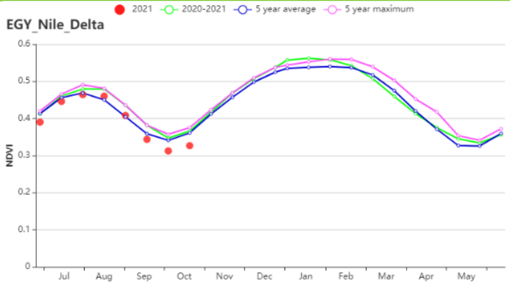


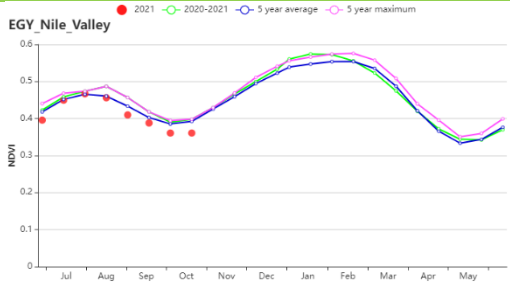
(b) Crop condition development graph based on NDVI (c) Maximum VCI



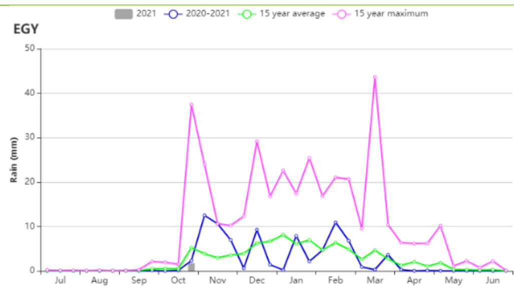


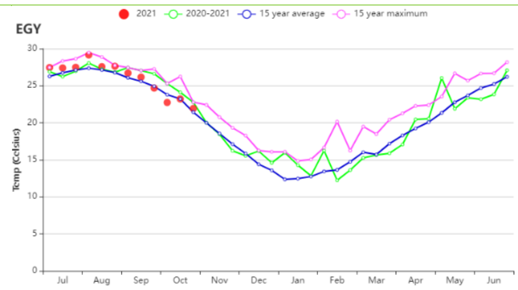
(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles





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





(g) Time series profile of rainfall (h) Time series profile of temperature

Table 3. 20 Egypt's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2021

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 (%)
Nile Delta and Mediterranean coastal strip	3	-60	26.0	0.5	1389	0.4	108	-23
Nile Valley	1	-17	28.2	0.5	1436	-0.1	20	-34

Table 3.21 Egypt's agronomic indicators by sub-national regions, current season's values and departure from 15YA/5YA, July - October 2021

Region	CALF		Cropping Intensity		Maximum VCI
	Current (%)	Departure from 5YA (%)	Current (%)	Departure from 5YA (%)	Current
Nile Delta and Mediterranean coastal strip	64	3	182	19	0.72
Nile Valley	70	3	158	13	0.79

[ETH] Ethiopia

The main food crops in Ethiopia are teff, wheat, barley and maize. The monitoring period is from July to October and encompasses the main growing and developmental seasons of all Meher crops. It was pointed out in the last report that delayed planting and armed conflict negatively affected crop production in Ethiopia. The situation is slightly different in this report. On the one hand, the idling of cropland due to armed conflict continued in Tigray, but on the other hand, the delayed sowing elsewhere did not have a significant impact on crop growth and development, and crops grew well, aided by generally favorable rainfall conditions.

At the national level, cumulative precipitation (RAIN -5%), average temperature (TEMP -0.2°C) and photosynthetically active radiation (RADPAR -2%) decreased slightly, as compared to the average of the last 15 years. The cumulative potential biomass (BIOMSS) decreased by 3%. As we can see from crop condition development graph based on NDVI, the effects of delayed crop sowing were still present in July, with NDVI values below the 5-year average. But thanks to abundant precipitation and suitable temperatures during the subsequent months, the NDVI values returned to the average levels. The maximum VCI graph also confirms this fact, as almost the whole country has a maximum VCI greater than 0.8. The spatial distribution of NDVI profiles reveals that the areas affected by the delayed sowing in July and early August are mainly located in the Oromiya and Southern Nations region. However, the NDVI values subsequently recovered to close to average levels. In general, crops are growing well in most regions of Ethiopia and CropWatch estimates favorable outputs for the summer crops, except for Tigray, where farmland was left idle due to the armed conflict.

Regional analysis

In **the Semi-arid pastoral areas**, a typical livestock production zone, cumulative precipitation, mean temperature and photosynthetically active radiation were close to the 15-year average (RAIN +4%, TEMP +0.2°C, RADPAR -3%) and cumulative potential biomass increased by 11%. At the same time, the NDVI values in the region were around the 5-year average for the reporting period. The maximum VCI was 0.86. Compared to the 5-year average, CALF increased by 16%. Cropping index was 100%, which means single-cropping in the region. Overall, the outlook for livestock production is favorable in the region.

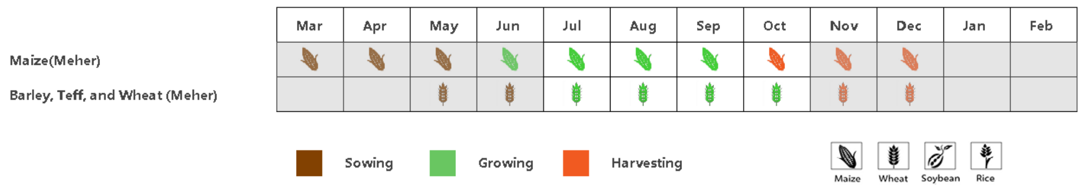
In **the Southeastern Mendebo highlands zone**, the CropWatch indicators are similar to the overall national situation. Cumulative precipitation (RAIN -4%), mean temperature (TEMP -0.3ºC) and photosynthetically active radiation (RADPAR -2%) were slightly lower than the 15YA. This resulted in a slight 7% decrease in cumulative potential biomass. The NDVI values were slightly below the 5-year average. Cropping index was 123%. In general, crop conditions in the region were average.

In **South-eastern mixed maize zone**, precipitation (RAIN +22%) and sunshine (RADPAR +0%) were adequate, temperature (TEMP -0.3°C) was suitable and cumulative potential biomass was higher than the average (+6%). The crop condition development graph based on NDVI shows that NDVI values fluctuated above or below the 5-year average after mid-August. The maximum VCI was 0.91 and CALF was 97%, equal to the 5-year average. Cropping index was 119%. CorpWatch estimates a favorable condition for autumn grain production in the region.

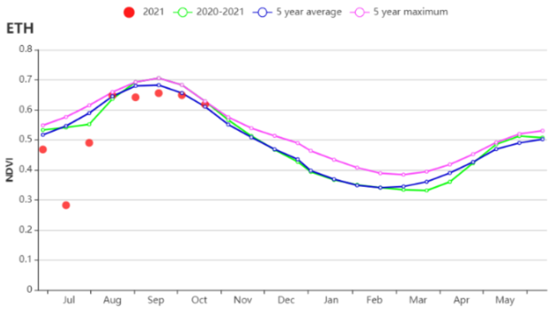
In **the Western mixed maize zone**, maize is the most important crop planted in the Meher season. The cumulative precipitation (RAIN -2%), average temperature (TEMP -0.4°C) and photosynthetically active radiation (RADPAR +1%) in the area were close to the 5-year average and estimated cumulative biomass was close to the 15-year average (-4%). The maximum VCI is 0.96 and CALF remains unchanged. Cropping index was 129%. The crops were in favorable conditions according to the CropWatch indicators.

The northern arid area is an agricultural area in northern Ethiopia. Due to the war, the cropped arable land fraction was almost zero and a severe food shortage is developing.

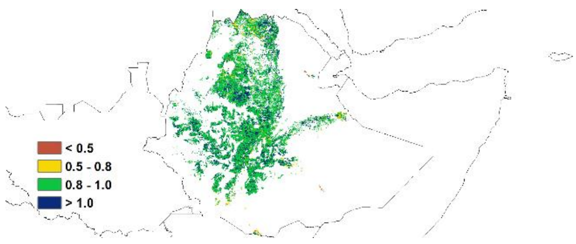
Figure 3.15 **Ethiopia's crop condition, July-October 2021**



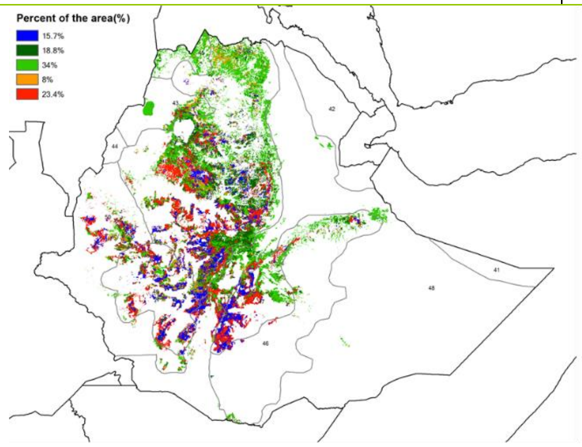
(a) Phenology of major crops

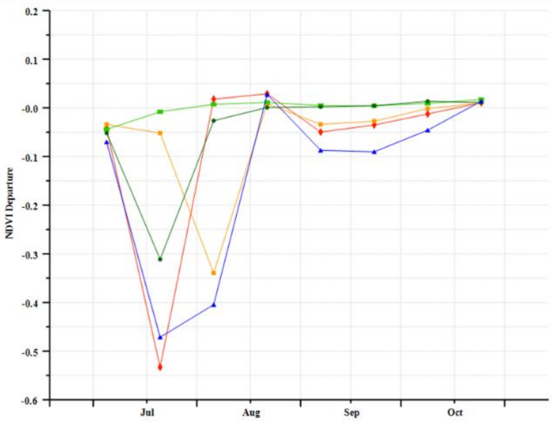


(b) Crop condition development graph based on NDVI



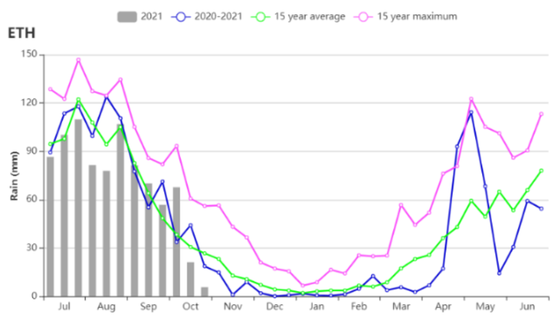
(c) Maximum VCI

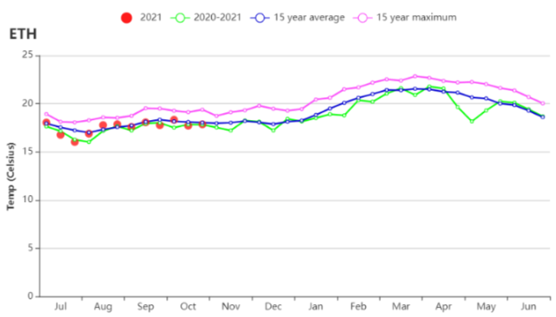




(d) Spatial NDVI patterns compared to 5YA

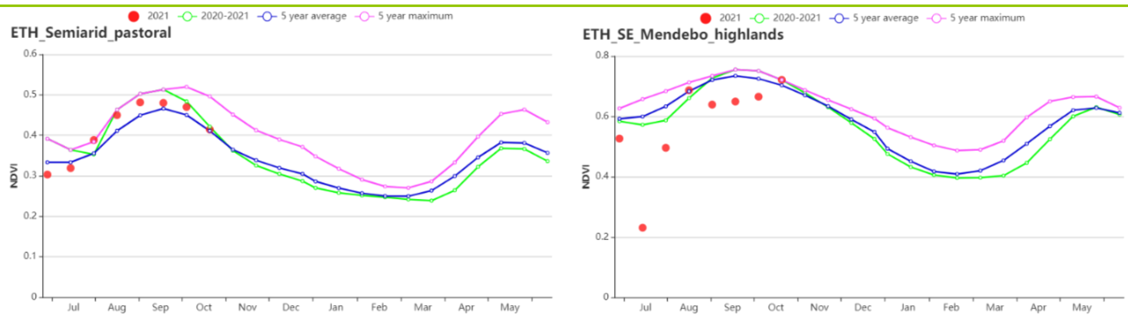
(e) NDVI profiles



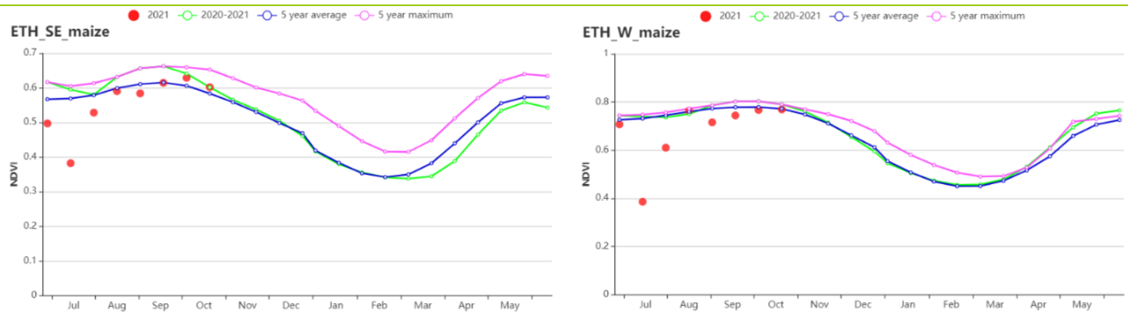


(f) Rainfall profiles

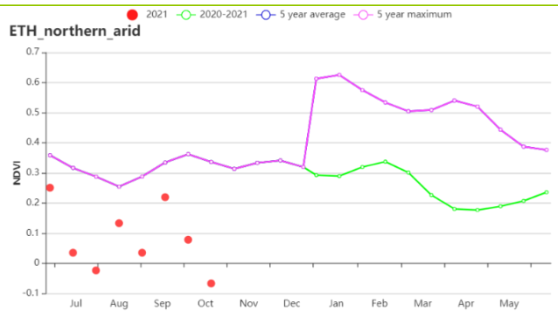
(g) Temperature profiles



(h) Crop condition development graph based on NDVI (Semi-arid pastoral (left) South-eastern Mendebo highlands (right))



(i) Crop condition development graph based on NDVI (South-eastern mixed maize zone (left) and South-eastern mixed maize zone (right))



(j) Crop condition development graph based on NDVI (Northern arid area)

Table 3.22 Ethiopia's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July-October 2021

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m2)	Departure (%)	Current (gDM/m2)	Departure (%)
Semi-arid pastoral areas	177	4	23.1	0.2	1325	-3	634	11
South-eastern Mendebo highlands	467	-4	14.6	-0.3	1107	-2	729	-7
South-eastern mixed maize zone	447	22	18.1	-0.3	1188	0	830	6
Western mixed maize zone	1286	-2	19.4	-0.4	1080	-1	1168	-4
Northern arid area	180	70	29.2	-0.4	1279	-7	719	25

Table 3.23 Ethiopia's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July-October 2021

Region	Cropped arable land fraction	Cropping intensity	Maximum VCI

	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Semi-arid pastoral areas	78	16	100	-11	0.86
South-eastern Mendebo highlands	100	0	123	-3	0.97
South-eastern mixed maize zone	97	0	119	-1	0.91
Western mixed maize zone	100	0	129	10	0.96
Northern arid area	0	-100	100	0	0.34

[FRA] France

This monitoring period covers the final stages of spring wheat and winter wheat cultivation and harvest of maize, which started in September. The sowing of winter wheat started in October and will be completed in November. CropWatch agro-climatic indicators showed slightly below-average temperatures over the period (TEMP, -0.6°C). RAIN was significantly higher than the average (RAIN, +17%), especially in July and early September, which continued the trend of above-average precipitation observed during of the previous monitoring period. Sunshine was slightly lower than the average (RADPAR, -1%). Due to the generally favorable rainfall, temperature and sunshine conditions, the biomass accumulation was significantly above the national 15-year average (BIOMSS, +8%). Cropping intensity was above average level by 9%.

The national-scale NDVI development graph shows that the NDVI values were also significantly above the 5-year average. The crop conditions were even better than the 5-year maximum during the summer season. The spatial distribution of maximum VCI (VCIx) across the country also reached a high range of 0.89-1.03. CALF departure increased by 1%. Overall, high precipitation and proper sunshine and temperature during the summer season caused favorable growth conditions for all of France's agricultural regions. However, the high rainfall negatively impacted the harvest of barley and wheat crops, resulting in poor grain quality in some regions.

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, slightly cooler weather was observed (TEMP, -0.6°C) while RAIN and RADPAR were above average (RAIN +33% and RADPAR +1%) over the monitoring period. The BIOMSS significantly increased by 17% when compared to the past 15-year average. The CALF was near average, and VCIx was relatively high at 1.03. Cropping intensity increased by 18%. Crop condition development based on NDVI for this region was above the past 5-year average, and even above the 5-year maximum in July and August.

In the Mixed maize/barley and rapeseed zone from the Center to the Atlantic Ocean, slightly cooler (TEMP -0.5°C) and drier (RAIN -1%) conditions were observed and RADPAR was at the average. BIOMSS was above average by 1% while the NDVI profile showed the regional crop conditions were higher than average levels especially in summer season. Cropping intensity was higher than the average level by 15%. The CALF was increased by 1%, and VCIx was 0.99.

In the Maize-barley and livestock zone along the English Channel, RAIN and RADPAR were above average by 16% and 4%. TEMP was lower than the average (-0.1°C). BIOMSS increased by 12%. Cropping intensity increased by 18%. CALF was average and VCIx was 1.01. The regional NDVI profile also presented an overall higher than average trend, and was also higher than the 5-year maximum in July and August.

In the Rapeseed zone of eastern France, the NDVI profile also indicated above-average and maximum conditions. Overall, RAIN in this period was 23% higher than the 15-year average, while TEMP decreased by 1.0°C and RADPAR dropped by 2%. BIOMSS was about 9% higher than average while CALF was at the average level, and VCIx was 1.02. Cropping intensity was higher than average level 15%.

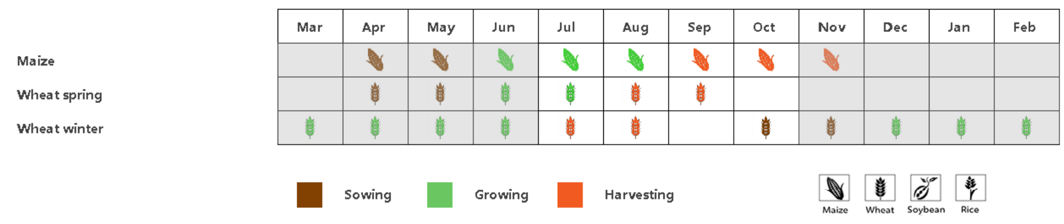
In the Massif Central dry zone, TEMP and RADPAR were 0.9°C and 5% lower than the average, respectively, while RAIN increased by 24%. CALF was at the average level. Cropping intensity decreased by 6%.The VCIx was high at 1.03 and BIOMSS increased by 9% which indicated a favorable cropping season in the region. Crop conditions based on the NDVI profile were also showing above-average levels during the whole monitoring period.

The Southwestern maize zone is one of the major irrigated regions in France. The regional NDVI profile presented an above-average trend. The VCIx was recorded at a high level (1.02). BIOMSS was 1% lower than average. CALF was average. Cropping intensity was above the average 5%. RAIN in the period was at the average level, while TEMP was 0.6°C lower than average, and RADPAR dropped by 2%.

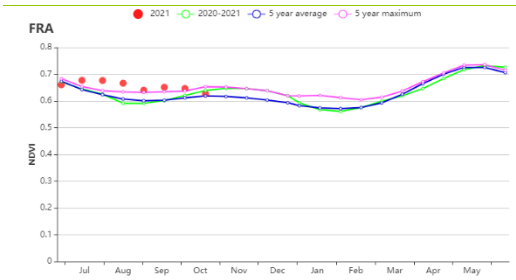
In the Eastern Alpes region, the NDVI profile also presented an above-average and close-to-maximum trend. RAIN in the region was 32% higher than average, while TEMP was lower than average (-0.9°C) and RADPAR was 6% lower than the 15YA. BIOMSS was 7% higher than the 15-year average. Cropping intensity was higher than average 3%. VCIx for the region was recorded at 1.02 and CALF was 1% higher than average level, indicating overall above-average crop conditions.

The Mediterranean zone also indicated an overall above-average NDVI profile, but was close to average in early July and late August. The region recorded a relatively low VCIx (0.89). RADPAR and TEMP were 2% and 0.4°C lower than average, while RAIN was higher than average (+11%) . Cropping intensity increased by 7%. BIOMSS and CALF increased by 6% and 2%. This region was also showing above-average crop conditions.

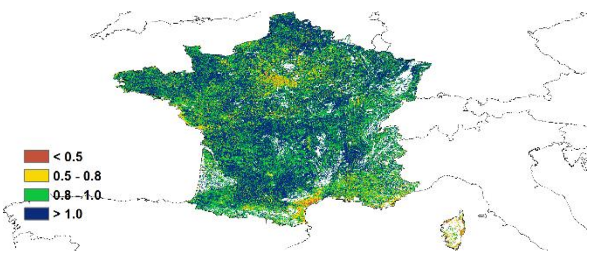
Figure 3.16 France's crop condition, July - October 2021



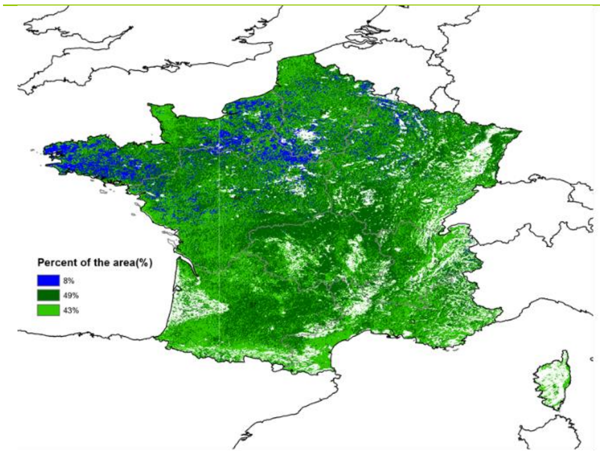
(a). Phenology of major crops



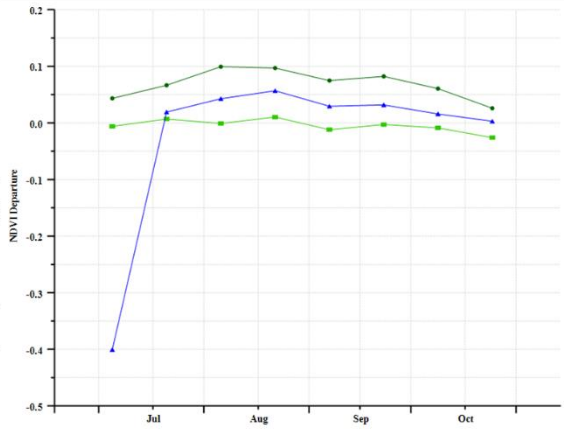
(b) Crop condition development graph based on NDVI



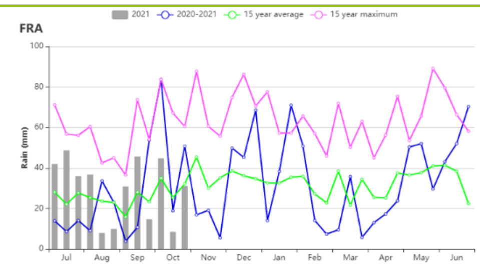
(c) Maximum VCI



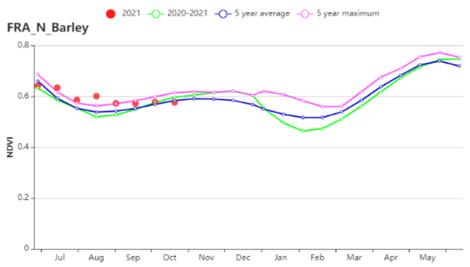
(d) Spatial NDVI patterns compared to 5YA

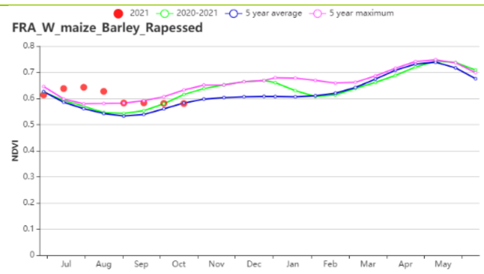


(e) NDVI profiles

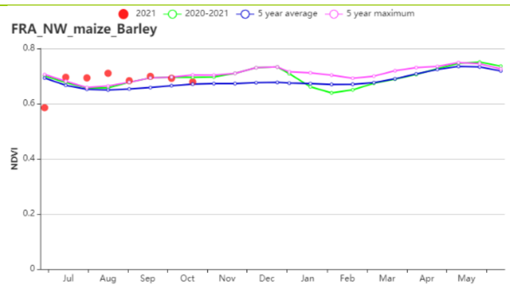


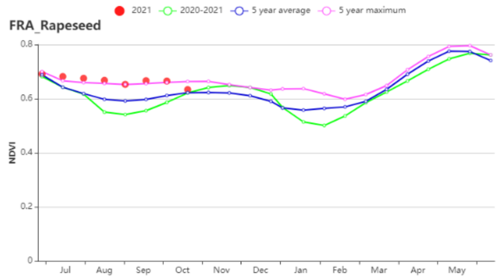
(f) Rainfall profiles (g) Temperature profiles



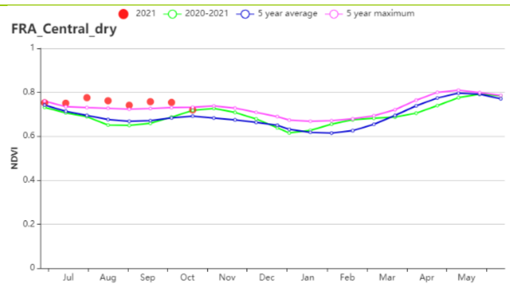


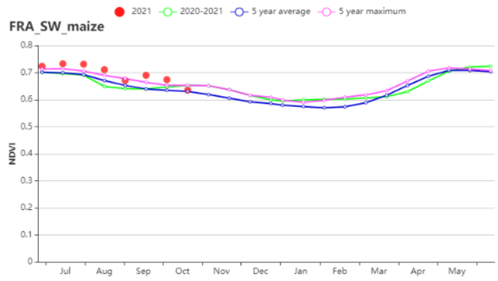
(h) Crop condition development graph based on NDVI (Northern barley region (left) and Mixed maize, Barley and Rapeseed zone (right))



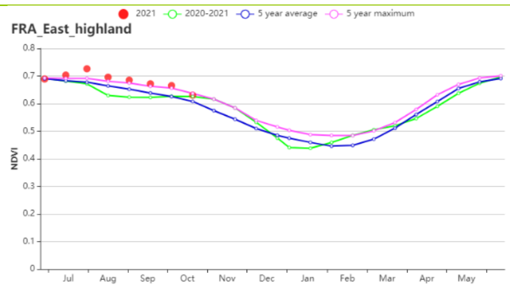


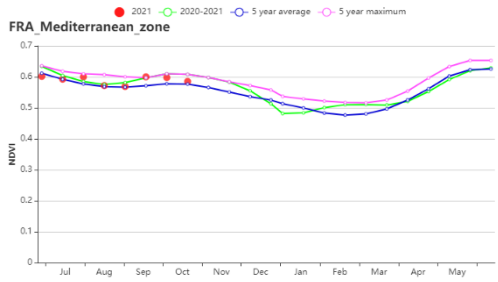
(i) Crop condition development graph based on NDVI (Maize, barley and livestock zone (left) and Rapeseed zone (right))





(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. 24 France's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2021

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Northern Barley zone	379	33	15.1	-0.6	855	1	885	17

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Mixed maize/barley and rapessed zone from the Centre to the Atlantic Ocean	256	-1	16.2	-0.5	946	0	738	1
Maize barley and livestock zone along the English Channel	311	16	15.4	-0.1	894	4	813	12
Rapeseed zone of eastern France	440	23	14.3	-1.0	918	-2	895	9
Massif Central Dry zone	391	24	14.3	-0.9	982	-5	883	9
Southwest maize zone	301	0	16.3	-0.6	1052	-2	797	-1
Alpes region	560	32	13.6	-0.9	1018	-6	925	7
Mediterranean zone	325	11	16.3	-0.4	1135	-2	772	6

Table 3. 25 France's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2021

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Northern Barley zone	100	0	130	18	1.03
Mixed maize/barley and rapessed zone from the Centre to the Atlantic Ocean	100	1	118	15	0.99
Maize barley and livestock zone along the English Channel	100	0	132	18	1.01
Rapeseed zone of eastern France	100	0	122	15	1.02
Massif Central Dry zone	100	0	102	-6	1.03
Southwest maize zone	100	0	111	5	1.02
Alpes region	98	1	107	3	1.02
Mediterranean zone	95	2	119	7	0.89

[GBR] Kingdom

By the end of this monitoring period, summer crops had been harvested and winter wheat was being sown. According to the crop condition development graph, crops experienced average conditions except July, when they were below or above the 5YA. NDVI values were close to average from August to October. Agro-climatic indicators show that rainfall, temperature and radiation were above average (RAIN, +2%, TEMP +0.6℃, RADPAR +1%), and favorable agro-climatic conditions resulted in an above-average BIOMSS (+7%). The seasonal RAIN profile shows that the rainfall was fluctuating in the monitoring period as compared to the 15 year average. The second half of August and September were below average, but October was close to the 15 year maximum. The temperature was close to the 15YA in most of the time and above average in mid-July, late July and early September.

The national average VCIx was 0.95. CALF (100%) was unchanged compared to its five-year average. The NDVI departure cluster profiles indicate that: (1) 73.6% of arable land experienced average crop conditions, mainly in the south and east of UK. (2) 26.4% of arable land experienced a marked drop in July and August, then recovered to average conditions, mainly in the southeast and northeast of the UK. Most likely, the large drops can be attributed to cloud cover in the satellite images. Altogether, the conditions in the UK are assessed as average.

Regional analysis

Based on cropping systems, climatic zones, and topographic conditions, three sub-national regions are described below: **Northern barley region**, **Central sparse crop region** and **Southern mixed wheat and barley region**. All three sub-regions are characterized by an unchanged fraction of arable land (CALF) compared to the 5YA.

In the **northern barley region**, NDVI was close to average except late July. Rainfall was below average (RAIN -7%), temperature (TEMP +0.9℃) and radiation (RADPAR +2%) were above average. Above-average temperature and radiation resulted in above-average biomass (+5%). This region is cultivated with a mixture of single and double cropping systems, and the CI (-1%) was slightly below average, while the VCIx was at 0.96.

The **Central sparse crop region** is one of the country's major agricultural regions in terms of crop production. Crop condition development graph based on NDVI is similar to the northern barley region. Rainfall was close to average, temperature (TEMP +0.8℃) and radiation (RADPAR +0.5%) were above average. Above-average temperature and radiation resulted in above-average biomass（BIOMSS +4%). This region is cultivated with a mixture of single and double cropping systems, and the CI (+1%) was slightly above average, while the VCIx was at 0.95.

In the **Southern mixed wheat and barley zone**, NDVI was overall close to average. This region experienced the largest rainfall excess (RAIN +13%), temperature (TEMP +0.3°C) and radiation (RADPAR +0.7%) were above average. The favourable agro-climatic conditions resulted in the remarked above-average biomass (BIOMSS +12%). This region is cultivated with a mixture of single and double cropping systems, and the CI (+3%) was above average. The region had an above-average VCIx (0.95).

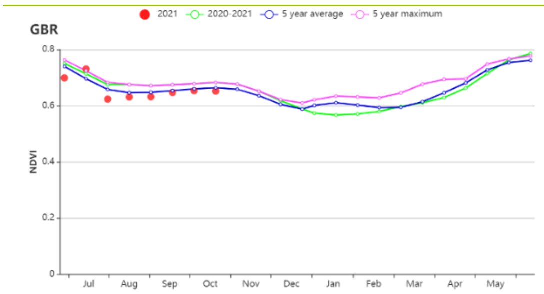
Figure 3.17 United Kingdom's crop condition, July - October 2021

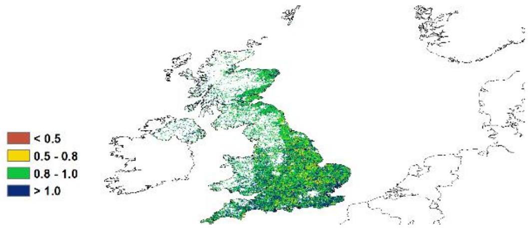
	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Wheat winter												

Sowing Growing Harvesting

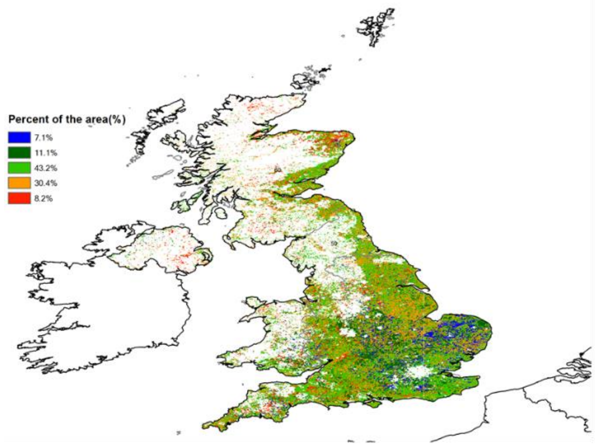
Maize Wheat Soybean Rice

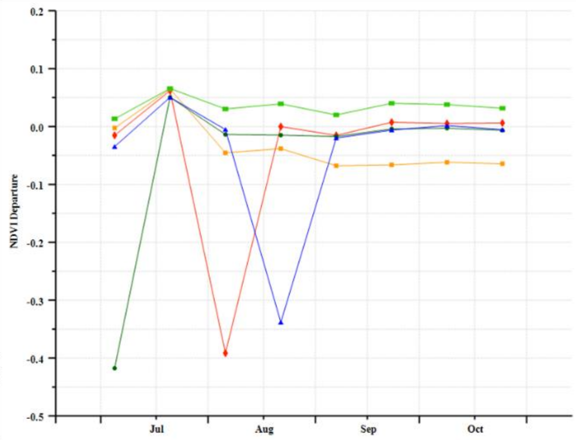
(a). Phenology of major crops



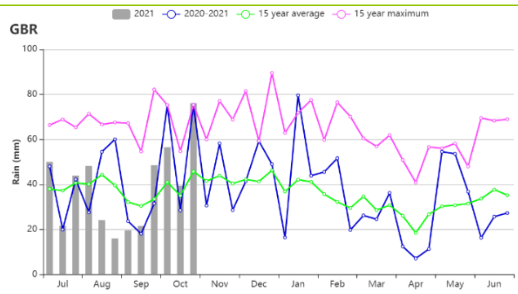


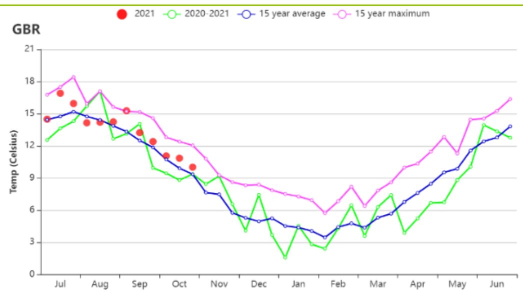
(b) Crop condition development graph based on NDVI (c) Maximum VCI



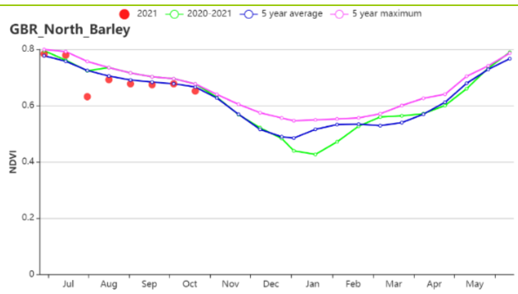


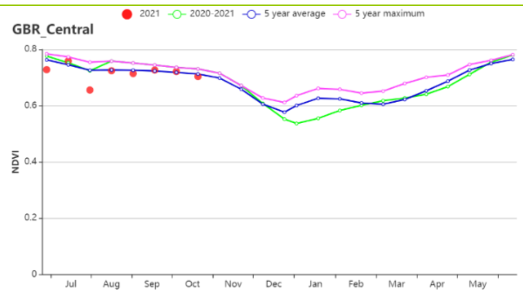
(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles



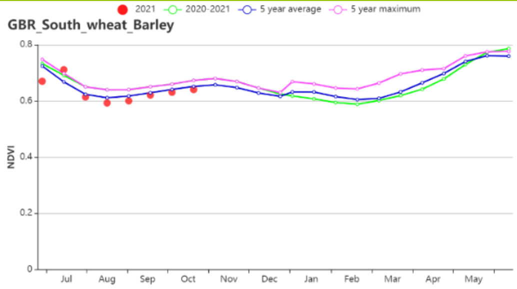


(f) Rainfall profiles (g) Temperature profiles





(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 3.26 United Kingdom's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2021

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)	536	-7	12	0.9	594	2	870	5
Central sparse crop region (UK)	486	0	13	0.8	633	0.5	901	4
Southern mixed wheat and Barley zone (UK)	392	13	14	0.3	725	0.7	882	12

Table 3.27 United Kingdom's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2021

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Northern Barley region(UK)	100	0	105	-1	0.96
Central sparse crop region (UK)	100	0	119	1	0.95
Southern mixed wheat and Barley zone (UK)	100	0	123	3	0.95

[HUN] Hungary

In Hungary, summer crops were harvested in September and October. Winter wheat was sown in September and October.

At the national level, accumulated rainfall was below average (RAIN -35%), temperature decreased by 0.2°C, and radiation increased by 3%, which resulted in a below-average BIOMSS (BIOMSS -17%), as compared to the 15YA. According to the national NDVI development graphs, crop conditions were below average throughout the monitoring period. With the maximum VCI value reaching 0.73 at the national level and the cropped arable land fraction (CALF) at 100%, crop conditions are estimated as unfavorable because of lower rainfall. Crop production in Hungary is expected to be below average.

Some spatial and temporal detail is provided by the NDVI clusters: There were two main remarkable areas where the NDVI departure across the period was significant: Excellent crop conditions were observed for 19.5% of the area. It is mainly located in far western Transdanubia and eastern Great Plain, where the NDVI departure was below average in July and above average from August to October. About 35.4% of the area, mainly located in the Great Plain and near the Transdanubia, represents poor crop conditions, which was below average throughout the monitoring period. About 25.9% of the area extending from west to east of Hungry, NDVI was below average from July to early October, and above average in mid-to-late October. For the rest 19.2% of the area, located in the mid-east region of Hungary, NDVI was hovering around average from July to August, and was below average from September to October.

Regional analysis

Based on cropping systems, climatic zones and topographic conditions, Hungary is divided into four sub-regions: Northern Hungary, Central Hungary, the Great Plain (Puszta) and Transdanubia. Specific observations for the reporting period are included for each region. All sub-regions are characterized by unchanged fractions of cropped arable land (CALF) compared to the average, i.e. 100%, indicating full cropping.

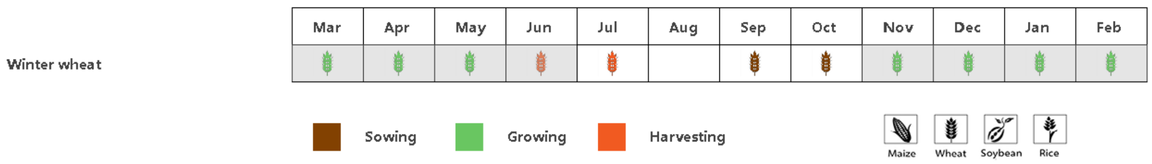
Central Hungary is one of the major agricultural regions in terms of crop production. A sizable share of winter wheat, maize and sunflower is planted in this region. According to NDVI development graphs, crop conditions were below average throughout the monitoring period. Agro-climatic conditions include below-average rainfall (RAIN, -38%) and temperature (TEMP -0.2°C), and above-average radiation (RADPAR +3%), which resulted in a below-average biomass (BIOMSS -16%). The VCIx was 0.68. Meanwhile Cropping intensity was 110% (+9%). So crop production in this region is expected to be below average.

The Puszta region mainly grows winter wheat, maize and sunflower especially in the counties of Jaz-Nagykum-Szolnok and Bekes. According to NDVI development graphs, crop conditions were below average throughout the monitoring period. The rainfall was below average (-35%). Temperature was also below average (TEMP -0.1°C), whereas radiation was above (RADPAR +2%), which resulted in a below-average biomass (BIOMSS -17%). The maximum VCI was 0.72. Cropping intensity was 117% (+14%). The crop production in this region is expected to be close to, but below average.

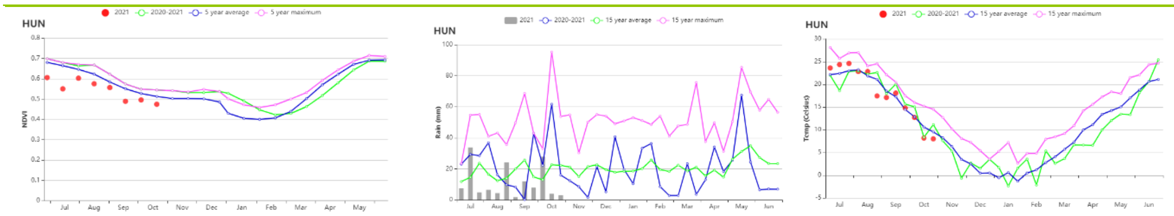
Northern Hungary is another important winter wheat region. During this reporting period crops showed unfavorable conditions according to the NDVI development curve. They were below average throughout this monitoring period, except for late August, when NDVI was near average. The rainfall was below average (RAIN -32%). Temperature was slightly below average (TEMP -0.4°C), and radiation was above average (RADPAR +2%). Estimated biomass decreased (BIOMSS -13%) due to the lower rainfall. The maximum VCI was 0.77. Cropping intensity was 125% (+21%). So the crop production in this region is expected to be close to, but below average.

Southern Transdanubia cultivates winter wheat, mostly in Somogy and Tolna counties. Crop condition was below average from July to October. Rainfall and temperature were below average (RAIN -35%; TEMP -0.2°C) , whereas solar radiation was above average (RADPAR +2%) and estimated biomass decreased (BIOMSS -18%) due to the lower rainfall in September and mid-to-late October. The maximum VCI was 0.74. Cropping intensity was 132% (+29%). The crop production in this region is expected to be close to, but below average.

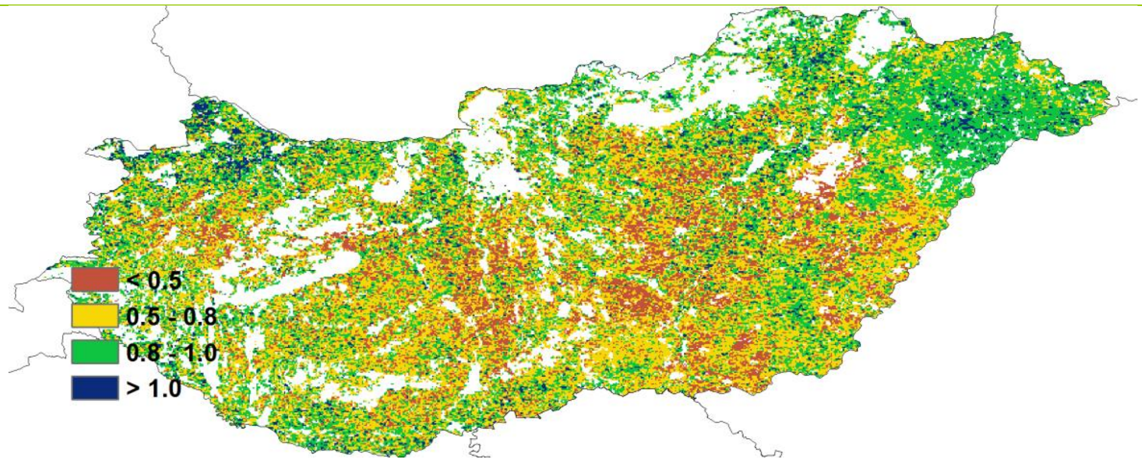
Figure 3.18 Hungary's crop condition, July -October 2021



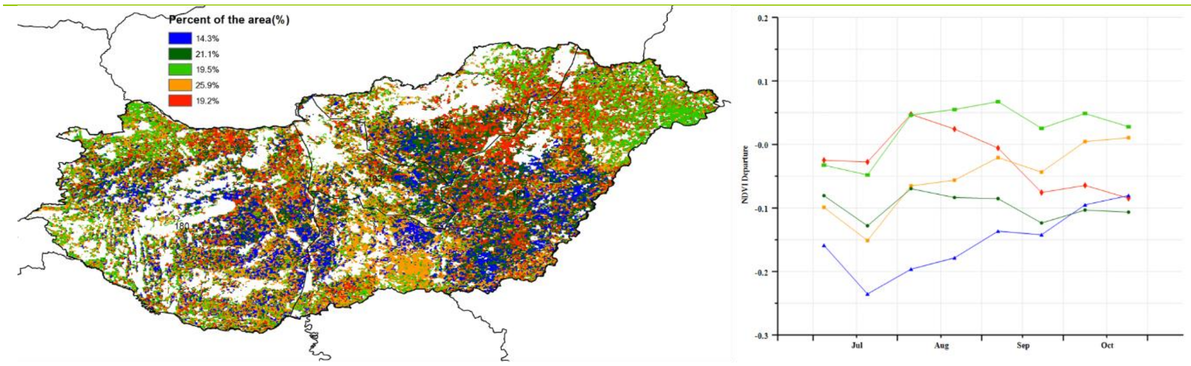
(a). Phenology of major crops



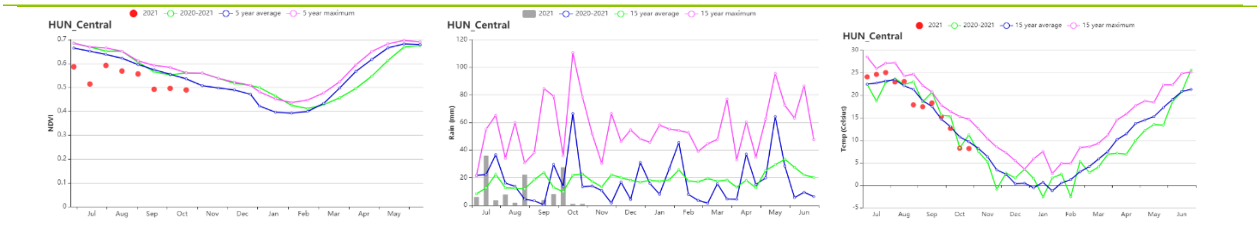
(b) Crop condition development graph based on NDVI, RAIN and TEMP



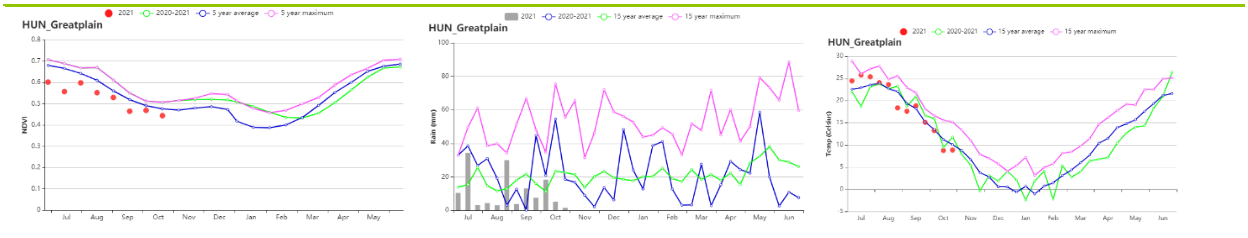
(c) Maximum VCI



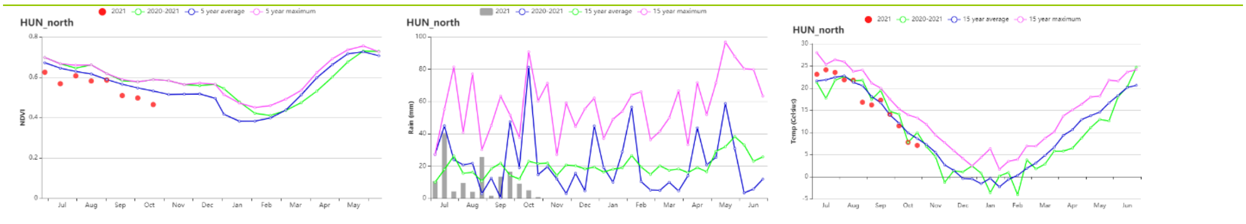
(d) Spatial distribution of NDVI profiles.



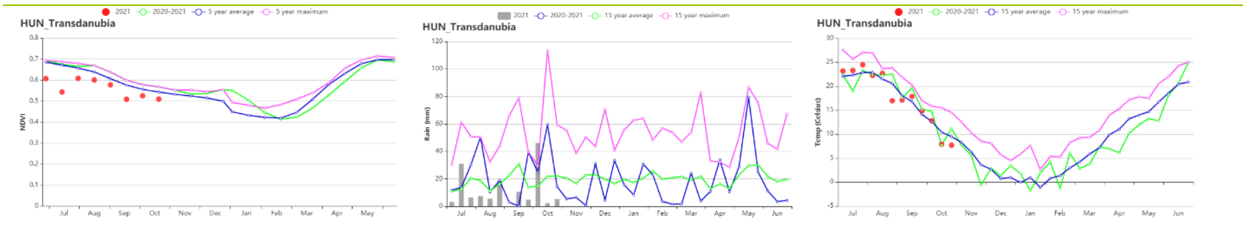
(e) Crop condition development graph based on NDVI, RAIN and TEMP



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



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



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

Table 3. 28 Hungary's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July -October 2021

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Central Hungary	119	-38	18	-0.2	1059	3	546	-16
The Puszta	134	-35	19	-0.1	1045	2	574	-17
North Hungary	140	-32	17	-0.4	1018	2	578	-13
Transdanubia	141	-35	18	-0.2	1071	4	568	-18

Table 3. 29 Hungary's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July -October 2021

Region	Cropped arable land fraction		Cropping Intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current (%)
Central Hungary	100	0	110	9	0.68
The Puszta	100	0	117	14	0.72
North Hungary	100	0	125	21	0.77

Region	Cropped arable land fraction		Cropping Intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current (%)
Transdanubia	100	0	132	29	0.74

[IDN] Indonesia

The dry season maize and the second rice were the main cereals being produced during this monitoring period. Their harvest began in October. The planting of the main rice crop also started in October. CropWatch agroclimatic indicators showed that temperature (TEMP +0.2°C), precipitation (RAIN +20%) and radiation (RADPAR +2%) were above the 15YA. The potential biomass production was above average (BIOMASS +12%).

According to the national NDVI development graph, crop conditions were slightly below the 5YA during this monitoring period. NDVI clusters and profiles showed that crop conditions in 61.9% of arable land were close to average or above average, mostly located in Java, Sumatra and West Papua. About 32.7% of arable land, located in Kalimantan, Sumatra, Molucca, Bandung, West Papua, were at first significantly below average but improved after October. The large negative departures can be attributed to cloud cover in the satellite images. The area of cropped arable land (CALF 99%) in the country was comparable to the 5YA and the VCIx value was 0.95. Cropping intensity (CI -1%) was near the 5YA. The national production is anticipated to be above average during the whole monitoring period.

Regional analysis

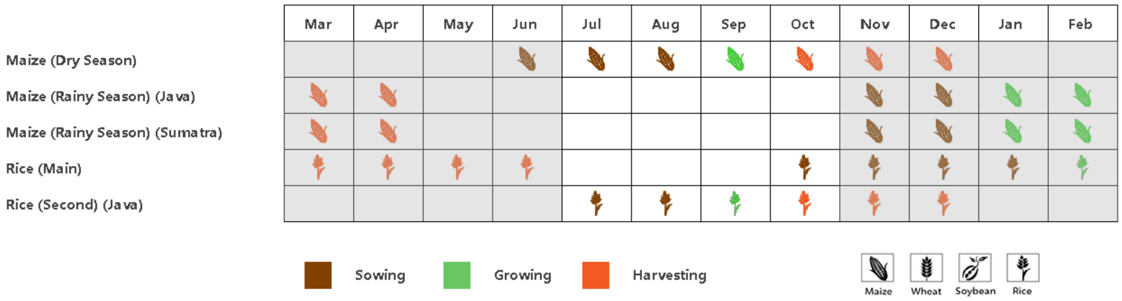
CropWatch focuses on four agro-ecological zones, namely **Sumatra** (92), **Java** (90), **Kalimantan and Sulawesi** (91) and **West Papua** (93), among which the former three are relevant for crops cultivation. The numbers of the zones correspond to the labels on the VCIx and NDVI profile maps. **Java** is the country's main agricultural region.

In the Java region, precipitation (RAIN +32%), temperature (TEMP +0.5°C) and radiation (RADPAR +3%) were above the 15YA, which may have resulted in the potential biomass production increase of 27%. According to the NDVI development graph, crop conditions were close to the 5YA. And cropping intensity (CI +6%) was above the 5YA. Overall, crop conditions in this region are expected to be above average.

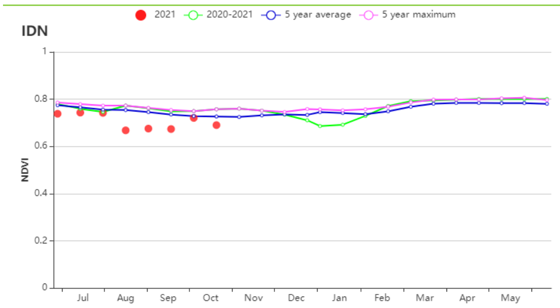
Kalimantan and Sulawesi experienced rainy conditions. Precipitation (RAIN +32%) was above average, whereas temperature (TEMP 0°C) was close to average and radiation (RADPAR -1%) was below the 15YA, which brought an increase in the potential biomass production (BIOMSS +14%). As shown in NDVI development graphs, crop conditions were below average in mid-August and mid-September, but close to average at other times. Cropping intensity (CI -2%) was below the 5YA. Crop conditions in this region are assessed as above average.

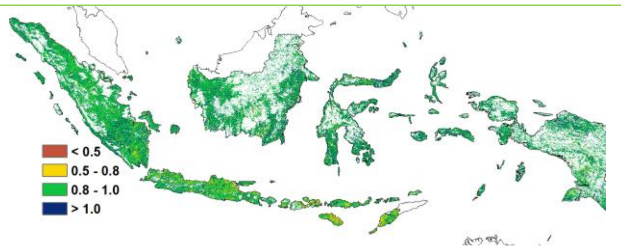
In **Sumatra**, the agroclimatic indices, precipitation (RAIN +7%), temperature (TEMP +0.2°C) and radiation (RADPAR +2%),were near average during the reporting period.They resulted in an increase in the potential biomass production (BIOMSS +5%). According to NDVI development graphs, crop conditions were slightly below the 5YA. In addition, cropping intensity (CI -1%)was below the 5YA. Crop conditions in **Sumatra** are expected to be above average.

Figure 3.19 Indonesia's crop condition, July – October 2021



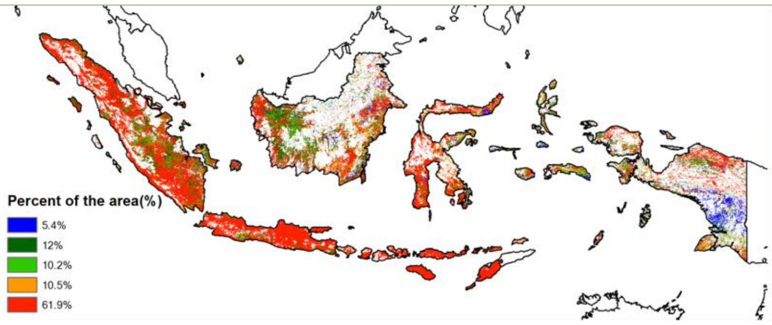
(a). Phenology of major crops

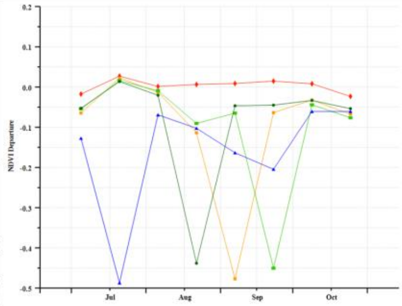




(b) Crop condition development graph based on NDVI

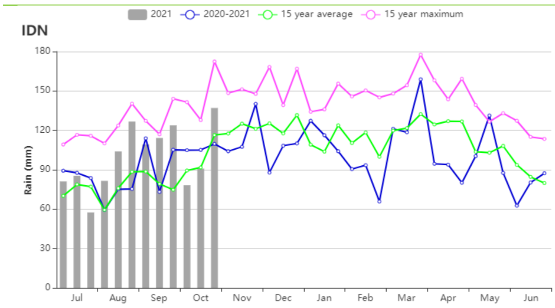
(c) Maximum VCI

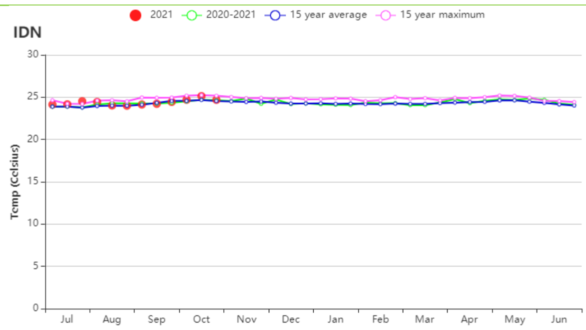




(d) Spatial NDVI patterns compared to 5YA

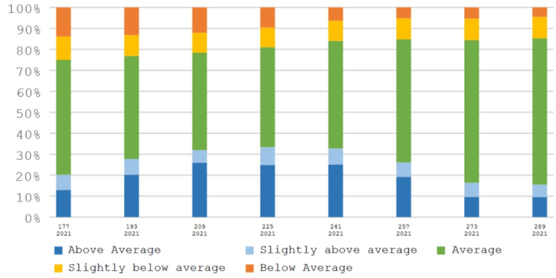
(e) NDVI profiles

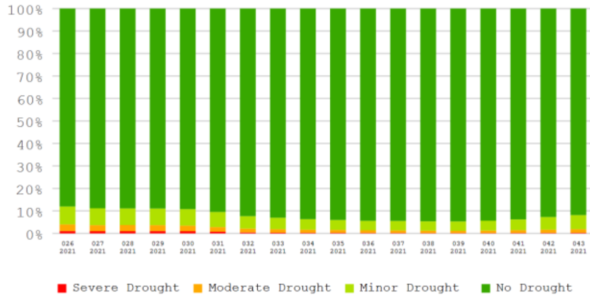




(f)Rainfall profiles

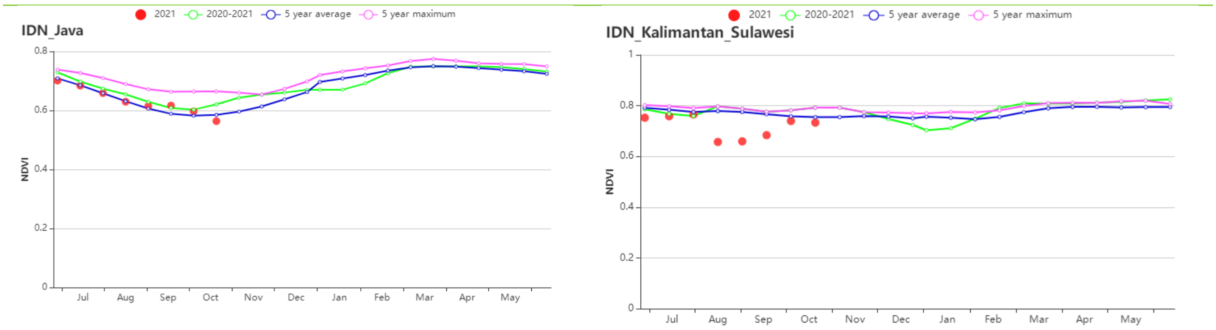
(g)Temperature profiles



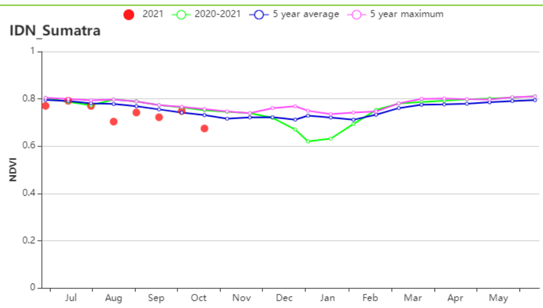


(h) Proportion of NDVI anomaly categories compared with 5YA

(i) Proportion of VHIn categories compared with 5YA



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



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

Table 3. 30 Indonesia's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July – October 2021

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(%)
Java	404	32	25.3	0.5	1318	3	909	27
Kalimantan and Sulawesi	1228	32	24.5	0.0	1191	-1	1490	14
Sumatra	987	7	24.7	0.2	1216	2	1401	5
West Papua	1713	14	23.4	0.6	1044	8	1391	9

Table 3. 31 Indonesia's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July – October 2021

Region	Cropped arable land fraction		Cropping Intensity		Maximum VCI
	Current (%)	Departure from 5YA(%)	Current(%)	Departure from 5YA(%)	Current
Java	98	1	131	6	0.89
Kalimantan and Sulawesi	100	0	131	-2	0.97
Sumatra	100	0	130	-1	0.95
West Papua	100	0	130	-3	0.97

[IND] India

The current monitoring period covers the monsoon season, during which the main rice crop (Kharif) is grown. It is planted at the beginning of monsoon in June and harvested in October. Other major crops grown during this monitoring period are maize and soybean. Rabi wheat sowing started in October. The graph of NDVI development shows that the crop conditions were below average in general, except in October. This may have been partly due to cloud cover in the satellite images.

The CropWatch agroclimatic indicators show that nationwide, TEMP (+0.1°C) and RADPAR were close to average, whereas RAIN was slightly below the 15YA (-11%). The average TEMP and RADPAR compensated for the low rainfall, resulting in a BIOMSS increase by 5% compared with the 15YA. The overall VCIx was high, with a value of 0.91. As can be seen from the spatial distribution, only the Northwestern region recorded values below 0.80. Most of India had high VCIx values. These spatial patterns of VCIx were thus generally consistent with those of NDVI. The southwestern and northeastern regions showed above-average crop conditions while the conditions were slightly below average in the northwestern regions. The spatial distribution of NDVI profiles shows that after October, 81.8% of the areas showed above-average crop conditions in the western and southern regions. CALF increased by 1% compared to the 5YA. The agroclimatic indicators were generally favorable.

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).

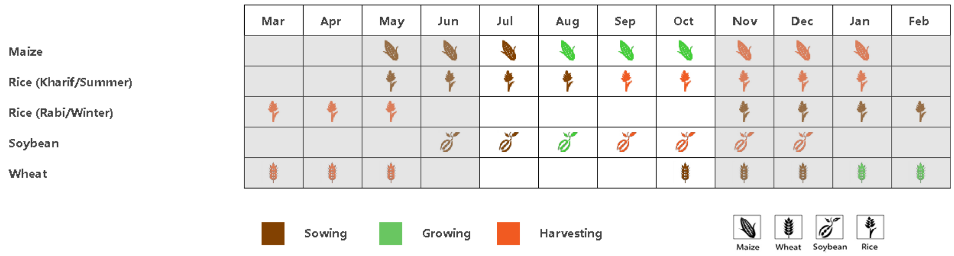
The three agro-ecological zones of the Deccan Plateau, the Assam and north-eastern regions, and the Western Himalayan region showed similar trends in agricultural indices. Compared to the same period of previous years, RAIN had decreased significantly, especially in the Western Himalayan region (-49%). The TEMP was slightly above average and RADPAR was above average, but the lower rainfall caused BIOMSS to be slightly lower than the 15-year average. CALF showed the same trends. They all were slightly above average (near+1%). The graph of NDVI development shows that the crop growth of these three agro-ecological regions during this monitoring period was below the 5-year average in most months. Generally, the crop production is expected to be below average.

The Agriculture areas in Rajasthan and Gujarat and the North-western dry region recorded similar trends of agricultural indices in this monitoring period. Compared to the same period of the previous years, RAIN had increased significantly by 27% in the Agriculture areas in Rajasthan and Gujarat and by 68% for the North-western dry region. TEMP was slightly above average. The RADPAR was below average for both regions and compensated for the rainfall effect and caused an increase in BIOMSS. Both regions recorded increases of CALF. VCIx was above 0.90. The graph of NDVI development shows that the crop growth for both regions was generally below the 5-year average. The crop production is expected to be below average.

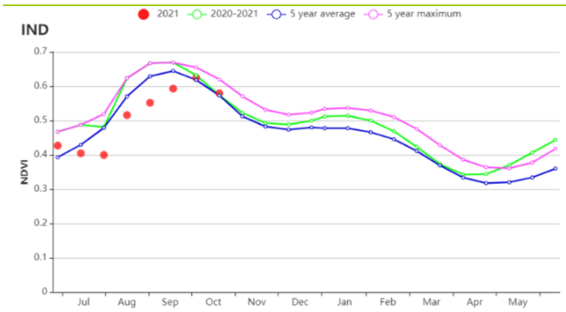
The Eastern coastal region and the Western coastal region recorded similar trends of agricultural indices in this monitoring period. Compared to the same period of the previous years, RAIN had decreased by 20% in the Eastern coastal region and by 7% for the Western coastal region. TEMP was near average. The RADPAR was above average for both regions. BIOMSS was below the average due to insufficient rainfall. Both regions recorded increases of CALF. VCIx was above 0.70. The graph of NDVI development shows that the crop growth for both regions was generally above the 5-year average. The crop production is expected to be above average.

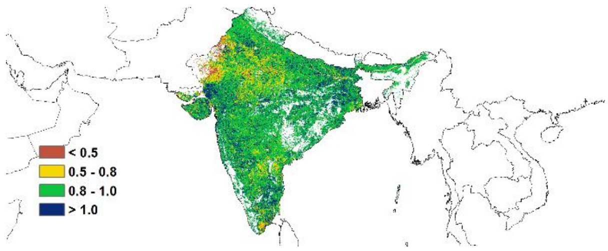
The Gangetic plain recorded 1084 mm of RAIN, which was slightly below average (-5%). TEMP was at 27.4°C (+0.1°C) and RADPAR was at 1103 MJ/m² (-2%). BIOMSS was above the 15YA (+8%). CALF reached 98% which was slightly above average, and VCIx was 0.93. The graph of NDVI development shows that the crop growth of the region during the monitoring period exceeded the 5-year average in most months. The outlook of crop production in this region is favorable.

Figure 3.20 India's crop condition, July - October 2021



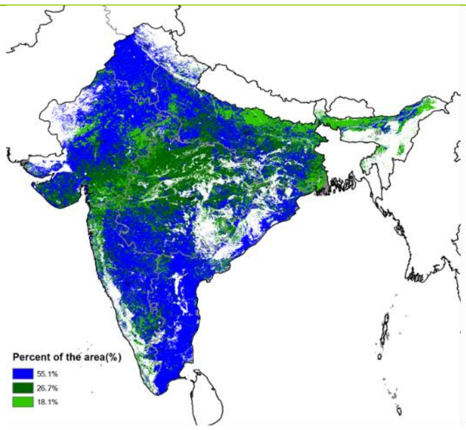
(a). Phenology of major crops

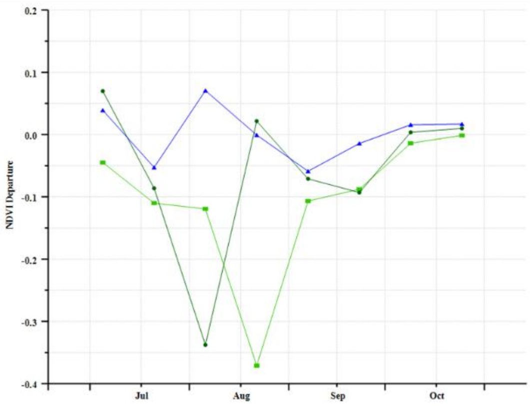




(b) Crop condition development graph based on NDVI

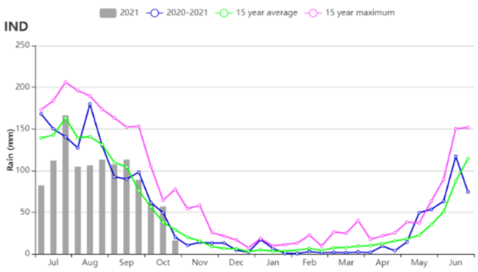
(c) Maximum VCI

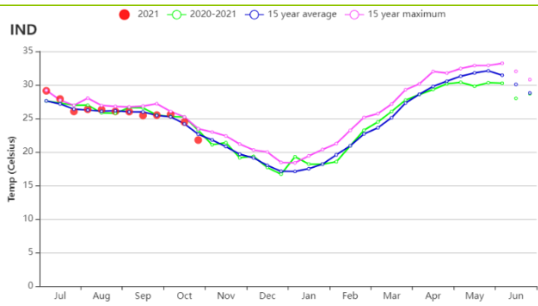




(d) Spatial NDVI patterns compared to 5YA

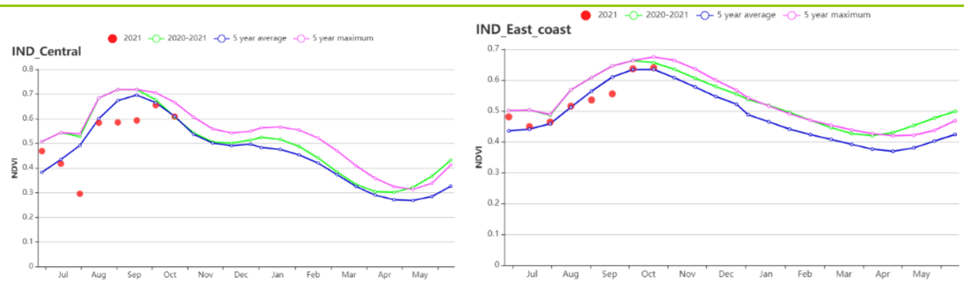
(e) NDVI profiles



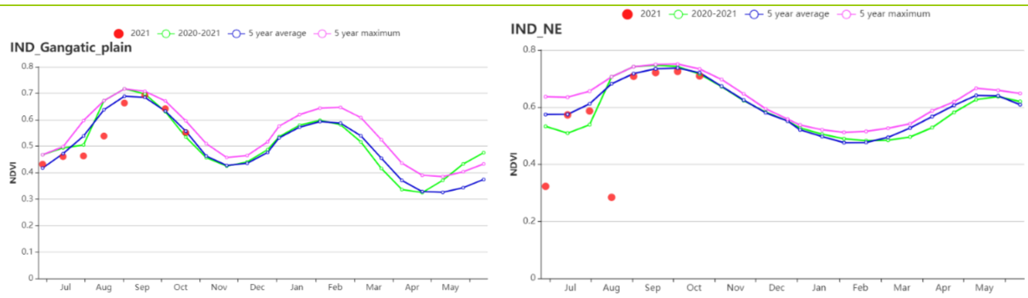


(f) Rainfall profiles

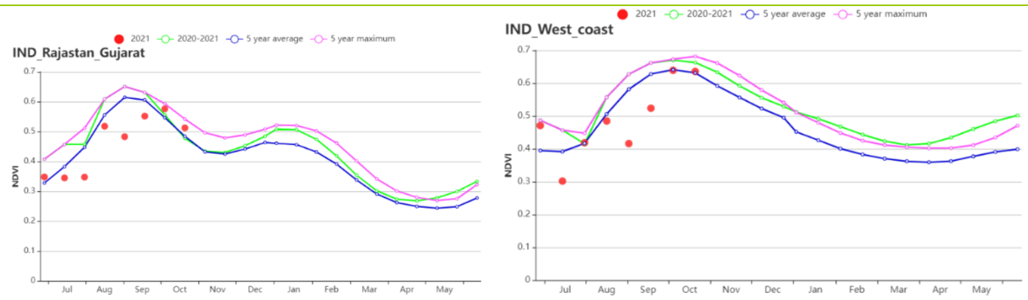
(g) Temperature profiles



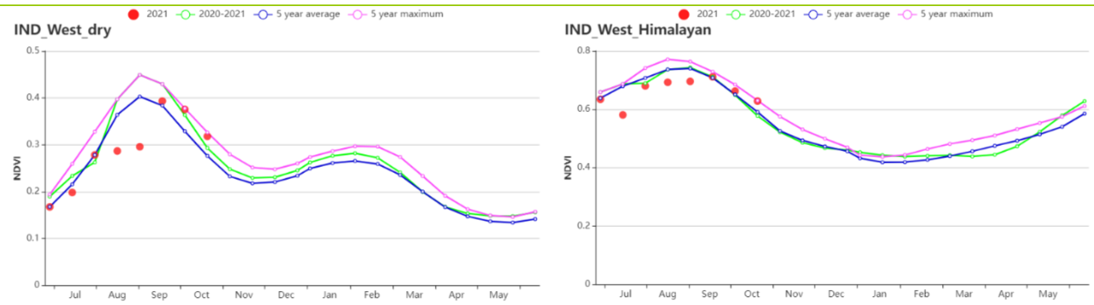
(h) Crop condition development graph based on NDVI (Deccan Plateau (left) and Eastern Coastal Region (right))



(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 3.32 India's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2021

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Deccan Plateau	866	-21	25.8	0.4	1075	2	1247	-2
Eastern coastal region	854	-20	26.7	0.2	1130	2	1292	-3
Gangatic plain	1084	-5	27.4	0.1	1103	-2	1362	8
Assam and north-eastern regions	2078	-14	24.1	0.2	951	2	1440	2
Agriculture areas in	1208	27	27.0	-0.4	1026	-4	1284	22

Rajastan and Gujarat								
Western coastal region	1336	-7	23.9	-0.1	1021	6	1327	6
North-western dry region	601	68	30.2	-0.6	1194	-1	936	44
Western Himalayan region	472	-49	19.2	0.5	1250	4	754	-12

Table 3.33 India's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2021

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Deccan Plateau	99	0	135	13	0.92
Eastern coastal region	95	4	110	-1	0.92
Gangatic plain	98	0	195	17	0.93
Assam and north-eastern regions	96	1	0	0	0.93
Agriculture areas in Rajastan and Gujarat	94	0	146	15	0.89
Western coastal region	99	4	107	1	0.95
North-western dry region	44	3	132	5	0.72
Western Himalayan region	99	0	122	9	0.94

[IRN] Iran

The harvest of summer crops (irrigated potatoes and rice) was almost over by the end of August, while winter crops (wheat and barley) started to be sown in September. According to the NDVI-based crop condition development graph, the crop conditions in Iran during this whole monitoring period were worse than the 5-year average. The photosynthetically active radiation was 1% below average. The average temperature was 0.1℃ above average, whereas the accumulative rainfall was up by 21%. The potential biomass was 2% higher than the 15-year average. The national maximum vegetation condition index (VCIx) was 0.45, while the cropped arable land fraction (CALF) was 6% smaller than the average of the past 5-years.

The NDVI spatial patterns show that from July to October, 3.7% (marked in blue) and 19.5% (marked in red) of the cropped area had above or slightly above the 5-year average crop conditions throughout the whole monitoring period. The remaining cropped area experienced below-average crop conditions during the whole monitoring period. Four percent of the croped area (marked in orange) had the worst below-average crop conditions, mainly located in some parts of Mazadaran, Golestan, and Khuzestan. The spatial pattern of maximum Vegetation Condition Index (VCIx) was in accord with the spatial distribution of the NDVI profiles. Although crop production during this period relies on irrigation, the generally drier-than-usual conditions had a negative impact on production. The prolonged drought will also have a negative impact on the sowing and establishment of rainfed winter wheat, which is mainly grown in the north-west of the country and Fars province.

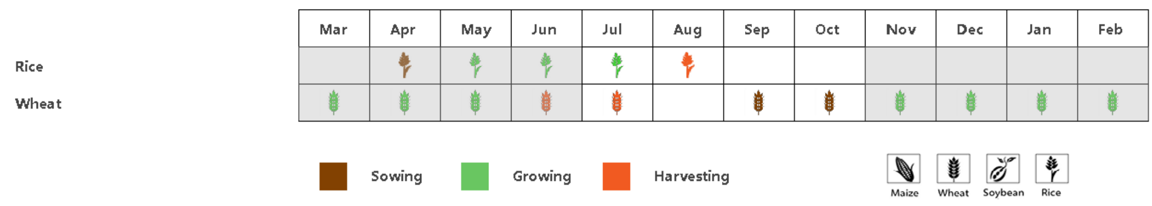
Regional analysis

Based on farming system, climate, and topographic conditions, Iran can be subdivided into three regions, two of which are the main areas for crop production, namely the **semi-arid to the subtropical hilly region in the west and the north** and the **coastal lowland in the arid red sea plain area**.

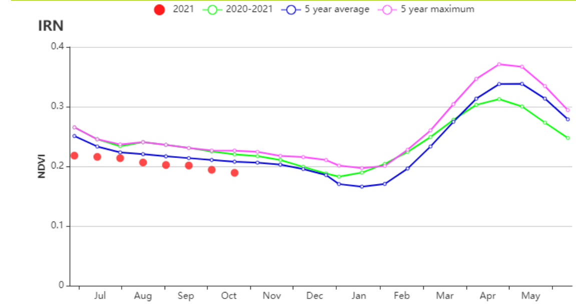
In the **semi-arid to the subtropical hilly region in the west and the north**, the cumulative precipitation during the monitoring period was 77 mm, 16% higher than average. Temperature was near average and photosynthetically active radiation was slightly below the 15YA (-1%). The potential biomass was 2% lower than average. Crop conditions were below the 5-year average. The proportion of cultivated land was 11%, which was 6% higher than the 5YA. Cropping intensity (CI) was slightly above the 5YA (+3%). The average VCIx for this region was 0.47, indicating an unfavorable crop prospect.

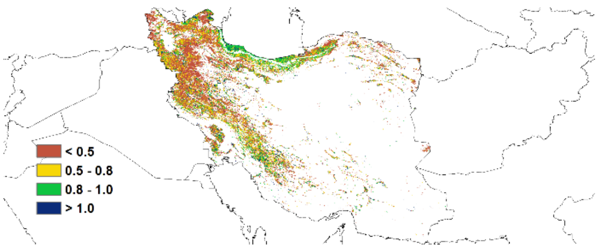
In the **coastal lowland in the arid red sea plain area**, the temperature was 0.4℃ above average. Although the accumulated precipitation was 219% above average, the total was only 35 mm. The photosynthetically active radiation was average. The potential biomass was 50% higher than the 15-year average. Crop conditions were generally around the 5-year average. During the monitoring period, CALF was 2% below the 5YA, while CI was 103% (2% below the 5YA). The value of VCIx was 0.37, also indicating unfavorable crop prospects.

Figure 3.21 Iran's crop condition, July - October 2021

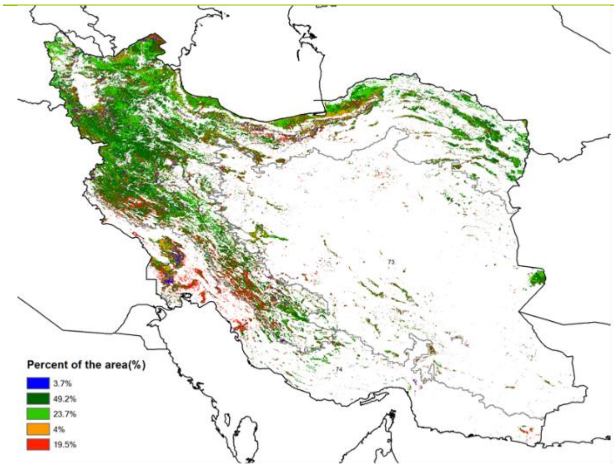


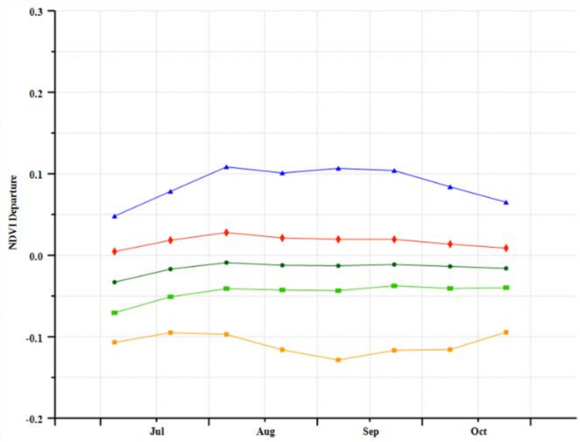
(a). Phenology of major crops



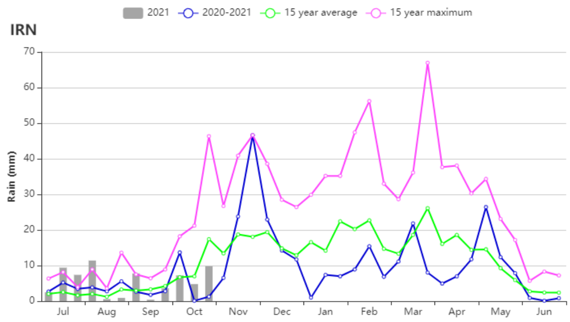


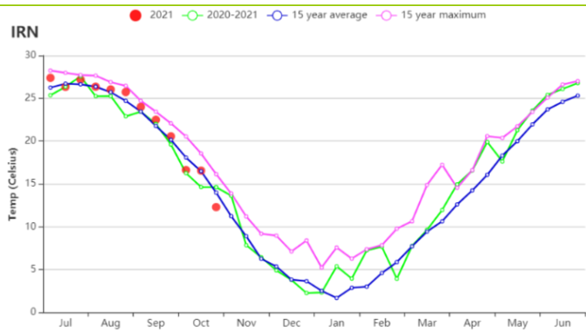
(b) Crop condition development graph based on NDVI (c) Maximum VCI



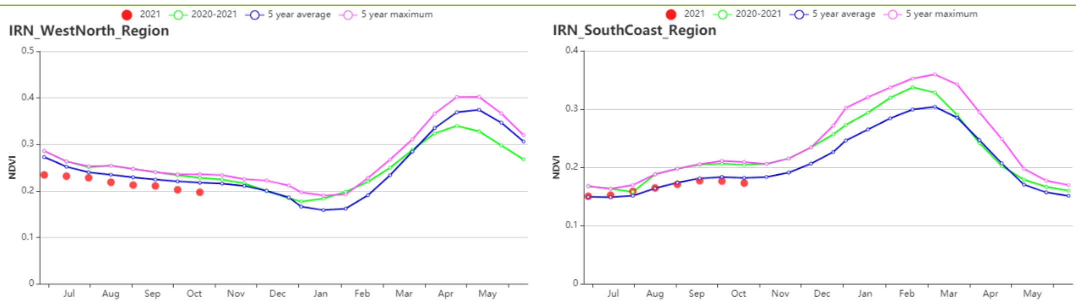


(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles





(f) Rainfall profiles (g) Temperature profiles



(h) Crop condition development graph based on NDVI (semi-arid to the subtropical hilly region in the west and the north (left) and coastal lowland in the arid red sea plain area (right))

Table 3. 34 Iran's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2021

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Semi-arid to sub-tropical hills of	77	16	21.0	0.0	1386	-1	224	-2

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m^2)	Departure (%)	Current (gDM/m^2)	Departure (%)
the west and north								
Arid Red Sea coastal low hills and plains	35	219	33.3	0.4	1463	0	136	50

Table 3. 35 Iran's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2021

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Semi-arid to sub-tropical hills of the west and north	11	-6	106	3	0.47
Arid Red Sea coastal low hills and plains	7	-2	103	-2	0.37

[ITA] Italy

During this reporting period, winter wheat harvest was completed in July and the new crop was sown in October. Based on the agroclimatic and agronomic indicators, the crop conditions in Italy were slightly below the 5-year average during this reporting period.

At the national level, rainfall (-6%) and solar radiation (RADPAR -1%) were below the 15YA. The temperature was unchanged. Precipitation in July and September was near average, which was favorable for wheat growth. Potential biomass production was 5% below average. CALF was 82%, and VCIx was 0.71. Except for a few areas in the south and central part of the country, the VCIx was above 0.80 for most of the cultivated land. The crop condition development graph indicates that NDVI was below average in this reporting period. In summary, the overall crop conditions during this period were near average.

About 15.7% of the crops (areas in blue color), mainly located in the north Italy (Piemonte and Lombardia), showed a positive departure from the 5YA from July to October. 12.8% of arable land experienced below-average crop conditions (areas in red color), scattered in Umbria, Molise and Marche. About 22.8% of arable land (mainly in Lombardia, Lazio and Sardegna) experienced above-average crop conditions between July and August, below-average conditions between August and October. On about 22.4% of arable land, NDVI was near average in September, and then below average in October. For the remaining 26.2% of arable land, NDVI remained below average in July and August, and above average in September and October.

Regional analysis

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

East coast (mainly in Puglia, Marche and Abruzzi) experienced below-average rainfall (RAIN -23%), unchanged temperature and unchanged solar radiation. The precipitation was below average in early August and September. The potential biomass production showed a decrease (BIOMSS -9%). VCIx was 0.59. The crop condition development graph indicates that NDVI was below the average of the past five years. The Cropping Intensity was 111%.

Crop production in the **Po Valley** (mainly in Piemonte, Lombardia and Veneto) was affected by slightly lower rainfall (RAIN -2%) and uchanged temperature and solar radiation. BIOMSS was below the 15YA by 5% and VCIx reached 0.83. The Cropping Intensity was 110%. The crop condition development graph indicates that the crop condition was near average during the entire reporting period. According to the agro-climatic indicators, a near-average output can be expected.

The Islands recorded a above-average precipitation (RAIN +26%) and temperature (TEMP +1°C). RADPAR was slightly below average (-1%). BIOMSS increased by 6% compared with the 15YA. The maximum VCI was only 0.59, the lowest among the four AEZs in Italy. The Cropping Intensity was 104%, which is the lowest in the four regions. NDVI was very close to average throughout the monitoring period. The crop production in this region is expected to be close to average.

In **Western Italy**, RAIN (-16%) and RADPAR (-1%) were all below average. The TEMP was unchanged. Although the precipitation was below average, it was sufficient for the growth of winter wheat in April and May, and the biomass production potential decreased in this region by 1%. The Cropping Intensity was 123%, which is the highest in the four regions. The NDVI was slightly below average. VCIx reached 0.69. CropWatch expects an average production.

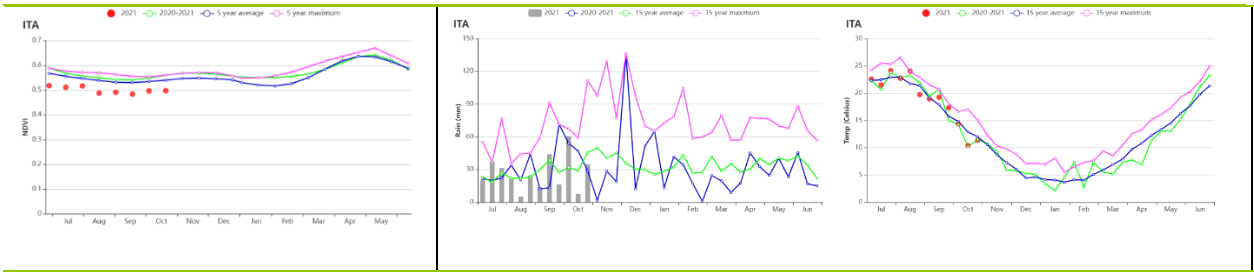
Figure 3.22 Italy's crop condition, July 2021- October 2021

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

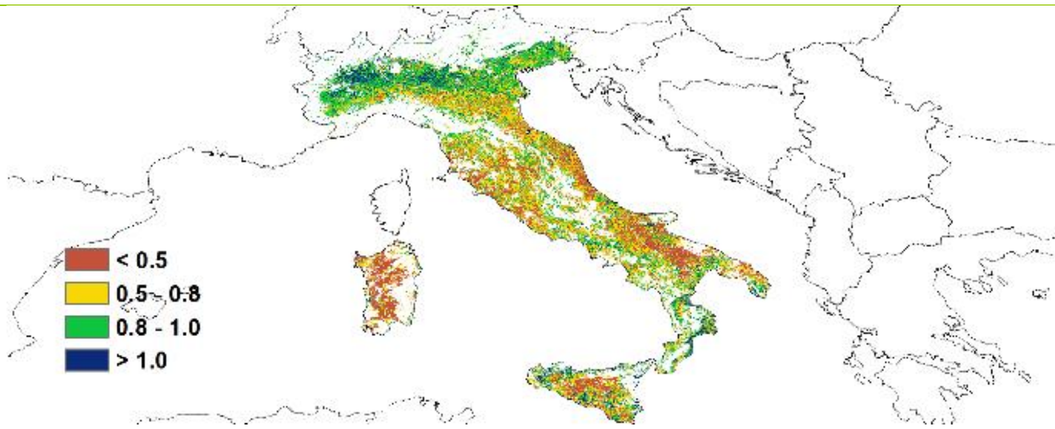
Sowing   Growing   Harvesting

Maize   Wheat   Soybean   Rice

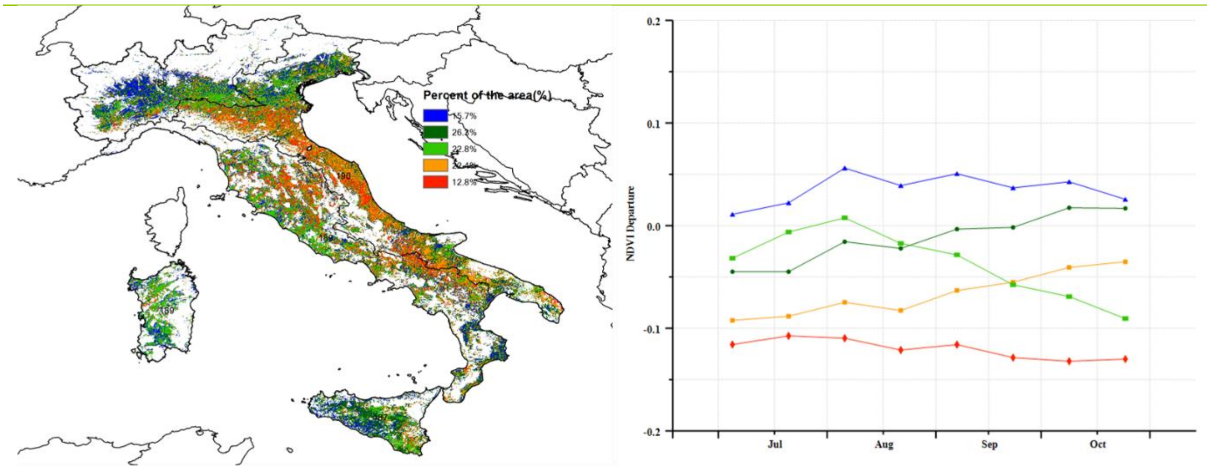
(a) Phenology of major crops



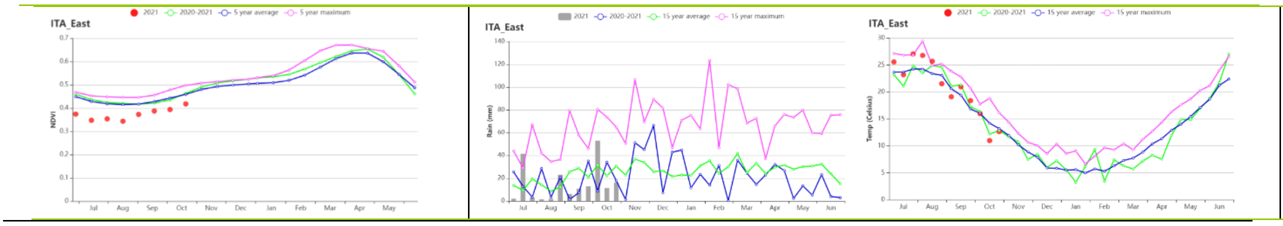
(b) Crop condition development graph based on NDVI, RAIN and TEMP (Italy).



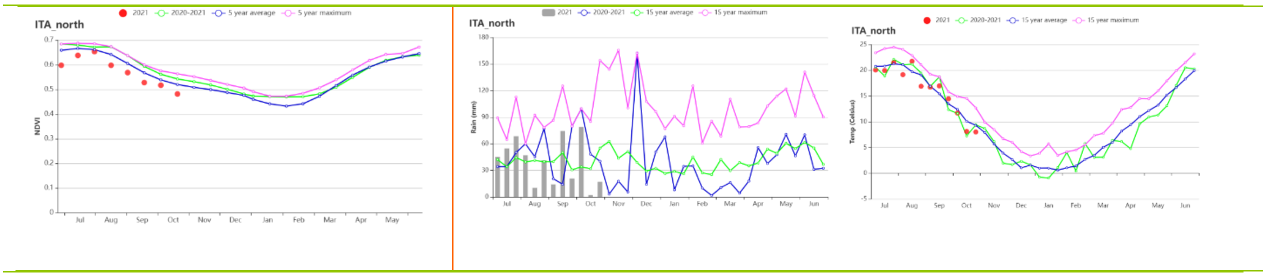
(c) Maximum VCI



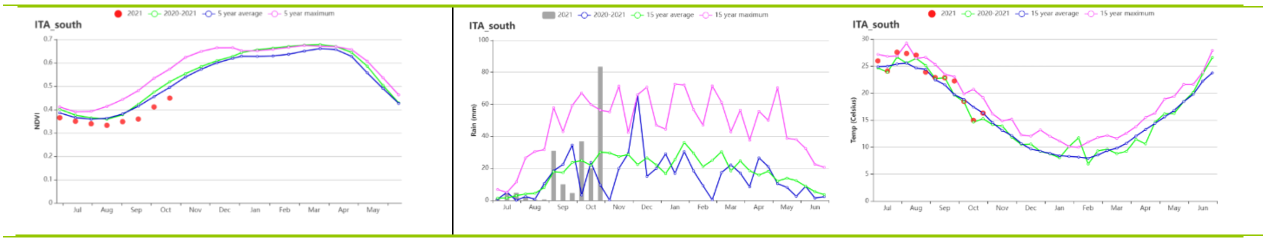
(d)Spatial distribution of NDVI profiles.



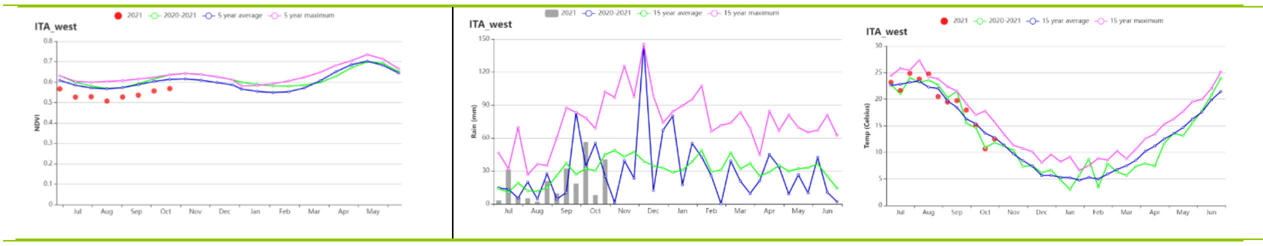
(e) Crop condition development graph based on NDVI, RAIN and TEMP (East Italy).



(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. 36 Italy's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, April 2021-July 2021

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
East Coast	182	-23	21	0	1166	0	659	-9
Po Valley	475	-2	16	0	1075	0	836	-5
Islands	199	26	23	1	1268	-1	604	6
Western Italy	234	-16	20	0	1162	-1	697	-7

Table 3. 37 Italy's agronomic indicators by sub-national regions, current season's values and departure from 5YA, April 2021-July 2021

Region	Cropped arable land fraction		Maximum VCI
	Current (%)	Departure (%)	Current
East Coast	53	-20	0.59
Po Valley	99	0	0.83
Islands	53	-15	0.59
Western Italy	91	-4	0.69

[KAZ] Kazakhstan

This report covers the growth and harvest of spring wheat In Kazakhstan. The crop conditions were generally below average from July to October. Compared to the 15-year average, accumulated rainfall and radiation were above average (RAIN +23%, RADPAR +1%), while temperature was below average (TEMP -0.3°C). The dekadal precipitation was above the 15-year maximum in early and mid-July. The dekadal temperature reached the 15-year maximum in early July, while in October, it dropped by 4.5°C below average.

The national average maximum VCI index was 0.64 and the Cropped Arable Land Fraction (CALF) was below the 5YA by 26%. The cropping intensity (CI) was slightly below average by 1%. The spatial VCIx map matched well with the national crop condition development graphs. About 79.5% of croplands in most of the northern and central regions experienced unfavorable crop conditions from July to August. About 21.5% of croplands, which were mainly distributed in the north of Pavlodar and Shyghys Kazakhstan states, experienced favorable crop conditions from July to September. Although there was above-average railfall in July, the drier-than-usual conditions from April to June had a negative impact on the growth of spring wheat. Therefore, the spring wheat production was below average, as indicated by the NDVI curves which trended below the 5YA and last year's data.

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).

The Northern region is the main spring wheat production area. Although the accumulated rainfall was above average by 20%, the rainfall deficit in the last monitoring season had a significant negative impact on wheat growth. According to NDVI profiles, crop conditions were below average during the monitoring period. The average VCIx for this region was 0.60, and the proportion of cultivated land was 31% lower than the average. The cropping intensity (CI) was slightly below average by 1%. The spring wheat production is estimated to be below average.

The Eastern plateau and Southeastern region had the largest positive precipitation departure (RAIN +24%) among the three regions, while temperature was below average (TEMP -0.3°C). Crop conditions in this region were below average during this reporting period. The average VCIx for this region was 0.76, and CALF was below average by 9%. The cropping intensity (CI) was close to the five-year average. Outputs for spring wheat are unfavorable.

The South region received 42 mm of rainfall, which was the lowest among the three regions. Due to the deficit of rainfall (RAIN -24%), the potential biomass decreased by 13%. The average VCIx for this region was 0.64 and CALF was below average by 22%. The cropping intensity (CI) was near average. The NDVI profiles show poor crop condition in this season. The lower soil moisture due to the rainfall deficit indicate unfavorable conditions for the sowing of winter crops in this region.

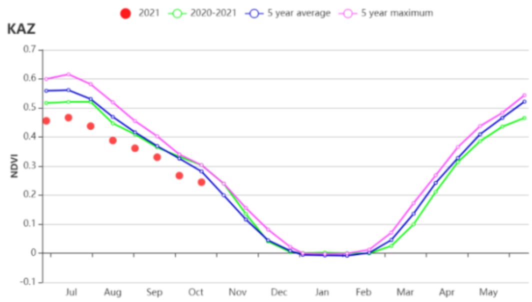
Figure 3.23 Kazakhstan’s crop condition, July – October 2021

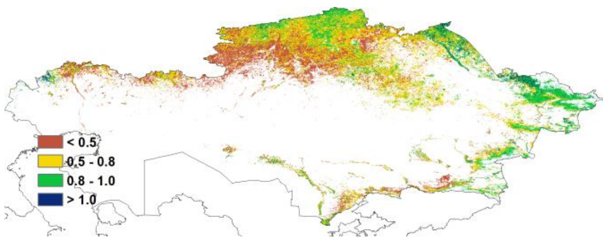
	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Wheat (Spring)												

Sowing Growing Harvesting

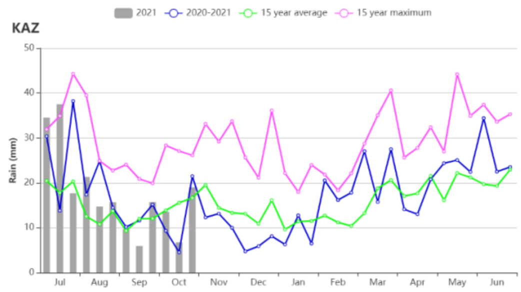
Maize Wheat Soybean Rice

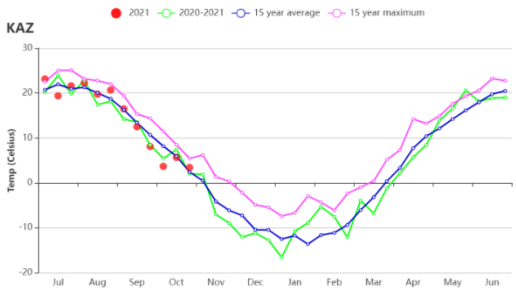
(a). Phenology of major crops



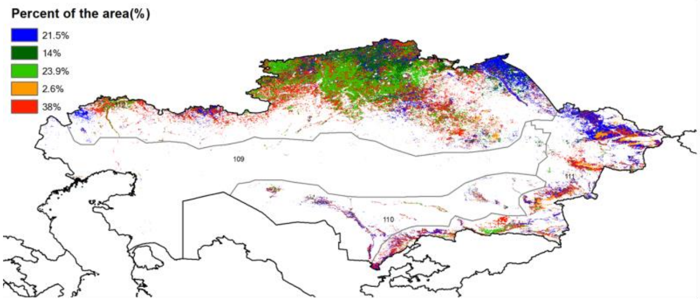


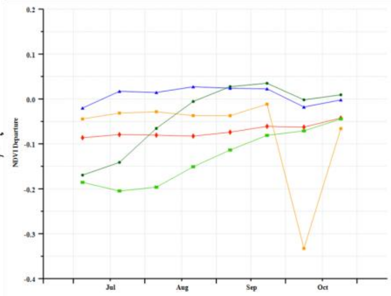
(b) Crop condition development graph based on NDVI (c) Maximum VCI



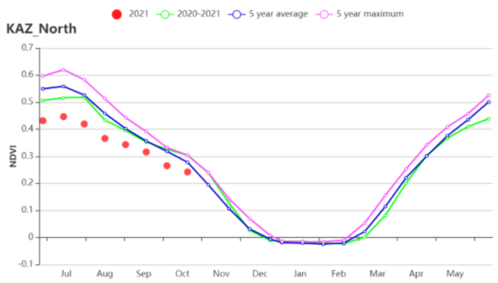


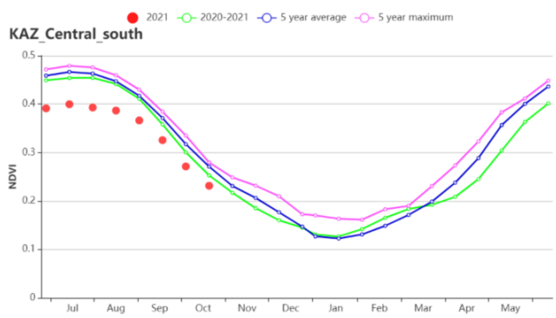
(d) Rainfall Index (e) Temperature Index



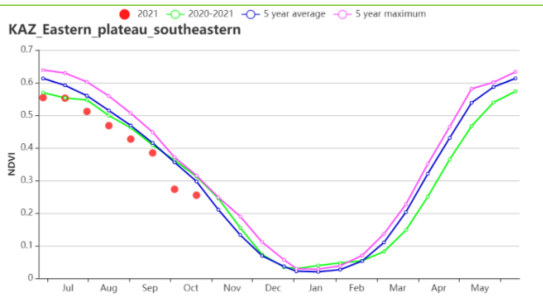


(f) Spatial NDVI patterns compared to 5YA (g) NDVI profiles





(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 3.1 Kazakhstan agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July – October 2021

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Northern region	198	20	14. 2	−0. 4	944	2	616	9
Eastern plateau and southeastern region	281	24	14. 5	−0. 3	1155	0	611	8
South region	42	−24	21. 7	0. 2	1273	2	298	−13

Table 3.2 Kazakhstan, agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2021

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Northern region	57	-31	99	-1	0.60
Eastern plateau and southeastern region	75	-9	100	0	0.76
South region	46	-22	100	0	0.64

[KEN] Kenya

Kenya has two rainy seasons. The long rainy season lasts from March to May and the short rainy season lasts from October to December. Maize can be grown during the long and short rains, whereas wheat is grown during the long rains only. During this reporting period, the long rain maize and wheat were harvested, and the short rain maize was at the sowing stage.

At the national scale, precipitation was 228 mm, 34% below average. Temperature and radiation was close to average. Due to the shortage of rainfall, the BIOMSS was 13% lower than average. At the sub-national level, almost all regions received less rainfall. The NDVI development graph at the national level shows lower-than-average NDVI values from July to October, it indicates crop growth conditions were significantly below average. This was mainly due to a significant decrease in rainfall. According to the NDVI clusters and the corresponding NDVI departure profiles, western Kenya accounting for 45.6% of national cropland (areas in green color) had near-average NDVI values, while other areas showed significant deviations in crop growth. This was in agreement with the maximum VCI graph which shows relatively low VCI between 0.5 and 0.8 in the central and southeastern regions. In general, crops in Kenya were affected by the drought, with the exception of the north-western region.

Regional analysis

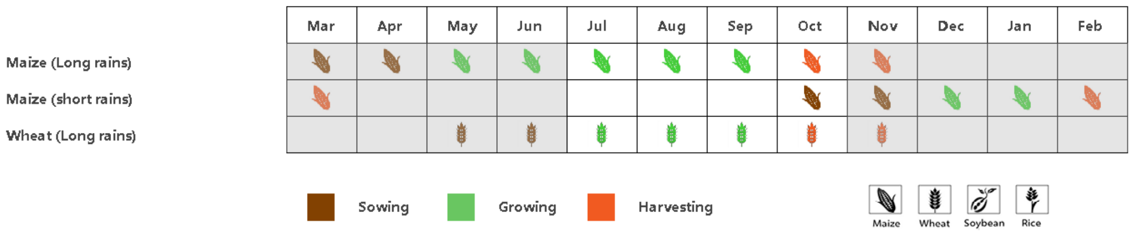
The largest negative departure in RAIN were observed in the **Eastern coastal region**, with 0.3°C above average TEMP and 5% above average RADPAR. The shortage of rainfall resulted in a 9% drop of BIOMSS and significant drop of NDVI compared with the 5YA throughout the monitoring period. The drought conditions also resulted in a reduction of crops planted area as indicated by a 24% drop in CALF compared to the 5YA. The maximum VCI was only 0.61. The Cropping Intensity was 143%, which was the highest in the four regions. In general, the crop condition were unfavorable in the coastal area with poor prospect for livestock and crop production.

The **Highland agriculture zone** recorded 248 mm of rain, which was below the 15YA (-31%). Although temperatures and RADPAR were close to average, significantly lower precipitation resulted in significant reductions in biomass (-13%). The NDVI was slightly below the 5YA from July to October. The maximum VCI value recorded was 0.71. The CALF was reduced (-13%) to 71%. The Cropping Intensity was 142%. Overall, crop growth has been severely affected by drought conditions in the upland agricultural areas where rainfall was below average.

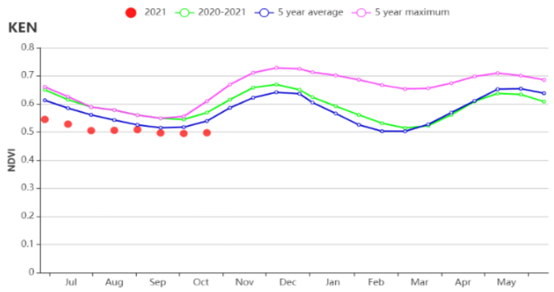
In **Northern rangelands region**, the precipitation was below average at 173 mm (-34%). Temperature was close to the 15YA, whereas RADPAR was above average (+2%). BIOMSS was below average (-12%). The below-average trend of its crop condition development graph indicates that the region was affected by drought. The maximum VCI was only 0.58, the lowest among the four AEZs in Kenya. Furthermore, the CALF was reduced (-25%) to 48%. The Cropping Intensity was 139%. All in all, the situation of crop growth in this area was very unfavorable.

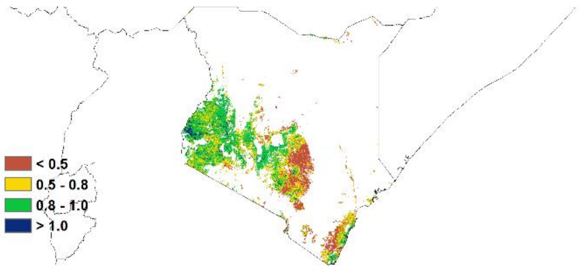
The **Southwest region** includes the districts Narok, Kajiado, Kisumu, Nakuru, and Embu. Precipitation was at 309 mm，41% below average. The following indicator values were observed: TEMP 19.1°C (-0.1°C); RADPAR (-3%) and BIOMSS (-17%) both decreased. NDVI values generally closely followed the five-year average. Despite the large variation in precipitation, its CALF and RADPAR were stable and the VCIx value remained at a level of 0.85. The Cropping Intensity was 138%, which is the lowest in the four regions. This indicates normal crop growth in this region.

Figure 3.24 Kenya's crop condition, July-October 2021

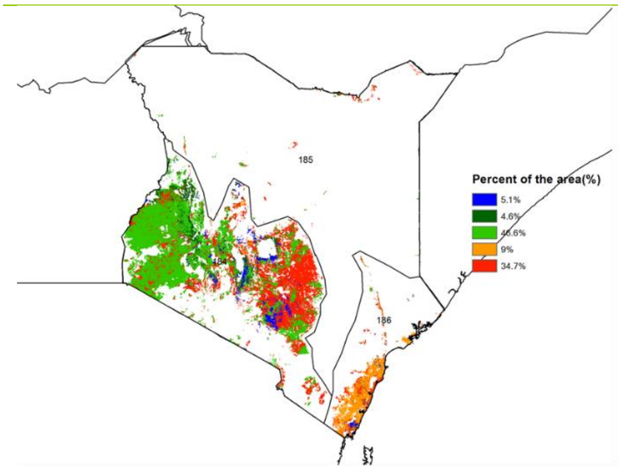


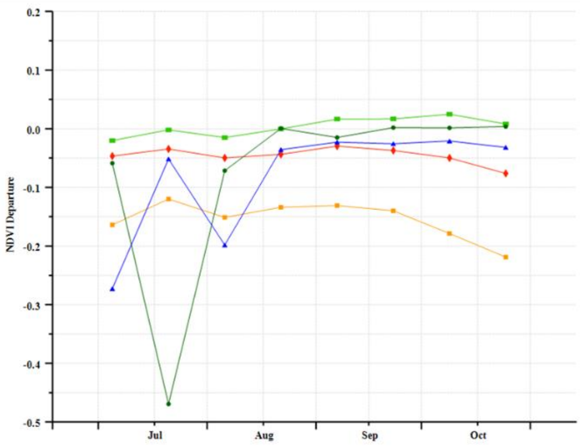
(a) Phenology of major crops



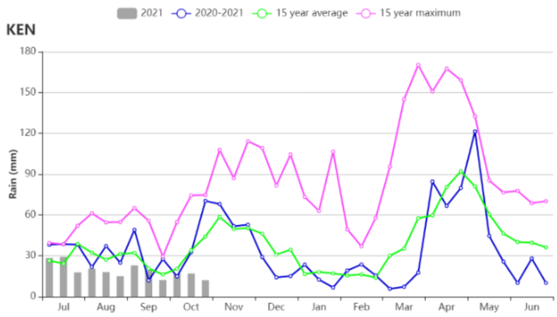


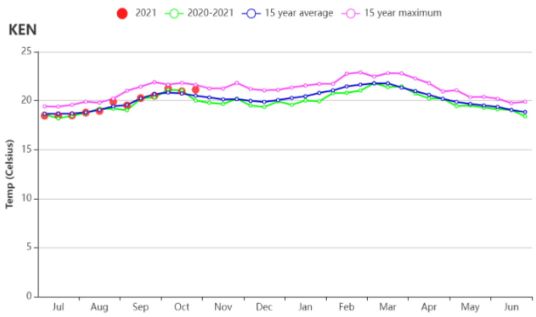
(b) Crop condition development graph based on NDVI (c) Maximum VCI



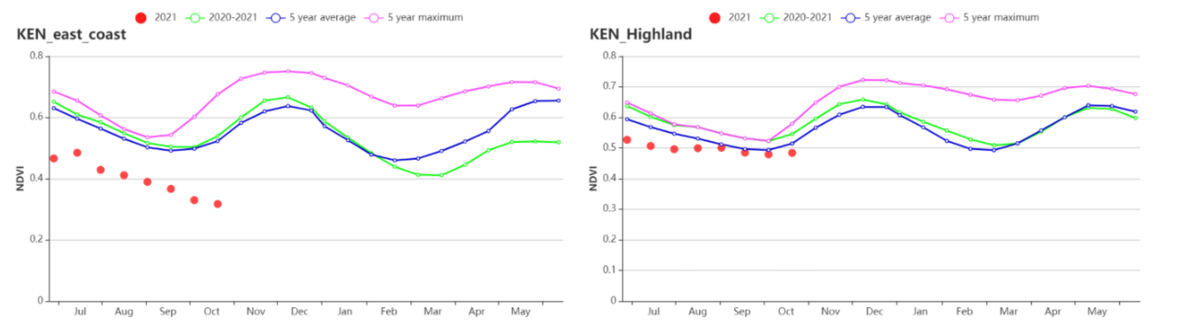


(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles

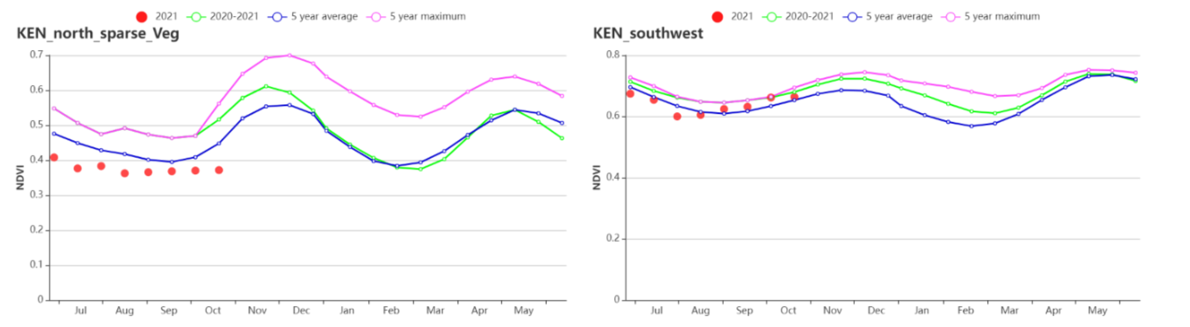




(f) Time series rainfall (g) Time series temperature



(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)

Table 3.40 Kenya's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July -October 2021

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m2)	Departure (%)	Current (gDM/m2)	Departure (%)
Coast	148	-41	24.6	0.3	1288	7	773	-9
Highland agriculture zone	248	-31	18.4	0.1	1120	-1	598	-13
nothern rangelands	173	-34	22.9	0.2	1259	2	630	-12
South-west	309	-41	19.1	-0.1	1177	-3	813	-17

Table 3.41 Kenya's agronomic indicators by sub-national regions, current season's values and departure, July - October 2021

Region	Cropped arable land fraction		Maximum VCI	Cropping Intensity CI	
	Current (%)	Departure (%)	Current	Current (%)	Departure (%)
Coast	71	-24	0.61	143	2
Highland agriculture zone	71	-13	0.71	142	4
northern	48	-25	0.58	139	-3

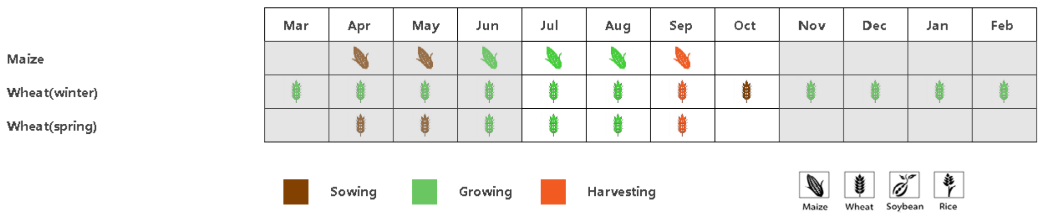
rangelands					
South-west	100	1	0.85	138	-10

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

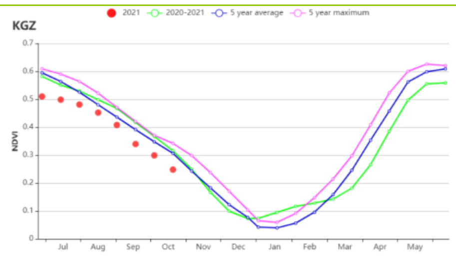
[KGZ] Kyrgyzstan

The reporting period covers the growth and harvest of wheat and maize. On the whole, crop conditions were below the 5-year average throughout the whole monitoring period. Among the CropWatch agro-climatic indicators, RAIN (+24%) increased largely, RADPAR (+1%) was slightly above average, while TEMP (-0.2 ℃) was below average. The combination of these factors resulted in a slightly below-average BIOMSS (-1%). as compared to the 15YA. The time series precipitation profile shows that precipitation was higher than average and even exceeded the 15-year maximum in early July. The temperature profile indicates that temperatures were a bit lower than the 15-year average in middle July, early to middle August and October. The spatial NDVI clustering profile shows that only 15.5% of the cultivated area (marked in blue) had average or above-average crop conditions, the remaining cultivated area all had below-average crop conditions. 42% of the cultivated area (marked in orange and dark green) had below-average crop conditions at the beginning of the monitoring period and then had the tendency to recover to near-average crop conditions. 10.4% of the cultivated area had close-to-average crop conditions, and then the crop conditions dropped to an even lower level at the end of the monitoring period, mainly located in northeastern Osh, eastern Talas, southeastern Jalal-Abad and central Naryn. The spatial pattern of maximum Vegetation Condition Index (VCIx) was in accord with the spatial distribution of the NDVI profiles. CALF decreased by 11% and the nationwide VCIx average was 0.73, which is in line with the unfavorable NDVI trend. Cropping intensity is 99%, slightly down 1%. Crop conditions in Kyrgyzstan can be assessed as unfavorable, and the crop prospect is not promising.

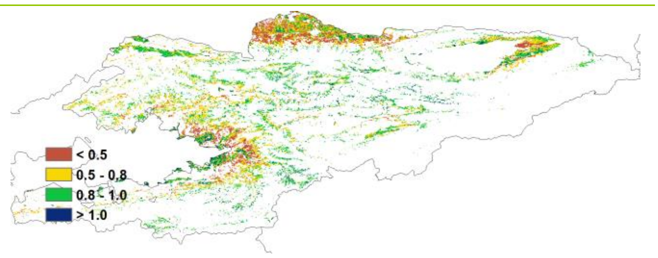
Figure 3.25 Kyrgyzstan's crop condition, July - October 2021



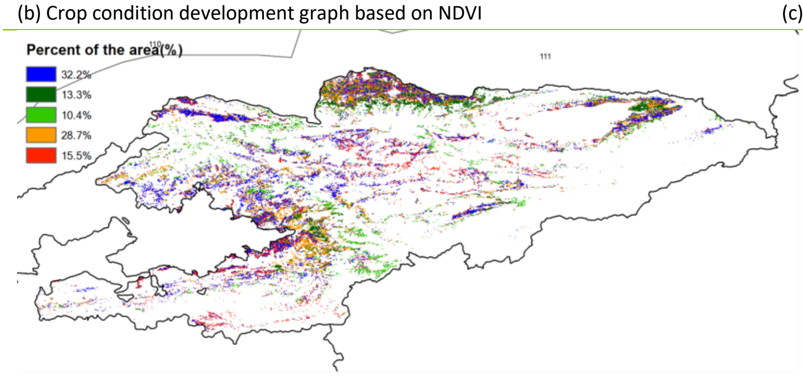
(a). Phenology of major crops

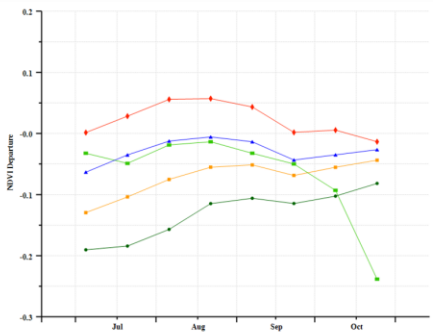


(b) Crop condition development graph based on NDVI



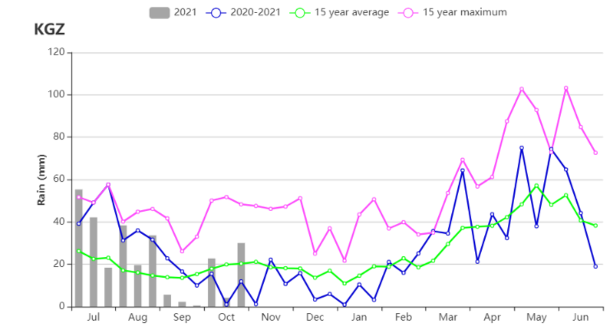
(c) Maximum VCI



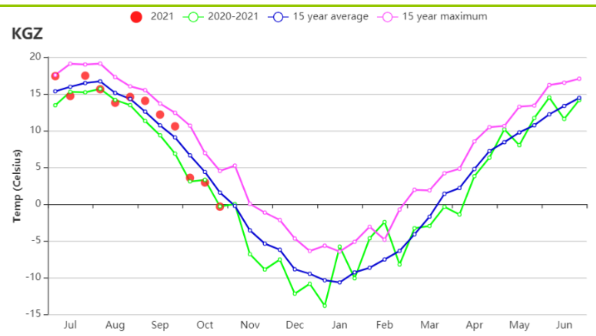


(d) Spatial NDVI patterns compared to 5YA

(e) NDVI profiles



(f) Rainfall profiles



(g) Temperature profiles

Table 3.38 Kyrgyzstan's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2021

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m^2)	Departure (%)	Current (gDM/m^2)	Departure (%)
Kyrgyzstan	273	24	11.4	-0.2	1304	1	474	-1

Table 3.39 Kyrgyzstan's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2021

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Kyrgyzstan	80	-11	99	-1	0.73

[KHM] Cambodia

This monitoring period covers the wet season in Cambodia, which lasts from May to October. The planting period of wet-season early rice and floating rice ended in July. It was followed by medium rice and late rice, which was completed in September and October, respectively. Harvest of the soybean and wet season maize ended in August and October, respectively.

Cambodia experienced wetter weather than usual during this monitoring period. As shown by the agro-climatic indicators, the precipitation (RAIN +5%) was above the 15YA, which can mainly be attributed to several tropical storms. Both the typhoon Cempakm in July and the tropical storms in September brought strong wind and rain, damaged the crops and decreased the NDVI. This is reflected in the NDVI profiles, although cloud cover in the satellite images can also cause large negative departures in NDVI. Temperatures were near average, and the radiation slightly increased (RADPAR +1%). The estimated potential biomass increased (BIOMSS +2%). The CALF was higher than average by 1% and the VCIx value was at 0.9. Moreover, the NDVI for the country was slightly lower than the average at the end of the monitoring period. All in all, the crop conditions were close to normal in Cambodia. The NDVI of 10.7% (orange color) of the arable land is mainly located in the southeast of Banteay Meanchey and the middle of Kampong Thom. It remained near or slightly below average until mid-August. For about 25.8% of the cropland, stable and slightly higher-than-average NDVI was observed. These croplands (blue color) were mainly located in Kandal, southern Preyveng, southern Svay Rieng and other areas scattered around the Tonle-Sap. The rest of the croplands (light green, dark green and red color) remained slightly below average for most of the monitoring period. All in all, the crop conditions were below average in the important Tonle Sap Lake area and near average for the rest of the country.

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.

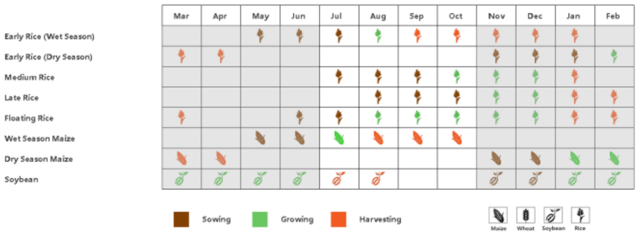
For the **Tonle Sap Lake** area, the rainfall (RAIN) increased by 12% while the temperature (TEMP) and radiation (RADPAR) were near average. In addition, the estimated biomass (BIOMSS) grew by 3%. Inflow from the Mekong River remained far below the long-term average, resulting in negative NDVI departures. As a result, the crop condition in this region was estimated below average.

The **Mekong valley** region experienced relatively dryer weather. The rainfall dropped by 2% (RAIN) and temperature increased by 0.2℃. The radiation was higher than average (RADPAR +1%). This resulted in a biomass estimate that was almost near average. According to the NDVI profile, although the NDVI fluctuated all the time, it recovered to average levels at the end, indicating the crop condition in this region was close to normal.

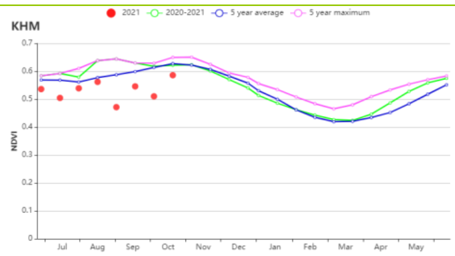
In the **Northern plain and northeast** region, the precipitation (RAIN) was 5% higher than average, accompanied by average temperature (TEMP) and above-average radiation (RADPAR, +3%). The resulted biomass (BIOMSS) increased by 2% and the VCIx value reached 0.93, which was the largest for all four regions. Moreover, the CALF stayed at 99%. All the indicators show that the crop growth for this region was good.

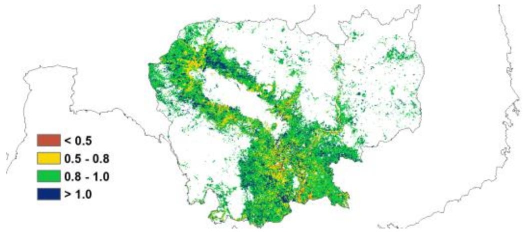
The **Southwest Hilly** region went through a wetter (RAIN, +9%) and slightly warmer period (TEMP, +0.2℃) compared to the 15YA. Although the radiation decreased (RADPAR -3%), the estimated biomass was near average (BIOMSS, no change). According to the NDVI profile, although the NDVI fluctuated, it recovered to average levels at the end of monitoring period, which indicates normal crop conditions.

Figure 3.26 Cambodia's crop condition, July - October 2021



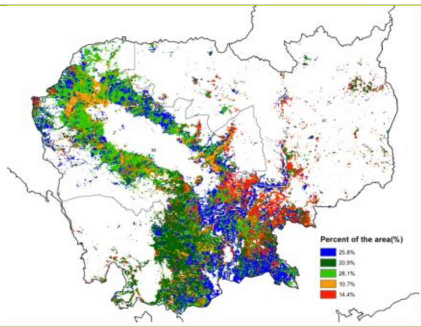
(a). Phenology of major crops

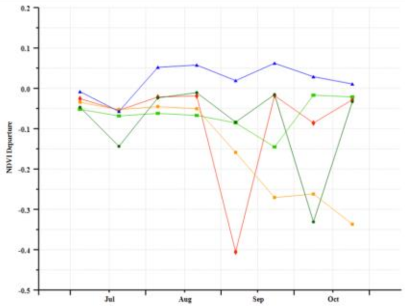




(b) Crop condition development graph based on NDVI

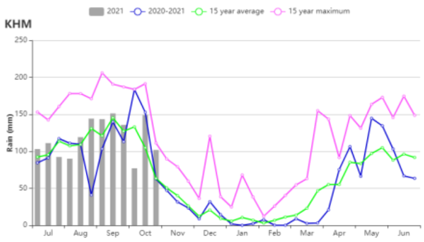
(c) Maximum VCI

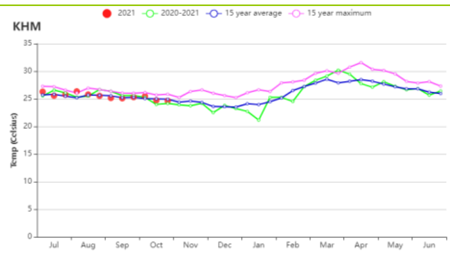




(d) Spatial NDVI patterns compared to 5YA

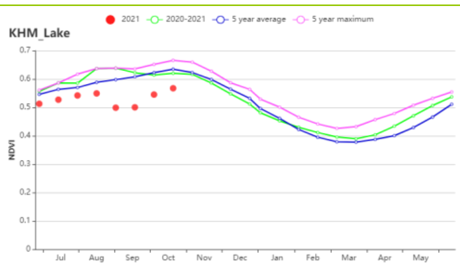
(e) NDVI profiles

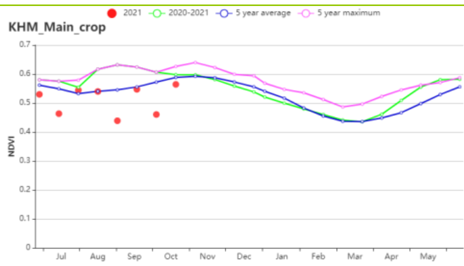




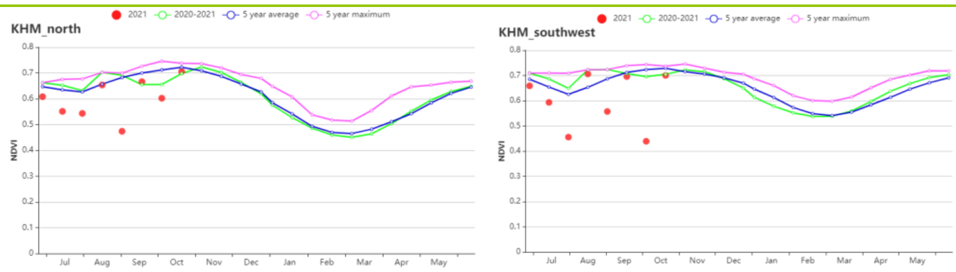
(f) Rainfall profiles

(g) Temperature profiles





(h) Crop condition development graph based on NDVI_Tonle-sap (left) and NDVI_Mekong valley (right)



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

Table 3.40 Cambodia's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2021

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Tonle-sap	1253	12	25.7	0.1	1102	0	1593	3
Mekong valley	1188	-2	26.0	0.2	1123	1	1604	0
Northern plain and northeast	1668	5	25.2	0.0	1089	3	1624	2
Southwest Hilly region	1367	9	24.6	0.2	1058	-3	1540	0

Table 3.41 Cambodia's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2021

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Tonle-sap	99	1	106	-8	0.90
Mekong valley	96	1	117	-6	0.90
Northern plain and northeast	99	0	102	-13	0.93
Southwest Hilly region	99	0	106	-17	0.93

[LKA] Sri Lanka

This report mainly covers the second season (Yala) of Sri Lanka, including the growing and harvesting of rice and maize from July to September, as well as the main season (Maha) early sowing of the crops in October. According to the CropWatch monitoring results, crop conditions were assessed as slightly below average for the monitoring period.

During this period, the country experienced the Southwest-Monsoon from July to September and the Second Inter-monsoon in October, during which the whole island experienced wide spread rain with strong winds. At the national level, precipitation was significantly above the 15YA (RAIN +33%), temperature was near average (TEMP -0.1°C) while radiation experienced a minor increase (RADPAR +4%). The remarkable increase of rainfall in early July ensured sufficient water supply for the crops and further contributed to the good crop condition. The fraction of cropped arable land (CALF) was comparable to the 5YA. BIOMSS was up by 12% compared to the 15YA. As shown in NDVI development graph, NDVI was generally close to, yet below average during the period. The maximum VCI for the whole country was 0.93.

As shown by the NDVI clusters map and profiles, nearly half of country's cropland showed above-average crop condition while the rest showed unfavorable situation with negative NDVI departures. These croplands were mainly distributed along the west coast of the country, including Provinces of North Western, Western, Southern and Sabaragamuwa, as well as scattered areas over Provinces of Northern Central and Eastern. The maximum VCI showed high values around the country excepted for some areas along the east coast.

Regional analysis

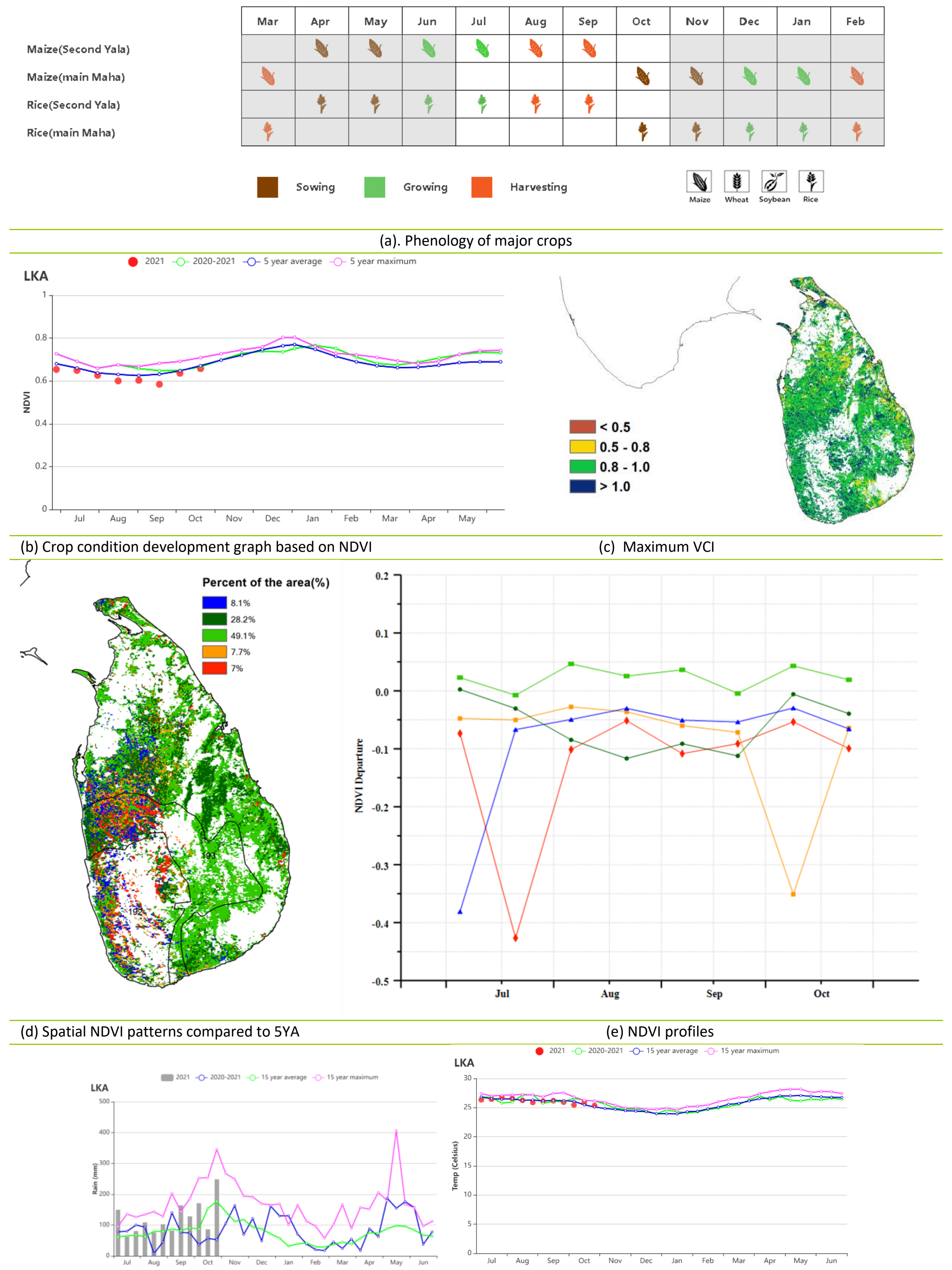
Based on the cropping system, climatic zones and topographic conditions, three sub-national agroecological regions can be distinguished for Sri Lanka. They are the Dry zone, the Wet zone, and the Intermediate zone.

In the **Dry zone**, the recorded RAIN (735 mm) was 23% above average. TEMP was 0.1°C below average and RADPAR was up by 4%, while BIOMSS increased by 16% as compared to the 15YA. CALF was near the 5YA level with 98% of cropland utilized. NDVI slightly fluctuated around the average. The VCIx for the zone was 0.91. Overall, crop conditions were near average for this zone.

For the **Wet zone**, RAIN (2958 mm) was 39% above average as compared to the 15YA. TEMP was average and RADPAR increased by 3%. BIOMSS was 3% above the 15YA and cropland was fully utilized. NDVI values showed significant deviation from average for the whole period. The VCIx value for the zone was 0.98. Crop conditions were below average for this zone.

The **Intermediate zone** also experienced sufficient rain (1563 mm) with a 39% increase from the 15YA. TEMP dropped by 0.2°C and RADPAR was 11% above average compared to the 15YA. With full use of cropland, BIOMSS was 2% above average. The NDVI values were similar to the whole country and the VCIx value for this zone was 0.96. Conditions of crops were close to average.

Figure 3.27 Sri Lanka's crop condition, July - October 2021



(a). Phenology of major crops

(b) Crop condition development graph based on NDVI

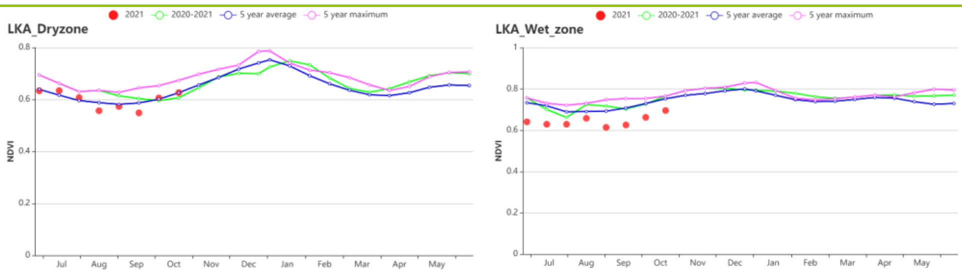
(c) Maximum VCI

(d) Spatial NDVI patterns compared to 5YA

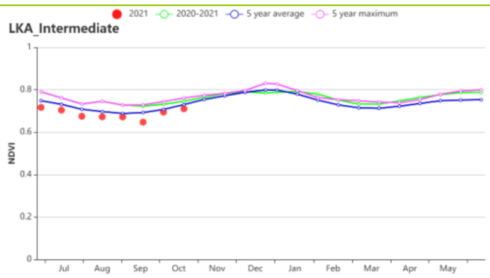
(e) NDVI profiles

(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 3.42 Sri Lanka's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2021

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m^2)	Departure (%)	Current (gDM/m^2)	Departure (%)
Dry zone	735	23	27.1	-0.1	1303	4	868	6
Wet zone	2958	39	24.1	0.0	1195	3	801	3
Intermediate zone	1563	39	24.5	-0.2	1177	2	769	2

Table 3.43 Sri Lanka's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2021

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Dry zone	98	1	147	3	0.91
Wet zone	100	0	106	-8	0.98
Intermediate zone	98	1	147	3	0.91

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

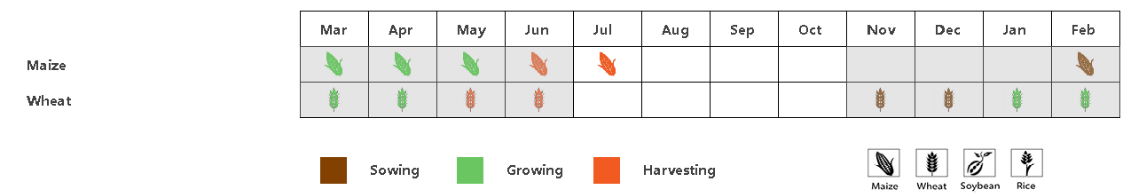
[MAR] Morocco

The reporting interval (July - October) covers only a part of irrigated maize harvested in July; no cereal crops are grown during this monitoring period (a slack season). The sowing of winter wheat starts in November. The cumulative rainfall was 38 mm, which is lower than the 15-year average (15YA) by 56%. The rainfall profile shows that the rainfall fell mainly during mid-September (> 20 mm). The average temperature was 22.9°C, which was higher than the 15YA by only 0.2°C. The temperature profile fluctuated around the average.

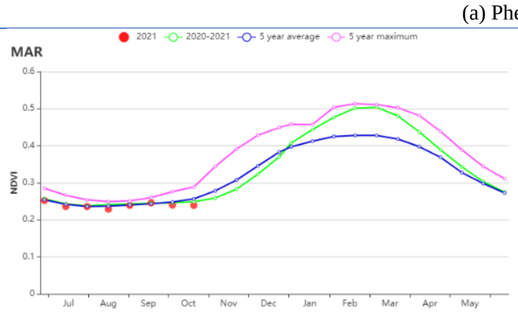
Regional analysis

CropWatch adopts three agro-ecological zones (AEZs) relevant to crop production in Morocco: the Sub-humid northern highlands, the Warm semiarid zone, and the Warm sub-humid zone. For the three zones in their listed order, respectively, rainfall was below the 15YA by 52%, 66%, and 49%; the temperature was higher than the 15YA by 0.3°C, 0.1°C, 0.2°C; RADPAR was higher than the 15YA by 3%, 4%, 3%; and BIOMSS were below the 15YA by 26%, 30%, 19%. Generally, the NDVI development graph shows that crop conditions were around the average in the three zones. The cropped arable land fraction (CALF) was below the 5YA by 3% and 25%, 10%, accordingly, the Maximum VCI value was 0.58, 0.59, 0.58 for the three zones in their listed order, implying the near-average conditions. Cropping Intensity estimates were at 104%, 101%, and 105% for the three zones in their listed order, respectively, indicating all regions dominated by single cropping during the investigation period.

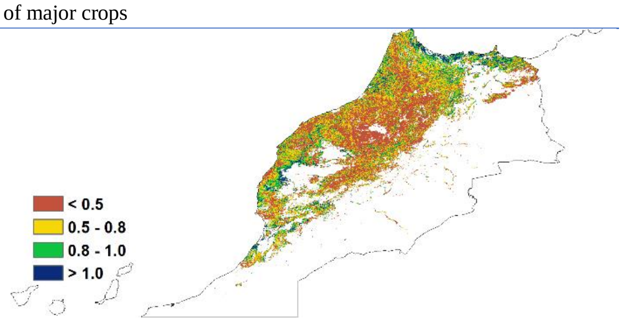
Figure 3.28 Morocco's crop condition, July - October 2021



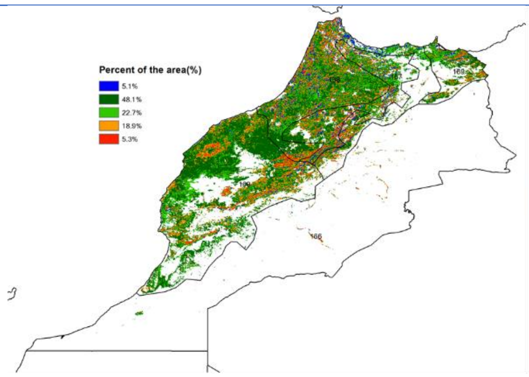
(a) Phenology of major crops

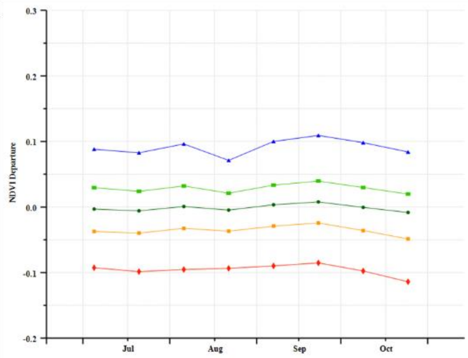


(b) Crop condition development graph based on NDVI



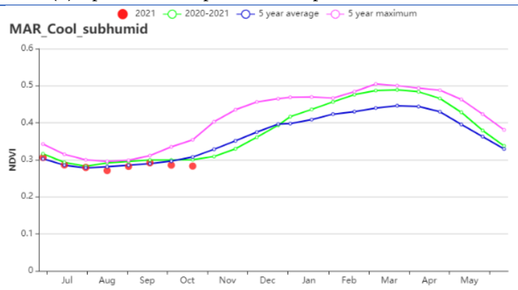
(c) Maximum VCI

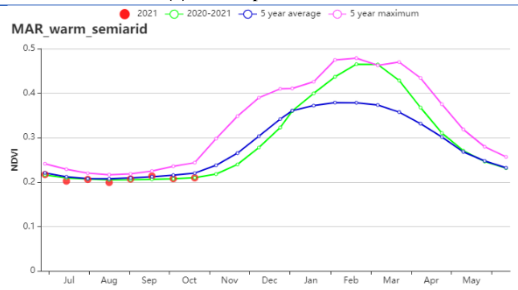




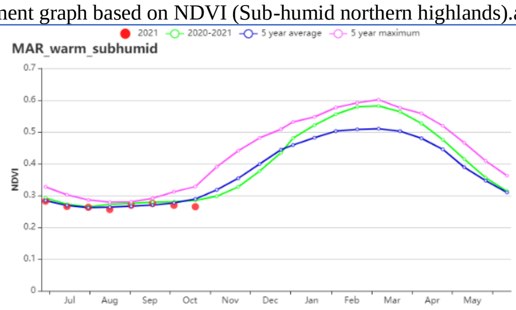
(d) Spatial NDVI patterns compared to 5YA

(e) NDVI profiles

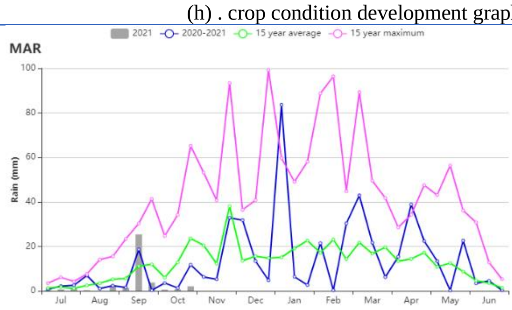


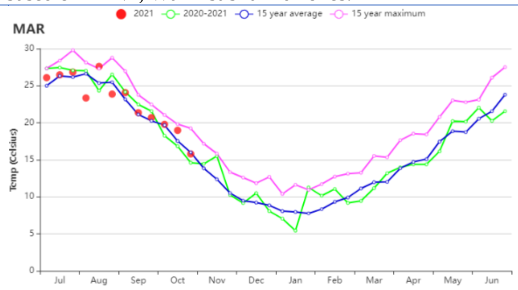


(f). Crop condition development graph based on NDVI (Sub-humid northern highlands).and (g). Warm semiarid zones)



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





(i) Time series profile of rainfall

(j)Time series profile of temperature

Table 3.44 Morocco's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2021

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 (%)
Sub-humid northern highlands	50	-52	23	0.31	1396	3	365	-26
Warm semiarid zones	24	-66	23	0.10	1429	4	309	-30
Warm sub-humid zones	51	-49	23	0.18	1389	3	400	-19

Table 3.45 Morocco's agronomic indicators by sub-national regions, current season's values and departure from 15YA/5YA, July - October 2021

Region	CALF		Cropping Intensity		Maximum VCI
	Current (%)	Departure from 5YA (%)	Current (%)	Departure from 5YA (%)	Current
Sub-humid northern highlands	17	-3	104	0	0.58
Warm semiarid zones	2	-25	101	-1	0.59
Warm sub-humid zones	12	-10	105	2	0.58

[MEX] Mexico

Maize is the most important crop grown in Mexico. In the rainfed production regions of the country, maize reached maturity in September and October. The sowing of irrigated maize started in September. Its main production region is in Sinaloa, in the northwest. Winter wheat sowing begins in November. Both soybean and rice reached maturity by the end of this reporting period.

The CropWatch agroclimatic indicators show that TEMP and RAIN were close to average and RADPAR was above average (+3%). Accordingly, BIOMSS increased by 1% as compared to the 15YA. CALF was close to average and reached 91% and cropping intensity decreased by 3%. Favorable weather conditions and relatively high CALF made the VCI reach 0.92.

In terms of Agro-climatic conditions, the national precipitation and temperature was at the average level during the monitoring period of this bulletin. According to figure b, crop growth was also at an average level. According to VCI spatial patterns, very high values (greater than 1.0) occurred mainly in eastern coastal areas, including Tamaulipas. Extremely low values (less than 0.5) occurred in the northeast border area, mainly in the Nuevo León, Coahuila de Zaragoza and western coastal areas.

As shown in the spatial NDVI profiles and distribution map, 20.8% of the total cropped areas were above average during the entire monitoring period, mainly distributed in the northeast coastal and border areas. 50.7% of the total cropped areas were at an average level. Only 7.8% of the total cropped areas were below average, mainly in Sinaloa. In addition, 14.1% of the total cropped areas were at an average level in July and August and below average in September and October. This phenomenon may be caused by the harvest stage of maize and rice and other summer crops.

Overall, the crop conditions were at an average level. Although the crop land was affected by severe drought in winter, the agro-climatic conditions gradually returned to the normal level by April, so the impact of drought on crop growth was limited and a favorable production of the summer crops is estimated.

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. According to the NDVI development graph, crop condition in this region was close to average before September. CALF increased by 3% compared with the 5YA. The agro-climatic condition showed that RAIN increased by 3% and TEMP decreased by 0.1°C and RADPAR increased by 4%. The Arid and semi-arid region was the most drought affected region and the VCIx was 0.88.

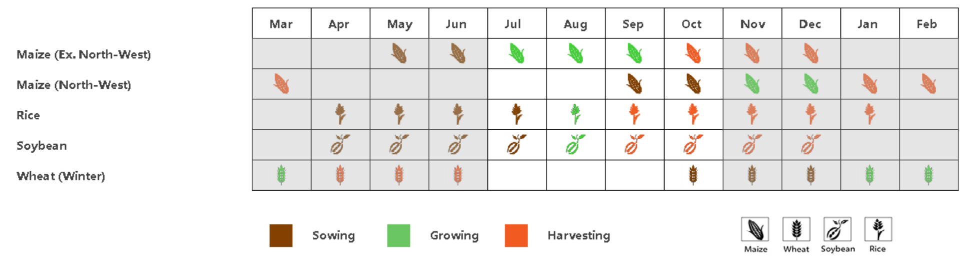
The region of Humid tropics with summer rainfall is located in southeastern Mexico. Conditions were favorable. RAIN was slightly below average (-2%), TEMP was 0.2℃ warmer and RADPAR increased by 5% and BIOMSS increased by 3%. As shown in the NDVI development graph, crop conditions were close to average from July to October. The VCIx (0.93) confirmed favorable crop conditions in this region.

The Sub-humid temperate region with summer rains is situated in central Mexico. According to the

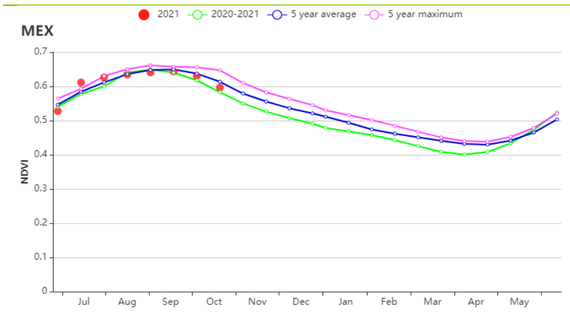
NDVI development graph, crop conditions were close to average in July and below average in August, but then recovered to average levels. The agro-climatic conditions were close to the average level. RAIN increased by 4%, TEMP increased by 0.1°C , and RADPAR increased by 1% compared to the 15YA. BIOMSS was also near average and CALF was 99%. Favorable meteorological conditions and high CALF made VCIx reach 0.96.

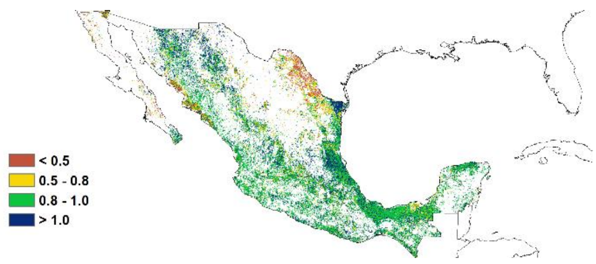
The region called Sub-humid hot tropics with summer rains is located in southern Mexico. During the monitoring period, crop conditions were below average in August and closed to average in other months as shown by the NDVI time profiles. Agro-climatic conditions were closed to average levels, including RAIN (+1%), TEMP (+0.2℃) and RADPAR (+3%). The VCIx for the region was 0.95 and BIOMSS was near average.

Figure 3.29 Mexico's crop condition, July-October 2021

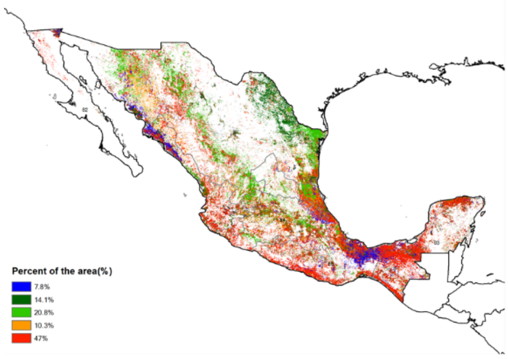


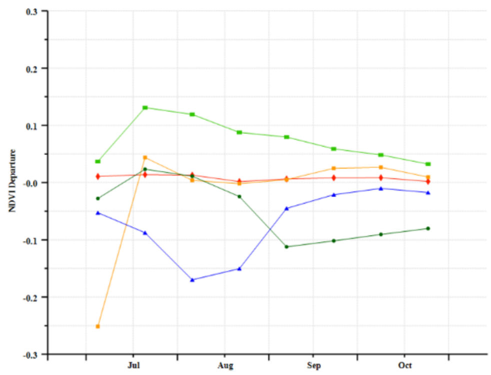
(a) Phenology of major crops



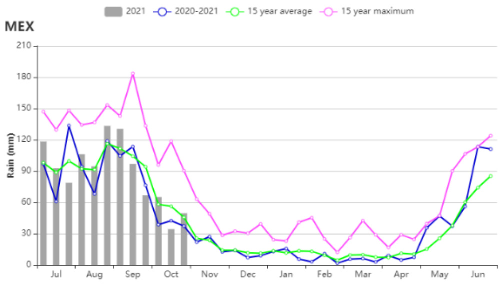


(b) Crop condition development graph based on NDVI (c) Maximum VCI

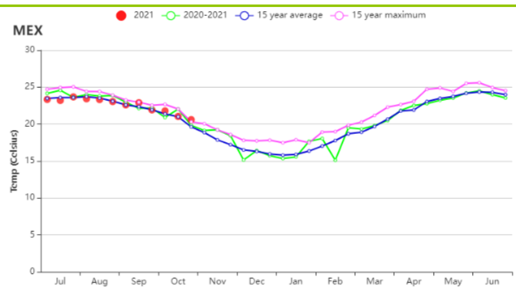




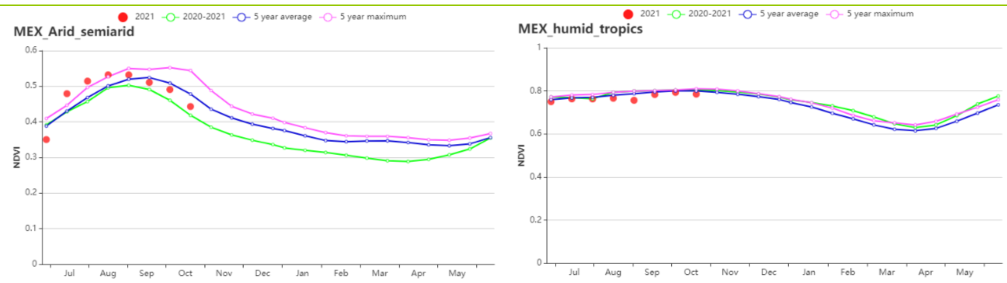
(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles



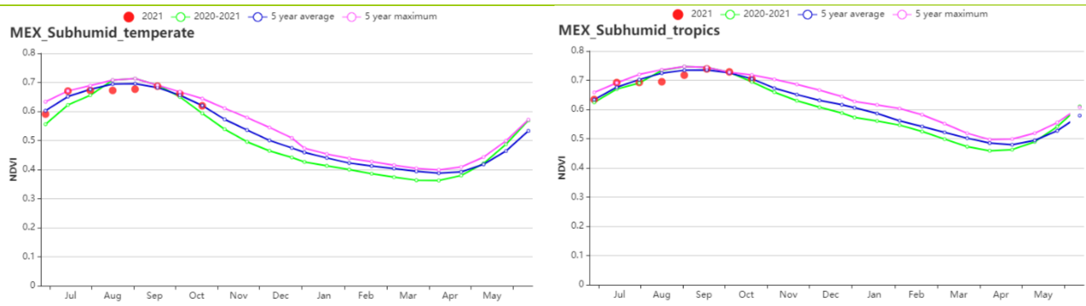
(f) Rainfall profiles



(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 3.46 Mexico's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July – October 2021

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	747	3	22.6	-0.1	1339	4	1056	2
Humid tropics with summer rainfall	1252	-2	25.1	0.2	1324	5	1495	3
Sub-humid temperate region with summer rains	1258	4	18.8	0.1	1230	1	1165	0
Sub-humid hot tropics with summer rains	1241	1	22.5	0.2	1265	3	1293	0

Table 3.47 Mexico's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July – October 2021

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Central region	82	3	98	-7	0.88
Dry region	100	0	112	1	0.93
Dry and irrigated cultivation region	99	1	104	-3	0.95
Dry and grazing region	96	1	110	-1	0.95

[MMR] Myanmar

This reporting period was dominated by the monsoon season. It will be followed by the drier and cooler winter months. The main rice growing season started in June and ended in October. The planting of maize and wheat started in September. According to the CropWatch monitoring results, crop conditions in Myanmar were below average during this monitoring period.

Compared to the 15YA, RAIN was lower (-13%) while TEMP was higher (+0.6ºC), and RADPAR was up by 7%. As a result, BIOMSS was 2% below the average. The utilization of cropland was close to the 5YA. NDVI values were below average during the entire period, especially in early August and late September. The maximum VCI during this period was 0.94.

A majority of the country’s croplands suffered from slightly below-average crop conditions during the period. The above-average crop condition with positive NDVI departures only occurred in August. These areas accounted for 66.8% of the cropland and were mainly located in Mandalay Regions, as well as scattered areas over Regions of Bago, Ayeyarwady, Yangon, Tanintharyi and States of Shan, Kayin and Mon. The abnormally low NDVI departure values could be caused by cloudy weather. The maximum VCI showed high values over most regions of the country.

Regional analysis

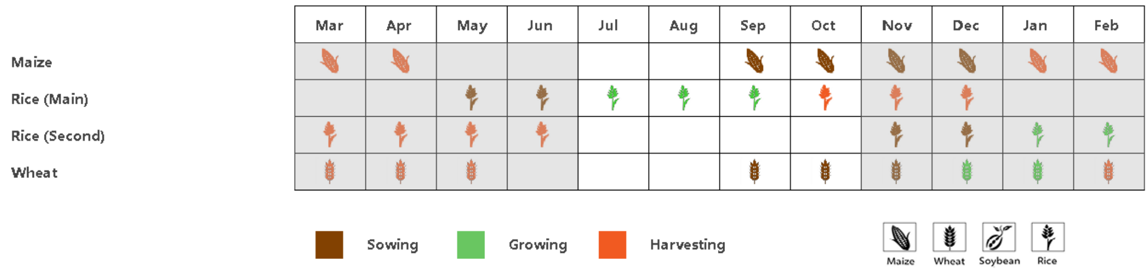
Three sub-national agro-ecological zones (AEZ) can be distinguished for Myanmar based on the cropping system, climatic zones and topographic conditions. They are the Central plain, the Hills and the Delta and Southern Coast regions.

The **Central Plain** had a marked rainfall deficit (RAIN -26%), with RADPAR up by 8% and TEMP up by 0.9ºC compared to the 15YA. BIOMSS was 5% lower than the 15YA. CALF showed that 98% of the cropland was fully utilized, and it was 1% above the 5YA. NDVI was consistently below the 5YA level during the whole period. The VCIx was 0.94. Crop conditions for this region were slightly below average.

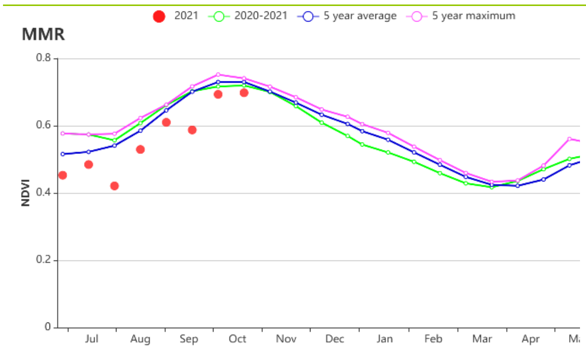
The **Hills** region also had a lack of rainfall, at 1593mm, with RAIN 12% below the 15YA. RADPAR was 9% above average and TEMP increased by 0.5 ºC. BIOMSS was close to the 15YA. The cropland was almost fully used (CALF 99%). The NDVI values were below the 5YA during the whole period. The VCIx was 0.96. Crop conditions are assessed as below the 5YA level.

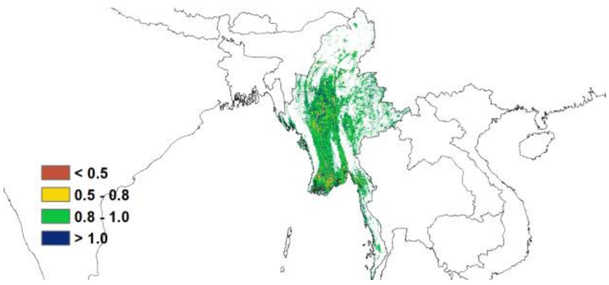
The **Delta and Southern Coast** region had the highest RAIN (1849 mm) compared with the other two sub-national regions, but it was still 8% below the 15YA. TEMP and RADPAR increased by 0.3ºC and 5% respectively. BIOMSS was close to the 15YA. CALF was comparable to the 5YA and VCIx was 0.92. The NDVI values were below the 5YA except for July and late August, when they were near average. Crop conditions in this region were below average.

Figure 3.30 Myanmar's crop condition, July - October 2021



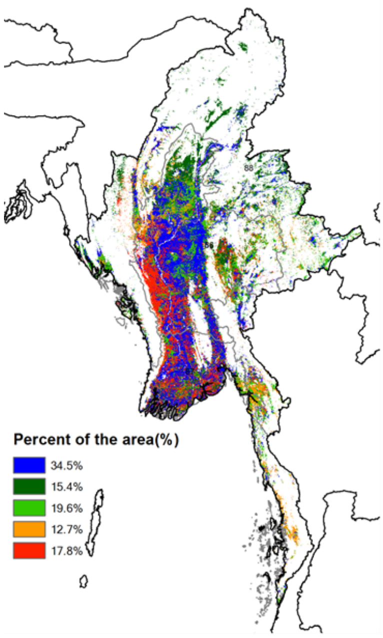
(a). Phenology of major crops

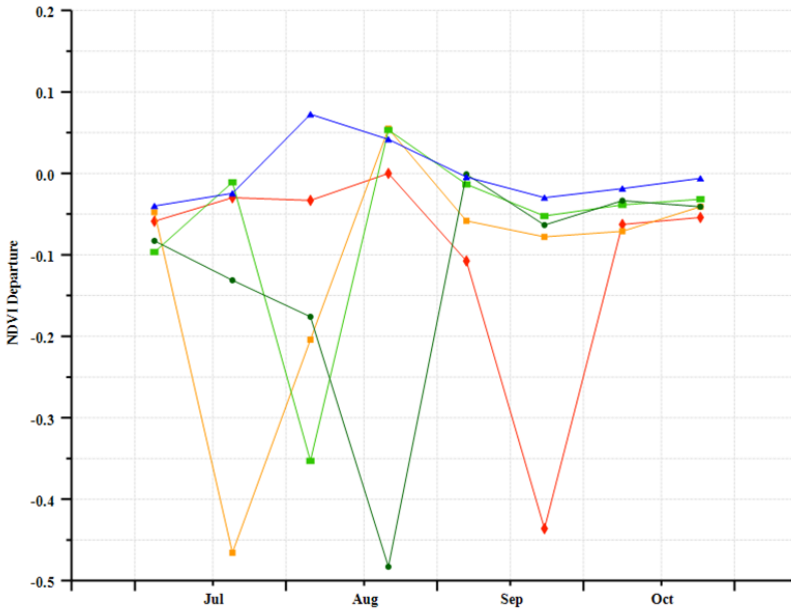




(b) Crop condition development graph based on NDVI

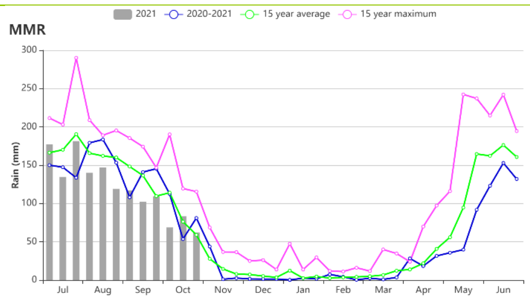
(c) Maximum VCI

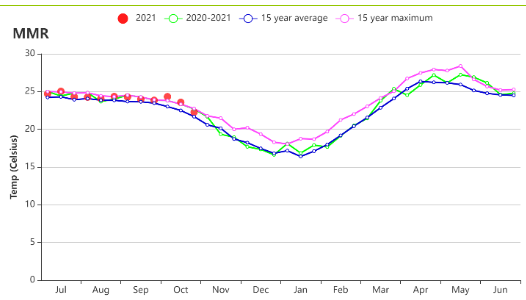




(d) Spatial NDVI patterns compared to 5YA

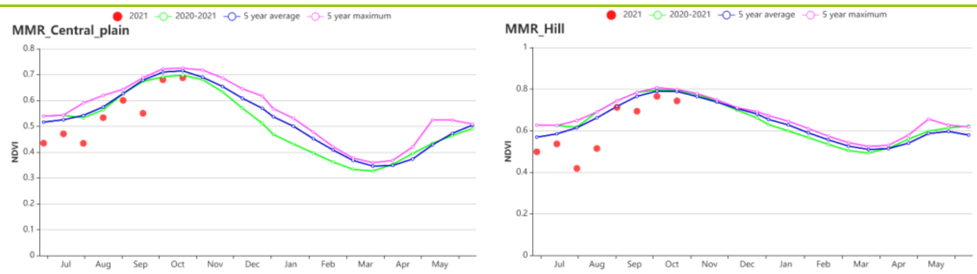
(e) NDVI profiles



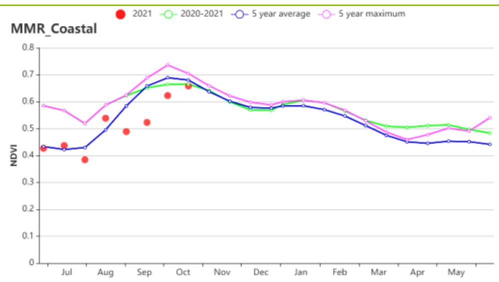


(f) Rainfall profiles

(g) Temperature profiles



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



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

Table 3.48 Myanmar's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2021

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Central plain	864	-26	24.9	0.9	1133	8	733	5
Hills region	1593	-12	22.9	0.5	1041	9	635	4
Delta and southern-coast	1849	-8	26.0	0.3	1137	5	773	5

Table 3.49 Myanmar's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2021

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Central plain	98	1	95	-10	0.94
Hills region	99	0	104	-4	0.96
Delta and southern-coast	95	1	118	-5	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

[MNG] Mongolia

This reporting period from July to October covers the humid summer and autumn season in Mongolia, which corresponds to the main growing stage and harvesting stage of wheat in September, the main cereal crop in Mongolia. Among the CropWatch agroclimatic indicators, RAIN was above the 15YA (+36%), while TEMP and RADPAR were slightly below average (-0.6°C and -4%). The sufficient rainfall helped increase the estimated biomass by 12% as compared to the 15YA. The national VCIx was 1.02, the cropped arable land fraction increased by 1.5%, and the cropping intensity was 102, which had increased by 2% compared to the 5YA.

The spatial NDVI patterns map shows that the NDVI indices of 79.1% of areas in Mongolia were above average compared with the 5YA, and the maximum VCI map also demonstrates favorable crop conditions in the major crop production region.

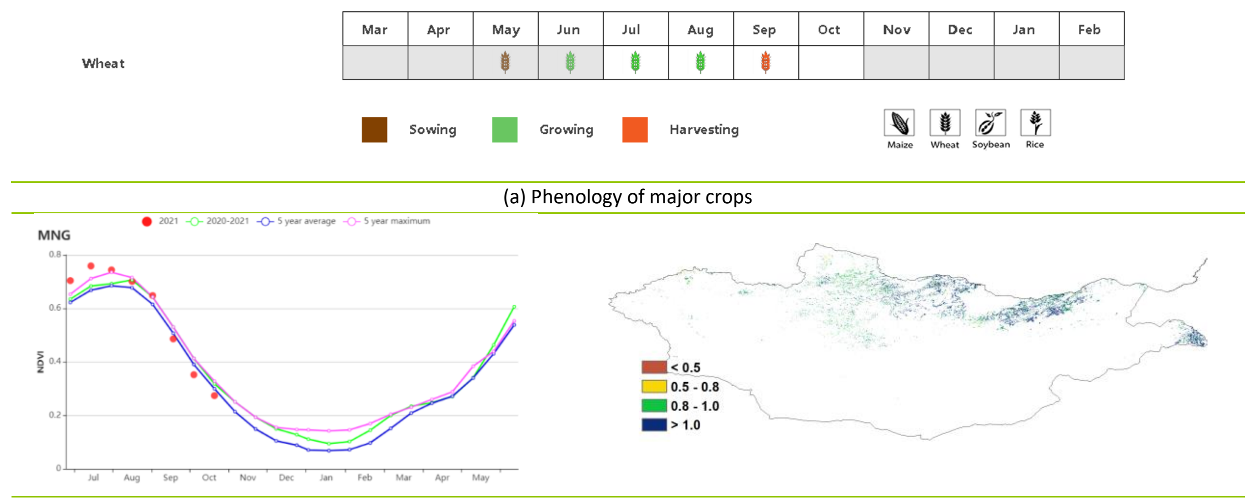
Regional analysis

Hangai Khuvsgul Region: TEMP and RADPAR decreased by 0.5°C and 5%, while RAIN was 49% above average. Accordingly, BIOMSS increased by 7% from the 15YA. The maximum VCI index was 0.97 and the cropped arable land fraction was 100%, up by 1%. The NDVI profile was above average and near the five-year maximum from July to early September. In conclusion, the crop conditions in Hangai Khuvsgul Region were favorable.

Selenge-Onon Region: TEMP and RADPAR were slightly below average (-0.8°C and -4%), while RAIN was above average (+28%). The BIOMSS increased by 11% compared to the 15YA. The maximum VCI index was 1.04, and the cropped arable land fraction increased by 1%. Crop conditions were significantly above the five-year maximum from July to August, and the maximum VCI indices of most areas were greater than 0.8. Overall, for this important agricultural production region of Mongolia, the crop production prospects were positive.

Central and Eastern Steppe Region: According to the NDVI development graph, crop conditions were above the five-year maximum from July to September. Rain was above average (+59%), while TEMP and RADPAR were below average (-0.6°C and -6%). Benefitting from the increased rainfall, BIOMSS increased by 32% compared to 15YA. The maximum VCI index was 1.04, and the cropped arable fraction increased by 2%. Overall crop prospects were favorable.

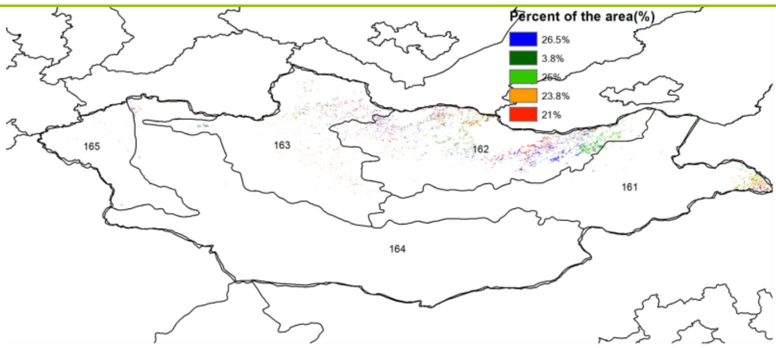
Figure 3.31 Mongolia's crop condition, July - October 2021



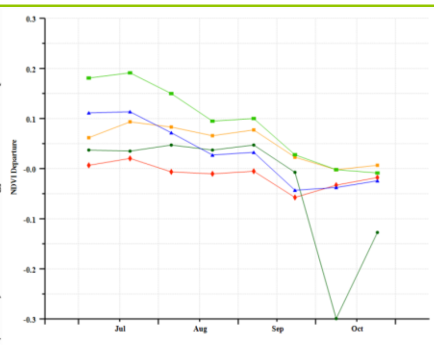
(a) Phenology of major crops

(b) Crop condition development graph based on NDVI

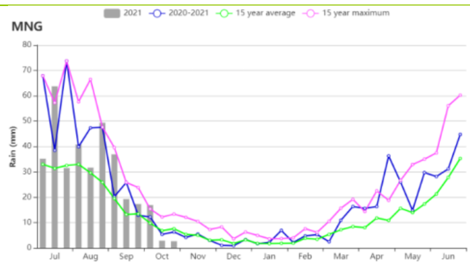
(c) Maximum VCI



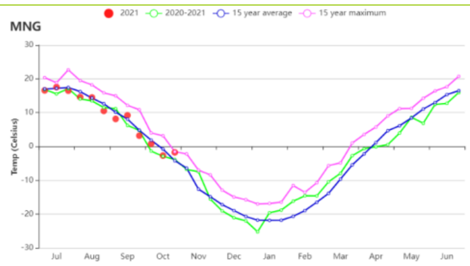
(d) Spatial NDVI patterns compared to 5YA



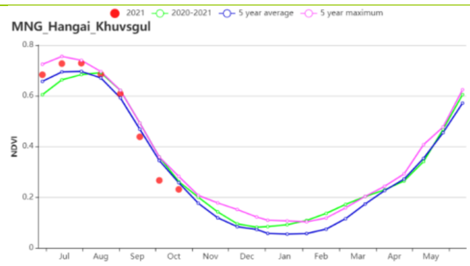
(e) NDVI profiles

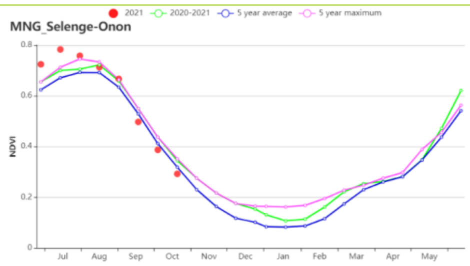


(f) Rainfall profiles

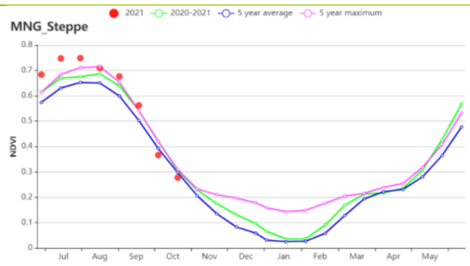


(g) Temperature profiles

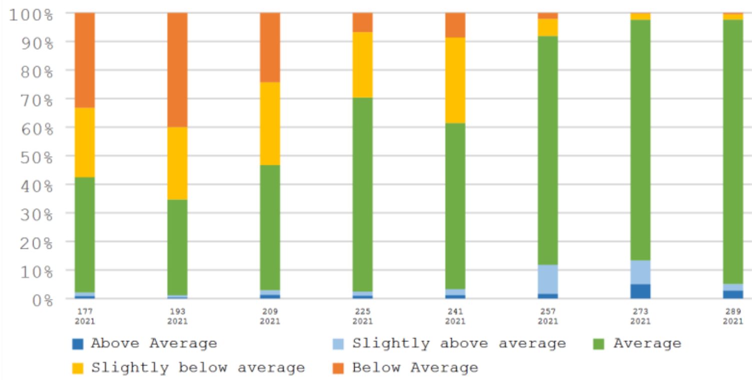




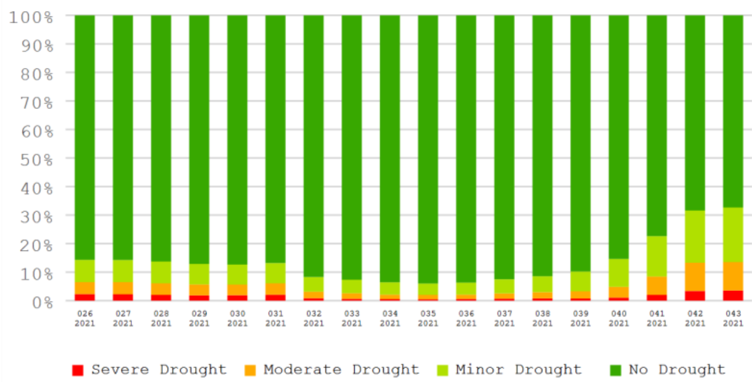
(h) Crop condition development graph based on NDVI (Hangai Khuvsgul Region (left) and Selenge-Onon Region (right))



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



(j) Proportion of NDVI anomaly categories compared with 5YA in Mongolia



(k) Proportion of VHIm categories compared with 5YA in Mongolia

Table 3.50 Mongolia's agroclimatic indicators by sub-national regions, current season's values, and departure from 15YA, July - October 2021

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m^2)	Departure (%)	Current (gDM/m^2)	Departure (%)
Hangai Khuvsgul Region	420	49	6.4	-0.5	1006	-5	658	7
Selenge-Onon Region	329	28	9.4	-0.8	998	-4	733	11
Central and Eastern Steppe Region	333	59	12.8	-0.6	978	-6	855	32
Altai Region	360	-5	6.5	-0.4	1052	2	583	4
Gobi Desert Region	195	0	9.8	-0.1	1096	1	509	-1

Table 3.51 Mongolia's agronomic indicators by sub-national regions, current season's values, and departure from 5YA, July - October 2021

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Hangai Khuvsgul Region	100	1	100	0	0.97
Selenge-Onon Region	100	1	102	2	1.04
Central and Eastern Steppe Region	100	2	100	0	1.04
Altai Region	83	4	100	0	0.87
Gobi Desert Region	81	9	101	1	0.91

[MOZ] Mozambique

The monitoring period in the analysis coincides with the dry period in Mozambique. This period covers mostly the land preparation for the 2021/2022 agricultural season. During the same period, the sowing of maize has started in southern Mozambique, followed by rice in late October. The agroclimatic indicators for this period reveal that except for the rainfall and potential biomass (RAIN +17% and BIOMSS +6%), the remaining indicators recorded a drop in about 0.3ºC and 2%, for temperature and radiation, respectively.

Nationwide, the NDVI development graph indicates average crop conditions during the entire monitoring period when compared to the average of the past five years. The maximum VCI recorded for this period was 0.87. The spatial distribution of VCIx across the country shows that better crop conditions were observed along the Limpopo and Zambezi River valleys, the Gùrué district (Zamgbézia province) and Nampula province where irrigation activities and annual crops can be found. Altogether, these regions account for 65.2% of the arable land. With the cropped arable land fraction increasing by 3% and Cropping Intensity about the average, overall, the crop conditions were favourable across the country.

Regional analysis

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

A significant increase in rainfall (RAIN +34%) was recorded in the Buzi basin, while the temperature and radiation decreased by 0.5ºC and 4%. Combined, these conditions led to an increase in the potential biomass production in the region by 14%. The NDVI development graph indicates above-average crop conditions from early August until the end of the monitoring period. With CALF being situated near the average and Cropping Intensity increasing in 8%, the maximum VCI recorded for this region was 0.80.

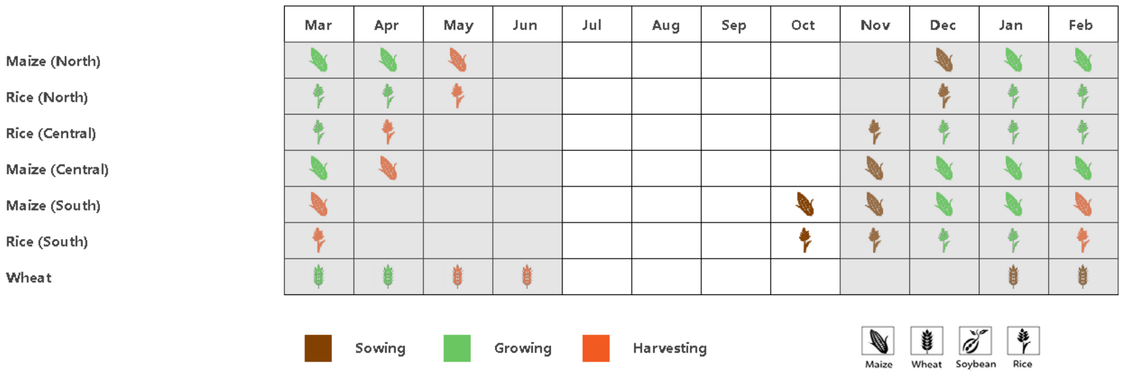
Contrary to the Buzi basin, the rainfall in the Northern High-altitude areas recorded a significant drop by about 30% compared to the average of past fifteen years, followed by decreases in temperature (TEMP -0.1ºC), radiation (RADPAR -1%) and potential biomass (BIOMSS -6%). Even with these conditions, the NDVI development graph indicates close-to-average crop conditions during almost the entire monitoring period. Both the CALF and Cropping Intensity in this region increased by 5% and 1%, respectively, while the maximum VCI recorded was 0.84.

Increases in rainfall (RAIN +16%) were also observed in the Lower Zambezi River basin. Temperature and radiation recorded decreases of about 0.4ºC and 2%, respectively. The potential biomass production increased by 13%. According to the NDVI development graph, crop conditions were favourable compared to the average of the past five years. The region recorded an increase in CALF by 5% and the maximum VCI observed was 0.82.

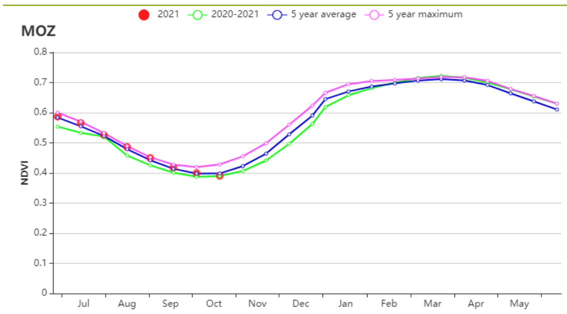
Except for the potential biomass production (BIOMSS +4%), in the Northern coast, all the remaining agroclimatic indicators registered decreased (RAIN -1%, TEMP -0.1ºC, and RADPAR -1%). Crop conditions in this region were near the average of the past five years from July till late August, when the conditions dropped, remaining below the average till the end of the monitoring period. With CALF increasing by 1%, the maximum VCI was 0.89.
In the Southern region, rainfall increased by 19% while both temperature and radiation decreased by 0.5ºC and 4%. The potential biomass production in this region increased by 7% compared to the past fifteen years. These agroclimatic conditions led to above-average crop conditions during the entire monitoring period as indicated by the NDVI development graph. This region recorded the highest increase in CALF (CALF +7%).

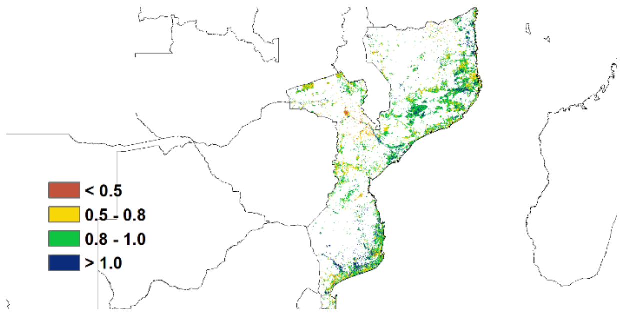
The maximum VCI in this region was 0.90. The region can expect good production prospects of the current maize and rice, which were planted in October.

Figure 3.32 Mozambique's crop conditions, July-October 2021



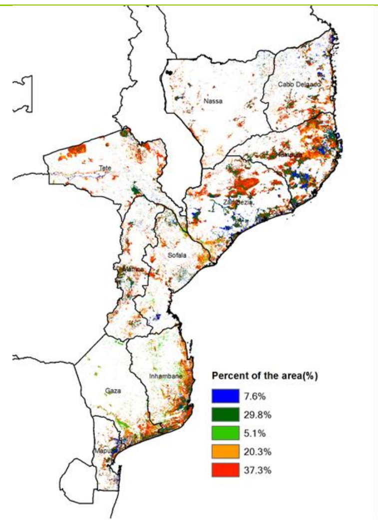
(a) Phenology of major crops

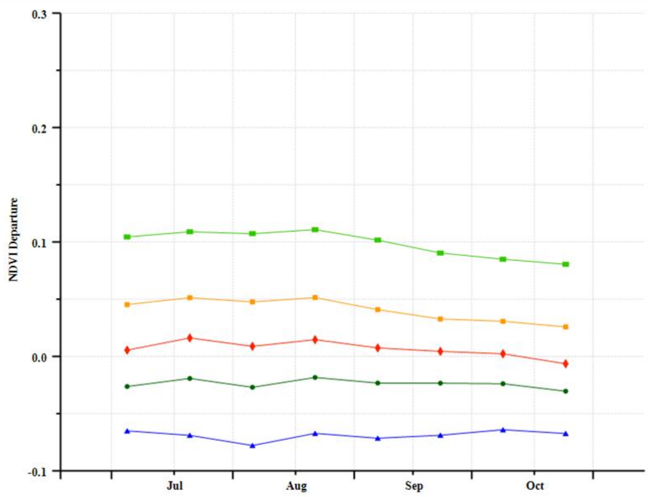




(b) Crop condition development graph based on NDVI

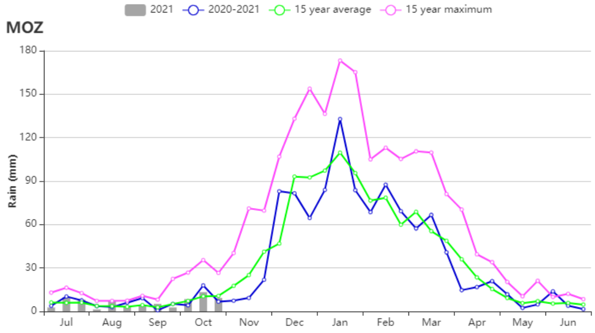
(c) Maximum VCI

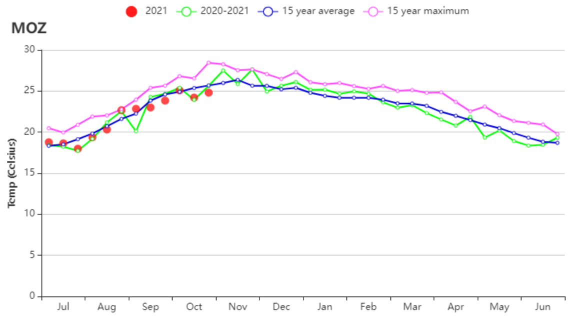




(d) Spatial NDVI patterns compared to 5YA

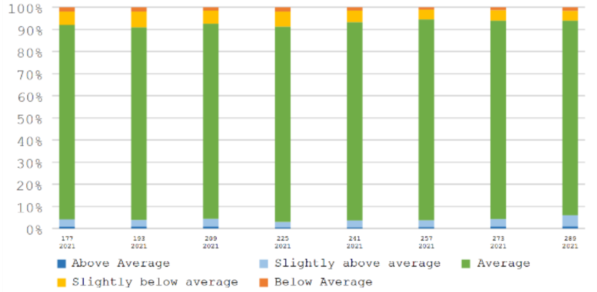
(e) NDVI profiles

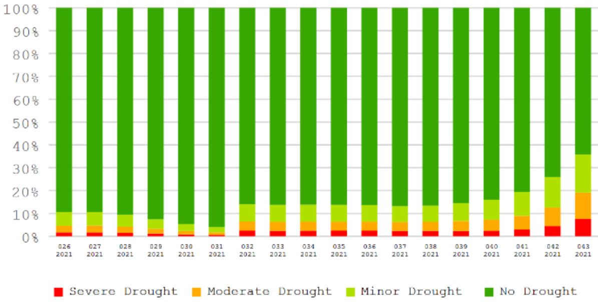




(f) National rainfall profiles

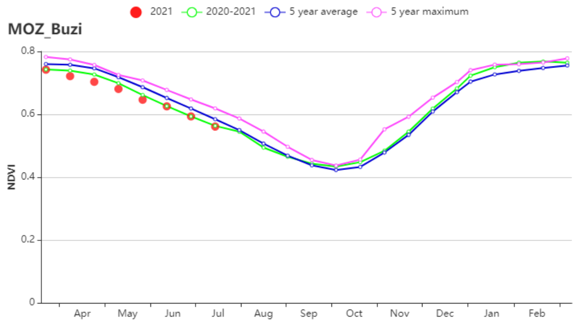
(g) National temperature profiles

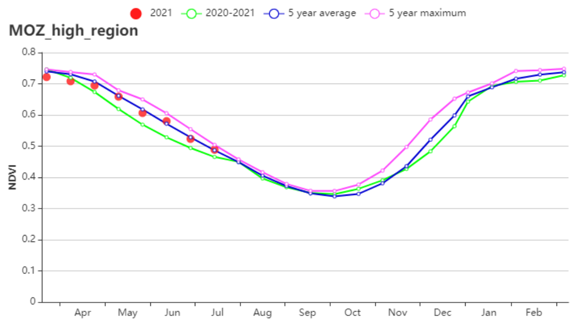




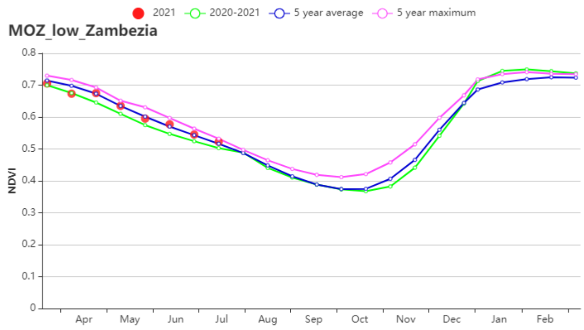
(h) Proportion of NDVI anomaly categories compared with 5YA

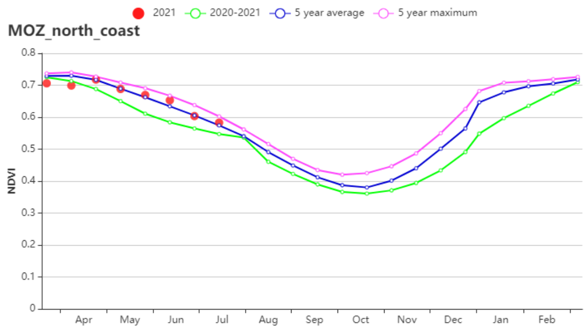
(i) Proportion of VHIm categories compared with 5YA



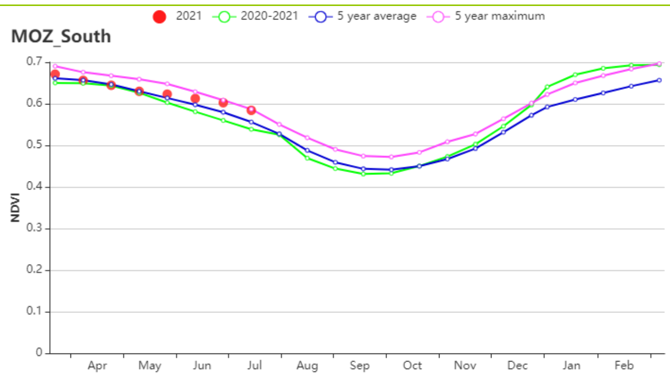


(i) Crop condition development graph based on NDVI-Buzi basin (left), and Northern high-altitude areas (right)





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



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

Table 3.52 Mozambique's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July – October 2021

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Buzi basin	90	34	19.1	-0.5	1174	-4	595	14
Northern high-altitude areas	33	-30	21.7	-0.1	1181	-1	604	-6
Low Zambezia River basin	74	16	21.9	-0.4	1179	-2	646	13
Northern coast	75	-1	22.8	-0.1	1151	-1	667	4
Southern region	106	19	21.2	-0.5	1023	-4	576	7

Table 3.53 Mozambique's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July – October 2021

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure from 5YA (%)	Current (%)	Departure from 5YA (%)	Current
Buzi basin	96	0	108	8	0.80
Northern high-altitude areas	85	5	101	1	0.84
Low Zambezia River basin	75	5	101	0	0.82
Northern coast	98	1	100	0	0.89
Southern region	95	7	100	0	0.90

[NGA] Nigeria

This report covers the main rainy season in Nigeria, during which, maize , rice and other crops such as sorghum are grown. In the northern region, the harvest of the main maize started in August. It was followed by the sowing of the second season maize, which will reach maturity in December or January. In the south, maize was harvested in July and August. The harvesting of rainfed rice was started in August, followed by that of irrigated rice two months later.

The CropWatch agroclimatic indicators show that the rainfall was below the 15YA (-32%) and the average temperature was higher than the 15YA (+0.7°C). Rainfall had stayed below the 15YA starting in late August. Solar radiation increased by 5%. Due to the decline of rainfall, the BIOMSS was below the 15YA (-15%). The observed maximum vegetation condition index (VCIx) was 0.91 and the CALF was lower than the 5YA (-3%).

According to the crop condition development graph based on NDVI, the NDVI of the country was below the 5YA during the reporting period. The maximum VCI graph shows that both higher and lower values appeared mainly in the northern area. As shown in the spatial NDVI profiles and distribution map, 24.5% of the total cropped areas were above the 5YA from the middle July to the end of October. About 42.1% of the total cropped areas were below the 5YA from July to early August and near the 5YA from August to October in the northern area of the country. Overall, the crop conditions in most of the cropped areas were below average.

Regional Analysis

The analysis focuses on four major agroecological zones in the country, i.e., **Sudan-Sahel savanna** region across the northern region, **Guinea savanna and Derived savanna** within the central region and **Humid forest** situated towards the southern region.

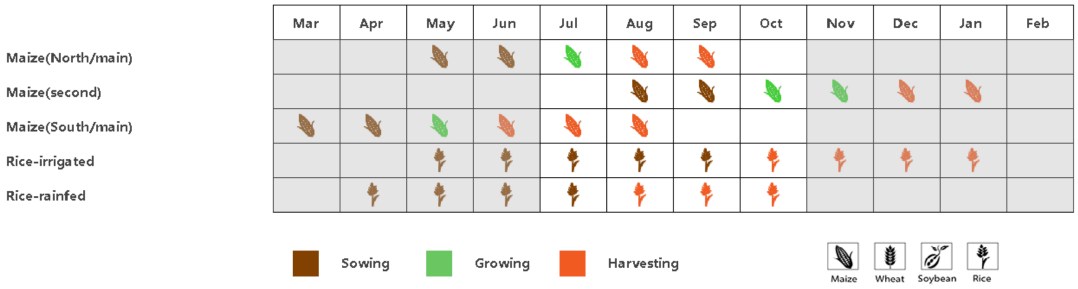
The **Sudan-Sahel savanna** zone is located in northern Nigeria. The agro-climatic condition showed that rainfall decreased by 42% and the overall temperature had increased by 0.6°C. The radiation increased by 2%. The BIOMSS was below the 15YA (-18%). The CALF was 84% and the maximum VCI was 0.89. According to the NDVI development graph, crop conditions in the zone were below average from July to August and near average from September to October.

The **Guinea savanna** region is predominantly located in the central region of the country. Compared to the 15YA, TEMP increased by 0.8°C, RAIN decreased by 42%, RADPAR was 4% above the 15YA, and BIOMSS was below the 15YA (-21%). The CALF was 99% and the maximum VCI was 0.91. According to the NDVI development graph, crop conditions in the region were below average from July to August and near average from September to October.

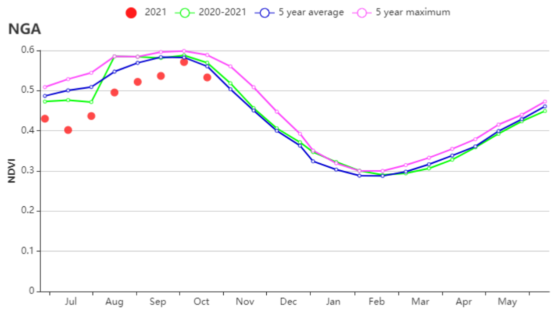
The **Derived savanna** region is a transition zone between the Guinea savanna and Humid forest zones. Rainfall decreased by 37% and the temperature increased by 0.7°C. The radiation increased by 7% compared to the 15YA and the BIOMSS decreased by 15% compared to the 15YA. The CALF was 99% and the maximum VCI was 0.95. According to the NDVI development graph, crop conditions in the region were below average from July to September and near average in October.

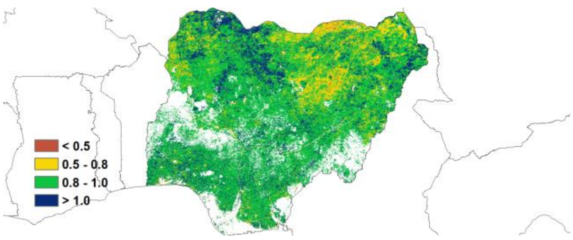
In the **Humid forest** zone the precipitation is quite high as compared to other regions. The rainfall decreased by 16% and the average temperature increased about 0.3°C. The radiation increased by 8% and the BIOMSS was near the 15YA (-1%). The CALF was 99% and the maximum VCI was 0.94. According to the NDVI development graph, crop conditions in the zone were below average throughout the monitoring period.

Figure 3.33 Nigeria's crop condition, July-October 2021

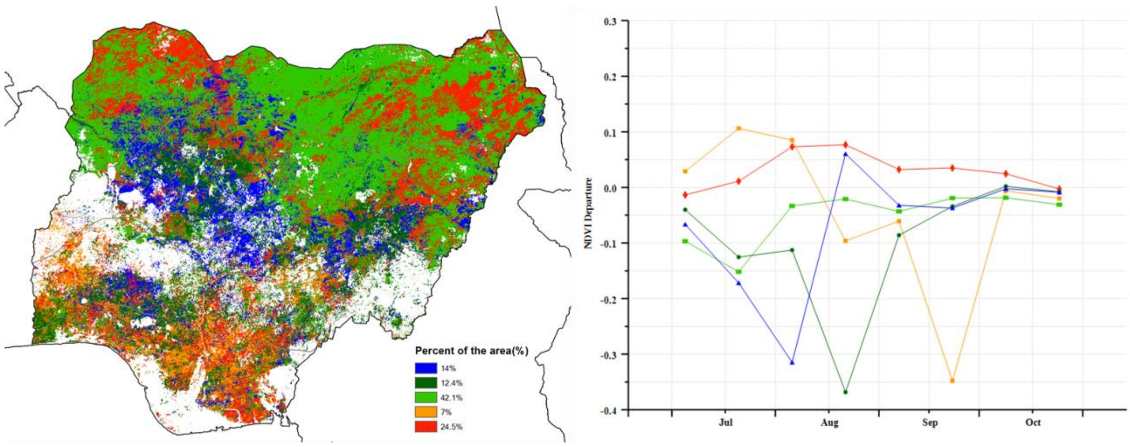


(a) Phenology of major crops

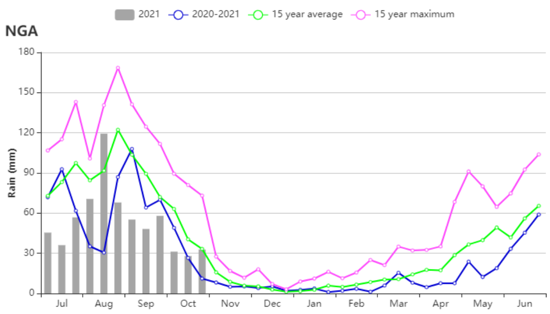


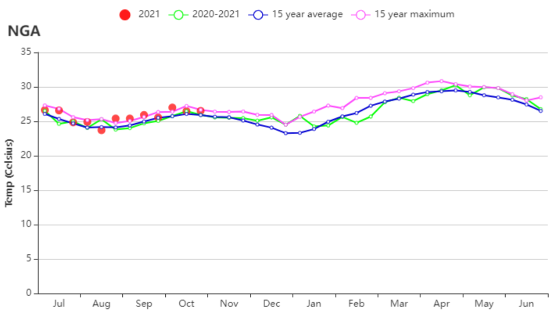


(b) Crop condition development graph based on NDVI (c)Maximum VCI

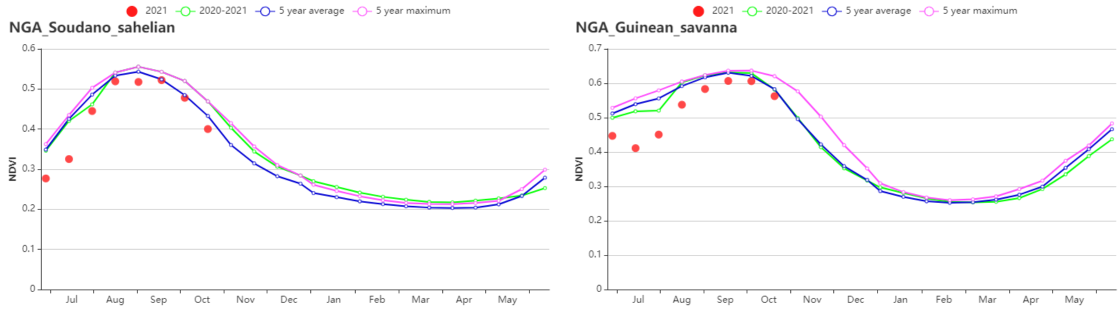


(d) Spatial NDVI pattern compared to 5YA and NDVI profiles

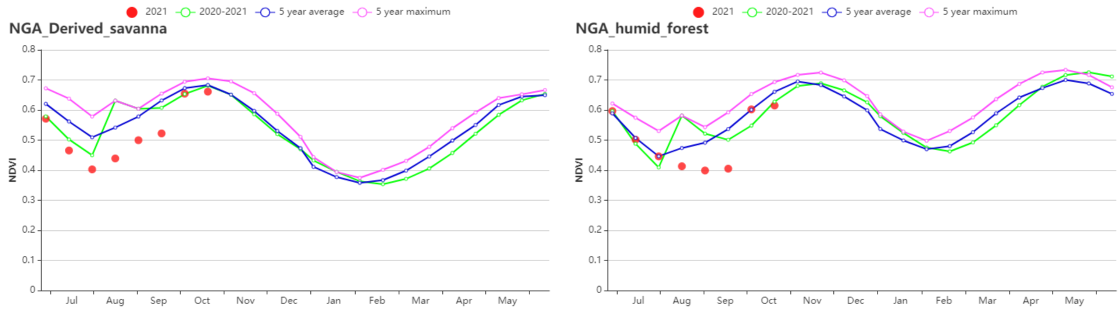




(e) Time series temperature profile (f) Time series rainfall profile



(g) Crop condition development graph based on NDVI(Left:Sudan-Sahel savanna, Right:Guinean savanna)



(h) Crop condition development graph based on NDVI(Left:Derived savanna, Right:Humid forest)

Table 3.54 Nigeria's agro-climatic indicators by sub-national regions, current season's values and departure from 15YA. July-October 2021

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(%)
Sudan-Sahel savanna	264	-42	28	0.6	1222	2	768	-18
Guinea savanna	468	-42	26	-0.8	1191	4	1003	-21
Derived savanna	668	-37	25	0.7	1127	7	1197	-15
Humid forest	1332	-16	24	0.3	1025	8	1503	-1

Table 3.55 Nigeria's agro-climatic indicators by sub-national regions, current season's values and departure from 5YA. July-October 2021

region	CALF		VCI
	Current (%)	Departure from 5YA(%)	Current
Sudan-Sahel savanna	84	-0.6	0.89
Guinea savanna	99	-0.4	0.91
Derived savanna	99	0.02	0.95
Humid forest	99	0.7	0.94

[PAK] Pakistan

This reporting period includes the production period for main maize and rice, which were harvested in October. It also covers the sowing of winter barley and wheat.

RAIN was sharply below average (-35%), together with higher TEMP and RADPAR (0.3℃and 2% respectively), which resulted in a slight increase of estimated BIOMSS (+4%). CropWatch agro-climatic indicators were below average over the 15YA. The dekad rainfall was continuously below average for most dekads, except for second dekad in July, when it reached maximum levels. Especially the significantly drier-than-usual conditions in August caused unfavorable conditions for the production of summer crops, although most of them are irrigated. About 30% of the crop areas experienced drought in August, as shown in the VHIn graph. The fraction of cropped arable land was slightly above average (+1%).

As shown by the nationwide NDVI development graph, crop conditions were gradually getting better and reached average levels in early August, but stayed below average until middle of September due to low precipitation. According to the spatial NDVI patterns and profiles, 31.8% of the cropped areas presented continuously below-average conditions during the reporting period, which were mostly distributed in the North highland and Lower Indus basin. About 9.7% of cropland, concentrated in Timur Dan, north and west of Sukkur and southern Sindh, presented below-average conditions before early August but later recovered to average levels. At the annual scale, cropping intensity increased by 13% indicating that the total cultivated crop area was at an above-average level. All in all, crop production estimates for the summer crops are slightly below average.

Regional analysis

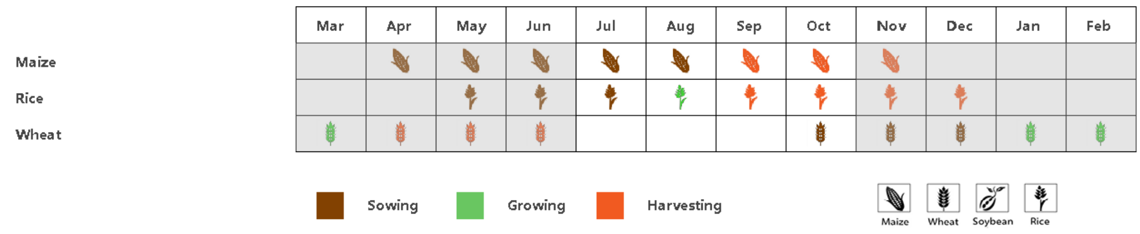
For a more detailed spatial analysis, CropWatch subdivides Pakistan into three agro-ecological regions based essentially on geography and agro-climatic conditions: the Northern highlands, Northern Punjab region and the Lower Indus river basin.

RAIN was slightly below average (-3%) and TEMP was above average by 0.2℃ in the **Lower Indus basin**. The estimated BIOMSS was 18% above average. NDVI was below average in late July and August, and later recovered to above average levels. The CALF value of 61% exceeds the average by 3% and the VCIx was 0.73. Overall, the situation for the region is below average.

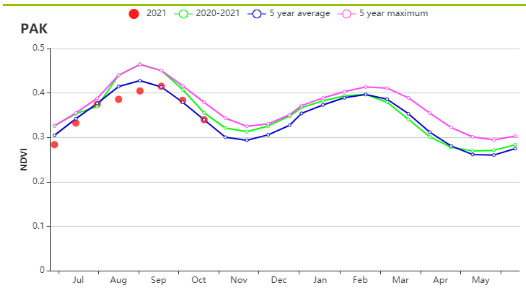
Compared to average, in the **Northern highland** region, RAIN sharply decreased by 49%, RADPAR and TEMP were above average (+3% and +0.2℃respectively). BIOMSS decreased by 17%. The region also showed a low CALF of 56%, which was lower than the 5YA by 4%. The NDVI profile stayed below average during July and late August, and subsequently recovered and exceeded the maximum in early August. In short, the situation for the region is assessed as below average.

In **Northern Punjab** region, which is the main agricultural region of Pakistan, recorded an above-average RAIN (+4%). TEMP and RADPAR were above average (+0.3℃ and +1% respectively). The resulting BIOMSS was above average by 15%. The NDVI profile presented below-average conditions in early July and late August, mainly due to a slow start of the monsoon rains. Heavy rainfall in middle July and early September promoted crop growth and NDVI exceeded the maximum of the 5YA in late September. In addition, CALF in this area reached 84%, which was up by 5% compared to the 5YA, and VCIx was at 0.90. Overall, the crop production potential for the region is assessed as favorable.

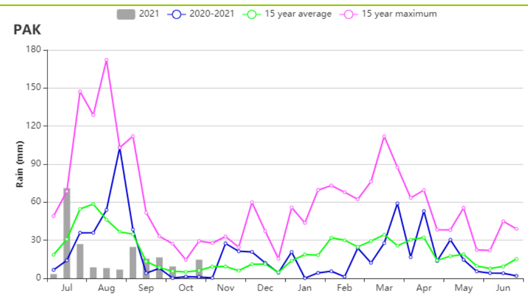
Figure 3.34 Pakistan crop condition, July-October, 2021



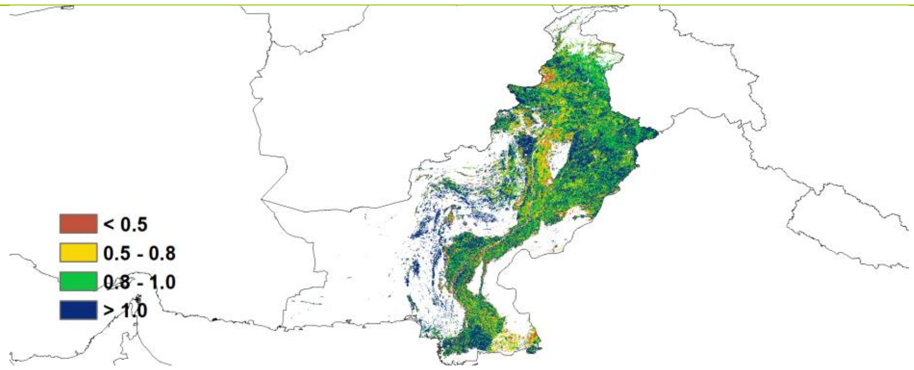
(a). Phenology of major crops



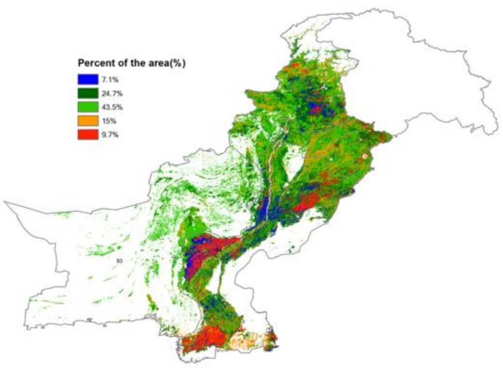
(b) Crop condition development graph based on NDVI

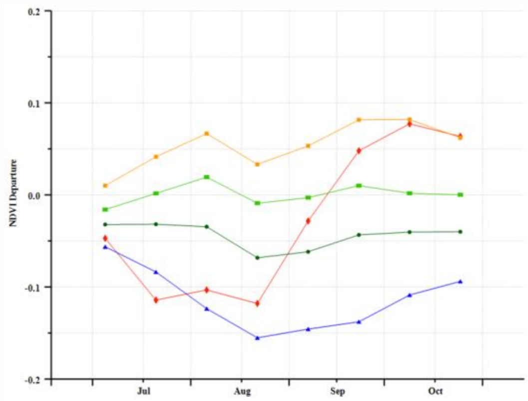


(c) Time series precipitation profile



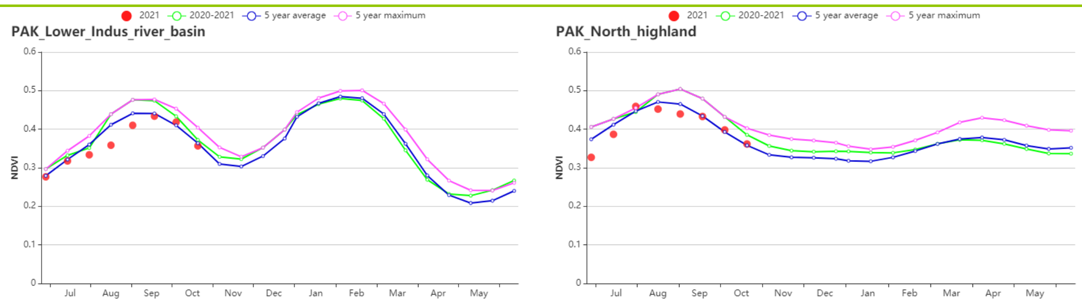
(d) Maximum VCI



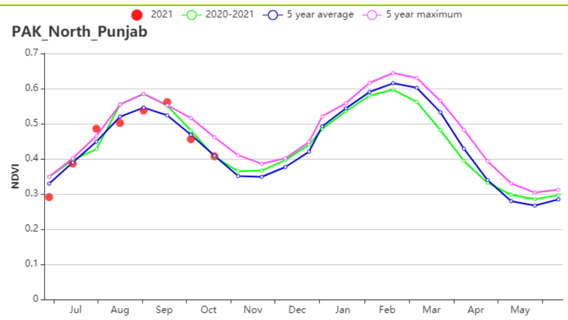


(e) Spatial NDVI patterns compared to 5YA

(f) NDVI profiles



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



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

Table 3.56 Pakistan's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July-October 2021

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (℃)	Departure (℃)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Lower Indus river basin	156	-3	33.0	0.2	1306	0	578	18
Northern highlands	191	-49	21.7	0.2	1407	3	578	-17
Northern Punjab	378	4	30.1	0.3	1275	1	884	15

Table 3.57 Pakistan's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July-October 2021

Region	Cropped arable land fraction		Cropping Intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Lower Indus river basin	61	3	175	13	0.74
Northern highlands	56	-4	139	9	0.76
Northern Punjab	84	5	206	20	0.90

[PHL] Philippines

This monitoring period covers the rainy season in the Philippines, which usually lasts from May to early October. Within this monitoring period, the harvest of main maize ended in September, followed by the harvest of main rice in October. The sowing of second maize and second rice began in October.

The country experienced slightly dryer and warmer weather during this monitoring period. As shown by the agro-climatic indicators, average precipitation dropped by 5% as compared to the 5YA, despite of several typhoons that made landfall over the Philippines. One of them, named Chanthu, brought record precipitation and decreased the NDVI for the country to some extent. The temperature increased by 0.4℃ (TEMP) and the radiation by 7% (RADPAR). The estimated biomass remained near average (BIOMSS +1%). The CALF did not change and the VCIx value was as high as 0.96. All of these indicate that the crop conditions were close to normal in the Philippines.

With respect to the crops at the local scales, the NDVI for 12.9% (orange color) of the arable cropland decreased by about 0.2 units in August and by about 0.1 in October. Furthermore, about 54.8% of the cropland shared stable and close-to-average NDVI. These croplands (light green color) were mainly located in northern Luzon Island and Mindanao Island. The rest of the croplands (dark green and blue color) remained slightly below average for most of the monitoring time, and these areas were mainly clustered in southern Luzon Island and northern Visayas Island.

Regional analysis

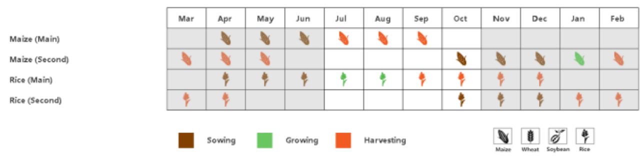
Based on the cropping systems, climatic zones and topographic conditions, three main agro-ecological regions can be distinguished for the Philippines. They are **the Lowlands region** (northern islands), **the Hilly region** (Island of Bohol, Sebu and Negros), and **the Forest region** (mostly southern and western islands). All the regions are characterised by a stable cropped arable land fraction (CALF almost 100%) and a high maximum VCI value (VCIx ⩾0.96).

For the L**owland region**, the rainfall decreased by 11% (RAIN), while the temperature increased by 0.4℃ (TEMP) and radiation increased by 7% (RADPAR). The estimated biomass dropped by 1% (BIOMSS). As shown by the NDVI profile, the negative NDVI departure increased throughout July and reached a maximum at the end of September, while the average precipitation and temperature in the region were at normal levels during the same period. Thus, the large negative departures in NDVI can be mainly attributed to cloud cover in the satellite images. In addition, warmer weather and more sunshine had a positive impact on the crops, bringing the NDVI values back to average levels by the end of October. As a result, the crop condition in this region is estimated to be generally normal.

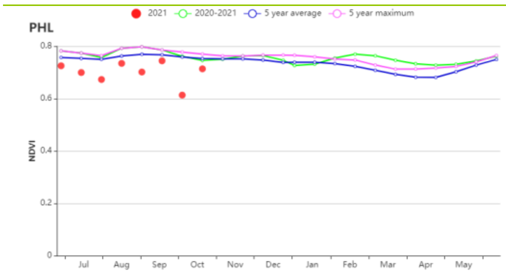
The **Hilly region** experienced a slightly wetter and warmer period. The rainfall was slightly higher than average by 1% (RAIN) and temperature increased by 0.5℃ (TEMP). The radiation was higher than average by 6% (RADPAR) and resulting biomass was higher than average by 2% (BIOMSS) as well. However, the NDVI was fluctuating below average since the end of July, which indicates that the crop conditions in this region are unfavorable.

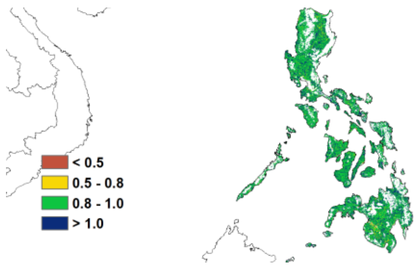
In the **Forest region**, the precipitation was higher than average (RAIN +2%), accompanied by above-average temperature (TEMP, +0.4℃) and above-average radiation (RADPAR, +6%). The resulted biomass increased by 2% (BIOMSS). The VCIx value reached 0.96 and the CALF stayed at 100%. As shown by the NDVI profile, the NDVI for the region remained stable, slightly below average. All the indicators suggest that the crop growth for this region is normal.

Figure 3.35 Philippines' crop condition, July - October 2021



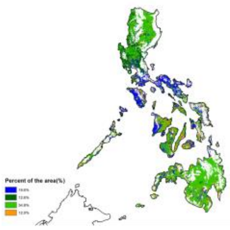
(a). Phenology of major crops

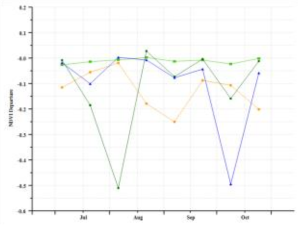




(b) Crop condition development graph based on NDVI

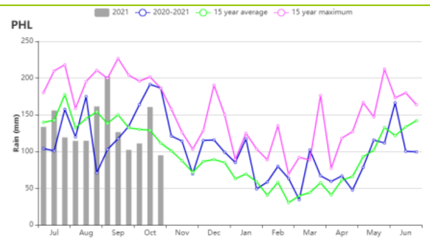
(c) Maximum VCI

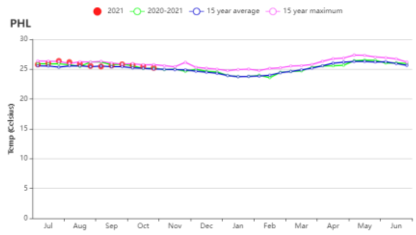




(d) Spatial NDVI patterns compared to 5YA

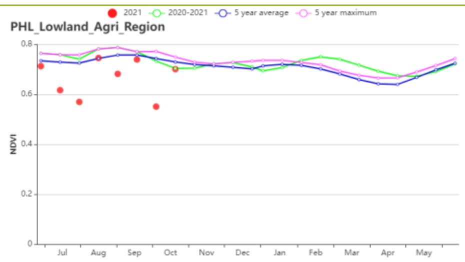
(e) NDVI profiles

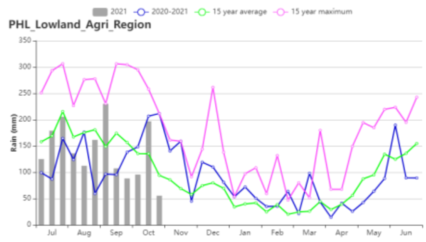




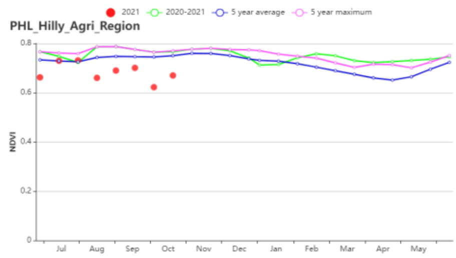
(f) Rainfall profiles

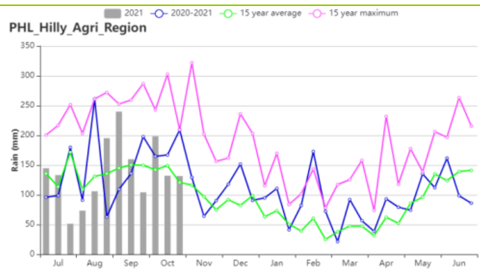
(g) Temperature profiles



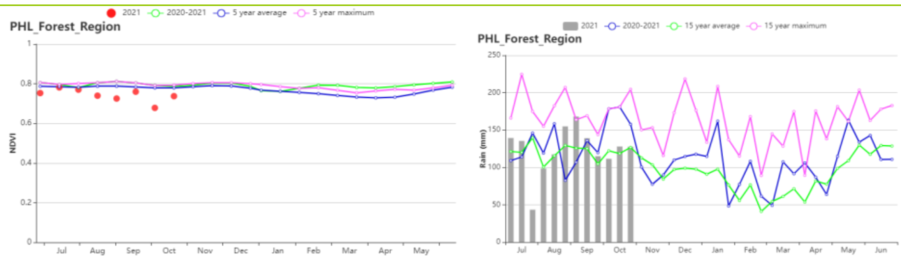


(h) Crop condition development graph based on NDVI (left) and time series rainfall profile (right) in Lowlands region





(i) Crop condition development graph based on NDVI (left) and time series rainfall profile (right) in Hilly region



(j) Crop condition development graph based on NDVI (left) and time series rainfall profile (right) in Forest region

Table 3.58 Philippines' agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2021

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m^2)	Departure (%)	Current (gDM/m^2)	Departure (%)
Forest region	1478	2	25.6	0.4	1291	6	1552	2
Hilly region	1670	1	27.2	0.5	1314	6	1653	2
Lowlands region	1693	-11	25.7	0.4	1245	7	1565	-1

Table 3.59 Philippines' agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2021

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Forest region	100	0	137	-3	0.96
Hilly region	100	0	121	-3	0.96
Lowlands region	100	0	154	5	0.96

[POL] Poland

The monitoring period covers the harvest of spring and winter wheat in July and August, as well as the main growth period of maize and its harvest in September and October. The planting of the new winter crops started in September. During this monitoring period, the agroclimatic conditions were close to the average and the crop growth was normal, but the yield of winter wheat, a summer crop, may be slightly below average due to the high temperatures and drought that affected the crops during the grain filling period, while the yield of maize can be expected to reach normal levels. Compared with the average of last 15 years, the national scale precipitation was 4% higher, temperature and photosynthetic effective radiation were slightly lower by 0.2°C and 3%, respectively, and the potential biomass was close to the average. Furthermore, CALF was up to 100% and VCIx was 0.94.

As shown by the graph, crop growth was close to average in July-August, reached the highest level in the past 5 years in early September, dropped back to the average level thereafter, and went below average in late October, which may be related to some delay in crop harvesting and sowing for the next season. This is also reflected in the temporal distribution of rainfall, which was above the highest level of last 15 years in early and late August. Overall, crop growth appears to be near average levels. The distribution map of VCIx shows that the vast majority of cultivated areas were above 0.8, and areas between 0.5 and 0.8 are only sporadically distributed in the eastern and central-western parts of the country. The crop clustering map shows that in all regions, NDVI was below average in October, which might have been due to delayed harvest of the summer crops because of wet conditions in September. They were followed by drier-than-normal conditions in October, which might have delayed germination of the winter crops. The maps show that 27% of the crops were above average during the monitoring period, mainly in the central and southern regions, 14.9% of the crops were consistently below the average for the same period, mainly in the northern regions, and 2.2% of the areas were significantly below average in late September and then recovered to the average. This may have been influenced by short term rainfall and flooding, mainly in the northwest.

Overall, crop growth in Poland seems to be normal, with harvested crop yields only slightly below average and average conditions for growing winter wheat.

Regional analysis

The country is divided into four zones according to agro-ecological characteristics, including: (a) the **Northern oats and potatoes areas** covering the northern half of West Pomerania, eastern Pomerania and Warmia-Masuria, (b) the **Northern-central wheat and sugar-beet area** (Kuyavia-Pomerania to the Baltic sea), (c) the **Central rye and potatoes area** (Lubusz to South Podlaskie and northern Lublin), and (d) the **Southern wheat and sugar-beet area** (Southern Lower Silesia to southern Lublin and Sub-Carpathian along the Czech and Slovak borders).

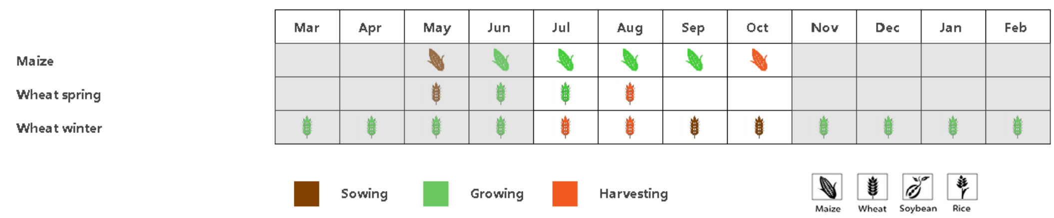
Compared to the average of the last 15 years, precipitation in the **Northern oats and potatoes area** was 3% higher, temperature was close to average, RADPAR was 5% lower, and BIOMSS was 3% higher benefiting from abundant precipitation. CALF was 100% and VCIx was 0.92. The crop growth curve shows that the crop growth was below average from July to early August due to the early drought and recovered to the average level from late August to September as the precipitation increased in August. But the precipitation in August-September also delayed the crop harvest and the sowing of the next season. The NDVI in October was significantly lower than the average level in the same period. Overall, crop growth appears normal and yields may be slightly below average. In addition, the CI for the year was only 90%, which is 12% lower than average.

In the **Northern-central wheat and sugar-beet area**, precipitation was 2% above average, temperature was on par with previous years, RADPAR was 4% below average, and BIOMSS was near the average of the last 15 years. The percentage of cultivated land was 100% and VCIx was 0.89. The crop was affected by high temperature and low precipitation in July, from near average in July to below average in early August, and recovered with the recharge of sufficient precipitation in August, even above average in early September, and declined to average thereafter and a low NDVI in October. Overall, crop growth was normal, but crop yield was below average due to the impact of the early drought and high temperature. CI of this sub-district was 97%, 8% lower than the average, and the annual crop planting was lower than in previous years.

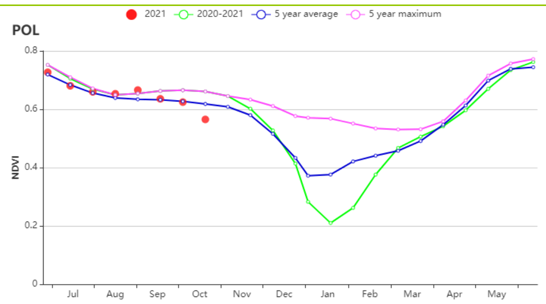
Compared with the average of the last 15 years, in the **Central rye and potatoes area**, precipitation was 6% higher, temperature was 0.2°C lower, RADPAR was 3% lower, and BIOMSS was flat. CALF was 100% and VCIx was 0.94. The crop growth in the zone was consistently above average, especially from late August to early September, and the NDVI was higher than the highest level of the last 5 years. NDVI was significantly lower in October. Overall, the crop growth was normal and the crop yield was close to the average. CI of this sub-district was 106%, which was slightly lower by 2% compared to the average.

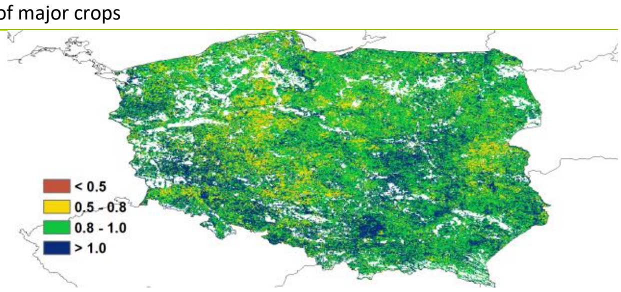
In the **Southern wheat and sugar-beet area**, precipitation was 4% higher, temperature was 0.4°C lower, RADPAR was 1% lower, and BIOMSS was 1% lower. CALF was 100% and VCIx was 0.97. The crop growth in this sub-region was consistently above average, especially from August to early September, when the NDVI was higher than the highest level of the last 5 years, and similarly, the NDVI in October was significantly lower than the average level due to the delay in phenology. Overall, the crop growth was normal and the yield was stable. CI of this sub-district was 133%, which was 26% higher than the average.

Figure 3.36 Poland's crop condition, July-October 2021



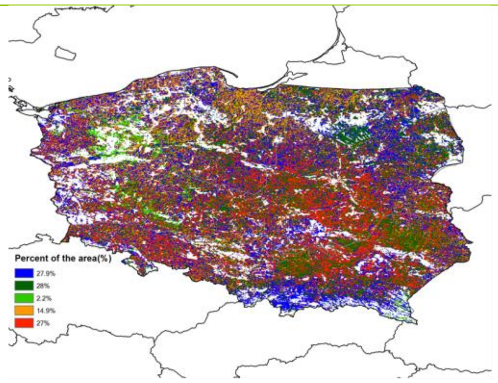
(a). Phenology of major crops

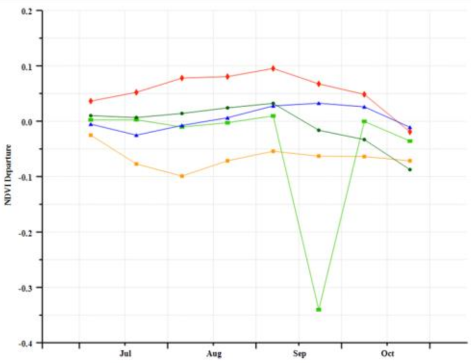




(b) Crop condition development graph based on NDVI

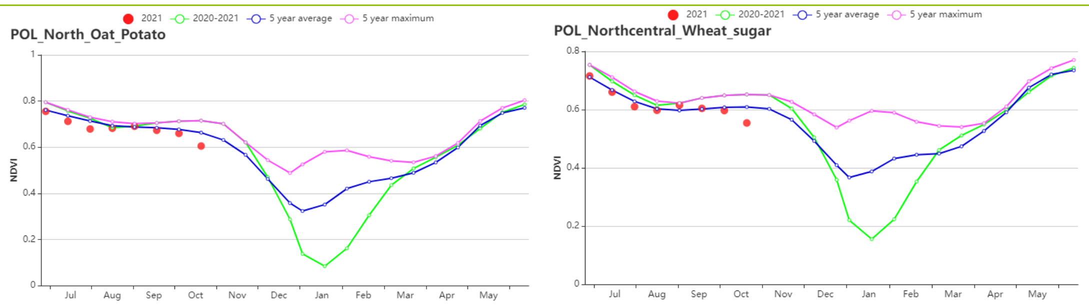
(c) Maximum VCI



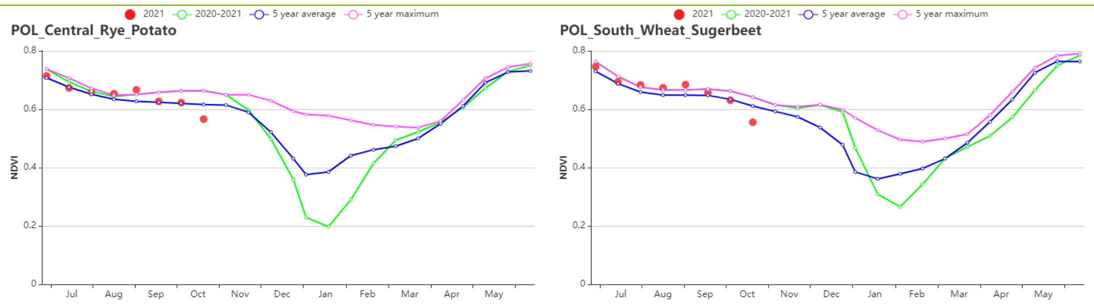


(d) Spatial NDVI patterns compared to 5YA

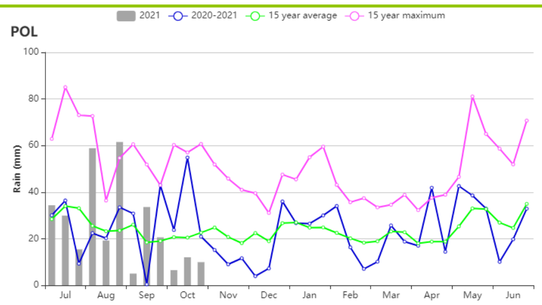
(e) NDVI profiles

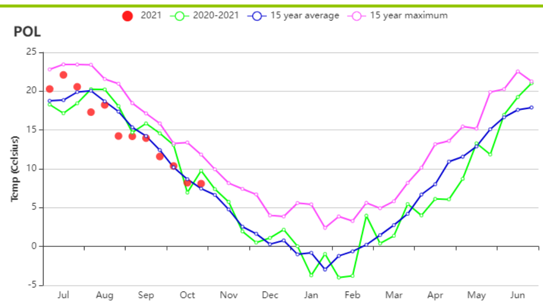


(f) Crop condition development graph based on NDVI, Northern oats and potatoes area (left) and Northern-central wheat and sugar beet area (right).



(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 3.60 Poland's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July-October 2021

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	335	3	14.7	0.0	761	-5	819	3
Northern-central wheat and sugarbeet area	291	2	15.1	0.0	783	-4	751	0
Central rye and potatoes area	298	6	15.3	-0.2	812	-3	748	0
Southern wheat and sugarbeet area	315	4	14.5	-0.4	889	-1	759	-1

Table 3.61 Poland's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July-October 2021

Region	Cropped arable land fraction		Cropping Intensity		Maximum VCI
	Current	Departure (%)	Current	Departure (%)	Current
Northern oats and potatoes areas	100	0	90	-12	0.92
Northern-central wheat and sugarbeet area	100	0	97	-8	0.89
Central rye and potatoes area	100	0	106	-2	0.94
Southern wheat and sugarbeet area	100	0	133	26	0.97

[ROU] Romania

The reporting period includes the harvest of wheat (which started in July), the sowing of the 2020-21 winter wheat (which started in September) and also the harvest of maize and other summer crops in September. Overall, crop conditions were fair. Rainfall was 38% lower than average; TEMP (-0.5°C) was below the 15YA, whereas RADPAR (+3%) was a bit higher than average and BIOMSS (-18%) was below average. The nationwide NDVI profile shows that crop conditions were a bit lower than average from July to early October and above average in late October. The temperature fluctuated around above-average levels and rainfall was below average in August. The southeast suffered from drought conditions, which had started already in the previous reporting period. The CALF of Romania during the reporting period was 99%, 1% lower than average and the maximum VCI was 0.84, which was fair. According to the spatial distribution of VCIx, the eastern subregion has higher values (0.8-1.0) than the western and central subregion (0.5-0.8). The NDVI pattern profile shows that regions marked with blue color located in the western and central maize, wheat and sugar beet plateau experienced a sharp decrease during July-October. NDVI was also far below average in the eastern and southern maize, wheat and sugar beet plain, shown in light green and red. Conditions improved in October, but all major summer crops grown in that region had reached maturity by then. These crops suffered from drought conditions, which had been observed already in the previous report. Hence, production prospects for this important region of Romania are unfavorable, while they are closer to normal for the other regions.

Regional analysis

More details are provided below for three main agro −ecological zones: the Central mixed farming and pasture Carpathian hills (160), the Eastern and southern maize, wheat and sugar beet plains (161) and the Western and central maize, wheat and sugar beet plateau (162).

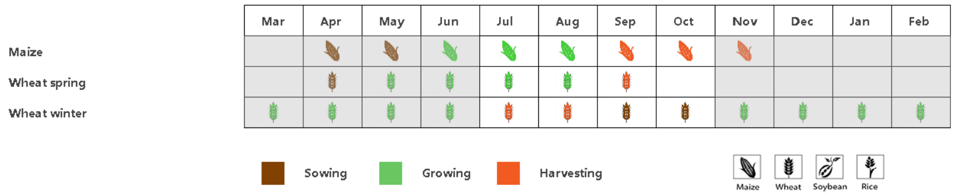
For the Western and central maize, wheat and sugar beet plateau, rainfall was lower than average by 39%, temperature was average (-0.4℃) and radiation was a bit higher (RADPAR +2%), and biomass decreased 17%, due to a decrease in rainfall. Spatial NDVI profiles show that crop condition was worse than average during July to early September, covering the growing periods of maize and spring wheat. Maximum VCI of this region was 0.80, a bit low and the spatial distribution was between 0.5 and 1.0. Also, the NDVI development decreased from July to October, consistent with the VCI values. The cropping intensity is 110, 9% higher than last year.

For the Central mixed farming and pasture Carpathian hills, rainfall decreased by as much as 41% below average while temperature decreased 0.6℃ and radiation increased 3%, and BIOMSS decreased 21%. The maximum VCI map shows values above 0.8, with the regional average at 0.84. The NDVI spatial distribution shows that NDVI was below average from July to August. As this AEZ occupies only a small fraction of cropland in Romania, a small patch of irrigated land in Transylvania, its fair NDVI cannot represent much of Romania's crop production. The cropping intensity is 108, 8% higher than last year.

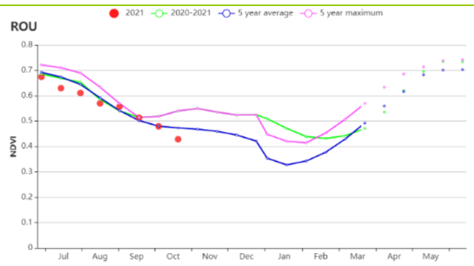
For the Eastern and Southern maize, wheat and sugar beet plains, rainfall decreased 38%, temperature decreased 0.5℃, radiation increased by 4% and biomass decreased 18%. The NDVI development graph shows that crop conditions were close to, yet a bit lower than average. The decrease of precipitation in this period caused drought conditions. VCIx value of this region was 0.86 and according to the distribution map, VCIx values were between 0.8-1.0 in most of the central and middle region (counties of Tulcea and Constanta), representing about 14.3% of national cropland. The cropping intensity was 129, 19% higher than last year.

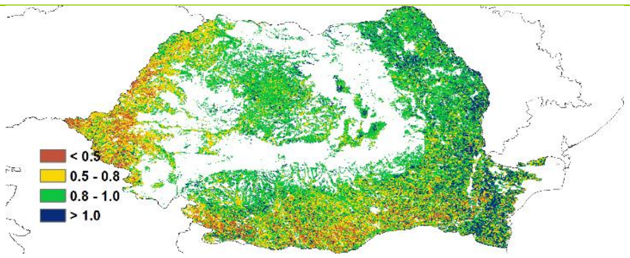
Overall, the widespread lack of rainfall has caused a negative impact on crop conditions and the production prospect is unfavorable.

Figure 3.37 Romania's crop condition, July-October 2021



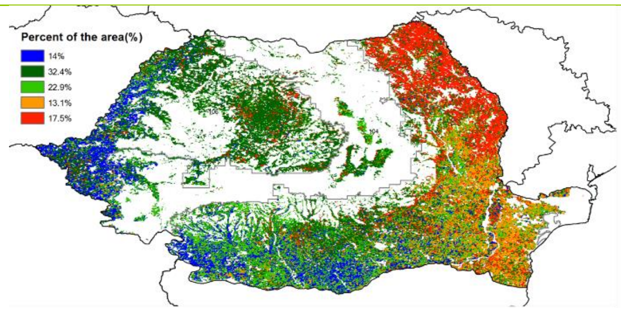
(a). Phenology of major crops

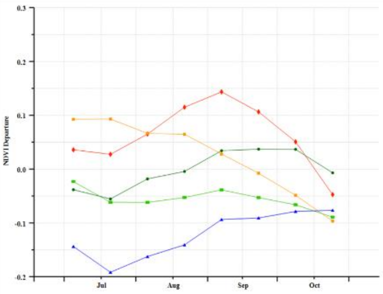




(b) Crop condition development graph based on NDVI

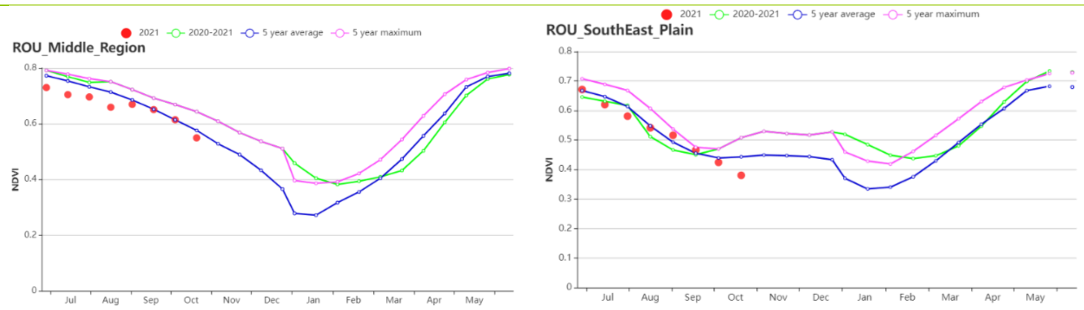
(c) Maximum VCI



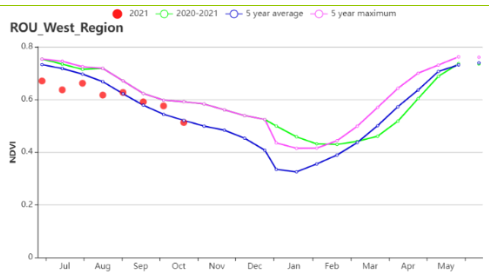


(d) Spatial NDVI patterns compared to 5YA

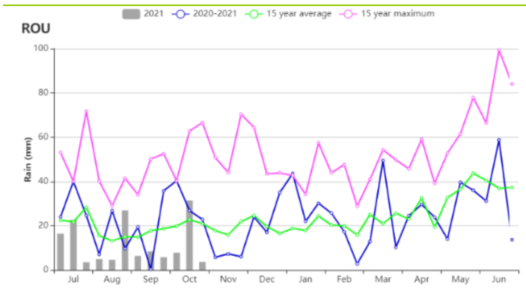
(e) NDVI profiles



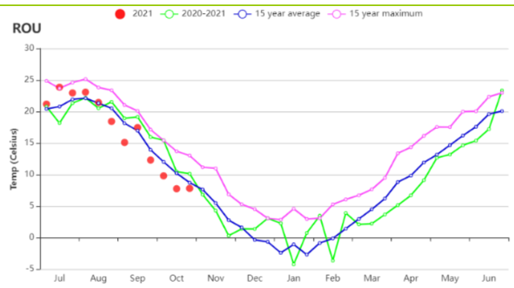
(f) Crop condition development graph based on NDVI (Central mixed farming and pasture Carpathian hills (left) and Eastern and southern maize, wheat and sugar beet plains (right))



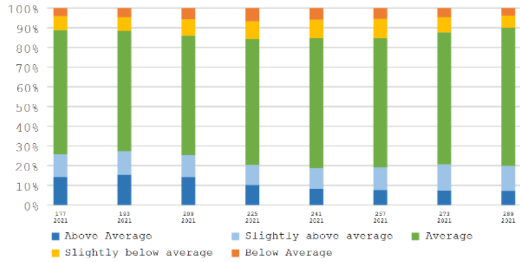
(g) Crop condition development graph based on NDVI (Western and central maize, wheat and sugar beet plateau)

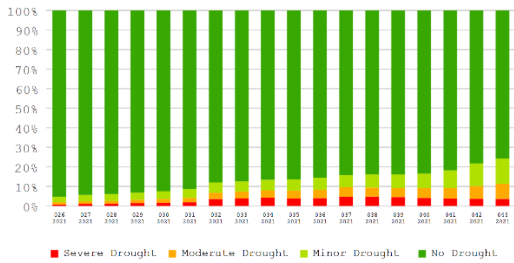


(h) Time series rainfall profile



(i) Time series temperature profile





(j) Proportion of NDVI anomaly categories compared with 5YA (k) Proportion of VHIn categories compared with 5YA

Table 3.62 Romania's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July-October 2021

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 (%)
Central mixed farming and pasture Carpathian hills	159	-41	14.4	-0.6	1080	3	569	-21
Eastern and southern maize wheat and sugar beet plains	132	-38	17.8	-0.5	1107	4	553	-18
Western and central maize wheat and sugar beet plateau	144	-39	16.3	-0.4	1073	2	571	-17

Table 3.63 Romania's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2021

Region	Cropped arable land fraction		Maximum VCI	Cropping intensity	
	Current (%)	Departure from 5YA (%)	Current	Current (%)	Departure from 5YA (%)
Central mixed farming and pasture Carpathian hills	100	0	0.84	108	8
Eastern and southern maize wheat and sugar	100	2	0.86	129	19

Region	Cropped arable land fraction		Maximum VCI	Cropping intensity	
	Current (%)	Departure from 5YA (%)	Current	Current (%)	Departure from 5YA (%)
beet plains					
Western and central maize wheat and sugar beet plateau	100	0	0.8	110	9

[RUS] Russia

The monitoring period from July to October is the main time for harvest in Russia. Winter crops are harvested from late June to late July and spring crops are harvested from mid-August to late September, with July being the peak season. Sowing of winter crops begins in September. Therefore, weather conditions during the monitoring period are important for both spring and winter crops.

At the beginning of the period, rainfall was below average. By the end of August, precipitation decreased sharply. In early August and late September, there was a sharp increase in precipitation, which exceeded last year and the 15-year average.

Temperatures in Russia during the monitoring period from July to August exceeded last year and the 15-year average. At the end of August and until the end of the monitoring period the temperature was below the 15-year average and last year.

According to the national CropWatch data, NDVI during the monitoring period was below both the 5-year average and previous year. However, there were significant differences between regions: Above average crop conditions with VCIx above 0.8 are observed in Central and Black soil region with positive NDVI departure; South and North Caucasus regions also show positive NDVI departure with VCIx ranging from 0.5 to 1; Spring crop producing regions (Volga, Urals, Siberia) showed negative NDVI departure with VCIx ranging from <0.5 to 0.8 due to unfavourable weather conditions.

In regions with positive NDVI departure the crop yield is expected to be above or at the level of the previous year. In Volga and Ural regions the yield of spring crops is likely to be lower than in the previous year.

Regional analysis

South Caucasus

Rainfall was 15% above the 15-year average. Temperature and RADPAR were less than average by 0.6°C and 1%, respectively. BIOMSS showed a negative deviation of 9%. CALF was higher by 14% relative to the 5-year average. In the South Caucasus, CI increased by 4%. VCIx was 0.90.

In July, the NDVI was equal to last year's value, but it gradually increased in early August and exceeded the 5-year highest in September and October. This is an indicator of good situation with winter crop sowing, and good crop status before the snow cover establishment.

Judging by the Cropwatch indicators, the wheat harvest of 2020-2021 would be bigger than last year's and the average of last 5 years. It is expected that the harvest of summer crops will be equal to or slightly bigger than last year.

North Caucasus

Rainfall was down by 2% and temperature was down by 0.6°C. RADPAR increased slightly by 1%, and BIOMSS increased by 4% relative to the 15-year average. CALF increased by 14%. In the North Caucasus, CI increased by 4%. VCIx was 0.91.

At the beginning of the monitoring period, the NDVI was equal to last year and the 5-year average. But in September the NDVI reached a 5-year highest and was equal to average until the end of October. It is quite likely that summer crop yield would be slightly higher than last year.

Central Russia

Rainfall was down by 12%. Temperature and RADPAR increased by 0.1°C and by 3% respectively. BIOMSS increased by 9%. In Central Russia, CI decreased by 3% and CALF was equal to the 5-year average. VCIx was 0.94.

From July to October, the NDVI was below last year and the 5-year average, only reaching the 5-year average in early September.

The yield of 2020-2021 winter crop should be below last year and 5-year average. The yields of spring and summer crops should show a similar trend.

Central black soil area

Rainfall was 9% less than the 15-year average. Temperature was close to average. RADPAR and BIOMSS increased by 3% and 9% respectively. In the Central black soils area, CI decreased by 3% and CALF was equal to the 5-year average. VCIx was 0.88.

From July through mid-August, NDVI was below 5-year average, but in September and October it reached the last year's value.

Summer crop yield should be slightly below the average.

Middle Volga

Rainfall decreased by 21% relative to the 15-year average, which is the maximum deviation in Russia. Temperature decreased by 0.1°C. RADPAR and BIOMSS increased by 7% and 9% respectively. CALF decreased by 5% relative to the 5-year average. In the Middle Volga, CI decreased by 5%. VCIx at 0.76 showed the lowest value for Russia over the period.

NDVI was well below the 5-year average and last year, which was due to a decrease in rainfall in the Middle Volga.

The yields of winter, spring, and summer crop are all expected to be below the average of last year and the 5-year average. The 2021-2022 winter crop sowing campaign is likely to be delayed due to low soil moisture content.

Ural and western Volga

In the Ural and western Volga, rainfall was down by 16% relative to the 15-year average, while temperature increased by 0.2°C. RADPAR and BIOMSS increased by 8% and 6% respectively. CALF and CI decreased by 3% and 1% relative to the 5-year average. VCIx was 0.81.

Throughout the monitoring period, NDVI was below the 5-year average and the last year. At the end of October, NDVI was equal to average. The decrease in NDVI was due to a decrease in rainfall and an increase in temperature.

The yields of winter, spring, and summer crops are all expected to be below last year and the 5-year average. The 2021-2022 sowing campaign is likely to be close to normal.

Western Siberia

In Western Siberia, rainfall increased by 17% over the 15-year average. Temperature was down 0.2°C. Both of RADPAR and BIOMSS increased by 2%. CALF and CI decreased by 1% relative to the 5-year average. VCIx was 0.92.

The NDVI in Western Siberia was equal to last year and the 5-year average.

There are very few winter crops in this region. The yield of spring and summer crops is expected to be slightly below the 5-year average and previous year.

Middle Siberia

In Middle Siberia, rainfall and temperatures decreased by 19% and 0.1° C relative to the 15-year average, respectively. RADPAR and BIOMSS increased by 1% and 4% respectively. CALF decreased by 1% and CI increased by 4%. VCIx was 0.95.

In Middle Siberia, NDVI was higher than the 5-year maximum from July to August, andwas equal to the 5-year average from September to October.

The yields of spring, and summer crops are all expected to be above the 5-year average and previous year.

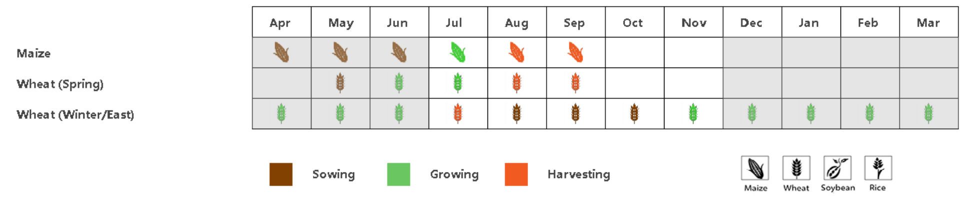
Eastern Siberia

In Eastern Siberia, compared to the 15-year average, rainfall decreased by 31%, while temperature increased by 0.1°C. RADPAR and BIOMSS increased by 10% and 4% respectively. CALF decreased by 1% and CI increased by 13%. The VCIx was 0.95.

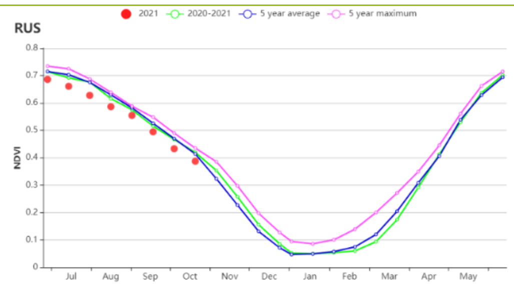
NDVI was close to the 5-year average from July to October.

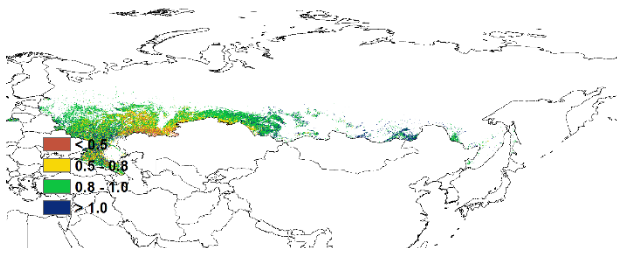
According to the graphs, the yields of spring and summer crops are all expected to be below the 5-year average.

Figure 3.38 Russia's crop condition, July - October 2021

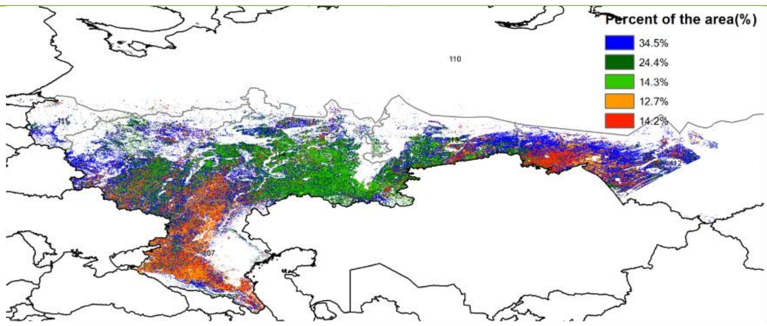


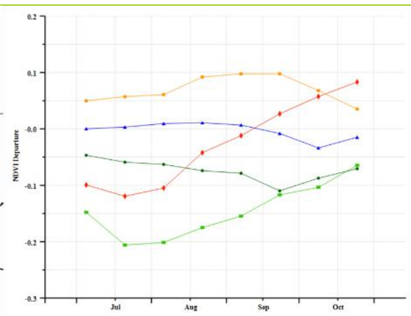
(a) Phenology of major crops



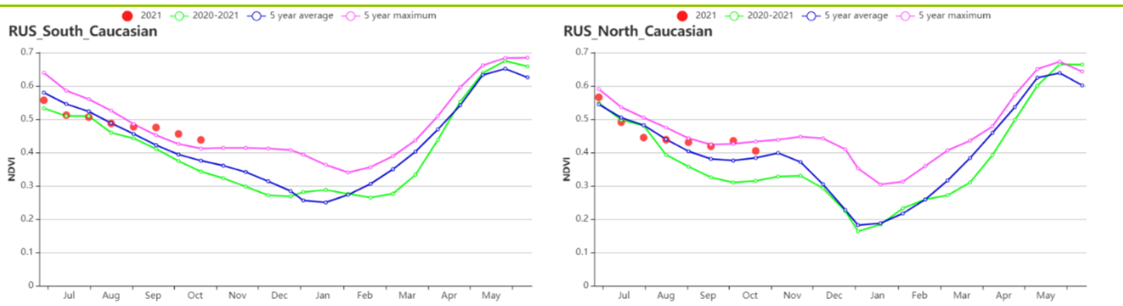


(b) Crop condition development graph based on NDVI (c) Maximum VCI

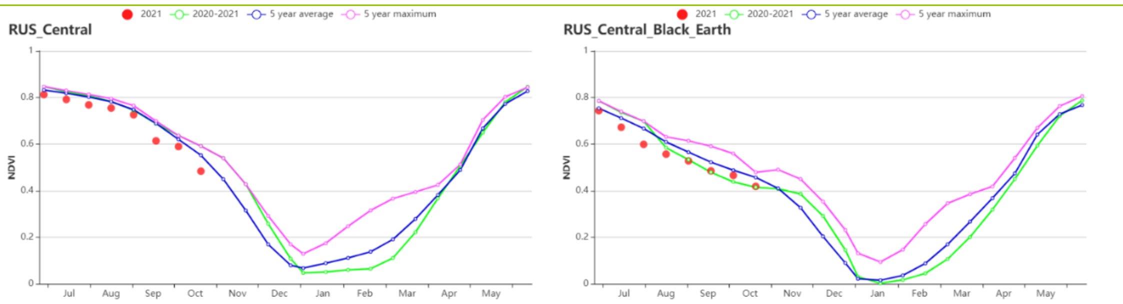




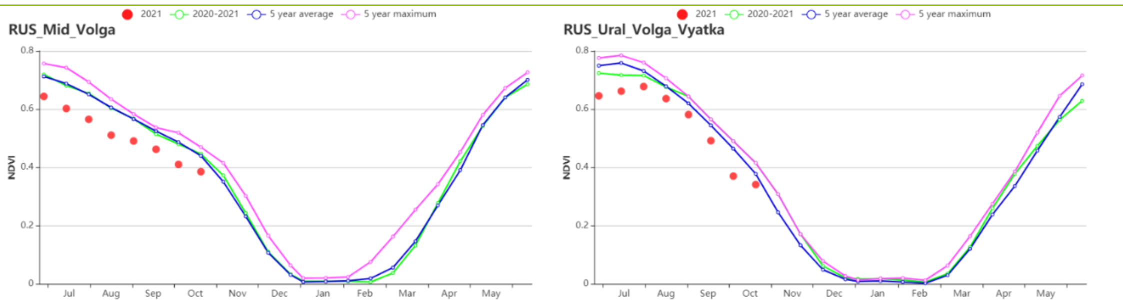
(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles



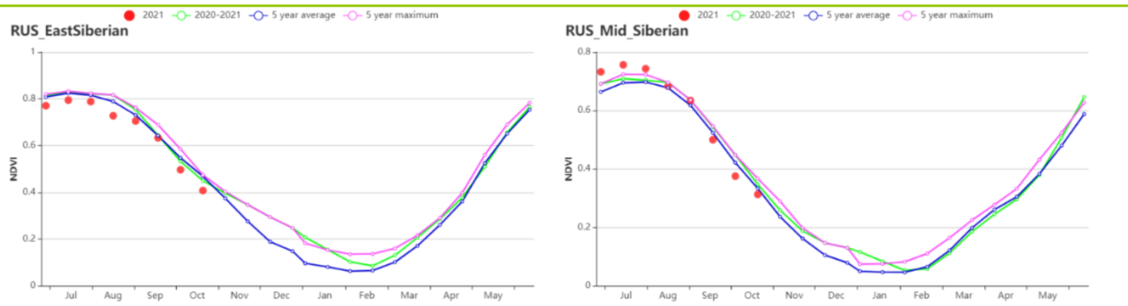
(f) Crop condition development graph based on NDVI, Southern Caucasus (left) and Northen Caucasus (right).



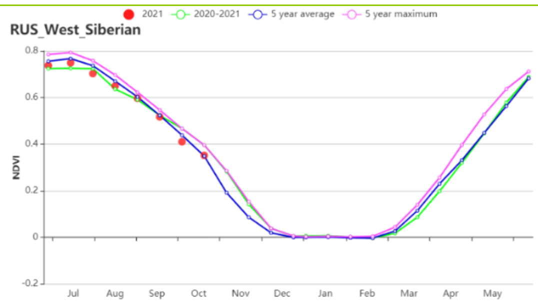
(g) Crop condition development graph based on NDVI, Central Russia (left) and Central black soils area (right).



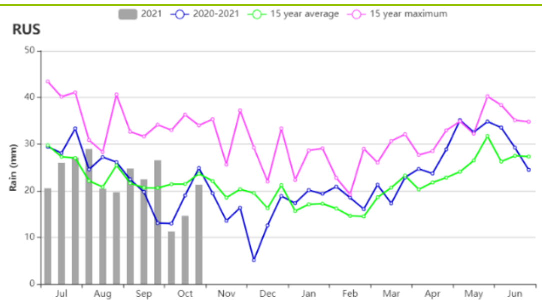
(h) Crop condition development graph based on NDVI, Middle Volga (left) and Ural and western Volga region (right).



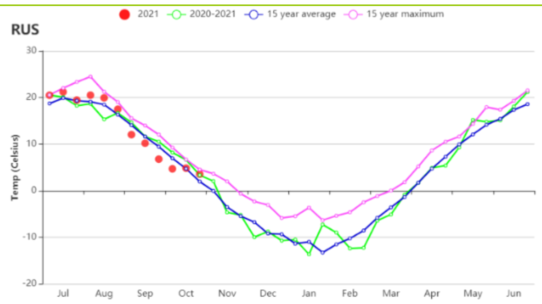
(i) Crop condition development graph based on NDVI, Eastern Siberia (left) and Middle Siberia (right).



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



(k) Rainfall index



(l) Temperature Index

Table 3.64 Russia's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2021

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m^2)	Departure (%)	Current (gDM/m^2)	Departure (%)
Central Russia	276	-12	13.2	0.1	750	3	342	9
Central black soils area	213	-9	14.9	0.0	867	3	430	9
Eastern Siberia	346	-31	14.1	1.0	943	10	391	4
Middle Siberia	263	-19	9.4	-0.1	929	1	316	-4
Middle Volga	213	-21	13.9	0.3	852	7	396	9
Northern Caucasus	192	-2	18.7	-0.3	1054	1	563	4
Southern Caucasus	386	116	16.5	-0.6	1062	-1	465	-9
Ural and western Volga region	221	-16	12.3	0.2	803	8	341	6
Western Siberia	317	17	11.7	-0.2	822	2	340	2

Table 3.65 Russia's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October

Region	Cropped arable land fraction		Cropping Intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Central Russia	100	0	97	-3	0.94
Central black soils area	100	0	97	-3	0.88
Eastern Siberia	99	-1	113	13	0.95
Middle Siberia	99	1	104	4	1.00
Middle Volga	91	-5	95	-5	0.76
Northern Caucasus	95	14	107	4	0.91
Southern Caucasus	87	14	106	4	0.90
Ural and western Volga region	96	-3	99	-1	0.81
Western Siberia	99	-1	99	-1	0.92

[THA] Thailand

This monitoring period covers most of the growth cycle of main rice and the harvest of maize. According to CropWatch agroclimatic indicators, Thailand experienced wetter and warmer weather as compared to the 15YA. The rainfall (RAIN, +11%), temperature (TEM, +0.2°C), and radiation (RADPAR, +5%) from July to October were above average resulting in an above-average biomass production potential (BIOMSS, +4%). According to its profile, the temperature was around average but reached a 15-year maximum at the end of July and September. According to the NDVI development graph, crop conditions were close to average before September but were below average after that. The decrease of NDVI at the end of August may have been mainly due to cloud cover in the satellite images.

According to the NDVI departure clusters and the corresponding profiles, crop conditions were close to average on 73.5% of total arable land, located in all regions of Thailand. In an area accounting for 11.5% of total cropped area, crop conditions were close to average but deteriorated to below average after August. Crop conditions on 15.1% of total cropland were below average throughout this monitoring period, mostly located in Prachuap Khilikhan, Chumphon, and Krabi. In general, favorable conditions for crops were observed during the July to October period as indicated by high VCIx values at 0.95. Considering the average CALF and below-average crop intensity (Cropping Intensity, -8%), the crop conditions during this season are assessed as close to the average level.

Regional analysis

The regional analysis below focuses on some of the already mentioned 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 (115), South-eastern horticulture area (116), the Single-cropped rice north-eastern region (118), and Western and southern hill areas (117). Among these regions, the first three of them are major agricultural production regions of Thailand.

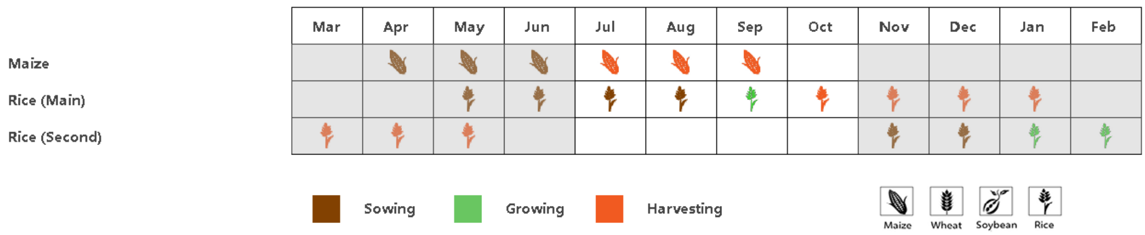
The **Central double and triple-cropped rice lowlands** is the major rice production zone of Thailand. It had received plenty of rainfall during this period. Rainfall was above average (RAIN, +34%), accompanied by average temperature (TEMP, 0.0°C) and slightly above-average radiation (RADPAR, +5%). As a result, above-average weather conditions resulted in an increase of potential production (BIOMSS, +9%). The NDVI development graph shows that crop conditions started to drop below average in September when the crops were approaching maturity.

The agro-climatic conditions in the **South-eastern horticulture area** were the same as in the Central region**:** Rainfall was above average (RAIN, +34%), accompanied with close-to-average radiation (RADPAR, +1%). The temperature was close to average (TEMP, +0.0℃). This agro-climatic condition led to a slight increase of potential production (BIOMSS, +5%). According to the NDVI development graph, the crop condition is close to the average of the recent 5 years after removing the effect of cloud contamination in the satellite images.

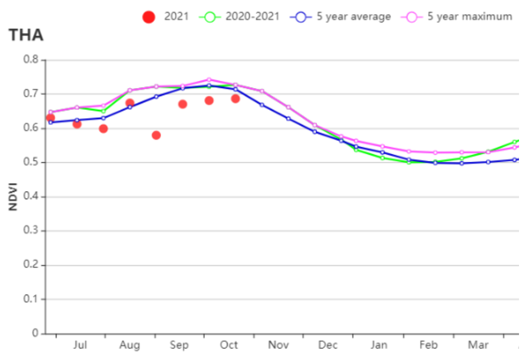
In the **Single-cropped rice north-eastern region,** precipitation was above average by 14%, while temperature and radiation were above average by 0.1℃ and 7%, respectively. These agro-climatic conditions led to an increase of BIOMSS by 7%. As a result, crop conditions were above average before September but dropped to slightly below average thereafter, according to the NDVI development graph.

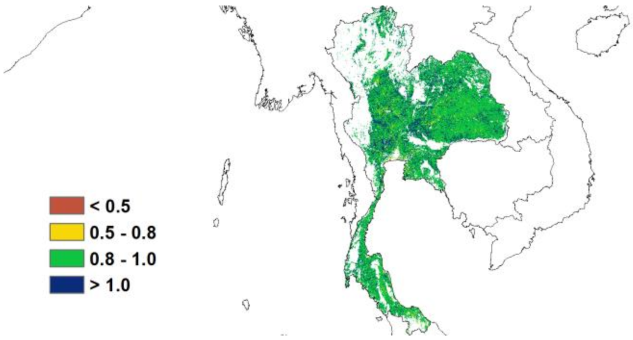
For each region, the VCIx ranging from 0.95 to 0.96 indicates that the peak season was comparable to the 5YA. Almost all cropland was cultivated during the monitoring period.

Figure 3.39 Thailand's crop condition, July - October 2021



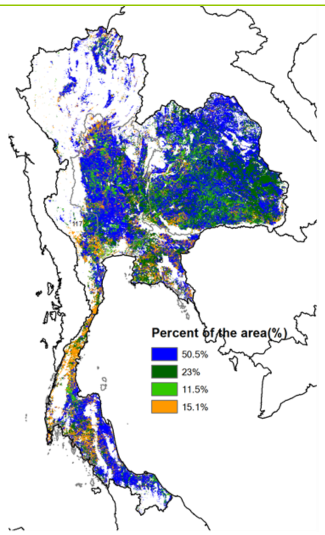
(a). Phenology of major crops

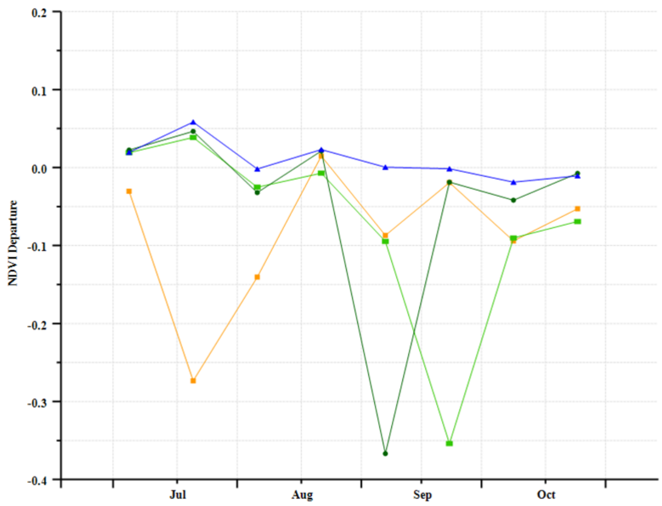




(b) Crop condition development graph based on NDVI

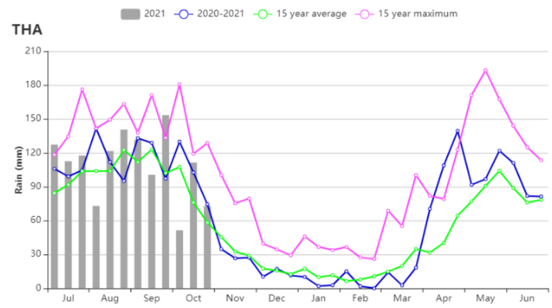
(c) Maximum VCI

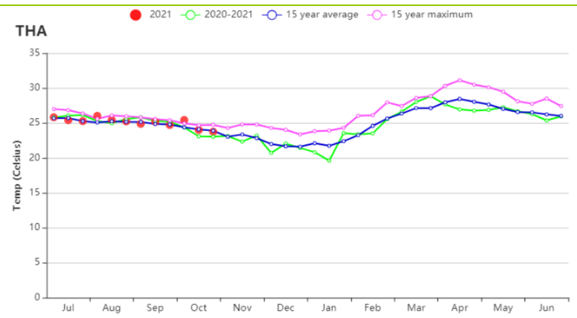




(d) Spatial NDVI patterns compared to 5YA

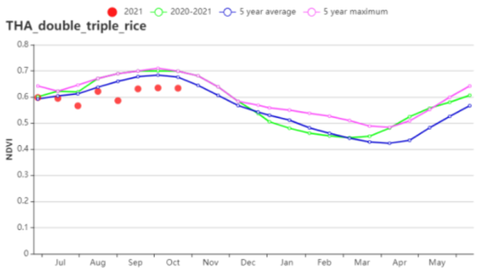
(e) NDVI profiles

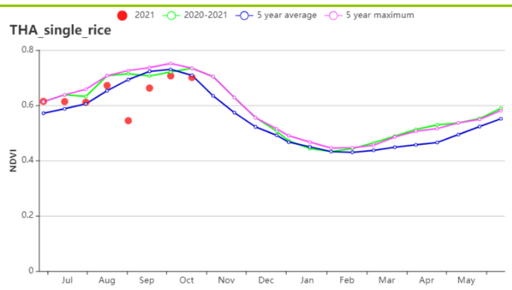




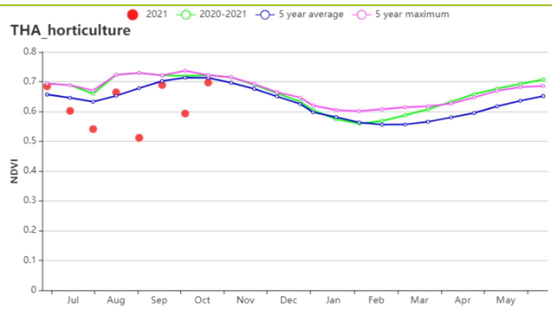
(f) Rainfall profiles

(g) Temperature profiles





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



(i) Crop condition development graph based on NDVI (South-eastern horticulture area)

Table 3.66 Thailand's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2021

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	1545	40	25.4	0	1121	5	1616	9
South-eastern horticulture area	1759	34	25.8	0	1126	1	1651	5
Single-cropped rice north-eastern region	1477	14	25.4	0.1	1162	7	1625	7

Table 3.67 Thailand's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2021

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Central double and triple-cropped rice lowlands	100	0	121	-3	0.96
South-eastern horticulture area	100	0	113	-12	0.95
Single-cropped rice north-eastern region	100	0	100	-10	0.95

[TUR] Turkey

This monitoring period covers the end of the harvest period of winter wheat in July, as well as the growing seasons for rice and maize. Winter wheat sowing started in October. Nationwide, RAIN (-20%) and temperature (-0.6℃) were below average, whereas RADPAR (+0.1%) was slightly above the 15YA. BIOMSS was 14% below average. During this monitoring period, especially in mid-August and October, lack of rainfall has caused a negative impact on the growth of crops and caused a biomass decrease.

The NDVI-based crop condition development graph indicates below-average crop conditions during the whole monitoring period. The national average VCIx was 0.76. The southeastern, southern, and western provinces, such as Sanliurfa, Mardin, and Adana, experienced low VCIx values ranging from 0.5 to 0.8, indicating that crops in those regions were not satisfactory. Low VCIx (< 0.5), which indicates below-average crop conditions, was mainly observed for the central provinces such as Ankara, Yozgat and Kayseri.

In terms of the NDVI spatial departure clustering map, the results confirmed the spatial pattern described above. Due to the impact of low rainfall in April and May, strong negative departures of NDVI were observed. As shown by the VHIn graph, some areas went through dry conditions in the reporting period. Germination and establishment of winter wheat is also negatively impacted. All in all, due to the drought impact, crop conditions were below average for Turkey.

Regional analysis

The regional analysis includes four agro −ecological zones (AEZ): the Black Sea area, Central Anatolia, Eastern Anatolia and Marmara Aegean Mediterranean lowland zone.

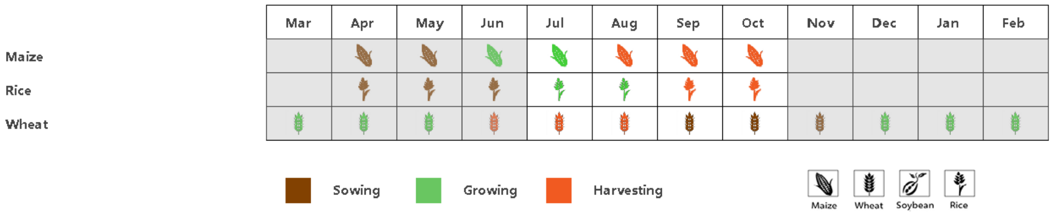
In the Black Sea zone, crop conditions were close to average. The rainfall was above average (RAIN +22%), while the temperature (TEMP) decreased by 1℃ and radiation decreased from the average (-6%). The cropped arable land fraction was 89%, 7% below average. The average value of VCIx was high at 0.81, the highest among all four AEZs of Turkey. Cropping intensity was at 111, 8.47% higher than average. The crop conditions are assessed to be close to normal.

In the Central Anatolian plateau, rainfall was far below average (RAIN -32%) during this monitoring period. TEMP (-0.8℃) and RADPAR (+0%) were close to the 15YA average, resulting in a decrease of the BIOMSS index (-17%). The average VCIx for this region was 0.62. The cropped arable land fraction was only 31%, a decrease by 10%. Cropping intensity was at 103, 1.12% higher than average. Crop conditions are assessed as below average.

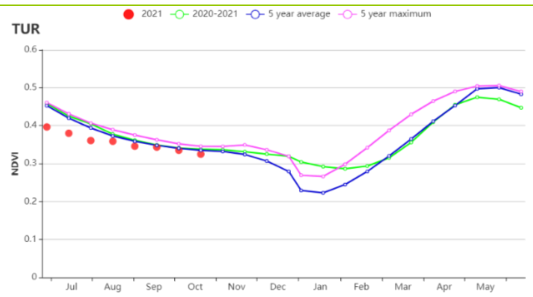
In Eastern Anatolia, rainfall was 5% below average, TEMP was 0.5℃ below average and RADPAR remained average. The lack of rainfall led to a decrease of biomass by 4%. The CALF was greatly lower at 24%, a 52% decrease compared to the average. With VCIx only at 0.46, cropping intensity 0.59% higher at 105, crop output is assessed to be below average.

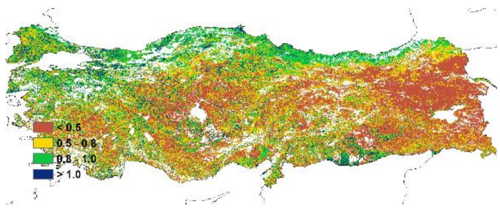
As indicated by the NDVI profile, in the Marmara Aegean Mediterranean lowland zone, the crop conditions were below average during the reporting period (BIOMSS -25%). RAIN was 48% below average, which is the largest decrease among the four AEZs. The temperature was slightly below average (TEMP -0.2℃) and radiation increased slightly (RADPAR +2%) but not enough to offset the impact of lower rainfall. VCIx was 0.71, and CALF was down 1% at 56%. Cropping intensity was 2% higher at 109. Production in this region is expected to be below average.

Figure 3.40 Turkey's crop condition, July-October 2021

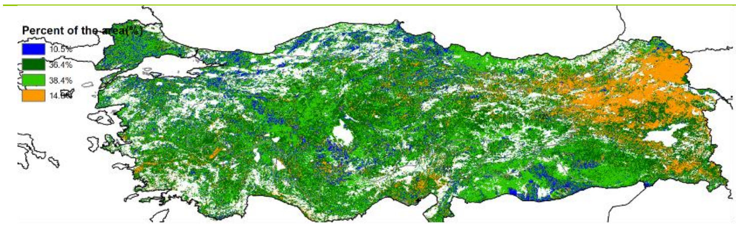


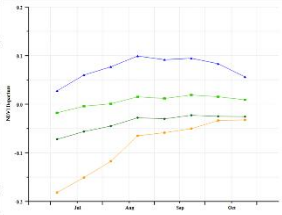
(a). Phenology of major crops



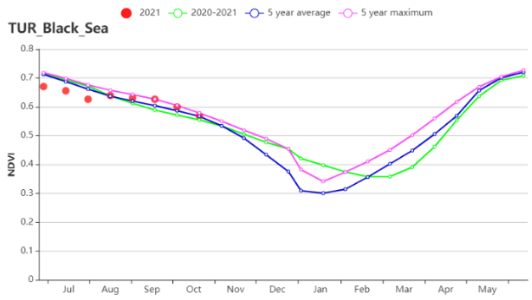


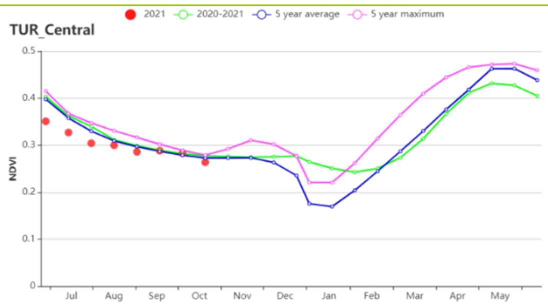
(b) Crop condition development graph based on NDVI (c) Maximum VCI



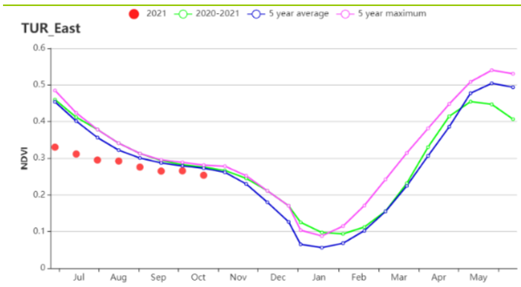


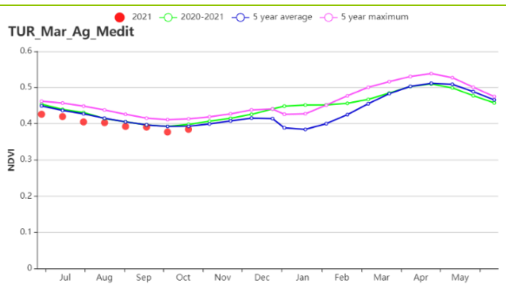
(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles



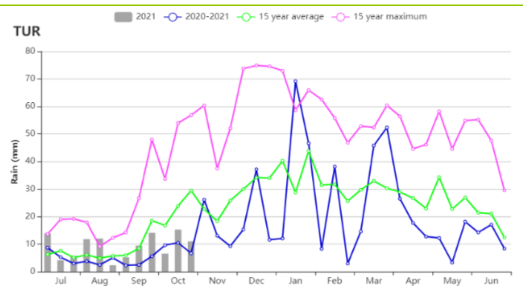


(f) Crop condition development graph based on NDVI (Black Sea region) (g) Crop condition development graph based on NDVI (Central Anatolia region)

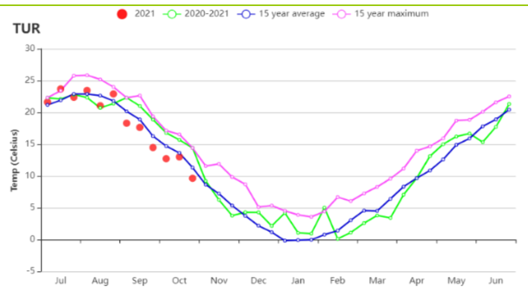




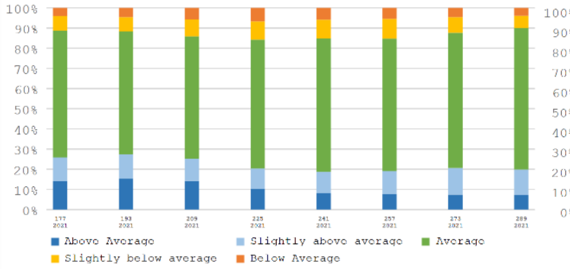
(h) Crop condition development graph based on NDVI (Eastern Anatolia region) (i) Crop condition development graph based on NDVI (Marmara_Agean_Mediterranean lowland region)



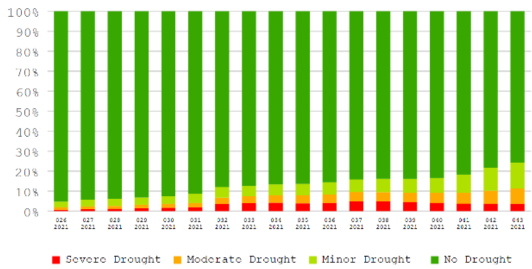
(h) Time series rainfall profile



(i) Time series temperature profile



(j) Proportion of NDVI anomaly categories compared with 5YA



(k) Proportion of VHIn categories compared with 5YA

Table 3.68 Turkey's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2021

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	335	22	14.3	-1	1050	-6	739	7
Central Anatolia region	73	-32	17.1	-0.8	1286	0	378	-17
Eastern Anatolia region	138	-5	17	-0.5	1310	0	419	-4
Marmara Agean Mediterranean lowland region	63	-48	21.3	-0.4	1339	2	332	-25

Table 3.69 Turkey's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2021

Region	Cropped arable land fraction		Maximum VCI	Cropping intensity	
	Current (%)	Departure from 5YA (%)	Current	Current	Departure from 5YA (%)
Black Sea region	89	-7	0.81	111	8.47
Central Anatolia region	31	-10	0.62	103	1.12
Eastern Anatolia region	24	-52	0.46	105	0.59
Marmara Agean Mediterranean lowland region	56	-1	0.71	109	2.13

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

[UKR] Ukraine

This monitoring period covers the harvests of wheat in July and August, followed by maize in September and October. Winter wheat sowing started in September.

According to the agroclimatic and agronomic indicators of CropWatch, this season in Ukraine was drier than usual, rainfall was 15% less, temperature was 0.6℃ lower than the 15YA, and sunshine reached 998 MJ/m² (+4%). Nearly all cropland was cultivated (CALF reached 99%, +4%), cropping intensity was at 123% (+19%) and maximum vegetation condition index (VCIx) was 0.95, which indicated the conditions for the crops were favorable. Estimated biomass (BIOMSS, 610 g DM/m², -4%) at the national level was slightly below the 15YA.

During this period, NDVI at the national level was generally above the 5YA, even exceeding the 5-year maximum before October. As shown in the spatial NDVI patterns, NDVI in about 85.8% area of cropland was above or close to the 5YA until September. However, an obvious depression of NDVI was observed in middle October, which could be attributed to the rainfall deficiency in October. Time series of rainfall profile suggested the amount of precipitation was less than one-third of the 15YA in this month and the proportion of drought area had risen to 40% accordingly. Spatial VCIx pattern showed crop conditions in most croplands of Ukraine were good (VCIx was between 0.8 and 1), especially favorable in Donetsk, Crimea and Odessa region.

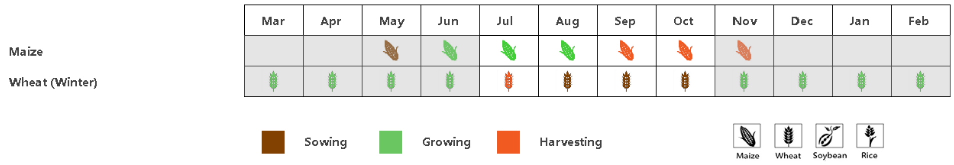
In summary, crop conditions in Ukraine were close to average and CropWatch estimates favorable production for wheat and maize. It is also noteworthy that the low rainfall at the end of the monitoring period is favorable for the drying and harvest of maize but has a negative impact on the germination and establishment of winter wheat.

Regional analysis

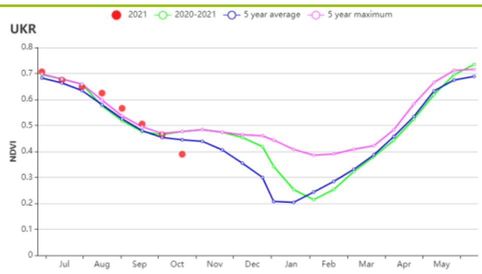
Regional analyses are provided for four agro-ecological zones (AEZ) defined by their cropping systems, climatic zones and topographic conditions. They are referred to as **Central wheat area** with the Poltava, Cherkasy, Dnipropetrovsk and Kirovohrad Oblasts; **Northern wheat area** with Rivne; **Eastern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

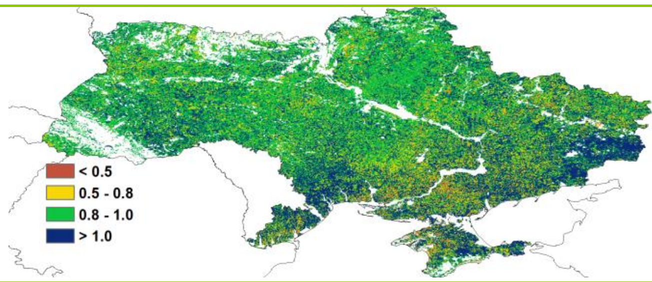
All four AEZs shared a similar pattern of agroclimatic conditions. Compared to the 15YA, the four zones received less rainfall from -3% in **Southern wheat and maize area** to -33% in **Eastern Carpathian hills**. Cooler temperature was also detected, from 0.4°C lower in Northern wheat area to 0.7°C lower in Southern wheat and maize area. Radiation was close to average with the largest positive departures for **Central wheat area** and **Northern wheat area** at 5% above average. The below-average rainfall in October had no impact on maize yields. It may have helped its harvest, but may have had a negative impact on the early development of winter wheat. Potential biomass showed a below-average level in most AEZs except for Southern wheat and maize area (0%), which had the smallest rainfall deficit (-4%). Agronomic indicators suggest the crop conditions were favorable for all AEZs. Cropping intensity was higher (+16-21%). CALF (0.99 to 1) and VCIx (0.92 to 0.98) indicate good crop prospects.

Figure 3.41 Ukraine's crop condition, July- October 2021

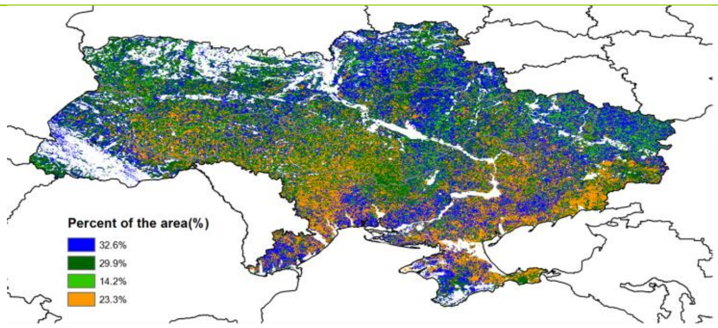


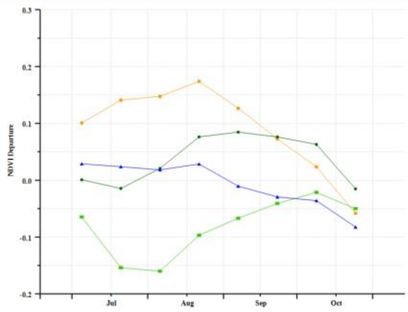
(a). Phenology of major crops



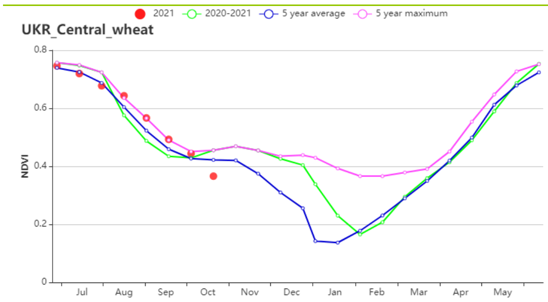


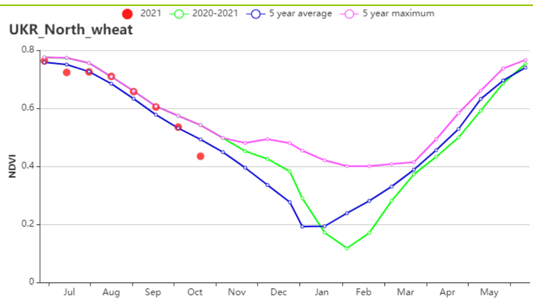
(b) Crop condition development graph based on NDVI (c) Maximum VCI



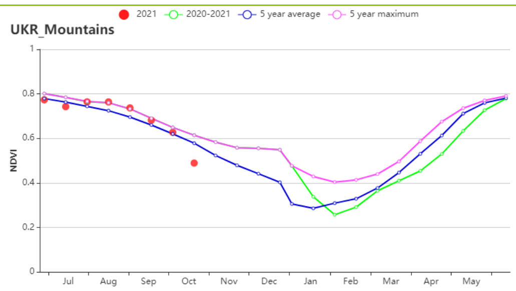


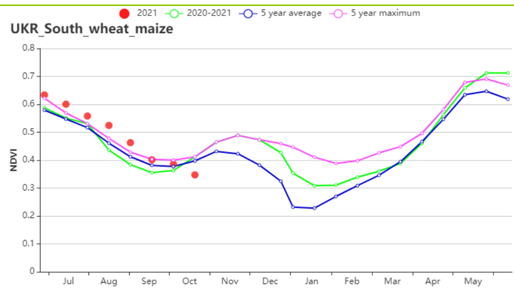
(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles



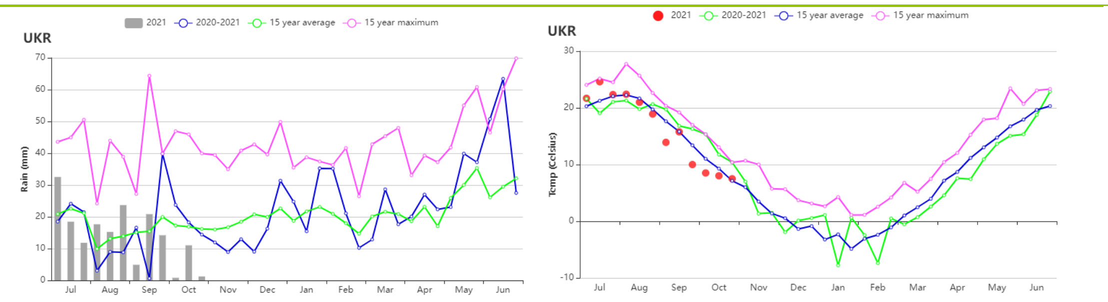


(e) Crop condition development graph based on NDVI (Central wheat area(left) Northern wheat area(right))

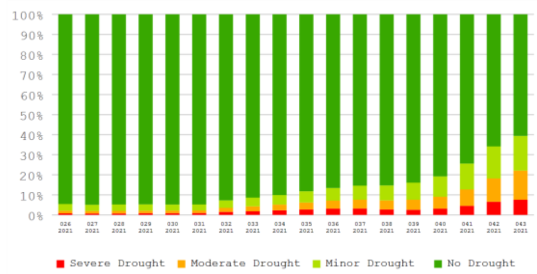




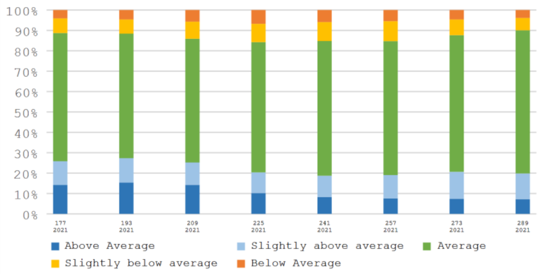
(f) Crop condition development graph based on NDVI (Eastern Carpathian hills(left) Southern wheat and maize area(right))



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



(h) Proportion of drought categories from January-July 2021



(i) Proportion of VHIm categories compared with 5YA

Table 3.70 Ukraine's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2021

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Central wheat area	153	-17	16.1	-0.6	995	5	601	-3
Eastern Carpathian hills	189	-33	14.5	-0.5	968	1	599	-19
Northern wheat area	185	-19	15.2	-0.4	936	5	619	-7
Southern wheat and maize area	152	-4	17.8	-0.7	1045	3	598	0

Table 3.71 Ukraine's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2021

Region	Cropped arable land fraction		Crop Intensity		Maximum VCI
	Current (%)	Departure (%)	Current	Departure (%)	Current
Central wheat area	100	0	121	21	0.92
Eastern Carpathian hills	100	0	122	21	0.95
Northern wheat area	100	0	117	16	0.93
Southern wheat and maize area	99	9	129	21	0.98

[USA] United States

The current reporting period (July to October) covers the mid- to late-growth stages of maize, rice, soybeans and the harvest period of spring wheat in the United States. The harvest of summer crops was almost completed by the end October. Overall, crop conditions were near the 5-year average.

Warm and wet weather prevailed in the United States, with higher rainfall (+22%), temperature (+0.4℃) and RADPAR (+2%) than the 15YA. Adequate precipitation effectively replenished soil moisture for crops at the late-growth stages, and warm weather created favorable conditions for photosynthetic processes, resulting in potential biomass being 11% higher than average at the national level. However, there were large differences among the regions, as discussed in the subsequent paragraphs. Significant increases in precipitation in the Northeast, Southeast, and Southwest resulted in local severe flooding events in some states, such as Tennessee (RAIN: +33%), Arizona (RAIN: +86%), and other states. Although some fields in these states were damaged by flooding, the increased precipitation effectively replenished soil moisture and was in general beneficial for summer crop growth.

As a whole, the national average cultivated arable land fraction (CALF) reached 86%, which was 2% below the 5YA, and the VCIx was 0.87, while the crop condition showed strong spatial heterogeneity. Thanks to the improved weather compared with the previous bulletins, crops had recovered from the stressed conditions during the previous months in parts of the Corn Belt, Northeast, Southeast, and Southwest. The VCIx was high in Alabama (0.97), Arizona (1.12), Georgia (0.98), Illinois (0.98), Indiana (0.97), Iowa (0.97), Mississippi (0.96), Ohio (0.98), and Tennessee (0.96). It's noteworthy that precipitation remained high during maturity and harvest stage. Excessively wet soil conditions may have impacted harvest progress in some regions. Poor crop conditions were observed in some states on the North Plain and northwest region, including Washington, Idaho, Montana, North Dakota, and South Dakota. Although increased precipitation was also observed in these areas during the monitoring period, the CALF still decreased by 9% to 18% and the maximum vegetation index (VCIx) ranged between 0.57 and 0.73. This region had experienced drought conditions already during the previous monitoring period.

In short, the favorable weather conditions in the Midwest and South helped boost production of maize, rice and soybean, whereas wheat, grown in the Western and northern states, suffered from the severe drought conditions.

Regional analysis

Corn Belt

This region is the most important maize and soybean producing area in the United States. During this monitoring period, crop growth conditions were above average due to favorable agro-climatic conditions. Rainfall (+10%), temperature (+1.2℃) and RADPAR (+4%) were higher than the 15YA, which favored the photosynthetic process of crops, resulting in 8% higher potential biomass than average. VCIx reached to 0.95, indicating the good crop growth condition. The CALF reached 100%, 2% above the 5YA and cropping intensity was also 2% above the average. All in all, production for this region recovered to the above-5YA level.

Northern Plains

This area is an important spring wheat and maize producing area. In general, the poor crop condition was indicated by the NDVI development profile. Rainfall in the current reporting period returned to normal and was 7% above the 15YA, and temperature (+1.6℃) and RADPAR (+2%) were higher than 15YA. The increased precipitation mitigated the effects of drought to some extent. However, the crop condition improved little due to strong negative impact of severe droughts that occurred in the northern plains in the previous reporting period. Agronomic indicators also showed unfavorable conditions, with a VCIx of only 0.59, the lowest among the AEZs, indicating poor crop growth in the region. Compared to the 5-year average, the CALF had significantly dropped by 24%. In short, CropWatch assessed below-average crop conditions in the region, and crop production is expected to be far below average.

Lower Mississippi

The region is an important production area for rice, soybeans and maize. During this monitoring period, good crop growing conditions continued from the previous reporting period to the current reporting period. Overall, weather conditions were favorable for crop growth, with rainfall 15% above 15YA and RADPAR 4% below 15YA. The average temperature was 24.1°C, 0.1°C below the 15YA, but still the highest among the AEZs. The potential biomass was 15% above 15YA. The favorable crop condition was also confirmed by average VCIx of 0.95. The intensity of arable land use also increased during the monitoring period, with cropping intensity 2% higher than average. In short, the CropWatch assessed that above crop production can be expected in this region.

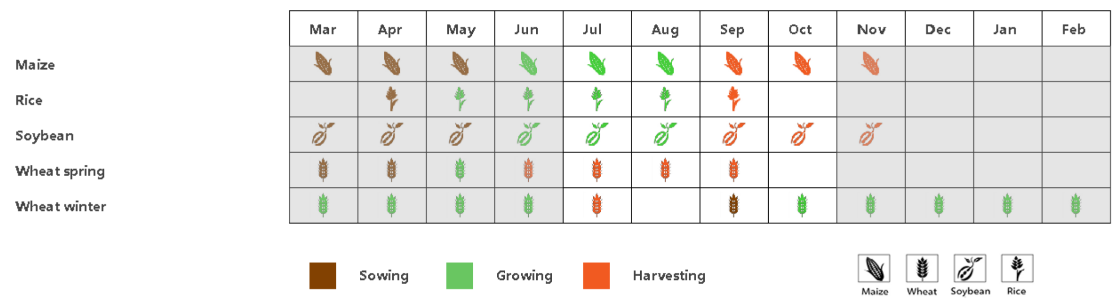
Southern Plains

The region is an important cotton, rice, and sorghum producing area in the United States. The crop conditions, as indicated by NDVI, were favorable. Compared to the 15 years average, rainfall (+18%), temperature (+0.1℃), and RADPAR (+5%) were above the 15YA, respectively, which provided generally favorable conditions for crop growth. The potential biomass was 11% above the 15-year average. The average value of VCIx reached 0.90, which indicates good crop conditions. The CALF was 4% above the 5YA. In short, good crop conditions were assessed by CropWatch for the South Plain.

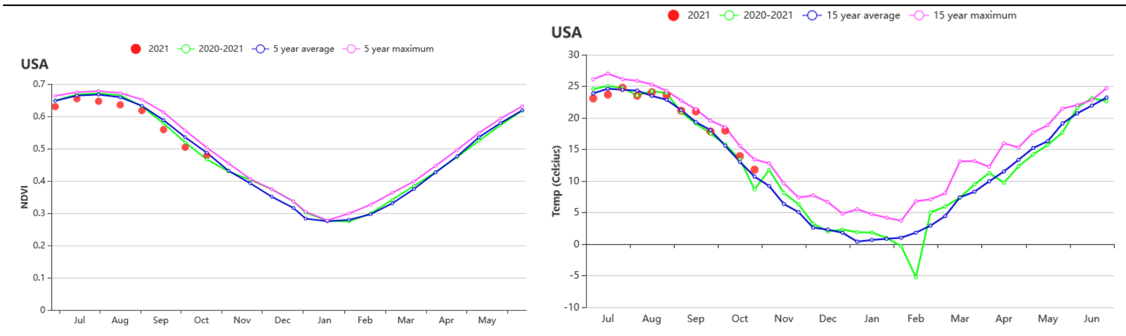
Northwest

The Northwest region is an important spring wheat producing region. During the reporting period, the climate was wet and warm with rainfall (+17%) and temperature (+0.5℃) above the 15YA, and RADPAR (+0%) close to average. During the last reporting period, the region had suffered from a severe drought that caused significant damage to crops in the area. Even when precipitation returned to above-average levels, the poor condition of the crops did not change. The VCIx was only 0.63 compared to the last five-year average, indicating poor crop conditions. The proportion of arable land under cultivation and the intensity of arable land use in the area decreased significantly during this monitoring period, with CALF at only 61% (12% below 5YA), and cropping intensity 4% below 5YA. In short, poor crop production in this area was assessed by CropWatch.

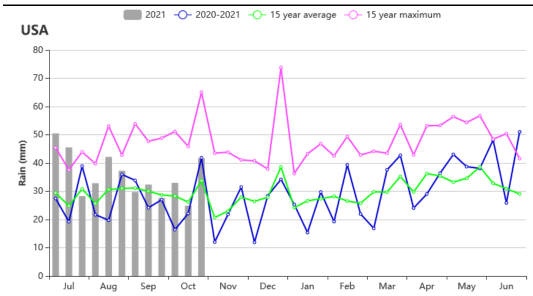
Figure 3.42 United States crop condition, July 2021 to October 2021

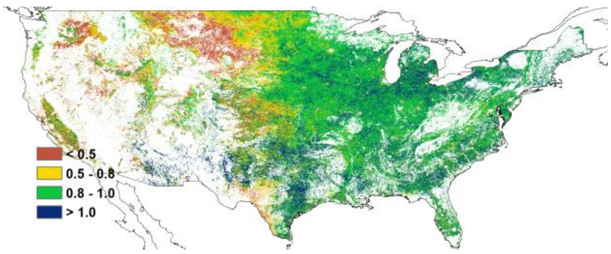


(a). Phenology of United States from July to October 2021

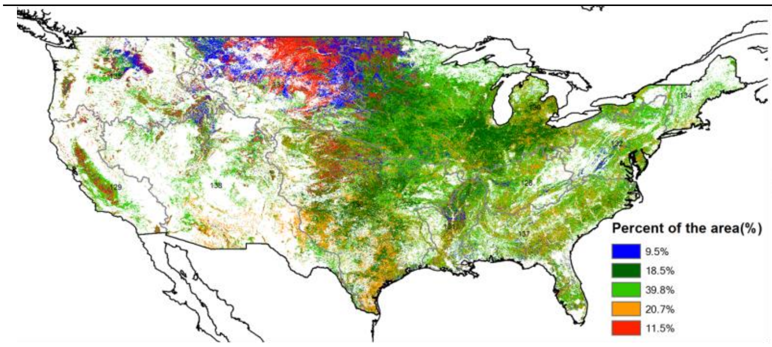


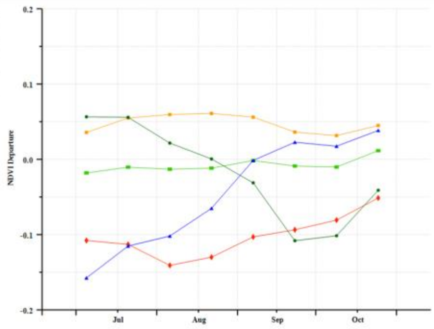
(b). Crop condition development graph based on NDVI (c) Time series temperature profile



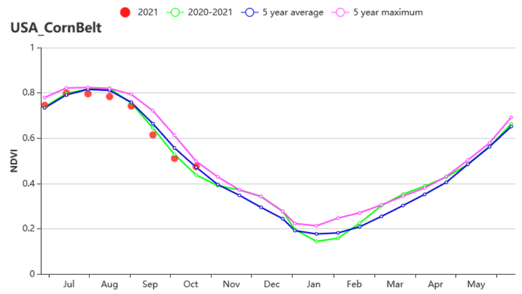


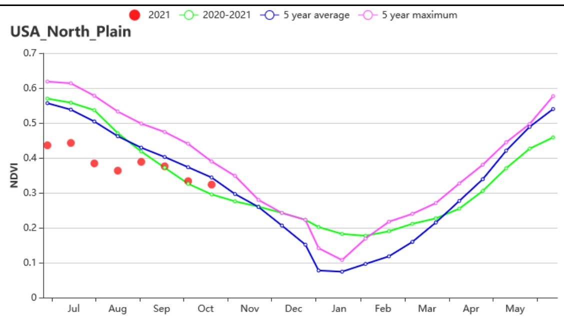
(d). Time series rainfall profile (e). Maximum VCI



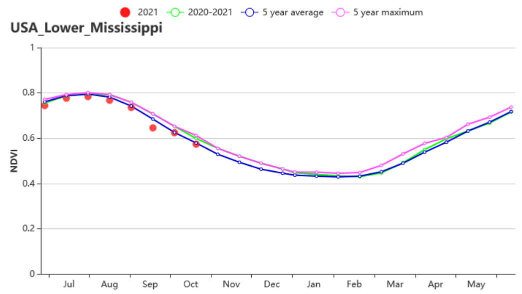


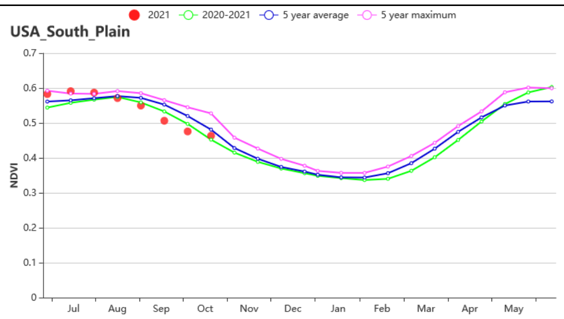
(f). Spatial distribution of NDVI profiles



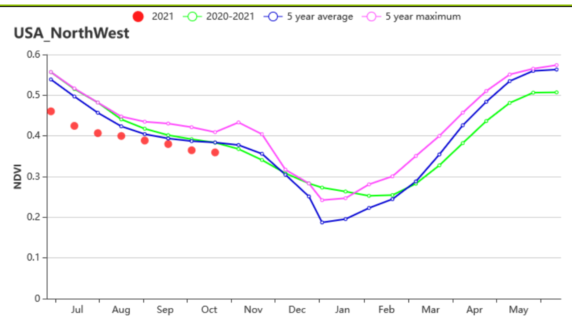


(g) Crop condition development graph in Corn Belt (h) Crop condition development graph in North Plain





(i) Crop condition development graph in Lower Mississippi (j) Crop condition development graph in South Plain



(i) Crop condition development graph in Northwest

Table 3.72 United States' agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July 2021 - October 2021

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current(°C)	Departure(°C)	Current(MJ/㎡)	Departure (%)	Current (gDM/m2)	Departure (%)
Corn Belt	339	10	19.7	1.2	1126	4	909	8
Northern Plains	224	7	18.3	1.6	1185	2	746	7
Lower Mississippi	572	15	24.1	-0.1	1233	4	1225	15
Southeast	676	31	23.5	-0.4	1218	2	1291	16
Southern Plains	425	18	23.9	0.1	1274	5	995	11
North-eastern areas	514	36	18.6	0.8	1025	-2	1068	13
Northwest	193	17	15.5	0.5	1183	0	581	13
Blue Grass region	436	26	20.7	0	1168	1	1066	16
California	145	156	20.1	0.1	1388	-1	406	31

Table 3.73 United States' agronomic indicators by sub-national regions, current season's values and departure, July 2021 - October 2021

Region	Cropped arable land fraction		Maximum VCI	Cropping Intensity	
	Current (%)	Departure from 5YA (%)	Current	Current	Departure from 5YA (%)
Corn Belt	100	0	0.95	102	2

Northern Plains	62	-24	0.59	104	2
Lower Mississippi	100	0	0.95	102	2
Southeast	100	0	0.95	102	1
Southern Plains	89	4	0.9	102	-3
North-eastern areas	100	0	0.96	107	6
Northwest	61	-12	0.63	101	-4
Blue Grass region	100	0	0.95	103	3
California	100	0	0.95	103	0

[UZB] Uzbekistan

This monitoring period from July to October covers the growing and harvesting stage of maize. Wheat was harvested in July and August. Winter wheat sowing started in September and October. Summer precipitation is minimal, as rain falls mostly during winter. Most of the summer crops are irrigated. Among the CropWatch agroclimatic indicators, RAIN was below average (-48%), while TEMP and RADPAR were above average (+0.2°C and +1%). The combination of these factors resulted in a decrease of estimated BIOMSS (-27%) compared to the fifteen-year average. The NDVI development graph shows that crop conditions were below the five-year average during the monitoring period. As shown in the NDVI cluster graph and profiles, only about 14.7% of the agricultural areas had above-average conditions during the whole monitoring period, these areas are located mainly in the northern part of Namangan Province, the southern part of Ferghana Province, and along the Amu Darya River. The agricultural areas with maximum VCI indices above 0.8 were in Andijon Province, Namangan Province, Ferghana Province, Khorezm Province, and the eastern part of Bukhoro Province. The national average VCIx was 0.73, the cropped arable land fraction decreased by 11%, and the cropping intensity was 118. It had increased by 2%.

Overall, the prospects for crop production in Uzbekistan are unfavorable.

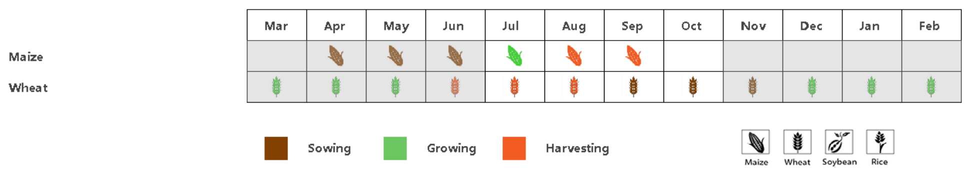
Regional analysis

In the **Aral Sea cotton zone**, crop condition was below the five-year average according to the NDVI development graph. TEMP and RADPAR were above 15YA (+0.3°C and +2%), while RAIN was below average (-61%). BIOMSS decreased by 45% compared to the 15YA. The maximum VCI index was 0.69 and the cropped arable land fraction decreased by 25%. The cropping intensity was close to the average. Affected by these factors, the crop prospects for this zone are unfavorable.

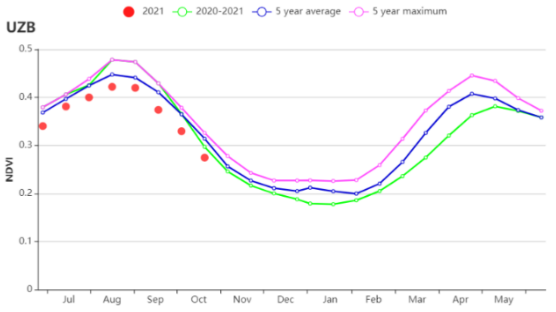
In the **Eastern hilly cereals zone**, NDVI was below the five-year average from July to October. The RAIN was below average (-48%), while TEMP and RADPAR were slightly above the fifteen-year average (+0.2°C and +1%). The combination of these factors resulted in a decreased BIOMSS (-23%). The maximum VCI index was 0.73 and the cropped arable land fraction decreased by 6%. The cropping intensity was above average by 2%. Overall, crop productions in this zone are expected to be negative.

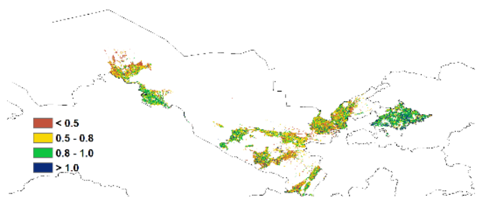
The **Central region with sparse crops** also suffered from severe rainfall shortage (decreased by 71%), whereas temperature was slightly warmer (+0.3°C) and RADPAR was close to average (+1%). Consequently, BIOMSS decreased by 48% as compared to the 15YA. The maximum VCI was 0.81, cropping intensity was equal to the 5YA and the cropped arable land fraction increased by 3%. However, it is noteworthy that the unfavorable crop condition of this region had little impact on the crop productions of Uzbekistan since the crop fields are sparse in the region.

Figure 3.43 Uzbekistan crop condition, July - October 2021



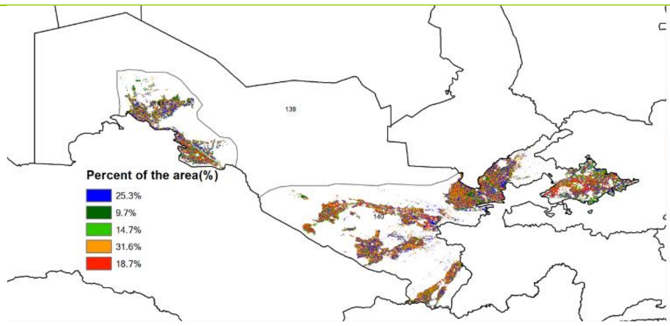
(a) Phenology of major crops

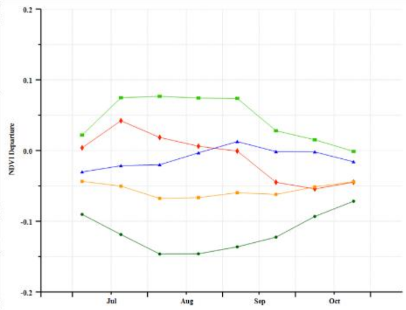




(b) Crop condition development graph based on NDVI

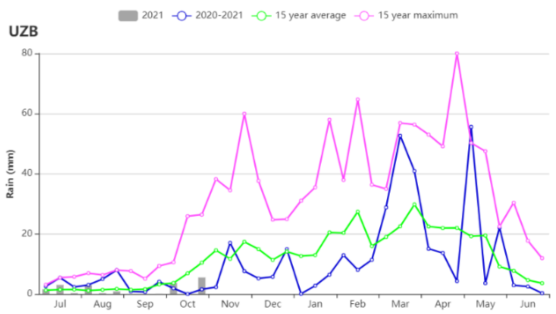
(c) Maximum VCI

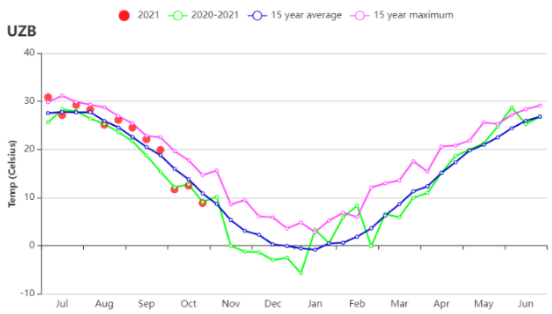




(d) Spatial NDVI patterns compared to 5YA

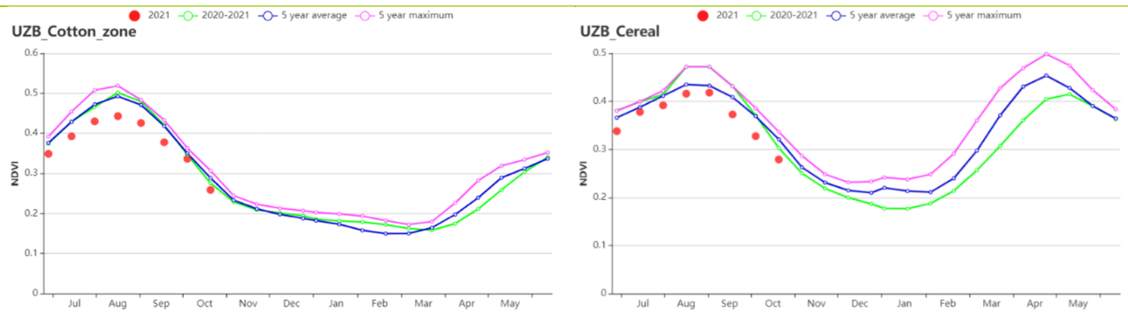
(e) NDVI profiles



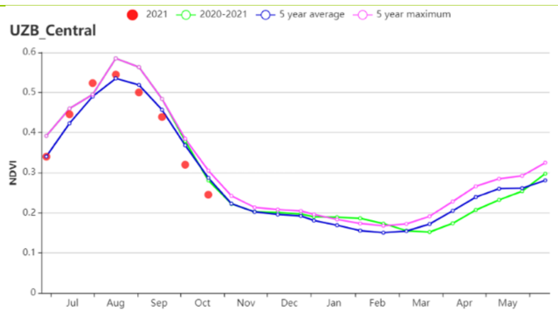


(f) Rainfall profiles

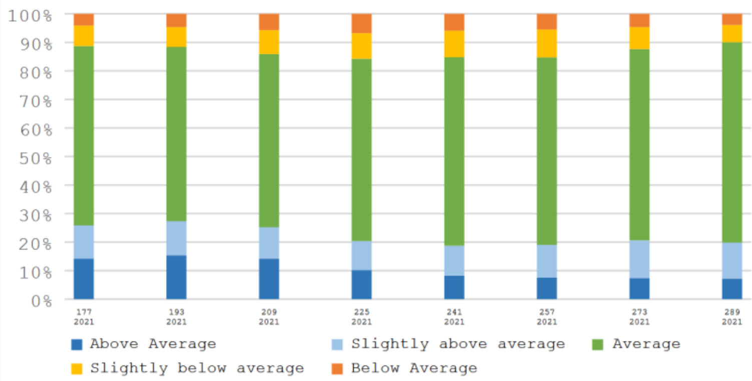
(g) Temperature profiles



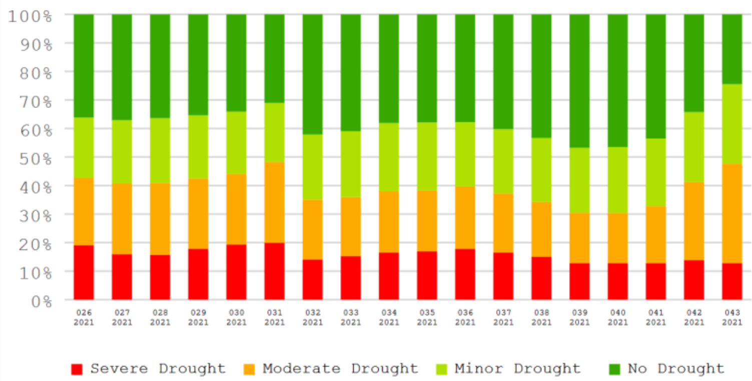
(h) Crop condition development graph based on NDVI Aral Sea cotton region (left) Eastern hilly cereals region (right)



(i) Crop condition development graph based on NDVI Central region with sparse crops



(j) Proportion of NDVI anomaly categories compared with 5YA in Uzbekistan



(k) Proportion of VHIn categories compared with 5YA in Uzbekistan

Table 3.74 Uzbekistan's agroclimatic indicators by sub-national regions, current season's values, and departure from 15YA, July - October 2021

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m^2)	Departure (%)	Current (gDM/m^2)	Departure (%)
Aral Sea cotton zone	5	-61	23.5	0.3	1320	2	104	-45
Eastern hilly cereals zone	20	-48	22.0	0.2	1389	1	168	-23
Central region with sparse crops	4	-71	24.0	0.3	1356	1	88	-48

Table 3.75 Uzbekistan's agronomic indicators by sub-national regions, current season's values, and departure from 5YA, July - October 2021

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Aral Sea cotton zone	54	-25	101	1	0.69
Eastern hilly cereals zone	54	-6	124	3	0.73
Central region with sparse crops	79	3	100	0	0.81

[VNM] Vietnam

This monitoring period covers the entire period from the planting to harvesting of spring-winter rice in the Mekong river delta and rainy season rice in the north. In July, summer rice in Central Vietnam was harvested, followed by the planting of rainy season rice in August and September. It will be harvested in November.

CropWatch agro-climatic indicators showed higher precipitation (1451 mm, +3%), and TEMP (24.0°C, +0.2°C) as compared to the 15YA. Combined with above average radiation (1152, +5%), the BIOMSS (+2%) showed an increase compared to the 15YA. The VCIx (0.95) was high, and the CALF (97%, +1%) was above the 5YA. The cropping intensity was also above the five-year average (139%, +2%).

Based on the NDVI development graph, the crop conditions were below the 5YA during the whole monitoring period, especially from September to the end of this monitoring period. From July to August the precipitation was below the 15YA, but surpassed it after September, while the temperature was near the 15YA, except for a spike in early August. As to the spatial distribution of NDVI profiles, crop conditions on about 48% of the country were above the average, mainly distributed over Tuyen Quang Province, Cao Bang Province, Thai Binh Province, Thanh Hoa Province and Nam Dinh Province. Overall, the crop conditions are assessed as normal, except for the South Central Coast, where they were below average.

Regional analysis

Based on cropping systems, climatic zones, and topographic conditions, several agro-ecological zones (AEZ) can be distinguished for Vietnam: **Central Highlands, Mekong River Delta, North Central Coast, North East, North West, Red River Delta, South Central Coast, and South East**.

In the **Central Highlands**, RAIN was significantly higher than the 15YA (1658 mm, +9%) and TEMP was near the 15YA (22.7°C). The RADPAR (1058 MJ/m2, +3%) and the BIOMSS (1473 gDM/m2, +2%) were both above the 15YA. Cropping intensity (115%, -9%) significantly decreased. CALF was 100% and VCIx was 0.96. The crop condition development graph shows that NDVI fluctuated greatly. Based on the agroclimatic indicators, the crop conditions were mixed.

In the **Mekong River Delta region**, TEMP (26.9°C, +0.2°C) was close to the 15YA, and RADPAR (1240 MJ/m2, +4%) was above the 15YA. The RAIN (1259 mm, -7%) was below average. The cropping intensity (184%, +7%) was significantly higher than the 5YA. CALF was higher (91%, +4%) and VCIx was 0.91. According to the NDVI development graph, crop conditions were above the 5YA in early July and August. Overall, the crop conditions were near average.

In the region of **North Central Coast**, RAIN increased 3% compared to the 15YA, and TEMP was 23.8°C with an increase by 0.2°C. RADPAR (1133 MJ/m2, +7%) showed a significantly increase, and BIOMSS increased slightly (+3%). Cropping intensity (119%, -7%) was significantly below the 5YA. CALF was the same as the 5YA, and VCIx was 0.96. According to the NDVI development graph, crop conditions were slightly below the 5YA, expect in the July showing a high value exceeding the 5-year-maximum. Crop condition in this region are expected to be near average.

In the **North East region**, TEMP (23.5°C, +0.1°C) was about the 15YA. Although RAIN (1565 mm, +4%) and RADPAR (1165 MJ/m2, +6%) both increased and were above the 15YA, the BIOMSS (1534 gDM/m2, +5%) was above average. Cropping intensity (146%, +13%) was significantly higher than the 5YA. CALF was 100% and VCIx was 0.98. According to the NDVI development graph, crop conditions were below the 5YA, especially in the early September and October. Overall, the crop conditions were expected to be favorable at most.

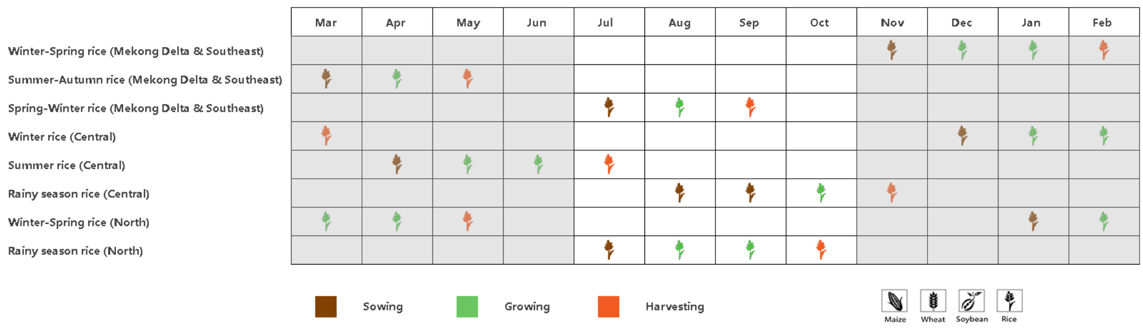
In the **North West region**, RAIN (1143 mm, +8%) showed a remarkable increase, and the TEMP (22.0°C, +0.2°C) was about the 15YA. RADPAR increased by 6%, which resulted in an increase of the BIOMSS (1399 gDM/m2, +2%). Cropping intensity (127%, +5%) was higher than the 5YA. CALF was 100% and VCIx was 0.98. According to the NDVI development graph, except in early September and October, NDVI values were below the 5YA. Crop conditions in this region were expected to be average at most.

In the region of **Red River Delta**, RAIN (1572 mm, +7%) and RADPAR (1185 MJ/m2, +3%) increased significantly. TEMP (26.4°C, +0.1°C) was near the 15YA and the BIOMSS (1662 gDM/m2, +4%) was higher. Cropping intensity (151%, +1%) was slightly above the 5YA. CALF was 97% and VCIx was 0.93. According to the crop condition development graph, the NDVI was generally below the 15YA. Regarding the agroclimatic indicators, the crop conditions in this region were near average.

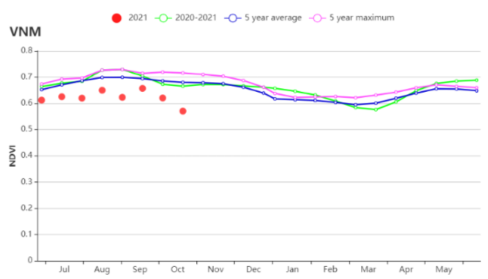
In the **South Central** Coast, with the increases of RAIN (1464 mm, +14%), TEMP (23.8°C, +0.4°C) and RADPAR (1109 MJ/m2, +4%), BIOMSS (1379 gDM/m2, 0%) was still the same as the 15YA. Cropping intensity (135%, -3%) was reduced. CALF was 96% and VCIx was 0.89. According to the crop condition development graph, the NDVI was both below the 5YA and the value of last year. Thus, crop conditions in this region were below average.

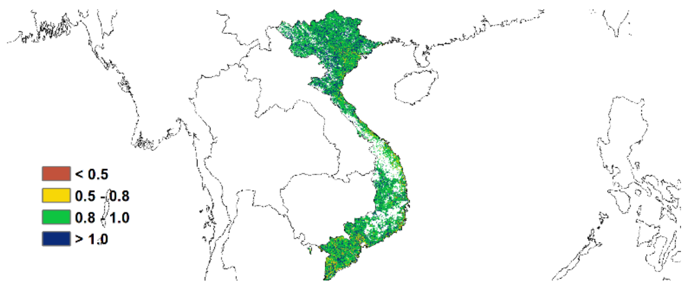
In the **South East region**, RAIN (1553 mm, -3%) was below the 15YA, TEMP (25.4°C, +0.2%) and RADPAR (1191 MJ/m2, +4%) were both above the 15YA, while BIOMSS (1542 gDM/m2, 0%) was the same as the 15YA. Cropping intensity (124%, -3%) was below the 5YA. CALF was 96% and VCIx was 0.97. As shown by the crop condition development graph, the NDVI fluctuated greatly. According to the agroclimatic indicators, crop conditions in this region were mixed.

Figure 3.44 Vietnam's crop condition, July - October 2021

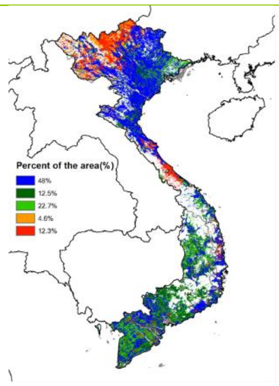


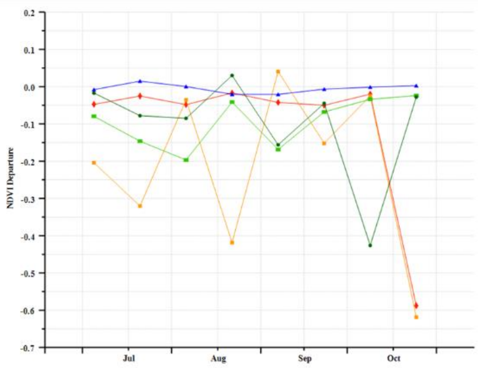
(a). Phenology of major crops



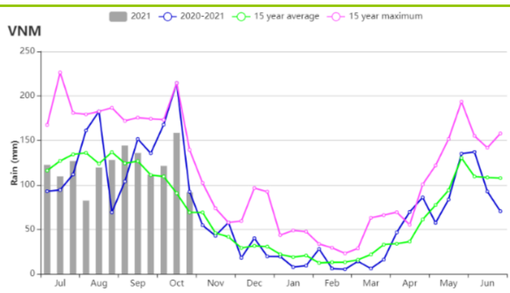


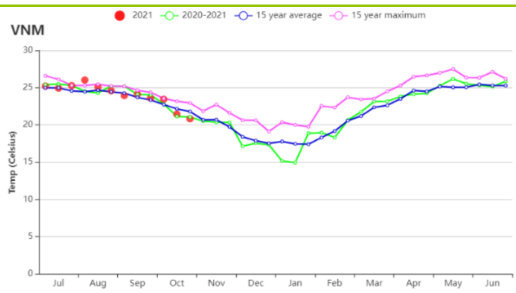
(b) Crop condition development graph based on NDVI (c) Maximum VCI



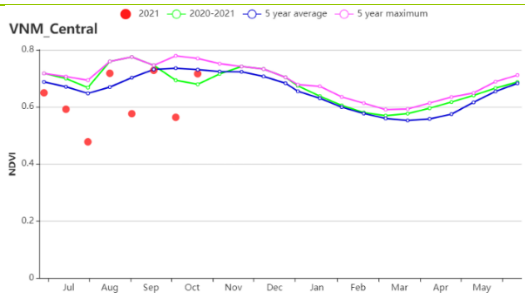


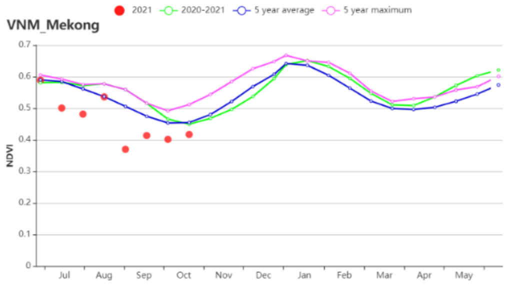
(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles



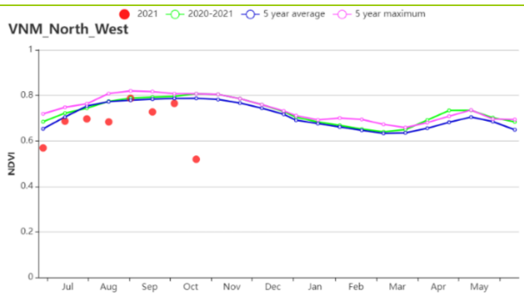


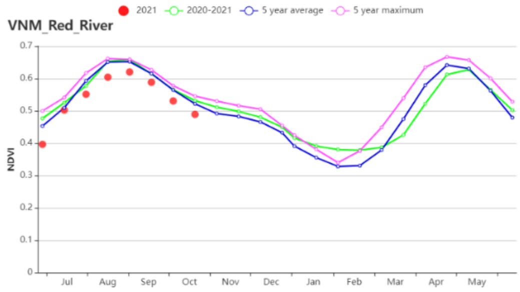
(f) Rainfall profiles (g) Temperature profiles



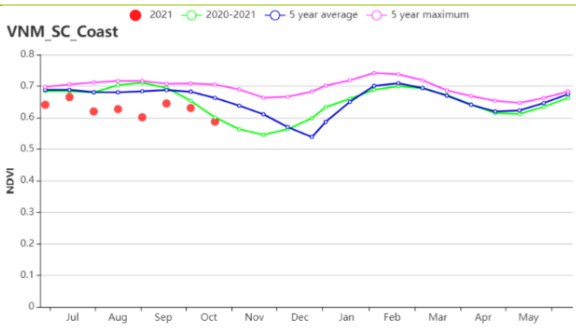


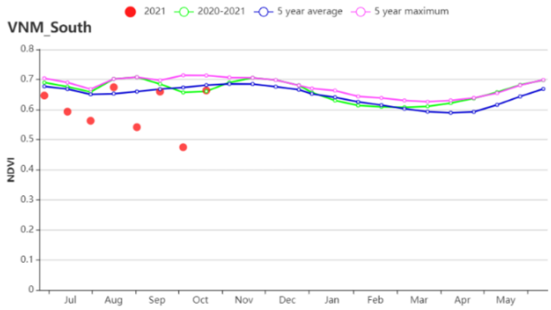
(h) Crop condition development graph based on NDVI Central Highlands Vietnam (left), and Mekong River Delta (right).



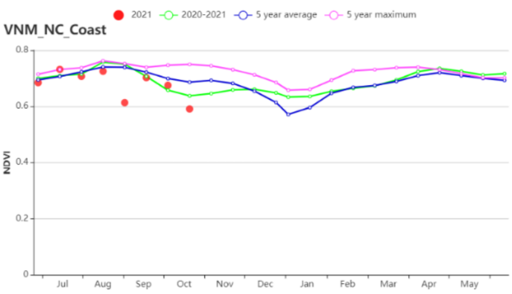


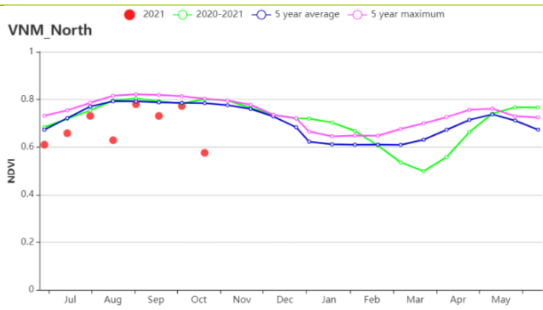
(i) Crop condition development graph based on NDVI North West Vietnam (left), and Red River Delta (right).



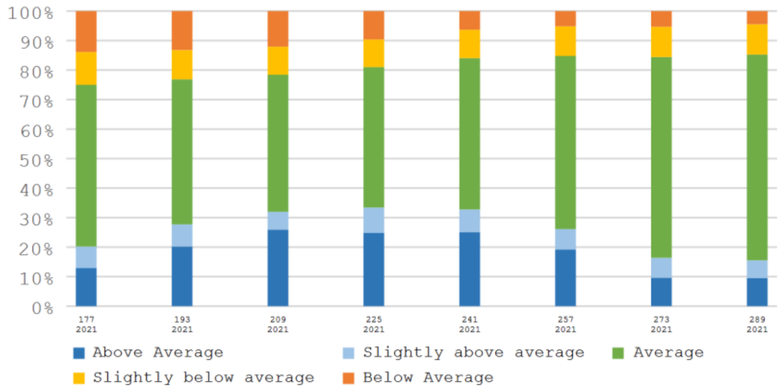


(j) Crop condition development graph based on NDVI South Central Coast Vietnam (left), and South East Vietnam (right).

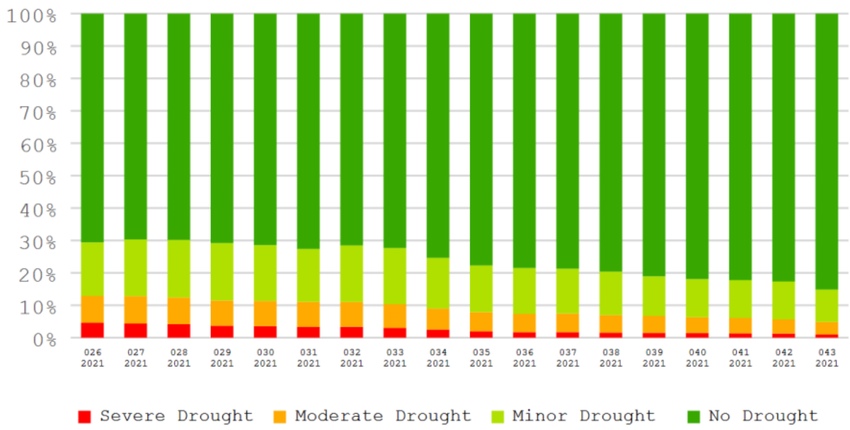




(k) Crop condition development graph based on NDVI North Central Coast Vietnam (left), and North East Vietnam (right).



(l) Proportion of NDVI anomaly categories compared with 5YA



(m) Proportion of VHIm categories compared with 5YA

Table 3.76 Vietnam's agronomic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2021

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Central Highlands	1658	9	22.7	0.1	1058	3	1473	2
Mekong River Delta	1259	-7	26.9	0.2	1240	4	1706	1
North Central Coast	1441	3	23.8	0.2	1133	7	1484	3
North East	1565	4	23.5	0.1	1165	6	1534	5
North West	1244	0	22.0	0.2	1143	8	1399	2
Red River Delta	1572	7	26.4	0.1	1185	3	1662	4
South Central Coast	1464	14	23.8	0.4	1109	4	1379	0
South East	1553	-3	25.4	0.2	1191	4	1542	0

Table 3.77 Vietnam's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2021

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Central Highlands	100	0	115	-9	0.96
Mekong River Delta	91	4	184	7	0.91

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
North Central Coast	98	0	119	-7	0.96
North East	100	0	146	13	0.98
North West	100	0	127	5	0.98
Red River Delta	97	1	151	1	0.93
South Central Coast	96	0	135	-3	0.89
South East	96	1	124	-3	0.94

[ZAF] South Africa

In South Africa, wheat is the main crop being produced during this monitoring period. In the east, maize sowing started in October. Soybean planting also started in October.

Based on the NDVI development graph, the crop conditions were slightly above the 5-year average during this monitoring period and even exceeded the 5-year maximum in August and October. At the national level, the CropWatch agroclimatic indicators show that radiation was slightly above the 15-year average (RADPAR +2%). With a lower rainfall (RAIN -15%) and a slightly lower temperature (TEMP -0.7℃), the potential biomass decreased by 3% compared to the 15-year average. The maximum vegetation condition index (VCIx) was 0.91, and the cropped arable land fraction (CALF) increased significantly by 22% compared with the last 5 years. According to the VCIx, conditions in the Mediterranean zone, where wheat is an important crop, were better than in the eastern region (like Gauteng, Mpumalanga). As to the spatial distribution of NDVI profiles, crop conditions on about 58.2% of the cropland were below average during the whole monitoring period, 21.8% was on average during July to August and about 41.8% of the area was above average starting in September. The areas with negative departures were mainly in the center of the eastern region (like Gauteng, Mpumalanga province). Overall, crop conditions were slightly above average.

Regional analysis

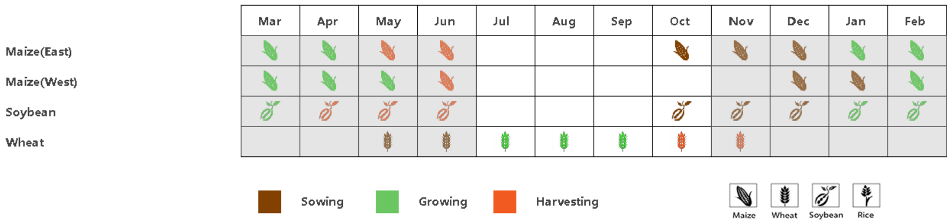
Rainfall in the Arid and desert zones was slightly below average (77mm, -9%) and the temperature was near average (12.7°C, -0.7°C), whereas radiation was slightly above average (+3%), and potential biomass decreased by -3% due to the insufficient rainfall. Cropped arable land fraction (CALF) increased significantly (+36%) and VCIx was 0.78. The cropping intensity was average (108%, +1%), indicating cropland utilization rate was normal. The crop condition development graph based on NDVI indicates that the crop conditions were generally above the 5-year average and only in late-July was slightly below average. Crop production is expected to be favorable.

In the Humid Cape Fold mountains, the temperature was near average (14.7 °C, -0.6 °C), and rainfall was below average (175mm, -15%). With lower rainfall (-15%), potential biomass was below the 15-year average (-5%). CALF was 83% and VCIx was 0.94. The cropping intensity was average (105%, +2%), indicating cropland utilization rate was normal. The crop condition development graph based on NDVI also indicates favorable conditions.

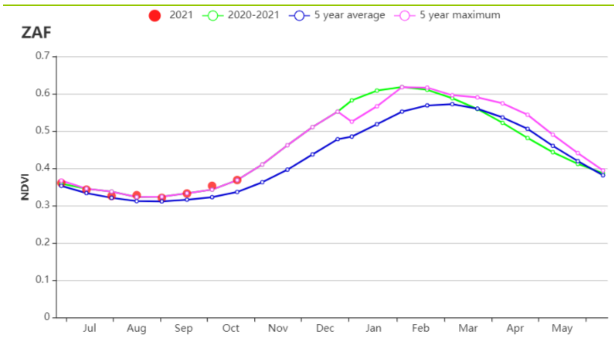
In the Mediterranean zone, the temperature was near average (11.8 °C, -0.8 °C), while rainfall witnessed a significant increase (316mm, +13%) and radiation was slightly above average (990 MJ/m2, +4%). The estimated potential biomass was increased significantly by 10% due to the sufficient rainfall. CALF increased substantially (89%, +6%) and VCIx was 0.93. The cropping intensity was average (101%, +1%), indicating cropland utilization rate was normal. According to the crop condition development graph, the NDVI was above the 5-year maximum for most of the period. Crop conditions were favorable.

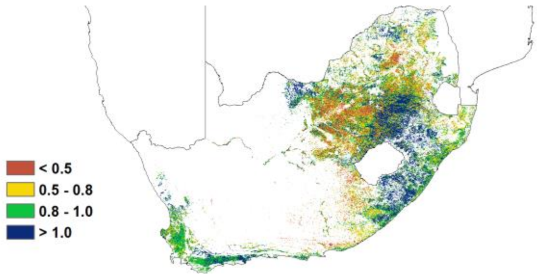
In the Dry Highveld and Bushveld maize areas, rainfall (69 mm, -23%) and temperature (13.7 °C, -0.7°C) were were below the 15-year average. Radiation was near average (1182 MJ/m2, +1%). Potential biomass decreased by 6%. CALF was significantly above the 5YA (17%, +47%) and VCIx was 0.90. The cropping intensity was near average (101%, 0%) indicating cropland utilization rate was normal. The crop condition development graph based on NDVI shows the NDVI was below the 5-year average for most of the period. However, most of land was fallow during the winter months and the planting of summer crops started in October only.

Figure 3.45 South Africa's crop condition, July - October 2021

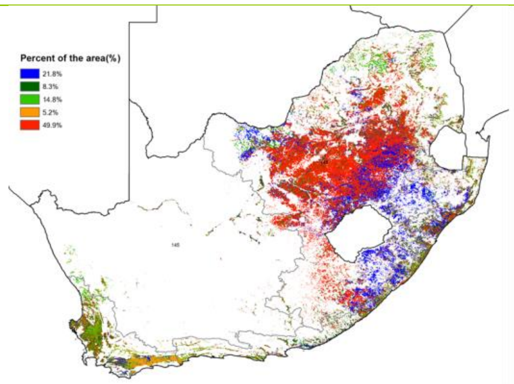


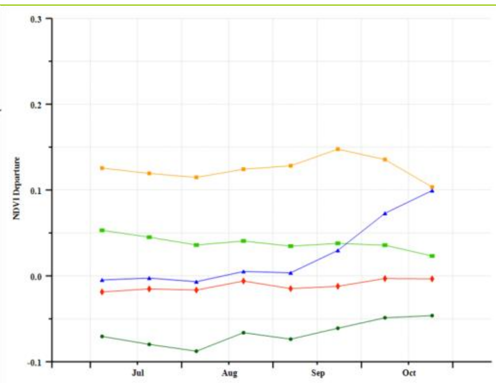
(a). Phenology of major crops



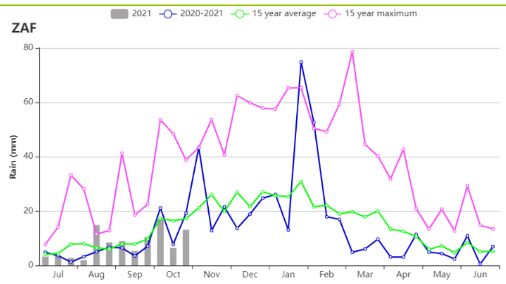


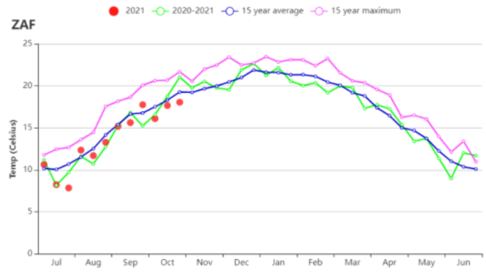
(b) Crop condition development graph based on NDVI (c) Maximum VCI



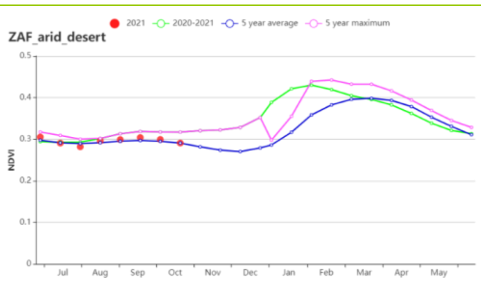


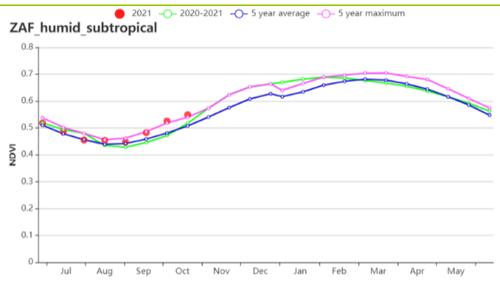
(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles



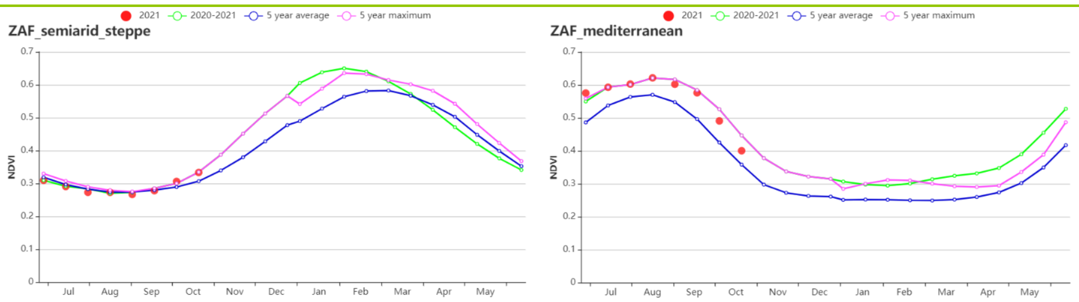


(f) Rainfall profiles (g) Temperature profiles





(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 3.78 South Africa's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2021

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Arid and desert zones	77	-9	12.7	-0.7	1142	3	340	-3
Humid Cape Fold mountains	175	-15	14.7	-0.6	989	3	568	-5
Mediterranean zone	249	13	11.8	-0.8	990	4	644	10
Dry Highveld and Bushveld maize areas	69	-23	13.7	-0.7	1182	1	345	-6

Table 3.79 South Africa's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2021

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Arid and desert zones	24	36	108	1	0.78
Humid Cape Fold mountains	83	13	105	2	0.94
Mediterranean zone	89	6	101	1	0.93
Dry Highveld and Bushveld maize areas	17	47	101	0	0.90

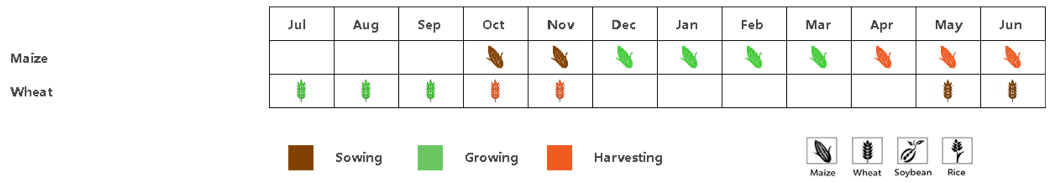
[ZMB] Zambia

This period covers the maturity and harvesting of the irrigated dry-season crops and the onset of the rainfed season. The key irrigated crops are wheat, green maize, horticultural crops and vegetables. Irrigated wheat was harvested from late September into October. At the national level, rainfall (-35%) and solar radiation (RADPAR -1%) were below the 15YA. The average temperature was 21.6℃ (+0.2%) and potential biomass production was 231 gDM/m2 (+9%). The cropped arable land fraction (CALF) was 46% and maximum VCI was 0.81. The overall conditions for the irrigated crops during this period were favorable. The total cereal production, the bulk being maize, was forecasted at about 4 million. Wheat production also benefitted from the generally favorable conditions.

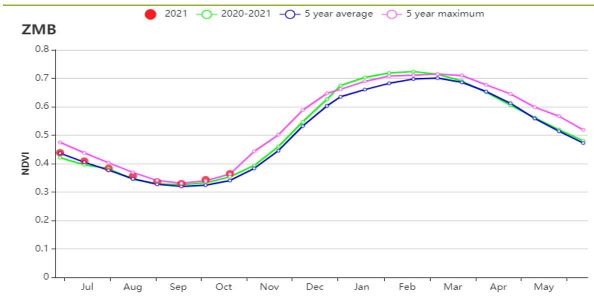
Regional Analysis

Based on regional analyses of the agro-ecological region, rainfall in all the agro-ecological zones was below the 15 years average with the **Northern High Rainfall Zoneand Central-Eastern and Southern Plateau** recording highest negative departure (-38% and -36% respectively). The temperature varied from **Northern High Rainfall Zone** (21.3℃, +0.1%) to **Western Semi-arid Plain** (22.3℃, +0.4%). The radiation in all agro-ecological zones was above 1350 MJ/m2 (+4%) except for the **Luangwa-Zambezi Rift Valley** with a slight decrease (-2%). Negative BIOMSS departures were observed in the **Luangwa-Zambezi Rift Valley** (-2%). A similar pattern was observed for the cropped arable land fraction (CALF), with the highest CALF in **Northern High Rainfall Zone** (81%, +3%), and with lower values but hihger positive departures in **Luangwa-Zambezi Rift Valley** (32%, +15%), **Central-Eastern and Southern Plateau** (36%, +22%) and the **Western Semi-Arid Plateau** (54%, +6%). The vegetation health index (VCIx) was above 80% in all the agro-ecological region except for **Luangwa-Zambezi Valley** (VCIx 75%). CropWatch expects an above-average production for 2021/2022 season which is estimated to be sufficient to meet the national consumption requirements.

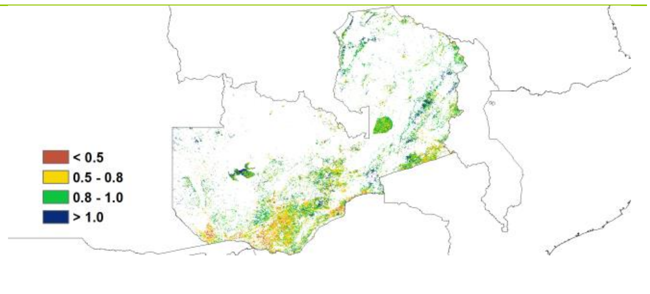
Figure 3.46 Zambia 's crop condition, July -October 2021



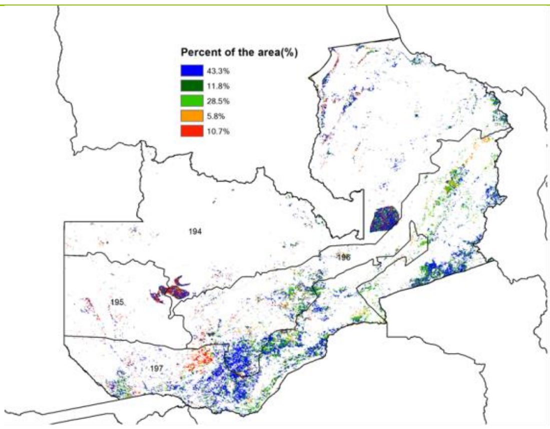
(a). Phenology of major crops

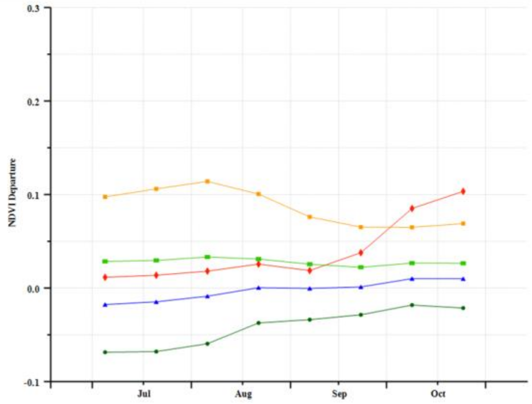


(b) Crop condition development graph based on NDVI



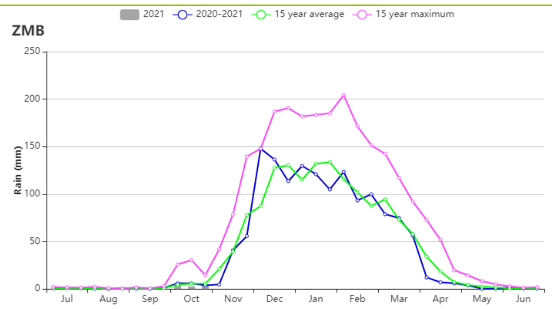
(c) Maximum VCI

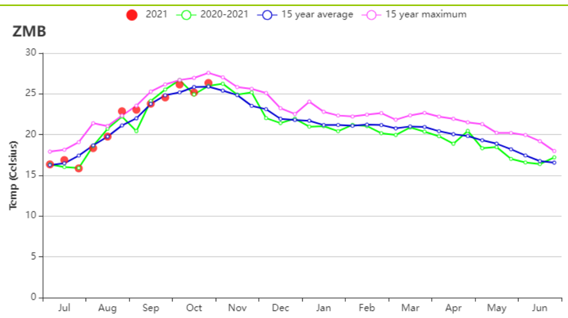




(d) Spatial NDVI patterns compared to 5YA

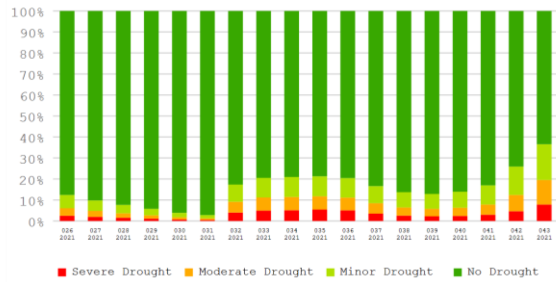
(e) NDVI profiles





(f) Rainfall time series profile

(g) Temperature time series profile



(h) Proportion of VHIm categories compared with 5YA

Table 3.80 Zambia 's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July -October 2021

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 (%)
Northen high rainfall zone	20	-38	21.3	0.1	1408	0	20	-38
Central-eastern and southern plateau	7	-36	21.6	0.1	1359	-1	7	-36
Western semi-arid plain	12	-3	22.3	0.4	1374	-1	12	-3
Luangwa Zambezi rift valley	7	-12	21.6	0.1	1366	-2	7	-12

Table 3.81 Zambia 's agronomic indicators by sub-national regions, current season's value and departure from 5YA, July - October 2021

Region	Cropped arable land fraction		Cropping Intensity		Maximum VCI
	Current (%)	Departure from 5YA (%)	Current (%)	Departure from 5YA (%)	Current
Northen high rainfall zone	263	1	81	3	0.88
Central-eastern and southern plateau	244	15	36	22	0.83
Western semi-arid plain	161	-2	54	6	0.81
Luangwa Zambezi rift valley	212	24	32	15	0.75

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 a revised 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). Section 4.4 describes trade prospects of major cereals and soybean. Additional information on the agro-climatic indicators for agriculturally important Chinese provinces are listed in table A.11 in Annex A.

4.1 Overview

From the perspectives of agroclimatic indicators, the overall conditions were generally favorable in China from July to October 2021, with rainfall, temperature and radiation all above average by 13%, 0.2°C and 2%, respectively. As a result, the potential biomass was 11% higher than the 15YA. The maximum Vegetation Condition Index (VCIx) was rather high at 0.95. The national Cropping Intensity (CI) was 5% above 5YA. Moreover, the mean of CALF for the whole country was at an average level compared to the 5YA.

Over the entire growing period, all of the main agricultural regions of China except Southern China (-3%) recorded above-average rainfall, with the largest positive departure occurring in Huanghuaihai (+75%). According to the spatial distribution of rainfall profiles, both above-average and below-average rainfall was observed during the monitoring period. In some provinces of the lower Yangtze River Basin (most parts of Zhejiang, southern Jiangsu, southern Anhui, northeastern Jiangxi, marked in dark green) rainfall per dekad exceeded the 15YA by 150 mm in mid-August. Regions along the Yellow River including some parts in Shandong, Hubei, Shaanxi, Shanxi, Henan, Beijing and Tianjin also experienced excessive rainfall. It exceeded the average of the mid-July dekad by 90 mm. Heavy rainfall in July in Henan caused severe flooding and led to the crop failure of maize in Hebi and other regions, and several rounds of heavy rainfall weather, continued flooding and low sunshine led to a 3.4% year-on-year decline in maize production in Henan province. Shanxi was also affected by excessive rainfall (such as heavy rain in early October), and the maize production fell 4.1%. Moreover, the excessive soil moisture due to excessive rainfall resulted in the delayed sowing of winter wheat for parts of the provinces along the Yellow river in Henan and Shandong.

Four of the main agricultural region in China recorded above-average temperatures ranging from +0.1℃ (Loess region) to +0.5℃ (Lower Yangtze region), while the other regions recorded below-average temperatures with negative departures ranging from -0.5°C (Inner Mongolia) to -0.1°C (Northeast China). The map of the spatial distribution of temperature profiles indicates that temperatures fluctuated during the monitoring period as follows: 40.8% of cultivated regions (marked in blue) in most parts of Southern China, Lower Yangtze region and Southwest China had positive temperature anomalies by more than 2.5°C in late September and early October, while 37.6% of the cultivated regions (marked in dark green) in most parts of Inner Mongolia, Loess region and Huanghuaihai had positive temperature anomalies by more than 2.0°C in late September. The blue and dark green marked regions also experienced negative temperature anomalies by more than 2.0°C in mid-October.

As for RADPAR, four of the seven regions in China (Huanghuaihai, Loess region, Inner Mongolia and Northeast China) received less radiation as compared to the 15YA, while the other regions received above-average radiation. In respect to BIOMSS, most parts of China had positive departures, including all of the AEZs with a range from +4% (Southern China) to +28% (Huanghuaihai). As can be seen in the spatial distribution of potential biomass departure from the 15YA, most of China had positive departures, but there were areas with negative departures and for very few of them, mainly concentrated in some parts in Shanxi, Shaanxi, Ningxia and Inner Mongolia where crops suffered from drought, BIOMSS was even 20% below average.

The VCIx values were mostly quite high in all of the main producing regions of China, with values between 0.89 (Loess region) and 0.98 (North-east China) except for the northern Shaanxi, central and sourthern Ningxia and part of Gansu. This coincided with the below-average BIOMSS pattern because those reigons are dominated by rainfed crops. Accordingly, not all of the cropland was cultivated, or rather crops were lost due to excessive rainfall, as shown on the CALF map. Nationally, CALF was average in all AEZs of China as compared to the 5YA. Among them, Inner Mongolia recorded slightly below-average CALF (-1%) while all the remaining regions showed an average CALF. When it comes to the cropping intensity (CI), values of 200% are mainly observed in the North China Plain with the wheat-and-maize rotation system while values of 300% are sparsely distributed in Southwestern and Southern China. The largest CI departure occurred in Southwest China (+14%), while all the other AEZs in China had the CI departure ranging from -1% to +8%.

Table 4.1 CropWatch agroclimatic and agronomic indicators for China, July - October 2021, departure from 5YA and 15YA

Region	Agroclimatic indicators				Agronomic indicators		
	Departure from 15YA (2004-2018)				Departure from 5YA (2014-2018)		Current period
	RAIN (%)	TEMP (°C)	RADPAR (%)	BIOMSS (%)	CALF (%)	Cropping intensity (%)	Maximum VCI
Huanghuaihai	75	-0.4	-6	28	0	8	0.93
Inner Mongolia	58	-0.5	-4	21	-1	0	0.97
Loess region	53	0.1	-1	12	0	3	0.89
Lower Yangtze	4	0.5	5	6	0	8	0.96
Northeast China	36	-0.1	-2	22	0	0	0.98
Southern China	-3	0.4	7	4	0	-1	0.94
Southwest China	18	0.3	2	7	0	14	0.97

Figure 4.1 China crop calendar

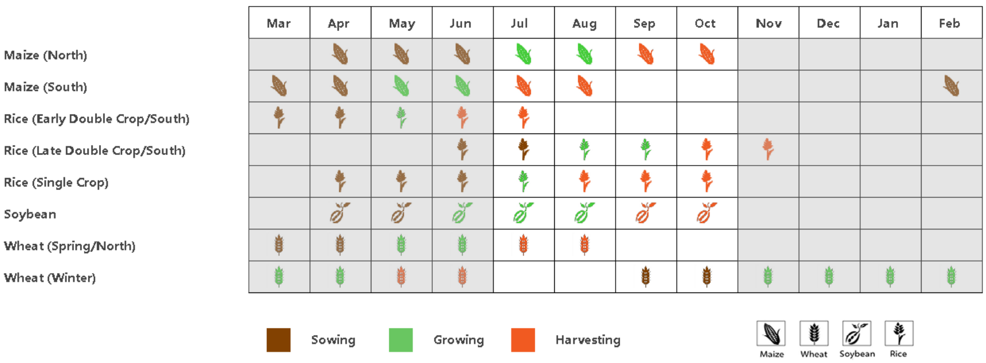
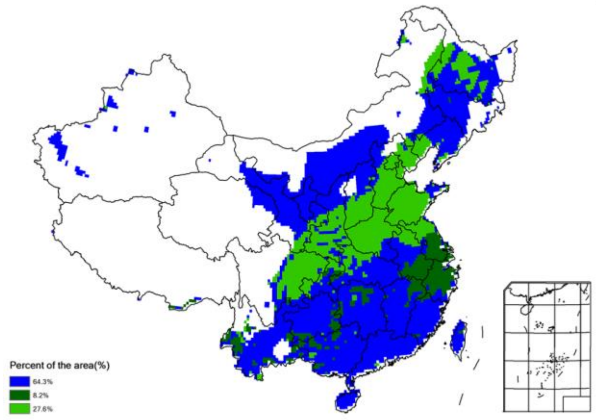


Figure 4.2 China spatial distribution of rainfall profiles, July to Oct 2021



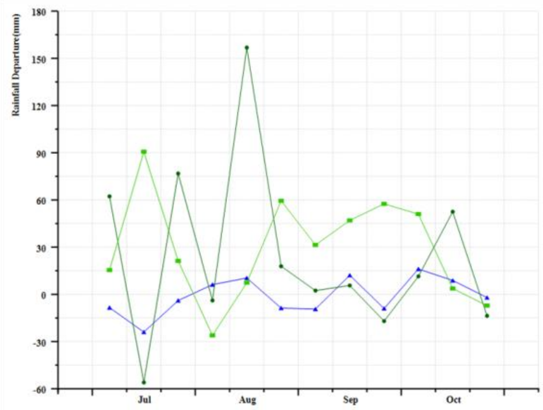
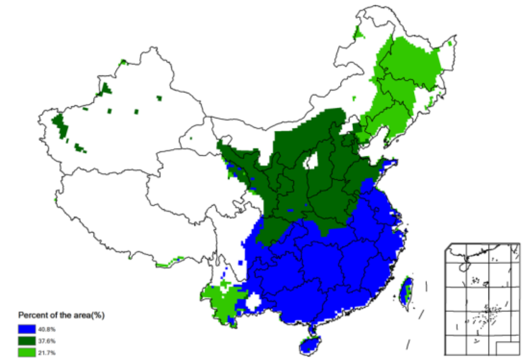


Figure 4.3 China spatial distribution of temperature profiles, July to Oct 2021



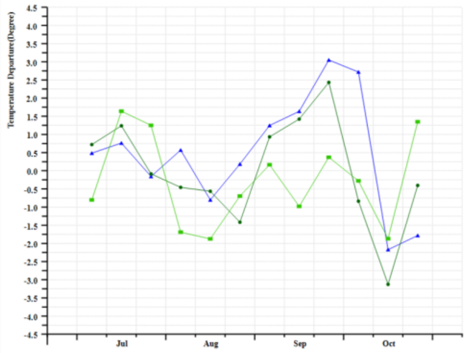
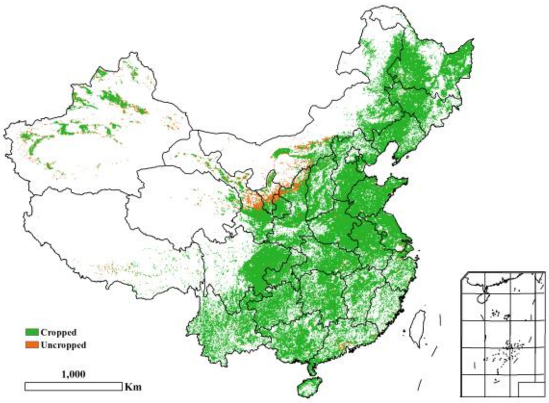


Figure 4.4 China cropped and uncropped arable land, by pixel, July to Oct 2021

Figure 4.5 China maximum Vegetation Condition Index (VCIx), by pixel, July to Oct 2021



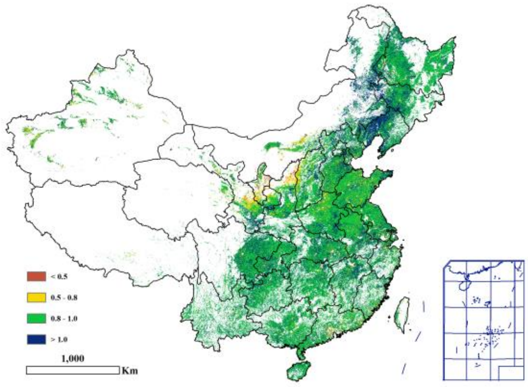
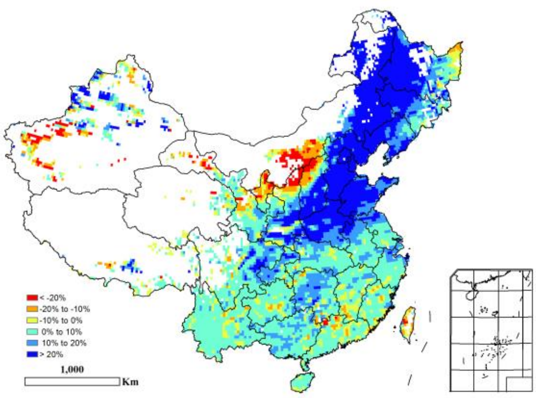


Figure 4.6 China biomass departure map from 15YA, by pixel, July to Oct 2021

Figure 4.7 China minimum Vegetation Health Index (VHIn), by pixel, July to Oct 2021



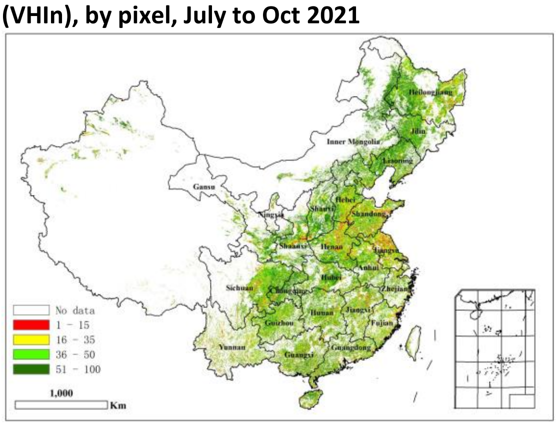
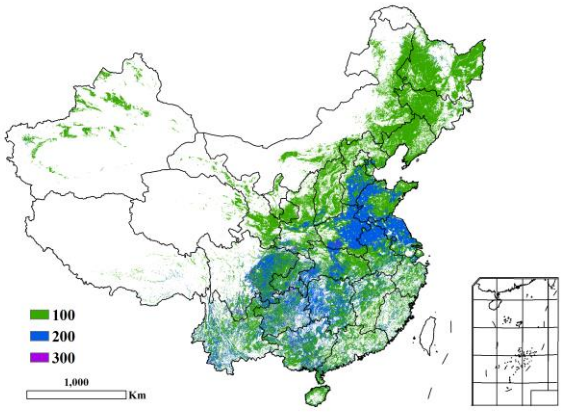


Figure 4. 8 China Cropping Intensity (CI), by pixel, July to Oct 2021



4.2 China's winter crops production

In 2021, the agro-meteorological conditions at national scale were generally favorable for crops, with the north dominated by rainy weather, leading to regional flooding in the HuangHuaiHai region, the Yangtze River basin, the southwest and the western part of the northeast. High temperature and low precipitation dominated in southern China, leading to meteorological drought in Guangdong and Fujian.

Based on multi-source remote sensing data including Sentinel 1/2, Landsat 8, in combination with the latest agro-meteorological information and ground truth samples, as well as 10m resolution cropland mask, a remote sensing-based crop yield model and big data method for crop planted area estimation method were used to monitor and review the national maize, rice and soybean production as well as the total production of summer crops and annual total outputs in 2021.

Total grain production for the year was 636.86 million tonnes, an increase of 5.42 million tonnes or 0.9% over the same period last year. The total output of summer crops (including maize, medium rice, late rice, spring wheat, soybeans, tuber crops and some other minor crops) was 470.82 million tonnes, an increase of 4.34 million tonnes, or up by 0.9% over 2020. Northeast China recovered from the 2020 disaster years, and the total annual crop production increased significantly. Annual total crop production in Heilongjiang, Inner Mongolia and Jilin increased by 2.57 million tonnes, 1.91 million tonnes and 1.17 million tonnes, respectively. Shandong, Liaoning and Hebei provinces benefited from favorable weather conditions and annual total crop production increased by 1.39 million tonnes, 0.88 million tonnes and 0.87 million tonnes, respectively. Henan Province encountered several disasters in 2021, with winter crops affected by hailstorms at the maturity stage of the winter crops. Summer crops were affected by several rounds of heavy precipitation, resulting in flooding, and destroyed part of the summer crop. The total summer crops production in Henan decreased by 0.99 million tonnes. The rest provinces and regions presented limited annual crop production year-on-year changes.

Maize

Total maize production is estimated at 229.70 million tonnes in 2021, an increase of 3.63 million tonnes or up by 1.6% from 2020 (Table 4.2). The increase is mainly due to market factors such as maize prices, which have remained at a high level since 2020, prompting a 1.8% increase in maize planted area. As China's largest maize producing region, maize in the northeast received abundant precipitation during the growing season, and agro-meteorological information were significantly better than in the disaster year of 2020 when several typhoons passed through. The favorable weather conditions provided suitable water and heat conditions for maize production in Heilongjiang, Jilin, Liaoning and Inner Mongolia. Meanwhile, the maize planted area in those provinces also increased, maize production in the four provinces and regions increased by 6.1%, 3.2%, 4.3% and 6.7% respectively, which in total produced 5.81

million tonnes more maize production than the previous year. Maize production increased in Shandong (+2.5%), Hebei (+1.1%), Xinjiang (+3.9%) and Yunnan (+1.1%) compared with 2020. Maize production in Gansu (-2.9%), Ningxia (-2.1%) and Shaanxi (-4.1%) decreased as a result of low precipitation during the monitoring period, which resulted in water deficit during the grain-filling period. In Henan Province, heavy precipitation in July caused flooding, leading to crop failures in Hebi and some other places. Besides, Henan also suffered several rounds of heavy rainfall. All those negative factors led to a 2.6% drop in maize yield in Henan, and the province's corn production decreased by 3.4%. Shanxi Province suffered from heavy rainfall and flooding at the end of summer crops harvesting period, with maize production dropped by 4.1%. Anhui was affected by continuous rain and other adverse weather, with maize production reduced by of 1.5%.

Table 4.2 China 2021 production (thousand tonnes) of maize, rice, wheat, and soybean, and percentage change from 2020, by province

	Maize		Rice		Wheat		Soybean	
	2021	△(%)	2021	△(%)	2021	△(%)	2021	△(%)
Anhui	3,551	-1.5	17,685	1.9	11,679	1.3	1,074	0.8
Chongqing	2,119	-0.4	4,724	0.5	1,146	0.3		
Fujian			2,755	-2.4				
Gansu	5,562	-2.9			3,077	-1.7		
Guangdong			11,368	-0.7				
Guangxi			10,713	0.4				
Guizhou	5,185	0.2	5,324	1.1				
Hebei	19,219	2.5			12,341	2.6	196	4.3
Heilongjiang	43,488	6.1	22,015	1.4	451	3.4	4,792	-6.5
Henan	15,356	-3.4	3,819	-0.5	27,694	-1	808	-1.4
Hubei			15,798	1.7	3,904	-1		
Hunan			25,607	1.4				
Inner Mongolia	24,637	6.7			1,938	2.1	1,210	2.2
Jiangsu	2,191	0.4	16,407	2	9,867	-1.2	768	2.7
Jiangxi			16,541	0.7				
Jilin	30,718	3.2	5,923	2.9			819	2.8
Liaoning	18,912	4.3	4,463	1.4			437	4.5
Ningxia	1,694	-2.1	442	0.2	752	-0.8		
Shaanxi	3,809	-4.1	1,052	0.7	4,053	-2.1		
Shandong	19,215	1.1			26,554	4.5	714	2.2
Shanxi	9,184	-0.8			2,197	-3.5	158	0.5
Sichuan	7,210	0.7	15,167	2.6	5,004	1.3		
Xinjiang	6,948	3.9			5,052	-1.6		
Yunnan	6,422	1.1	5,827	1.7				
Zhejiang			6,565	0.6				
Sub total	225,419	2.7	192,194	1.3	115,711	0.9	10,976	-2
China*	229,703	1.6	202,956	0.9	127,981	0.7	14,346	-1.6

* Production of Taiwan province is not included.

Rice

Total national rice production was 202.96 million tonnes, an increase of 0.9% and 1.78 million tonnes. Early rice production was 33.55 million tonnes, an increase of 0.3%; Semi-late or single rice production was 133.85 million tonnes, an increase of 1.1%, and late rice production was at 35.56 million tonnes, an increase of 0.8% (Table 4.3). Agro-meteorological conditions in the main production areas have been generally normal since the sowing of semi-late or single rice, and it's estimated that rice yield increased by 0.9% and total rice production increasing by 1.4 million tonnes. Most of the main rice-producing provinces in the southwest and the Yangtze River Basin and Huai River basin have experienced high precipitation and insufficient light since August, narrowing the increase in rice yields. Moderate rice production increased in Hubei (+2.9%), Sichuan(+2.6%), Jiangsu(+2.0%), Zhejiang(+1.9%), Hunan (+1.9%) and Anhui (+1.8%) provinces ; Agricultural weather conditions in the single rice producing areas in the northeast were better than last year. With rice production increased in Heilongjiang(+1.4%), Jilin (+ 2.9%) and Liaoning (+1.4%) . During the late growing stages of late rice, Guangdong, and Fujian's precipitation was more than 10% lower from 15YA, but irrigation and other management measures somehow compensate the impact of water shortage. As a result, late rice production in Guangdong and Fujian reduced by 1.1%and 0.3%; Hubei Province, affected by continuous heavy precipitation, is estimated to generate 3.5% year-on-year increase of maize.

Soybean

Total soybean production in 2021 was 14.35 million tonnes, a year-on-year decrease of 0.23 million tonnes, or up by 1.6% from 2020. The main reason for the year-on-year reduction is the decline in planted area, which is concentrated in the northeast. The two major producing provinces of Heilongjiang and Inner Mongolia putout a reduced soybean planted area by 6.7% and 1.1% respectively. Since July, despite local flooding in Heilongjiang's soybean-producing areas, the province's soybean yields only increased slightly by 0.2% and the soybean production decreased by 6.5% mainly due to the reduced planted area. In contrast, Inner Mongolia Soybean production increased by 2.2 per cent from 2020 thanks to well-matched rain and heat conditions during the podding and grain-filling period of soybean, The increase in yields compensated the impact of reduced planted area. Other soybean producing provinces had limited changes in production.

Table 4. 3 Production of early rice, semi-late or single rice and late rice by province in China in 2021 (thousand tonnes) and variation (%)

	Early rice		Semi-late or single rice		late rice	
	2021	Variation (%)	2021	Variation (%)	2021	Variation (%)
Anhui	1,983.6	3.8	13,973	1.8	1,728	0.2
Chongqing			4,724	0.5		
Fujian	1,499.3	-4.1			1,256	-0.3
Guangdong	5,048.3	-0.2			6,320	-1.1
Guangxi	5,247.0	2.1			5,466	-1.3
Guizhou			5,324	1.1		
Heilongjiang			22,015	1.4		
Henan			3,819	-0.5		
Hubei	2,135.6	2.8	10,885	2.9	2,777	-3.5
Hunan	8,527.0	1.5	8,844	1.9	8,236	0.6
Jiangsu	-	-	16,407	2		
Jiangxi	7,160.5	-0.6	2,986	-0.7	6,395	2.8
Jilin			5,923	2.9		
Liaoning			4,463	1.4		
Ningxia			442	0.2		
Shaanxi			1,052	0.7		
Sichuan			15,167	2.6		
Yunnan			5,827	1.7		
Zhejiang	794.3	-0.9	4,939	1.9	875	
Subtotal	32,395.5	0.8	126,789	1.8	33,053	
China*	33,549.3	0.3	133,852	1.1	35,555	0.8

* Production of Taiwan province is not included.

4.3 Regional analysis

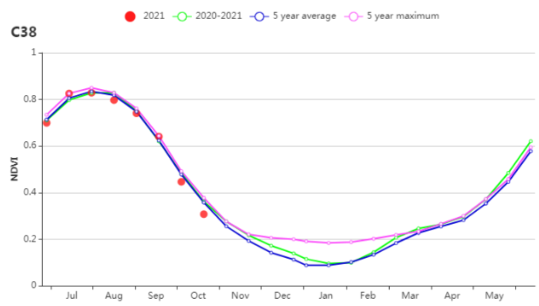
Figures 4.9 through 4.15 present crop condition information for each of China's seven agricultural regions. The provided information is as follows: (a) Phenology of major crops; (b) Crop condition development graph based on NDVI, comparing the current season up to October 2021 to the previous season, to the five-year average (5YA), and to the five-year maximum; (c) Spatial NDVI patterns for July to October 2021 (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 July to October 2021. Additional information about agro-climatic indicators and BIOMSS for China is provided in Annex A.

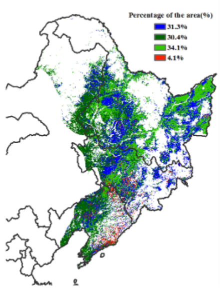
Northeast region

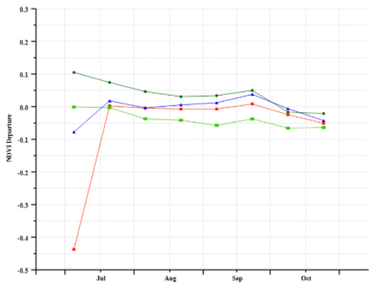
The current monitoring period (July to October) covered the peak of the summer crops in July until the harvest in September and October in northeast China. The crops including maize, rice and soybeans, reached maturity stage in August to September in Heilongjiang, Jilin and Liaoning provinces, and the harvest was mostly completed by the end of October. Overall, crop growth in northeast China was normal. Precipitation in northeast China was 36% higher than the average level, the average temperature was 0.1 °C lower, and the photosynthetic effective radiation was 2% lower. Temperatures in mid-July and late July were higher than the average level, and after August they were in line with the average. During the monitoring period, the potential biomass in northeast China was 22% above the fifteen-year average. The eastern parts of northeast China were slightly lower than average, while the western parts of northeast China were significantly above average. This could be attributed to the abundant rainfall and moderate temperature in northeast China during the current monitoring season.

The spatial distribution map of the VCI shows that the crops in the whole northeast region were in good conditions, with VCIx values higher than 0.8 in almost all areas, except for small parts near the rivers. In general, crops in northeast China grow well in 2021, with good prospects for crop yield.

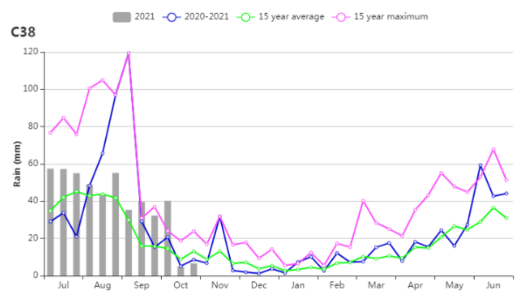
Figure 4.9 Crop condition China Northeast region, July-October 2021

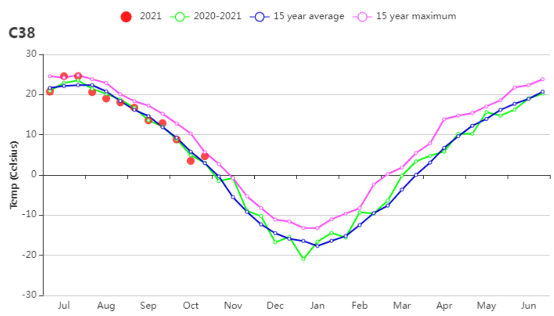






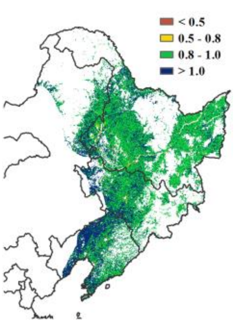
(a) Crop condition development graph based on NDVI (b) Spatial NDVI patterns compared to 5YA(c) NDVI profiles

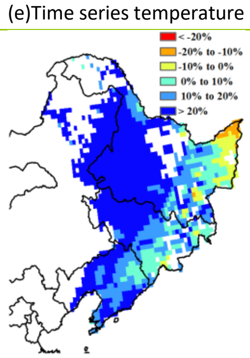




(d)Time series rainfall profile

(e)Time series temperature profile





(f) Maximum VCI

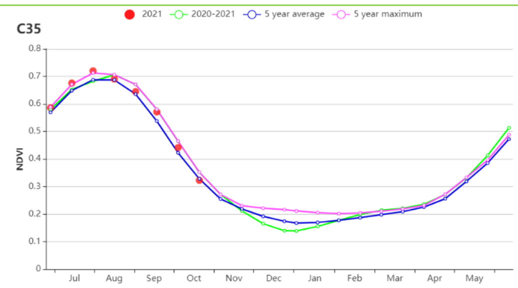
(g) Biomass departure

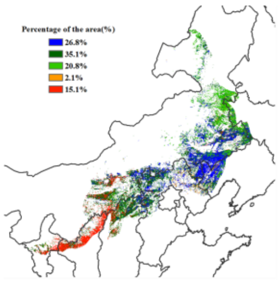
Inner Mongolia

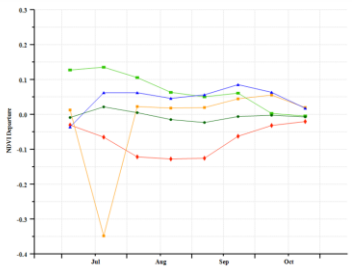
During this monitoring period, maize and soybean are the main summer crops grown in Inner Mongolia.

CropWatch Agroclimatic Indicators (CWAIs) show that rainfall was above average (+58%). TEMP (-0.5°C) and RADPAR (-4%) were both below average. Abundant rainfall resulted in a higher-than-average BIOMSS estimate (+21%). But, drought in northern Shaanxi during the monitoring period and heavy rain in Shanxi in October resulted in below-average BIOMASS in both areas. The NDVI development graph indicates above-average crop conditions during the whole period and they even exceeded the maximum of the 5YA in July. The spatial NDVI pattern shows that more than 80% of the crops were close to the 5YA, mainly distributed in Western Liaoning, northern Hebei and eastern Inner Mongolia. 2.1% of the cropped areas had a big drop in July and 15.1% of the region was below average throughout the season, mostly in the north of Shannxi, which suffered from severe drought. The fraction of cropped arable land (CALF) reached 95% and VCIx was above average (0.97). Generally favorable crop production is expected for Inner Mongolia.

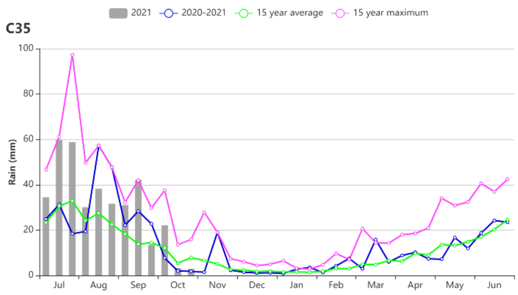
Figure 4.10 Crop condition Inner Mongolia, July - October 2021

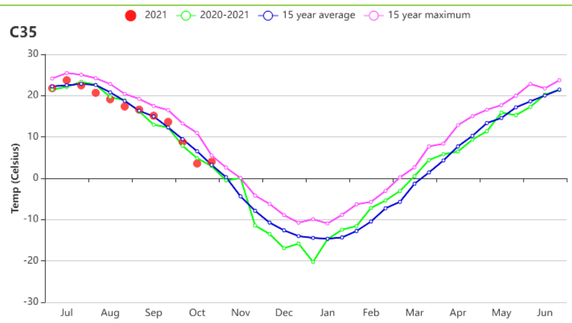




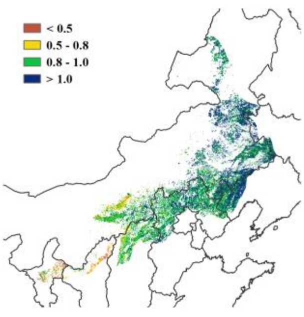


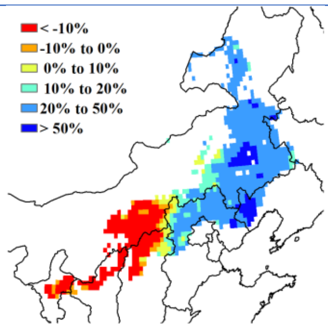
(a) Crop condition development graph based on NDVI (b) Spatial NDVI patterns compared to 5YA (c) NDVI profiles





(d)Time series rainfall profile (e)Time series temperature profile





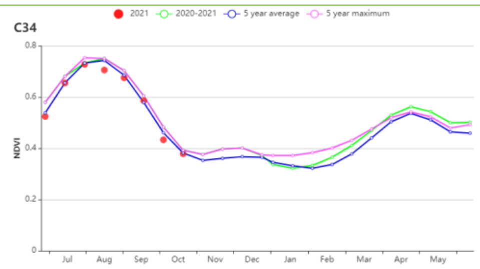
(f) Maximum VCI (g) Biomass departure

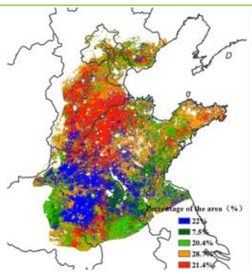
Huanghuaihai

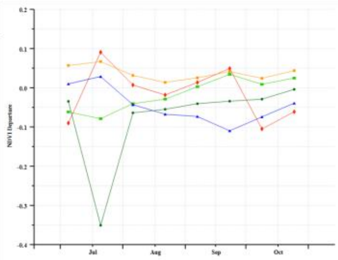
The main crops in Huanghuaihai region are summer maize and winter wheat. The whole cycle period of summer maize is from July to September and the winter wheat is sown in early October during this monitoring period. Agroclimatic indicators illustrate that the precipitation increased by 75% dramatically, the temperature and radiation decreased by 0.4 degree and 6% respectively. Abundant rainfall brings a good growth environment for plants, and the potential biomass is 28% higher. As shown on the biomass departure map, most areas presented significant above average level. The cultivated area was equal to the 5YA, and the maximum VCI value was 0.93.

The crop growth condition was lower than the 5YA in mid-August, and was generally close to the average level or the same as the average level in other periods of the monitoring period, which based on the NDVI-based crop growth profile. As it showed in NDVI cluster nad profiles, Zhengzhou City in Henan Province and Suzhou City in Anhui Province (accounting for 7.5% of the total area) were affected by local floods caused by continuous heavy rainfall in mid-July. NDVI was significantly lower than the average level, but it started to improve in August and after September Above average. In central Henan and northern Anhui (accounting for 20.4% of the total area), the NDVI value of early crop growth was slightly lower than the average level, due to abundant rainfall, the crop growth began to improve after August and was higher than the average level. Besides, 28,7% of cropland in Southeastern Hebei, Central and Eastern Shandong presented positive NDVI departures. Only a small part of the area has been showed the poor growth of crop in the map of maximum VCI, even the crop conditions in Southern Henan and Eastern Shandong exceeded the optimal level in recent five years. Due to the impact of flood disasters in some parts of Henan, the sowing of wheat this year has been delayed by 10-15 days compared with previous years. Generally, the crop condition in whole area seems optimistic.

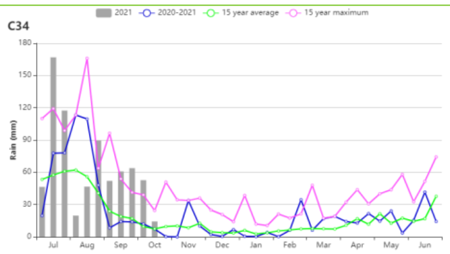
Figure 4.11 Crop condition China Northeast Huanghuaihai, July - October 2021

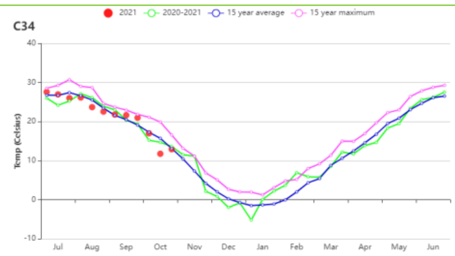






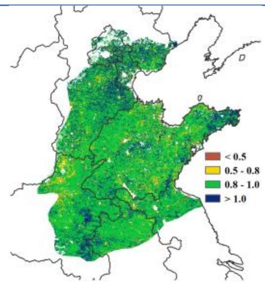
(a) Crop condition development graph based on NDVI (b) Spatial NDVI patterns compared to 5YA (c) NDVI profiles

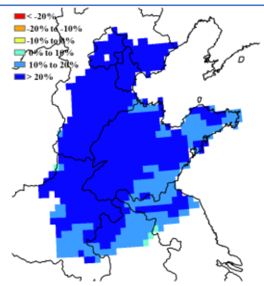




(d)Time series rainfall profile

(e)Time series temperature profile





(f) Maximum VCI

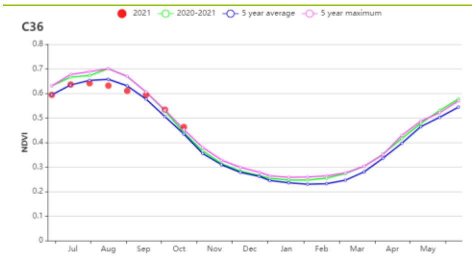
(g) Biomass departure

Loess region

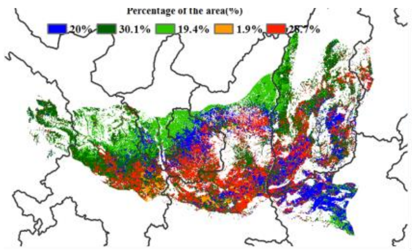
During the reporting period, maize was harvested in late September and early October, and winter wheat was planted in October.

Crop conditions in the Loess Region were close to the 5YA from July to early September and close to the 5-year maximum in late September and October. The CropWatch Agroclimatic Indicators (CWAIs) show that rainfall (RAIN) increased by 53%, temperature (TEMP) was above average by 0.1°C, and radiation (RADPAR) was reduced by 1% compared to the 15 YA. The potential biomass (BIOMSS) was above average by 12%. However, the precipitation was decreased in western Gansu province, northern Shaanxi Province and northwest Shanxi Province resulted in lower potential biomass. According to the regional NDVI development graph, the crop conditions were significantly higher than the 5YA in late September and October. Precipitation also exceeded the maximum of the past 15 years by far from late September to early October. The heavy rainfall during the harvest season in late September and early October caused delays in harvest and impacted the quality of maize. NDVI clusters and profiles show that crop conditions in most parts of the region were close to average. The Maximum VCI map shows high VCIx average values with 0.89 in most cropped areas of the region. CALF was at 96% which is in line with the 5YA. Cropping intensity (CI+3%) was above the 5YA. All in all, during the monitoring period, the Loess Region's overall crop conditions were favorable.

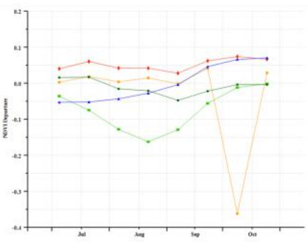
Figure 4.12 Crop condition China Loess region, July - October 2021



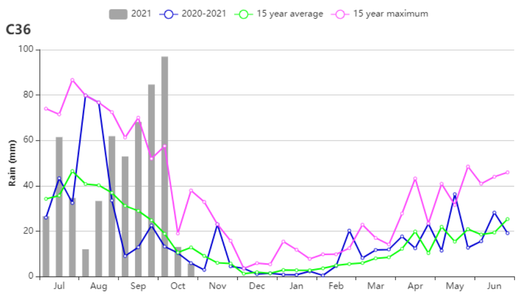
(a) Crop condition development graph based on NDVI



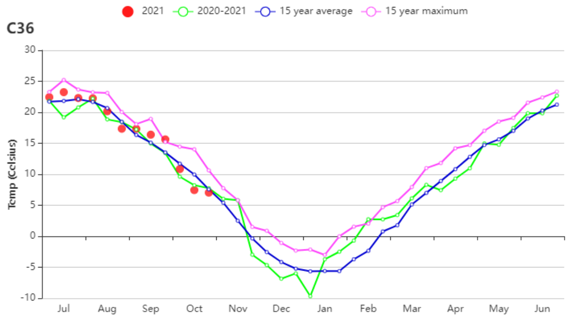
(b) Spatial NDVI patterns compared to 5YA



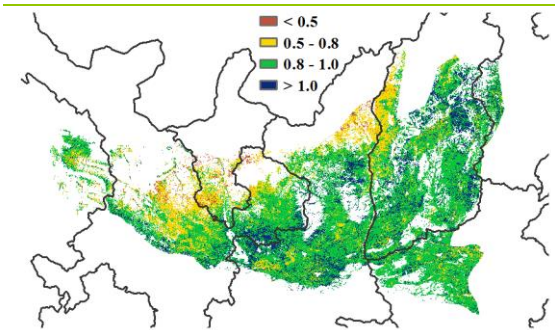
(c) NDVI profiles



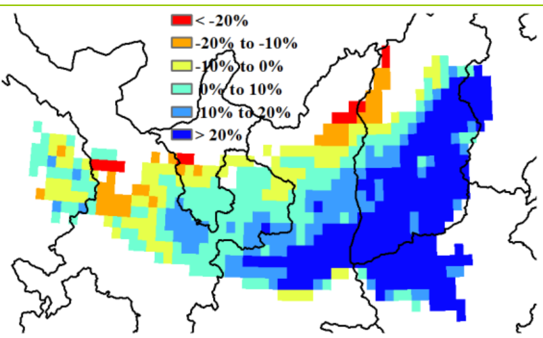
(d) Time-series rainfall profile



(e) Time-series temperature profile



(f) Maximum VCI



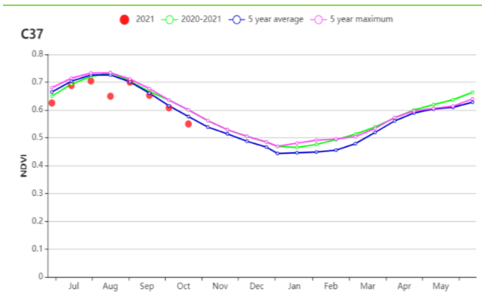
(g) Biomass departure

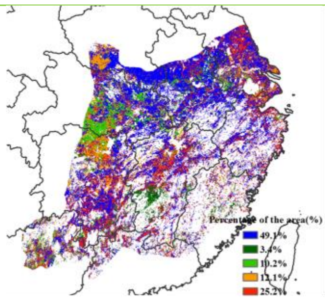
Lower Yangtze region

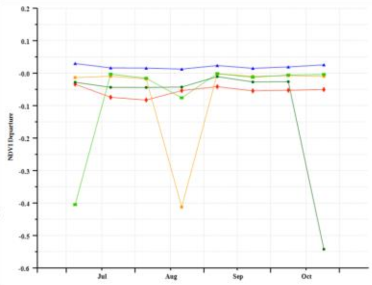
By October, the late rice had matured in the center of Lower Yangtze region including Hubei, Hunan, Jiangxi and Fujian provinces. The harvest of semi-late rice and maize had been completed in Jiangsu, Anhui and Zhejiang provinces by then.

The comparison of the current crop NDVI development curve with the 5YA indicates that the crop conditions were slightly below average. According to CropWatch agro-climatic indicators, the accumulated precipitation, photosynthetically active radiation and temperature were 4%, 5% and 0.5℃ higher than the 15-year averages, respectively. The above-average agro-climatic conditions resulted in an estimate of the potential biomass that was 6% higher than the 5-year average. The biomass departure also shows that the potential biomass in most areas of the region was above the average level, up to a maximum of 20%. As shown in spatial NDVI patterns, 49.1% of the area, mostly distributed in the north of this region including Jiangsu, Anhui and Hubei provinces, presented better crop conditions compared to the five-year average. The remaining areas had slightly below average crop conditions. This was basically consistent with the spatial distribution of potential biomass departure, indicating that there were better agro-climatic conditions in the north of the region during this monitoring period. The average VCIx of this region was 0.96, and most area had VCIx values ranging from 0.8 to 1. Overall, the crop conditions in the lower Yangtze region were normal.

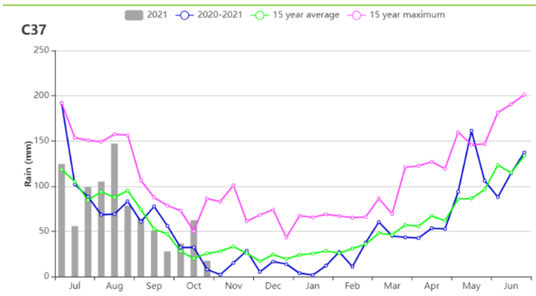
Figure 4.13 Crop condition China Lower Yangtze region, July - October 2021

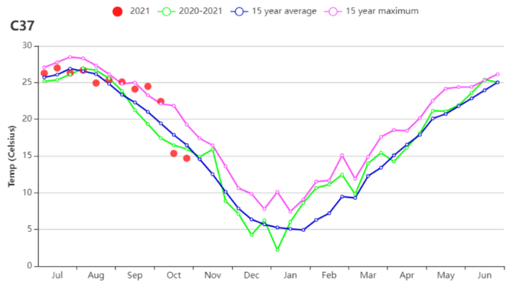




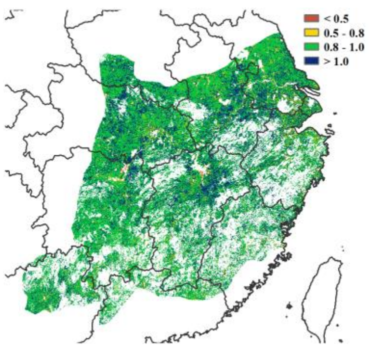


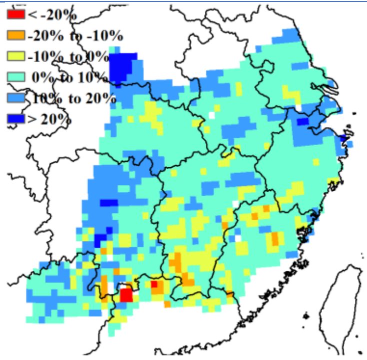
(a) Crop condition development graph based on NDVI (b) Spatial NDVI patterns compared to 5YA (c) NDVI profiles





(d)Time series rainfall profile (e)Time series temperature profile





(f) Maximum VCI (g) Biomass departure

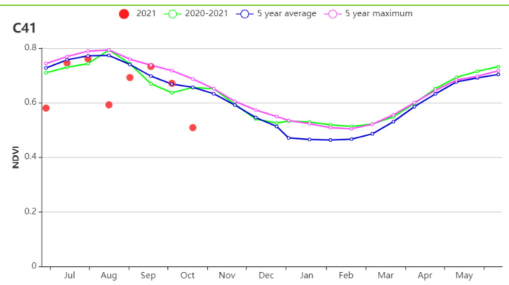
Southwest region

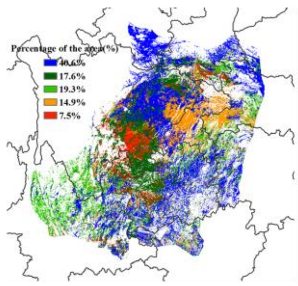
The reporting period covers the growth and maturity stages of summer crops, including late rice, semi-late rice and maize. Their harvest was followed by the sowing of winter wheat on some fields. Overall, crop condition was almost close to or above the 5-year average except for a few periods.

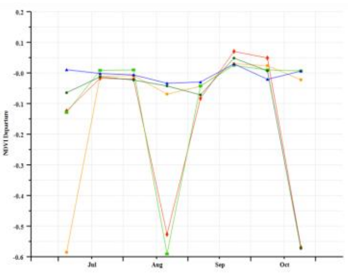
On average, rainfall and solar radiation were above the 15-year average (RAIN +18%, RADPAR +2%). Temperature was close to average (TEMP +0.3°C). The resulting BIOMSS was 7% above average mainly due to the above-average rainfall. The cropped arable land fraction remained at the same level as in the last five years, which indicated the crops planted area was generally normal for this period.

According to the NDVI departure clustering map and the profiles, NDVI values were close to average in most regions. In northeastern Sichuan and eastern Guizhou, the NDVI values were average during the monitoring period. Chongqing experienced similar conditions, except for July. Rainfall was significantly above average in Chongqing and Sichuan (RAIN +30%) which benefited crops there. Average to above-average NDVI values in September and October were observed in Yunnan, where radiation and precipitation were both above average (See Annex A.11). The maximum VCI reached 0.97, indicating that peak conditions were comparable to the last five years. All in all, crop condition was generally average.

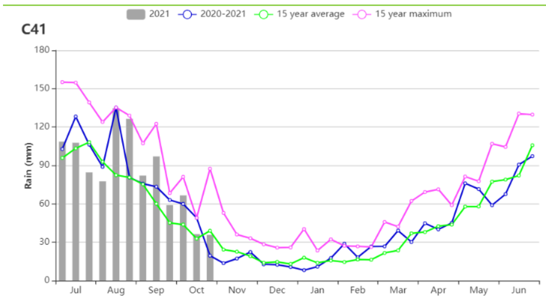
Figure 4.14 Crop condition China Southwest region, July - October 2021

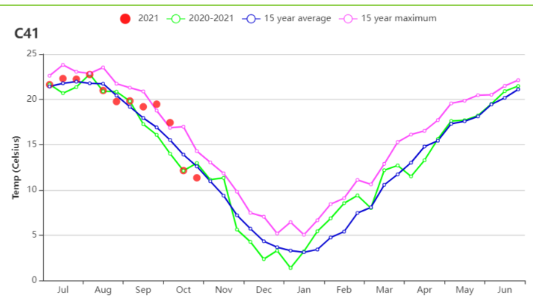




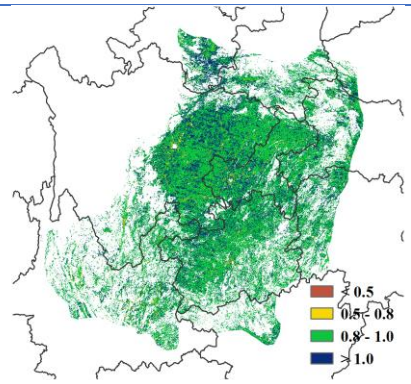


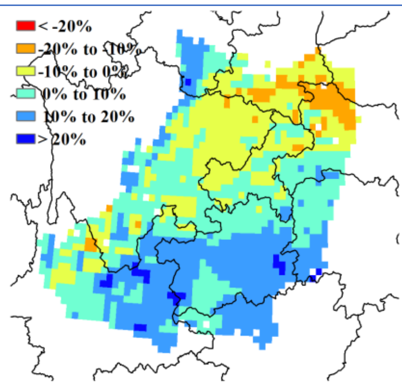
(a) Crop condition development graph based on NDVI (b) Spatial NDVI patterns compared to 5YA (c) NDVI profiles





(d)Time series rainfall profile (e)Time series temperature profile





(f) Maximum VCI (g) Biomass departure

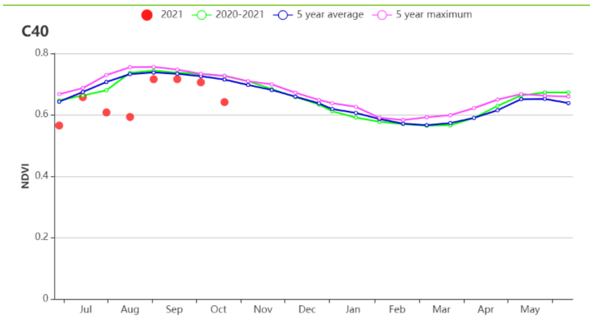
Southern China

By October, late rice was maturing in Southern China. The average VCIx of the Southern China region during the monitoring period was 0.94. According to the regional NDVI profile, crop conditions were generally below the 5-year average, but reached close to average levels in September and early October during the peak season of late rice.

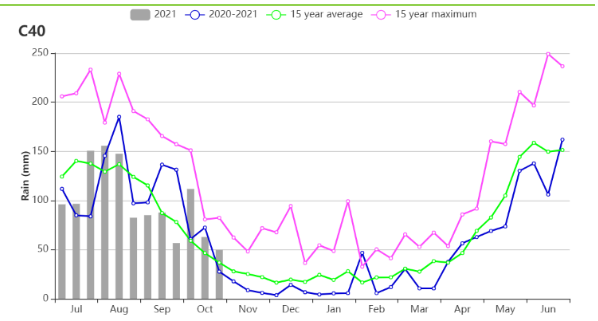
On average, rainfall reached 1183 mm, which was 3% lower than the average. Provincial departures were as follows: +12% in Yunnan, +1% in Guangxi, -22% in Guangdong, and -11% in Fujian. The average temperature during the monitoring period in Southern China was 23.0°C, which was above average by 0.4°C. Radiation (RADPAR) exceeded the average by 7%. BIOMSS was 4% above average mainly due to the favourable weather conditions with high rainfall and sufficient radiation during the heading and grain filling stages of late rice。 As shown by NDVI clusters and profiles, 45.2% of cropland of Southern China did not have significant tendency of variation during the monitoring period. In August, almost all cropland presented negative NDVI departures. In early August, 16.6% of cropland in Eastern Guangxi and Western Guangdong fell to below average levels, but conditions improved subsequently. At the end of the monitoring period, only 8.3% of the cropland in southern Yunnan presented negative NDVI departures.

Overall, the crop conditions during the monitoring period were close to normal.

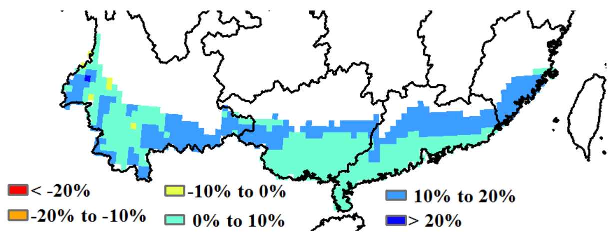
Figure 4.15 Crop condition Southern China region, July - October 2021



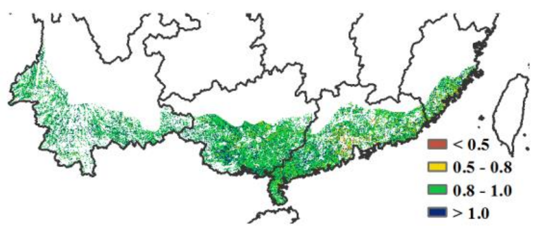
(a) Crop condition development graph based on NDVI



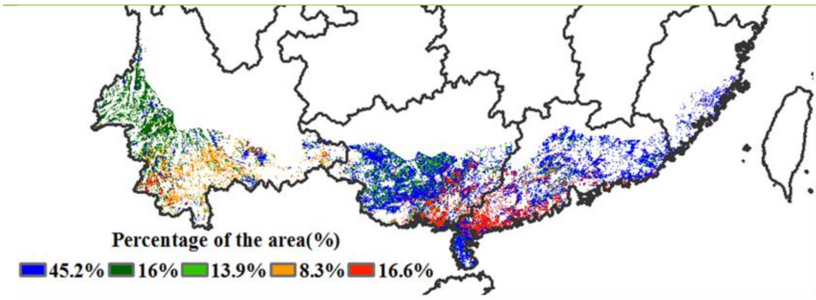
(b)Time series rainfall profile



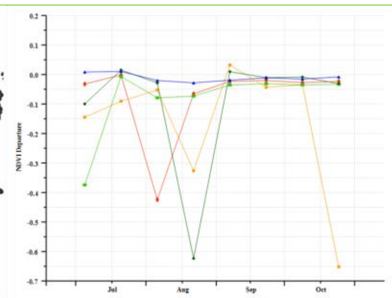
(c)BIOMSS departure from 15YA



(d) Maximum VCI



(e) Spatial patterns of NDVI departure from 5YA



(f) NDVI departure profiles

4.4 Major crops trade prospects

Import and export of major crops in the first three quarters of 2021

Maize

In the first three quarters, China imported 24.93 million tonnes of maize, nearly four times of the same period last year. The main import sources were the United States (70.7%) and Ukraine (29%), with an import value of US $6.929 billion. The export of maize was 4.4 thousand tonnes, with an export value of US $2.37 million.

Rice

China imported 3.58 million tonnes of rice, more than double of the same period last year, with the main source countries being India, Vietnam, Pakistan, Myanmar and Thailand, accounting for 23.8%, 22.9%, 18.8%, 16.8% and 10.2% of total import, respectively. The total imported rice valued at US$1.63 billion. The export of Rice was 1.85 million tonnes, a decrease of 1.2% over the same period last year. It was mainly exported to Sierra Leone (accounting for 9.1% of the total export), South Korea (8.8%), Egypt (8.5%), Niger (6.7%) and Papua New Guinea (6.6%), with a total export value of US $760 million.

Wheat

China imported 7.60 million tonnes of wheat, an increase of 25.5% over the same period last year. The main import sources were Canada, the United States and Australia, accounting for 32.2%, 30.4% and 24.7% of total import, respectively and the total import wheat valued at US$2.346 billion. The export of wheat was 54.1 thousand tonnes, a significant decrease of 66.4% over the same period last year.

Soybean

China imported 73.99 million tonnes of soybeans, an increase of 0.7% over the same period last year. The main source countries were Brazil (66.2% of the total imports), the United States (29.5%) and Argentina (2.0%), with an import value of US $25.435 billion. Soybean experts were at 44.8 thousand tonnes, a decrease of 21.3% over the last year.

Trade prospects for major cereals and oil crop in China for 2021

On the basis of remote sensing-based production prediction in major agricultural producing countries in 2021 and the Major Agricultural Shocks and Policy Simulation Model, it is predicted that the import of major crops will increase and the export will decrease in 2021. The details are as follows:

Maize

Due to the structural change of domestic maize supply and demand and the adjustment of market price, it is expected that China's maize import will increase significantly by 258% from 2020, and export will decrease by 1.5% in 2021.

Rice

The global rice market maintains a loose supply and demand pattern, and the price difference at home and abroad continues. It is expected that China's rice import will increase by 121% and export will decrease by 1.1% in 2021.

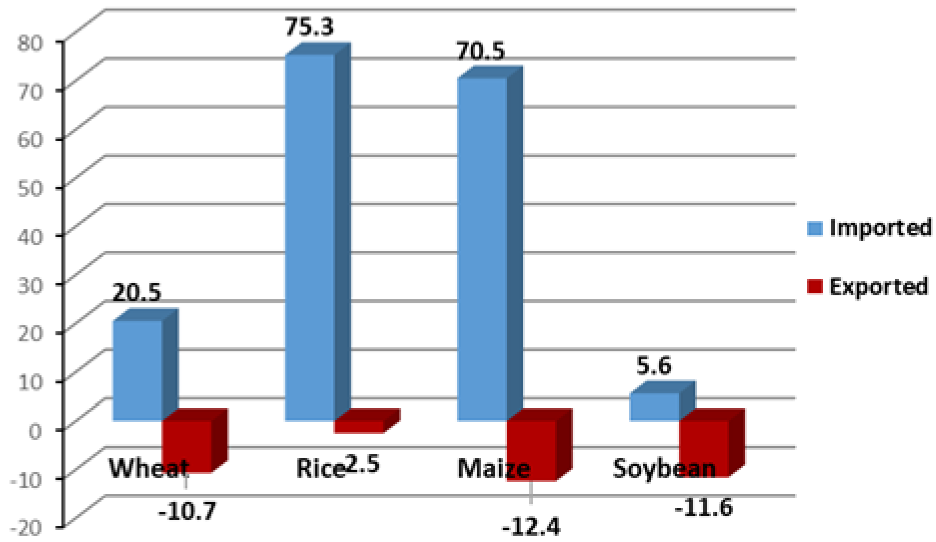
Wheat

Affected by natural disasters such as drought, the global wheat output has declined and the price is bullish. However, wheat production in China's wheat import source countries is relatively stable. It is expected that China's wheat import will increase by 27.5% and export will decrease by 32.4% in 2021.

Soybean

Due to sufficient global soybean supply and stable domestic soybean consumption demand, it is expected that China's soybean import will be basically the same as last year (+1%) and export will decrease by 15.2% in 2021.

Figure 4.16 Rate of change of imports and exports for rice, wheat, maize, and soybean in China in 2021 compared to those for 2020(%).



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 2021 (section 5.1), as well as sections on recent disaster events (section 5.2), and an update on El Niño (section 5.3).

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 43 major producers and exporters are estimated and predicted for 2021.

Production estimates

In 2021, total production of major cereal and oil crops globally is estimated to be at 2,882 million tonnes, a decrease by 0.4%, equivalent to 10.3 million tonnes. Maize production is estimated at 1,077 million tonnes, an increase of 0.6% or equivalent to 6.9 million tonnes; global rice production is at 764 million tonnes， an increase of 0.5% or an increase of 3.5 million tonnes; global wheat production is 720 million tonnes, a 2.4% decrease or 17.7 million tonnes drop from 2020, due to the consistent drought impact in North America and Western Asia. The global soybean production is estimated to be at 320.78 million tonnes, a decrease by 0.9%.

Table 5.1 2021 cereal and soybean production estimates in thousand tonnes. Δ% is the percentage of change of 2021 production when compared with corresponding 2020 values.

	Maize		Rice		Wheat		Soybean	
	2021	**Δ%**	**2021**	**Δ%**	**2021**	**Δ%**	**2021**	**Δ%**
Afghanistan					3905	-25		
Angola	2623	-11.4	45	-1.9				
Argentina	53440	-1.1	1901	-1.9	17674	12.3	51608	-1.9
Australia					29577	-2.1		
Bangladesh	3930	0.8	48100	4.5				
Belarus					3029	-2		
Brazil	83345	-4.8	11851	2.4	7337	17.7	96300	-4.7
Cambodia			9940	-1.8				
Canada	12149	1.8			28777	-15.2	7845	2.3
China	229703	1.6	202956	0.9	127981	0.7	14346	-1.6
Egypt	5864	-4.2	6487	-4.5	11466	-4.9		

	Maize		Rice		Wheat		Soybean	
	2021	Δ%	2021	Δ%	2021	Δ%	2021	Δ%
Ethiopia	6751	-2.6			3607	-2.3		
France	15573	7.9			35663	2.4		
Germany	4995	3.4			26223	-1.6		
Hungary	5683	-10.3			4942	-5.2		
India	18242	-1.9	181939	0.9	93439	-2.5	12996	11.5
Indonesia	16731	0.5	66353	2.2				
Iran			2453	-16.5	12678	-22.9		
Italy	6292	-2.4			7750	-0.9	1471	-9
Kazakhstan					11235	-12.7		
Kenya	2285	-20.9			292	-7.9		
Kyrgyzstan	617	-12.8			528	-15.6		
Mexico	24690	3.9			3436	-20.3	888	2.6
Mongolia					316	13.2		
Morocco					9024	43.2		
Mozambique	2102	4.1	399	4.5				
Myanmar	1897	1.1	24873	-2.8				
Nigeria	10374	2.9	4272	1.9				
Pakistan	5511	-1.8	11355	-1.1	26492	-3.7		
Philippines	7082	-0.9	20542	-1				
Poland					10792	0.4		
Romania	12945	1.1			8002	8		
Russia	13583	-1.7			53934	-3.1	3582	-4.7
South Africa	11459	-2.6			1820	6.2		
Sri Lanka			2525	0.5				
Thailand	4243	1	40344	-0.7				
Turkey	6366	-2.6			16809	-13.1		
Ukraine	35947	28.7			24122	9		
United Kingdom					12875	1.2		
United States	381103	1.8	11332	-3	51892	-2.7	104713	0.2
Uzbekistan					7508	-17.6		
Vietnam	5381	-0.4	46612	-0.5				
Zambia	3586	4			223	16.4		
Total	994491	1.4	694281	0.6	653348	-2.3	293748	-1.5
Global	**1077184**	**0.6**	**764019**	**0.5**	**720382**	**-2.4**	**320365**	**-0.9**

Affected by persistent hot and dry weather in Northwestern North America, Brazil, Central Asia, West Africa, and Southern Africa, global rice, wheat, and soybean production is expected to reduce. Global maize production in 2021 is expected to be 1.082 billion tonnes, an increase of 1.1%, 11.3 million tonnes. Global rice production is expected to be 751 million tonnes, a decrease of 1.3%. Global wheat production is expected to be 711 million tonnes, a 3.7% decrease of 26.99 million tonnes; global soybean production is expected to be 321 million tonnes, a 0.9% decrease.

Maize

In the United States, the world's largest maize producer, the major producing areas experienced abundant rainfall since late July, effectively alleviating early drought conditions in the northern corn belt. Maize production reached 381 million tonnes, an increase of 6.83 million tonnes (up by 1.8%). Maize production in the U.S. corn belt in Illinois, Iowa, Idaho and Indiana, as well as Nebraska and Kansas increased. The agro-meteorological conditions were favorable during the maize growing period in Ukraine. Regular rainfall befitted crop growth, prompting the recovery of maize yields from the reduced production in 2020. Coupled with the increase in maize planted area, Ukraine's maize production reached 35.95 million tonnes, an increase of 8 million tonnes or up by 28.7%. Maize production in France, Mozambique and Zambia also increased by more than 4%. Kenya (-20.9%), Kyrgyzstan (-12.8%), Angola (-11.4%), Hungary (-10.3%), Brazil (-4.8%) and Turkey (-2.6%) suffered from persistent drought during the maize reproductive period and maize production decreased. Ethiopia was affected by desert locusts, conflicts and other adverse factors. Its maize production shrank by 2.6%. The output of the remaining major maize producing and exporting countries is comparable to 2020. They have a small impact on the change in total global maize production.

Rice

Asian rice production dominates the world with most rice grown in areas with abundant rainfall or well-developed irrigation facilities. Inter-annual fluctuations in rice production are generally smaller than those of the other three major crops. China, India and Indonesia are the world's three largest rice producers, the overall rice production situation is favorable. Production increased by 1.78 million tonnes, 1.66 million tonnes and 1.44 million tonnes respectively. Agro-climatic conditions in Thailand and Vietnam are in general at average level, and rice production was slightly reduced. Affected by severe drought, Iran's rice production decreased significantly by 16.5%. Myanmar was also affected by drought and rice production was reduced by 2.8%. Rice production in Brazil, Nigeria, Mozambique have increased, while rice production in Argentina, the United States, Egypt, Angola and some other countries decreased slightly. Overall, the global rice production and supply situation is stable.

Wheat

In most spring wheat production countries wheat yields decreased due to below average rainfall, resulting in significantly reduced wheat production in Afghanistan (-25.0%), Iran (-22.9%), Uzbekistan (-17.6%), Kyrgyzstan (-15.6%), Canada (-15.2%) and Kazakhstan (-12.7%). Russia's wheat also experienced decreased rainfall and wheat production was reduced by 3.1%. In the southern hemisphere, the drought in the central region of Brazil continues. Severe drought conditions resulted in a decline in wheat yields nationwide, but the impact of the drought on wheat production is limited in central Brazil as wheat is all irrigated in this region. On the other hand, a significant increase in planted area contributed to a 17.7% increase in wheat production. Despite the widespread drought in South Africa, the drought mainly occurred in the main producing areas of summer crops, while the wheat production areas located in the Mediterranean climate zone in the southwest of South Africa experienced overall normal conditions. Both wheat yield and planted area have increased, prompting the wheat production of South Africa to increase by 6.2%. Morocco, Argentina and Zambia wheat yield increased significantly from the severe drought in 2020, and wheat production increased by 43.2%, 12.3% and 16.4%, respectively. Overall, the global wheat supply situation is basically normal.

Soybean

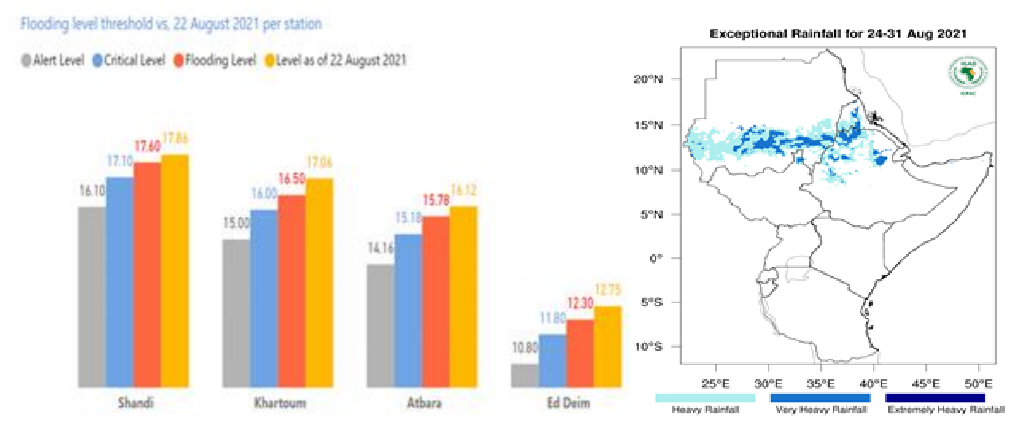
The widespread hot and dry weather in South America led to a decline in soybean production in Brazil and Argentina to 96.3 million tonnes and 51.61 million tonnes, a decrease of 4.74 million tonnes and 0.98 million tonnes respectively. The U.S. soybean planted area increased by 0.4%, prompting its soybean production to increase by by 0.2% to 104.7 million tonnes. Canada's soybean production area received regular rainfall. Its soybean production increased by 2.3%. India's soybean planted area and yield increased simultaneously, prompting India's total soybean production to increase by about 11.5% or 1.34 million tonnes from the previous year. Russia was affected by drought conditions and soybean production decreased by 4.7%. Overall, total global soybean production decreased slightly by 0.9%, which is expected to have a limited impact on the international soybean supply situation and global soybean market remains stable.

5.2 Disaster events

Several disasters are impacting human health, the economy, and food production chains worldwide. This report discusses the main disasters and their negative impacts.

Floods

During August and September 2021, floods hit several regions globally, such as in Africa (DR Congo, Sudan, Benin, Niger, Ghana, South Sudan, Uganda, Guinea, Nigeria, Chad) and in Europe (Turkey, Germany, Austria, Italy, Sweden, Russia, France, and Spain), causing the death and displacement of many citizens, in addition to the massive destruction in infrastructure and resources. In Niger, the severe floods that occurred in late August had caused over 60 deaths and affected 100,000 people, when 413 villages were flooded and thousands of homes mostly in the Maradi Region were destroyed. While in Sudan, the intensive rains during the period from 24 to 31 August, caused the rise of Nile River levels and flooding in 12 States, where the River Nile State was the hardest hit. The floods have affected 60,000 People and destroyed 3,800 homes nationwide. South Sudan has also been suffering severe floods since May this year. The floods have affected more than 380,000 people in 6 states from late August to September, where Unity State was the hardest hit.



(a) (b)

Figure 5.1 a) Nile River levels in Sudan on 22 August 2021 (Image via UN OCHA), and b) Rainfall forecast Sudan Ethiopia in August 2021 (Image: IGAD).

In Chad, driven by an uneven rainy season in 2021, floods affected 250,000 people across 400 villages during September. Fifteen people have lost their lives, 17 were reported missing, and a total of 329 people have been injured. Tandjilé Region was the worst affected, where 32,181 houses have been damaged and 160,000 people were left with no shelters. Thousands of livestock have been lost due to floods and almost 70,000 hectares of crops were damaged or destroyed, in particular sorghum, maize, peanuts, sesame, pearl millet, and cotton. In Nigeria, over 100,000 people have been directly affected by flash floods that occurred in August in Adamawa State of northeastern Nigeria, including the state capital Yola, as reported by the UN.

In Europe, and more particularly in Turkey, floods severely impacted people's life. In Turkey, 77 people were reported dead and 34 still missing due to the flooding that began after heavy rainfall on 10 August, including 26 people Bozkurt district in Kastamonu Province, which was the hardest hit by the floods.

(a) (b)

Figure 5.2 a) Flood damage Bozkurt, Kastamonu, Turkey, in August 2021 (Photo source: Ministry of Interior), and b) Flood rescues Black Sea Region, Turkey, August 2021 (Photo source: General Directorate of Security, Turkey).

In October 2021, floods continued to threaten Africa (Cote d'Ivoire, Algeria, Tunisia, and Italy), Europe (Slovenia and Italy), and severe floods hit Asia (India, Indonesia, China, Philippines, Vietnam, Oman, and Nepal) and Americas (Colombia, Mexico, Ecuador, Guatemala, and USA). In Shanxi Province, in north China, the unusually heavy rains from 02 to 07 October in this relatively dry region caused the rise of water levels of main rivers, including the Yellow River, China's second-longest river, leading to severe flooding in Yuncheng. As a result, a total of 1.76 million people were affected by the intensive floods that hit the province in October 2021, and more than 120,000 people were forced to move from their homes. As reported by local media, 5 people lost their lives and 17,000 homes were severely damaged or destroyed. Besides, the heavy rain has also caused severe damage to crops (190,000 hectares) and infrastructure, since a section railway track was washed away by floodwaters in Qixian County on 07 October.

Figure 5.3 The flood-affected Yellow River beach near Lianbo village in Hejin city, North China's Shanxi province as captured by an Aerial photo on Oct 10, 2021.

Henan was another province in China that has also been severely affected by flooding since mid-July 2021. The rainfall amount observed in Zhengzhou, the provincial capital, in an hour reached a record-breaking amount of 201.9 millimeters. Local authorities reported that 302 people died, 50 more were missing, 815,000 people were evacuated, 1.1 million were relocated, and 9.3 million people were affected. Henan grows about 25% of China’s wheat and 10% of China’s corn. By the time of flooding, the crops remaining in the field (to be harvested in autumn) were approximately 50% corn and 15% peanut. As reported by provincial authorities on August 2, 2021, about 13% of the fall crop area (1,017,100 hectares) has been impacted and about 6% of the area (605, 500 hectares) had been impacted moderately (expected loss of yield greater than 30%).

CropWatch shows that heavy rainfall in July in Henan caused severe flooding and led to the crop failure of 540,000 acres of maize and 470,000 acres of other summer crops in Hebi and other regions. Several rounds of heavy rainfall weather, continued flooding and low sunshine led to a 2.6% year-on-year decline in yield per acre and 3.4% year-on-year decline in maize production in Henan province. Shanxi and Anhui was also affected by excessive rainfal, and the maize production fell 4.1% and 1.5% respectively.

Besides crop impacts, the flooding hit livestock operations. It has been reported that rains swamped 1,678 larger-scale farms and killed more than 1 million animals, mostly chickens, across the province.

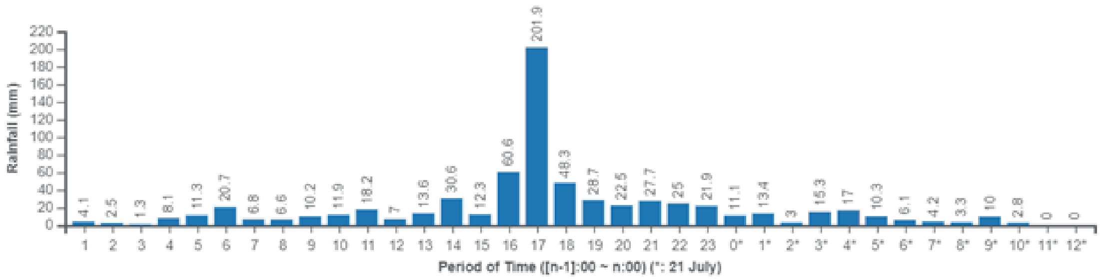


Figure 5.4 Hourly rainfall in Zhengzhou, from 0:00 on 20 July to 12:00 on 21 July 2021.

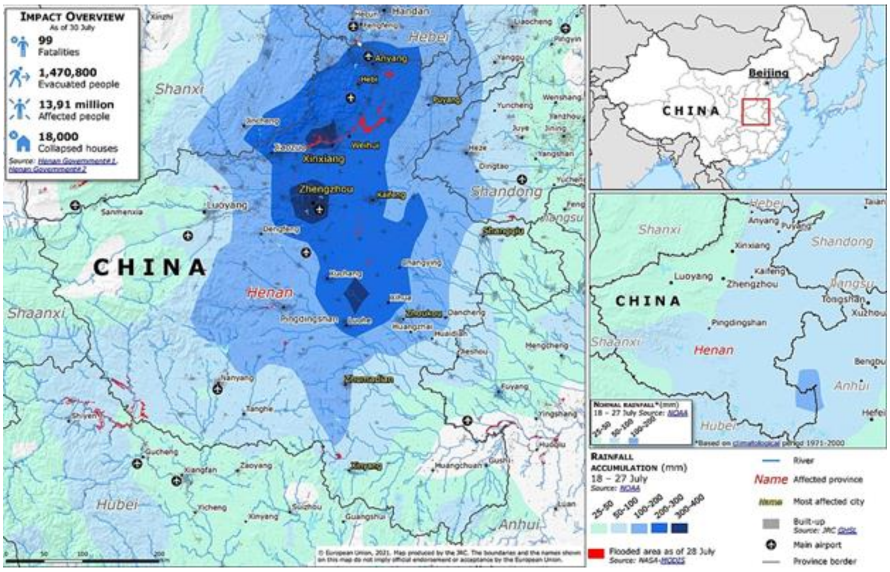


Figure 5.5 Heavy rainfall and floods occurred in Henan Province, China, in Mid-July 2021, (ECHO/European Commission - https://erccportal.jrc.ec.europa.eu/ECHO-Products/Maps#/maps/3780).

Drought

In California, USA, the drought this summer was the worst on record due to the warmer temperatures and the lack of precipitation that increase the plant's water demand. Based on the Palmer Drought Severity Index, July 2021 was the driest month on record in California since records began in 1895. June, July, and August were three out of the state's five driest months on record. Hence, the local authorities formally urged all Californians to reduce their water use by 15 percent. Because the drought conditions during the summer in California has become common, farmers have increasingly turned to those higher-value tree crops that turn every drop of water into a lot of money compared with other crops. Moreover, some farmers are forced to leave parts of their lands as fallow due to the limited water resources.

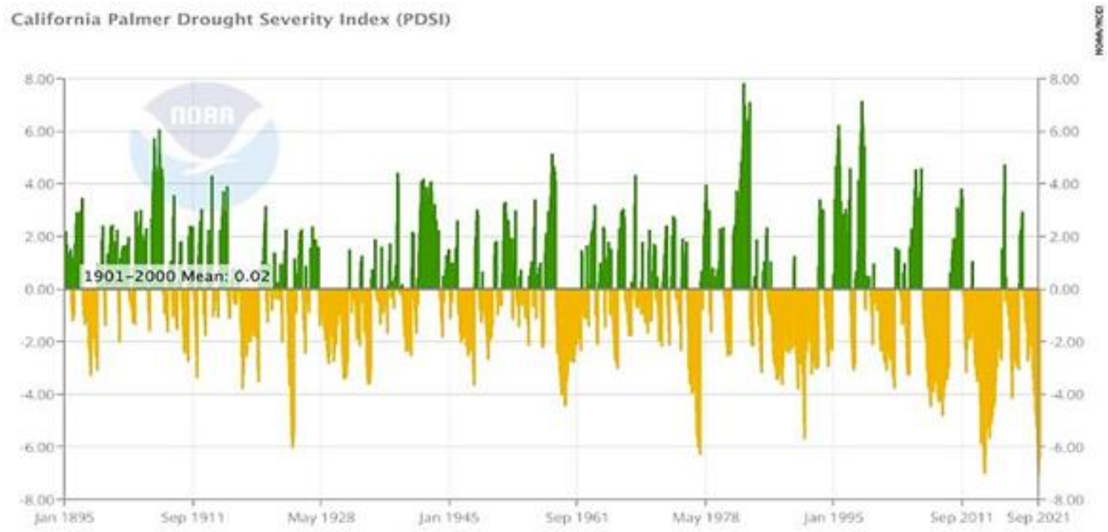


Figure 5.6 PDSI time series for every month from January 1895 to September 2021. A more negative value indicates a worse drought (Source: https://edition.cnn.com/2021/10/14/us/california-summer-drought-worst-on-record/index.html).

In Diyarbakir Province, Turkey, the cultivation of summer crops was delayed due to the lack of rainfall. Low production was estimated. In central Asia, drought was the main driver of rising food prices. In **Kazakhstan**, central Asia, severe drought conditions were observed during the summer in six of the country's 14 provinces: Aqmola, Aqtobe, East Kazakhstan, Mangistau, Kyzylorda, and Kustanay. Water levels in many small reservoirs and rivers were at less than half their normal amount in June. For saving more water, local officials In Kyzylorda reduced the number of rice fields under cultivation this year. Moreover, Kazakh officials reported more than 2,000 animals, most of them were horses, had died for lack of water and food in Kyzylorda and Mangistau provinces. Farmers in Chui Province, Kyrgyzstan, demanded that state action be taken to save their crops. The price of hay in Kyrgyzstan increased by 50% in the second week of June. Local authorities promised in Kyrgyzstan to bring in hay and water from other areas of the country and dig more wells in Mangistau. In Tajikistan, many farmers reported the lack of grass due to the rainfall shortage to feed animals in the Yavan district. While in Turkmenistan's eastern Mary and Lebap provinces, cotton fields were totally dried up due to high summer temperature with water and fertilizer shortage. Afghanistan is also facing the second drought in four years and consequent water scarcity impacting a third of the country. In September and October 2021 (the post-harvest season), nearly 19 million people in Afghanistan experienced high levels of acute food insecurity, with a 30% increase from the same season last year. The situation is exacerbated by the conflict and subsequent change of government. With another La Niña event on the horizon, threatening to extend this year's drought into 2022, immediate support has become crucial to meet the most basic humanitarian needs as Afghans confront a winter with no jobs, cash, or prospects.

Wildfires

Forest fire is the main driver of the high deforestation rate in Brazil's Amazon rainforest. Satellites registered 28,060 fires in the Brazilian Amazon in August, a decline of 4% compared to the same month in 2020 when fires likely hit the highest point in a decade, according to Brazil's national space research agency (INPE). Deforestation in Brazil's Amazon rainforest has reached a 15-year high this year. INPE estimated that 13,235 square kilometers of the forest were lost between August 2020 and July 2021, with a 22% increase from the previous year. The states of Pará, Amazonas, Mato Grosso and Rondônia saw the most deforestation during the 2020-21 period. To fight against the high deforestation rate, some governments have signed an agreement at the COP26 climate summit pledging to end deforestation by 2030.

In the United States, local officials reported that the burnt area was over 6.5 million acres during the last summer season of 2021. The fires were particularly intensive in the American west, where the wildfires have started earlier this year, burned more intensely, and scorched swaths of land larger than ever before. California State experienced the largest fire on record, named the Dixie fire. Over the last four years, California experienced more than half of the 20 largest fires in the state's history. The two main drivers of the high wildfire frequency and intensity in California are drought and heatwaves. Although the two factors were always a natural part of the western landscape, they play crucial roles in driving bigger blazes lately.

In Canada's western provinces, multiple fires threatened populated centers in Alberta, Saskatchewan, and Manitoba during the wildfire summer season. As of Sept. 15, the Canadian Interagency Forest Fire Centre (CIFFC) reported 6,317 wildfires that had burned 10.34 million acres (4.18 million hectares).

In Algeria, wildfires have been affecting the Kabylia Region in northern Algeria since 9 August. More than 70 fires have occurred in 13 prefectures in the north of the country. More than 40 people have died as a result of the fires, according to media reports. Fires raged in north and north-east of Algeria overnight on Monday 9 August 2021. The Algerian Government has requested assistance from the international community in response to the fires, including through the EU Civil Protection Mechanism on 11 August. On 25 October, the Algerian Government launched a national tree-planting campaign for 19 million trees across the affected government by the fires, in addition, the Government launched an online platform for rehabilitation of forests affected by the recent fires in order to enable citizens and civil society organizations to participate and volunteer in this program.

Desert locusts

East Africa is dealing with the worst desert locust invasion in 25 years. The situation in the Horn of Africa and Yemen was relatively calm during the period (August - October) compared to last year. A few spring-bred swarms remaining in northeast Somalia matured and laid eggs that hatched and new hopper bands started forming. As observed by FAO, some of these swarms moved to northwest Somalia and eastern Ethiopia with at least one small swarm nearly reaching the Kenya border on unusually strong and persistent northerly winds at the end of October. The future movement of swarms is highly dependent on rainfall and the success of survey and control operations. Due to insecurity in both Ethiopia and Yemen, control operations against immature swarms were not possible or limited. Consequently, a few swarms are likely to migrate to the Red Sea coast for winter breeding and more hopper bands are expected to form in north Somalia and extend to eastern Ethiopia and perhaps central Somalia, and reach northern Kenya in the coming weeks. In central and western Africa, the situation remained calm, where only scattered adults were present in Niger and Chad from summer breeding. The below-average rainfall (RAIN -5%) is conducive to curb the reproduction of desert locusts

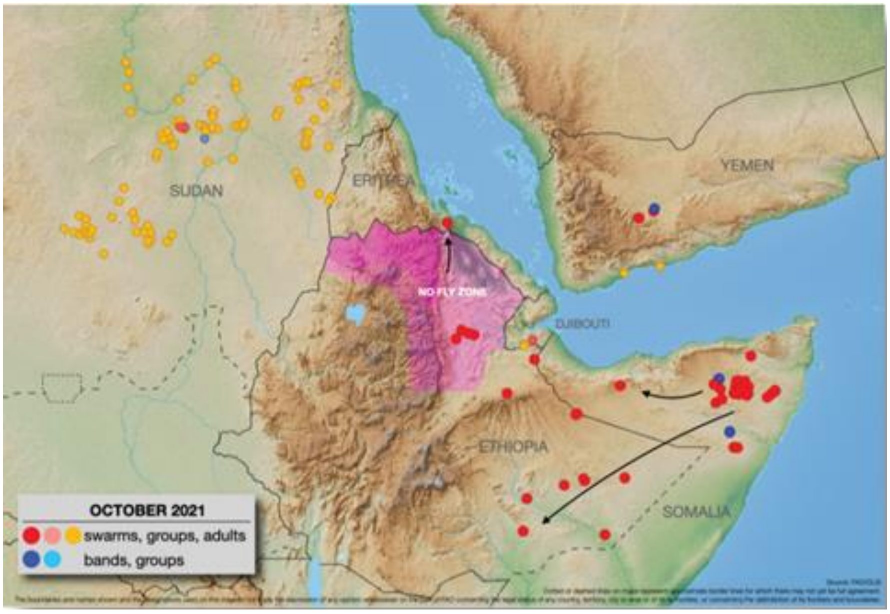


Figure 5.7 The distribution and movement of desert locusts in October 2021, as observed by FAO (https://www.fao.org/ag/locusts/common/ecg/1914/en/DL517e.pdf).

Covid-19

Since the spread of the new Covid-19 virus was announced as a global pandemic by WHO in March 2020, many countries closed their borders and imposed restrictions on human and goods movement. These restrictions hampered the transportation of food, materials, and labour, which impacted the economy and food production chain. In some countries, human movement restrictions due to the pandemic have resulted in farm-labour shortages, especially for high-value crops and sharecropping farmers. Also, the limited access to agricultural inputs (seed, fertilizer, veterinary inputs, fish fingerlings, and feed), which will likely drive a reduction in crop yields, was also reported. The agriculture and food systems in South Asia demonstrated unexpected resilience, most likely due to the investments in infrastructure and institutions for social transfers and safety nets, as well as the pandemic-related expansion of many of these programs. With the intensive vaccination campaigns in most countries, it is expected that the severity of the restrictions on the movement of people and goods will decrease, which helps in the recovery of the economy to normal levels.

5.3 Update on El Niño

The Australian Government Bureau of Meteorology's ENSO Outlook remains at La Niña ALERT, meaning around a 70% chance of La Niña forming in the coming months. Several climate drivers are combining to produce the current wet outlook for Australia.International climate models have strengthened their forecast likelihood of La Niña forming before the end of the year. However, atmospheric and oceanic observations have yet to consistently reach La Niña levels. The latest tropical Pacific Ocean temperatures, while cooler than average, are at similar levels to a fortnight ago and do not meet La Niña thresholds. Similarly, in the atmosphere, the Southern Oscillation Index (SOI) has eased back slightly from La Niña levels. Regardless of whether La Niña thresholds are met, a La Niña-like pattern in the Pacific may still increase the chances of above-average rainfall for northern and eastern Australia at times during spring and summer.

Figure 5.7 illustrates the behavior of the standard Southern Oscillation Index (SOI) published by the Australian Bureau of Meteorology (BOM) for the period from October 2020 to October 2021. Sustained positive values of the SOI above +7 typically indicate La Niña while sustained negative values below -7 typically indicate El Niño. Values between about +7 and -7 generally indicate neutral conditions. During this monitoring period, SOI decreased from 15.9 in July to 4.6 in August, then increased to 9.3 in September, then decreased to 6.7 in October.

Figure 5.8 shows several El Niño regions. Persistent NINO3 or NINO3.4 values cooler than −0.8℃ are typical of La Niña, while persistent values warmer than +0.8℃ typically indicate El Niño. Values of the three key NINO indices for October 2021 were: NINO3 −0.4℃, NINO3.4 −0.6℃, and NINO4 −0.3℃. There is no La Niña forming, but the risk remains

Sea surface temperature (SSTs) for October 2021 (Figure 5.9) show weak cool SST anomalies were present across much of the central to eastern equatorial Pacific, while generally weak warmer than average SSTs were present in waters around the north of Australia and the Maritime Continent.

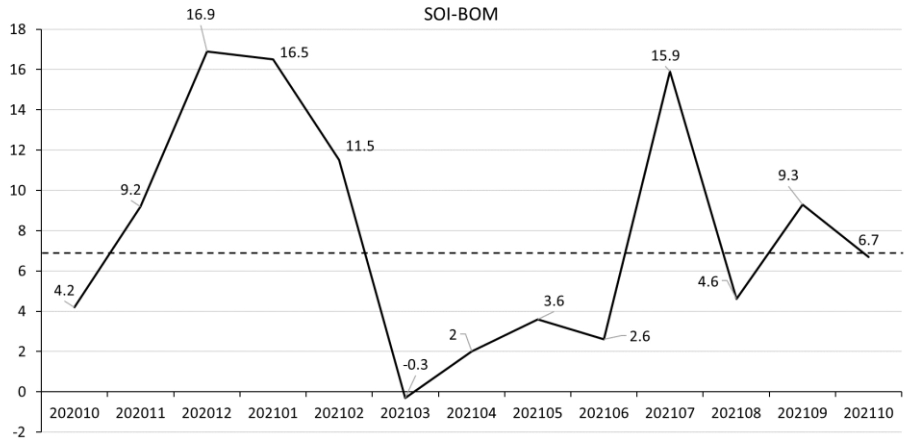


Figure 5.8 Monthly SOI-BOM time series from October 2020 to October 2021(Source: http://www.bom.gov.au/climate/enso/soi/**)**

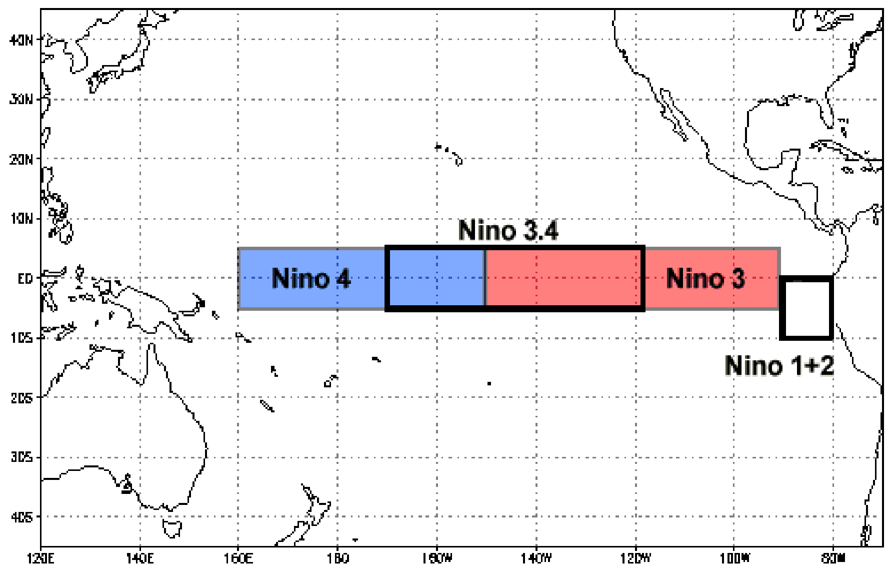


Figure 5.9 Map of NINO Region(Source: https://www.ncdc.noaa.gov/teleconnections/enso/sst)

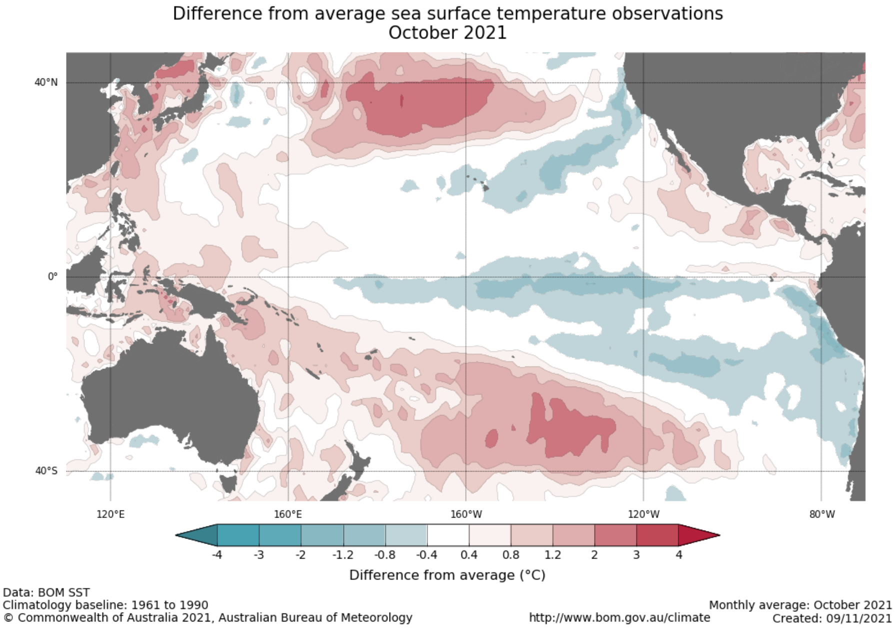


Figure 5.10 October 2021 sea surface temperature degree difference from normal conditions (climatology). (Source: http**p://www.bom.gov.au/climate/enso/wrap-up/#tabs=Sea-surface**)

Annex A. Agroclimatic indicators and BIOMSS

Table A.1 July - October 2021 agroclimatic indicators and biomass by global Monitoring and Reporting Unit (MRU)

65 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	628	-18	22.8	0.1	1244	4	984	-3
C02	East African highlands	714	-8	17.5	-0.1	1161	-2	830	-5
C03	Gulf of Guinea	669	-32	25.7	1.0	1145	6	1128	-16
C04	Horn of Africa	147	-17	21.1	0.0	1255	1	497	-10
C05	Madagascar (main)	176	4	19.7	0.0	1116	-1	593	3
C06	Southwest Madagascar	19	-46	22.3	0.1	1232	1	263	-19
C07	North Africa-Mediterranean	46	-46	23.9	0.6	1366	2	345	-21
C08	Sahel	490	-17	27.3	0.2	1229	3	952	-7
C09	Southern Africa	62	-14	19.4	-0.2	1215	0	367	0
C10	Western Cape (South Africa)	234	9	11.9	-0.8	979	4	626	8
C11	British Columbia to Colorado	306	13	12.9	0.5	1152	1	686	8
C12	Northern Great Plains	270	0	19.9	1.4	1162	4	791	3
C13	Corn Belt	422	17	18.4	0.8	1048	1	974	8
C14	Cotton Belt to Mexican Nordeste	564	26	23.8	-0.2	1234	3	1144	14
C15	Sub-boreal America	226	-27	13.2	1.4	897	4	652	-13
C16	West Coast (North America)	214	55	18.2	0.1	1263	-1	494	20
C17	Sierra Madre	1296	4	19.4	-0.2	1252	3	1220	2
C18	SW U.S. and N. Mexican highlands	352	20	21.2	0.1	1325	2	800	12
C19	Northern South and Central America	1296	-2	23.6	0.0	1240	3	1391	0
C20	Caribbean	653	-11	26.3	0.0	1385	3	1322	-4
C21	Central-northern Andes	466	-8	14.4	0.0	1203	1	534	-6
C22	Nordeste (Brazil)	64	-36	25.1	0.9	1277	5	434	-14
C23	Central eastern Brazil	136	-47	24.4	1.1	1169	3	484	-25
C24	Amazon	387	-6	25.9	0.3	1204	1	847	-4
C25	Central-north Argentina	163	8	18.2	0.6	1067	2	500	2
C26	Pampas	370	-12	15.7	0.4	926	5	705	-7
C27	Western	489	-30	7.0	0.5	812	11	522	-8

	Patagonia								
C28	Semi-arid Southern Cone	73	-28	11.3	0.6	1081	5	247	-22
C29	Caucasus	219	10	18.2	-0.4	1227	-1	527	1
C30	Pamir area	110	-37	17.7	0.0	1415	2	351	-15
C31	Western Asia	60	-4	23.0	0.0	1337	1	253	-3
C32	Gansu-Xinjiang (China)	202	3	16.0	0.1	1184	1	526	-1
C33	Hainan (China)	1330	2	26.2	0.4	1223	3	1517	3
C34	Huanghuaihai (China)	731	75	21.6	-0.4	996	-6	1137	28
C35	Inner Mongolia (China)	368	58	15.6	-0.5	1049	-4	829	21
C36	Loess region (China)	551	53	16.9	0.1	1066	-1	924	12
C37	Lower Yangtze (China)	868	4	23.6	0.5	1105	5	1297	6
C38	Northeast China	476	36	15.7	-0.1	979	-2	976	22
C39	Qinghai-Tibet (China)	1059	-7	11.5	0.2	1010	2	760	2
C40	Southern China	1183	-3	23.0	0.4	1151	7	1426	4
C41	Southwest China	1016	18	19.1	0.3	976	2	1231	7
C42	Taiwan (China)	1019	3	27.1	0.9	1234	3	1073	-7
C43	East Asia	669	3	17.3	0.4	965	2	1032	4
C44	Southern Himalayas	1257	-10	24.1	0.3	1069	1	1274	2
C45	Southern Asia	1112	-13	25.8	0.2	1092	3	1330	1
C46	Southern Japan and the southern fringe of the Korea peninsula	1100	18	21.9	0.4	1022	-1	1223	-1
C47	Southern Mongolia	160	-1	6.5	-0.5	1161	2	500	4
C48	Punjab to Gujarat	866	24	28.7	-0.2	1134	-2	1026	23
C49	Maritime Southeast Asia	1278	12	24.5	0.3	1187	3	1438	8
C50	Mainland Southeast Asia	1430	-1	25.3	0.3	1143	5	1537	2
C51	Eastern Siberia	263	-29	11.7	0.6	900	11	688	-14
C52	Eastern Central Asia	347	25	9.8	-0.3	926	-3	742	9
C53	Northern Australia	255	39	24.7	0.8	1289	2	697	18
C54	Queensland to Victoria	228	14	12.8	-0.2	916	-1	584	8
C55	Nullarbor to Darling	317	36	12.5	-0.6	817	-5	702	17
C56	New Zealand	393	5	8.6	0.3	712	3	670	2
C57	Boreal Eurasia	411	3	10.8	0.3	737	3	754	2
C58	Ukraine to Ural mountains	232	-13	14.5	0.0	855	4	680	-5
C59	Mediterranean Europe and Turkey	147	-11	19.2	-0.3	1257	1	506	-6
C60	W. Europe (non Mediterranean)	335	2	15.3	-0.3	932	0	769	0

C61	Boreal America	454	-5	7.1	-0.7	613	-1	629	-5
C62	Ural to Altai mountains	261	11	12.8	-0.2	911	3	669	6
C63	Australian desert	133	4	14.7	-0.2	982	2	481	3
C64	Sahara to Afghan deserts	37	55	28.8	0.4	1456	0	185	15
C65	Sub-arctic America	186	5	-0.2	0.7	609	-4	326	3

Table A.2 July - October 2021 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 (%)
ARG	Argentina	232	-11	14.8	0.5	964	5	535	-6
AUS	Australia	225	16	13.8	-0.1	935	-1	589	9
BGD	Bangladesh	1829	-8	26.9	0.2	1087	0	1615	0
BRA	Brazil	222	-27	24.3	0.8	1171	3	593	-16
KHM	Cambodia	1419	6	25.5	0.1	1100	1	1607	2
CAN	Canada	306	-8	14.0	1.2	926	1	697	-5
CHN	China	840	13	20.0	0.2	1054	2	1062	11
EGY	Egypt	3	-60	26.0	0.5	1394	0	77	-25
ETH	Ethiopia	865	-5	17.6	-0.2	1169	-2	913	-3
FRA	France	357	15	15.3	-0.6	976	-1	825	6
DEU	Germany	393	21	14.0	-0.7	837	-4	850	8
IND	India	1127	-11	25.9	0.1	1071	1	1272	5
IDN	Indonesia	1189	20	24.4	0.2	1177	2	1373	12
IRN	Iran	66	21	22.6	0.1	1408	-1	191	2
KAZ	Kazakhstan	212	21	14.7	-0.3	1023	1	590	8
MEX	Mexico	1067	1	22.6	0.1	1296	3	1181	1
MMR	Myanmar	1443	-13	24.1	0.6	1086	7	1419	-2
NGA	Nigeria	649	-32	25.7	0.7	1147	5	1043	-15
PAK	Pakistan	207	-35	25.1	0.3	1372	2	541	4
PHL	Philippines	1595	-5	25.7	0.4	1271	7	1566	1
POL	Poland	307	4	14.9	-0.2	827	-3	761	0
ROU	Romania	143	-38	16.8	-0.5	1090	3	564	-18
RUS	Russia	263	-6	13.4	0.0	862	3	705	-1
ZAF	South Africa	96	-15	13.7	-0.7	1140	2	403	-3
THA	Thailand	1314	11	25.1	0.2	1152	5	1550	4
TUR	Turkey	111	-20	18.4	-0.6	1284	0	406	-14
GBR	United Kingdom	465	2	13.6	0.6	660	1	885	7
UKR	Ukraine	172	-15	16.2	-0.6	988	4	610	-4
USA	United States	426	22	20.5	0.4	1175	2	902	11
UZB	Uzbekistan	18	-48	22.2	0.2	1382	1	155	-27
VNM	Vietnam	1451	3	24.0	0.2	1152	5	1511	2
AFG	Afghanistan	25	-38	19.1	-0.1	1466	1	111	-17
AGO	Angola	135	-15	21.9	0.2	1335	0	377	-6
BLR	Belarus	260	-8	14.2	-0.1	812	3	692	-5
HUN	Hungary	137	-35	17.9	-0.2	1052	3	571	-17
ITA	Italy	318	-6	18.9	0.0	1145	-1	720	-5
KEN	Kenya	228	-34	19.7	0.1	1164	0	639	-13
LKA	Sri_Lanka	1459	33	26.1	-0.1	1268	4	1372	12

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 (%)
MAR	Morocco	38	-56	22.9	0.2	1408	3	340	-27
MNG	Mongolia	348	36	8.9	-0.6	1003	-4	707	12
MOZ	Mozambique	74	7	21.8	-0.3	1140	-2	496	6
ZMB	Zambia	12	-35	21.6	0.2	1379	-1	231	9
KGZ	Kyrgyzstan	273	24	11.4	-0.2	1304	1	474	-1

*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 Jan - Apr.*

Table A.3 Argentina, July - October 2021 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	210	-16	12.1	0.6	897	6	524	-10
Chaco	225	-20	18.4	0.2	951	4	627	-8
Cordoba	118	-7	14.8	0.7	1043	5	413	-3
Corrientes	400	-12	16.8	0.2	897	5	824	-5
Entre Rios	278	-23	14.7	0.5	930	8	626	-15
La Pampa	204	23	12.9	0.6	952	7	476	2
Misiones	646	9	17.8	0.3	937	5	968	-4
Santiago Del Estero	97	-36	18.1	0.6	1055	4	441	-9
San Luis	132	30	13.4	0.7	1048	5	398	7
Salta	214	28	16.4	0.3	1108	-1	543	8
Santa Fe	184	-28	16.1	0.5	972	7	563	-11
Tucuman	210	-16	12.1	0.6	897	6	524	-10

Table A.4 Australia, July - October 2021 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	213	22	12.2	-0.5	943	-2	567	13
South Australia	220	8	13.0	-0.2	850	4	576	2
Victoria	324	16	10.4	-0.2	728	-1	668	8
W. Australia	283	34	13.9	-0.4	879	-3	644	15

Table A.5 Brazil, July - October 2021 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	45	-23	27.4	0.8	1393	1	494	-5

	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 (%)
Goias	7	-97	26.4	1.9	1292	6	162	-69
Mato Grosso Do Sul	134	-54	24.7	1.3	1123	4	500	-31
Mato Grosso	102	-56	27.1	1.0	1182	1	369	-36
Minas Gerais	126	-54	22.1	1.2	1162	4	431	-32
Parana	438	-18	18.2	0.3	994	2	843	-8
Rio Grande Do Sul	541	-14	15.5	0.2	877	4	927	-6
Santa Catarina	533	-15	15.0	-0.1	857	-2	902	-7
Sao Paulo	138	-62	21.6	1.1	1105	5	510	-34

Table A.6 Canada, July - October 2021 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	177	-26	13.2	1.2	979	2	575	-14
Manitoba	226	-21	16.2	2.2	965	5	698	-8
Saskatchewan	174	-24	15.2	1.6	996	4	597	-12

Table A.7 India, July - October 2021 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	830	-9	26.2	-0.2	1111	3	1332	4
Assam	2393	-11	24.9	0.2	917	0	1503	3
Bihar	1411	1	27.1	-0.1	1055	-5	1524	8
Chhattisgarh	616	-51	26.0	0.9	1119	5	1144	-17
Daman and Diu	1350	-15	27.5	-0.1	1139	0	1299	3
Delhi	927	59	28.1	-0.8	1138	-3	1441	47
Gujarat	1005	-11	27.4	-0.3	1051	-2	1171	8
Goa	2736	-5	24.9	-0.1	1058	4	1602	3
Himachal Pradesh	638	-36	19.9	0.6	1223	3	874	-3
Haryana	806	44	28.7	-0.3	1166	0	1248	40
Jharkhand	884	-32	26.1	0.5	1134	1	1380	-6
Kerala	1862	-14	24.1	0.1	1105	7	1503	1
Karnataka	1100	-1	23.4	-0.1	978	4	1283	7
Meghalaya	2318	-12	24.7	0.5	934	2	1473	1
Maharashtra	1134	-10	24.7	-0.1	1056	7	1335	5
Manipur	1553	-22	21.7	0.3	989	13	1377	1
Madhya Pradesh	1005	-8	25.9	0.4	1023	-2	1235	1

	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 (%)
Mizoram	1931	-5	23.6	0.1	1015	3	1527	1
Nagaland	2009	-8	21.9	0.2	934	6	1394	4
Orissa	917	-35	26.4	0.6	1115	2	1323	-11
Puducherry	1239	-24	27.6	0.1	1181	5	1418	-3
Punjab	604	-3	29.1	0.2	1209	2	1043	14
Rajasthan	1106	74	28.3	-0.5	1083	-5	1144	41
Sikkim	729	-19	17.5	0.3	1133	6	836	-7
Tamil Nadu	683	-24	26.6	0.4	1122	4	1116	-7
Tripura	1626	-16	26.2	0.3	1049	3	1580	-1
Uttarakhand	457	-58	21.2	0.8	1185	5	829	-14
Uttar Pradesh	1081	7	27.6	0.0	1057	-5	1344	10
West Bengal	1576	-15	26.9	0.2	1109	-1	1572	0

Table A.8 Kazakhstan, July - October 2021 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	201	26	13.3	-0.8	934	0	634	14
Karagandinskaya	196	38	12.6	-0.9	1024	1	634	21
Kustanayskaya	167	-4	14.6	-0.1	945	5	580	0
Pavlodarskaya	238	32	13.3	-0.8	909	0	690	16
Severo kazachstanskaya	261	24	12.8	-0.3	821	-1	681	9
Vostochno kazachstanskaya	257	10	12.6	-0.7	1093	2	694	9
Zapadno kazachstanskaya	114	-8	18.3	0.3	1040	3	514	-3

Table A.9 Russia, July - October 2021 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.	188	-36	13.0	0.5	881	11	610	-18
Chelyabinskaya Oblast	172	-33	12.9	0.2	871	8	580	-15
Gorodovikovsk	154	-19	19.8	-0.4	1076	0	658	-2
Krasnodarskiy Kray	266	-13	15.0	-0.3	995	4	712	-8
Kurganskaya Oblast	202	-17	12.8	0.2	813	7	602	-11
Kirovskaya Oblast	271	-17	12.1	0.3	740	8	736	-6
Kurskaya Oblast	185	-19	14.7	-0.2	907	6	632	-4
Lipetskaya Oblast	222	-2	14.8	-0.1	853	2	698	6
Mordoviya Rep.	242	-13	14.0	0.2	819	3	714	-3
Novosibirskaya Oblast	329	25	11.7	-0.1	784	2	817	17
Nizhegorodskaya	219	-28	13.7	0.5	775	4	667	-12

	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 (%)
O.								
Orenburgskaya Oblast	145	-23	15.6	0.4	988	8	536	-11
Omskaya Oblast	316	32	11.9	0.0	744	-1	752	15
Permskaya Oblast	301	-12	11.4	0.1	735	10	749	-4
Penzenskaya Oblast	260	2	14.1	0.0	847	2	741	6
Rostovskaya Oblast	139	-18	18.8	-0.3	1060	2	593	-6
Ryazanskaya Oblast	240	-11	14.4	0.2	796	1	724	0
Stavropolskiy Kray	320	14	18.7	-0.8	1064	-1	808	1
Sverdlovskaya Oblast	203	-33	11.7	0.4	780	13	596	-19
Samarskaya Oblast	168	-31	15.1	0.4	908	7	586	-15
Saratovskaya Oblast	175	-7	16.2	0.1	965	4	591	-4
Tambovskaya Oblast	238	8	15.1	0.0	859	0	725	10
Tyumenskaya Oblast	298	17	11.8	0.1	734	3	705	4
Tatarstan Rep.	218	-27	13.4	0.3	824	9	677	-11
Ulyanovskaya Oblast	204	-25	14.2	0.2	859	5	651	-10
Udmurtiya Rep.	267	-15	12.2	0.1	741	6	724	-5
Volgogradskaya O.	137	-10	17.9	0.1	1009	1	571	0
Voronezhskaya Oblast	201	6	16.1	0.0	927	1	679	9

Table A.10 United States, July - October 2021 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	356	-11	23.6	0.2	1251	6	1060	9
California	145	161	20.3	0.1	1391	-1	403	31
Idaho	154	15	15.9	0.7	1246	0	585	14
Indiana	428	38	20.4	0.7	1147	3	1047	19
Illinois	411	27	20.7	0.5	1150	2	1053	20
Iowa	319	0	20.3	1.3	1153	3	896	4
Kansas	302	-7	23.5	1.1	1265	6	905	0
Michigan	338	4	17.8	1.2	1031	3	877	3
Minnesota	303	3	18.3	1.9	1091	7	828	2
Missouri	389	15	21.8	0.4	1195	3	1051	15
Montana	175	-3	16.7	1.5	1163	0	642	0
Nebraska	224	-17	21.7	1.7	1247	6	828	1
North Dakota	249	4	19.2	2.4	1099	4	780	5
Ohio	371	25	19.8	0.9	1106	2	984	13
Oklahoma	345	2	24.5	0.1	1285	6	987	9
Oregon	185	19	16.1	0.4	1197	0	562	17

	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 (%)
South Dakota	306	24	20.6	1.7	1186	4	934	20
Texas	519	38	25.5	-0.4	1287	3	1047	16
Washington	245	18	15.9	0.3	1088	-2	591	11
Wisconsin	269	-7	17.8	1.3	1079	4	795	-1

Table A. 11 China, July - October 2021agroclimatic 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	887	28	23.2	0.3	1000	-2	1224	10
Chongqing	1113	30	21.1	0.3	973	-1	1336	9
Fujian	858	-11	23.3	0.6	1166	8	1346	2
Gansu	463	10	14.4	0.4	1074	5	804	2
Guangdong	976	-22	25.3	0.5	1242	8	1483	1
Guangxi	1165	1	23.8	0.4	1200	8	1504	7
Guizhou	887	0	19.9	0.5	1022	7	1302	4
Hebei	619	112	18.2	-0.8	1028	-6	1026	34
Heilongjiang	435	41	15.1	0.0	957	-2	941	21
Henan	757	74	21.6	-0.5	972	-7	1165	26
Hubei	766	10	21.7	0.2	1009	-2	1207	8
Hunan	789	0	23.1	0.6	1122	6	1303	8
Jiangsu	925	33	23.6	0.5	1012	-1	1239	11
Jiangxi	763	-7	24.1	0.7	1155	8	1287	3
Jilin	475	24	16.1	0.1	1019	-2	1008	21
Liaoning	559	40	17.8	-0.3	1010	-3	1068	25
Inner Mongolia	360	67	14.8	-0.5	1023	-5	825	24
Ningxia	214	-10	17.0	0.7	1161	5	645	-7
Shaanxi	790	49	17.9	0.2	996	-4	980	9
Shandong	661	55	21.6	-0.2	1004	-6	1127	26
Shanxi	524	67	16.8	0.0	1060	-3	901	15
Sichuan	1202	30	17.8	0.3	942	0	1159	7
Yunnan	1135	12	17.9	0.4	981	7	1200	3
Zhejiang	1252	37	23.1	0.6	1025	0	1367	7

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.cn**.**

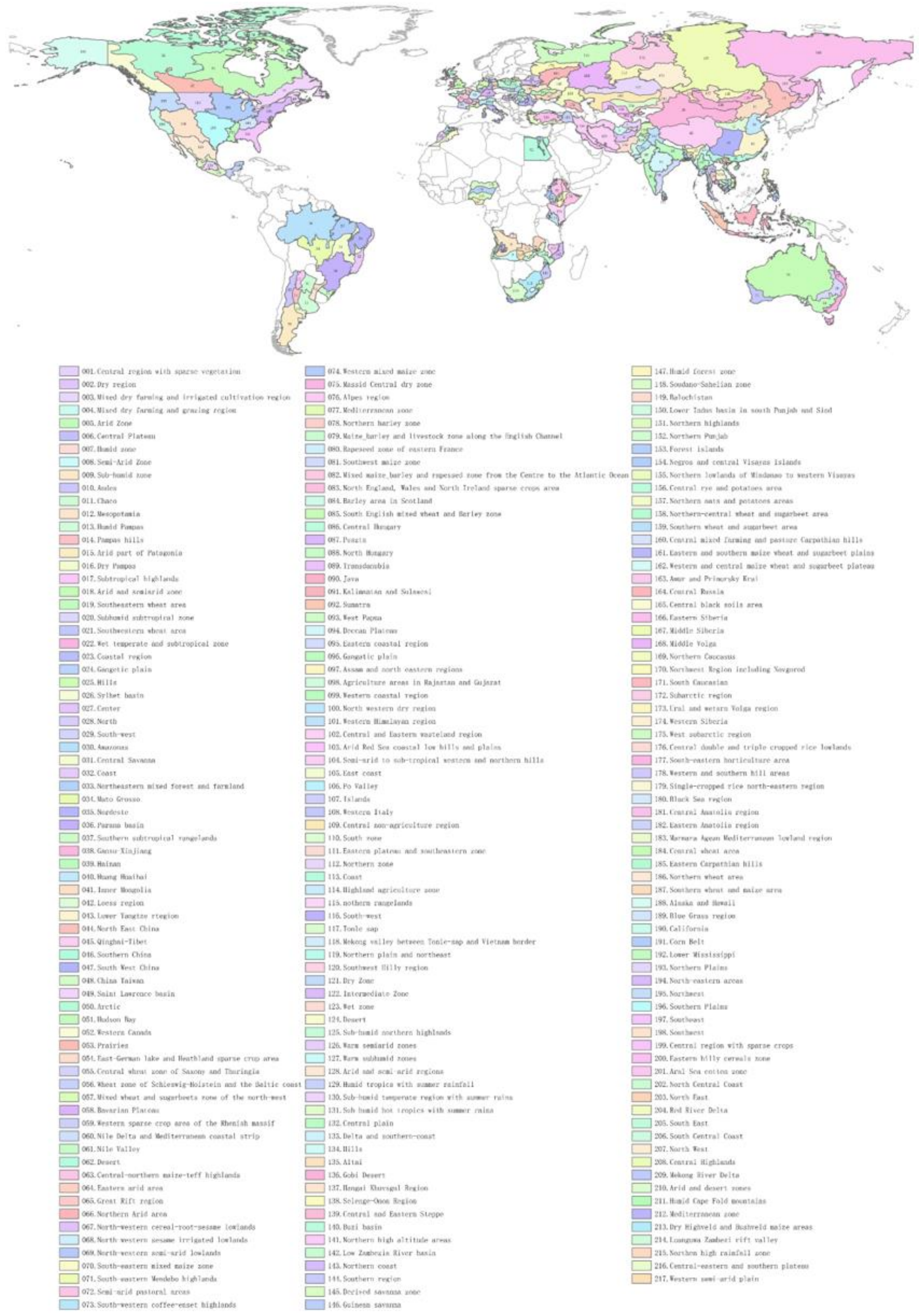
Agroecological zones for 43 key countries

Overview

217 agroecological zones for the 43 key countries across the globe

Description

43 key agricultural countries are divided into 217 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 43 key countries. Some regions are more relevant for rangeland and livestock monitoring, which is also essential for food security.



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/m², 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 last five years (2006-2020), 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 (2016-2020), with departures expressed in percentage.
CROPPING INTENSITY			
Cropping intensity Index			
Crop/ Satellite	0, 1, 2, or 3; Number of crops growing over a year for each pixel	Cropping intensity index describes the extent to which arable land is used over 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.	Cropping intensity is presented as maps by pixels or spatial average pixels values for MPZs, 43 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 (2016-2020), 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/m², 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 (2006-2020), 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/m², CWSU	The spatial average (for a CWSU) of rainfall accumulation over agricultural	RAIN is shown as the percent departure of the RAIN value for the reporting period, compared to

INDICATOR			
		pixels, weighted by the production potential.	the recent fifteen-year average (2006-2020), 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 (2006-2020), 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			
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.

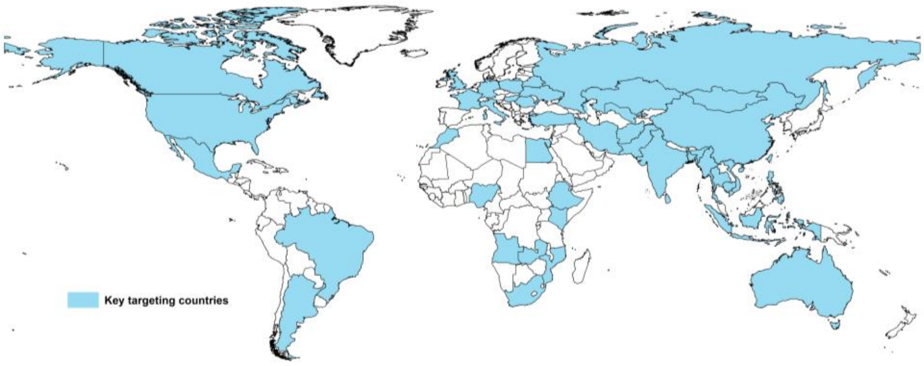
Note: Type is either "Weather" or "Crop"; source specifies if the indicator is obtained from ground data, satellite readings, or a combination; units: in the case of ratios, no unit is used; scale is either pixels or large scale CropWatch spatial units (CWSU). Many indicators are computed for pixels but represented in the CropWatch bulletin at the CWSU scale.

CropWatch spatial units (CWSU)

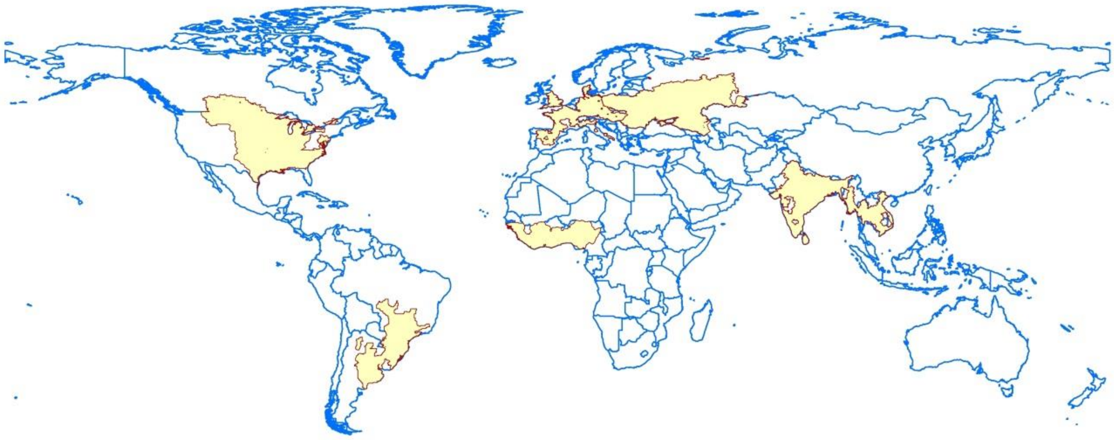
CropWatch analyses are applied to four kinds of CropWatch spatial units (CWSU): Countries, China, Major Production Zones (MPZ), and global crop Monitoring and Reporting Units (MRU). The tables below summarize the key aspects of each spatial unit and show their relation to each other. For more details 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.

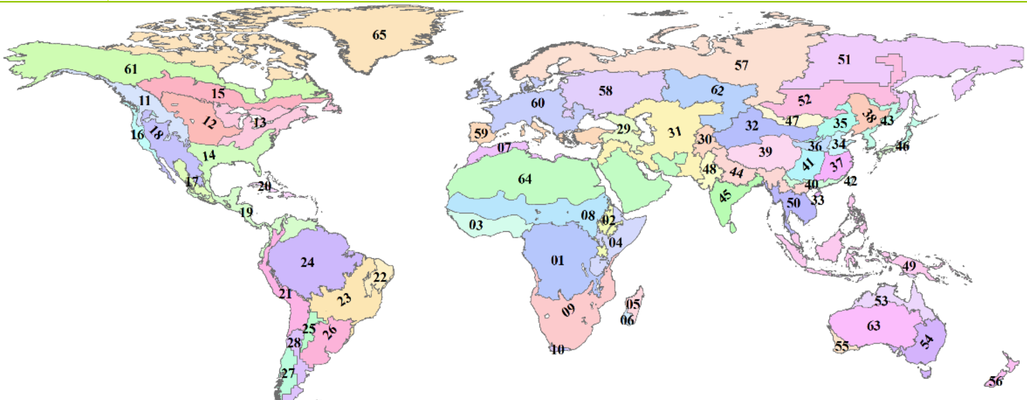
Countries (and first-level administrative districts, e.g., states and provinces)	
Overview	*Description*
"Forty two plus one" countries to represent main producers/exporters and other key countries.	CropWatch monitored countries together represent more than 80% of the production of maize, rice, wheat 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 "42 + 1," referring to 42 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.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*
65 agro-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 (e.g., MRU-63 to 65) 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.cn** .



01:Equatorial central Africa
02:East African highlands
03:Gulf of Guinea
04:Horn of Africa
05:Madagascar (main)
06:Southwest Madagascar
07:North Africa Mediterranean
08:Sahel
09:Southern Africa
10:Western Cape (South Africa)
11:British Columbia to Colorado
12:Northern Great Plains
13:Corn Belt
14:Cotton Belt to Mexican Noreste
15:Sub-boreal America
16:West Coast (North America)
17:Sierra Madre
18:Southwest U.S. and north Mexican highlands
19:Northern South and Central America
20:Caribbean
21:Central-northern Andes
22:Nordeste (Brazil)
23:Central eastern Brazil
24:Amazon
25:Central-north Argentina
26:Pampas
27:Western Patagonia
28:Semi-arid Southern Cone
29:Caucasus
30:Pamir area
31:Western Asia
32:Gansu-Xinjiang (China)
33:Hainan (China)
34:Huanghuaihai (China)
35:Inner Mongolia (China)
36:Loess region (China)
37:Lower Yangtze (China)
38:Northeast China
39:Qinghai-Tibet (China)
40:Southern China
41:Southwest China
42:Taiwan (China)
43:East Asia
44:Southern Himalayas
45:Southern Asia
46:Southern Japan and Korea
47:Southern Mongolia
48:Punjab to Gujarat
49:Maritime Southeast Asia
50:Mainland Southeast Asia
51:Eastern Siberia
52:Eastern Central Asia
53:Northern Australia
54:Queensland to Victoria
55:Nullarbor to Darling
56:New Zealand
57:Boreal Eurasia
58:Ukraine to Ural mountains
59:Mediterranean Europe and Turkey
60:W. Europe (non Mediterranean)
61:Boreal America
62:Ural to Altai mountains
63:Australian desert
64:Sahara to Afghan deserts
65:Sub-arctic America

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 43 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):

$$Area_i = a + b * CALF_i$$

Data notes and bibliography

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Online resources

Online Resources posted on **www.cropwatch.cn** , **http://cloud.cropwatch.cn/**

This bulletin is only part of the CropWatch resources available. Visit **www.cropwatch.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