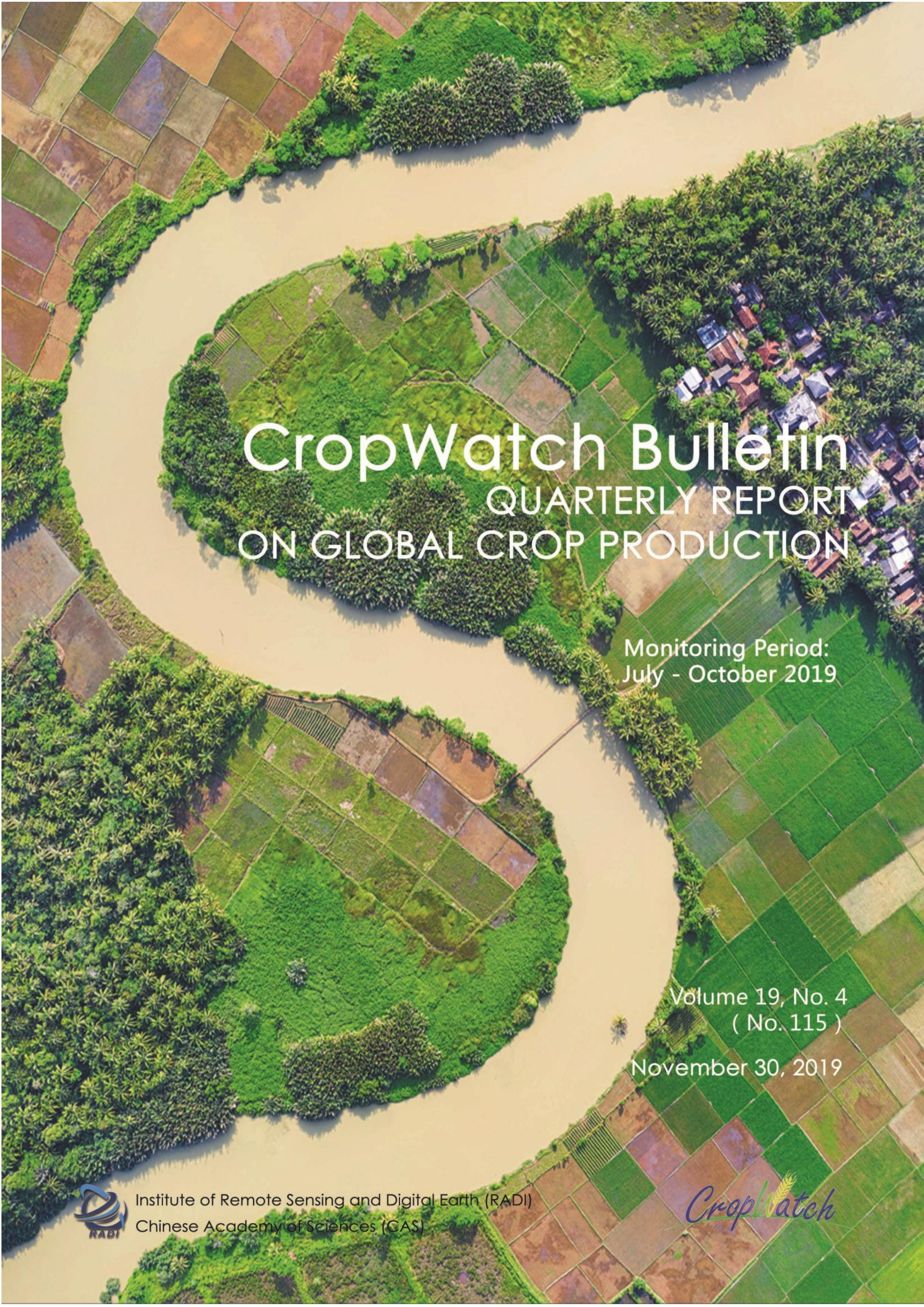

CropWatch Bulletin

QUARTERLY REPORT ON GLOBAL CROP PRODUCTION

Monitoring Period:
July - October 2019

Volume 19, No. 4
(No. 115)

November 30, 2019

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Chinese Academy of Sciences (CAS)

November 2019

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

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ⓘ *NOTE:* CROPWATCH RESOURCES, BACKGROUND MATERIALS AND ADDITIONAL DATA ARE AVAILABLE ONLINE AT WWW.CROPWATCH.COM.CN.

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Abbreviations

5YA	Five-year average, the average for the four-month period from July from 2014 to 2018 to October next year; one of the standard reference periods.
15YA	Fifteen-year average, the average for the four-month period from July from 2004 to 2018 to October next year; 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	Monitoring and Reporting Unit
NDVI	Normalized Difference Vegetation Index
OISST	Optimum Interpolation Sea Surface Temperature
PAR	Photosynthetically active radiation
PET	Potential Evapotranspiration
RADI	CAS Institute of Remote Sensing and Digital Earth
RADPAR	CropWatch PAR agroclimatic indicator
RAIN	CropWatch rainfall agroclimatic indicator
SOI	Southern Oscillation Index
TEMP	CropWatch air temperature agroclimatic indicator
Ton	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 January and April 2019, 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 115rd such publication issued by the CropWatch group at the Institute of Remote Sensing and Digital Earth (RADI) 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; and (ii) agronomic indicators—VHIn, CALF, and VCIx, Cropping Intensity, and vegetation indices, describing crop condition and development. 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. (ii) 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.com.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, 41 major agricultural countries, and 201 Agro-Ecological Zones (AEZs).

This bulletin is organized as follows:

Chapter	Spatial coverage	Key indicators
Chapter 1	World, using Monitoring 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 205 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.com.cn**, **http://cloud.cropwatch.com.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 2019. It is prepared by an international team coordinated by the Institute of Remote Sensing and Digital Earth (RADI), Chinese Academy of Sciences.

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 (the "core countries") while chapter 4 zooms into China. Special attention is paid to the major producers of maize, rice, wheat, and soybean fr which the bulletin presents a global production estimate for crops harvested throughout 2019 (Chapter 5.1).

The bulletin is issued at a time when virtually all 2019 crops have been harvested in the temperate northern hemisphere, while in many tropical areas in both hemispheres rice crops are growing (to be harvested in early 2020) or are close to harvest. In the southern hemisphere the summer season/monsoon season is ongoing.

Agro-climatic conditions (Chapter 1)

Global agroclimatic conditions are assessed based on CropWatch Agroclimatic Indices which describe weather and climate over agricultural areas only. They are referred to as RAIN, TEMP and RADPAR and expressed in the same units as the corresponding climatological variables (rainfall, temperature and photosynthetically active radiation). BIOMSS is an estimate of the plant biomass production potential.

The current reporting period was globally warm and dry, and this is confirmed by numerous fires listed in the section on Disasters (Chapter 5.2) on almost all continents. CropWatch uses 65 large spatial units (referred to as MRU) to asses global agro-climatic patterns, Most MRUs experienced average RAIN, 57% had above average temperature and 66% had above average sunshine.

On a continental basis, RAIN anomalies were largest in north America (+24% above average), central Asia (+22%) and in Oceania (down 38% compared with average). Low precipitation in southern and especially central America (-9%) is directly associated with a very tense situation in the "drought corridor" (refer to Chapter 5.2 on Disasters).

In North America, TEMP was 0.4°C below average. Positive anomalies occured in central and eastern Asia (+0.3°C compared with average) where almost all MRUs has consistently warmer than average weather positive over their agricultural areas (89% and 100%, respectively). RADPAR was generally close to average except in South and Central America (+3%) and Oceania (+6%), where all MRUs were affected. The largest BIOMSS increase occurred in central Asia (+5%)

Acutely abnormal or damaging weather conditions are described in Chapters 3.1 by country and in Chapter 5.2 impact type. They include several tropical cyclones in different Basins: Kyarr, in the Indian Ocean, affected southern Asia and the Horn of Africa; Dorian created havoc in the Caribbean and the western Pacific, Lekima, Faxai and Hagibis affected eastern Asia and south-east Asia.

Global Agricultural production estimates (Chapter 5.1)

The bulletin provides the second revised global estimate by the CropWatch team for 2019 production of the major commodities. About 90% of the production is actually modeled and about 10% is trend-based.

The volumes produced in 2019 include 1055 million tonnes of maize, up 0.5% from 2018, 754 millions for rice (as paddy; up 4.2%), 716 million tonnes of wheat (a 0.9% increase) and 324 million tonnes of soybeans, 1.0% lower than last year's output.

The largest net cereal production increases in million tonnes occurred in India (13.3, in spite of a drop in wheat output), China (10.6), United States (9.7), Pakistan (5.2) followed by Bangladesh (3.7), Argentina (3.3), Myanmar (2.6) and several central and western Asian countries where wheat did well after several years of poor performance (2.0 to 2.4 in Afghanistan, Iran and Uzbekistan). The largest net cereal production decreases in excess of 1 million tons affected Australia (-5.4 due to poor wheat), Kazakhstan (-3.5, wheat), South Africa (-1.7, maize), Indonesia (-1.6, rice) and Ukraine (-1.4, maize and wheat). As described in the country narratives in Chapter 3, the listed situations are directly related to prevailing environmental conditions

China (Chapter 4)

The total 2019 annual crop production is estimated at 628 million tons, up 2% from 2018. For summer crops (including maize, semi-late rice / single rice, late rice, spring wheat, soybean, tuber crops, and other minor summer crops) the output is put at 467 million tons, a 2% increase This is mainly due to the good performance of maize and rice, the production of which reached 224 million tons, 1% above the 2018 output. Maize yields in Heilongjiang, Jilin, Liaoning and Inner Mongolia were up 3%, 5%, 3%, and 2%, respectively. In contrast, Both Henan and Shandong maize production dropped by 2% due to drought at early growing stage.

At 203 million tons, rice production (mostly single rice and late rice) was 3% above last year's output. Yield increase due to favorable late season weather was the main factor behind the improved production. The wheat production estimate of 126 million tons was up 2% over 2018.

Soybean output (14441 thousand tons) underwent a year-on-year increase of 3%. 2019 was the fourth consecutive year of increased soybean hectarage and production. In Heilongjiang, the main soybean region of China, production was up 8%. This is exceeded in Jilin where increased planted area and yield resulted in an 10% increase in output. .

Chapter 1. Global agroclimatic patterns

1.1 Introduction to CropWatch agroclimatic indicators (CWAIs)

This bulletin describes environmental and crop conditions over the period from July to October 2019, 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 2019 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 2004 to 2018. Although departures from the 2004-2018 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. 2014-2018) but the BIOMSS indicator is nevertheless compared against the longer 15YA (fifteen years 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, BIOMSS) at MRU scale derive directly from climatology. For instance, the positive correlation ($R=0.354$) 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 a new calculation procedure of the biomass production potential in the previous (August 2019) bulletin. The new approach includes sunshine (RADPAR) as well next to TEMP and RAIN. Readers are referred to the previous bulletin for details.

1.2 Global overview

The current reporting period experienced yet another absolute global monthly temperature record (October). This followed other monthly records, especially July, the warmest month ever recorded on the planet (see Sources [1] to [5] at the end of the chapter). Considering that September was the second warmest on record, the current JASO was globally warm and dry, and this is confirmed by numerous fires listed in the section on Disasters (Chapter 5.2) on almost all continents. According to the source of data and calculation procedures, the global temperature anomaly for JASO against 2004-2018 reached between -0.1°C and +0.1°C over agricultural areas, thus excluding deserts and boreal areas.

Over the last two reporting periods, there has been a clear trend of decreasing quarterly rainfall accompanied by increasing temperature and sunshine (RADPAR), as shown in Figure 1.1. About half the MRUs experienced average RAIN, 57% had above average temperature and 66% had above average RADPAR.

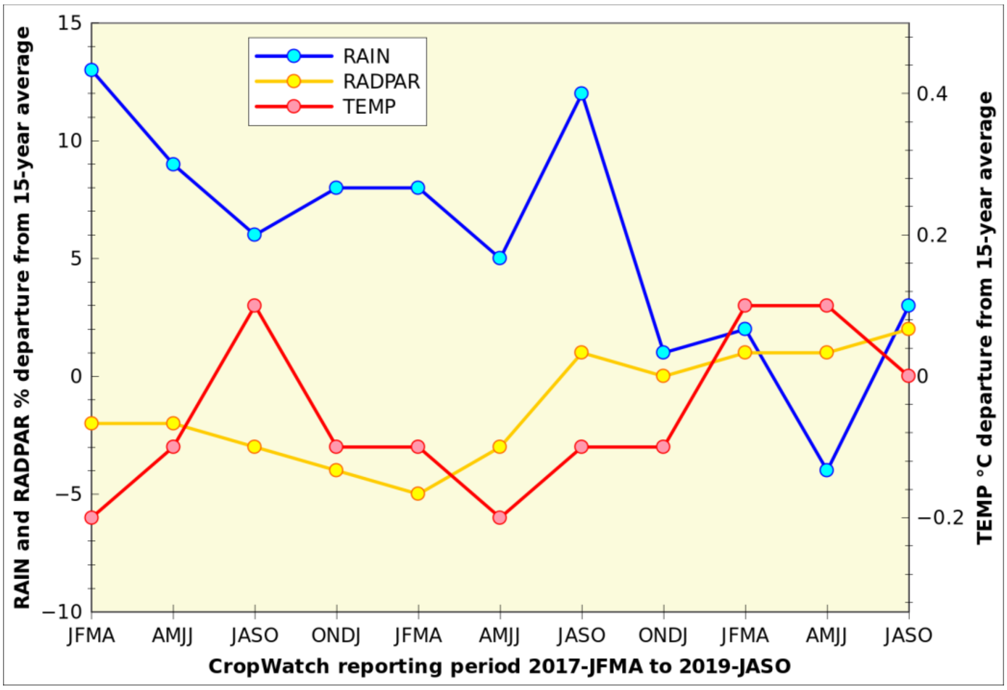


Figure 1.1 global departure from recent 15 year average of theRAIN, TEMP and RADPAR indicators since 2017 JASOperiod (average of 65 MRUs, unweighted)

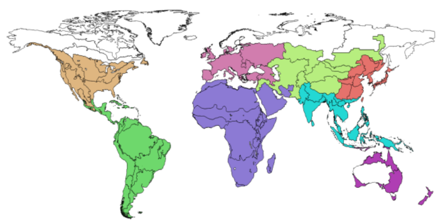
Figure 1.1 shows unweighted averages of the CropWatch Agro-climatic Indicators, i.e. the arithmetic means of all 65 MRUs, which are relatively close to average. CWAIs are computed only over agricultural areas, and they display a relatively average situation, globally (RAIN +3%, TEMP average, RADPAR +2% and BIOMSS +1%, as result of the combined positive departures of RAIN and BIOMSS).

When global MRU average departures are computed using agricultural area as a weighting factor, a positive rainfall departure of 7% is observed (Table 1.1), with average TEMP and BIOMSS but RADPAR up 1.7%. Because MRUs are large areas, and because sunshine tends to be less variable than rainfall and temperature, the close to 2% departure for RADPAR is rather significant.

Table1.1 Departures from the recent 15-year average of CropWatch agro-climatic indicators over regional MRU groups. Within each group, averages are weighted by the agricultural area of individual MRUs. "Others" include five non agricultural areas shown in white in the map. They are located mostly at high

northern latitudes, and characterized by the largest positive TEMP departure. Some of them experienced unusually intense fires in their recent summer season.

	RAIN %	TEMP °C	RADPAR %	BIOMSS %
Africa	13	−0.2	1	2
America S + C	−9	0.0	3	−2
America N	24	−0.4	1	2
Asia center	22	0.3	1	5
Asia East	2	0.3	2	−3
Asia South	11	0.0	1	2
Europe	−4	−0.1	1	−3
Oceania	−38	0.2	6	3
Others	−4	0.5	6	11
World	7.0	−0.1	1.7	0.5



On a continental basis, RAIN anomalies were largest in north America (+24% above average), central Asia (+22%) and in Oceania (-38%), reinforcing the anomalies that were observed during the previous AMJJ reporting period when the corresponding values were 19%, 20% and -30%. While AMJJ was relatively dry in East Asia (-12%) and in South Asia (-13%) the areas experienced precipitation that was average (+2%) and above average (+11%), respectively, during the current JASO reporting period. Low precipitation in southern and especially central America (-9%) is directly associated with a very tense situation in the “drought corridor” (refer to Chapter 5.2 on Disasters).

In North America, TEMP was 0.4°C below average, with most other areas recording closer to average temperature. Positive anomalies occur in central and eastern Asia (+0.3°C compared with average) where almost all MRUs has consistently warmer than average weather positive over their agricultural areas (89% and 100%, respectively).

RADPAR was generally close to average except in South and Central America (+3%) and Oceania (+6%), where all MRUs were affected.

The largest BIOMSS increase occurred in central Asia (+5%), with large differences between the individual MRUs, as listed below (1.6)

1.3 Rainfall (Figure 1.2)

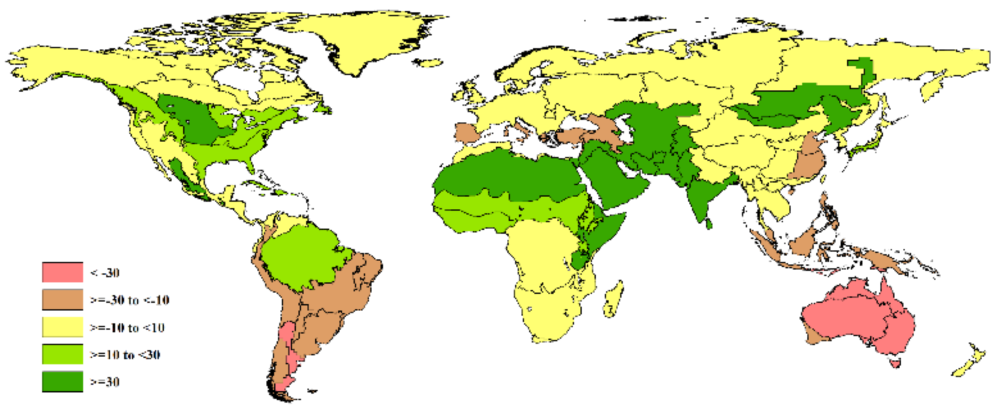


Figure 1.2 Global map of rainfall anomaly (as indicated by the RAIN indicator) by CropWatch Mapping and Reporting Unit: departure of July to October 2019 total from 2004-2018 average (15YA), in percent.

Dry conditions

Rainfall deficits occurred mostly in South America, south of and including the Central-northern Andes (MRU21), Central eastern Brazil (MRU23) and the Brazilian Nordeste (MRU22) , where deficits are just above 10%. Larger deficits in excess of 20% hit the Semi-arid Southern Cone (MRU28) with a 40% shortfall of rain and Western Patagonia (MRU27) at -25%. The major agricultural area of the Pampas had a deficit of 17%, corresponding to early and mid-season stages of winter crops at a time when summer crop land preparation is just starting.

The second deficit area extends from Australia across maritime south-east Asia to east Asia, with the driest conditions prevailing in Australia at the beginning of spring: Northern Australia (MRU53), -58% precipitation compared with average, Australian desert (MRU63, -52%), Queensland to Victoria (MRU54, -40%) and Nullarbor to Darling (MRU55, -27%). Precipitation in the southern areas (MRUs 54 and 55) is normally in excess of 200 mm during the reporting period but only 120 mm and 173 mm were recorded, respectively, at the late stages of winter crops. South-West Australia (MRU55) had one of the largest sunshine anomalies (+10%) globally.

The precipitation deficit reached 21% in Maritime Southeast Asia (MRU49) and 26% in north-eastern China (Huanghuaihai, MRU34).

A final dry area extends from the Caucasus (MRU29, -22%) to the northern Mediterranean areas in Turkey and Europe up to Spain (MRU59, -13%).

Wet conditions

The largest precipitation excesses extend over a contiguous area extending from Southern Asia to northern Africa, across several climatic zones which were all at or nearing the end of their summer cropping season over the reporting period. They include Southern Asia (MRU45, +47% precipitation compared with average), the Pamir area (MRU30, +50%), Punjab to Gujarat (MRU48, +100%, which represents about 1200 mm of precipitation), Western Asia (MRU31, +34%), the Sahara to Afghan deserts (MRU64, +41%) and the Horn of Africa (MRU04, 67%). In the two last MRUs, expected amounts are small (17 mm and 87 mm, respectively) and the rainfall has created local floods but also improved the biomass potential, especially in range-lands (+30% and +1%).

Slightly lower precipitation was recorded over the eastern-central parts of Asia with excesses in the range from 31% to 36%) in Southern Mongolia (MRU47), Eastern Central Asia (MRU52) and Northeast China (MRU38).

Very wet conditions prevailed over north America, with the largest late summer crop season excesses reported from the Sierra Madre (MRU17, +35%) and especially the Northern Great Plains (MRU12) which recorded 409 mm when 257 mm were expected, a positive departure of 59%. The area also experienced rather cool weather 1.4 below average low sunshine (-3%).

1.4 Temperatures (Figure 1.3)

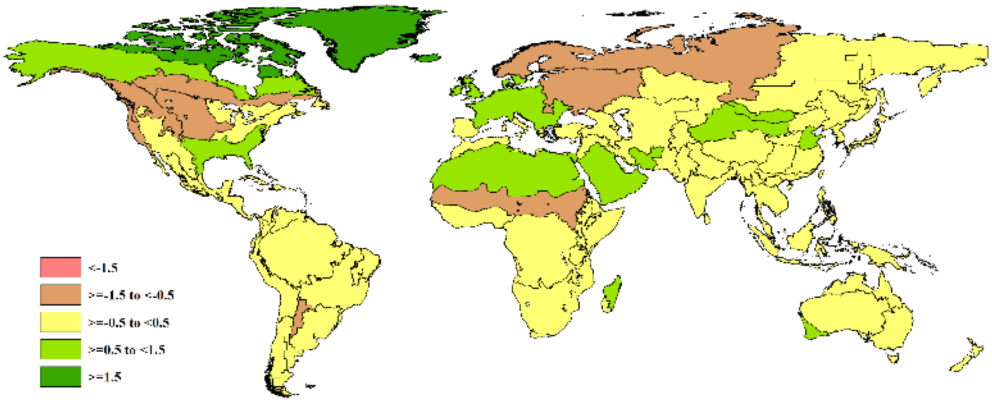


Figure 1.3 Global map of temperature anomaly (as indicated by the TEMP indicator) by CropWatch Mapping and Reporting Unit: departure of July to October 2019 average from 2004-2018 average (15YA), in °C .

Negative temperature of -1.0°C or larger occurred in Sub-boreal America (MRU15, 1.0°C below average). The area (Canada) is of limited agricultural importance for crop agriculture, contrary to British Columbia to Colorado (MRU11; -1.4°C) and especially the Northern Great Plains (MRU12, -1.4°C), which also experienced cool and wet weather. The West Coast MRU16, which includes most of California suffered more from drought (RAIN -6%) than from high temperature.Positive temperature departures larger than +1.0°C occurred in MRU47 (Southern Mongolia) and reached just 1.1°C.

1.5 RADPAR (Figure 1.4)

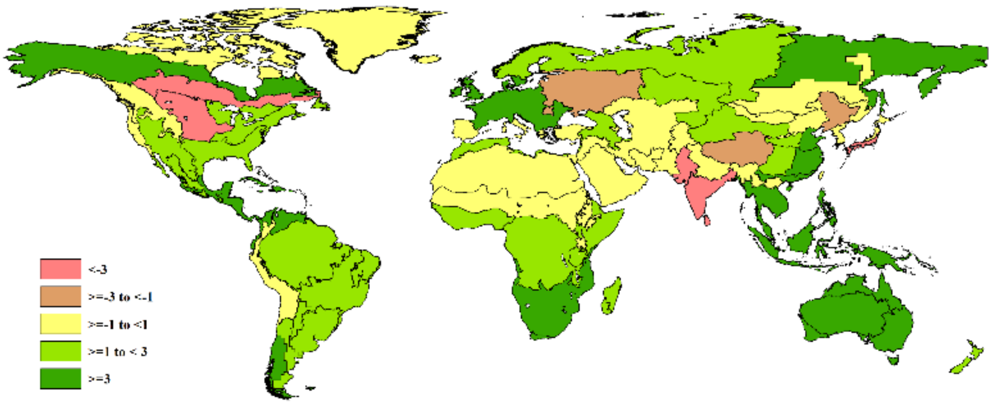


Figure 1.4 Global map of photosynthetically active radiation anomaly (as indicated by the RADPAR indicator) by CropWatch Mapping and Reporting Unit: departure of July to October 2019 total from 2004-2018 average (15YA), in percent.

The already mentioned MRU15 (Sub-boreal America, RADPAR down 3% below average) was one of two low sunshine areas in northern America, the other being the Northern Great Plains (MRU12) with the same -3% deficit.

Remaining low solar radiation areas all occur in the south and east of Asia. They include the two adjacent areas of Southern Asia (MRU45, essentially India) with a spectacular 9% drop in sunshine compared with average and Punjab to Gujarat (MRU48) where the drop reaches 5%. All the listed areas in America and Asia had above-average rainfall and low temperature. In Southern Japan and the southern fringe of the Korea peninsula (MRU46), the shortage of sunshine reached 3% with excess precipitation, but temperature was close to average. All the listed areas also have negative biomass production potentials, except in Punjab to Gujarat where the very large excess in precipitation (+100%) combined with reduced evaporation associated with low temperature and sunshine led to a biomass potential increase of 21%.

Large positive sunshine departures in excess of 5% occurred in thirteen MRUs on all continents. In America, with the exception of Sub-boreal America and the Northern Great Plains, the whole continent has above-average sunshine, with the largest values in Northern South and Central America (MRU19, +5%) and the Caribbean (MRU20, +6%) and, at the southern end of the continent, Western Patagonia (MRU27) with a 5% positive departure.

In Southern Africa (MRU09) the excess was 4% on average, with the Mediterranean area of the Western Cape (MRU10) having recorded 5%.

In eastern and south-eastern Asia the largest positive departures correspond to Maritime Southeast Asia (MRU49) and the Lower Yangtze (+8%), followed by Southern China (MRU40) and Hainan (MRU33) at 6% and Mainland Southeast Asia (MRU50) at +5%.

The largest departures occur in Australia with Nullarbor to Darling (MRU55) at +10%, the central Australian desert areas (MRU63) with Queensland to Victoria (MRU54) at +6% and Northern Australia (MRU53) at +5%

1.5 BIOMSS (Figure 1.5)

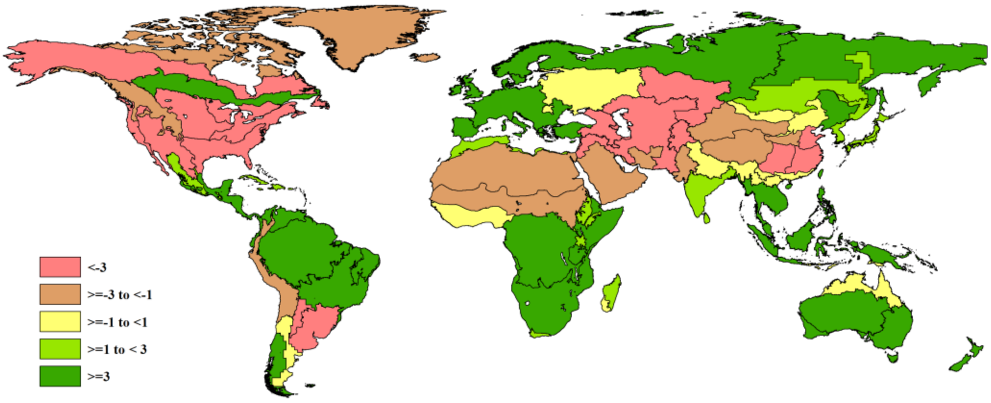


Figure 1.5 Global map of photosynthetically active vradiation anomaly (as indicated by the RADPAR indicator) by CropWatch Mapping and Reporting Unit (MRU), departure from 15YA between between January and April 2019

About half the variability of BIOMSS departures derives directly from RAIN, TEMP and RADPAR departures, with RAIN departures accounting for the largest (about 40%) BIOMSS variability and TEMP and RADPAR accounting for about 30% each. It remains that other factors play a part, which also explains why BIOMSS departure patterns do not closely follow RAIN departure patterns.

Large negative BIOMSS anomalies are widely dispersed among the continents. The largest potential biomass production deficit was recorded over Northern Australia (MRU53) at -20%, mostly in a grass and shrub-land area that plays a minor role for crop production, but includes some of the main livestock producing areas in the country. We next need to mention three adjacent south American MRUs, covering a large diversity of environmental conditions: the Central-northern Andes (MRU21, 14% below average), the Semi-arid Southern Cone (MRU28) and Central-north Argentina (MRU25), both at -11%. The first includes high elevation areas but practices irrigation in the coastal lowlands. All are relatively minor crop production areas but play a significant role in livestock production, and it is thus likely that range-lands and grasslands have suffered in the area.

Finally, two unrelated areas in Europe and in Africa: Ukraine to Ural mountains (MRU58) with a 13 % drop in biomass production potential and the East African highlands (MRU02) at -11%. Ukraine experienced average rainfall but low temperature and sunshine. In MRU02, rainfall was abundant (+11%) but temperature was below average.

If Boreal America (MRU61) and Sub-arctic America (MRU65) are excluded, positive BIOMSS anomalies larger than 20% occurred in Punjab to Gujarat (MRU48, +21%) and in the Sahara to Afghan deserts (MRU64, +30%). While the second is not relevant due to normally extremely low rainfall (the MRU recorded 25 mm instead of 18!) the doubling of precipitation in MRU48 (1203 mm instead of 601 mm) is very significant in spite of low temperature and sunshine. As detailed in the section on Disasters (5.2) parts of the area suffered bad floods, but the abundant rainfall has nevertheless benefited summer crops and grazing lands.

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 index (CI)— to describe crop condition in six Major Production Zones (MPZ) across all continents. For more information about these zones and methodologies used, see the quick reference guide in Annex C as well as the CropWatch bulletin online resources at http://www.cropwatch.com.cn/htm/en/bullAction!showBulletin.action#.

2.1 Overview

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

Table2.1 Agroclimatic indicators by Major Production Zone, current value and departure from 15YA (July to October 2019)

	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m^2)	Departure (%)	Current (gDM/m^2)	Departure (%)
West Africa	1058	12	24.6	-0.3	1086	1	724	3
North America	436	30	20.3	-0.3	1134	0	609	0
South America	292	-19	18.4	0.0	1018	3	437	5
S. and SE Asia	1534	21	25.4	-0.1	1044	-3	676	1
Western Europe	308	3	16.4	0.6	977	3	455	8
C. Europe and W. Russia	256	-2	14.6	-0.7	867	-1	376	-7

*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 2004-2018.*

Table2.2 Agronomic indicators by Major Production Zone, current season values and departure from 5YA (July to October 2019)

	CALF (Cropped arable land fraction)		Maximum VCI	CI (Cropping Intensity)	
	Current (%)	5A Departure (%)	Current	Current (%)	5A Departure (%)
West Africa	97	1	0.96	126	-2
North America	96	2	0.93	103	8
South America	89	-2	0.65	130	2
S. and SE Asia	97	2	0.99	141	6

Western Europe	90	0	0.87	133	3
Central Europe and W Russia	94	-2	0.84	108	0

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 2014-2018.

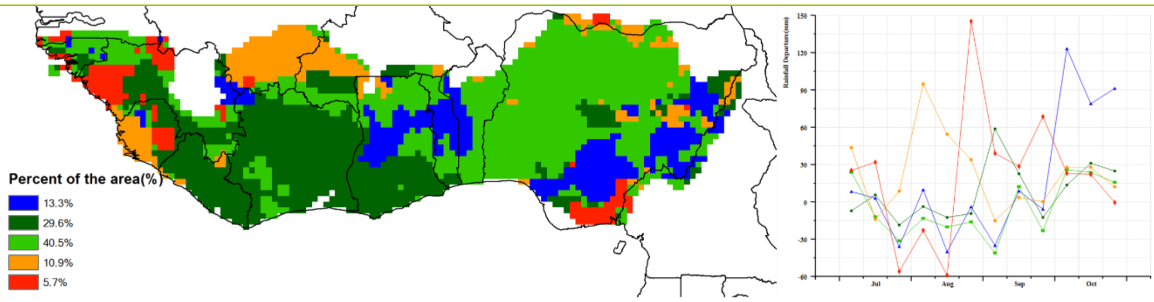
2.2 West Africa

The reporting period covers the onset of the main rainy season throughout south of the region and the end of the rainy season in the northern Sahelian areas. The main activities include the sowing of main cereals (maize, sorghum, millet, and rice) under both rainfed and irrigated conditions. Tuber crops like yam are being harvested while rice harvest extends into December and January. In the south with bimodal rainfall, the first maize crop was harvested in October; however cassava is still growing hence contributing to the cropped arable land as reflected by the CALF (97%).

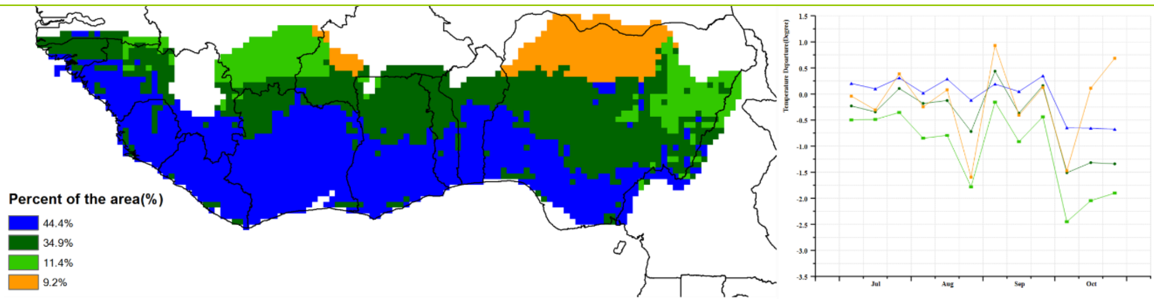
Indicators show close to but above average rainfall of 1058 mm (+12%), average temperature (TEMP 24.6°C, down 0.3°C) and sunshine (RADPAR 1086 MJ/m2, up 1%), leading to a marginal increase in biomass production potential (BIOMSS 724 gDM/m2, +3%) with larger departures observed in south-eastern Nigeria bordering Cameroon. The cropped arable land fraction (CALF) reached 97% for the region (1% above 5YA). The maximum VCI (VCIx) map as an index of crop condition shows an average value of 0.96 exceeding 1.0 in some areas of northern Nigeria, indicating generally favorable condition for crop growth.

These CropWatch indicators, show stable climatic conditions for the MPZ and mostly favorable prospects for 2019 crops due to adequate cumulative rainfall amounts.

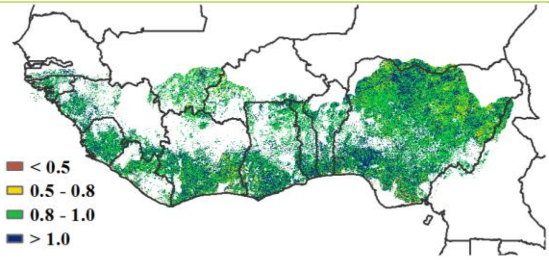
Figure 2.1 West Africa MPZ: Agroclimatic and agronomic indicators, July to October 2019.



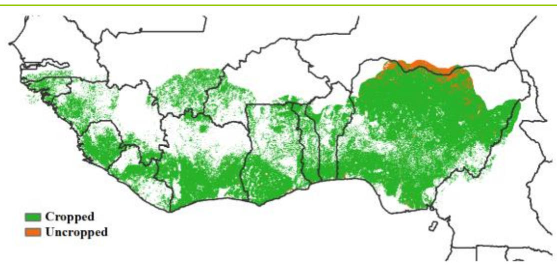
a. Spatial distribution of rainfall profiles b. Profiles of rainfall departure from average (mm)



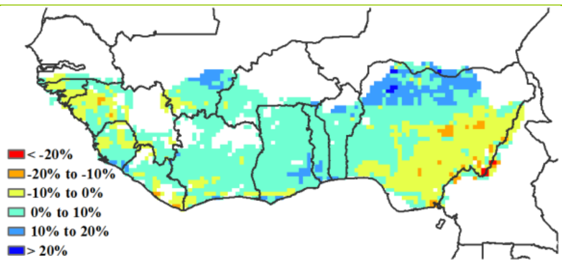
c. Spatial distribution of temperature profiles d. Profiles of temperature departure from average (mm)



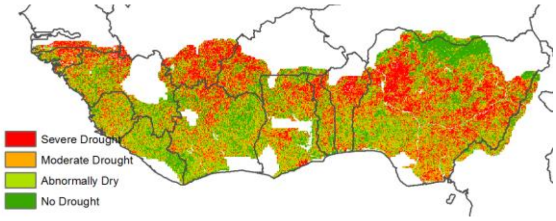
e. Maximum VCI



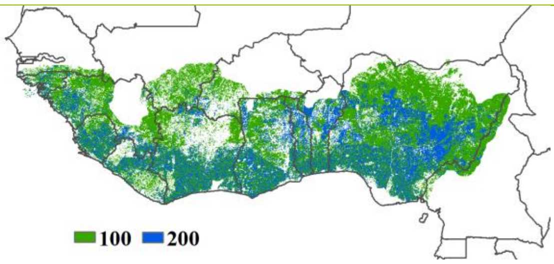
f. Cropped arable land



g. Biomass accumulation potential departure



h. VHI minimum



i. Cropping intensity

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

2.3 North America

This reporting period was the critical growth season of summer crops in North America, including maize, rice, spring wheat and soybeans. The agro-climatic condition was extremely wet: rain was significantly above (+30%), and temperature was below (by 0.3°C) average, however with significant spatial differences across the region. Sunshine as measured by the RADPAR indicator was average.

The Great Plains and Canadian Prairie were dominated by above average precipitation, especially in the north and east of the Great Plains. Large variations in precipitation were observed over time in the lower Mississippi, where the departure reached to -30 mm in late August but +75 mm in late October. Above average temperature was observed up to late September, but since then temperature declined rapidly in the Great Plains the Prairies, reaching -7.0°C in late October.

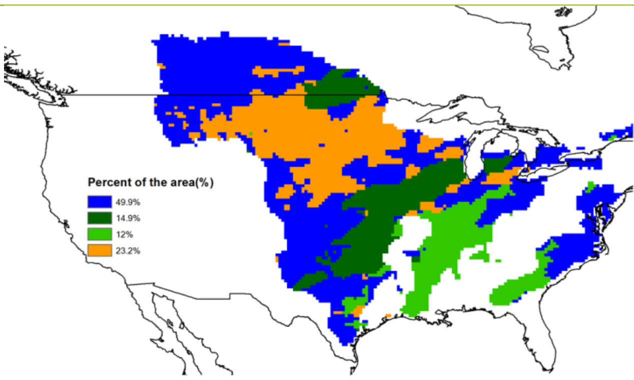
As a whole, potential biomass in the region was close to average, but a marked north-south gradient characterizes the variable: negative departures in excess of 20% in the Prairies and the northern Great Plains, but positive departures between 10% and 20% in other regions, from Texas to the East Coast.

The cropped arable land fraction (CALF) was up 2% compared to the average of the last 5 years and the cropping intensity reached 103%, up 8% over average.

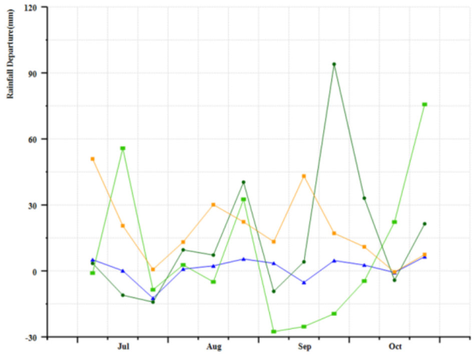
According to VCIx favorable crop conditions were observed in northern Canada and northern Great Plain, with average crop condition in the Corn Belt, and unfavorable conditions in the southern Great Plains where WHIn identifies drought conditions.

Overall, CropWatch assesses the situation in North America as close to average.

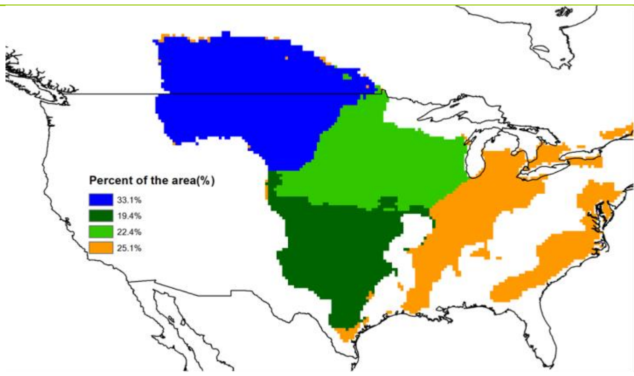
Figure 2.2 North America MPZ: Agroclimatic and agronomic indicators, January to April 2019.



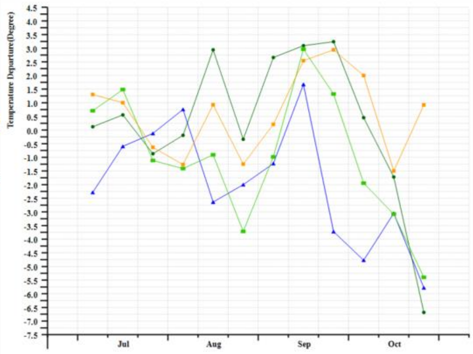
a. Spatial distribution of rainfall profiles



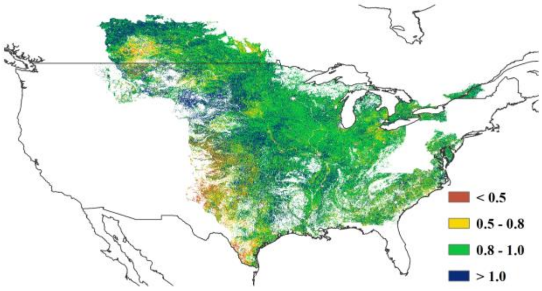
b. Profiles of rainfall departure from average (mm)



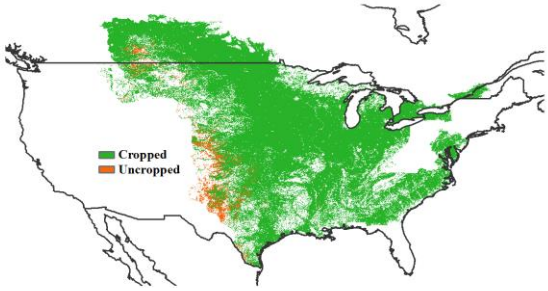
c. Spatial distribution of temperature profiles



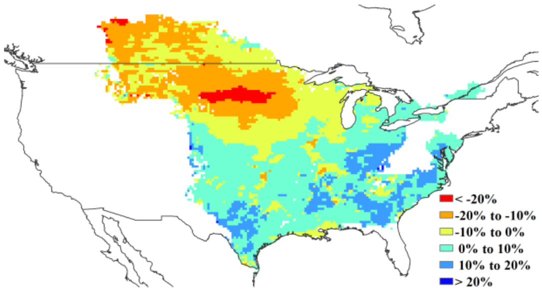
d. Profiles of temperature departure from average (mm)



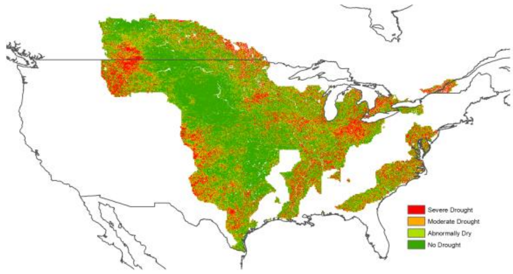
e. Maximum VCI



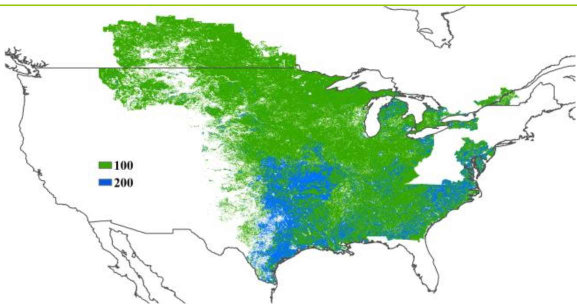
f. Cropped arable land



g. Biomass accumulation potential departure



h. VHI minimum



i.Cropping intensity

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

2.4 South America

High temporal and spatial variability of agro-climatic and agronomic indices was observed over the region. Globally, the region showed a strong negative anomaly in RAIN of about 19 %. Uruguay and Rio Grande do Sul in Brazil showed significant periods of excess during July and October and negative anomalies in August and September. South-east Paraguay, Misiones Province in Argentina and Paraná State in Brazil showed a near 45 mm precipitation shortfall in September, followed by a positive anomaly of similar magnitude at the beginning of October and a strong negative anomaly again at the end of October. Other areas showed mostly quite stable patterns during the first 3 months covered in this report but larger anomalies in October.

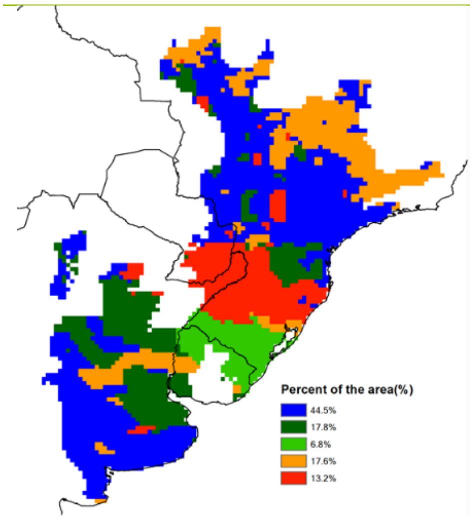
TEMP showed no anomaly on average for the whole MPZ; nevertheless, temporal and spatial variability was observed with positive and negative anomalies along the period. A clear North-South pattern is observed in temperature profiles. All regions showed a large negative anomaly and positive anomaly at the beginning and end of July respectively. Southern areas, including Santa Catarina State in Brazil and the regions further south showed negative anomalies in August and September, while Northern areas (north of and including Parana State) showed light positive anomalies in August and strong positive anomalies in September. Most of Argentina and the western third of Uruguay also displayed a marked positive anomaly at the end of September and a negative anomaly in October. Central areas (Parana, eastern Paraguay and northern Uruguay) showed positive temperature anomalies in October.

BIOMSS showed on average a 4.6 % positive anomaly. Larger positive departures were observed in most of Brazil. The largest BIOMSS deficits were in the Chaco and North of Argentine Pampas, as well as in the northern part of Brazilian agricultural area. CALF showed a reduction of 2%. Un-cropped areas were located mainly in western Argentinian Pampas and to some extent in central western and north-western Brazil. The cropping intensity of South America was 130% which is 2% above 5YA.

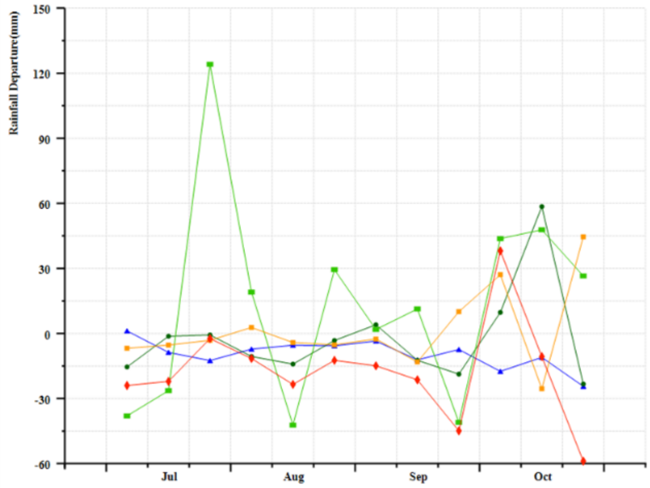
For the whole region VCIx was 0.65, a lower value than registered during the previous AMJJ reporting period. Low values were observed in southern and western Argentinian Pampas. Low values were also observed in Argentina Pampas and north-western Brazil. Scattered drought conditions were identified all over the MPZ. In particular, low minimum VHI values occurred in the south-western Pampas, central eastern Brazil and in Paraguay. Better conditions were found in the North of the Pampas and Mesopotamia in Argentina and South and East Brazil.

Although the fact is not clearly reflected in RAIN anomalies, some indices show poor conditions for crops in South and West Argentine Pampas.

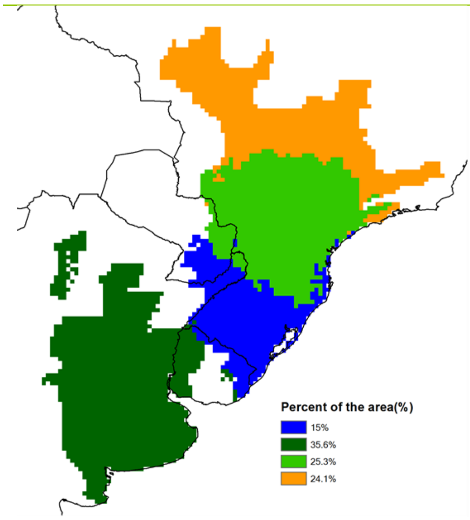
Figure 2.3 South America MPZ: Agroclimatic and agronomic indicators, July to October 2019.



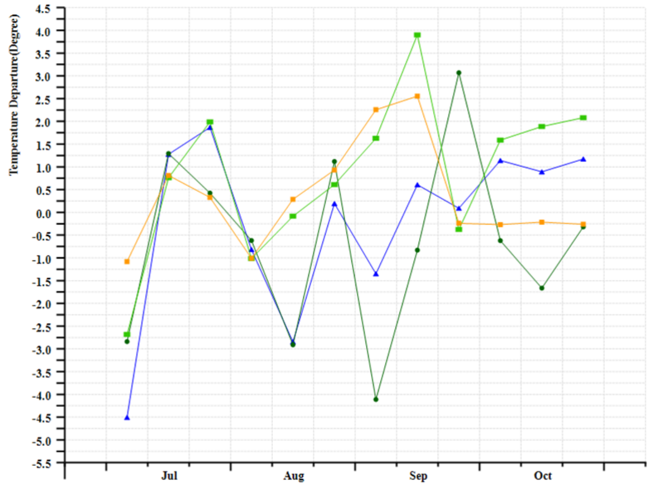
a. Spatial distribution of rainfall profiles



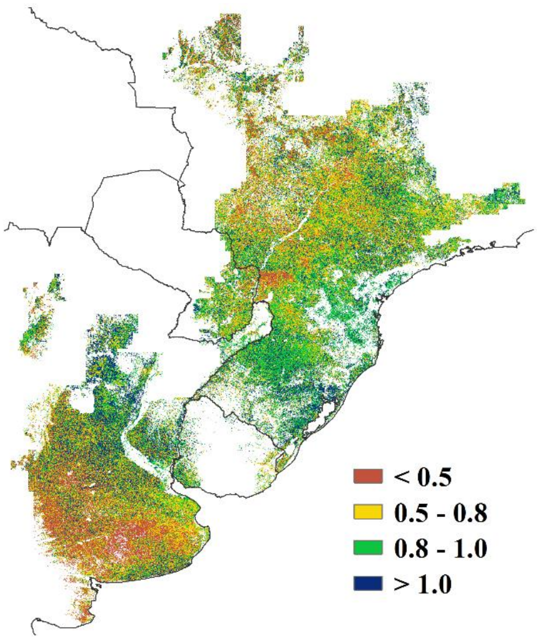
b. Profiles of rainfall departure from average (mm)



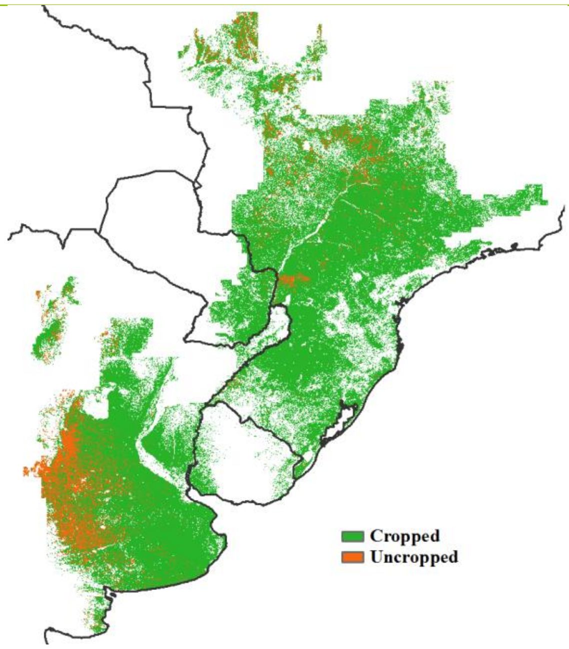
c. Spatial distribution of temperature profiles



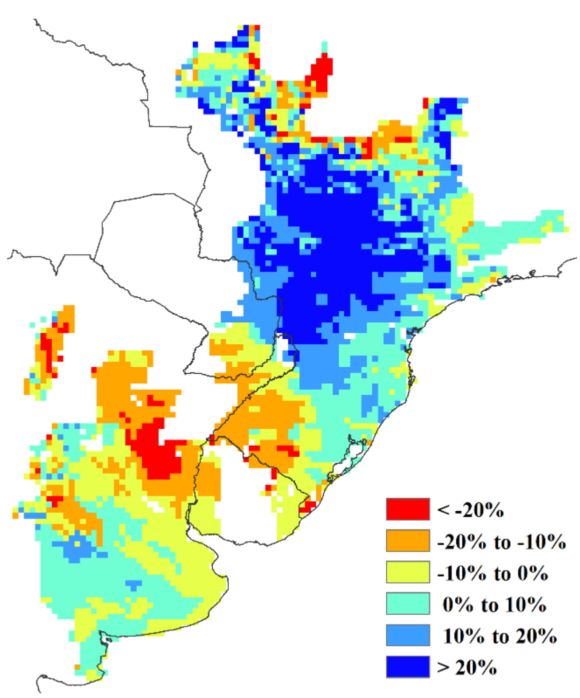
d. Profiles of temperature departure from average (mm)



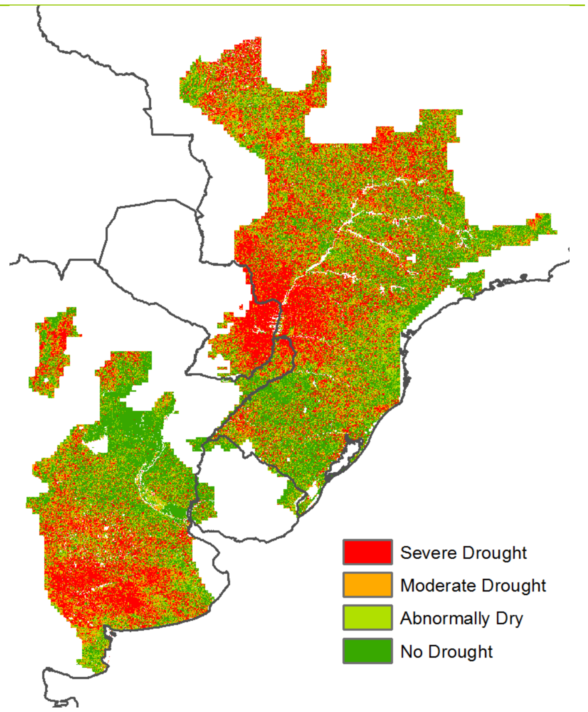
e. Maximum VCI



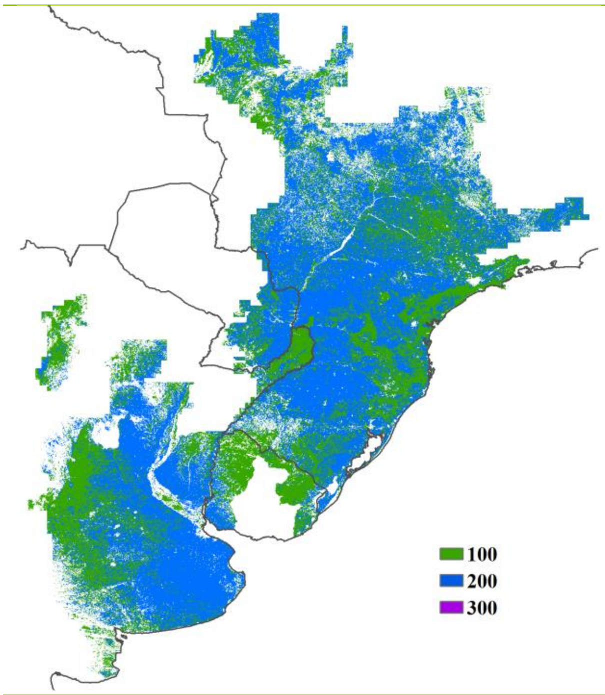
f. Cropped arable land



g. Biomass accumulation potential departure



h. VHI minimum



i. Cropping intensity

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

2.5 South and Southeast Asia

The South and South-east Asia MPZ includes India, Sri Lanka, Nepal, Bangladesh, Myanmar, Thailand, Cambodia, Laos and Vietnam, a region with very diverse climates, topography and phenology. The main cereals are maize and particularly rice, which were mostly planted during the monitoring period. In the case of long seasons and multiple cropping, one of the rice crops often reached maturity during the second half of the reporting period.

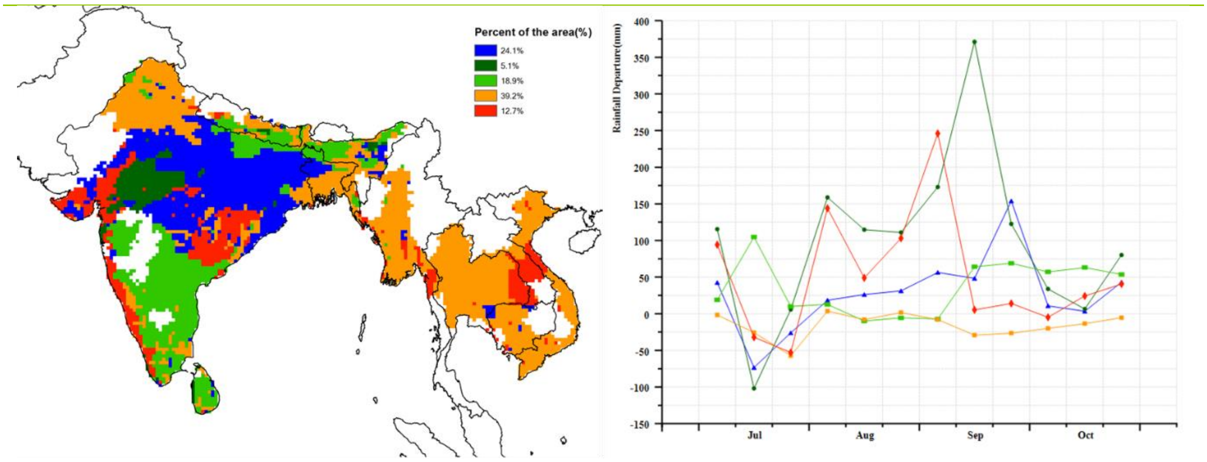
The agro-climatic conditions were favorable for the development of crops planted during the JASO period, in particular due to abundant precipitation (RAIN 1534 mm, +21%). The largest amounts were recorded in India (1616 mm, +40%). Rainfall exceeded average by 400 mm in early September in 18.9% of the area, mostly in central-eastern and southern India, Sri Lanka and the border area between India and Nepal. Low rainfall with negative departures was observed in Thailand (948mm, -17%), Cambodia (1181mm, -8%) and Vietnam (1130mm, -5%). Temperature was normal (25.4°C, -0.1°C), especially in most of the south-eastern region (Cambodia, Thailand, Vietnam, Laos and Myanmar). During mid-July heat wave conditions affected central and northern India with temperature more than 2.5 degrees above average and RAIN down by 100 mm; this is consistent with the low VHI values over the area.

Cropping intensity (CI) varied from 100% (single cropping) to 300% (three crops per year on the same land). The average CI from November 2018 to October 2019 was 141%. Most triple cropping is concentrated in Vietnam, south Thailand and Bangladesh while double cropping takes place mainly in the southern foothills of the Himalayas in India and the lower Irrawaddy River region in Myanmar. Potential biomass was mostly average (BIOMSS, 676 gDM/m2) but low values occurred between north-east and southwest India while higher values are noted in north-western India and northern Myanmar (departures larger than 20%).

Nearly all cropland was cultivated: average CALF value reached 96%. VCIx in most of the MPZ was above 0.8, locally reaching values as high as 1.0.

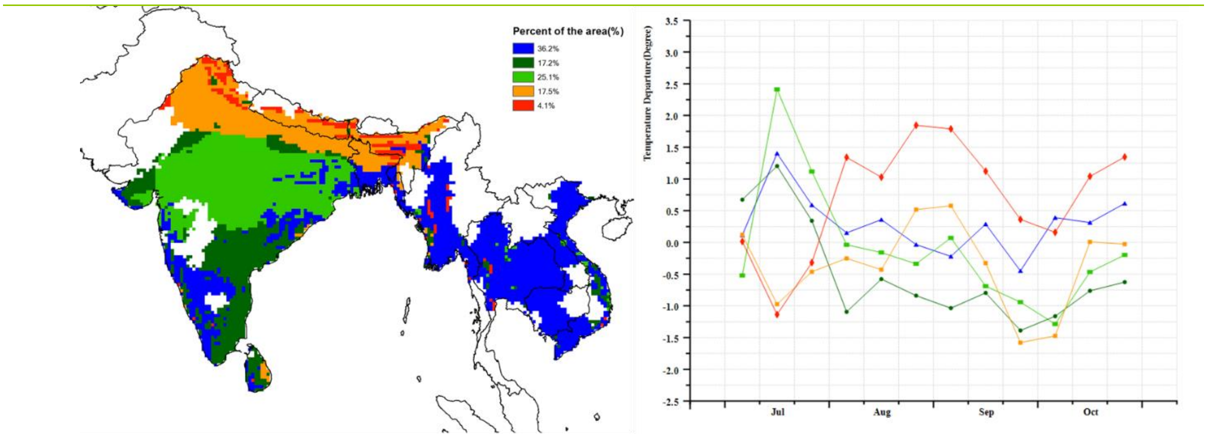
In general, in spite of localized floods and droughts, the production of the MPZ is assessed as fair.

Figure 2.4 South and Southeast Asia MPZ: Agroclimatic and agronomic indicators, July to October 2019



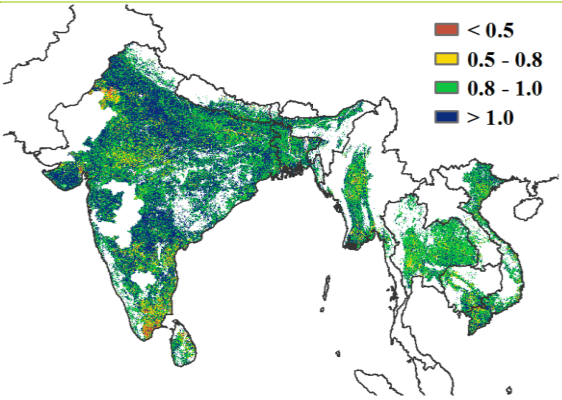
a. Spatial distribution of rainfall profiles

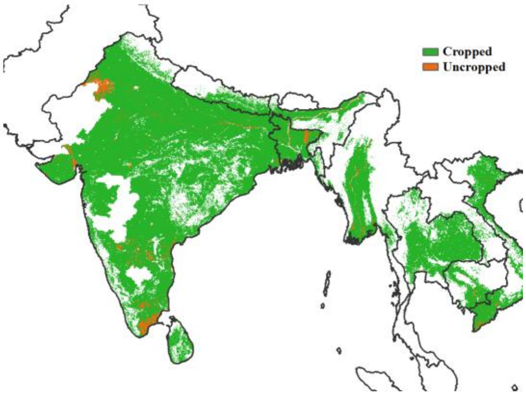
b. Profiles of rainfall departure from average (mm)



c. Spatial distribution of temperature profiles

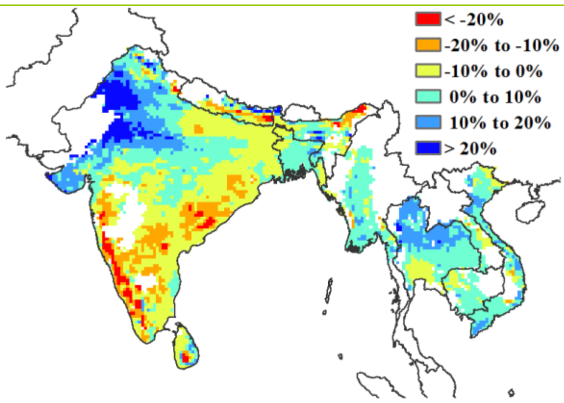
d. Profiles of temperature departure from average (mm)

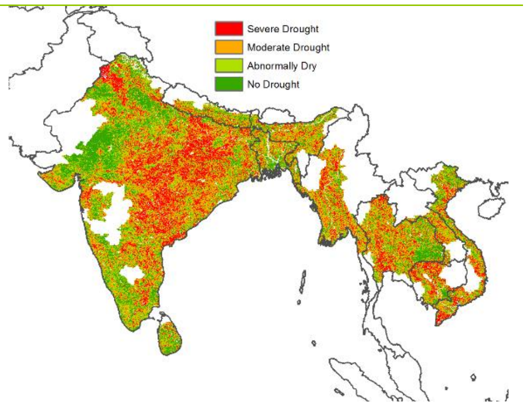




e. Maximum VCI

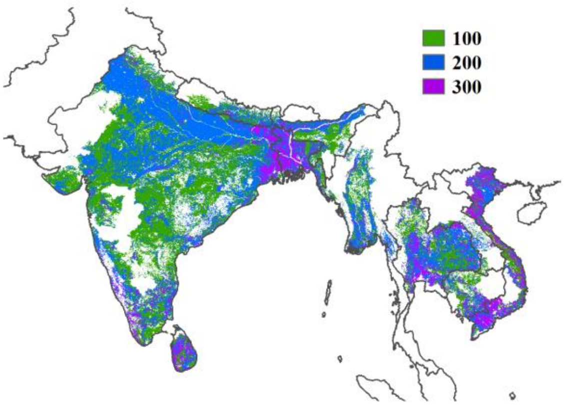
f. Cropped arable land





g. Biomass accumulation potential departure

h. VHI minimum



i.Cropping intensity

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

2.6 Western Europe

Crop condition was generally above average in the western European MPZ during this reporting period, resulting from a combination of positive temperature anomalies and overall above-average precipitation in most areas.

Significant differences in precipitation were observed between different countries but the MPZ as a whole recorded slightly above average RAIN (up 3%). Before mid-September, more than 90% of the MPZ suffered a deficit in rain; over the entire monitoring period, poor precipitation was observed in more than 60% of the areas (Germany, Austria, Slovakia, Czech Republic, and Hungary) with the most severe shortfalls in Slovakia (RAIN -33% compared with average), Hungary(-26%), Austria (-9%) and the Czech Republic (-5%). However, frequent and abundant rainfall was observed in the UK, France, and west-Germany, which benefited summer crops to some extent in those regions. RAIN deficit conditions persisted after September in Slovakia, Hungary Austria and the Czech Republic where they affected the sowing and emergence of winter crops: more rain is needed in those regions in the coming months to improve soil moisture and create favorable conditions for the winter crops.

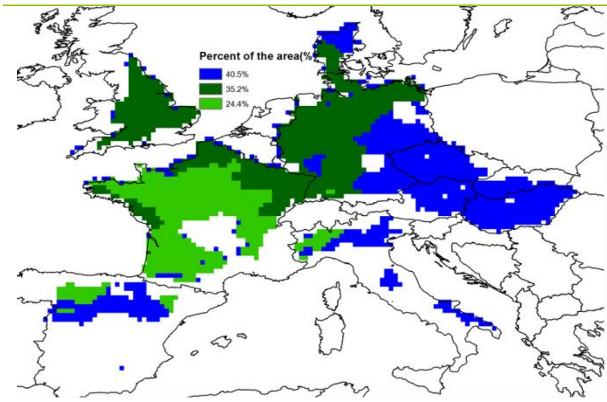
Temperature for the MPZ as a whole was slightly above average (TEMP +0.6°C), and sunshine was well above average with RADPAR up +3%. Most areas experienced warmer-than-usual conditions, while below the average temperature mostly occurred in early-September and early-October. The spatial distribution of temperature profiles indicates that three heat waves swept across Europe in late August, mid-September and mid-October. High temperature shortened the grain filling stage of crops and accelerated the maturity, which may reduce crop yields and - combined with rain deficit - may cause a reduction of sown area of winter crops in the North and East of the MPZ.

Due to warmer-than-usual conditions and favorable sunshine, the biomass accumulation potential was 8% above average. The lowest BIOMSS departures (-20% and less) occurred in Denmark and north of Germany, and scattered in other countries. In contrast, BIOMSS was above average (sometimes exceeding a 20% departure) over central France, south-eastern Italy, and central Spain.

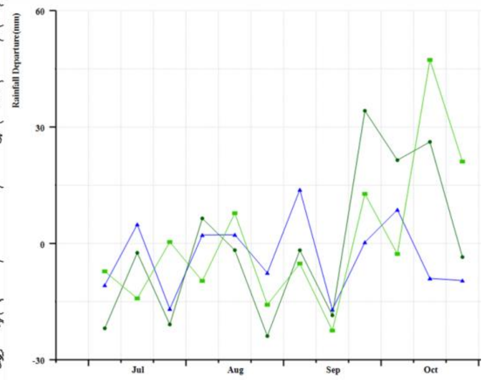
The average maximum VCI for the MPZ reached a value of 0.87, indicating mostly favorable crop condition. More than 90% of arable land was cropped, which is the same as the recent five-year average. Most un-cropped arable land was concentrated in Spain, and south-eastern Italy. Cropping intensity (133%) was up 3% compared with the five-year-average across the MPZ.

Altogether, the condition of harvested winter crops was above average during this reporting period, while the condition of summer crops was mixed, with large spatial differences. More rain is needed to ensure an adequate soil moisture for the ongoing winter crop season.

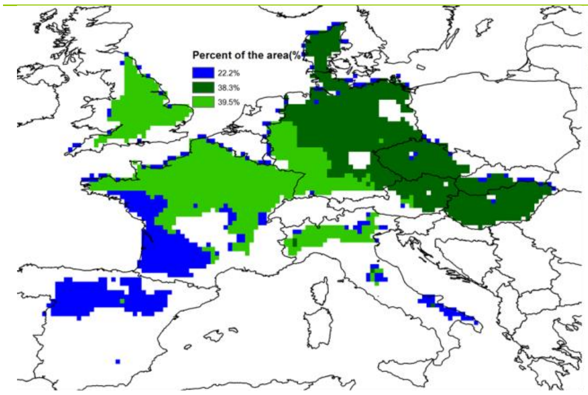
Figure 2.5 Western Europe MPZ: Agroclimatic and agronomic indicators, July to October 2019.

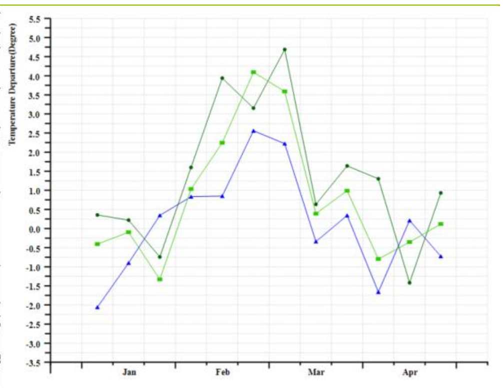


a. Spatial distribution of rainfall profiles



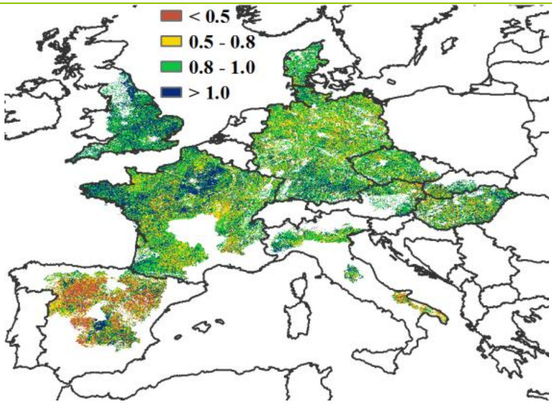
b. Profiles of rainfall departure from average (mm)

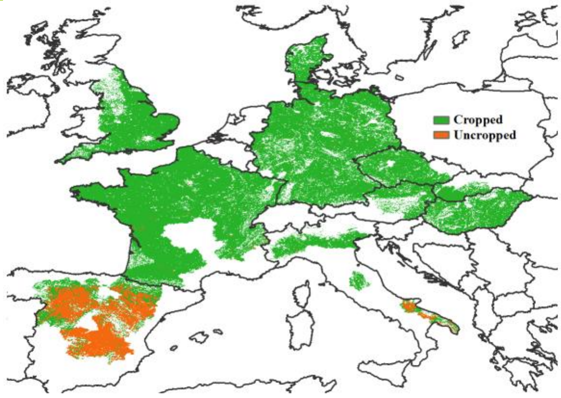




c. Spatial distribution of temperature profiles

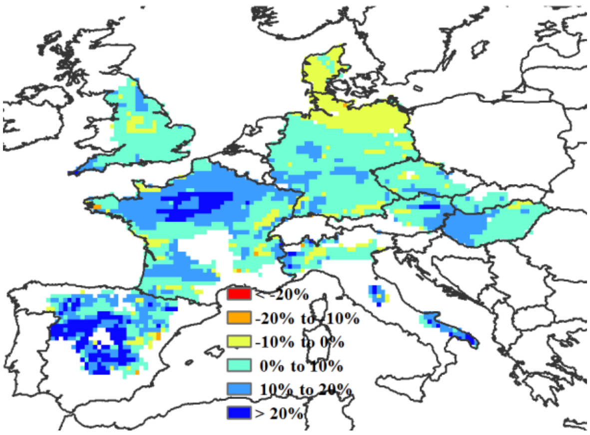
d. Profiles of temperature departure from average (mm)

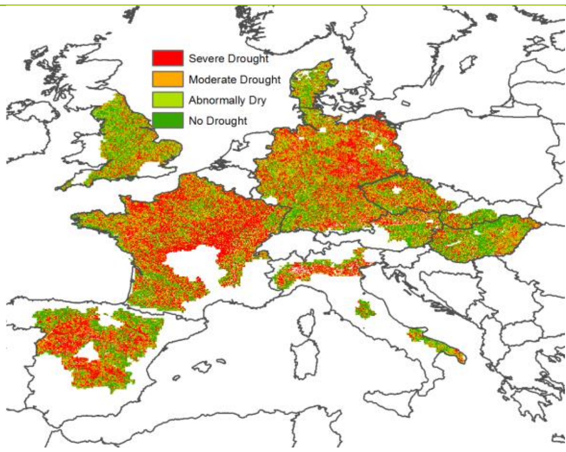




e. Maximum VCI

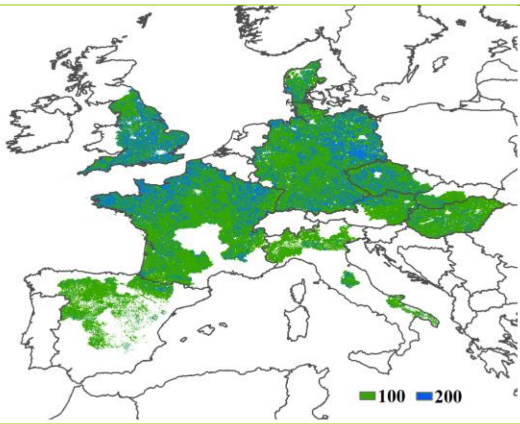
f. Cropped arable land





g. Biomass accumulation potential departure

h. VHI minimum



i.Cropping intensity

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

2.7 Central Europe to Western Russia

Harvesting of summer crops and sowing of winter crops took place, for the MPZ as a whole, under cool weather conditions (TEMP 0.7°C below average) with close to average radiation and rainfall (RADPAR -1%, RAIN -2%).

Crop condition was generally somewhat below average over the MPZ, but with regional differences. As indicated by the rainfall profiles, 64.9% of the region experienced below average precipitation throughout this monitoring period, including Poland, southern Belarus, Ukraine, Romania, Moldova, and the Russian Oblasts of Bryansk, Kursk, Orlov, Lipetsk, and Belgorod.

However, RAIN was mostly above average in mid-July and August, with a peak nearly 80% above average in the eastern part of West Russia, including the Orenburg and Perm Oblasts, and the Bashkortostan Republic.

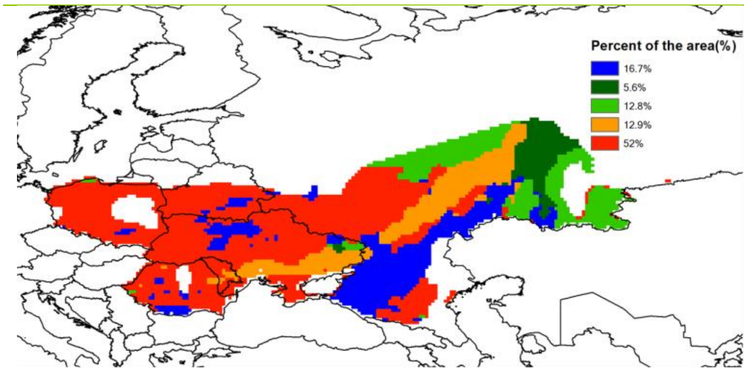
Temperature profiles show different patterns between the western and the central and eastern parts of the MPZ. While temperature varied from about average in July to well above average (4.5°C above average) in October in the West, it suffered from significant drops below average in in August (down 6.0°C) and September (up to 6.5°C) over central and eastern Belarus, eastern Ukraine, and the Oblasts of Bryansk, Kursk, Belgorod, Voronezh, Saratov, Orenburg and Rostov, and the Krays of Krasnodar and Stavropol in Russia. The lowest temperature departure (a 6.5°C drop) was recorded for the Orenburg Oblast. However, generally warm weather was recorded during late August and early September in Poland, western Belarus, Ukraine, Romania and Moldova.

The agro-climatic condition led to an average biomass potential drop for the MPZ as a whole (BIOMSS, -7% compared to the five-year average) with a VCIx value of 0.84. The distribution map of the VCIx index, however, shows regional differences and values below 0.8 in southern and eastern Ukraine, parts of Poland, the Krays of Stavropol and Krasnodar and the Oblasts of Rostov and Orenburg. VHIn basically follows the same spatial pattern.

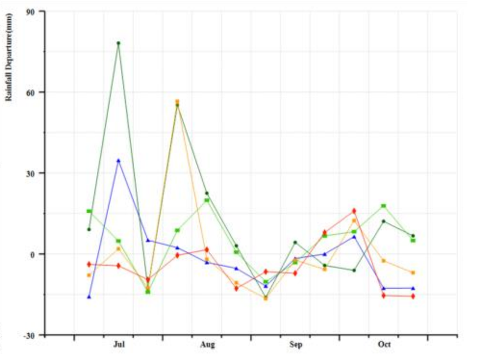
Almost 94% of the arable land was actually cropped during the reporting period (with CALF just 2% below average). Un-cropped land concentrated in southern Ukraine, eastern Orenburg Oblast, and northeastern Stavropol Kray. The cropping intensity remained stable compared to the recent five-year average. The double-cropping area was mainly distributed in the eastern Krasnodar Kray.

Generally, with most areas showing below average conditions, current prospects of crop production are not promising in the Central Europe to Western Russia MPZ.

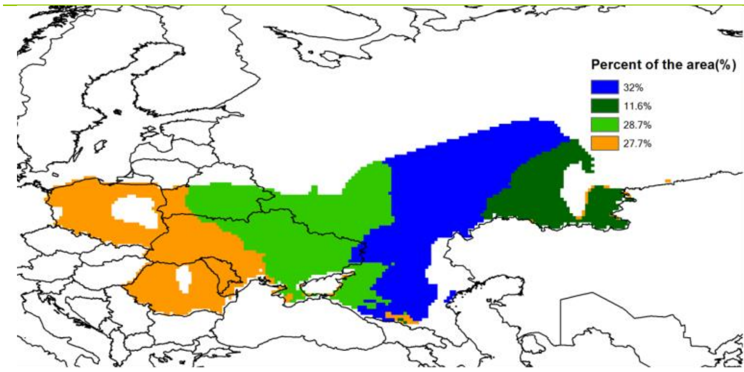
Figure 2.6 Central Europe-Western Russia MPZ: Agroclimatic and agronomic indicators, July to October 2019.



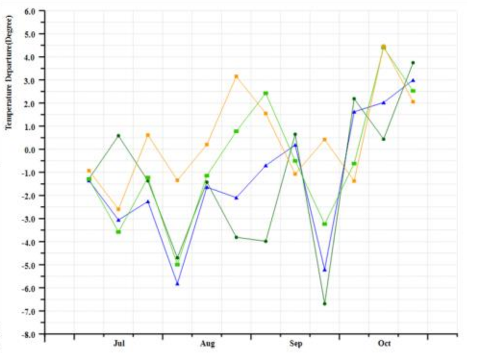
a. Spatial distribution of rainfall profiles



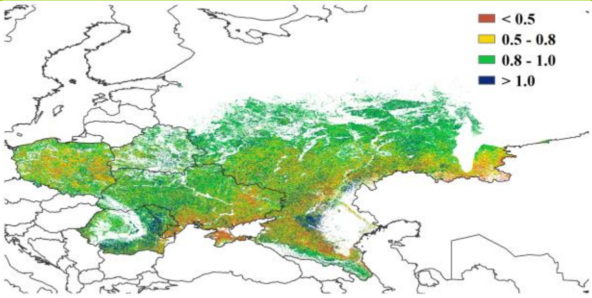
b. Profiles of rainfall departure from average (mm)



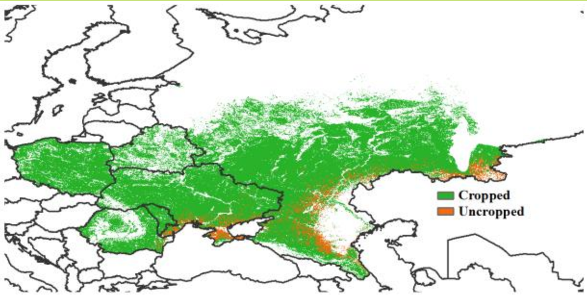
c. Spatial distribution of temperature profiles



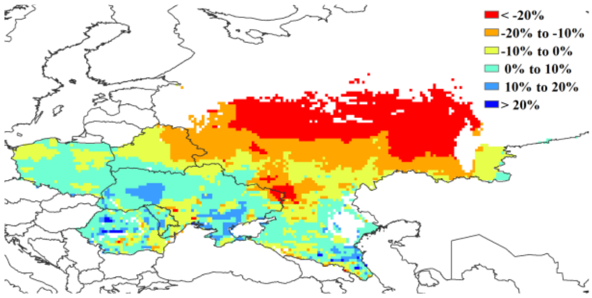
d. Profiles of temperature departure from average (mm)



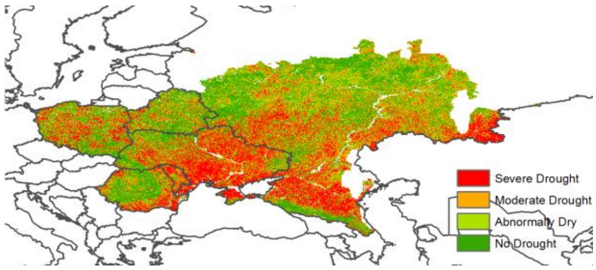
e. Maximum VCI



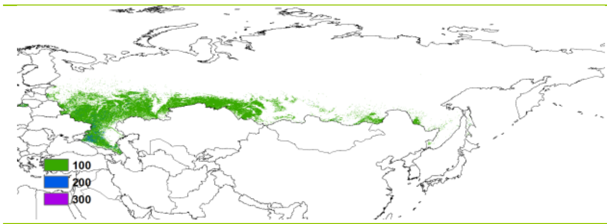
f. Cropped arable land



g. Biomass accumulation potential departure



h. VHI minimum



i.Cropping intensity

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.

1. 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.

2. 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. Just 20 countries include the top 10 exporters with the United States and Argentina exporting all four crops and Brazil, Ukraine and Russia exporting three of them each.

Maize: the crop is about to be planted in the southern hemisphere and was harvested in the northern hemisphere. In tropical countries (India), the reporting period corresponds mid-season summer (kharif) maize and early season winter (rabi) crops. Among the 14 countries that export more than 1 million tonnes of maize, only five had positive rainfall anomalies which did not reach 10% in France, Canada and Russia. In the United states, the excess precipitation was more significant (+24%). Among the listed countries, only Russia had a significant biomass production potential (BIOMSS) drop of 8%, which close to average values elsewhere. For more detailed information about maize growing areas in Russia, refer to spring wheat areas below, as they largely coincide.

All other exporters had below average precipitation, which was moderate only in Brazil (-5%) but exceeded 20% elsewhere, including Argentina (-20%) and Paraguay (-44%). Argentina recorded a notable BIOMSS drop of 10% and a poor maximum vegetation condition index (VCIx) of 0.44.

In central-eastern Europe, where temperatures and sunshine were relatively high compared to their averages, precipitation deficits range between 21% (Serbia, Ukraine) and -35% in Romania, with intermediate values in Hungary and Bulgaria. Agronomic indicators are usually average or close to average, except in Ukraine where the cropped arable land fraction (CALF) drops 4% and VCIx is moderate (0.8)

In India, precipitation excess was huge (40%) but all agronomic indicators remain fair. The rainfall deficit in South-Africa (-52%) regards the very beginning of the maize campaign which, however, will require additional soil moisture soon to compensate for the unfavorable start. BIOMSS and CALF are down (8% and 7%, respectively) and VCIx (0.66) is the second lowest of the group of exporters.

Rice: India and Pakistan, the first and fourth rice exporters had above average precipitation by 40% and 98%, respectively, with moderately below average temperature and sunshine, except for sunshine in India which was down 7%. Agronomic indicators give contrasting signals, although CALF is up in both countries (+3% and +14%, respectively). The second and third exporters, Thailand and Vietnam, recorded a precipitation deficit of 17% and 5%, respectively, with slightly above average temperature but more significant rises in sunshine (7% and 6%). All agronomic indicators are fair to good.

In the United states, the main rice producing states (Arkansas, California, Louisiana, Missouri, Texas, Mississippi) had generally above-average precipitation (+11% to +57%), except in California (-67%, 25 mm instead of 61 mm). Other conditions varied between States, which all recorded positive BIOMSS departures in the range from 2% (Missouri) to 7% (Texas), with the exception of California (-4%).

Wheat: Twenty countries in both hemispheres export more than 1 million tonnes of wheat. The top five exporters market more than 10 million tonnes internationally, including the USA, Canada, Russia, France and Australia. During the JASO reporting period, all of them were in at least one of their wheat season, e.g. winter and spring wheat were harvested in the northern hemisphere while harvest has started in Argentina and parts of Australia (Queensland, with other areas about to start). In the southern hemisphere, summer crop season is about to start. As such, current JASO rainfall and other weather variables were relevant for wheat crops everywhere.

Countrywide, the top four wheat exporters (United States, Canada, Russia and France) recorded positive rainfall a anomalies in the range from 3% (France) to 24% (USA). CALF values slightly increased in the United States 9 (+3%) but otherwise agronomic indicators were average (CALF) or favorable (VCIx close to 0.9). Russia and France deserve mentioning for their contrasting values of sunshine (RADPAR down 2% and up 4%, respectively) and BIOMSS (-8% and +8%).

In Russia, the main spring wheat production areas stretch from the Volga region (Baskyria and Orenburg Oblast) to western Siberia (Altai Oblast), along the Kazakh border, while winter wheat concentrates in the Caucasus and north of it. Most winter wheat was planted and has reached or is about to reach dormancy. Spring wheat areas had generally above-average rainfall (+9% on average) with favorable sunshine (+3%) and BIOMSS exceeding average by 3% as well. Only the Oblast of Chelyanbinsk and the Republic of Bashkortostan had below average BIOMSS (6% and 24%, respectively), which are directly related to low temperature and low sunshine combined with above average precipitation (+25% and +40%).

Winter wheat areas, which are now past planting, in contrast, had somewhat below average rainfall (nine administrative units out of twelve, 9/12) with generally below average temperature (11/12), close to average sunshine and a marked drop in BIOMSS (-10% in 11 out of twelve units). The largest BIOMSS drops occurred in he Oblasts of Voronezh (-15%), Penza (-19%), Ulyanovsk and Samarsky (both at -20%). All the areas had close to average rainfall but cool weather with departures close to or larger than -1.0 °C. The most favorable conditions where those in the Kray of Krasnodar.

Large rainfall deficits affected Australia (-38%), Romania and neighboring Hungary and Bulgaria (-35%, -26% and -24%, respectively) , and Argentina (-20%). In Australia, CALF dropped 15% and VCIx reaches just 0.29, by far the lowest value among all wheat exporters. In spite of its precipitation deficit, Hungary has the largest positive BIOMSS departure among the top 20 wheat exporters, with favorable CALF and VICx. Just positive departures occurred in the United Kingdom (+17%), Mexico (+16%) and India (+40%). Ukraine, the 6th largest exporter of wheat, and Kazakhstan (9th exporter) still need to be mentioned. Ukraine had a 21%

deficit in rainfall which coincided with late maturity and harvest of wheat; the increased sunshine (+6%) has benefited the crop, resulting in average condition. However, the shortage of moisture may negatively impact early stages of the 2020 winter wheat crop. In Kazakhstan, environmental conditions were average, resulting in a +5% change in BIOMSS. However, CALF fell 8% with VCIx at 0.76, a fair value.

Soybean: Among the eight countries that export more than one million tonnes of soybean only seven need to be considered as the Netherlands is a re-exporter of soybean products. Most countries have already been mentioned above for other summer crops (USA, N. 1 exporter; Argentina, N. 2; Canada N. 4 and Ukraine, N. 7). In addition to the USA and Canada, Uruguay had above average precipitation (+34%) in the presence of cool weather and a 3% drop in sunshine, resulting in a significant drop in BIOMSS (16%) and low VCIx, indicating a likely delay in soybean planting. The situation is very similar to the one observed in Argentina where the main soybean provinces (Cordoba and Buenos Aires) both experienced low precipitation (-23% and -35%, respectively) and temperature, but nevertheless close to average BIOMSS at the beginning of the planting season.

In Paraguay, rainfall was rather low (-44%) but BIOMSS and VCIx show more favorable values than in Uruguay. Brazil, with a slight rainfall deficit (-5%) has agronomic and BIOMSS indicator values rather similar those in Paraguay. The main soybean growing States (Mato Grosso, Parana and Rio Grande do Sul) experienced contrasting conditions with an 8% increase in BIOMSS in Parana in spite of low rainfall (-34%) but in the presence of favorable temperature and sunshine. Arguably, Parana and Mato Grosso do Sul had the most favorable soybean conditions so far.

3. Weather anomalies and biomass production potential changes

3.1 Rainfall (Figure 3.1)

A Caveat

Figure 3.1 sometimes shows “very dry” and “very wet” conditions in areas that are currently transitioning from dry season to wet season (e.g. the west African Sahel) or from wet season to dry season (e.g. the Brazilian Nordeste). Such locations typically have low precipitation values which do not allow to compute meaningful percentages. In Iraq, for instance, the JASO rainfall deficit reaches 68%, i.e. 8 mm were recorded over the period instead of 25 mm, which is about 0.3 mm per day on average (assuming 120 days for the JASO period). Clearly, when average amounts are very low, large negative departures are meaningless. In Iraqi Kurdistan, near the Turkish and Iranian borders, JAS rainfall is 0 with rainfall picking up only in October (21 mm). Large positive departures are, however, often more relevant, as they may indicate an early start of the season (e.g. before October in Iraqi Kurdistan), or floods. The text below refers only to areas where significant amounts of rainfall are actually expected.

It is also stressed that in many equatorial areas where large amounts of rainfall are actually expected, below average rainfall not necessarily constitutes drought. An example is Indonesia during the current reporting period, which corresponds to the beginning of the rainy season in Java, the main agricultural area in Indonesia: average rainfall reaches 1024 mm, so that the amount recorded (728 mm) is 29% below average. 728 mm, however, corresponds to about 6.1 mm per day, which is sufficient to cover the requirements even of water demanding crops over a period when potential evaporation reaches about 500 mm, 4.2 mm/day. In fact, the biomass production potential is up 2%, because the available water was still sufficient to satisfy crop water demand boosted by RADPAR, which is up 8%. In fact, the deficit in Indonesia probably corresponds to a slightly delayed beginning of the rather long monsoon season (6 months) and does not rise any concern.

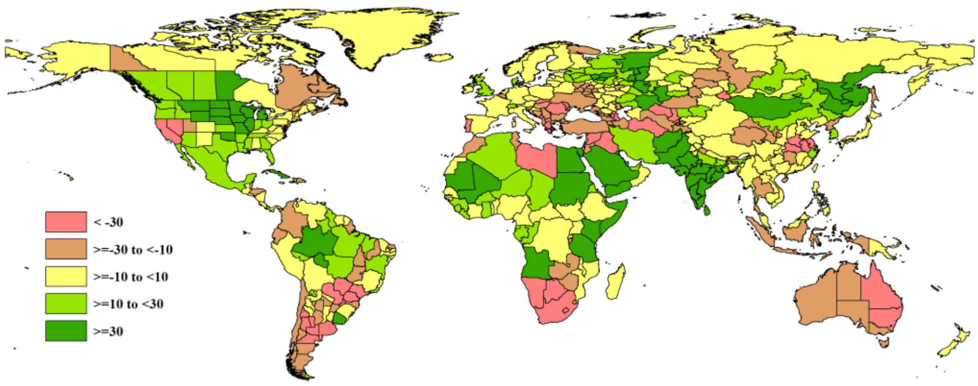


Figure 3.1 National and subnational rainfall anomaly (as indicated by the RAIN indicator) of July to October 2019 total relative to the 2004-2018 average (15YA), in percent.

Dry conditions

The current narrative includes only the countries where average rainfall over the JASO period exceeds 90 mm, a limit chosen to include Mediterranean and southern African countries where the cropping season is just starting.

A large number of countries (more than 30) had precipitation deficits larger than 20%, on all continents.

The largest group includes central European and Mediterranean to Black Sea countries which are all at the beginning of their winter crop season. The area extends north-east as far as the Moscow Oblast and east across Kazakhstan up to the Altay Republic and the Kray of Krasnoyarsk in Siberia. With some exceptions (Altay Republic, -31%) the easternmost locations usually experienced somewhat less severe water shortages than the western areas. A large block of countries recorded a deficit of 33% (Portugal, Slovakia, Republic of North Macedonia, Moldova, Montenegro, Greece and Romania). Slightly less severe shortages between 25% and 30% occurred in Turkey, Morocco,

Georgia and Hungary; Bulgaria, Albania, Ukraine, Serbia and Armenia has a deficit between 20% and 25%. For the time being, none of the listed countries should have experience crop stresses beyond slightly late planting, except possibly Portugal where CALF at 54% is 18% below average. Most of them show increased BIOMSS due to favorable sunshine.

Deficits between 29% and 33% affect south-east Asia and Oceania, including Indonesia, Timor Leste, New Caledonia and Australia. Australia is the only country in the group with a drop in CALF and poor VCIx.

In Asia, next to Bhutan (-26%), several Provinces need to be mentioned for China: Anhui -52%, Hubei -48%, Jiangsu -47%, Henan -36% and Ningxia -24%.

Deficits of the same magnitude occur in central and southern America, in Paraguay (-33%), Honduras (-29%), Chile (-26%) and Belize (-24%), as well as several Brazilian States (Mato Grosso Do Sul -48%, Sao Paulo -36%, Parana -34% and Santa Caterina -27%) and Argentinian Provinces (San Luis and La Pampa, -61%, San Juan -46%, Misiones -36% and Buenos Aires -34%).

In southern Africa, the onset of the main maize season is delayed as shown by low CALF values, especially in Southern Africa (RAIN down 52%). Other deficit countries include Lesotho (-86%), Eswatini (-24%) and others. Isolated countries with poor rainfall include Burundi (-33%), Mauritius (-24%) and Gambia (-21%).

Wet conditions

In addition to cool and wet northern America, moist conditions need mostly to be reported for the tropical northern hemisphere affected by intense late-monsoon conditions in Pakistan (+98%), Sri Lanka (+48%) and India (+42%) where the following States all recorded precipitation excesses between 50% and 120% (Tamil Nadu, Kerala, Maharashtra, Madhya Pradesh, Andhra Pradesh, Gujarat and Rajasthan).

As mentioned in the section on disasters (5.2), some of the excesses in Asia were related with Indian Ocean cyclone activity, which also affected the Horn of Africa, bringing above average precipitation to Somalia (+42%) and Kenya (+52%) in semi-arid locations where even minor excesses can create havoc. In the Sahel, Mali (+63%) and Mauritania (+44%), positive rainfall anomalies have benefited crops and range-lands during mid and late season stages. Contrary to its eastern and southern neighbors, Angola (+62%) had favorable precipitation benefiting crops and livestock at the beginning of the season.

3.2 Temperature anomalies (Figure 3.2)

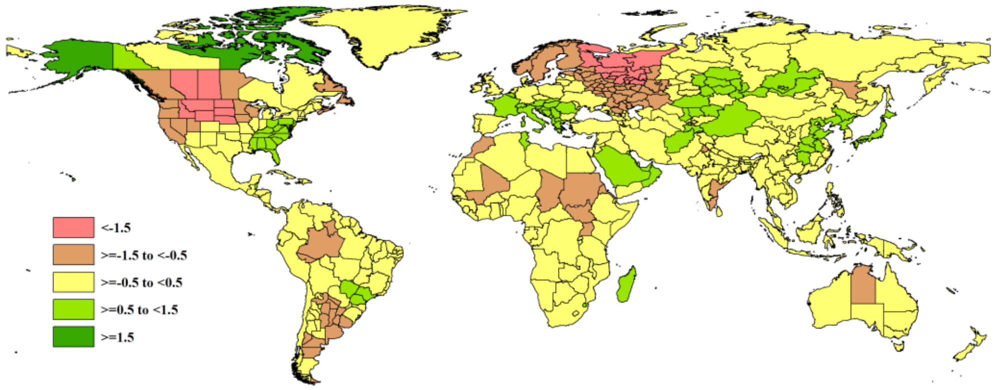


Figure 3.2 National and subnational temperatute rainfall anomaly (as indicated by the RAIN indicator) of July to October 2019 average relative to the 2004-2018 average (15YA), in °C

For the current reporting period, there is no global spatial coherence between RAIN and TEMP anomaly patterns (r^2=0.017, n=167). Continental data, however, show some coherence such as high rainfall and low temperature in north America, Baltic States and north-western Russia. The observation results from the visual examination of Figures 3.1 and 3.2 rather than from a statistical analysis.

Lowest nationwide temperature anomalies occurred in unrelated locations in Finland (-1.3°C), Timor Leste (-1.0°C) and in Uruguay (-1.0°C), as well as a group of neighboring central African countries: Sudan -1.2°C, South Sudan (-1.1°C) and Chad (-1.0°C). At the first sub-national level, however, 169 out of 2766 administrative units (6%) underwent negative temperature anomalies of 1.0°C or larger. In the United States, they include South Dakota (-2.8°C compared with average), Montana (-2.5°C), North Dakota and Idaho, both at -2.0°C. Departures in the range from -1.7°C to -1.2°C include Wyoming, Nebraska, Oregon, Washington, Nevada, Minnesota and Utah. In Russia, the lowest temperatures occur in areas neighboring the Baltic, especially in the Oblasts of Arkhangelsk -2.3°C, Kostroma -2.2°C, Vologda -2.1°C and the Komi Republic (-2.0), as well as in about 30 places in the agriculturally important areas mentioned above under wheat. The least severe departures (up to -1.0°C) occur, as mentioned, in the winter wheat areas.

Sub-national data also confirm the cool conditions in the Sudan, South-Sudan and Chad areas and encompass the area which reaches from Yemen to north-eastern Nigeria and includes 3 Governorates in Yemen (e.g. Raymah -1.6°C), 3 Regions Eritrea (e.g. Anseba -1.7°C), 4 districts in Kenya (e.g. Kakamega -1.5°C), 9 Districts in Uganda (e.g. Kapchorwa -2.9°C and Sironko -1.7°C), 12 States in the Sudan (e.g. Al Jazirah -1.4°C, Sennar -1.6°C), 5 States in South Sudan (e.g. Jungoli -1.5°C), 8 Regions in Chad (e.g. Batha -1.4°C) and 2 States in Nigeria (e.g. Gombe, -1.1). Most listed areas also recorded low sunshine.

The largest positive departures were just three at the national level: France with 1.0°C above average, Switzerland with 1.1°C and Kuwait at 1.4°C. 140 spatial units of at the first sub-national level had temperatures that were warmer than average by more than 1.0°C. The largest departures were recorded in Switzerland (Cantons of Lucerne +2.3°C and Obwalden +2.8°C), Bhutan (Dzong of Punakha +2.7°C) and the United States (Hawaii, +3.3°C).

3.3 RADPAR anomalies (Figure 3.3)

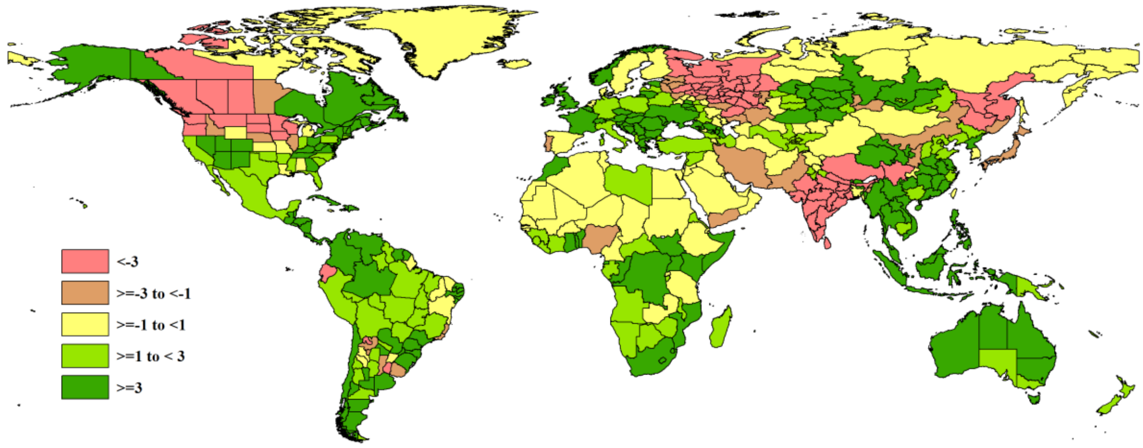


Figure 3.3 National and subnational sunshine anomaly (as indicated by the RADPAR indicator) of July to October 2019 total relative to the 2004-2018 average (15YA), in percent.

RADPAR anomaly patterns are rather close to rainfall patterns (compare Figure 3.1 with Figure 3.3), and the correlation between sunshine departures and rainfall departures (at the national level) reaches -0.198; it is stronger than the link between temperature and rainfall.

Significantly below average nationwide sunshine occurred essentially in southern Asia, in India (-7%), Sri Lanka (-5%) and (Nepal -4%) . At the first administrative level, low values were also recorded in the Baltic countries (Lapland -7%) and north-western part of European Russia (Oblasts of Perm -24%, Kostroma -20% and Kirov -20% and the Komi-Permyak Okrug -24%), north-western North America (e.g. Alberta Province -7%, Minnesota, N. and S. Dakota -8%) and Eastern Asia (e.g the Chinese provinces of Xizang and Sichuan, both at -6%; Khabarovsk Kray at -4%)

The largest positive sunshine anomalies at the national scale occurred in Central America and the Caribbean, and are directly related to the “drought corridor” (refer to section 5.2 on Disasters) which forced many people to out-migrate because they had lost their livelihoods: Guatemala +9%, Haiti and Costa Rica +10%, Honduras +12%, Panama +9%, Belize and El Salvador +7%).

Other high sunshine areas include parts of central-eastern Europe (+7% in Serbia, Bulgaria, Norway) and south-eastern Asia: Laos +9%, Malaysia and Indonesia +8%, Thailand and Timor Leste +7%, Vietnam +6%.

3.4 Biomass accumulation potential BIOMSS (Figure 3.4) and agro-climatic indices

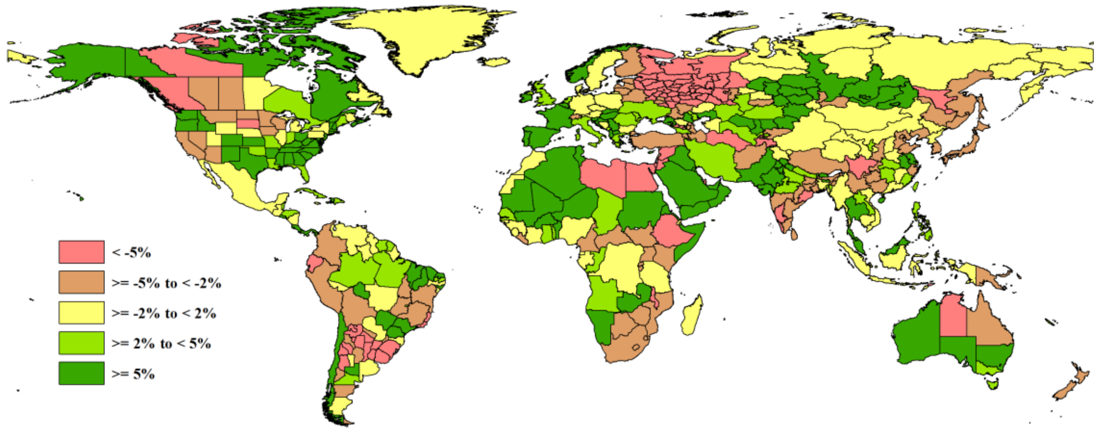


Figure 3.4 National and subnational bionass production potential anomaly (as indicated by the BIOMSS indicator) of July to October 2019 total relative to the 2004-2018 average (15YA), in percent.

The biomass accumulation potential indicator (BIOMSS) largely synthesizes the combined effect of the three previous indicators. It will be discussed below and compared to the agronomic indicators for the spatial units for which they are available. Remember, however, that RAIN, TEMP, RADPAR and BIOMSS are compared against their 2004-2018 average, while CALF departures result from the comparison with 2014-2018. As a result, global correlations between the two groups of variables are difficult to interpret, especially because of recent global climate trends.

About ten countries underwent a drop in their biomass production potential larger than 10%. At the high end, they include several countries with significant rainfall deficit in the presence of otherwise average conditions: Syria -30%, Egypt -25%, Jordan -19% and Israel -15%. Most of them practice irrigation and their CALF values were low with generally good VCIx values. Unfavorable BIOMSS departures with low VCIx occur simultaneously in Argentina (-10%, VCIx 0.44) and Uruguay (-16%, 0.37); both were already mentioned at the beginning of this chapter under the headings of major exporters. In Ethiopia (-13%), the main factor behind the BIOMSS reduction may be a relatively minor drop in temperature of 0.3°C.

BIOMSS departures from average exceeding 10% occurred in ten countries, including three "climatically Sahelian" ones as the result of above normal precipitation during the middle and final parts of the cropping season, which usually peaks in July or August: Niger +11%, Eritrea +12% and Mauritania +13%. VCIx values are exceptional in Eritrea, but this is most probably the result of the tail of cyclone Kyarr (see section 5.2 on Disasters) which caused a temporary – but nevertheless beneficial – greening of vegetation. In Europe and north Africa, increases resulted from various combinations of factors including improved water supply and favorable sunshine or temperature. The BIOMSS increases reached 11% in Hungary, 12% in Spain and in Croatia, 17% in Albania and 22% in Tunisia . The largest BIOMSS increases occurred in Yemen (+27%) and Pakistan (+29%) where RAIN was above average, TEMP was average and RADPAR just below average. Both had significant increases in CALF (+46% and +14%, respectively) and their VCIx are comparable with the best historical values.

3.6 Combinations of extremes

Several countries were characterized by unusual combinations of factors (climatic, agronomic or both) and deserve closer monitoring over coming reporting periods. In Portugal and South Africa, both agro-climatic and agronomic indicators show very unfavorable values. The countries with unfavorable CALF and VCIx, but generally acceptable climatic variables include several southern African countries (Botswana, Eswatini, Namibia and Zambia) and Spain. Although the listed countries belong to rather different agro-ecological settings, they are similar in that their main agricultural season is just starting; they can recover if precipitation improves.

Uruguay and Argentina also share some issues, including low temperature and low agronomic indices. They are at the beginning of their summer crop season and can recover.

Other potential problem countries include Afghanistan (low sunshine and poor VCIx), Montenegro and Romania (low precipitation with mixed CALF/VCIx).

Table 3.0. July – October 2019 agro-climatic and Agronomic indicators by country, current value and departure from average.

Code	Country	Agro-climatic indicators				Agronomic indicators	
		Departure from 15YA (2004-2018)				Departure from 5YA (2014-2018)	Current
		RAIN (%)	TEMP(°C)	PAR(%)	BIOMSS (%)	CALF (%)	VCIx
AFG	Afghanistan	-20	-0.8	1	-7	-1	0.44
AGO	Angola	-38	0.3	7	4	-15	0.29
ARG	Argentina	0	0.1	0	2	2	0.98

AUS	Australia	-5	0.1	2	5	0	0.84
BGD	Bangladesh	-8	0.0	3	3	1	0.93
BLR	Belarus	8	-0.9	-1	-5	0	0.95
BRA	Brazil	-4	0.3	4	1	2	0.95
KHM	Cambodia	923	0.3	0	-24	5	0.83
CAN	Canada	9	-0.3	0	-1	1	0.99
CHN	China	3	1.0	4	10	0	0.89
EGY	Egypt	-2	0.4	1	3	0	0.87
ETH	Ethiopia	40	-0.3	-7	1	3	1.00
FRA	France	-29	0.0	8	4	0	0.94
DEU	Germany	19	0.4	-1	8	28	0.97
HUN	Hungary	11	0.3	1	4	-8	0.76
IND	India	16	0.4	3	3	-4	0.87
IDN	Indonesia	-3	0.2	5	5	1	0.97
IRN	Iran	8	-0.4	-2	3	1	0.95
ITA	Italy	98	-0.2	-3	29	14	0.97
KAZ	Kazakhstan	-9	0.0	3	3	0	0.98
KEN	Kenya	-7	0.3	3	1	0	0.79
MEX	Mexico	-35	0.6	6	4	0	0.92
MNG	Mongolia	9	-0.6	-2	-6	-1	0.88
MAR	Morocco	-52	0.5	6	-6	-7	0.66
MOZ	Mozambique	-17	0.3	7	7	0	0.94
MMR	Myanmar	-30	-0.2	2	-4	3	0.81
NGA	Nigeria	17	0.0	4	6	0	0.98
PAK	Pakistan	-21	-0.1	6	3	-4	0.80
PHL	Philippines	24	-0.2	1	1	3	0.93
POL	Poland	-17	0.4	1	-2	19	1.00
ROU	Romania	-5	0.1	6	5	1	0.97
RUS	Russia	75	0.6	0	3	36	0.86
ZAF	South Africa	62	-0.2	1	0	-23	0.63
LKA	Sri_Lanka	-9	-0.4	2	-6	0	0.90
THA	Thailand	-26	0.7	5	8	0	0.89
TUR	Turkey	5	0.7	1	9	-1	0.83
UKR	Ukraine	52	-0.2	5	4	6	0.93
GBR	United Kingdom	48	-0.4	-5	-2	0	0.93
USA	United States	-27	-0.7	3	-3	-3	0.53
UZB	Uzbekistan	47	0.2	-1	-2	2	1.00
VNM	Vietnam	-10	-0.1	3	-1	0	0.90
ZMB	Zambia	-17	0.0	1	15	-33	0.59

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 January - April 2019 period to the previous season and the five-year average (5YA) and maximum; (c) Maximum VCI (over arable land) for January - April 2019 by pixel; (d) Spatial NDVI patterns up to January - April 2019 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 January - April 2019 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.com.cn**.

Figures 3.5 - 3.45 are Crop condition for individual countries ([AFG] Afghanistan - [ZMB] Zambia) including sub-national regions during January - April 2019.

[AFG] Afghanistan

Wheat, barley, maize and rice are the main cereals harvested in Afghanistan during the reporting period. Winter wheat started to be planted in October in the northern border provinces (to be harvested in May), while maize, spring wheat and rice were harvested between August and October. RADPAR was close to average, but both rain and temperature were above (RAIN at 55mm, up 75%; TEMP 19.5°C, up 0.6°C). The potential biomass was 3% higher than average. The cropped arable land fraction (CALF) increased by 36%, and the maximum vegetation condition index (VCIx) was 0.86. According to crop condition development graphs based on NDVI, the national crop growth was exceeded the average level of the past five years. Crop condition exceeded 5 year maximum between July and October and was better than average throughout the reporting period in 26.3% of crop lands, mainly in Badghis and the northern part of Hirat. In general, NDVI was close to the average in northern Afghanistan, above average in the northern part of Takhar and below average in 9.7% of crop land scattered over Khost, Paktya and Kunar Provinces. According to the VCIx), the vegetation in the west was better than that in the east.

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.

All the AEZs below except the Mixed dry farming and irrigated cultivation region recorded "above average" rainfall. Considering that average rainfall is very low, the large positive departures involve insignificant amounts of water. For instance, in the Mixed dry farming and grazing region, average rainfall is 8 mm over 4 months, so that 22 mm is close to three times the average. The amount of water, however (14 mm) is insignificant, and probably fell in October (when the rainy season starts) at a time when the potential evapotranspiration reaches 160 mm. The important points are that ‘above average’ stands for "early start of the season" and that rangeland and low lying areas vegetation have benefited before frost sets in.

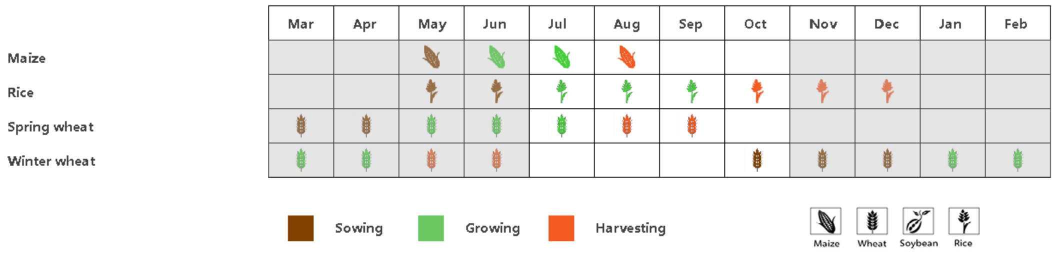
RAIN in the Central region with sparse vegetation was 36 mm (+77%), TEMP was 16.0°C (up 0.6°C), and RADPAR was average at 1470 MJ/m^2. NDVI was slightly higher than the average, and the potential biomass decreased by 15%. CALF had increased substantially (+73%), and VCIx at 0.8.

The Dry region recorded 29 mm of RAIN, 58% above average, TEMP was 0.9°C below average at 23.0°C and RADPAR was 1487 MJ/m2, 1% below average. The CALF was 66% higher than the average. VCIx was 0.5, and the potential biomass increased by 57%.

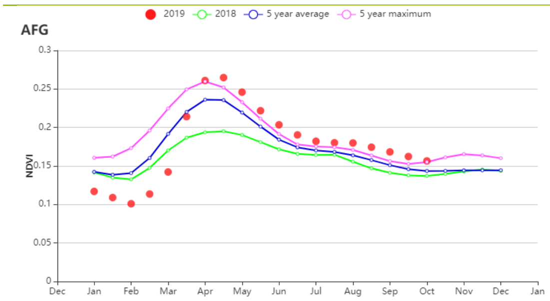
In the Mixed dry farming and irrigated cultivation region the following indicator values were observed: RAIN 94 mm, +73%; TEMP 18°C, +0.5°C; RADPAR 1430 MJ/m2, +1%. CALF (+22%) in this area was the highest among the four regions. Abundant rainfall and higher CALF improved production prospects in this AEZ, where VCIx reached 0.9.

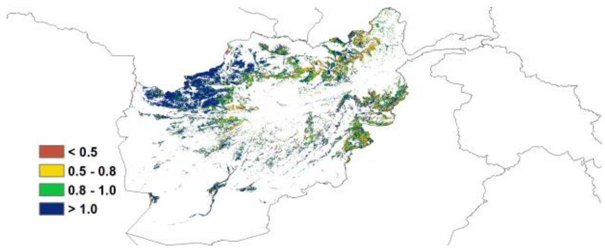
Mixed dry farming and grazing region recorded 22 mm of RAIN, 171% above average, TEMP was 21.0 °C, 0.5°C lower than average, and the RADPAR was 1476 MJ/m2, 1% below average. According to the NDVI development graph, crop condition was higher than the five-year average and reached the maximum five years value during the monitoring period. CALF in this region more than doubled by remained nevertheless very low (0.5%). VCIx reached 1.3. Range-land had benefited from the early rainfall. So far, everything is proceeding normally.

Figure 3.5 Afghanistan's crop condition, July - October 2019



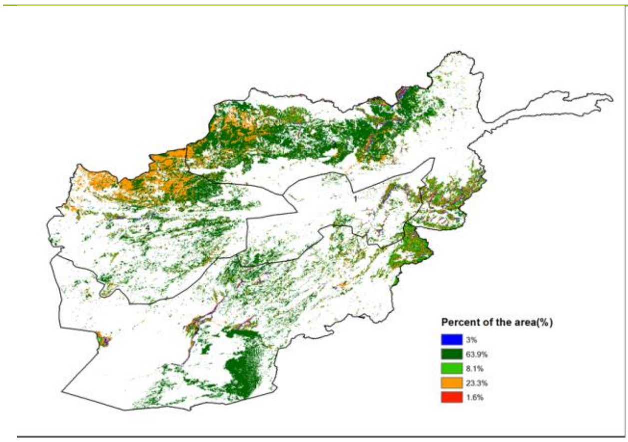
(a). Phenology of major crops

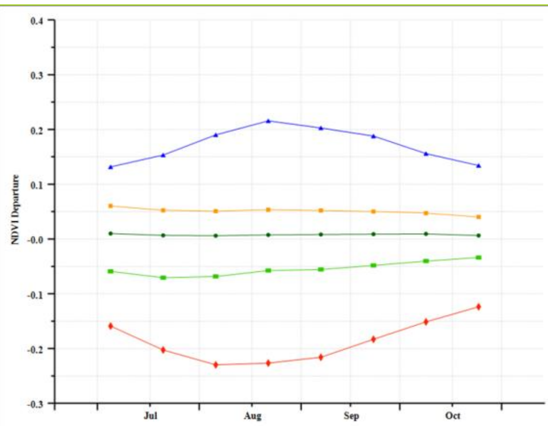




(b) Crop condition development graph based on NDVI

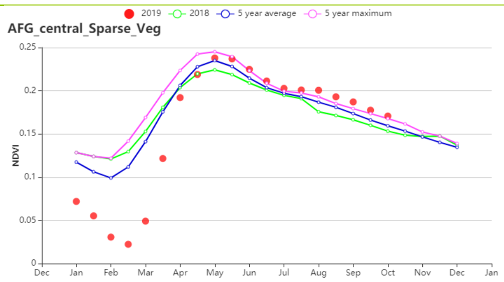
(c) Maximum VCI

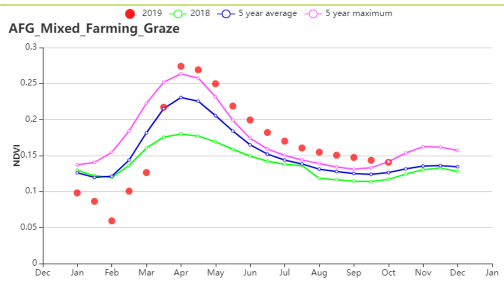




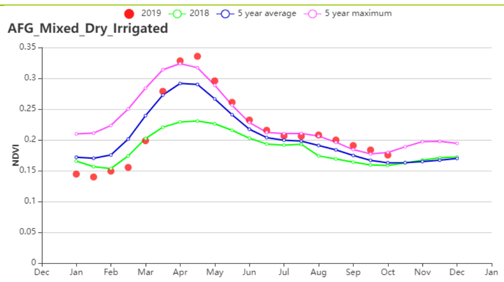
(d) Spatial NDVI patterns compared to 5YA

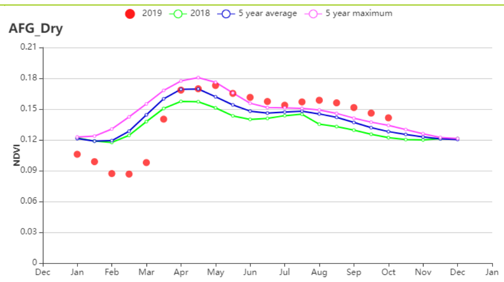
(e) NDVI profiles





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





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

Table 3.1 Afghanistan's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2019

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Central region	36	77	16	0.6	1470	0.3	161	
Dry region	29	58	23	0.9	1487	-0.7	212	
Dry and irrigated cultivation region	94	73	18	0.5	1430	0.5	151	
Dry and grazing region	22	171	21	0.5	1476	-0.5	68	

Table 3.2 Afghanistan's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2019

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Central region	9	73	11	83	0.8
Dry region	4	66	6	100	0.5
Dry and irrigated cultivation region	12	22	27	78	0.9
Dry and grazing region	0	233	15	213	1.3

[AGO] Angola

The reporting period covers the harvesting of wheat, which started in late October, as well as the preparation of land and planting of the 2019/20 maize.

Rainfall was 62% above average, with the amount recorded in October above both fifteen-years average and fifteen-years maximum. Both temperature and radiation were close to average. The conditions resulted in a slight increase in BIOMSS (+3%) but CALF fell by about 23%. In the southern part of the country, the NDVI development graph shows below-average crop conditions during the entire monitoring period. The VCIx was just 0.63.

The spatial distribution of the NDVI profiles reveals diverse behaviors. 71.2% of the cropped area, including most the southern provinces of Cuando, Cubango, Cunene and Huila had negative anomalies during the entire period. A positive NDVI anomaly persisted throughout the reporting period in Uige, Zaire, Kwanza Norte and Benguela Provinces, accounting for 15.6% of the total cropped area. The remaining regions registered complex spatial patterns with a mixture of negative, positive and about average NDVI anomalies but all underwent a significant drop in late October.

Nationwide, the crop condition was unfavorable. The high precipitation had a significant negative impact on wheat but will benefit the recently planted maize.

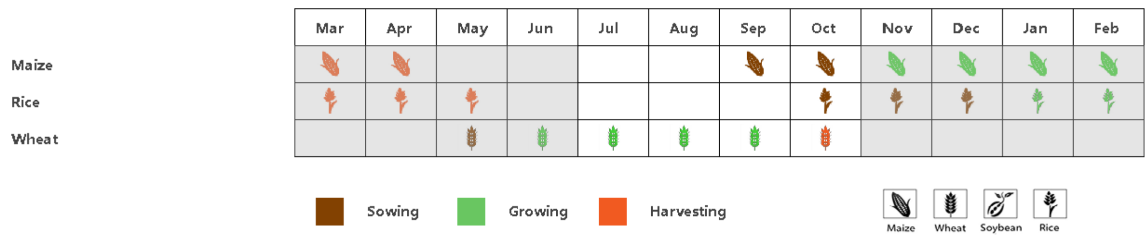
Regional Analysis

CropWatch subdivides Angola into five zones based on cropping systems, climatic zones and topography. They are referred to as **Arid zone**, **Central Plateau**, **Humid zone**, **Semi-arid zone** and **Sub-humid zone**. A mixture of double and single cropping characterizes the Humid and Subhumid zones. In these zones, the cropping intensity increased by about 9% and 5%, respectively. Remaining areas practice single cropping. The Arid zone is of marginal relevance for crops.

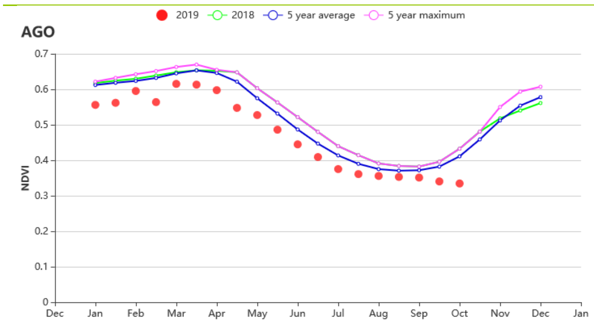
All the agro-ecological regions have recorded significant increases of rainfall above average during the reporting period. The **Humid zone** recorded the highest increases (up 108%). Except for the **Arid zone**, all regions recorded a slight decrease in the temperature. The radiation increased everywhere. With CALF decreasing in all the agro-ecological zones with the exception for the humid zone, the NDVI development graphs indicate bellow average crop conditions during the entire period in these regions. Compared with average, only slight variations in biomass were verified in all the agroecological zones. Considering, in addition, VCIx suggests poor crop prospects. However, the high rainfall has benefited the range-land and created favorable conditions for the ongoing planting of Maize.

In the Humid zone, where NDVI indicates favorable conditions from early august until the end of the monitoring period, crop prospects are excellent as the maximum VCIx reached 1.0 and CALF did not register any variations.

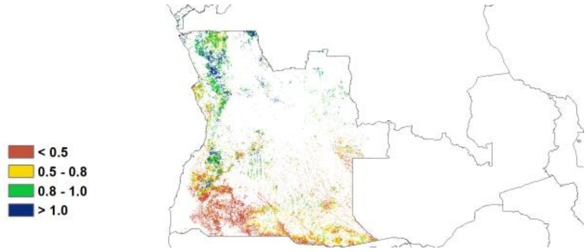
Figure 3.6 Angola's crop condition, July – October 2019



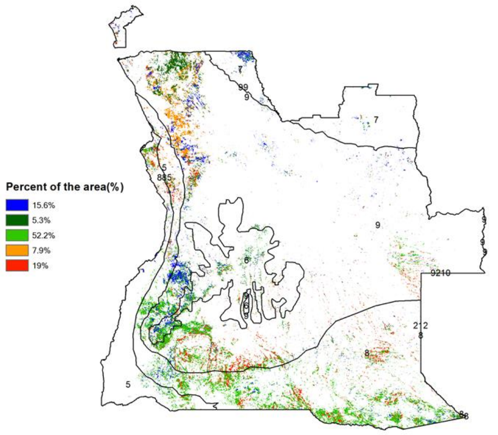
(a). Phenology of major crops



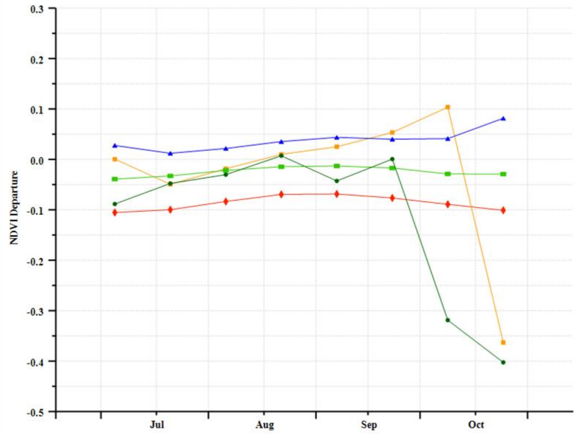
(b) Crop condition development graph based on NDVI



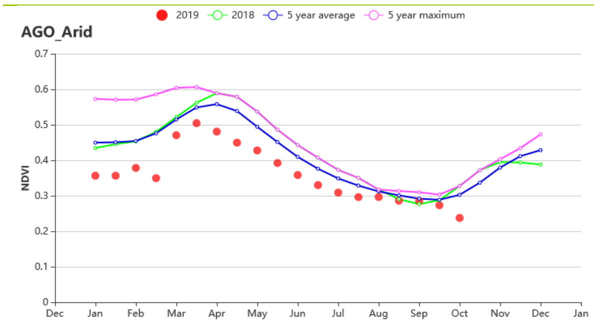
(c) Maximum VCI



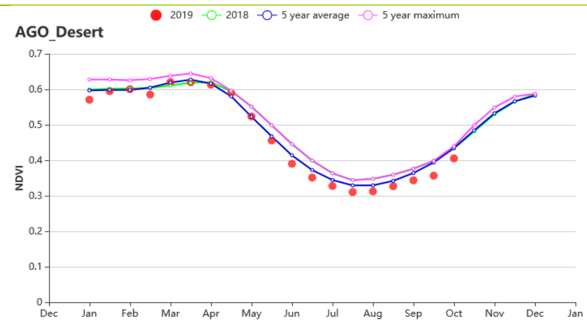
(d) Spatial NDVI patterns compared to 5YA



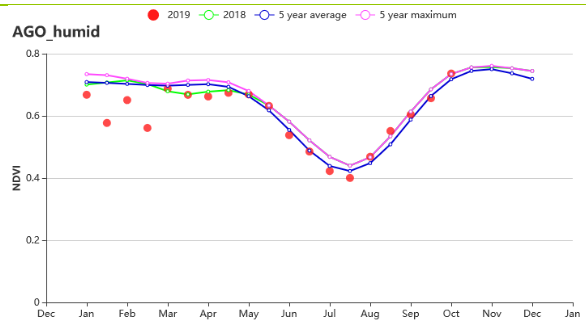
(e) NDVI profiles



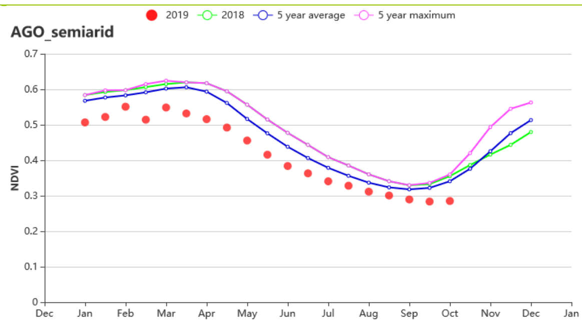
(f) Crop condition development graph based on NDVI- Arid zone



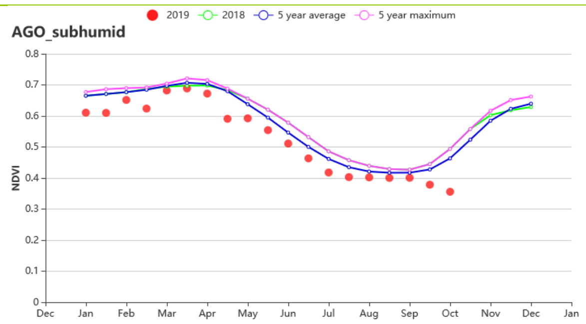
(g) Crop condition development graph based on NDVI - Central Plateau



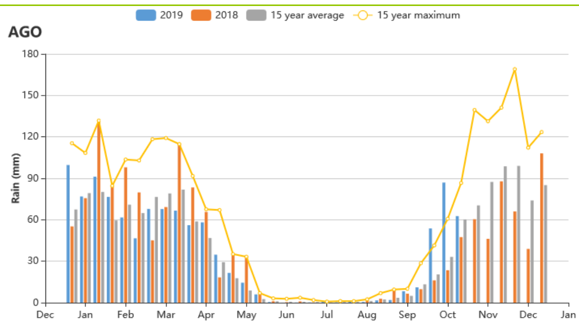
(h) Crop condition development graph based on NDVI- Humid zone

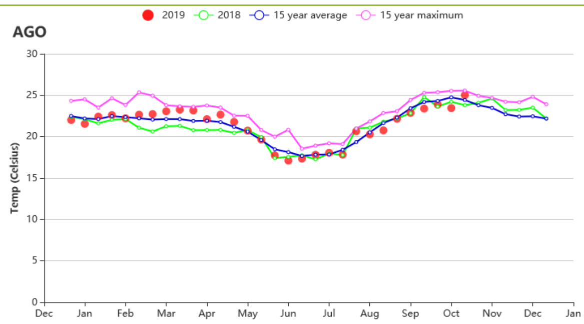


(i) Crop condition development graph based on NDVI - Semi-arid zone



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





(k) National time-series rainfall profiles (l) National time-series temperature profiles

Table 3.3 Angola agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2019

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Arid Zone	142	55	22.1	0.2	1339	1	590	7
Central Plateau	248	58	18.4	-0.5	1394	3	299	-9
Humid zone	652	23	23.5	-0.5	1285	3	660	1
Semi-Arid Zone	69	108	21.0	-0.1	1409	1	318	4
Sub-humid zone	324	66	21.9	-0.3	1314	1	472	4

Table 3.4 Angola agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2019

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Arid Zone	16	-37	61	-30	0.51
Central Plateau	36	-12	99	1	0.71
Humid zone	100	0	125	9	1.02
Semi-Arid Zone	13	-52	86	-8	0.53
Sub-humid zone	56	-15	119	5	0.70
Arid Zone	16	-37	61	-30	0.51

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

[ARG] Argentina

This reporting period covers the main growing season of wheat, as well as the planting time of maize and rice crops, which started in September.

Nationwide, RAIN showed a strong negative anomaly (-20%) and TEMP a slight negative anomaly (-0.8°C); RADPAR was up 1 % compared with average. Negative RAIN anomalies affected major agricultural areas of Argentina: Humid Pampas (-29 %), Chaco (-16 %), Mesopotamia (-12 %), and Subtropical highlands (-10 %). TEMP also dropped below average in the Chaco (-1.2°C), Mesopotamia (-1°C), Pampas (-0.6°C) and Subtropical highlands (-0.4°C). RADPAR showed positive anomalies for the Pampas (+2%) and Chaco (+1%), and negative anomalies for Subtropical Highlands (-2%) and Mesopotamia (-1 %).

BIOMSS underwent a 7% drop nationwide (-7%) as well as in all the agricultural regions considered: Mesopotamia (-14 %), Chaco (-12 %), Subtropical Highlands (-10 %), and Humid Pampas (-1.5 %).

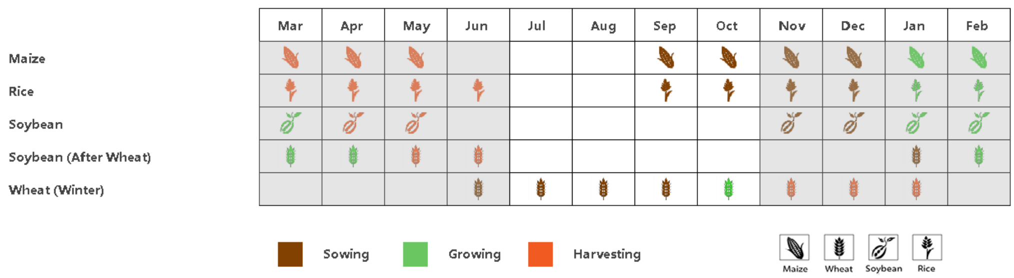
The spatial distribution of NDVI profiles shows negative anomalies for most of the country. Lowest values were observed in southern and western Pampas, while positive anomalies were mostly scattered over the northern Pampas, Mesopotamia and Chaco areas.

Nationwide, the NDVI development graph shows that it was lower than the 5 years average during most of the reporting period, with a recovery at the end of our reporting period. The Pampas show near average conditions for most of the period with a positive anomaly at the end. **Mesopotamia** showed negative anomalies except for recent stages, which had a positive anomaly. The Chaco showed mostly positive anomalies, with near average values at the middle of the period. The Tropical highlands showed negative anomalies since August.

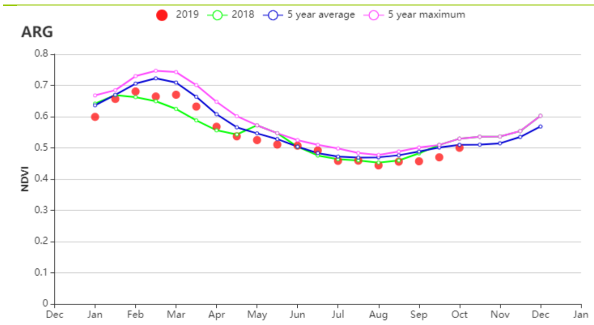
The VCIx map shows poor crop condition in most of the country. Lowest values are observed in **southern** and **western Pampas**. High VCIx values are scattered over the **northern Pampas**, **Mesopotamia** and the Chaco. The spatial pattern from VCIx map coincided with NDVI departure clustering. Maximum VCI values showed very low values for the Humid Pampas, but high values for **Subtropical highlands** (0.83), Chaco (0.97) and Mesopotamia (0.88). CALF showed positive anomalies in the **Chaco** (+9 %), Subtropical Highlands (+5 %) and Mesopotamia (+0.5 %); negative anomalies were observed in the **Humid Pampas** (-3 %).

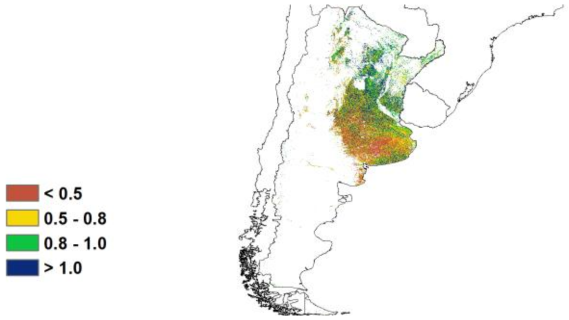
Some indicators show poor crop growth in the Pampas, the main agricultural area of Argentina. Better conditions are observed in general for the rest of the country's crop production areas.

Figure 3.7 Argentina's crop condition, July - October 2019

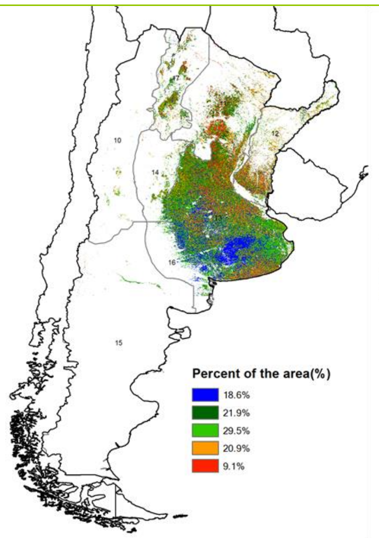


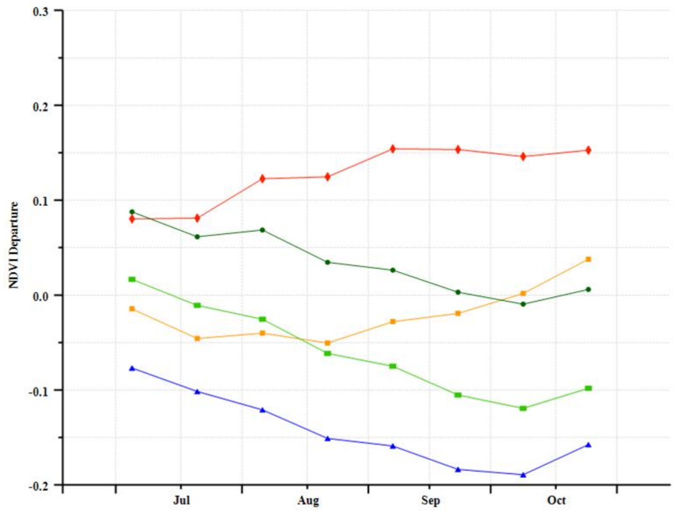
(a). Phenology of major crops



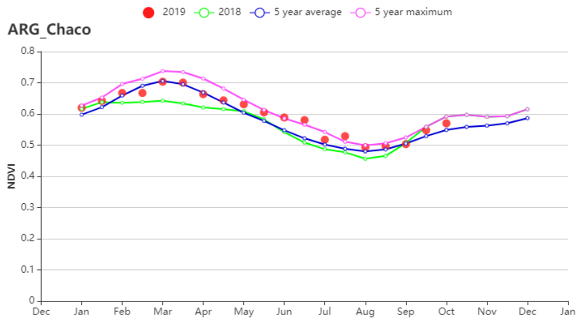


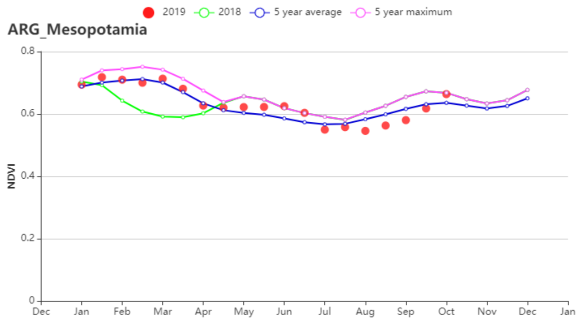
(b) Crop condition development graph based on NDVI (c) Maximum VCI



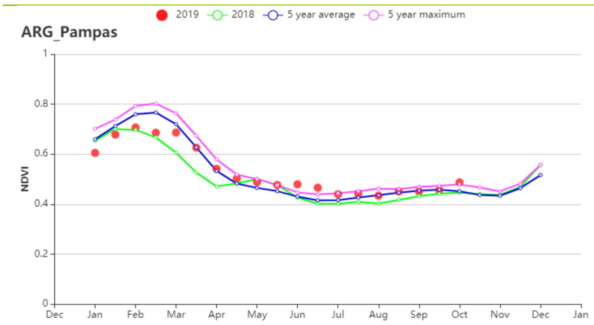


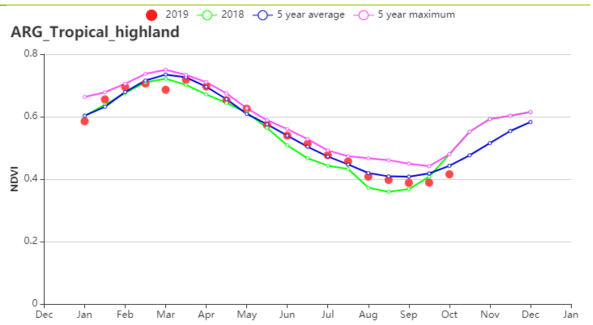
(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles





(f) Crop condition development graph based on NDVI (NDVI_Chaco (left) and Mesopotamia (right))





(g) Crop condition development graph based on NDVI (Humid Pampas (left) and Subtropical highlands (right))

Table 3.5 Argentina’s agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July – Octoberl 2019

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m^2)	Departure (%)	Current (gDM/m^2)	Departure (%)
Chaco	209	-16	16.7	-1.3	945	1	378	-12
Mesopotamia	392	-12	14.8	-1	855	-1	315	-14
Pampas	160	-29	12.1	-0.6	905	2	300	-1
Subtropical highlands	117	-10	15.8	-0.4	1103	-2	384	-10

Table 3.6 Argentina’s agronomic indicators by sub-national regions, current season's values and departure from 5YA, July – October 2019

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Chaco	96	9.1	117	-6	0.98
Mesopotamia	99	0.5	123	-9	0.88
Pampas	79	-2.7	124	-4	0.26
Subtropical highlands	78	5.3	119	2	0.84

[AUS] Australia

Wheat and barley, the main crops of Australia, are planted mainly from the end of April to July and harvested from October to January. This reporting period covers the complete growing season and the early harvest of wheat and barley. The national NDVI profile shows overall average conditions compared to the last 5-year average. However, the national NDVI was above last year's.

Overall Australia experienced somewhat above-average temperature and 7% above average radiation. Although it suffered from a significant shortfall in rainfall (a 38% drop), the developed irrigation system in the country has provided sufficient water for crop growth. The rainfed BIOMSS index increased by 4%. The spatial NDVI profiles show that poor crop conditions prevailed in south-eastern and north-eastern parts of New South Wales and generally support the analysis by agro-ecological regions below.

Regional analysis

This analysis adopts five agro-ecological regions for Australia, namely the South-eastern wheat zone, South-western wheat zone, Arid and semi-arid zone, Wet temperate and subtropical zone, and Sub-humid subtropical zone.

Crop condition in the **South-eastern wheat zone** was basically above average from July to September, although the condition returned to average in October during the early harvesting stage. The region experienced a 29% deficit of rainfall, with average temperature and RADPAR, resulting in a VCIx of 0.79. CALF decreased by 12%. Output was average and below.

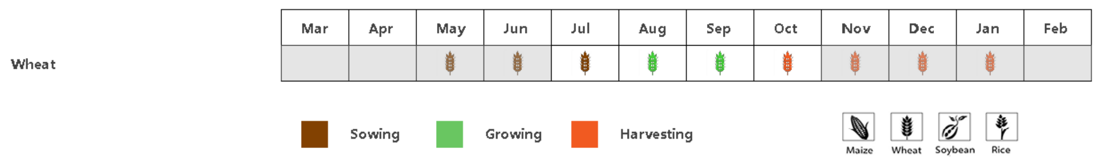
The **South-western wheat zone** shows average crop condition according to the regional NDVI profile. The region experienced the least severe rainfall deficit (-28%) among the five agro-ecological regions; radiation (RADPAR) was high (10%) and temperature was 0.5℃ above average. The weather-based potential biomass was 15% higher than its average of the last five years. The CALF only decreased by 4%. The situation here is also reflected by the NDVI cluster maps in the Western Australia region, with a fair VCIx of 0.79.

Crop condition based on NDVI profiles was below average in the **Arid and Semi-arid zone**. The region experienced a 47% rainfall deficit with average temperature and RADPAR, resulting in a low VCIx of 0.59. Furthermore, the CALF decreased by 11% indicating a reduction of the cropped area and production.

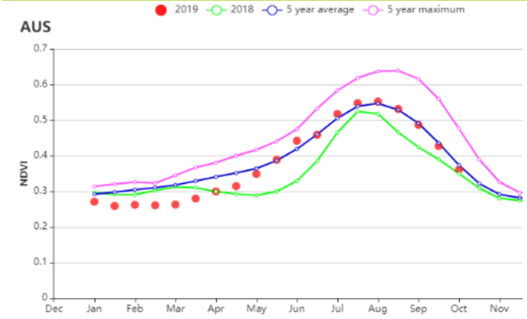
In the **Wet Temperate and Subtropical Zone** crop condition was above average according to the regional NDVI profile. Although the region was 34% deficient in rainfall (with average temperature and radiation), the irrigation infrastructure has supplemented enough water to the crops. As a result, the VCIx finally reached 0.76 with CALF reaching 88%, indicating average to above average crop condition.

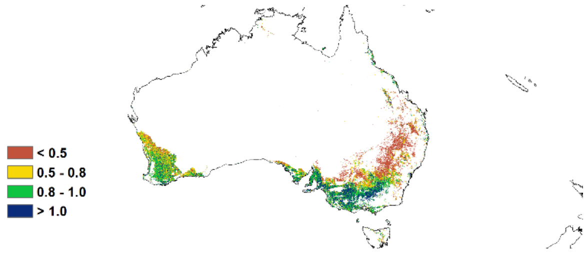
The **Sub-humid subtropical zone** showed apparently below average condition during the monitored period based on NDVI. The region was 72% deficient in rainfall, with average temperature and RADPAR. Furthermore, the region experienced a sharply decreased CALF (-61%) and CI (-51%), indicating a marked decrease of the cropped area. With VCIx reaching just 0.33, crop prospects are assessed as poor.

Figure 3.8 Australia's crop condition, July - October 2019



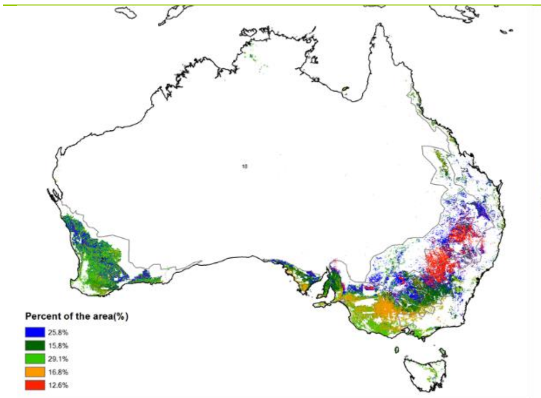
(a). Phenology of major crops

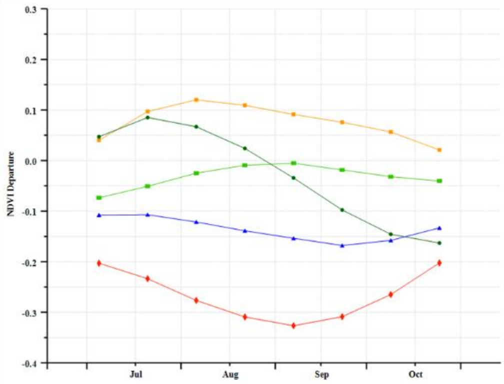




(b) Crop condition development graph based on NDVI

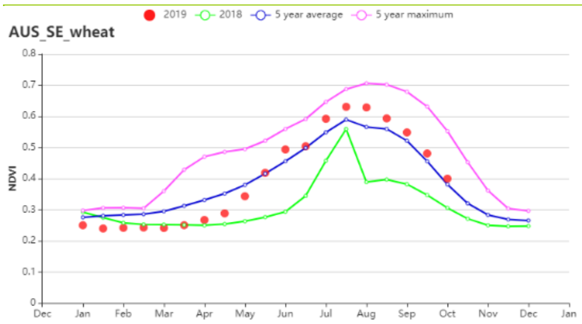
(c) Maximum VCI

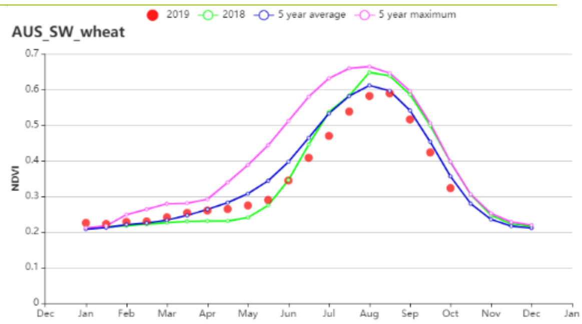




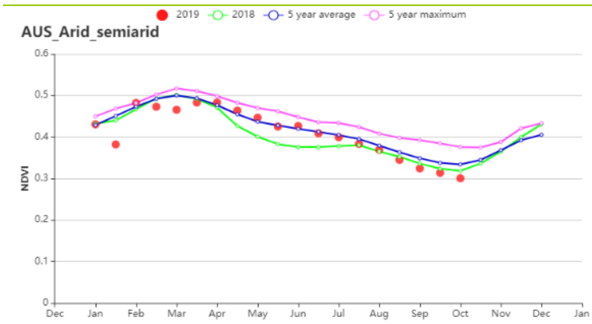
(d) Spatial NDVI patterns compared to 5YA

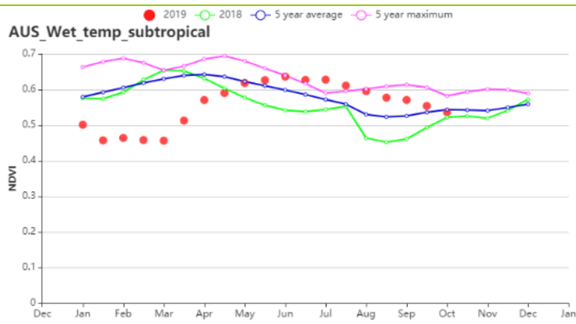
(e) NDVI profiles



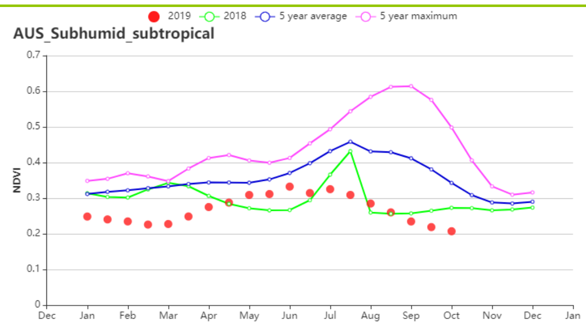


(f) Crop condition development graph based on NDVI (Southeastern wheat zone (left) and Southwestern wheat zone (right))

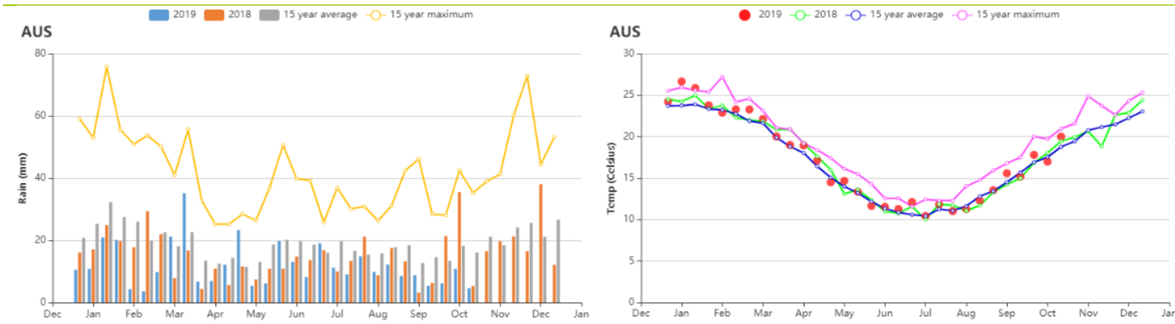




(g) Crop condition development graph based on NDVI (Arid and semi-arid zone (left) and Wet temperate and subtropical zone (right))



(h)Crop condition development graph based on NDVI (Subhumid subtropical zone)



(i)Time series rainfall profile (left) and temperature profile (right))

Table 3.7 Australia's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July – Octoberl 2019

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure	Current (°C)	Departure	Current (MJ/m²)	Departure	Current (gDM/m²)	Departure (%)
Arid and semiarid zone	30	-47	23.3	-0.4	1349	7	294	-26
Southeastern wheat area	147	-29	12.1	0.1	865	3	323	9
Subhumid subtropical zone	42	-72	16.1	0.8	1150	8	400	-3
Southwestern wheat area	171	-28	13.3	0.5	934	10	356	15
Wet temperate and subtropical zone	146	-34	13.3	0.1	1017	7	350	1

Table 3.8 Australia's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2019

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Arid and semiarid zone	47	-11	77	-2	0.59
Southeastern wheat area	83	-12	79	-11	0.79
Subhumid subtropical zone	24	-61	32	-51	0.33
Southwestern wheat area	87	-4	80	-8	0.79
Wet temperate and subtropical zone	88	-8	111	-6	0.76

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[BGD] Bangladesh

The monitoring period covers the planting and growth of Aman rice and the harvest of Aus rice. The country received average rains (1915 mm). Temperature (26.8°C) was just above the average by 0.1°C, and the photosynthetically active radiation was 1094 MJ/m2 (0.3% up). The BIOMASS was average as well (up just 1%). The nationwide NDVI spatial pattern shows that 6.2% of the cultivated area was above the 5YA, 15.7% was below, and 78.1% was first below the 5YA till Mid-September. The maximum Vegetation Condition Index (VCIx) map shows that the condition of the current crops is favorable, with the national VCIx value of 0.98. CALF exceeded the 5YA by2%. According to spatial clusters of NDVI profiles, crops are poor in 15.7% of arable land, dispersed over the country but concentrated in parts of Rajshahi, Bogra and Tangail districts.

Regional analysis

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

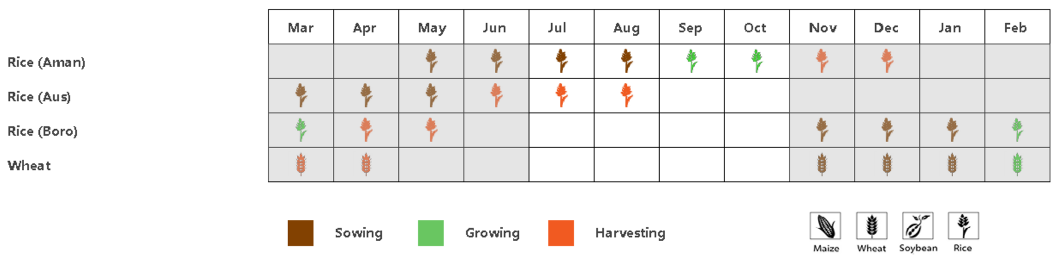
The Coastal region recorded 1717 mm of RAIN (-8% compared with average) and the temperature was 27.5°C (+0.2°C). RADPAR reached1221 MJ/m2, which represents a 3% increase over average; BIOMASS exceeded the average by 4%. The CALF value was just 2% higher than average and VCIx at 1.0 indicates good crop condition.

The Gangetic plain received a high amount of rain(1956mm, 10% over average). The temperature was average. RADPAR and BIOMASS both fell 1% below average, while VCIx was at 0.98.

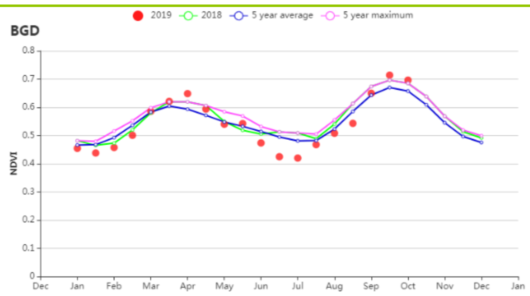
The Hills recorded the highest precipitation in Bangladesh (2459 mm, +10%). The temperature was average (up just 0.2°C), while RADPAR was lower by 2%. The BIOMASS reached 710 gDM/m2 and was 2% below the average. The CALF was average and VCIx reached 1.0, indicating good crop condition.

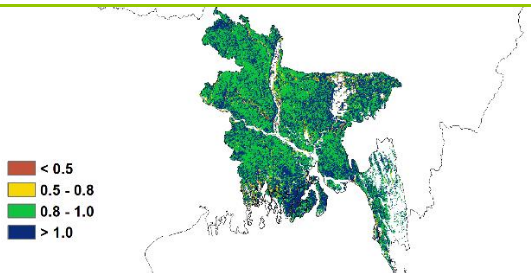
The precipitation in the Sylhet basin received 1676 mm (14% lower than average), with the temperature at 26.8°C (+0.3°C) and above-average RADPAR (1074 MJ/m2, +2%). BIOMASS and CALF were higher than average by 4%, with the VCIx value at 0.97.

Figure 3.9 Bangladesh's crop condition, July - October 2019.



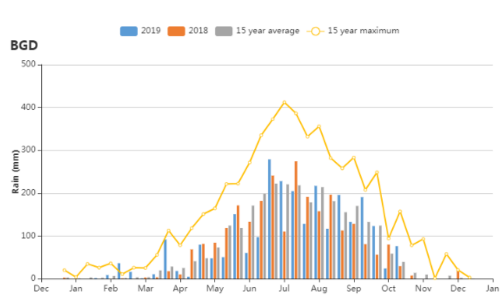
(a). Phenology of major crops

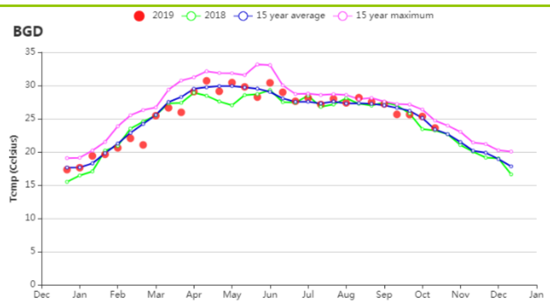




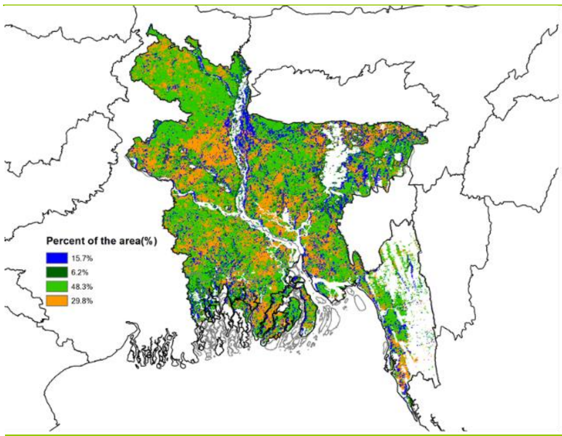
(b) Crop condition development graph based on NDVI

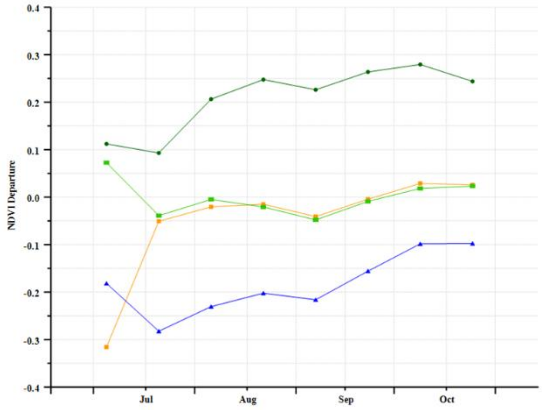
(c) Maximum VCI



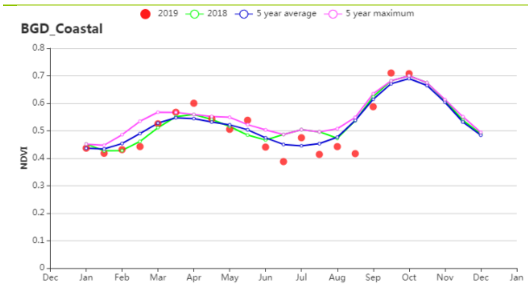


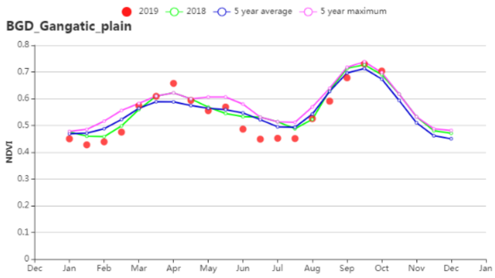
(d) Rainfall Index (e) Temperature Index



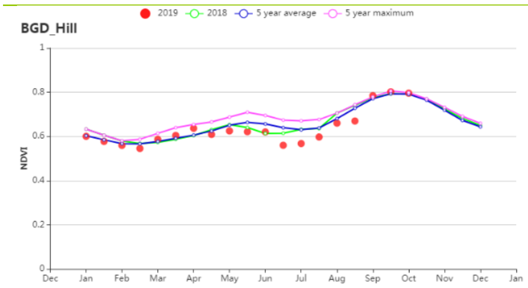


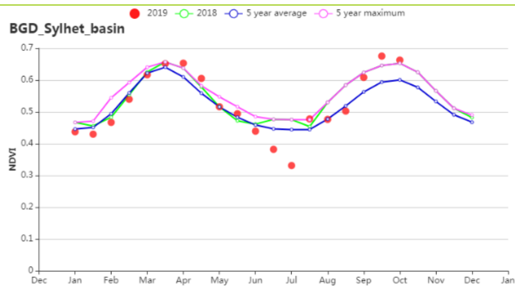
(f) Spatial NDVI patterns compared to 5YA (g) NDVI profiles





(k) Crop condition development graph based on NDVI(Coastal Region (left) and Gangetic Region (right))





(l) Crop condition development graph based on NDVI(Hill Region (left) and Sylhet Basin (right))

Table 3.9 Bangladesh's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July – Octoberl 2019

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure	Current (°C)	Departure	Current (MJ/m²)	Departure	Current (gDM/m²)	Departure (%)
Coastal region	1717	-8	27.5	0.2	1221	3	833	4
Gangetic plain	1956	10	26.9	-0.1	1086	-1	737	-1
Hills	2459	10	26.0	0.2	1051	-2	710	-2

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure	Current (°C)	Departure	Current (MJ/m^2)	Departure	Current (gDM/m^2)	Departure (%)
Sylhet basin	1676	-14	26.8	0.3	1074	2	731	4

Table 3.10 Bangladesh's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2019

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Coastal region	92	2	125	-15	1.02
Gangetic plain	96	1	184	-2	0.98
Hills	99	0	137	-1	1.00
Sylhet basin	90	4	155	-6	0.97

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[BLR] Belarus

Spring wheat was harvested from August and winter wheat was planted in August as well.

Rainfall amounted to 254 mm, 9% below average. Decreases were recorded in temperature (13.8°C, -0.4°C) while radiation was somewhat above average (RADPAR, 804MJ/m^2, +1.6%.) As a result of current agroclimatic condition, potential biomass decreased to 328 g DM/m2 , 7% below average. Cropped arable land fraction (CALF) was 100%, i.e. average. Maximum vegetation index (VCIx) reached 0.9, which was a relative high value. However, winter wheat was just at sowing, so rainfall could have an impact on production, especially in south-western Belarus where the rainfall decreased more than the national average.

The NDVI development curve at the national level indicates that crop condition gradually recovered to close to 5-year average before September (values had been below the 5-year average from mid-August). However, 24.2% of cropped areas in North Belarus and South Belarus was always above of 5-YA level, in agreement with the VCIx map. There was a sharp drop in NDVI profiles in most area in September, the reason for this may be that rain deficit conditions persisted after September where they affected the sowing and emergence of winter crops. According to the VCIx distribution map, VCIx was satisfactory in most cropped areas of the country (above 0.8), with most low values located in the western area.

Regional analysis

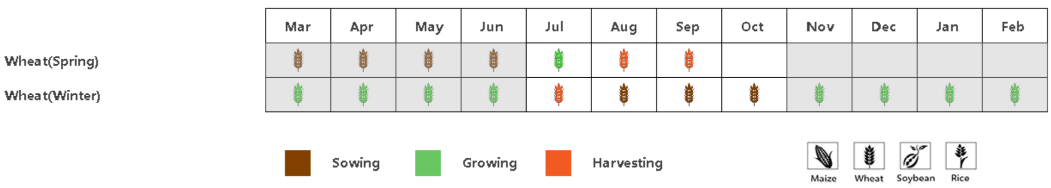
Regional analyses are provided for three agro-ecological zones (AEZ) defined by their cropping systems, climatic zones and topographic conditions. They are referred to as **North Belarus** (159) with the Regions of Vitebsk, northern area of Grodno, Minsk and Mogilev; **Central Belarus** (158)with the southern part of Grodno, Minsk and Mogilev, the north of Brest and Gomel and **South-west Belarus** (160)with the southern halves of Brest and Gomel regions.

North Belarus had normal rainfall (302 mm) and radiation (758 MJ/m^2) compared with average. No significant change occurred for temperature (12.9°C, -0.7°C). Potential biomass was down 12%. the CALF was 100% as the same to average. VCIx was satisfactory (0.92). Winter wheat may grow normally based on agro-climatic indicators in this area.

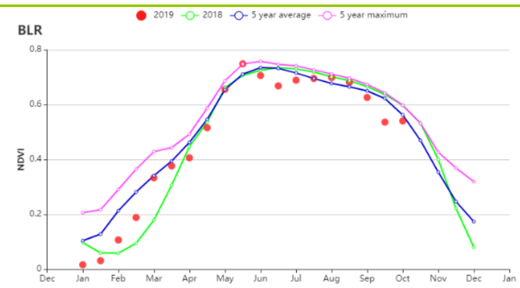
Central Belarus has a low rainfall (234 mm), 14% below average. The temperature was 14.4°C (down 0.2°C). RADPAR reached 823 MJ/m^2, up 2% compared to average. Weather conditions did not significantly affect the agronomic indicators, the CALF was average (100%), but the potential biomass decreased 4%. Winter wheat condition will need close monitoring.

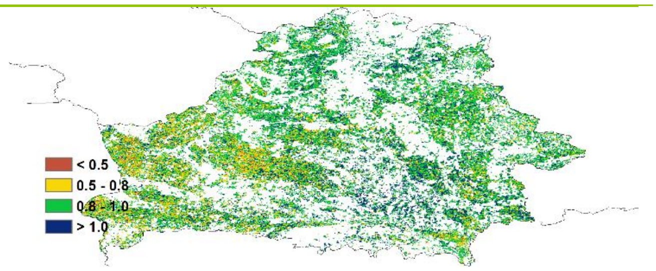
South-west Belarus had agroclimatic conditions similar to those of the other two AEZs. Rainfall fell 28% compared with average. Radiation was 878 MJ/m^2 (+5%). No significant change occurred for temperature (15.1°C, -0.1°C) and potential biomass (383 g DM/m^2). The area also experienced high CALF (100%) and good VCIx (0.9). More rain is needed in this regions in the coming months to improve soil moisture and create favorable conditions for the winter wheat.

Figure 3.10 Belarus's crop condition, July - October 2019

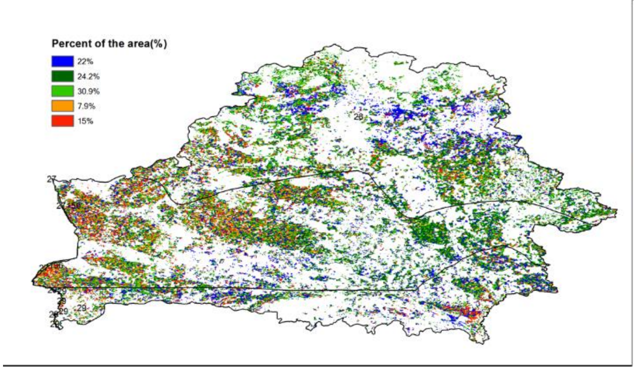


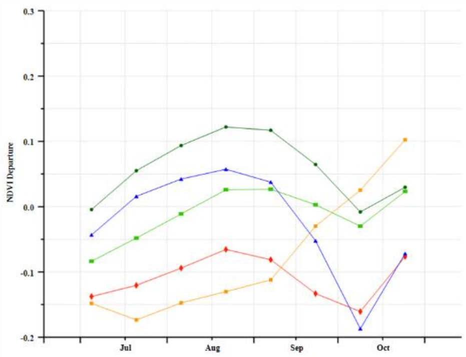
(a). Phenology of major crops



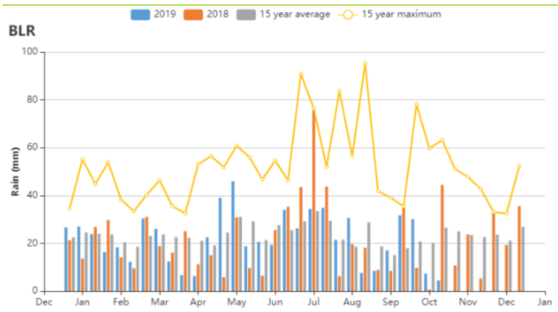


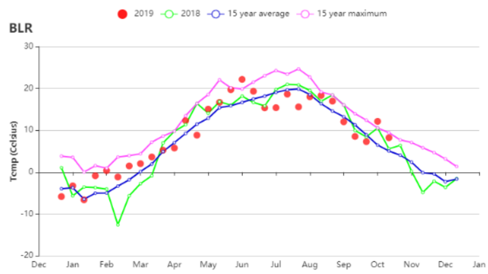
(b) Crop condition development graph based on NDVI (c) Maximum VCI



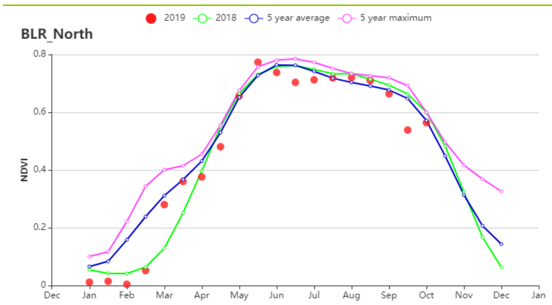


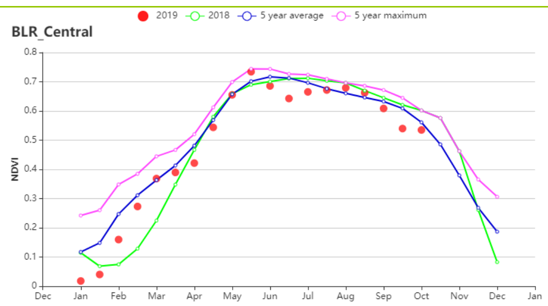
(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles



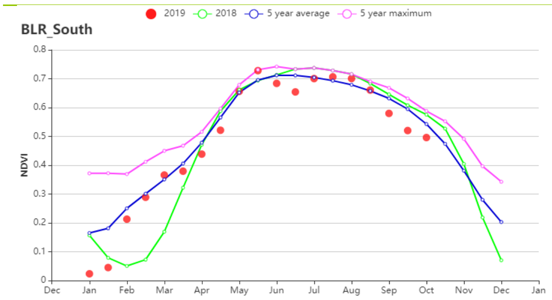


(f)Rainfall time series (g) Temperature time series





(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 3.11 Belarus's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2019.

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Center Belarus	234	-14	14.4	-0.2	823	2	344	
North Belarus	24	-56	12.9	-0.7	758	0	291	
South-west Belarus	96	-19	15.1	-0.1	878	5	383	

Table 3.12 Belarus's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2019.

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Center Belarus	100	0	117	3	0.88
North Belarus	100	0	108	-3	0.92
South-west Belarus	100	0	114	2	0.90

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[BRA] Brazil

The harvest of winter wheat is ongoing. In early October, sowing of maize and rice in central-southern Brazil, as well as of soybean started . Overall crop conditions were average as compared to the previous five years.

Agro-climatic indicators at the national level present slightly below average conditions with rainfall 5% below average, temperature 0.1°C above and radiation up by 2%. The potential BIOMSS by integration of rainfall, temperature and PAR was 5% above 15YA. The current monitoring period is the dry season in Brazil and the total amount of rainfall during the four months (July to October) was just 275 mm, nationwide. According to the seasonal rainfall profile, no single decade had any significant rainfall departure from 15YA. However, most of the major agricultural states in the country presented below average rainfall except for Mato Grosso (13% above 15YA) and Minas Gerais (average). Mato Grosso Do Sul, Parana, Santa Catarina and Sao Paulo suffered from water shortage since the rainfall was 28% or more below average. Most of the States presented slightly above average temperatures except for Ceara and Rio Grande Do Sul where TEMP was 0.1°C and 0.3°C degree lower than average, respectively. The seasonal TEMP profile presents overall average values except from late August to early September, when the temperature exceeded average by more than 1.0°C. All the nine major agricultural States recorded above average radiation, ranging from +1% in Ceara to +7% in Parana. Large positive departure of BIOMSS from 15YA was observed in Ceara (+10%), Goias (19%), Parana (+20%), Santa Catarina (+8%) and Sao Paulo (+17%). Biomass was close to average in other major agricultural States.

The national NDVI development profile for Brazil presents slightly below average starting in July. Since the current period covers the harvest of winter crops and sowing of summer crops, the slightly below average reflects the advanced harvesting and slightly slow development of summer crops at the early stage. When crop condition is classified into five categories (figure g), proportion of above/slightly above average conditions increased from July to October. The VCIx map shows high values (>0.8) in most regions except for scattered farmland in the Mato Grosso and Parana river basins. Nationally, the average VCIx was 0.84. The spatial and temporal pattern of NDVI departures presents similar situations: About 10.6% of arable land areas with average NDVI is scattered across the country. Below average conditions were mostly located at Mato Grosso Do Sul, Parana, and western Sao Paulo. Crops in Rio Grande Do Sul, which is the top wheat producing State, as well as northern and north-eastern Brazil were generally at average level throughout the monitoring period. Average wheat production is projected by CropWatch considering the overall favorable agro-climatic conditions during the key growing stages. CALF indicates that 93 % of the farmland was cultivated, which is at above average. Cropping intensity for 2019 is 134%, 8% above average.

Note: the figure I were determined based on the NDVI departures from average: Above average >0.125; Slightly above average >0.075 to 0.125; Average: >-0.075 to 0.075; >-0.125 to -0.075; Below Average: up to -0.125. The numbers on X-axis are the Julian day of the year and the bar indicates the proportion of different crop condition categories over the 16 days starting from the julian date below the bar.

Regional analysis

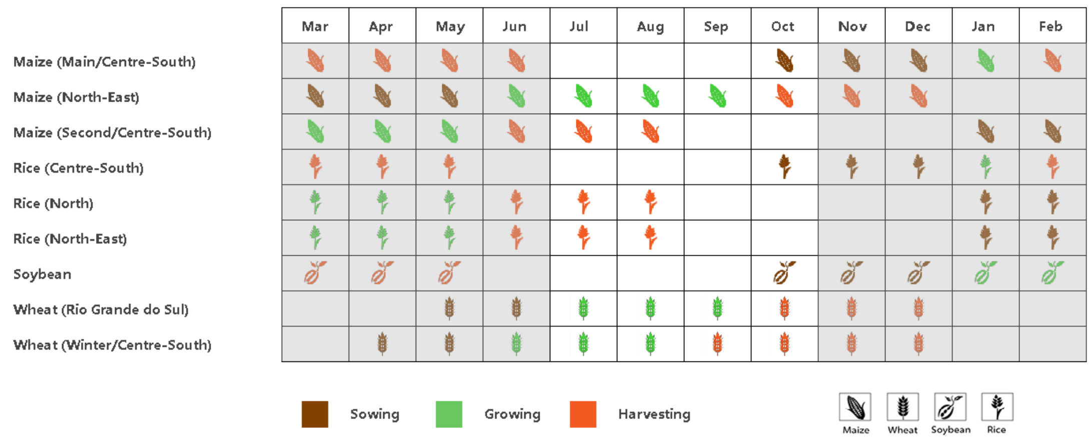
Based on cropping systems, climatic zones, and topographic conditions, eight agro-ecological regions (AEZs) are identified for Brazil. They include the Amazonas, Central Savanna, Coast, North-eastern mixed forest and farmland, Mato Grosso, Nordeste, Parana basin and Southern subtropical range-lands.

Over the current reporting period, although nationwide rainfall was close to average, large differences occurred among AEZs. All eight AEZs in Brazil recorded large departures of rainfall ranging from 28% below average in Parana basin to 21% above average in Mato Grosso. In contrast to rainfall, TEMP and PAR departures were similar across AEZs, with close to average and slightly above average PAR (+1% to +3%) for all AEZs. The Southern Subtropical range-lands received 3% above average PAR in contrast with the below average radiation in previous monitoring periods (JFMA & AMJJ). The Central Savanna received 16% lower rainfall which resulted in a 4% drop of BIOMSS. Although rainfall in Southern subtropical range-lands was at 663 mm and 11% above average, low temperature hampered the development of the crops. As a result, BIOMSS was 8% below 15YA while most of other zones presented above average BIOMSS.

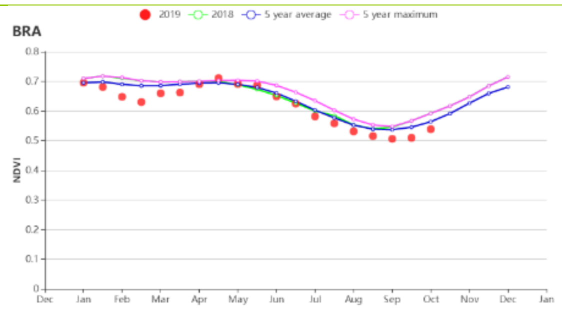
As reflected by the regional NDVI profiles, Central Savanna and Nordeste presented generally above average crop condition thanks to the overall favorable agro-climatic conditions. The seasonal NDVI profile was above 5YA and the previous year throughout the monitoring period in the Central Savanna and Nordeste as it benefited from more favorable conditions than during the previous period (AMJJ). Accordingly, the cropped arable land fraction (CALF) in the two regions was also significantly above average (+16% and +13%, respectively). The NDVI peaks of southern subtropical range-lands exceeded both 5YA and optimal condition of the past five years indicating favorable prospects for wheat output. Crop condition was average in the Coast and North-eastern mixed forest and farmland AEZs thanks to favorable rainfall.

Although Amazonas and Mato Grosso received above average rainfall from July to October, the adverse climatic condition from April to July (rainy season and the major growing season) hampered the crop development, resulting in below average crop conditions. CALF was close to 100% in Amazonas, Coast, North-eastern mixed forest and farmland, and Southern subtropical range-lands, indicating high intensity of cropland utilization. Below average CALF compared to 5YA was observed in Mato Grosso and the Parana basin. VCIx for each zone was larger than 0.85 except for Mato Grosso and Parana basin where average VCIx was at 0.79 and 0.80, respectively, the lowest values among the zones. Cropping Intensity at AEZs level ranged from 122% in Central Savanna to 159% in Amazonas. All AEZs presented above average levels except for the Mato Grosso at 1% below 5YA.

Figure 3.11 Brazil's crop condition, July - October 2019

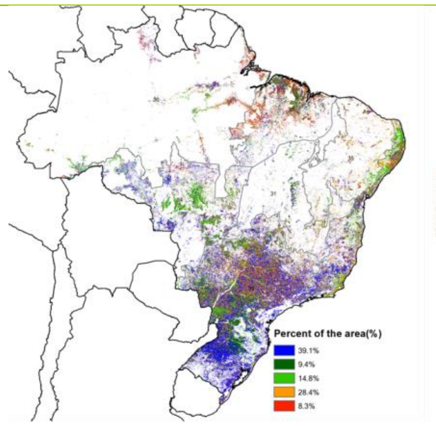


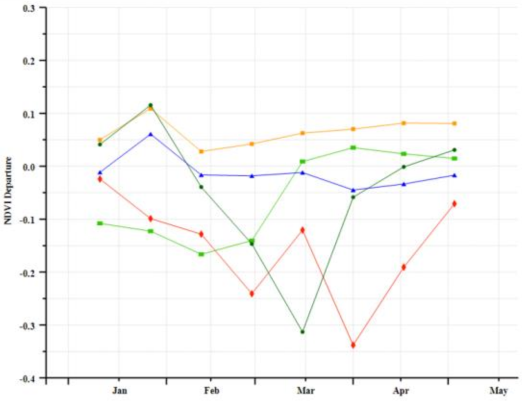
(a). Phenology of major crops



(b) Crop condition development graph based on NDVI

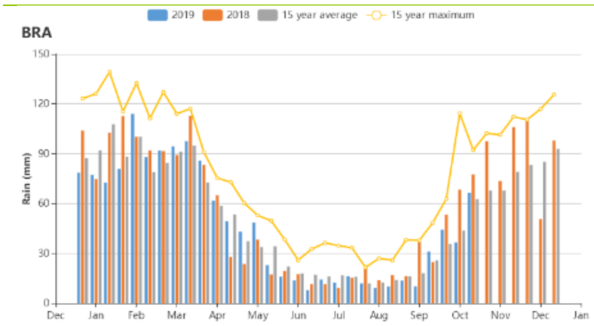
(c) Maximum VCI

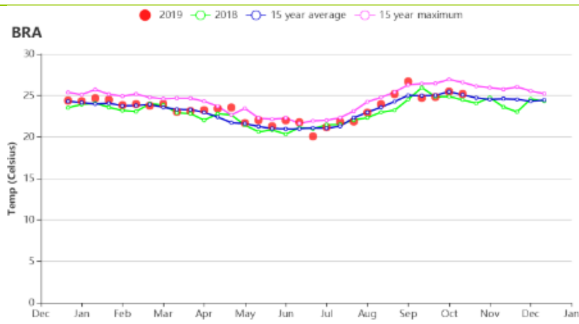




(d) Spatial NDVI patterns compared to 5YA

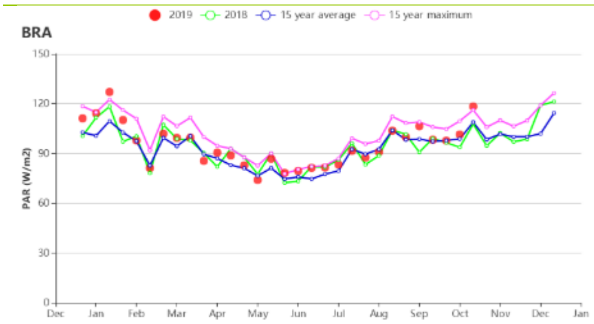
(e) NDVI profiles

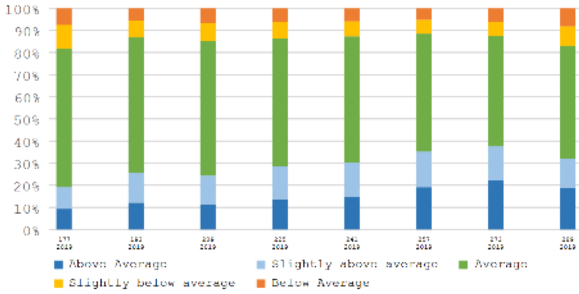




(f)Time series profile of rainfall

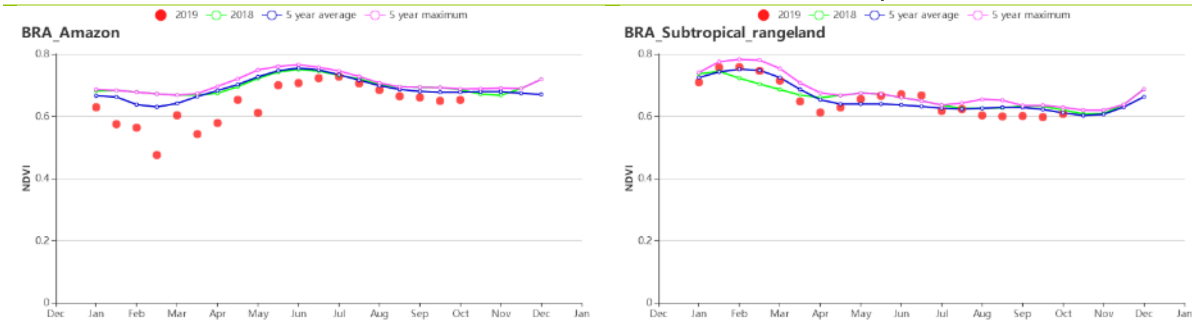
(g)Time series profile of temperature



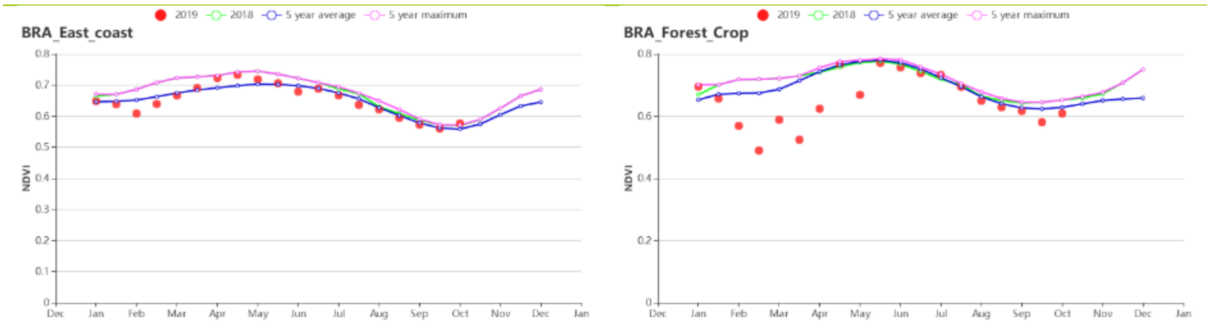


(h)Time series profile of rainfall

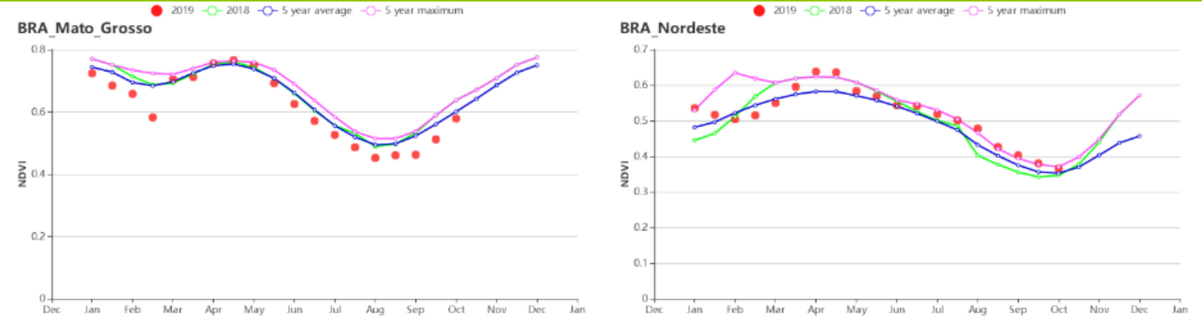
(i) Proportion of NDVI anomaly categories compared with 5YA from July to October, 2019



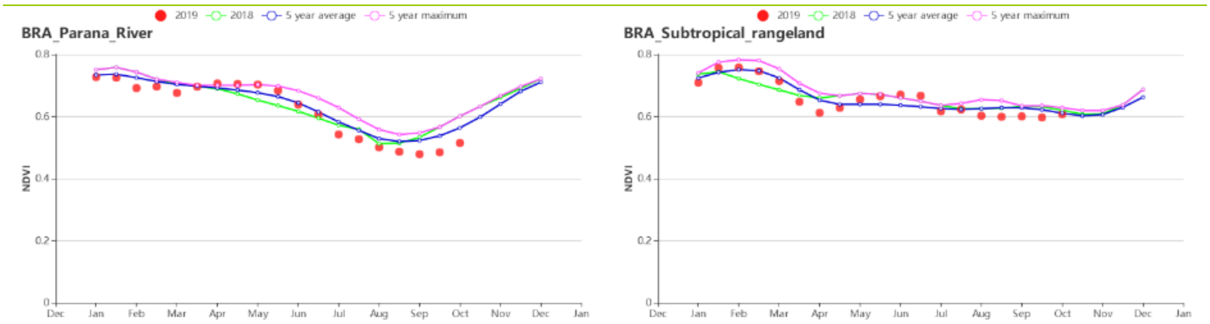
(j) Crop condition development graph based on NDVI ((Amazonas) (left) and (Central Savanna) (right))



(k) Crop condition development graph based on NDVI (Coast (left) and Northeastern mixed forest and farmland (right))



(l) Crop condition development graph based on NDVI (Mato Grosso region (left) and Nordeste (right))



(m) Crop condition development graph based on NDVI (Parana basin (left) and Southern subtropical rangelands (right))

Table 3.13 Brazil's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2019

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure	Current (°C)	Departure	Current (MJ/m²)	Departure	Current (gDM/m²)	Departure (%)
Amazonas	453	14	26.5	-0.3	1251	2	804	3
Central Savanna	135	-16	24.7	0.2	1249	1	452	-4
Coast	319	16	20.8	0.0	1003	1	571	2
Northeastern mixed forest and farmland	214	11	27.1	0.0	1286	2	762	5
Mato Grosso	268	21	26.2	0.0	1182	3	539	4
Nordeste	63	-15	24.8	0.1	1258	1	690	7
Parana basin	287	-28	20.6	0.5	1081	3	543	12
Southern subtropical range-lands	663	11	14.7	-0.4	854	3	314	-8

Table 3.14 Brazil's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2019

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Amazonas	100	0	159	9	0.94
Central Savanna	71	16	122	13	0.87
Coast	98	0	123	11	0.90
Northeastern mixed forest and farmland	99	0	157	10	0.95
Mato Grosso	89	-4	137	-1	0.79
Nordeste	70	13	127	20	0.90
Parana basin	95	-2	131	8	0.80
Southern subtropical range-lands	98	1	133	5	0.93

[CAN] Canada

The monitoring period covers the harvest of winter wheat, and the peak development and early harvest of summer crops.Spring wheat was harvested in September and the planting of winter wheat was ongoing at the time of reporting.

Rainfall was nationwide above average(+8%) , while both the temperature and radiation were below (TEMP -0.9°C;RADPAR -1%). The conditions resulted in somewhat below average BIOMSS(-1%).

Based on the national NDVI profiles and clusters, the overall JASO crop condition improved over the previous season and was close to the last 5-year average. The situation was also an improvement over earlier periods of this year (JFMA and AMJJ). More precipitation fell over the three main winter wheat production provinces (Alberta +17%, Manitoba +39% and Saskatchewan +16%). However, lower temperatures and less radiation took their toll on crop conditions with BIOMSS decreasing below average in the three provinces (-10%, -2% and -3%, respectively). The maximum VCI value was nevertheless 0.95 and CALF was equal to the recent 5-years average.

Then NDVI clusters show that 21.7% of the cropland in Canada have a good contidion in the JASO period, while 16.1% are lower than average in the whole period. Besides, there is an isolated dramatic drop (3.1%) area of NDVI in SW Alberta, which may be caused by the cloud in the remote sensing data, can be ignored.

The final outcome of the season could be better than last year's due to the improved weather conditions, depending whether the beneficial effect rainfall was offset or not by low temperature and radiation. Conditions of spring wheat and maize were fine, and generally better than winter wheat and soybean.

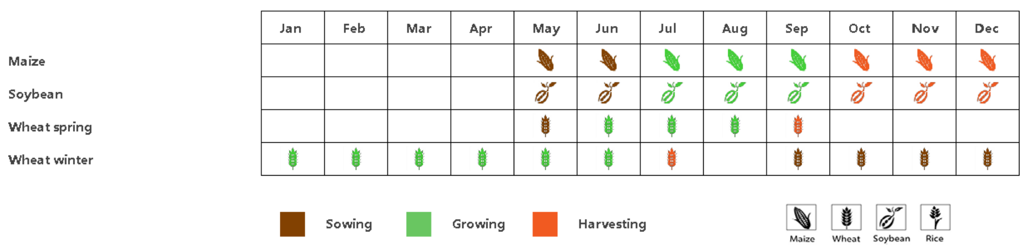
Regional analysis

The Prairies (the region identified as 53 in the crop condition clusters map) and Saint Lawrence basin (region 49, covering Ontario and Quebec) are the major agricultural regions in Canada.

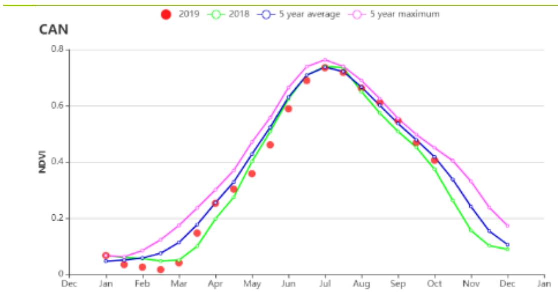
In the **Prairies**, the main production area for spring wheat, winter wheat and soybean, rainfall was well above average (RAIN 311 mm, +24%), but radiation (-1%) and particularly temperatures (-1.7°C) were below average. The biomass production potential was below average as well (BIOMSS -6%). Overall, the NDVI profiles show an improvement in crop conditions over last year. Therefore, after a poor start of the season, crop conditions are assessed as average.

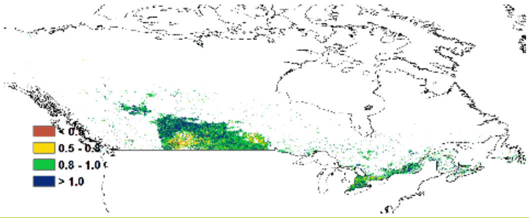
In the **Saint Lawrence basin**, RADPAR was above average (+5.2%), and both the temperature and rainfall were slightly below average (TEMP, -0.3°C; RAIN, -5.9%). The potential biomass was slightly above average (BIOMSS, +3%). However, the NDVI profiles indicated that the crop conditions did not reach 2018 levels. Similar to the Prairies the crop conditions are assessed as average.

Figure 3.12 Canada's crop condition, July - October 2019

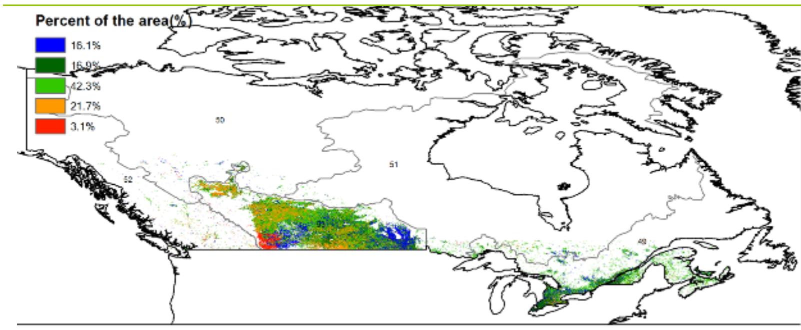


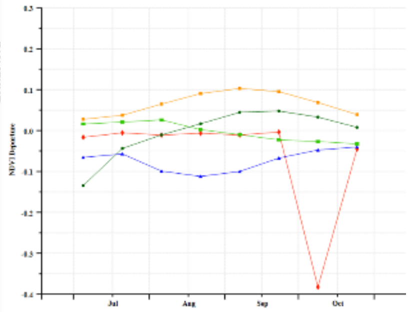
(a). Phenology of major crops



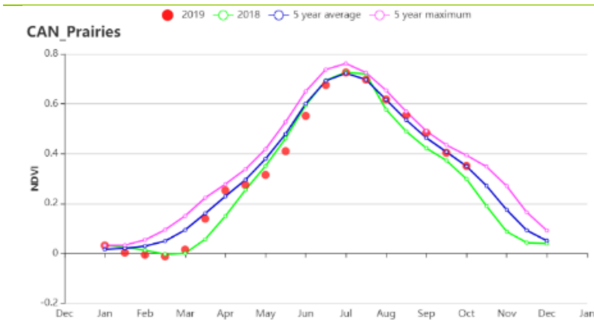


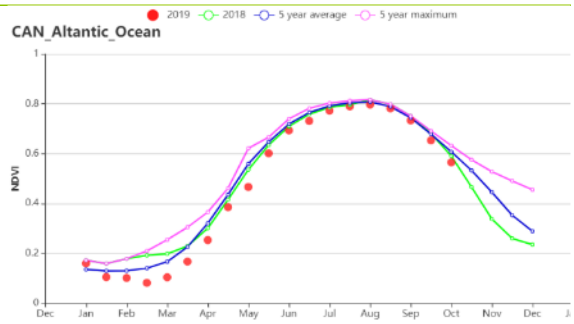
(b) Crop condition development graph based on NDVI (c) Maximum VCI



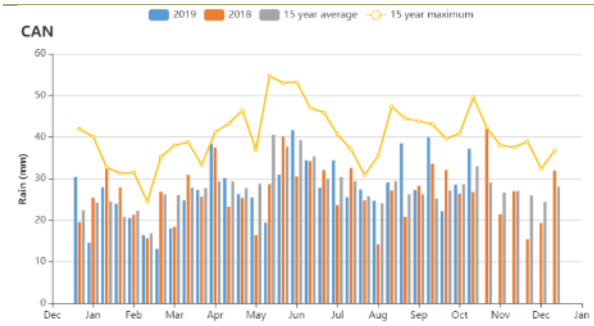


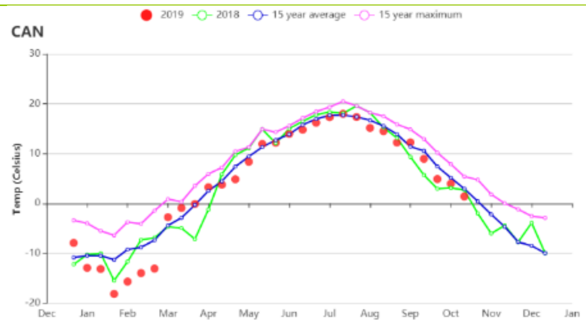
(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles





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





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

Table 3.15 Canada's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2019

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Saint Lawrence basin	311	24	11.6	-1.6	910	-5	356	-6
Prairies	411	-6	14.0	-0.3	942	5	387	5

Table 3.16 Canada agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2019

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Saint Lawrence basin	98	0	97	1	0.94
Prairies	100	0	111	2	0.95

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

[DEU] Germany

The condition of crops in Germany was generally below both the average and the situation in July 2018. Currently, summer crops have been harvested, and winter crops are at the planting stage.

At the national level, total precipitation of the monitoring period was slightly below average (RAIN, -2%), with temperature and radiation slightly above (Temp +0.4°C, RADPAR +1%). Significantly above average precipitation occurred in most of Germany from late-September to mid-October, except the region of Brandenburg, Saxony-Anhalt, Thuringia and Bavaria. Most parts of Germany experienced warmer-than-usual conditions during this reporting period, except in early September, early October, as three heat waves swept across Germany in late July, late August and mid-October. Due to favorable sunshine conditions and warmer-than-usual conditions, the biomass production potential (BIOMSS) is expected to increase 3% over average nationwide.

As shown by the NDVI development graph at the national scale, the reporting period experienced crop condition that was below average, and close to the average until October, while after August, it was above the situation in 2018. These observations are confirmed by the spatial NDVI profiles. Crop condition was below average before mid-August in 86.8% of cropland, and below average from mid-August to October in 51.7% of cropland. Only 13.2% of arable land had crops that were above average during the entire monitoring period, as a result of warmer-than-usual temperature coupled with a persistent rainfall deficit at the early monitoring period. The most favorable crops occur in Schleswig-Holstein and the North of Lower Saxony as well as, in the South, in Baden-Württemberg and Bavaria. Overall, the above-mentioned pattern of crop growth is also reflected by VCIx, the value of which reaches 0.87 country wide. CALF during the reporting period was the same as the recent five-year average. Cropping intensity was down 1% compared with the five-year-average.

Generally, the values of agronomic indicators show somewhat unfavorable condition for most summer crops; significantly increased precipitation during the sowing period has affected winter crop planting in the eastern and south-eastern areas while providing adequate soil moisture.

Regional analysis

Based on cropping systems, climatic zones, and topographic conditions, six sub-national agro-ecological regions are adopted for Germany. They include: the Wheat zone of Schleswig-Holstein and the Baltic coast, Mixed wheat and sugar beets zone of the North-west, Central wheat zone of Saxony and Thuringia, Sparse crop area of the east-German lake and Heathland area, Western sparse crop area of the Rhenish massif, and the Bavarian Plateau.

Schleswig-Holstein and the Baltic coast is among the major winter wheat zones of Germany. It recorded above average rainfall (RAIN +6%), average temperature and, below average radiation (RADPAR -4%). BIOMSS is expected to decrease by 4% compared to average. Three heat waves affected this region in late July, late August and mid-October, and the highest temperature was close to or above the historical maximum. As shown in the crop condition development graph based on NDVI, the values were close to or below average during the whole reporting period. Cropping intensity was down 13% compared with the five-year-average. The area had a high CALF (100%) as well as a favorable VCIx (0.87), indicating a high cropped area.

The **Mixed wheat and sugar-beets zone of the North-west** experienced a slight precipitation deficit (RAIN -1%), somewhat above average temperature (TEMP, +0.4°C) and average radiation, which led to a small increase (+3%) of BIOMSS over average. Due to the three heat waves and persistent rainfall deficit at the early monitoring period, the NDVI values and crop condition were below average during the monitoring period. The area had high CALF (100%) and a high VCIx (0.84). Cropping intensity was down 7% compared with the five-year-average.

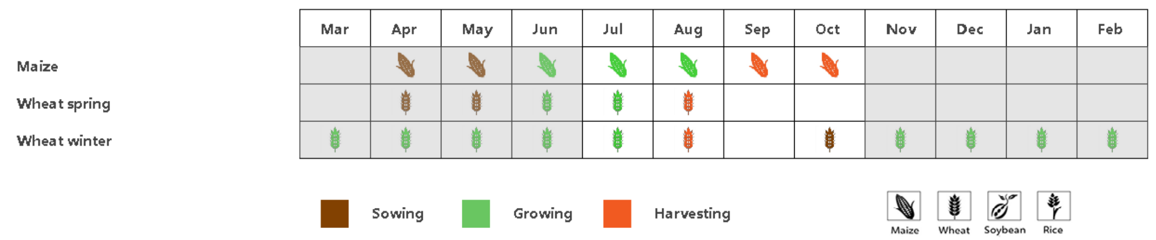
The **Central wheat zone of Saxony and Thuringia** is another major winter wheat zone. Compared to average, this area experienced a precipitation deficit (RAIN, -7%), above average TEMP (+0.6°C) and radiation (RADPAR, +1%). Due to warmer-than-usual conditions, the biomass potential (BIOMSS indicator) fell 3% below average. The mentioned heat waves led NDVI values to be below average during this monitoring period based the crop condition development graph. The area had a high CALF (100%) and VCIx was at 0.82. Cropping intensity was up 2% compared with the five-year-average.

Crop condition was unfavorable in the **East-German lake and Heathland sparse crop area**, with a rainfall deficit (RAIN, -6%) but with above average temperature (TEMP, +0.4°C), low radiation (RADPAR, -1%) and about average BIOMSS (+1%). NDVI values were below average. The area had a high CALF (99%) and a high VCIx (0.83). Cropping intensity was up 2% compared with the five-year-average.

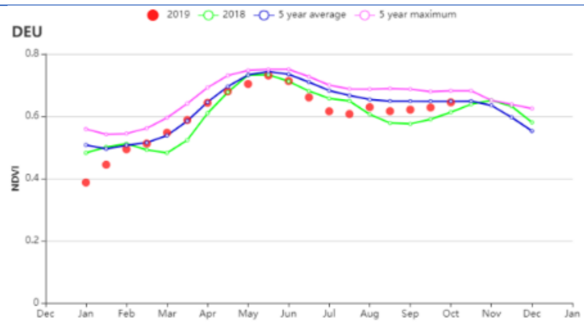
In the **Western sparse crop area of the Rhenish massif** CropWatch agro-climatic indicators show a precipitation deficit (RAIN, -6%), but above average TEMP (+0.6°C), RADPAR (+4%) and BIOMSS (+8%). Significantly above average precipitation affected this region from mid-August to October, while three heat waves occurred in late July, late August and mid-October. NDVI changed from below average to close to average, to below average (summer crop time), and again to close to average (winter crop time). The area had a high CALF (100%) and a high VCIx (0.86). Cropping intensity was up 10% compared with the five-year-average.

Next to wheat, two summer crops (maize and potato) are the major productions on the **Bavarian Plateau**. The CropWatch agro-climatic indicators showed average RAIN, TEMP (+0.6°C) and RADPAR (+3%). Compared to average, BIOMSS is expected to increase by 5%. In spite of the three heat waves, cropping intensity was up 5% compared with the five-year-average. The area had a high CALF (100%) as well as a favorable VCIx (0.94) with equally favorable crop prospects.

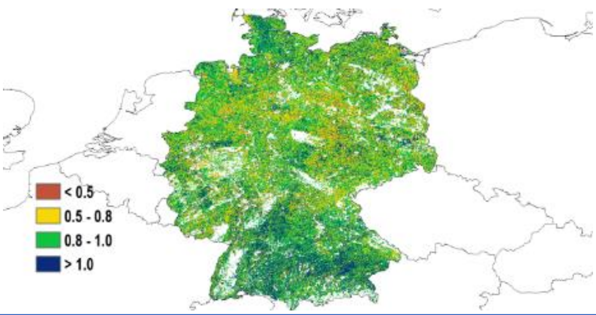
Figure 3.13 Germany's crop condition, July-October 2019



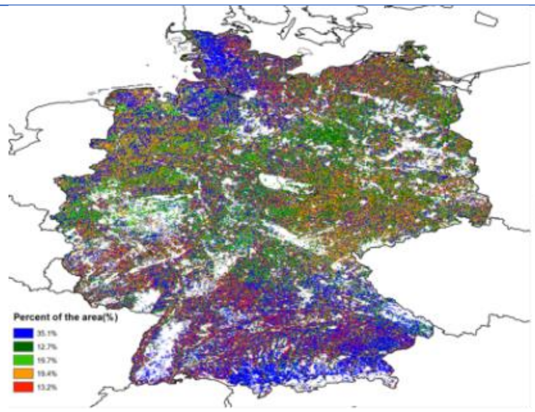
(a). Phenology of major crops



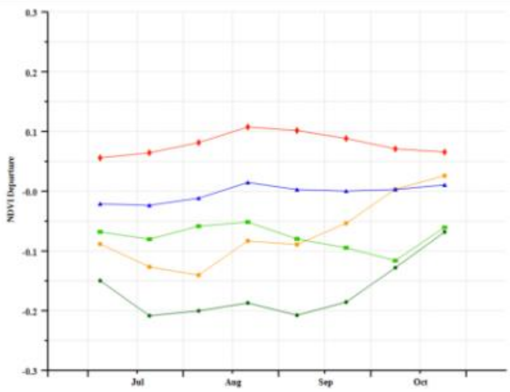
(b) Crop condition development graph based on NDVI



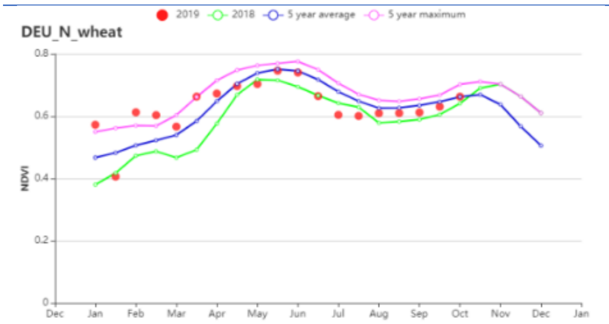
(c) Maximum VCI

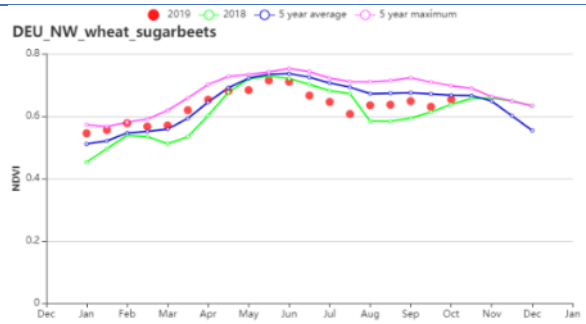


(d) Spatial NDVI patterns compared to 5YA

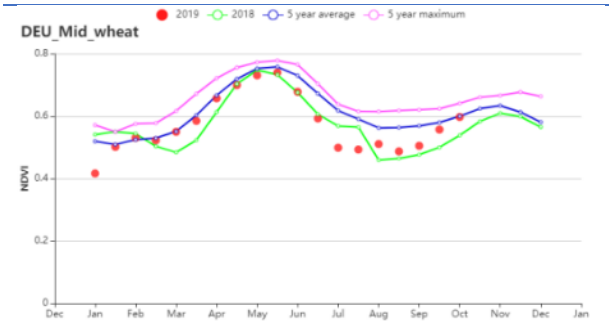


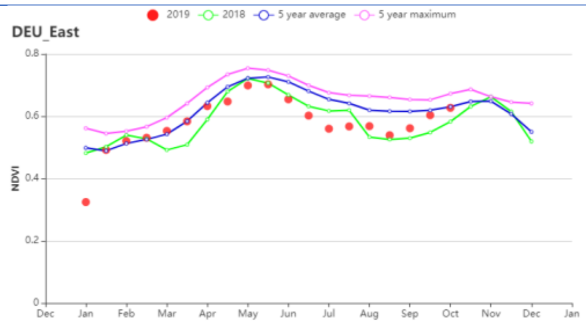
(e) NDVI profiles



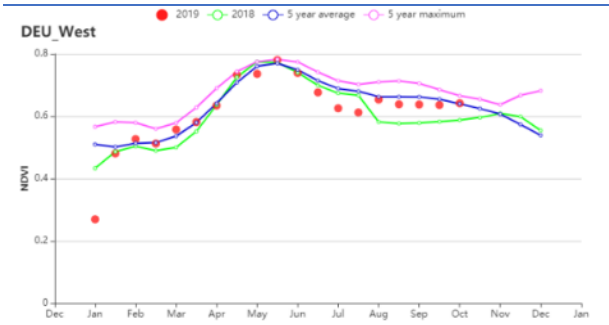


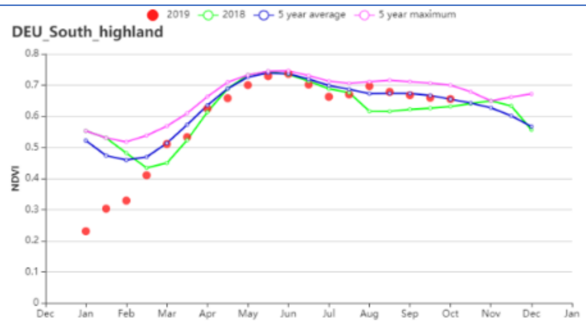
(f) Crop condition development graph based on NDVI (Wheat zone of Schleswig-Holstein and the Baltic coast (left) and Mixed wheat and sugar beets zone of the north-west(right))



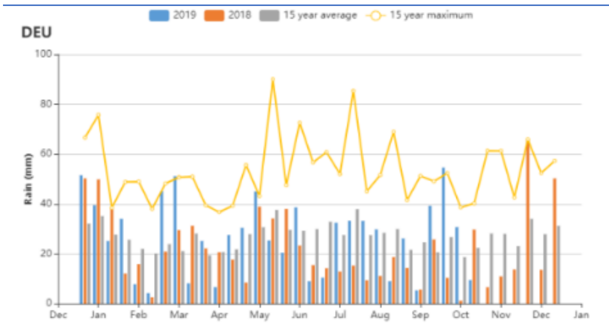


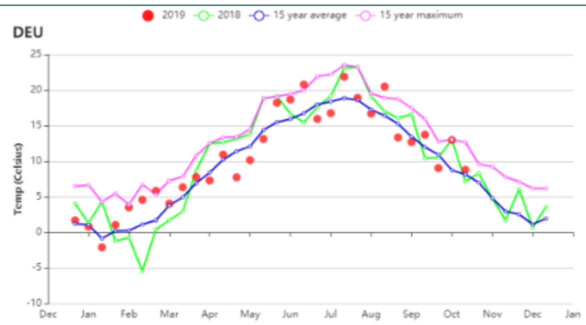
(g) Crop condition development graph based on NDVI (Central wheat zone of Saxony and Thuringia(left) and Sparse crop area of the east-German lake and Heathland (right))





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





(f)Time series profile of rainfall

(g)Time series profile of temperature

Table 3.17 Germany agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July-October 2019

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	341	6	15.3	0.0	762	-4	340	-4
Mixed wheat and sugarbeets zone of the north-west	297	-1	15.3	0.4	819	0	365	3
Central wheat zone of Saxony and Thuringia	245	-7	15.3	0.6	877	1	391	4
East-German lake and Heathland sparse crop area	269	-6	15.7	0.4	857	-1	390	1
Western sparse crop area of the Rhenish massif	238	-6	15.0	0.6	920	4	404	8
Bavarian Plateau	389	0	14.6	0.6	966	3	404	5

Table 3.18 Germany's agronomic indicators by sub-national regions, current season's value and departure from 5YA, July - October 2019

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	127	-13	0.87
Mixed wheat and sugarbeets zone of the north-west	100	0	136	-7	0.84
Central wheat zone of Saxony and Thuringia	99	0	162	2	0.82
East-German lake and Heathland sparse crop area	99	0	148	-1	0.83
Western sparse crop area of the Rhenish massif	100	0	168	10	0.86
Bavarian Plateau	100	0	127	-13	0.87

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

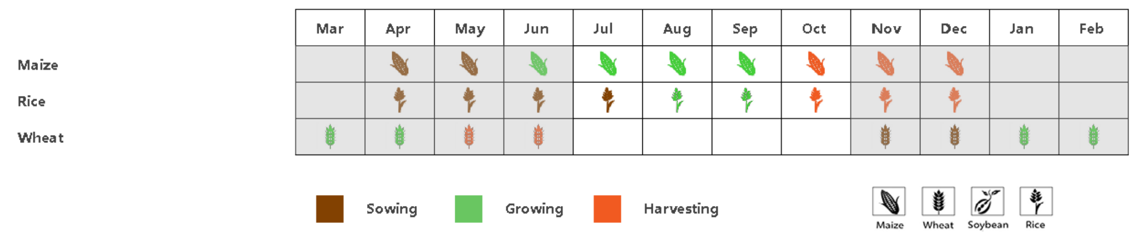
During most of the monitoring period summer crops (rice and maize) were in their growing season until their harvest started at the beginning of October. Winter wheat season is about to start. The cumulative rainfall reached 38 mm, an unusually high amount that fell late in the reporting period. The average temperature reached 25.8 °C (+0.3°C), and the photosynthetically active radiation was 1396 MJ/m2 (+0.1%). The NDVI spatial pattern shows that 25% of the cultivated area was above the 5YA, 52.1% fluctuated around the 5YA, and 22.9% was below. The Vegetation Condition Index (VCIx) map shows that the condition of the current crops is satisfactory. This agrees with the whole country VCIx value (0.83). CALF exceeded the 5YA by 5%. Overall, the crop condition was favorable.

Regional Analysis

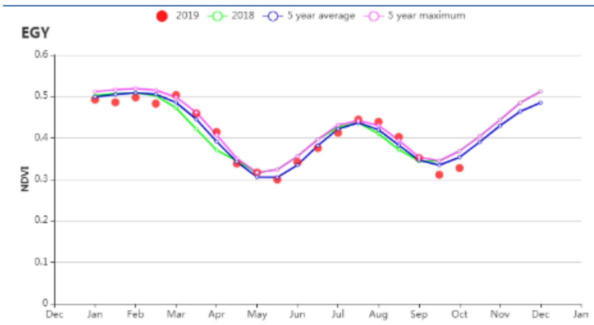
Based on crop planting systems, climate zones and topographical conditions, Egypt can be divided into three agro-ecological zones(AEZ), two of which are suitable for crop cultivation, namely the **Nile Delta** and the **southern coast of the Mediterranean and the Nile Valle**y.

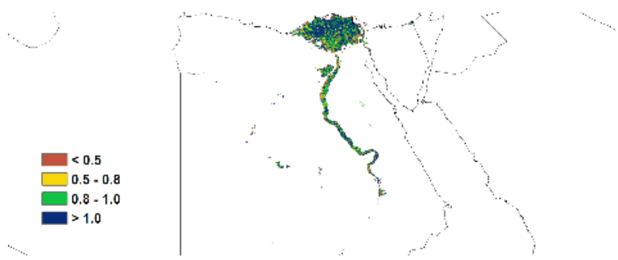
In the **Nile Delta and Mediterranean coast**, the average rainfall was 53 mm, while the **Nile Valley** recorded only 2 mm. Since virtually all crops in Egypt are irrigated, the impact of precipitation on crop yield is limited but additional precipitation is nevertheless always useful. The cumulative photosynthetically active radiation was average in both regions. Rainfed BIOMASS fell 39% in the first region and increased by 89% for the second region which is, however, mostly irrelevant for Egyptian agriculture. The NDVI development graph shows that crop condition fluctuated about the average in both zones, with below average values in October. Both regions have a mixture of single and double-cropping.

Figure 3.14 Egypt's crop condition, July - October 2019



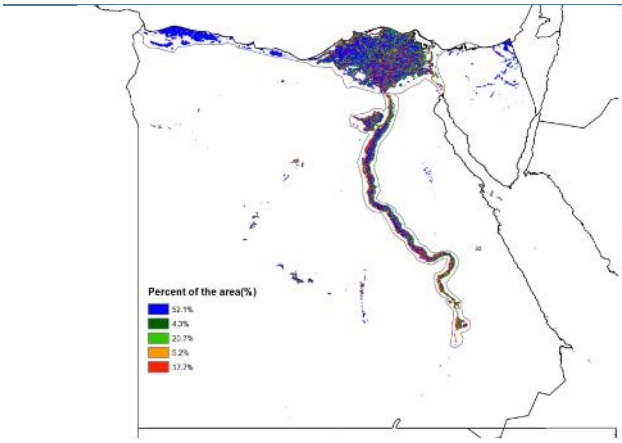
(a). Phenology of major crops



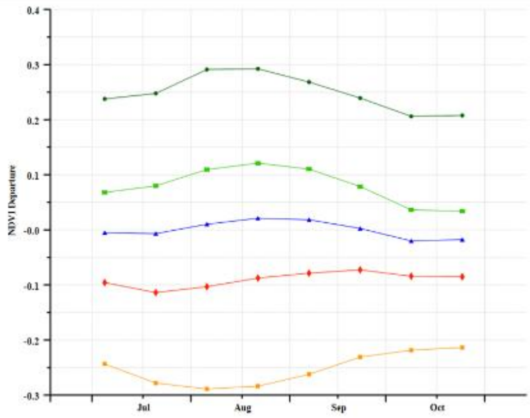


(b) Crop condition development graph based on NDVI

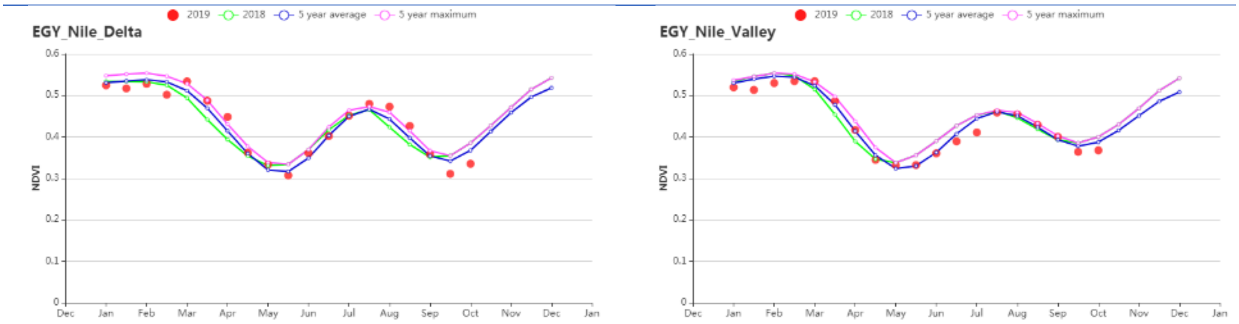
(c) Maximum VCI



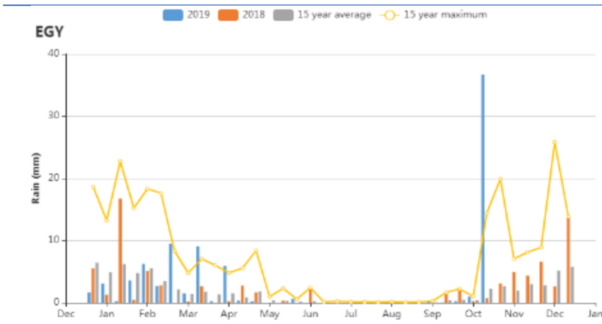
(d) Spatial NDVI patterns compared to 5YA



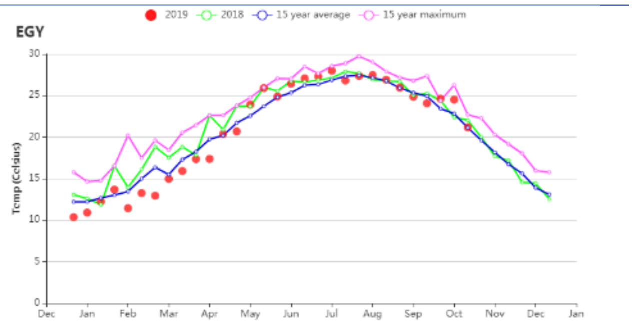
(e) NDVI profiles



(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 3.19 Egypt's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2019

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Nile Delta and Mediterranean coastal strip	53	1248	25.8	0.3	1388	0.0	188	-39
Nile Valley	2	314	28.2	0.5	1448	0.0	85	89

Table 3.20 Egypt's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2019

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Nile Delta and Mediterranean coastal strip	65	5	124	13	0.94
Nile Valley	69	4	130	14	0.87

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[ETH] Ethiopia

The two main cropping seasons of Ethiopia are referred to as Belg and Meher. Meher corresponds to the main rainy season from June-September and includes all the crops that are harvested from August, and sometimes as late as December. The peak of rainfall is usually recorded during July and August but rainy seasons may be very long and bimodal, especially in the drier parts of the country. Most of the cereal crops were in full growth during the reporting period. Meher rmaize was harvested during October.

At the national level, the CropWatch indicators had RAIN at 977 mm, 9% above average. The temperature (TEMP) and sunshine (RADPAR) were close to average. BIOMASS fell 13% compared to average, which is confirmed by the NDVI development graph showing below average crop condition at the national scale. However, spatial NDVI patterns indicate that NDVI was above average in 34.3% of arable land and below-average elsewhere. This spatial pattern is reflected by the maximum VCI in the different areas, with high values of VCIx at 0.99 and a 1% increase in CALF. Most other regions had VCIx values between 0.8 and 1.0. Generally, even though the crop condition from the national NDVI profile was below the five-year average, the agronomic and agro-climatic indicators show that conditions were favorable and correspond to fair Meher crops.

Regional Analysis

The central-northern maize-teff highlands, south-eastern mixed-maize zone, semi-arid pastoral zone, and western mixed maize regions, are the major cereal and grain-producing areas of Ethiopia reported on in the analysis below.

Maize and teff are commonly cultivated in the Central-northern maize teff highlands. Compared to the 2018 JASO period, rainfall was high during the current season at 1028 mm, 5% above average. Temperature and radiation were somewhat below average with TEMP down 0.1°C and RADAR down -2%. Even though rainfall was above-average, the total biomass production potential underwent a 13% drop; CALF was up 1%. The region had above-average VCIx (0.98). The NDVI development graph shows below 5YA crop condition. Most parts of the AEZ practice single cropping and cropping intensity rose 5%. Crop condition was favorable and a good harvest is expected.

The southeastern mixed-maize zone contains central Oromia and northern Amhara and grows mainly maize and teff. The total amount of rainfall reached 462 mm, a significant increment above average (+35%). Temperature was below 15YA while RADAR was up 1%; BIOMSS fell -17%, which likely resulted in low livestock feed availability. CALF increased by 4% above the five-year average, and the maximum VCIx value was 1. Similarly, the Crop condition was above 5YA average according to the NDVI development graph. Overall the crop condition of this zone was favorable.

The production of crops is limited in the Semi-arid pastoral zone. Rainfall was low (145mm) but nevertheless significantly higher than average by 37%, with BIOMSS up 4%, which has favored range-land production in this predominantly pastoral area. Sunshine and the cropped arable land fraction were below (RADPAR -1%, CALF -16%) but VCIx exceeded 1, indicating a favorable livestock situation.

The Western mixed maize zone recorded 1619 mm of rainfall (RAIN +21%). Other CropWatch agro-climatic indicators such as temperature and RADPAR were below average (TEMP -0.6°C, RADPAR -3%). Similarly, the Crop condition was below average according to the NDVI development graph, an observation confirmed by the significant drop of total biomass production by18% compared to the five-year average. CALF remained constant, with a high VCIx value recorded for the region as a whole (1.00). In this zone, the cropping intensity (108%) remained constant compared to the last five years. In general, the conditions were favorable for crop production.

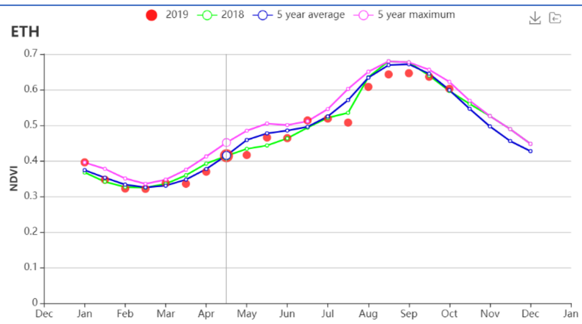
Figure 3.15 Ethiopia's crop condition, July - October 2019

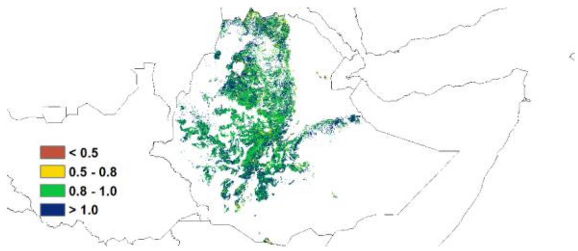
	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Maize(Meher)												
Barley, Teff, and Wheat (Meher)												

Sowing Growing Harvesting

Maize Wheat Soybean Rice

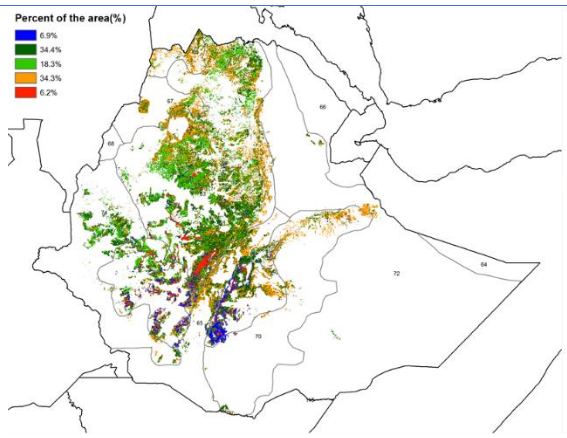
(a). Phenology of major crops

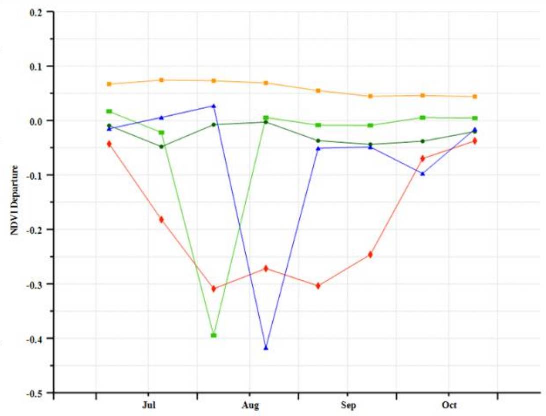




(b) Crop condition development graph based on NDVI

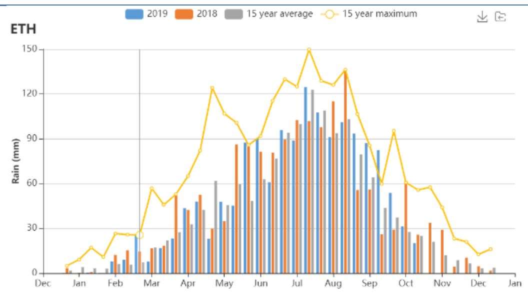
(c) Maximum VCI

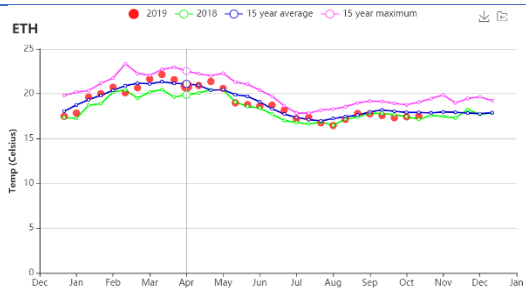




(d) Spatial NDVI patterns compared to 5YA

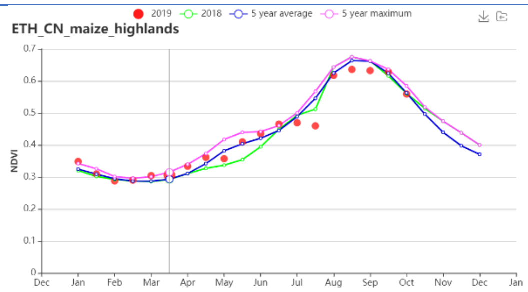
(e) NDVI profiles

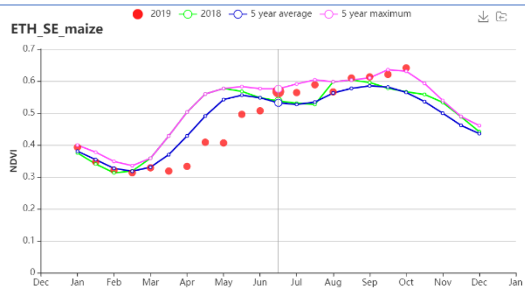




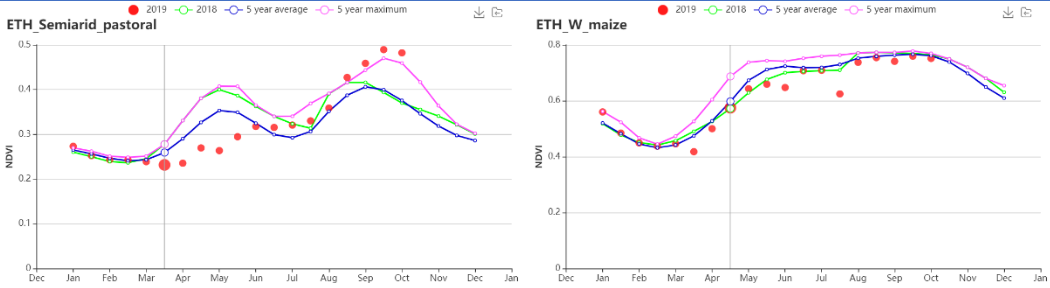
(f) Rainfall Index

(g) tempratrure index





(h) Crop condition development graph based on NDVI (central-northern maize-teff highlands (left) and south-eastern mixed maize zone (right))



(i) Crop condition development graph based on NDVI (semi-arid pastoral (left) and Western mixed maize zone (right))

Table 3.21 Ethiopia's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2019

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Central-northern maize-teff highlands	1028	5	16.7	-0.1	1223	-2	460	-13
South-eastern mixed maize zone	462	35	18.7	-0.3	1210	1	568	-17
Semi-arid pastoral	154	37	25.1	0.2	1356	-1	748	4
Western mixed maize zone	1619	21	19.1	-0.6	1061	-3	533	-18

Table 3.22 Ethiopia's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2019

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Central-northern maize-teff highlands	99	1	110	5	0.98
South-eastern mixed maize zone	99	4	105	0	1.04
Semi-arid pastoral	77	-16	61	52	1.11
Western mixed maize zone	100	0	108	0	1

[FRA] France

The monitoring period covers the final stages of the Maize and spring wheat cultivation and harvesting, as well as the initial planting of winter wheat in October, expected to be completed in November.

Indicators show that crop condition was less favorable than during the previous year and the 5-year average in August, but recovered in September and October. Compared with the average of the past 15 years, RAIN was up 3%, the temperature was slightly below while sunshine recorded a significant increase (RADPAR +4%). The resulting BIOMSS indicator is up 7%.

The spatial NDVI patterns compared to the five-year average indicate that NDVI was above average in 26.4 % of arable land, with just below average values in 52.3% of areas; rather negative NDVI anomalies reaching 0.2 units occurred in remaining areas. Generally crop conditions are quite mixed over the country. However NDVI patterns and VCIx largely agree in several areas: (1) favorable crops occurred in Bretagne, Aquitaine, eastern Picardie, eastern Ile de France and western Champagne-Ardennes as well as western coastal Languedoc-Roussillon; (2) unfavorable to poor crop condition occurred in Bourgogne, eastern Languedoc-Roussillon, western Rhône-Alpes and western Provence-Alpes-Côte-d'Azur. The average VCI nevertheless averaged 0.89, and the CALF reached 99%, a significant increase over the same period last year.

Regional analysis

Considering cropping systems, climatic zones, and topographic conditions, additional sub-national detail is provided for eight agro-ecological zones. They are identified in the maps by the following numbers: (54) **Northern barley region,** (58) **Mixed maize/barley and rapeseed zone from the Center to the Atlantic Ocean,** (55) **Maize_barley and livestock zone along the English Channel**, (56) **Rapeseed zone of eastern France,** (51) **Dry Massif Central zone,** (57) **Southwestern maize zone,** (52) **Eastern Alpes region** and (53) **the Mediterranean zone.**

In the Northern barley region both TEMP and RADPAR were above average (by 0.7°C and 8%, respectively), while RAIN was 15% down. High VCIx values (0.98) reflect overall satisfactory crop condition.

The Maize/barley and livestock zone along the English Channel recorded 260 mm of rainfall over four months, which is average. The temperature was average as well, but RADPAR was 5% above. The BIOMSS rose 9% compared to average. The NDVI profile confirms the conditions of crop was better than during the same period in 2018.

The Mixed maize/barley and rapeseed zone from the center to the Atlantic Ocean experienced warm temperature (up 1.1°C), RAIN was 2% above average, while RADPAR was 5% above. According to the NDVI profile and VCIx map, crop condition was better than last year.

Mostly unfavorable climatic conditions dominated the Rapeseed zone of eastern France with rainfall was 15% below average (302 mm). Temperature was 1.2°C above, and radiation was 6% above average. The CALF reached almost 100% VCIx at 0.88 and with BIOMSS up 7%. The overall situation improved compared with the same period of last year.

The Dry Massif Central zone recorded a 3 rainfall increase, with above average values for both RADPAR (4%) and TEMP (1.2°C). BIOMSS for the region is 4% above the average, and VCIx is fair (0.80). Crop condition is assessed as generally unsatisfactory.

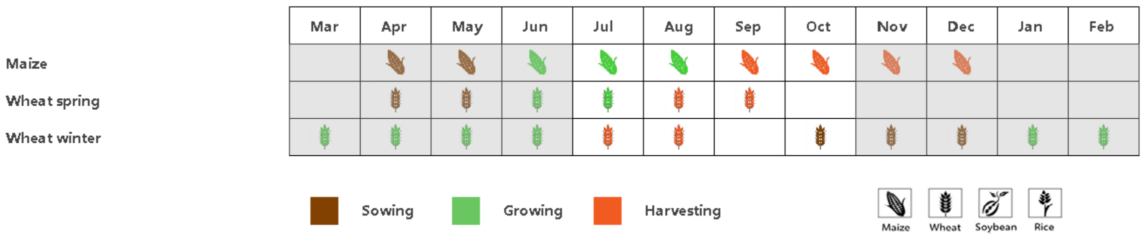
The Southwestern maize zone is one of the major irrigated maize regions in France. The rainfall was up 8% above average, the temperature was above average (+0.9°C), but radiation was above expected values (RADPAR +4%). Crop condition was a little above average according to the NDVI development graph, as confirmed by the 5% increase of BIOMSS. The VCIx map, however, shows that the crop condition was favorable.

Generally, environmental conditions for the eastern Alpes region were close to average with the following values: RAIN +17%, TEMP +0.8°C, and RADPAR+2%. CALF was 97% during the monitoring period, the average VCIx is 0.86 and BIOMSS is up 3%. The NDVI profile confirms the generally fair crop condition.

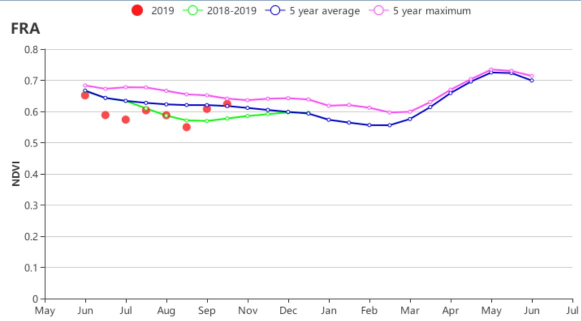
Finally, the largest departures were observed in the Mediterranean zone, especially for rainfall (+42%) even if other indicators remain closer to average: TEMP up 0.9°C and RADPAR up +1%. According to the

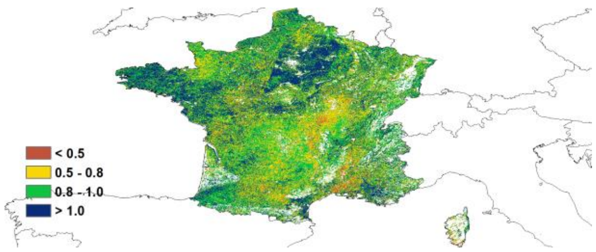
NDVI profiles, crop condition remained favorable since July. BIOMSS was 10% above average, and the VCIx value reached 0.87. CALF increased 2% to 96%. Crops condition is fair.

Figure 3.16 France's crop condition, July - October 2019



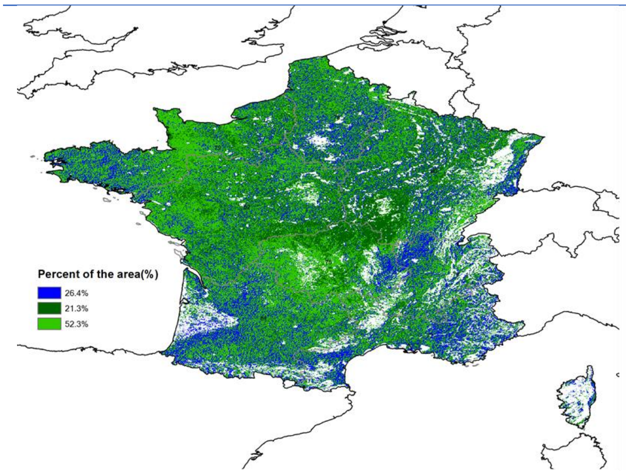
(a). Phenology of major crops

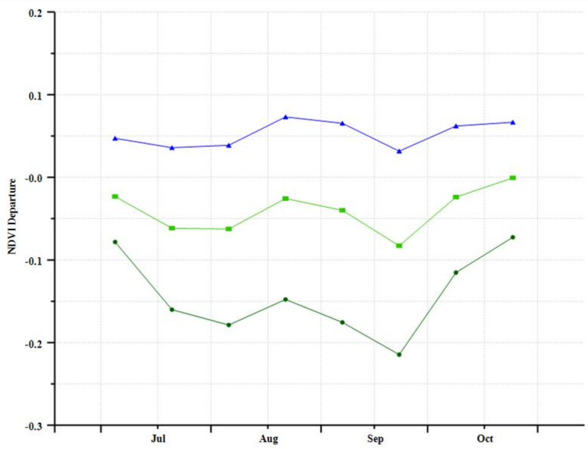




(b) Crop condition development graph based on NDVI

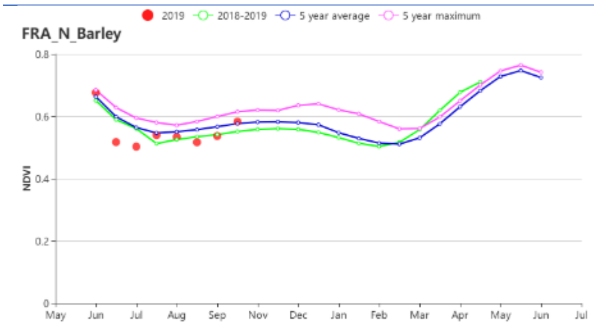
(c) Maximum VCI

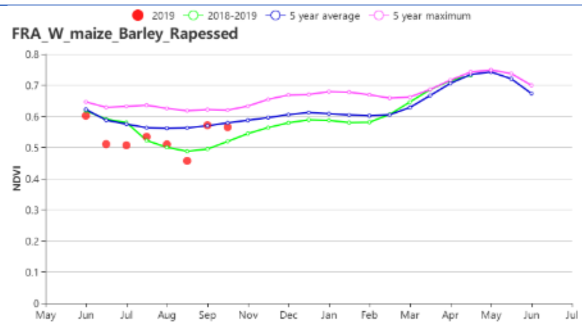




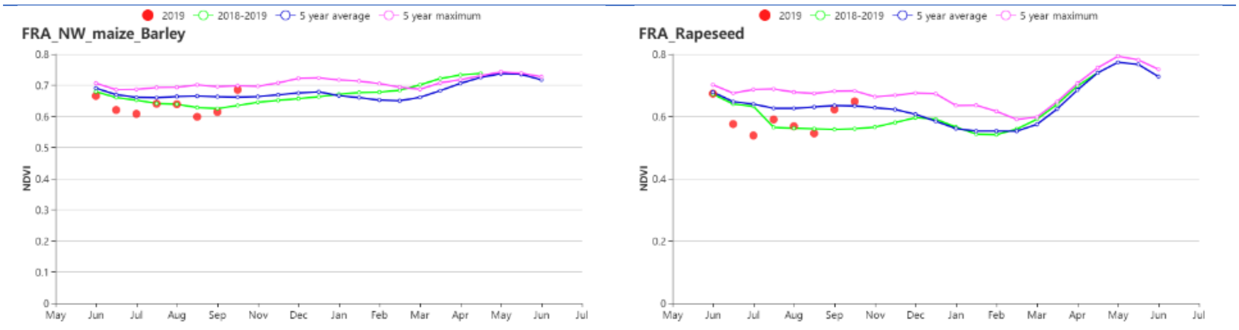
(d) Spatial NDVI patterns compared to 5YA

(e) NDVI profiles

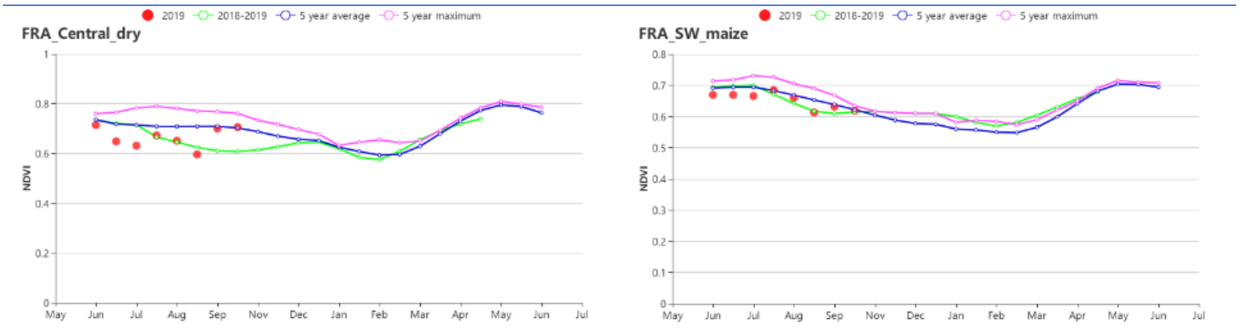




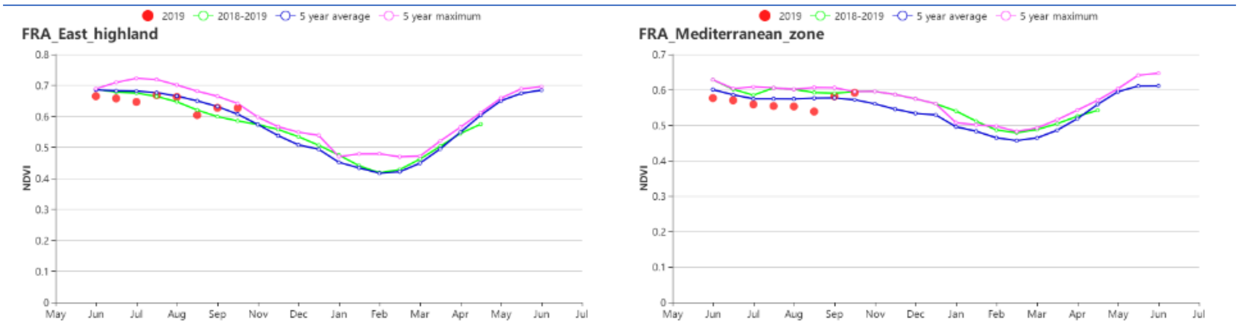
(f) Crop condition development graph based on NDVI (Northern barley region (left) and Mixed maize, Barley and Rapeseed zone (right))



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



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



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

Table 3.23 France's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2019

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Northern Barley zone	330	3	16.1	1.2	1065	4	468	4
Mixed maize/barley and rapessed zone from the Centre to the Atlantic Ocean	458	17	15.4	0.8	1111	2	460	3
Maize barley and livestock zone along the English Channel	383	42	18.2	0.9	1183	1	595	10
Rapeseed zone of eastern France	298	10	16.0	0.6	901	6	397	9
Massif Central Dry zone	249	-15	16.4	0.7	915	8	431	14
Southwest maize zone	300	-15	16.5	1.2	983	6	446	7

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Alpes region	317	8	18.0	0.9	1107	3	548	5
Mediterranean zone	260	2	18.0	1.1	991	5	488	9

Table 3.24 France's agronomic indicators by sub-national regions, current season's value and departure from 5YA, July - October 2019

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Northern Barley zone	100	0	149	12	0.8
Mixed maize /barley and rapessed zone from the Centre to the Atlantic Ocean	97	0	126	6	0.9
Maize barley and livestock zone along the English Channel	95	2	108	6	0.9
Rapeseed zone of eastern France	100	0	123	5	0.9
Massif Central Dry zone	100	0	157	7	1
Southwest maize zone	100	0	167	13	0.9
Alpes region	100	0	128	2	0.9
Mediterranean zone	100	0	139	12	0.9

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

[GBR] United Kingdom

In the United Kingdom crops showed favorable conditions during this reporting period. Currently, summer crops have been harvested, while winter crops (wheat and barley) are at the sowing stage. According to NDVI development graphs, crop condition was below average from July to October. Rainfall, radiation and biomass for the country as a whole were above average (RAIN +17%, RADPAR +4%, BIOMSS +6%) with about average teperature. 21.5% of arable land had above average crop condition at the time of reporting, including most of eastern Leicester, northern Swindon, Southampton, and parts of Dundee. About 21.5% of the region with below average NDVI includes East Norwich, some areas in eastern Lincoln and in eastern Canterbury. The VCIx (0.98) for the country was above average and CALF is unchanged compared to its five-year average, while the Cropping Intensity (CI -5%) was below average.

Regional analysis

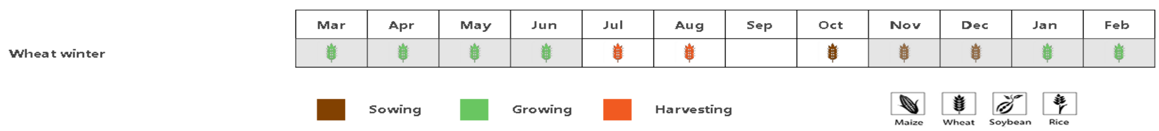
Based on cropping systems, climatic zones, and topographic conditions, three sub-national regions are described below: **Northern barley region**, **Central sparse crop region** and S**outhern mixed wheat and barley region**. All three sub-regions are characterized by unchanged fraction of arable land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

In the **northern barley region**, NDVI was below average from early July to late August and close to average from late August to October. Compared to average, rainfall, sunshine and temperature were all relatively high (RAIN +6%, RADPAR +2%, TEMP +0.1°C). The biomass production potential was up 5% compared to average. The VCIx was above average at 0.97, CI (CI +2%) was above average as well. Although the winter crops season just started, no negative impacts are currently envisaged.

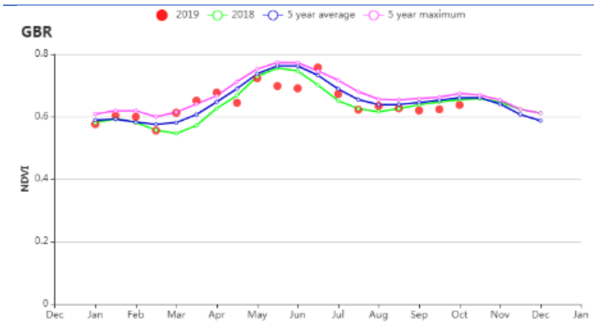
The **central sparse crop region** is one of the country's major agricultural regions in terms of production. NDVI was mostly close to average except for low values at the end of July and during early September. Rainfall (RAIN+20%) was above average, temperature was average and radiation (RADPAR +6%) was above average, which resulted in above average BIOMSS (+8%). The CI (CI -4%) for this region was below average, while VCIx at 1.0 indicates favorable crop condition.

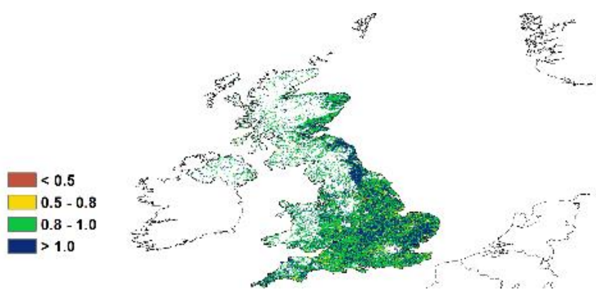
In the **southern mixed wheat and barley zone**, rainfall was above average (RAIN +27%), and temperature (TEMP -0.1°C) was about average. NDVI was below average according to the crop condition graph. The region had above average radiation (RADPAR +4%) and VCIx (0.98), close to other regions, while its CI (CI -6%) was below average. Crop condition is currently neutral.

Figure 3.17 United Kingdom crop condition, July - October 2019



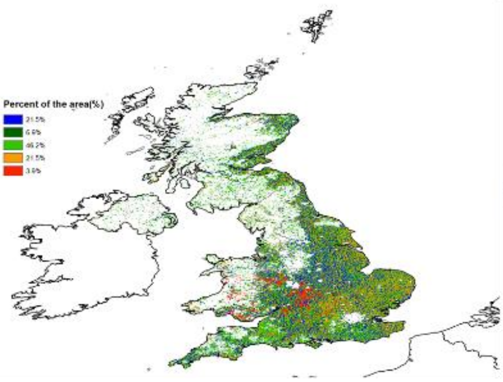
(a). Phenology of major crops

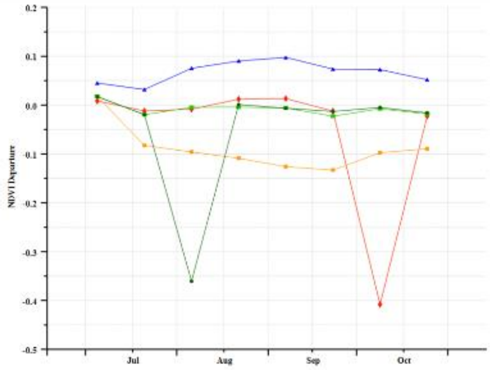




(b) Crop condition development graph based on NDVI

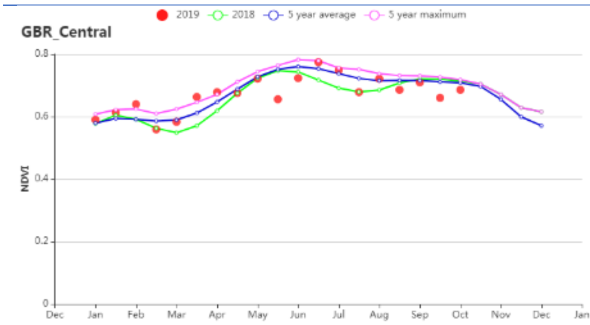
(c) Maximum VCI

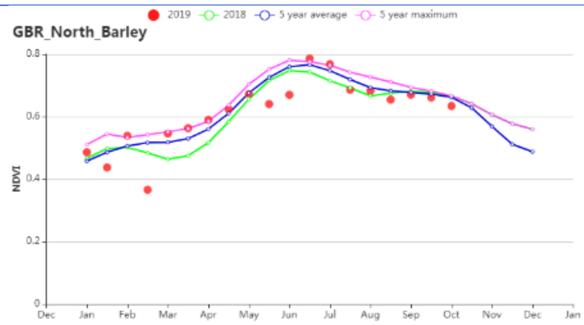




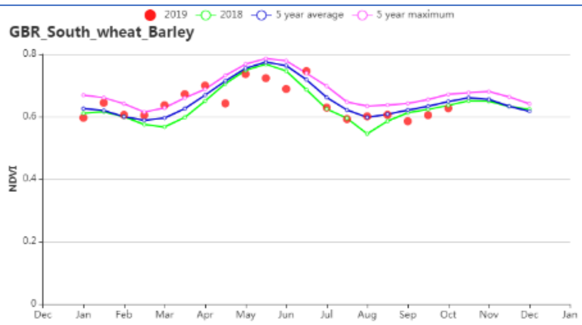
(d) Spatial NDVI patterns compared to 5YA

(e) NDVI profiles





(f) Crop condition development graph based on NDVI (Sparse crop area of N England, Wales and N. Ireland (left) and Northern Barley region (right))



(g) Crop condition development graph based on NDVI (Southern mixed wheat and Barley region)

Table 3.25 United Kingdom's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2019

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure from 15YA (%)	Current (°C)	Departure from 15YA (°C)	Current (MJ/m^2)	Departure from 15YA (%)	Current (gDM/m^2)	Departure from 15YA (%)
Central sparse crop region (UK)	582	20	12.6	0.0	670	6	244	8
North Barley region (UK)	614	6	11.3	0.1	580	2	197	5
South mixed wheat and Barley zone(UK)	427	27	14.2	-0.1	755	4	306	6

Table 3.26 United Kingdom's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2019

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure from 5YA (%)	Current
Central sparse crop region (UK)	100	0	134	-4	1.00
North Barley region (UK)	100	0	157	2	0.97
South mixed wheat and Barley zone(UK)	100	0	138	-6	0.98

[HUN] Hungary

In Hungary, summer crops have now been harvested and winter crops (wheat and barley) have been planted.

Accumulated rainfall was below average (RAIN -25%) while temperature and especially radiation and the resulting BIOMSS were above (TEMP +0.7°C, RADPAR +5%, BIOMSS +12%). According to the national NDVI development graphs, crop condition was above average from July to early August and below average from late August to October. Some spatial and temporal detail is provided by NDVI clusters: NDVI was above average throughout the monitoring period in 15.6% of arable land, below average throughout in 12.0% and just about average in 25.9%.

With the maximum VCI value at the national level reaching 0.91 and the cropped arable land fraction (CALF) at 100% (unchanged compared to the recent five-year average) crop condition is assessed as below but close to average.

Regional analysis

Based on cropping systems, climatic zones and topographic conditions, Hungary is dividedinto 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 cultivated arable land (CALF) compared to average, i.e. 100%, indicating full cropping.

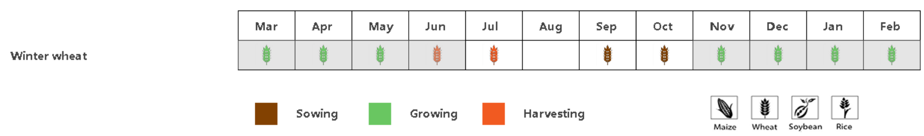
Central Hungary is one of the major agricultural regions in terms of crop production. A sizable share of winter wheat, maize and sunflower is planted in this region. According to the NDVI development graphs, NDVI was above average from July to early August, below average from late August to October. Agro-climatic conditions include above average radiation (RADPAR +6%), temperature (TEMP +0.6°C), biomass(BIOMASS +10.8%) and below average rainfall (RAIN, -29%). The Cropping Intensity was 128(+9%). The VCIx was just fair at 0.87. The crop production in this region is expected to be below but close to average.

Northern Hungary is another important winter wheat region. During this reporting period crops showed favorable conditions according to the crop condition graph. The RAIN was below average (-21%) while temperature, radiation and biomass increased (TEMP +0.3°C, RADPAR +6%, BIOMSS +7%). The Cropping Intensity was 148% (+15%). The VCIx was favorable at 0.91.The crop production in this region is expected to be close to average.

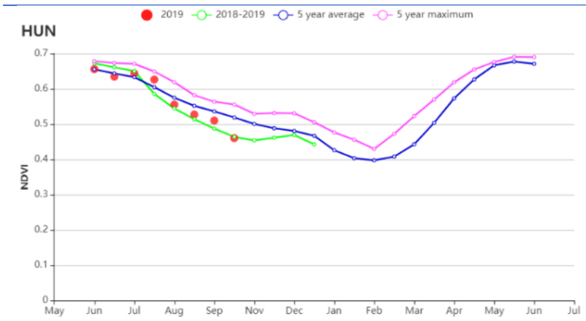
The Puszta region grows mostly winter wheat, maize and sunflower especially in the counties of Jaz-Nagykum-Szolnok and Bekes. According to the NDVI development graph, crop condition was above average from July to early August and below average from late August to October. The rainfall was below average (-16.5%) but temperature, radiation and biomass were all above average (TEMP +0.5°C, RADPAR +5%, BIOMSS +8%). The Cropping Intensity was 115 (down 4%), the maximum VCI was 0.91.The crop production in this region is expected to be below but close to average.

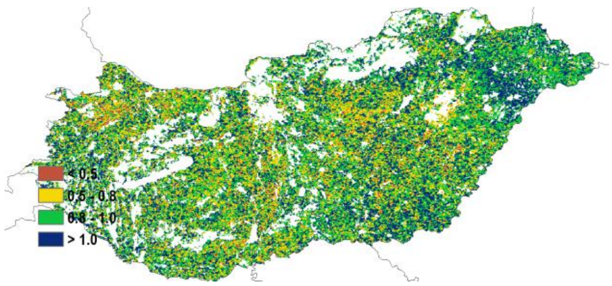
Southern Transdanubia cultivates winter wheat, maize, and sunflower, mostly in Somogy and Tolna counties. Crop condition was below average from July to early August, and above average from late August to October. The RAIN was below average (-35%) with all temperature, radiation and biomass above average (TEMP +1°C, RADPAR +5%, BIOMSS +14%). The Cropping Intensity was 144 (+19%). The maximum VCI was favorable at 0.87.The crop production in this region is expected to be below average.

Figure 3.18 Hungary's crop condition, July - October 2019.

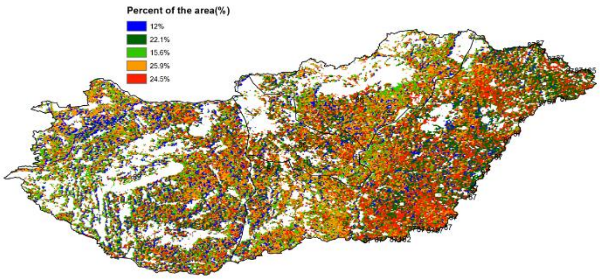


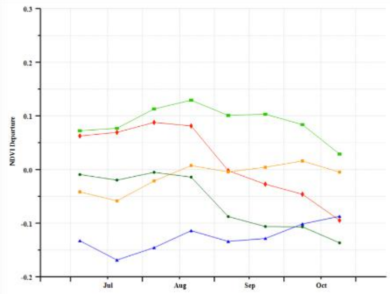
(a). Phenology of major crops



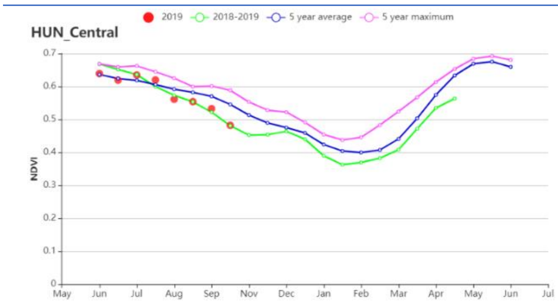


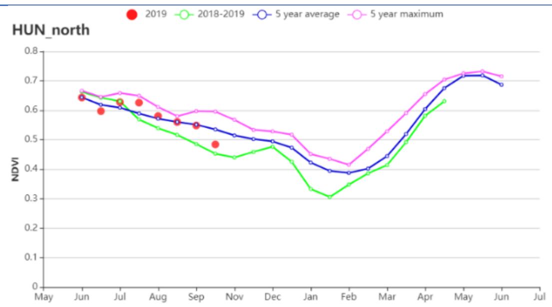
(b) Crop condition development graph based on NDVI (c) Maximum VCI



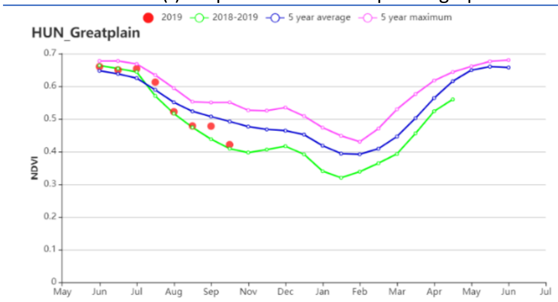


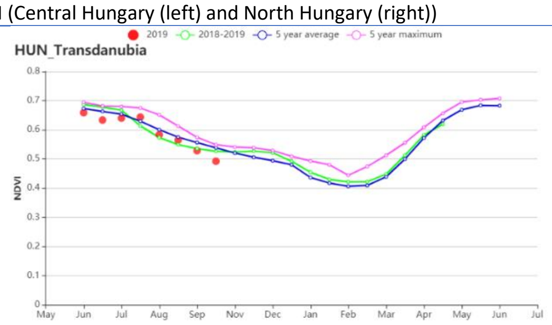
(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles





(f) Crop condition development graph based on NDVI (Central Hungary (left) and North Hungary (right))





(g) Crop condition development graph based on NDVI (Great Plain (left) and Western Transdanubia (right))

Table 3.27 Hungary's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2019

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 region	140	-29	19	-0.6	1087	6	568	11
North Hungary	172	-21	18	0.4	1038	6	519	7
Puszta	180	-17	19	0.5	1070	5	558	8
Transdanubia	142	-35	19	1	1079	5	576	14

Table 3.28 Hungary's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2019

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure from 5YA (%)	Current
Central region	100	0	128	9	0.87
North Hungary	100	0	148	15	0.91
Puszta	100	0	115	-4	0.91
Transdanubia	100	0	144	19	0.87

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[IDN] Indonesia

The dry season maize and second rice reached maturity during the monitoring period, while the main rice started being planted. Sunshine was above average (RADPAR up 8%) and temperature was just average. Although precipitation (RAIN -29%) suffered a significant decrease, potential biomass production was unaffected (BIOMASS+2%). According to NDVI profiles, crop condition was below average in 57.2 % of total cropped areas. In 22.3% of arable land - mostly located in West Kalimantan, Riau and Jambi Provinces - NDVI was slightly below average at first but deteriorated at the end of this monitoring period. Considering that the area of cropped arable land (CALF) in the country is comparable to the five-year average and the VCIx value reached 0.94, the national production is anticipated to be average or slightly below.

Regional Analysis

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

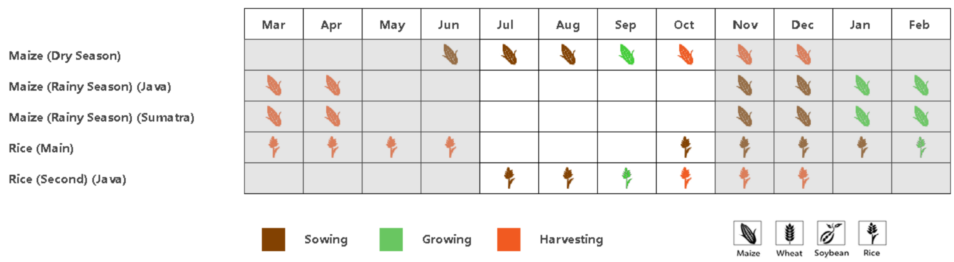
In Java, compared with average weather was dry (RAIN, -88%), cool (TEMP, -0.3°C) and sunny (RADPAR +7%) was above average. Due to the scarcity of rainfall, biomass production potential suffered a significant decrease of 13%. According to the NDVI development graph and average cropping intensity, crop condition was below 5-year average. Overall, the crop condition in Java was unfavorable.

The weather in Sumatra differed little from the national average: slightly increased temperature (TEMP, 0.4°C) and radiation (RADPAR +9%), and significantly reduced RAIN (-36%) which brought about a decrease in biomass production potential (BIOMSS, +3%). According to NDVI development graphs, crop condition was initially slightly below 5-year average but deteriorated at the end of August. Crop condition in Sumatra is assessed as below average.

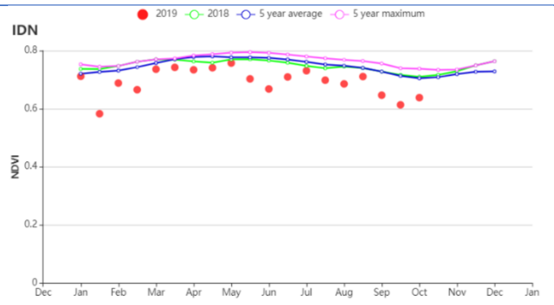
Kalimantan and Sulawesi experienced dry conditions with rainfall falling 34% below average, temperature close to average and radiation increasing 9%, which resulted in an increase of biomass production potential by 4% compared to the recent five-year average. As shown in NDVI development graphs, crop condition was below average at the beginning of August and the end of September, and below but close to average at other times. Crop condition in Kalimantan and Sulawesi was slightly below average.

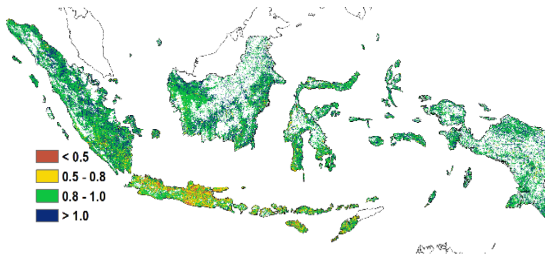
Considering that all the arable land was cultivated, CropWatch anticipates crop condition will be unfavorable.

Figure 3.19 Indonesia's crop condition, July - October 2019



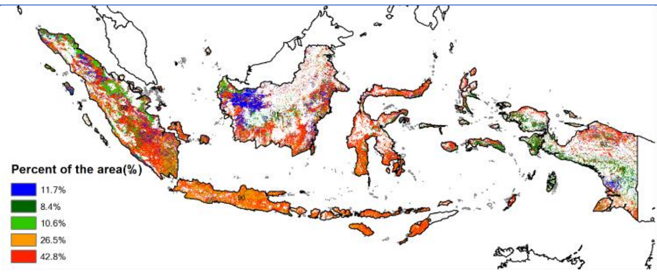
(a). Phenology of major crops

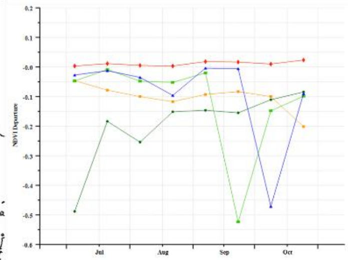




(b) Crop condition development graph based on NDVI

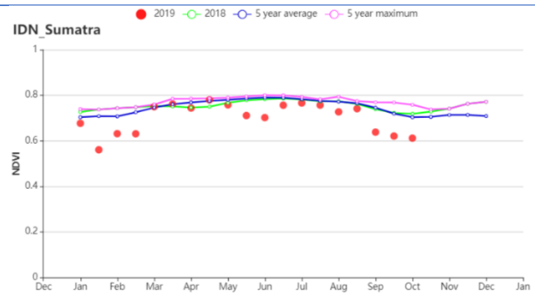
(c) Maximum VCI

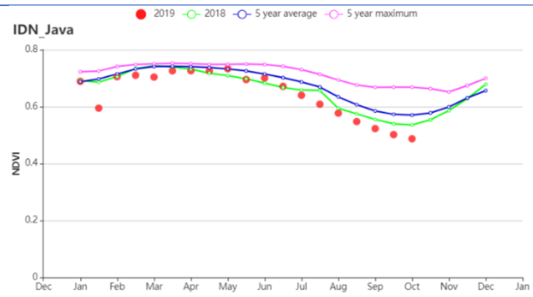




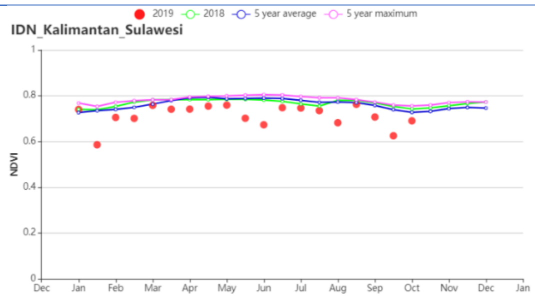
(d) Spatial NDVI patterns compared to 5YA

(e) NDVI profiles





(f) Crop condition development graph based on NDVI (Sumatra (left) and Java (right))



(g) Crop condition development graph based on NDVI (Kalimantan-Sulawesi)

Table 3.29 Indonesia's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2019

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	41	-88	24.2	-0.3	1327	7	634	-13
Kalimantan and Sulawesi	608	-34	24.4	0	1300	9	811	4
Sumatra	626	-36	24.6	0.4	1276	9	791	3
West Papua	1361	-11	22.4	-0.2	989	5	610	1

Table 3.30 Indonesia's agronomic indicators by sub-national regions, current season's value and departure from 5YA, July - October 2019

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure from 5YA (%)	Current (%)	Departure from 5YA (%)	Current
Java	97	-1	126	-1	0.78
Kalimantan and Sulawesi	100	0	136	2	0.97
Sumatra	100	0	139	6	0.96
West Papua	100	0	166	11	0.98

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

[IND] India

The current monitoring period covers the vegetative development and flowering of the rainfed Kharif (summer) season crops: maize, rice, and soybean, to be harvested from November. Rabi wheat was planted in October. Crop condition as assessed by NDVI dropped below average starting July, but recovered to average values in October.

At the national scale rainfall was far higher (+40%) than the average, with large spatial differences: Deccan Plateau (+58%), Eastern coastal region (+47%), Gangatic plain (+21%), Assam and north-eastern regions (+4%), Agriculture areas in Rajasthan and Gujarat (+106%), Western coastal region (+53%), North-western dry region (+145%). Only the Western Himalayan region had close to average precipitation (RAIN down 3%). The 2019 rainy season was one of wettest in recent history, especially since July, and created widespread havoc (refer to section 5.2 on Disasters). Heavy rainfall is probably the main factor behind India's unfavorable crop growth development from July to September. The temperature was average (0.3°C lower than the average) but sunshine was more significantly down (RADPAR -5%).

BIOMSS generally improved over Rajasthan and Gujarat, the North-western dry region and the Western Himalayan region, where rainfall was generally beneficial and less destructive. CALF nevertheless dropped 35% in the in the North-western dry region.

Overall, due to water damage, the condition of rice, maize and soybean was significantly lower than average during this period.

Regional analysis

India is divided into eight agro-ecological zones: the **Deccan Plateau** (94), the **Eastern coastal region** (95), the **Gangatic plain** (96), **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 **Deccan Plateau region** recorded 1621 mm of RAIN (+58% relative to average), 25.1°C TEMP (-0.2°C) and 960 MJ/m² RADPAR (-9%). Biomass tends to the average. The CALF reached 99% which was close to the 5YA, and VCIx was 1.0. But crop condition as assessed by NDVI dropped below average starting July, just recovered to average values in October. Indicates that crops in this region may be affected by heavy rainfall during the rainy season.

The **Eastern coastal region** recorded 1492 mm of RAIN (+47% relative to average) and 26.1°C TEMP (-0.6°C).The RADPAR of 1020MJ/m² RADPAR was 8% lower than the average and BIOMASS was 8% below the 15YA. The region recorded 3% lower than average cropped area and a VCIx of 1.0 indicating moderate to good crop condition.

The **Gangatic region** recorded 1390 mm of RAIN (+20% relative to average), 26.9°C TEMP (-0.1°C) and 705 MJ/m² RADPAR (-4%). Biomass was close to average with CALF at 98% (1% higher than 5YA slightly) and VCIx at 1.0. But crop condition as assessed by NDVI dropped below average starting July, just recovered to average values in October. In general, the summer crop yield in this region may be lower than the average.

The **Assam and North-eastern region** recorded 2372mm of RAIN (+4% relative to average) and 23.8°C TEMP (average). The RADPAR of 930 MJ/m² was 2% lower than the average and BIOMASS was 1% below the 15YA. The CALF reached 96% which is nearly the 5YA. Crop condition was good with VCIx at 1.0.

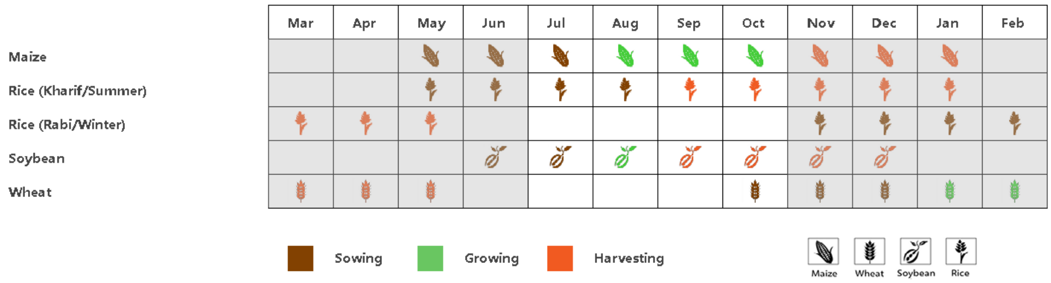
The **Agricultural areas** in Rajasthan and Gujarat region recorded up to 1749 mm of RAIN (+106% relative to average), 27°C TEMP (-0.4°C) and 982MJ/m² RADPAR (-9%). The BIOMASS was higher than average by 14%. The CALF recorded 97%, close to the 5YA value, and VCIx was high at 1.0, indicating good production in general. However, this area is the main soybean planting area in India. And soybean production may be affected by heavy rainfall, resulting in significant yield reduction.

The **Western coastal region** received 53% higher than average rainfall, average TEMP (-0.1°C) and low sunshine (RADPAR 841MJ/m², -10%). This region had 13% lower than average BIOMASS. The CALF recorded 97% which is 5% higher than 5YA, and VCIx was 1.0. But crop condition as assessed by NDVI dropped generally below average, this indicates that the crop production may be below average.

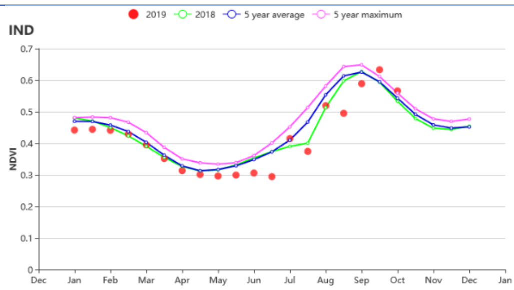
The **North-western dry region** recorded 145% higher than average rainfall, average TEMP and a minor drop in sunshine (RADPAR 1196MJ/m², down -2%). This region had 27% higher than average BIOMASS. The CALF was just half the arable land of the previous seasons due to a 35% drop (from 85% to 50%), and VCIx was 0.9. Although crop growth in this region was satisfactory, the large reduction in planted area of CALF will cause a drop in production.

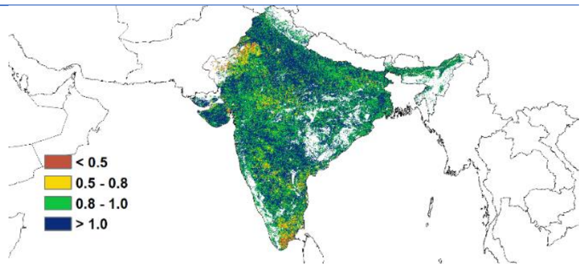
The **Western Himalayan region r**eceived 3% lower than average rainfall, with average TEMP (-0.2°C) and sunshine (RADPAR up 1% to 1197MJ/m²). This region had 9% higher than average BIOMASS. The CALF recorded 99% which is 1% higher than 5YA, and VCIx was high at 1.0 indicating good production in general.

Figure 3.20 India's crop condition, July - October 2019

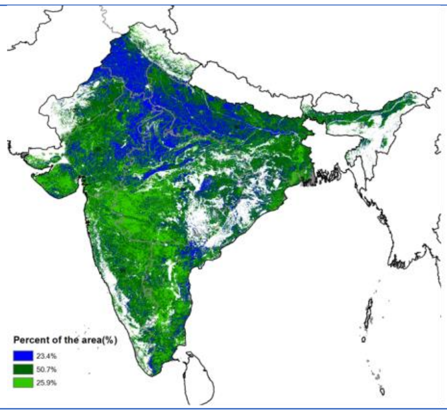


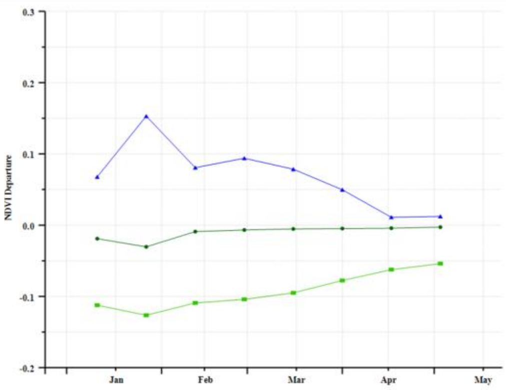
(a). Phenology of major crops



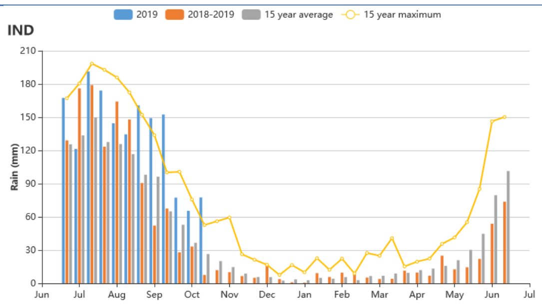


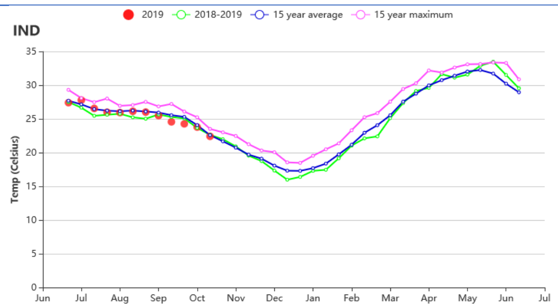
(b) Crop condition development graph based on NDVI (c) Maximum VCI



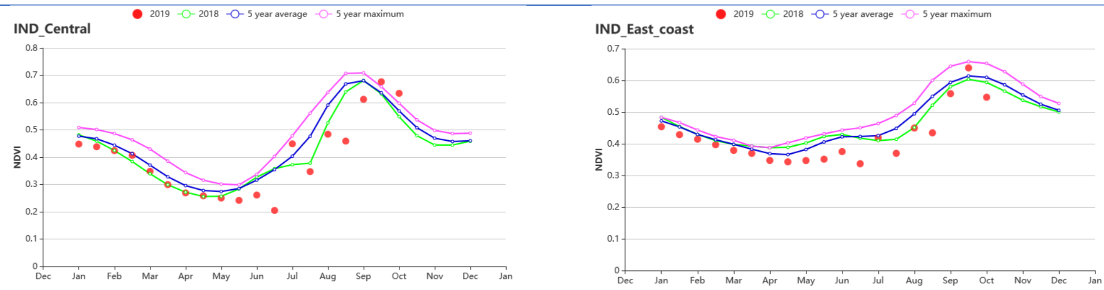


(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles

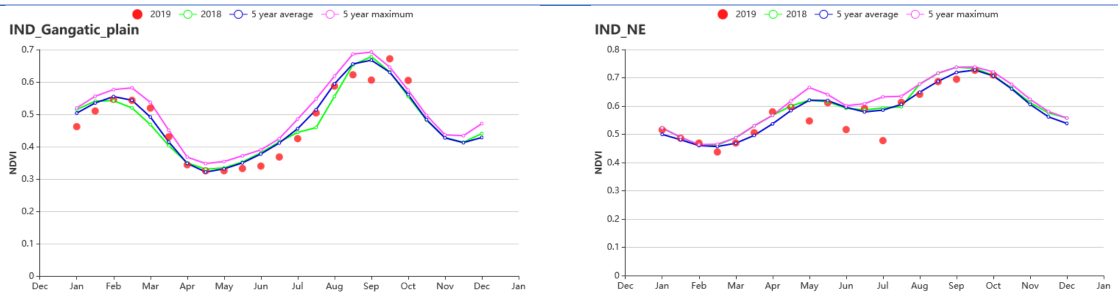




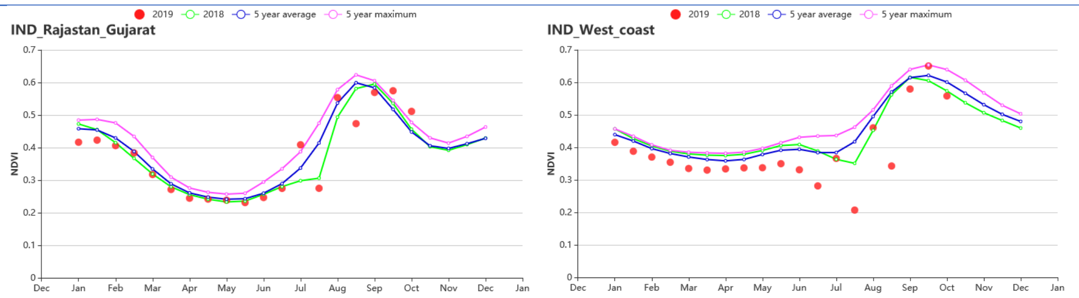
(f) Rainfall profiles (g) Temperature profiles



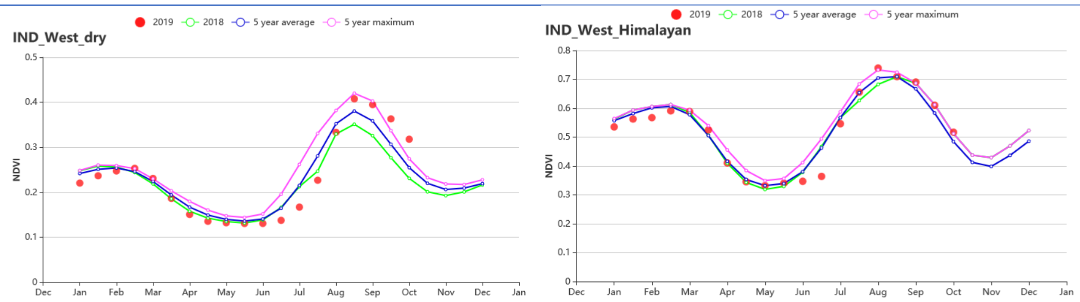
(h) Crop condition development graph based on NDVI (Deccan Plateau (left) and Eastern Coastal Region (right))



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



(j) Crop condition development graph based on NDVI (Agriculture areas in Rajastan 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 3.31 India's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2019

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m^2)	Departure (%)	Current (gDM/m^2)	Departure (%)
Deccan Plateau	1621	58	25.1	-0.2	960	-9	633	0
Eastern coastal region	1492	47	26.1	-0.6	1020	-8	679	-8
Gangatic plain	1390	21	27	-0.1	1079	-5	706	0
Assam and north-eastern regions	2373	4	23.8	0	930	-2	576	-1
Agriculture areas in Rajasthan and Gujarat	1749	106	27	-0.4	980	-9	652	14
Western coastal region	2074	53	23.6	-0.1	841	-13	543	-10
North-western dry region	655	145	30.9	0	1196	-2	695	27
Western Himalayan region	753	-3	22.2	-0.2	1197	0	591	9

Table 3.32 India's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2019

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure from 5YA (%)	Current (%)	Departure from 5YA (%)	Current
Deccan Plateau	99	0	133	4	1.01
Eastern coastal region	93	3	117	6	0.97
Gangatic plain	98	1	171	6	1.02
Assam and north-eastern regions	96	1	141	4	0.98
Agriculture areas in Rajasthan and Gujarat	97		127	8	1.01
Western coastal region	97	5	100	-4	0.99
North-western dry region	50	-35	48	81	0.9
Western Himalayan region	99	1	178	11	1.02

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

[IRN] Iran

Crop condition was generally above the five-year maximum from July to October 2019 in Iran. The harvest of summer crops (potatoes and rice) was almost over by the end of August, while winter crops (wheat and barley) started to be sown in September. Accumulated rainfall and temperature were above average (RAIN +19%, TEMP +0.4°C), while radiation was close to average. The favorable agro-climatic conditions resulted in an increase in the BIOMSS index by 8% above average. The national average of maximum VCI index was 0.97, and the Cropped Arable Land Fraction (CALF) was up by 28% over the recent five-year average. The cropping intensity (65% above the five-year average) indicated higher crop land utilization in 2019.

According to the national crop condition development graphs, crop condition in about 77.1% of croplands was above or close to average from July to October. Remaining croplands experienced unfavorable crop condition in about 20% of arable land, mainly in some patches of Ardabil, Gilan, Mazandaran and Golestan Provinces in the North, and in the south-western Province of Khuzestan.

Overall, the outputs of summer crops are estimated to be favorable.

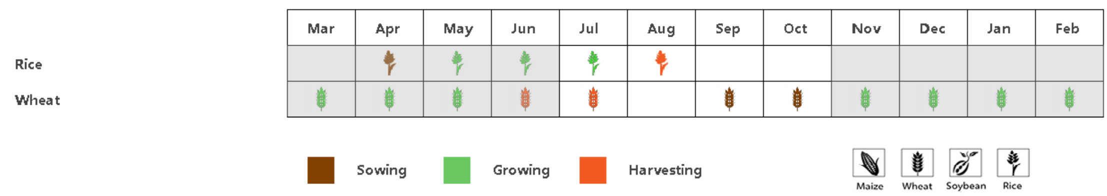
Regional analysis

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

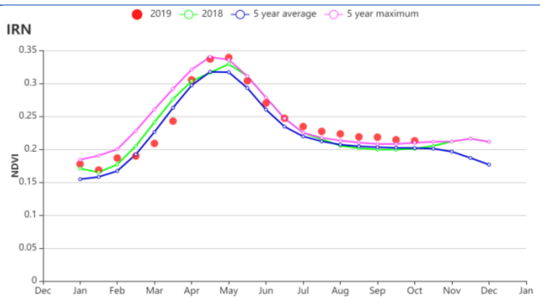
In the **Semi-arid to sub-tropical hills of the west and north region**, the accumulated rainfall was 72mm (18% above average), and temperature was close to average (TEMP up 0.2°C). The CALF increased by 23%. The cropping intensity CI (33%) indicates single cropping in this region. According to the NDVI profiles, the crop condition was above or close to five-year maximum in the reporting period. The national maximum VCI (VCIx) reached a high value of 0.99. The outcome of summer crops is assessed as favorable in this region.

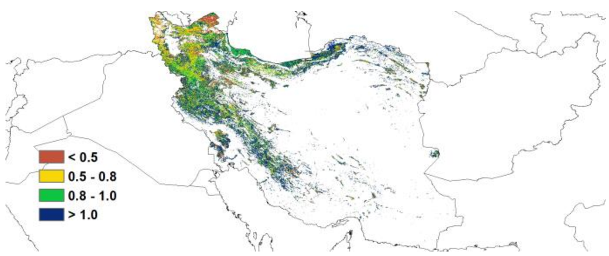
Crop condition in the **Arid Red Sea coastal low hills and plains region** was above average. The region received seasonably low rainfall (11 mm). The BIOMSS was 82% higher than average due to favorable weather condition. NDVI profiles showed that NDVI did not exceed 0.2 from July to September. The CALF was 10% and the average VCIx was 0.97. The cropping intensity (38%) indicates single cropping. The agro-climatic conditions were favorable for winter crop sowing and early emergence.

Figure 3.21 Iran's crop condition, July - October 2019



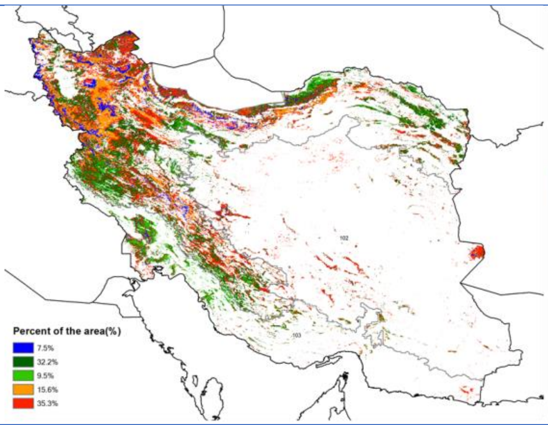
(a) Phenology of major crops

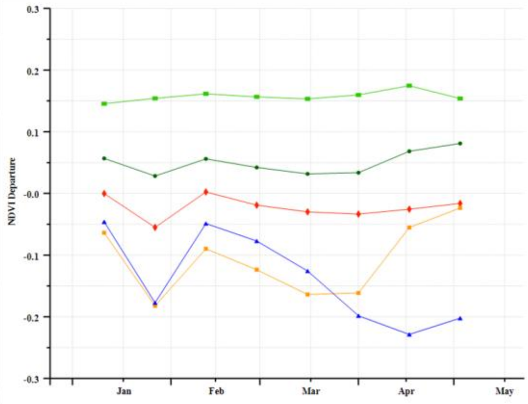




(b) Crop condition development graph based on NDVI

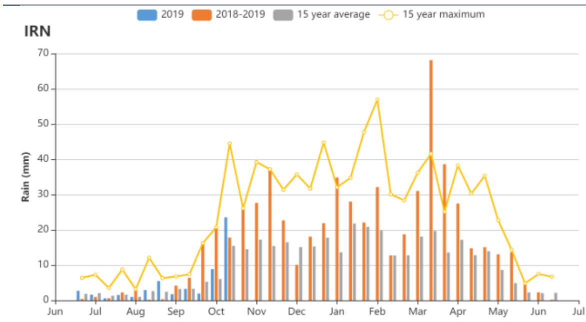
(c) Maximum VCI

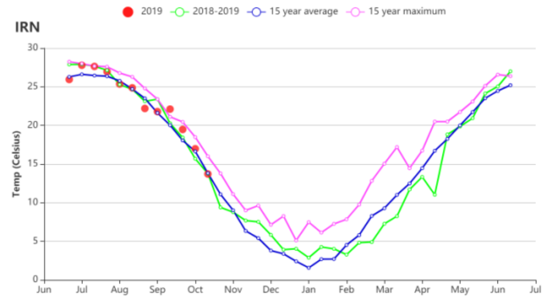




(d) Spatial NDVI patterns compared to 5YA

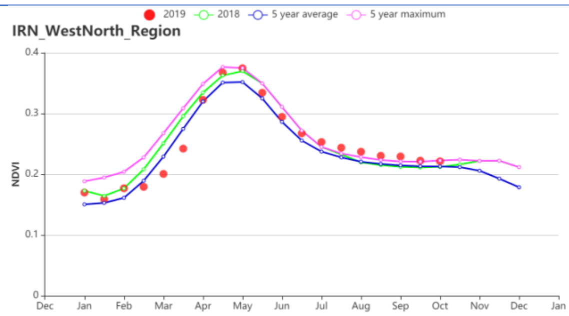
(e) NDVI profiles

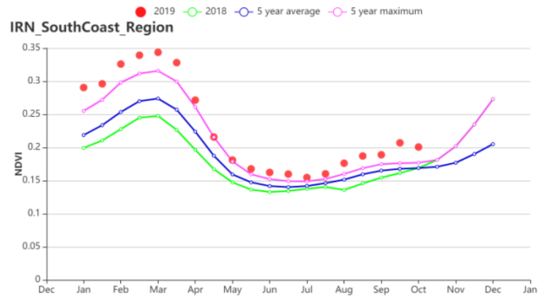




(f) Rainfall profiles

(g) Temperature profiles





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

Table 3.33 Iran's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2019

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m^2)	Departure (%)	Current (gDM/m^2)	Departure (%)
Semi-arid to sub-tropical hills of the west and north	72	18	20.6	0.2	1402	-1	282	-2
Arid Red Sea coastal low hills and plains	11	33	34.4	0.9	1453	-1	220	82

Table 3.34 Iran's agronomic indicators by sub-national regions, current season's value and departure from 5YA, July - October 2019

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure from 5YA (%)	Current (%)	Departure from 5YA (%)	Current
Semi-arid to sub-tropical hills of the west and north	13	23	33	56	0.99
Arid Red Sea coastal low hills and plains	10	100	38	144	0.97

[ITA] Italy

Winter wheat was harvested in July and the 2019-20 crop was sown in October. Summer crop harvest took place in September and early October, sometimes later for rice. According to the NDVI development graph, crop condition was generally above the average of the past five years and almost the same as during the previous season. About 43.1% of arable land in the eastern coastal areas (northern half of the country) and southern Po valley showed average or above-average crop condition. The situation was more mixed in some areas (southern coast ans islands) where VCIx was poor as well (28.4% of arable land). In the central Po valley (16.9% of areas) crop condition was less than favorable at the beginning of July and August before the harvest of winter wheat but gradually improved as only summer crops remained in the field and the new wheat crop was planted.

The rainfall profile indicates high rainfall over the country in July and mid-August. Rainfall (343 mm) was just above average (+5%). The temperature profile shows a heat wave from mid-July to August, during which the TEMP exceeded average. Nationwide and for the whole reporting period TEMP and RADPAR were slightly above the average (by 0.7°C and 1%, respectively. CALF was 86% and BIOMSS increased 5% over average; VCIx was about 0.8. Overall crop condition in the country is satisfactory.

Regional analysis

Based on cropping systems, climatic zones, and topographic conditions, four sub-national regions can be distinguished for Italy: **the Eastern coast**, **Po Valley**, **the Islands** and **Western Italy**.

On **the Eastern coast**, with low RAIN (-13%), somewhat high TEMP (+0.9°C) and RADPAR (+3%), overall condition of wheat was average at best: BIOMSS increased by 7% compared with the averages but VCIx was just fair (0.78) and CALF fell -29%. Cropping intensity increased (+14%). The NDVI development graph of NDVI exceeds the 5 years average and the previous season values from July to August, but dropped to the 5 years average after September after the harvest of winter wheat. According to agro-climatic indicators, just average output is expected.

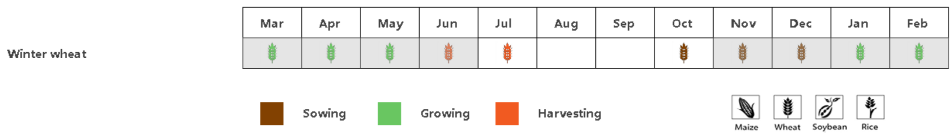
The **Po Valley** recorded above average RAIN (+10%) and CI (+17%), average temperature (+0.7°C). and RADPAR (0%) with high VCIx (0.91) and CALF (100%). BIOMSS is down 2%. The NDVI development graph indicates that crop condition was better than the 5 years average during this period, and exceeds 5 year maximum in October. Based on agro-climatic indicators, about average output is expected.

In the **Islands**, RAIN, TEMP and RADPAR exceeded their averages by 14%, 0.7°C and 1%, respectively. Other indicators were close to their values on the Eastern coast: CI up 15% and BIOMSS up 11%. VCIx was only 0.62 with low CALF (54%). The crop condition development graph of NDVI indicates values closed to the 5 year average but dropping below September. Generally, output is expected to be average or below.

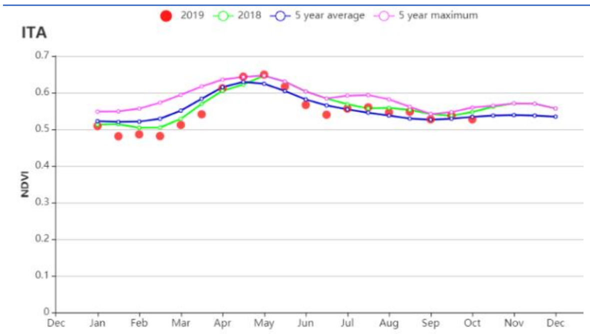
The situation in **Western Italy** resembles that of the Po valley: RADPAR +2%, TEMP +0.6°C, CI at 132%, VCIx at 0.88 and CALF close to full cropping (95%). RAIN was average and BIOMSS was up 8%. The NDVI development graph indicates mostly above average crop condition. CropWatch expects fair average production.

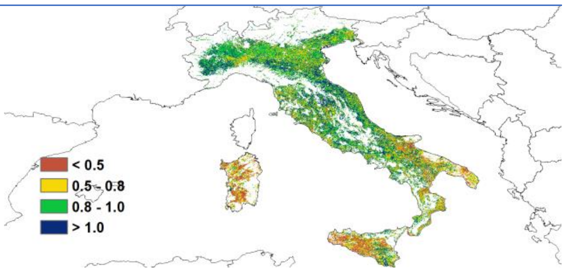
With the mentioned situations, crop prospects are generally average or above for summer crops, but average or below for winter wheat.

Figure 3.22 Italy's crop condition, July - October 2019.



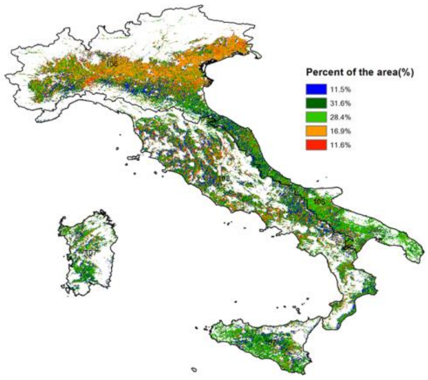
(a). Phenology of major crops

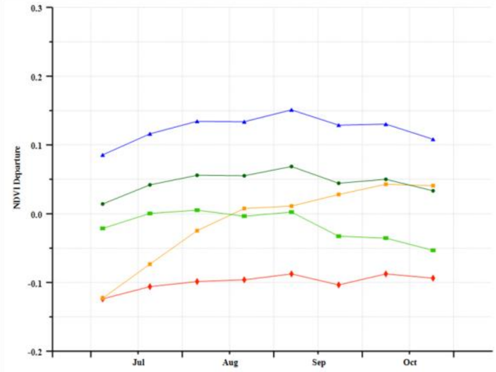




(b) Crop condition development graph based on NDVI

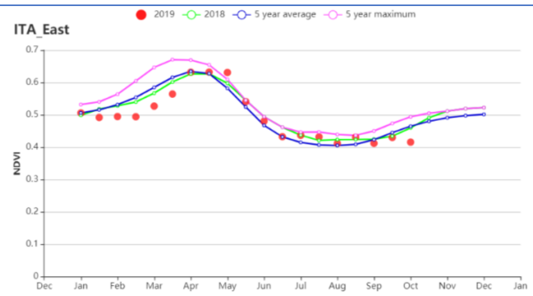
(c) Maximum VCI

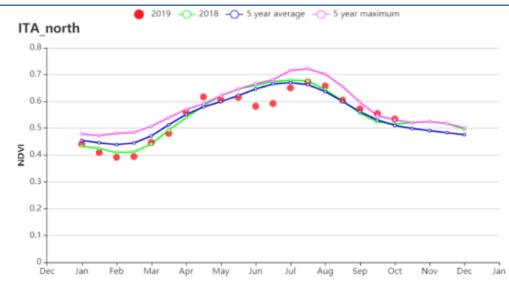




(d) Spatial NDVI patterns compared to 5YA

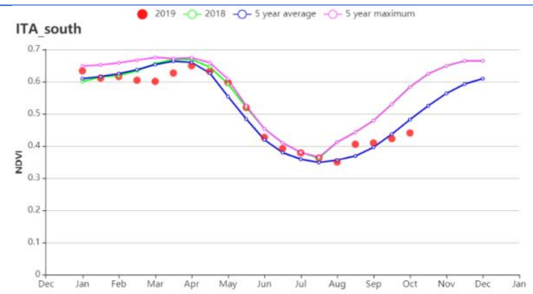
(e) NDVI profiles

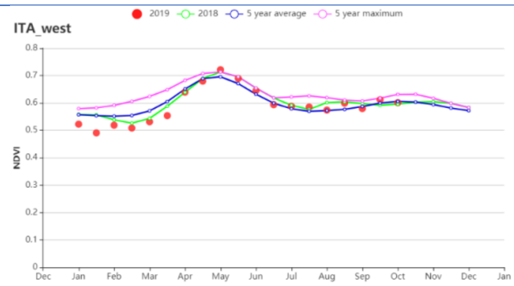




(f) East coast (Italy) crop condition development graph based on NDVI

(g) Po Valley (Italy) crop condition development graph based on NDVI





(h)Islands (Italy) crop condition development graph based on NDVI

(i). Western Italy (Italy) crop condition development graph based on NDVI

Table 3.35 Italy's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2019

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 (%)
East coast	183	-13	22	0.9	1221	3	704	7
Po Valley	500	10	18	0.7	1083	0	551	-2
Islands	181	14	23	0.7	1295	1	648	11
Western Italy	267	0	20	0.6	1196	2	633	8

Table 3.36 Italy's agronomic indicators by sub-national regions, current season's value and departure from 5YA, July - October 2019

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Current (%)	Current (%)	Departure from 5YA (%)	Current
East coast	64	-28.5	117	14	0.78
Po Valley	100	0.3	135	17	0.91
Islands	54	7.8	117	15	0.62
Western Italy	95	8.2	132	12	0.88

[KAZ] Kazakhstan

The monitoring period covers the growth of spring wheat up to July and the harvest in August and September. Only one crop is grown (CI is 100%). There have no crops in October in Kazakhstan, except for winter rye. The national average VCIx was 0.76 and the Cropped Arable Land Fraction decreased by 8% compared to the five-year average. Among the Crop Watch agro-climatic indicators, RAIN and RADPAR were above average (+11% and +1%) at the national scale. However, rainfall dropped well below average and last year's in July and August. Furthermore, TEMP was also slightly above average (0.3°C) during the monitoring period. Especially in July temperature was close to the fifteen-year maximum. The combination of the factors resulted in high BIOMSS (+4%) compared to the fifteen-year average. As shown by the NDVI development graph, crop condition was generally below the five-average in the whole monitoring period, except during October. High temperature and low precipitation between July and August, have negatively affected spring wheat yields. NDVI cluster graphs and profiles show that 22.5% (July to late August) of the cropped areas was above average in northern part of Oral, some parts of East Kazakhstan, Semey, Shymkent and Kzyl-orda provinces and small parts of North Kazakhstan, Karaganda, Pavlodar, Kokshetau, Karanganda, Taldy Kurgan, Almaty and Taraz provinces. 77.5% of the cropped areas was below average in other provinces from July to late August. Overall, crop condition and output were unfavorable in the reporting period.

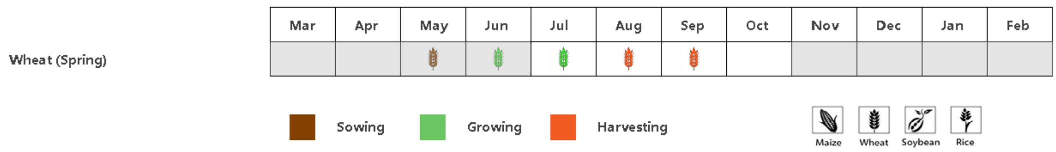
Regional analysis

In the **Northern region**, crop condition was lower than the five-year average from July to September and close to the average in October. RAIN was above average (12%)., together with TEMP and RADPAR (+0.2°C and +1%, respectively). BIOMSS was up 1% but cropped arable land fraction fell 12%. The maximum VCI index was 0.72 in this region. Overall, the outcome of the crop deemed to be unfavorable.

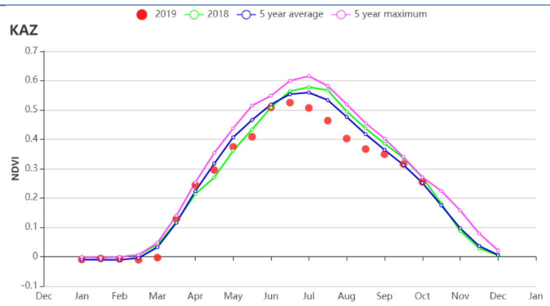
The **Eastern plateau and southeastern region** had below average NDVI in July and October and close to 5YA conditions in August and September. RAIN, TEMP and RADPAR were above average (12%, 0.2°C and 1%, respectively). The resulting BIOMSS variation was +7%. The maximum VCI index was 0.88 and cropped arable land fraction increased by 3%. Overall crop prospects are normal.

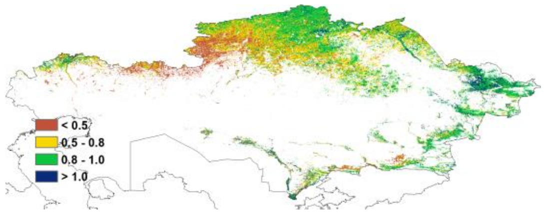
Crop condition for the **South region** was close to the average and slightly higher than the five-year average. RAIN was down (-14%) and TEMP and RADPAR were above their average by 0.2°C and 1%, respectively. Both the BIOMSS index and cropped arable land increased by 15%. The maximum VCI index was 0.87. Overall crop condition was favorable.

Figure 3.23 Kazakhstan's crop condition, July - October 2019

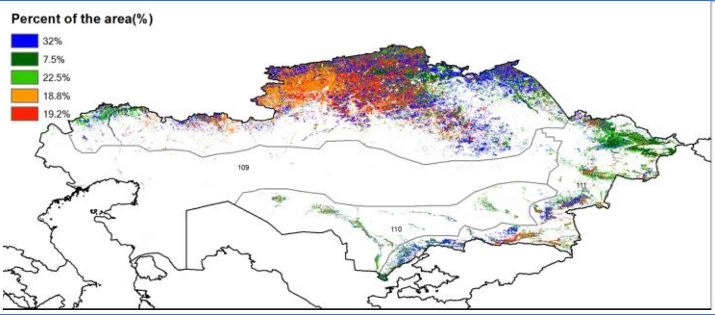


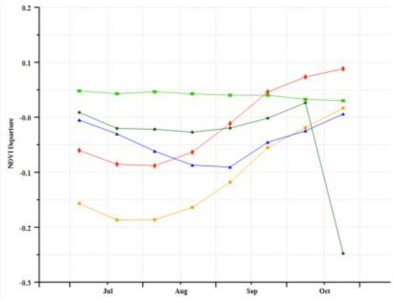
(a). Phenology of major crops



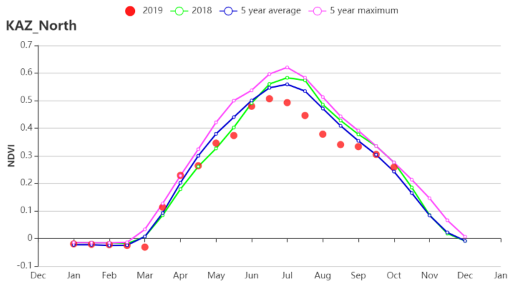


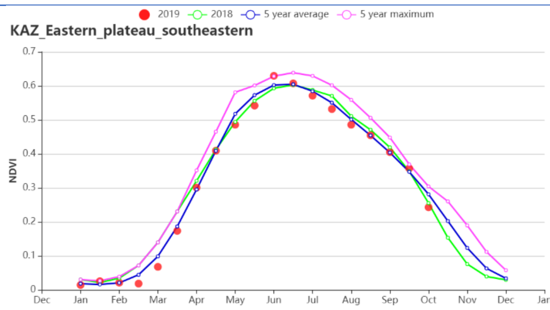
(b) Crop condition development graph based on NDVI (c) Maximum VCI



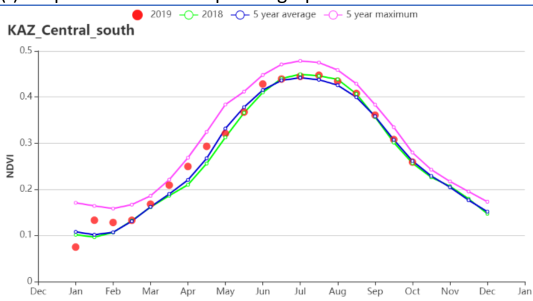


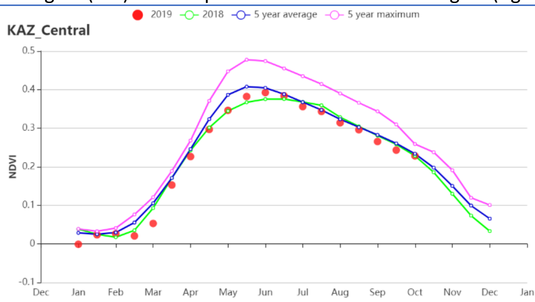
(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles





(f) Crop condition development graph based on NDVI in Northern region (left) Eastern plateau and southeastern region (right))





(g)Crop condition development graph based on NDVI in South region(left) and Central non-agricultural region (right)

Table 3.37 Kazakhstan agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2019

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Northern region	180	12	14.9	0.2	937	1	423	1
Eastern plateau and southeastern region	232	10	15.5	0.5	1173	1	463	7
South region	39	-14	22.3	0.5	1270	1	515	15
Central non-agriculture region	120	28	17.1	-0.4	1072	-1	532	6

Table 3.38 Kazakhstan, agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2019

Region	BIOMSS		CALF		Maximum VCI
	Current (gDM/m²)	Departure from 15YA (%)	Current (%)	Departure from 5YA (%)	Current
Northern region	463	2	-	-	0.74
Eastern plateau and southeastern region	534	13	38	3	0.82
South region	633	15	-	-	1.02
Central non-agriculture region	538	-2	-	-	0.66

[KEN] Kenya

Kenya experiences a large variety of "long" rain and "short rain" patterns according to elevation and distance from the ocean. They result in corresponding cropping patterns (long rain maize and wheat, short rain maize). During the reporting period, the long rain maize and wheat were harvested and the short rain maize was planted and started growing.

Both the rainfall and RADPAR experienced increases above average, a significant 52% and 5 % respectively. The temperature was about average (down 0.2°C) with cropped arable land fraction up 6%. The significant above-average of rainfall nevertheless resulted in a drop in BIOMASS (-3%). As shown by the crop condition development graph, national NDVI values were mostly above those for the five-year average. The spatial NDVI patterns further indicate that NDVI is above average in 57.5% of arable land (around Nairobi, Murang'a and Nyeri, with below-average NDVI in the other regions. This spatial pattern is reflected by the maximum VCI, which averages 0.93 countrywide. The national crop condition is assessed as generally favorable.

Regional analysis

Considering the cropping system, climatic zones and topographic conditions we divide Kenya into four Agro-ecological regions: The Coast, Highland agriculture zone, northern rangelands, and South-west.

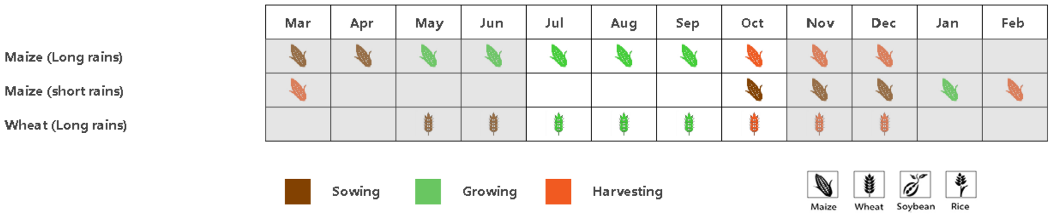
The **Coast** includes the districts of Kilifi, Kwale, and Malindi. During the monitoring period, except temperature, all CropWatch agro-climatic and agronomic indicators were above average. The rainfall was recorded as 615 mm with a significant increase by 150 % compared to average. RADPAR also exceeded average by 5% and biomass was up 3%. The NDVI profile stayed below the five-year average with slight fluctuations throughout the reporting period. VCIx reached 0.96 with CALF up 10%. The cropping intensity was 180%, 19% above the 5YA. Conditions were favorable for both livestock and crops in the coastal areas.

The **Highland agriculture zone** recorded 416 mm of rain, above-average by 38%. While the temperature was average (TEMP up just 0.1°C) BIOMSS fell by -6% and sunshine was up (RADPAR +4%). In the highland agriculture zone, the NDVI profile was average during the whole reported period. The maximum VCIx value was recorded at 0.90. In this area the cropping intensity was ranked as double-cropping (150%) with a positive departure of 24%. In general, the crop condition was favorable.

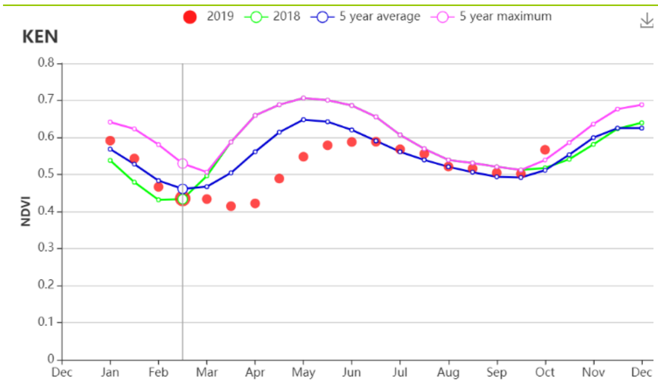
In the **northern region** with sparse vegetation, except for the stable temperature all CropWatch agro-climatic and agronomic indicators were above average. Compared to other regions, the total rainfall was low (RAIN 345 mm) but nevertheless about double the average. This region is mostly pastoral and a 2% increase in BIOMSS has benefited livestock. RADPAR slightly increased by 3%. The NDVI development curve shows values below the five years average during the entire monitoring period. The maximum VCI was high at 1.00 with a significant increase in CALF (+55%). The cropping intensity (ranked as single cropping, 98%) recorded a negative departure of 1%. Overall, the CropWatch indicators point at favorable conditions.

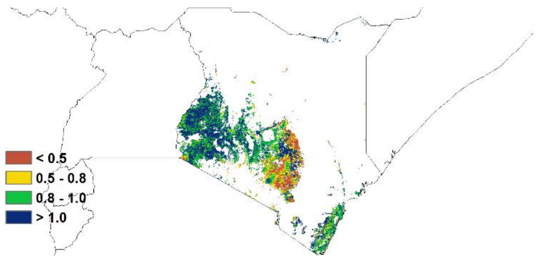
South-west of Kenya includes the districts Narok, Kajiado, Kisumu, Nakuru, and Embu which are major producers of long rain wheat and maize. The total amount of rainfall recorded during the reported period reached 562 mm (43% above average). All CropWatch indicators were recorded as above average, except for the minor negative departure in temperature (-0.6°C). The total biomass production was above average (+1%). RADPAR was up 10% and CALF 27%. NDVI was above the five-year average during the entire monitoring period with a maximum VCI value of 1.00 In the South-west of Kenya, the cropping intensity was 144% and ranked as double cropping with positive departure of 12% compared to the last five-years. In general, the crop outlook is favorable in south-west of Kenya.

Figure 3.24 Kenya's crop condition, July – October 2019

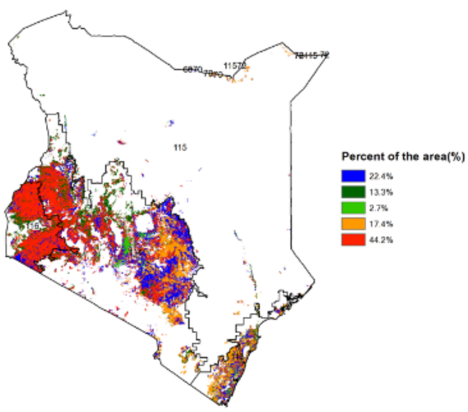


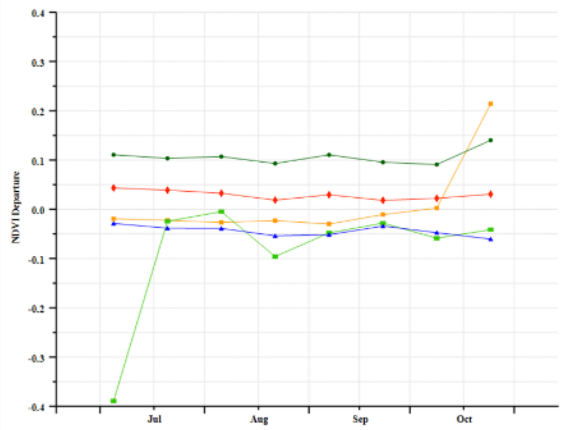
(a). Phenology of major crops



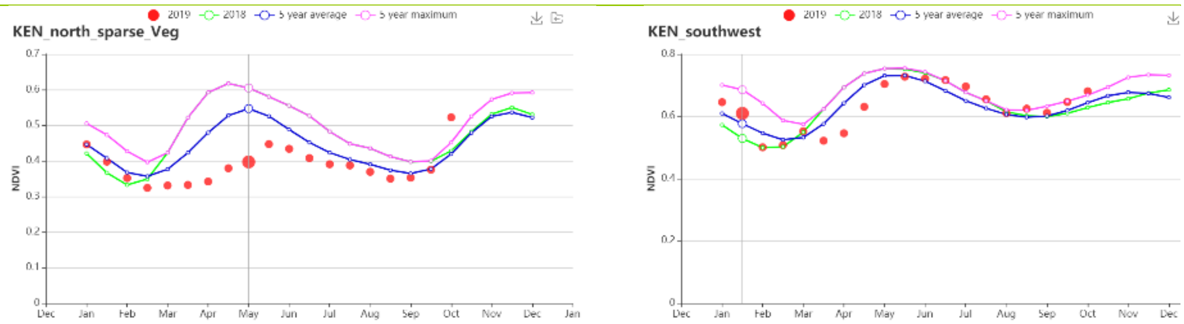


(b) Crop condition development graph based on NDVI (c) Maximum VCI

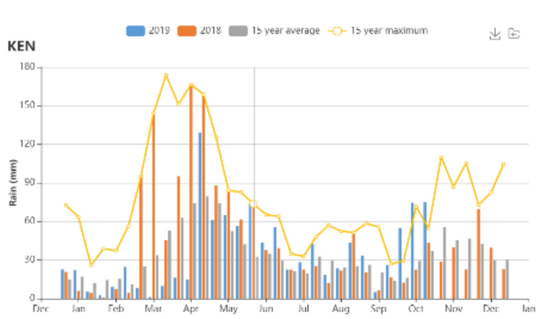




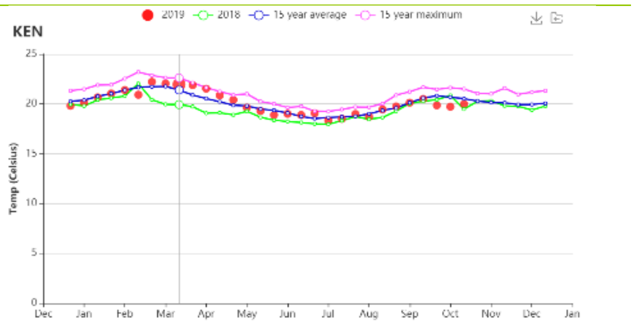
(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles



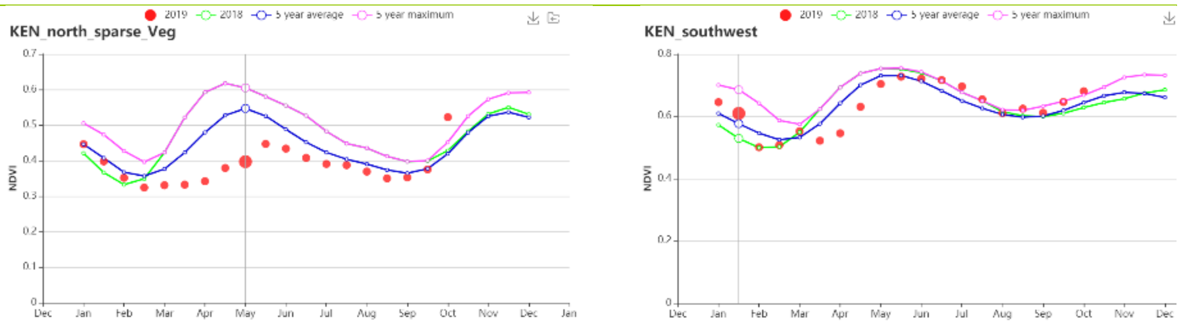
(f) Crop condition development graph based on NDVI (Coast(left) and Highland agriculture zone(right))



(d) Rainfall Index



(e) tempratrure index



(g) Crop condition development graph based on NDVI (Northern rangelands (left) and South-west (right))

Table 3.39 **Kenya's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July – Octoberl 2019**

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 (%)
Coast	615	150	24.3	0	1260	5	829	3
Highland agriculture zone	416	38	18.1	-0.1	1168	4	538	-6
nothern rangelands	349	103	23.9	0	1255	3	773	2
South-west	562	43	19.1	-0.6	1329	10	663	1

Table 3.40 **Kenya's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July – October 2019**

Region	Cropped arable land fraction		CROP INTENSITY		Maximum VCI
	Current (%)	Departure from 15YA (%)	Current (%)	Departure from 5YA (%)	Current
Northern region	72	-12	64	-16	0.72
Eastern plateau and southeastern region	83	3	92	13	0.88
South region	61	15	56	28	0.87
Central non-agriculture region	42	9	45	19	0.73

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

[KHM] Cambodia

The monitoring period covers the whole growing and harvesting season of maize in Cambodia; it was also the sowing period for the wet season rice. Nationwide Cambodia suffered a deficit in rainfall (RAIN, 1181 mm, -8%), but temperature (TEMP, 25.4°C, +0.0°C) and radiation (1115 MJ/m2, +3%) were close to average. According to the rainfall profiles, rain was short mainly in early and mid July, but quickly recovered to normal in August. In addition, agronomic indicators show a favorable crop situation, with nearly all arable land cropped (CALF 0.97), maximum vegetation condition index (VCIx) at 0.93 and stable potential biomass (BIOMSS, 750 gDM/m2, +3%) under single and double cropping (CI, 121%).

National NDVI data show that crop condition gradually recovered to 5 year average after the sudden decrease in July (probably caused by low rainfall); VCIx was above 0.8 in most areas. According to spatial NDVI patterns, the NDVI in 41% of cropped areas was consistently close to 5 year average, with 11% of arable land always above the average. 25% of cropland, concentrated in the south-western hilly region and the northern plain was influenced by the July rain deficit. Eventually, about 90% of agricultural areas was close or above the average at the end of monitoring period.

Generally, seasonal rainfall deficiency did not impact the overall crop development, and the production of Cambodia can be expected to be fair.

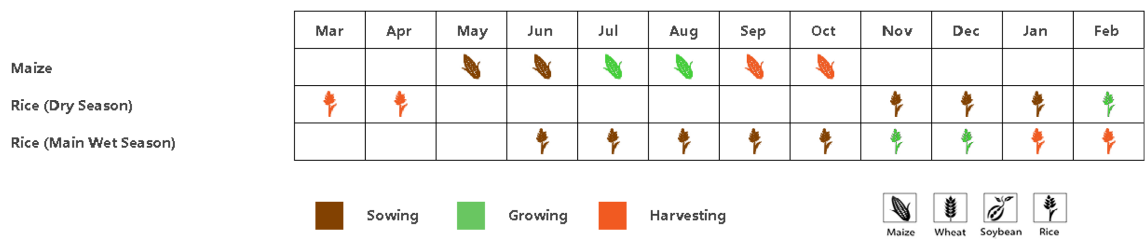
Region analysis

Based on climate differences and topography four agro-ecological regions (AEZs) can be distinguished for Cambodia, the **Tonle-Sap lake area** where the seasonally inundated freshwater lake and especially temperature are influenced by the lake itself, the **Mekong valley between Tonle-sap and Vietnam border** and **Northern plain** and **north-east** covers agriculturally important regions East of the Lake, and the **South-western Hilly region along the Gulf of Thailand coast.**

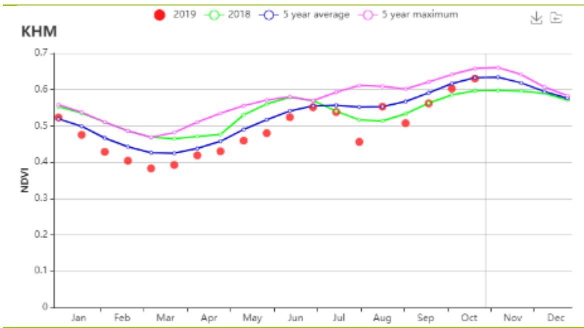
In spite of a minor NDVI drop (0.05 units) from July to September, everything in the **Tonle Sap** region was as expected: stable agro-climate (RAIN -1%, TEMP +0.1°C, RADPAR +1%) and average agronomic conditions (CALF and CI) with VCIx at 0.91, resulting in average biomass (758 gDM/m2, +1%).

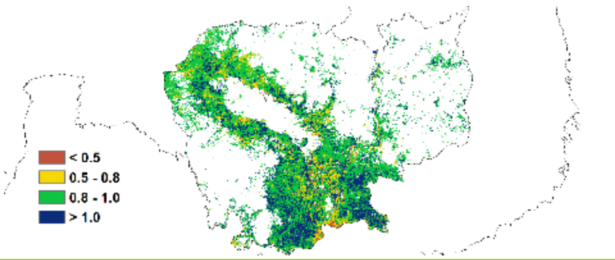
Remaining areas (**Mekong valley between Tonle-sap and Vietnam border, Northern plain and north-east and South-western Hilly region**) experienced similar patterns of agro-climate and agronomic indicators: a rainfall deficit of 4% to 14%, average temperature (TEMP, -0.2 to +0.2°C) and radiation (RADPAR, +3 to +5%), stable high CALF and VCIx and similar cropping intensities (123% to 146%). NDVI development curves were similar, falling in late July and reverting to average in September. With the potential biomass would up by 3% to 4%, the overall situation was favorable for crops.

Figure 3.25 Cambodia's crop condition, July – October 2019



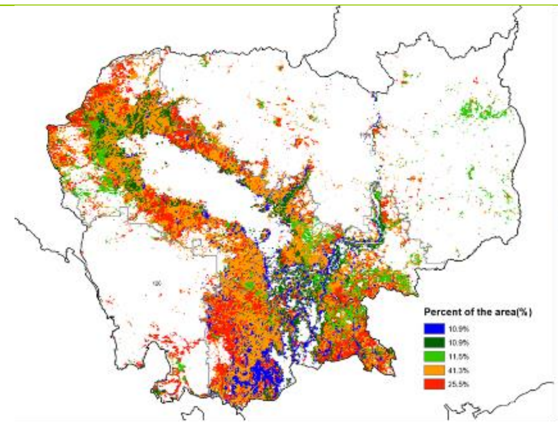
(a). Phenology of major crops

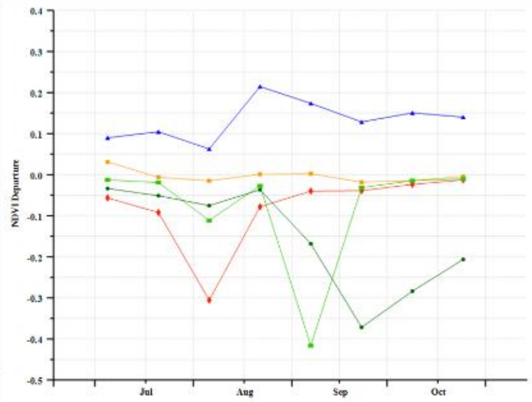




(b) Crop condition development graph based on NDVI

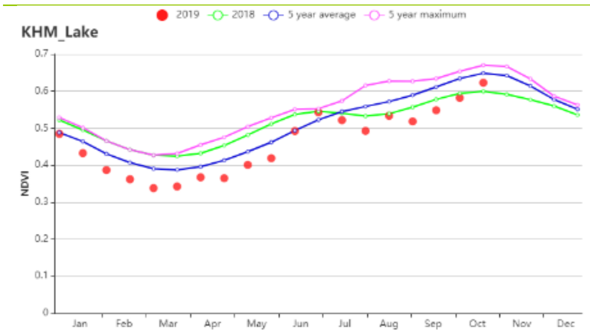
(c) Maximum VCI

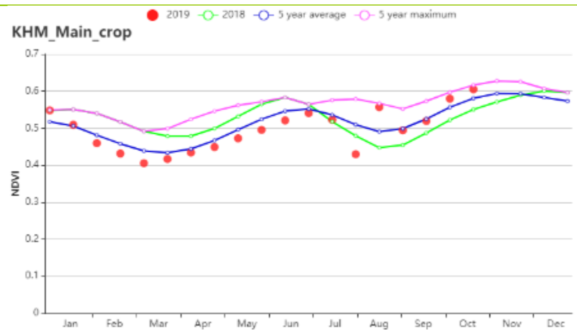




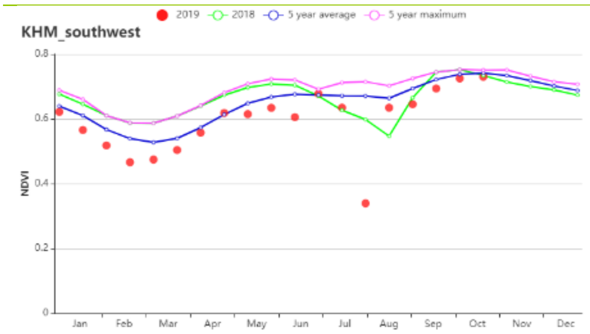
(d) Spatial NDVI patterns compared to 5YA

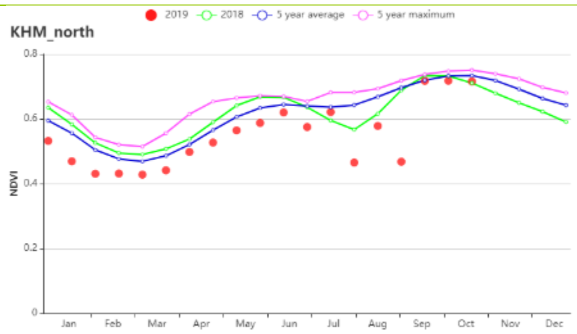
(e) NDVI profiles



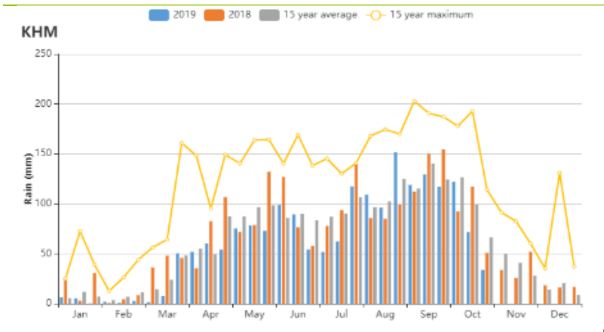


(f) Crop condition development graph based on NDVI_Central Tonle-Sap plain (left) and Mekong valley between Tonle-sap and Vietnam borders (right))

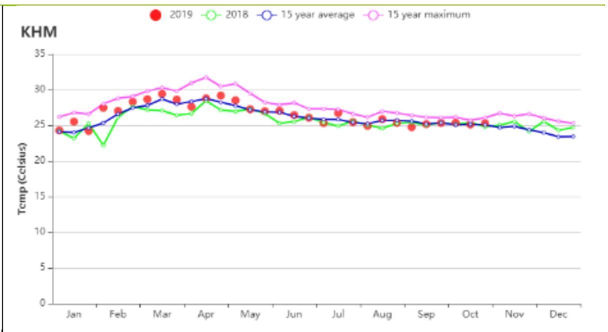




(g) Crop condition development graph based on NDVI_Southwest Hilly region (left) and Northern plain and northeast (right))



(h) Rainfall Index



(i) tempratrure index

Table 3.41 Cambodia agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July – Octoberl 2019

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Tonle Sap	1008	-1	25.8	0.1	1126	1	758	1
Mekong valley between Tonle-sap and Vietnam border	1118	-4	25.8	-0.1	1142	3	772	3
Northern plain and northeast	1388	-14	25.1	-0.2	1092	5	731	4
Southwest Hilly region	1214	-7	24.0	0.2	1092	4	738	4

Table 3.42 Cambodia, agronomic indicators bysub-national regions, current season's values and departure from 5YA, July – October 2019

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Tonle Sap	98	0	113	3	0.91
Mekong valley between Tonle-sap and Vietnam border	95	0	123	2	0.94
Northern plain and northeast	99	0	137	3	0.94
Southwest Hilly region	99	0	146	5	0.96

[LKA] Sri Lanka

Sri Lanka cultivates maize and rice as its two main crops and two growing periods are rotated in one year for every kind of crop. The main season (Maha) covers October to March while the rest belongs to the second season, Yala. The reporting period covers the late Yala growth and harvest of rice and maize, and early sowing season of Maha rice and maize.

According to the CropWatch monitoring results, crop condition was generally below average for the whole period.

The country experienced a period of abundant precipitation with rainfall (RAIN) 48% above average, while temperature (TEMP) and radiation (RADPAR) were lower by 0.4℃ and 5%, respectively. The fraction of cropped arable land (CALF) remained comparable to the recent average. BIOMSS slightly decreased (down 2%) due to reduces sunshine which affected Yala crops. The NDVI development graph displays stable crop condition throughout the period but slightly below the 5YA. Similar crop conditions also occurred in three AEZs as described below. The relatively poor performance of crops may result from the effect of continuous rainfall. The maximum VCI value for the whole country was 0.93.

As shown by NDVI clusters map and profiles, spatial heterogeneity of crop condition was significant throughout the country's cropland. 32.3% area of cropland displayed above-average crop condition for the whole period, including eastern coastal areas, south of Badulla and the area between Puttalam, Kurunegala and Anuradhapura. 13.8% area of cropland located in western Hambantota showed fair crop condition during the entire period except for late September. Other cropland was consistently below average and distributed mainly in eastern and north-Central Provinces. The VCIx map confirms NDVI clusters with high values in the West-Northern Province and relatively low values in the North-Central Province.

Regional analysis

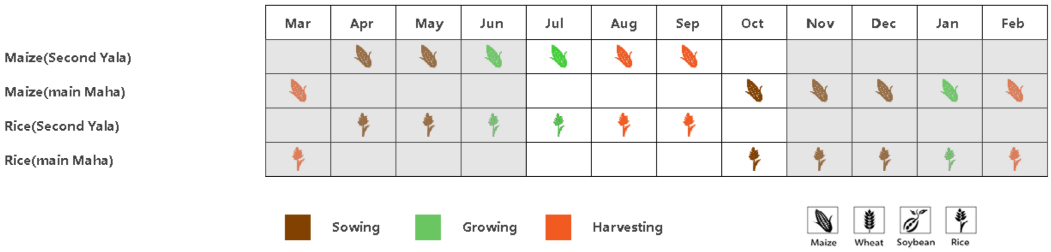
Based on the cropping system, climatic zones and topographic conditions, three sub-national agro-ecological zones (AEZ) can be distinguished for Sri Lanka. They are the Dry zone, the Wet zone, and the Intermediate zone.

The **Dry zone** experienced its rainy season from September. The recorded RAIN (919mm) was 67% above average and amounts to over 7 mm per day. TEMP was down 0.5°C below average with RADPAR down as well, by -5%; BIOMASS and CALF were average. The cropping intensity was 180% (near double cropping), which is 44% above the 5YA. The maximum VCIx for the zone was 0.9. Overall, crop condition was below the recent 5YA.

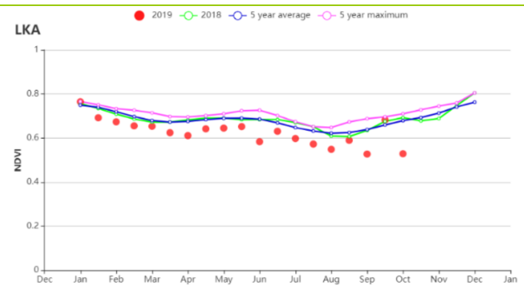
The rainy season in the **Intermediate zone** started from September with RAIN reaching 2752 mm, 31% above average. More than 20 mm precipitation per day is adequate for any crop. TEMP, RADPAR and BIOMASS were all below average by 0.1°C, 4% and 4%, respectively. The region was a mixture of single and double cropping, with cropping the intensity at 135%, slightly above 5YA. The maximum VCIx value for the zone was 0.98. Condition of crop was better than the other two sub-national regions but nevertheless below its 5YA.

The **Wet zone** is the one with potential for the largest diversity of crops. RAIN was 1703 mm (over 14 mm/day) and 62% up compared to average. However, TEMP and RADPAR both decreased by 0.5°C and 7%, leading to 6% drop in BIOMSS. The cropping intensity of the region is akin to the Intermediate zone and 27% up compared to 5YA. The maximum VCIx value for the zone was 0.95. Crop condition for the zone was the least favorable among the three sub-national regions.

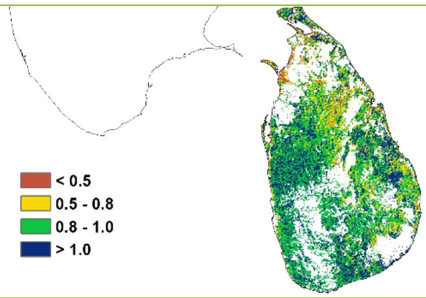
Figure 3.26 Sri Lanka's crop condition, July - October 2019



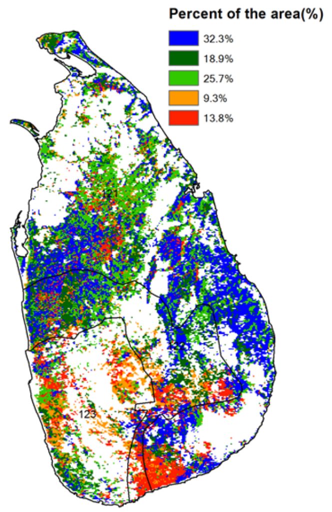
(a). Phenology of major crops



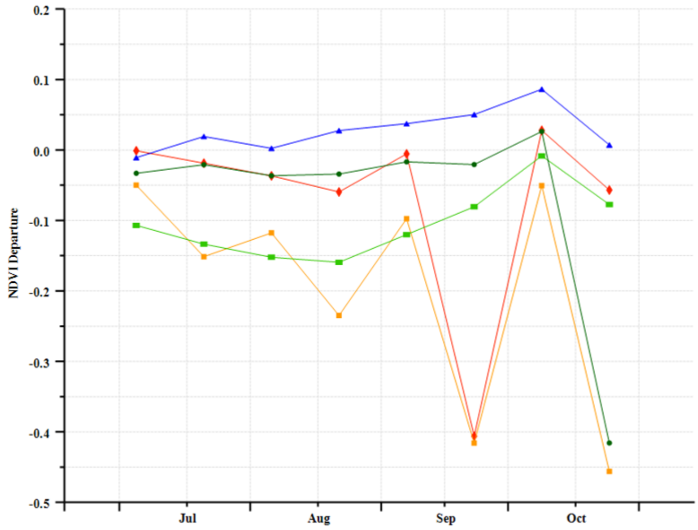
(b) Crop condition development graph based on NDVI



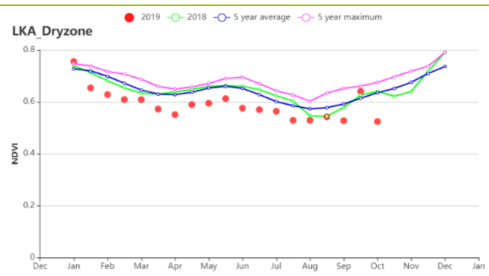
(c) Maximum VCI

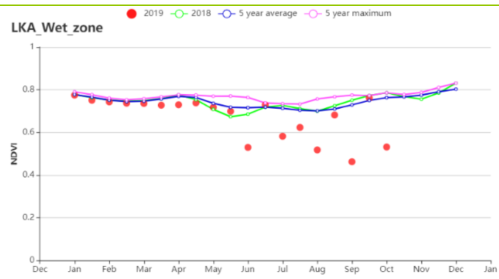


(d) Spatial NDVI patterns compared to 5YA

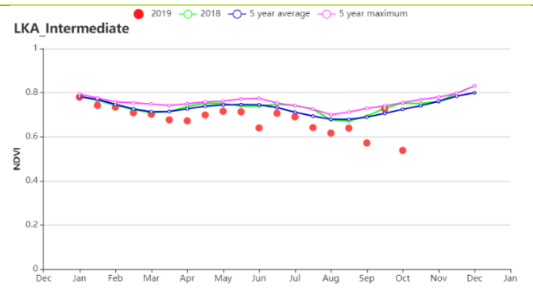


(e) NDVI profiles





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



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

Table 3.43 Sri Lanka's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2019

Region	RAIN		TEMP		RADPAR	
	Current (mm)	Departure from 15YA (%)	Current (°C)	Departure from 15YA (°C)	Current (MJ/m²)	Departure from 15YA (%)
Dry zone	258	-45	28	-0.1	1303	3
Wet zone	698	-9	25	-0.1	1217	7
Intermediate zone	446	-32	27.1	-0.1	1213	4

Table 3.44 Sri Lanka's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2019

Region	Cropped arable land fraction		Cropping Intensity		Maximum VCI
	Current (%)	Departure from 5YA (%)	Current (%)	Departure from 5YA (%)	Current
Dry zone	97	0	180	44	0.90
Wet zone	100	0	135	4	0.98
Intermediate zone	100	0	147	27	0.95

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 period corresponds to the harvest of summer crops (maize, sunflower...), while wheat had already been harvested earlier. Winter wheat and barley started in October and will last until January. The cropped arable land fraction was down 3% to 7%, including mostly irrigated land since about one-fifth of agriculture is irrigated in Morocco. The average rainfall was 63 mm, 27% down from average. Temperature, RADPAR and BIOMSS were below the average by 0.7 ℃, 3% and 3%, respectively.

Based on the NDVI the timing and condition of early winter crops (barley and wheat) was average or slightly below in October. The map of maximum VCI indicates low values (< 0.5) for Rabat-Salé-Kénitra and Béni Mellal-Khénifra regions, and the coast of Marrakech-Safi and Souss-Massa regions. According to the NDVI profiles' spatial distribution map, 41.4% of the total cropped area had below average crops, especially in northern districts, while remaining areas were average. Overall, the nationwide VCIx was moderate (0.53). Generally, the low CALF values (also those listed below) result from the predominant crop stage at the time of reporting, i.e. ongoing planting of winter crops. Negative CALF departures most likely result from delayed planting due to a relative shortage of precipitation. If winter rain picks up as expected.

Regional analysis

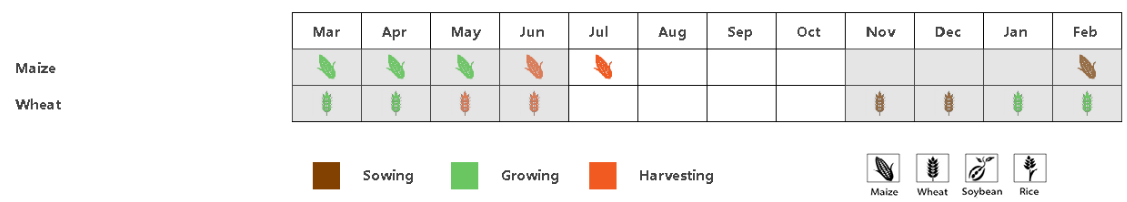
CropWatch adopts three agro-ecological zones (AEZs) relevant for crop production in Morocco: The Sub-humid northern highlands, the Warm semiarid zone, and the Warm sub-humid zone.

In the **Sub-humid northern highlands**, rainfall and temperature were both below average (RAIN -13%, TEMP -0.6 ℃). The RADPAR increased by 3%, while the BIOMSS fell 3%. The cropped arable land fraction (CALF) was 14% (9% below average), under the single-cropping system. NDVI profiles also indicate slightly below-average crop condition throughout the monitoring period. The maximum VCI estimated for this zone was moderate (0.51).

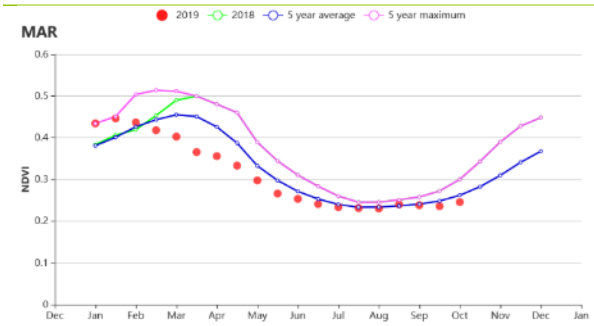
In the **Warm semiarid zone**, rainfall was 32% down from the average and temperature was below average by 0.7 ℃ as well. The RADPAR was 4% above average, while the BIOMSS was 5% below. The cultivated area was only 3% with conditions slightly below the average and moderate maximum VCI (0.52).

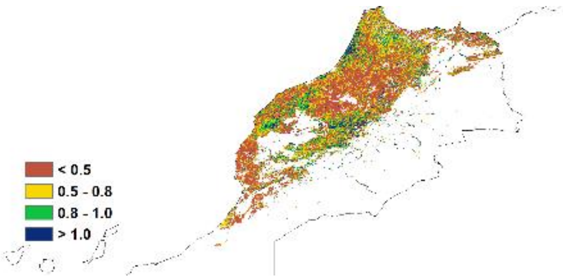
The **Warm sub-humid zone** recorded a drop below average of rainfall (-32%) and of temperature (down 1.0℃). The RADPAR was 3% above average, and the BIOMSS was just 1% above. The CALF was also below the average by 7%. The cultivated area was 11% of the total cropland area, under a single-cropping system. The crop condition development graph based on NDVI indicated at-average conditions and the VCIx was moderate (0.53).

Figure 3.27 Morocco's crop condition, July - October 2019

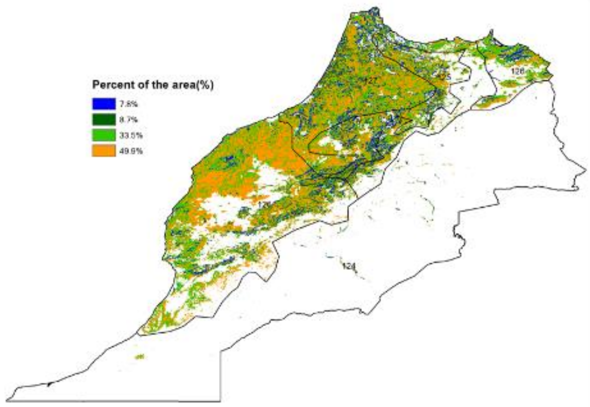


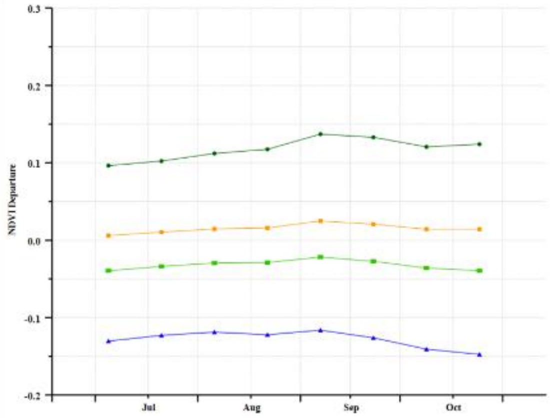
(a). Phenology of major crops



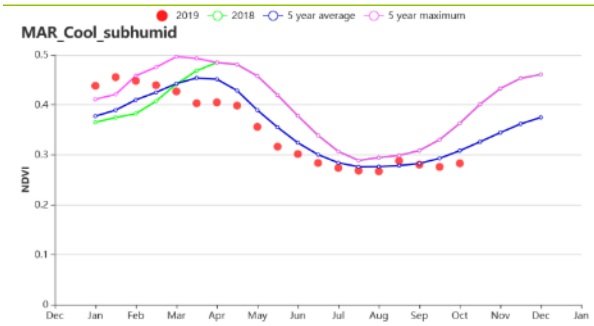


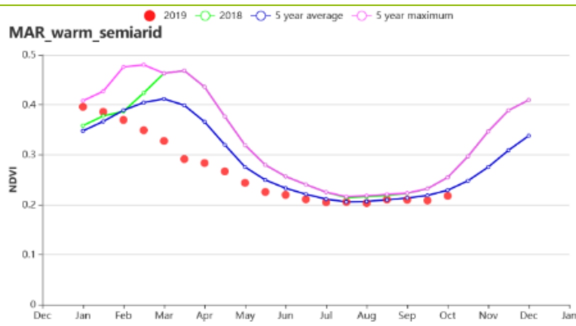
(b) Crop condition development graph based on NDVI (c) Maximum VCI



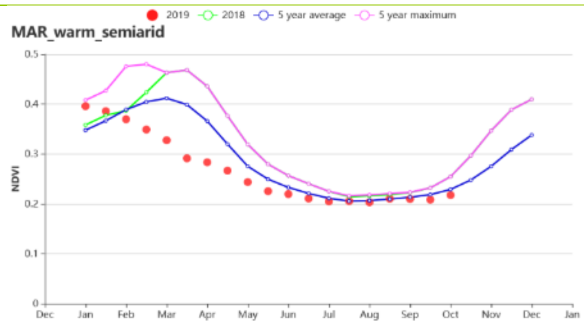


(d) Spatial NDVI patterns compared to 5YA € NDVI profiles





(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.

Table 3.45 Morocco's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2019

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	92	-13	21.8	-0.6	1392	3	584	-3
Warm semiarid zones	46	-32	22.5	-0.7	1422	4	563	-5
Warm sub-humid zones	65	-32	21.9	-1.0	1394	3	613	1

Table 3.46 Morocco's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2019

Region	Cropped arable land fraction		CROP INTENSITY		Maximum VCI
	Current (%)	Departure from 15YA (%)	Current (%)	Departure from 5YA (%)	Current
Sub-humid northern highlands	14	-9	50	5	0.51
Warm semiarid zones	**3**	**18**	**32**	**8**	**0.52**
Warm sub-humid zones	11	-7	77	13	0.53

[MEX] Mexico

As the most important crop of Mexico, maize began to be sowed about September in the northwest. In other areas of the country the crop was at growing stage between July and September and reached harvest in October. Winter wheat sowing began in October. Both soybean and rice were at harvesting stage over the reporting period.

Crop condition was close to average between July to October according to crop condition development graph based on NDVI. The CropWatch agroclimatic indicators show that temperature (+0.4°C) and RADPAR (+3%) were close to average and rainfall was more significantly up (+16%) had significantly increased, which was beneficial for crop growth, as indicated by a relatively high value of maximum VCI (0.87). CALF decreased by 4%, compared with the previous 5-year average. BIOMSS increased by 3% compared to average

Crop condition displayed obvious differences in spatial distribution. According to the spatial pattern of maximum VCI, very high values (greater than 1.0) occurred mainly in southeastern Mexico (including Coahuila and northern Nuevo León) whereas extremely low values (less than 0.5) occurred in the North-east and middle of the country (Baja California, Baja California Sur, Sonora and Chihuahua). The maximum VCI in other regions of Mexico was moderate, with the values between 0.5 and 1.0. As shown in the spatial NDVI profiles and distribution map, about 25.2% of the total cropped area was above average during the entire monitoring period, with 34.5% being just slightly below average.

Regional analysis

Based on cropping systems, climatic zones, and topographic conditions, Mexico is divided into four agro-ecological regions. These regions including Arid and semi-arid regions (82), Humid tropics with summer rainfall (83), Sub-humid temperate region with summer rains (84) and Sub-humid hot tropics with summer rains (85). Regional analyses of crop situation can provide more detail for the production situation in Mexico.

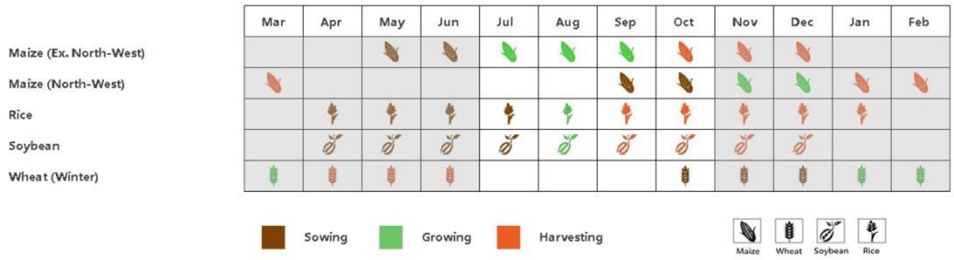
The Arid and semi-arid regions located in northern and central Mexico, account for about half of planted areas in the country. According to the NDVI development graph, crop condition in these regions was generally below average during July to October. Although the maximum VCI was relatively low with a value of 0.77 and CALF decreased by 9% compared with average, rainfall temperature, RADPAR increased by 29% ,0.6°C,2%, which made the incline of BIOMSS(+2%). On the whole, crop was growing well in these regions.

Sub-humid temperate region with summer rains situated in central Mexico. Crop condition in these regions were closed to average from July to August but were below average since September. The agro-climatic condition showed that rainfall, temperature and radiation increased by 28%, 0.3°C and 2% compared to average, BIOMSS also increased by 3%. Cropping intensity was 100%. The maximum VCI (0.97) confirmed favorable crop condition in these regions.

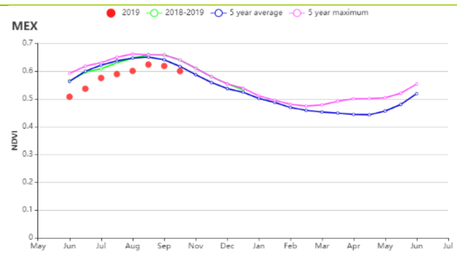
Sub-humid hot tropics with summer rains are located respectively in southern. During the monitoring period, crop condition was continuously below average in these regions, as shown by the NDVI time profiles. Agroclimatic conditions showed that rainfall was significantly above average (+14%) while temperature and RADPAR were near average (+0.5°C and +3%).The Maximum VCIx in these areas was 0.93 and BIOMSS increased by 4%, which meant crop grew well.

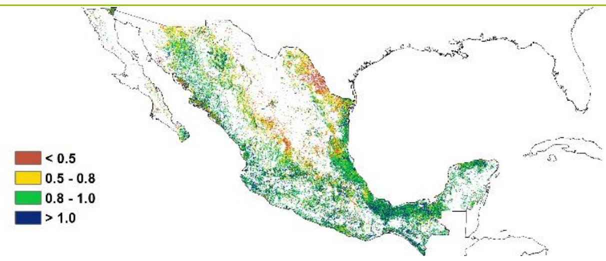
Humid tropics with summer rainfall located in southeastern Mexico. Rainfall was significantly above average (+14%),average temperature was 0.8℃ warmer and RADPAR up 4%.%. As shown in the NDVI development graph, crop condition was below average from July to September and improved to average in October. BIOMSS increased (+5%) and the Maximum VCI (0.97) confirmed favorable crop condition in these regions.

Figure 3.28 Mexico's crop condition, July - October 2019

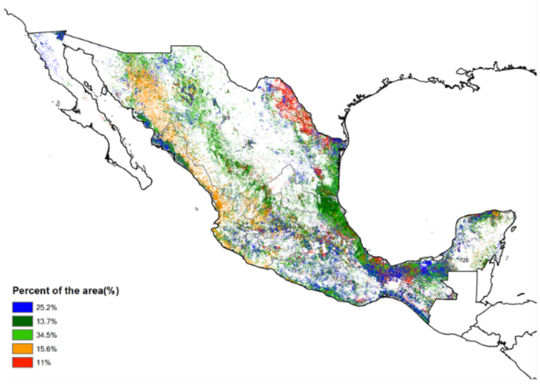


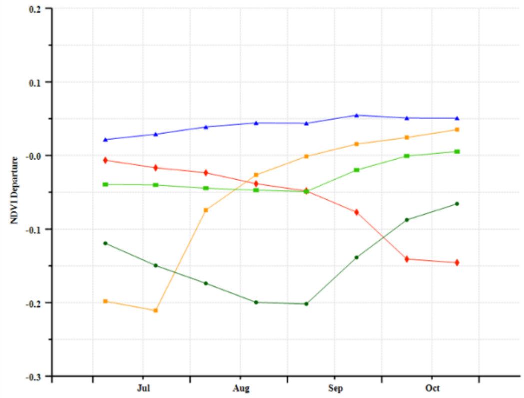
(a). Phenology of major crops



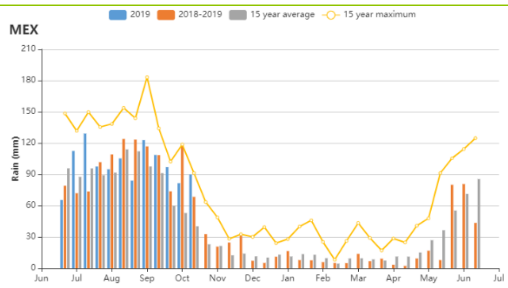


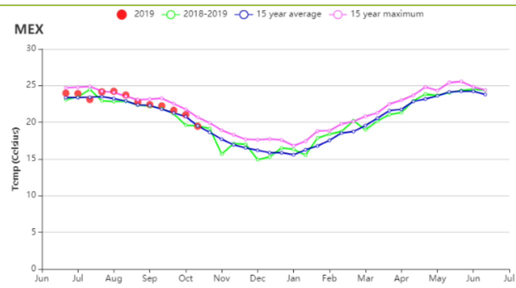
(b) Crop condition development graph based on NDVI (c) Maximum VCI



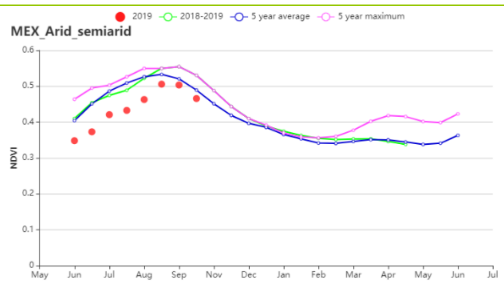


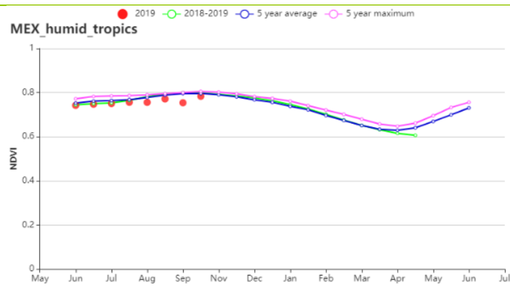
(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles



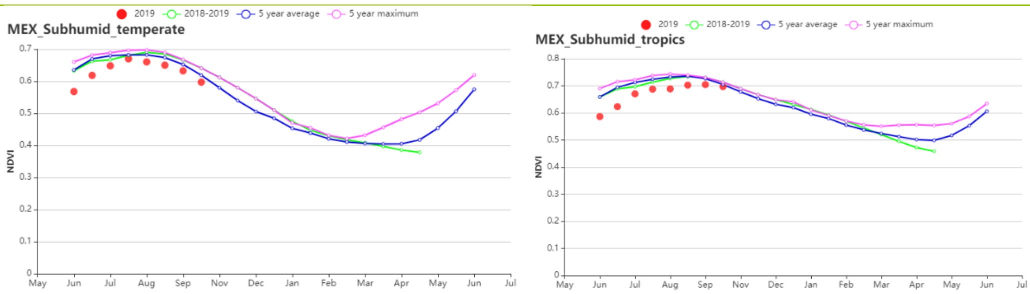


(f) Rainfall profiles (g) Temperature profiles





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



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

Table 3.47 Mexico's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2019

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 (%)
Arid and semi-arid regions	888	29	22.7	0.2	1311	2	716	2
Sub-humid temperate region with summer rains	1558	28	18.5	0.3	1229	2	600	3
Sub-humid hot tropics with summer rains	1401	14	22.8	0.5	1257	3	736	4
Humid tropics with summer rainfall	1184	-4	25.4	0.8	1312	4	862	5

Table 3.48 Mexico's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2019

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure from 5YA (%)	Current (%)	Departure from 5YA (%)	Current
Arid and semi-arid regions	76	-9	76	-13	0.77
Sub-humid temperate region with summer rains	97	-1	100	-5	0.91
Sub-humid hot tropics with summer rains	95	-1	114	3	0.93
Humid tropics with summer rainfall	100	0	123	7	0.97

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

[MMR] Myanmar

Myanmar produces maize, rice (two seasons) and wheat as its main crops. They are predominantly grown across the eastern mountains, central plains and the western coastal areas. This monitoring period covers the early sowing season of maize and wheat from September to October, as well as the growing season (July to September) and the early harvesting season (October) of the main rice crop. CropWatch assesses crop condition during this monitoring period as slightly below-average in general.

Temperature (TEMP) as well as radiation (RADPAR) were somewhat above 15YA (+0.2°C and +5%, respectively), while precipitation (RAIN) experienced a slight decrease (-3%). As shown in the NDVI development graph, crop condition was below the 5YA but close to the condition of the previous year during July and August, which is the growing season of wheat; NDVI returned to average values from September. BIOMSS underwent a 5% rise compared to average. The crop arable land fraction (CALF) increased by 1% as compared to its 5YA. The maximum VCI value for the whole country was 0.97. Crop condition is assessed as average.

Crop condition underwent marked spatial variations according to the NDVI cluster and profile maps. 19% of cropland had continuously above average crops, in the States of Yangon, eastern Bago and southern Sagaing. 26.4% of cropland showed negative NDVI departure lower than -0.15 in July but recovered to average from August in Mandalay and eastern Magwe. Crop condition in the States of eastern Bago, Kayin, Mon and Tanintharyi was below-average during the whole period. The VCIx map shows values between 0.5 and 0.8 over Mandalay and high values in other regions.

Regional analysis

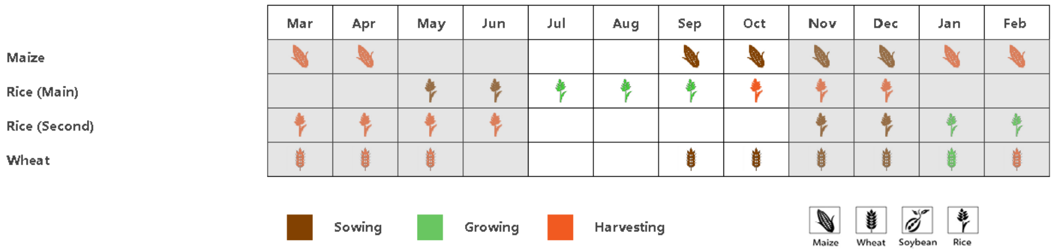
Based on the cropping system, climatic zones and topographic conditions, three sub-national agro-ecological regions (AEZ) can be distinguished for Myanmar. They are the Coastal region, the Central plain, and the Hills region.

The **Coastal region** experienced a rainy period with sufficient RAIN (1864 mm, 4% below average). TEMP and RADPAR increased by 0.2℃ and 7%, respectively. BIOMSS increased by 7% in parallel with CALF rising 1%. The cropping intensity was 181%, 20% higher that the 5YA, indicating near double cropping for the region. NDVI was below average in late July and late August. The maximum VCIx was 0.97 for this region. The crop condition is fair in general.

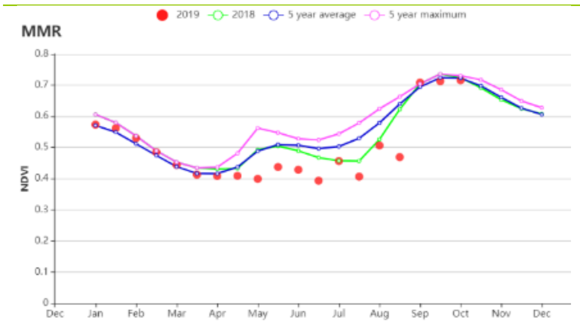
In the **Central plain** RAIN (1043 mm) was 8% down compared to average while TEMP and RADPAR both increased, by 0.3℃ and 5% respectively. BIOMSS and CALF were up 1% and 5% over average. The region was generally near single cropping during the monitoring period with cropping intensity was 116%, which is close to the recent average. NDVI was near the level of the previous year during the whole period. The maximum VCIx was 0.96 for the region. The crop condition is assessed as similar to the previous year but below 5YA.

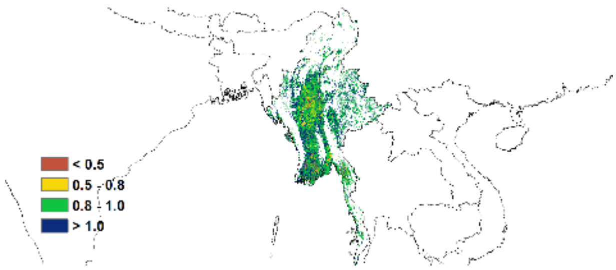
Similar to the Coastal region, the **Hills region** had an abundant RAIN (1707mm) and abundant sunshine with normal temperature (TEMP +0.1℃ and RADPAR +5%), similar to the Central plain. With the fully used cropland, BIOMSS was 5% up compared to average. The cropping intensity for the region was 158% and increase by 8% compared to 5YA, representing a mixture of single and double cropping. The maximum VCIx was 0.99 and the crop condition for the region was possibly below-average.

Figure 3.29 Myanmar's crop condition, July - October 2019



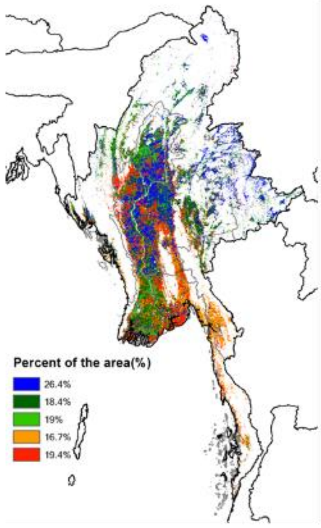
(a). Phenology of major crops

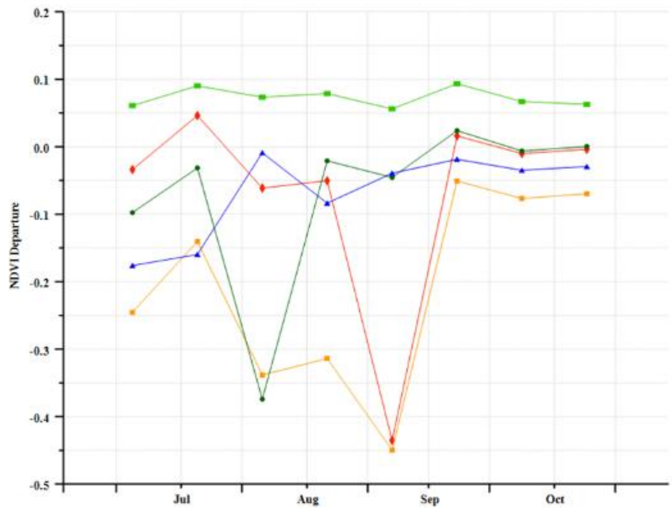




(b) Crop condition development graph based on NDVI

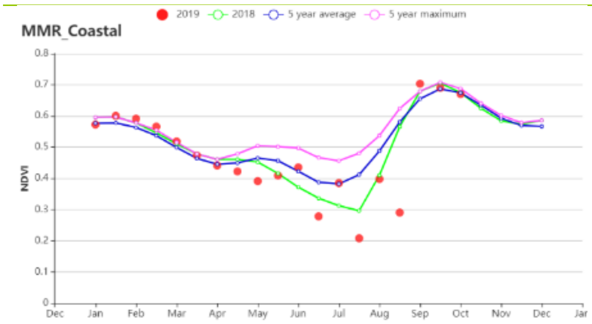
(c) Maximum VCI

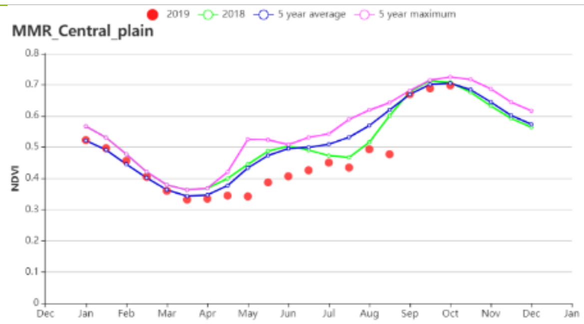




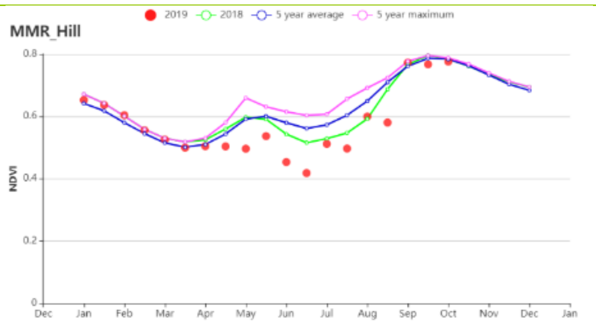
(d) Spatial NDVI patterns compared to 5YA

(e) NDVI profiles

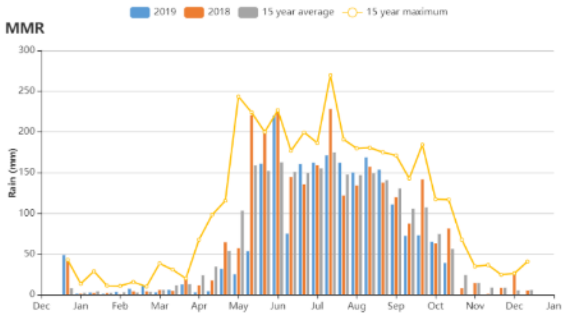




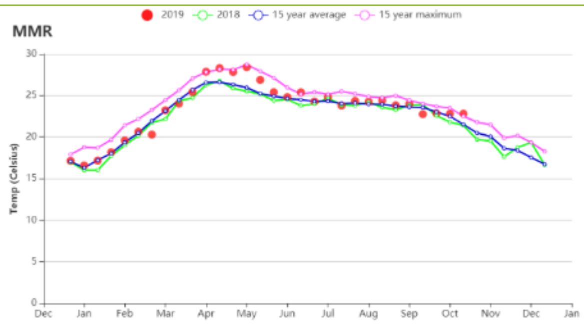
(f) Crop condition development graph based on NDVI (Coastal region (left) and Central plain (right))



(g) Crop condition development graph based on NDVI (Hill region)



(h)rainfall index



(i)temperature index

Table 3.49 Myanmar's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2019

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 (%)
Coastal region	1864	-4	26.0	0.2	1142	7	774	6
Central plain	1043	-8	24.4	0.3	1100	5	705	1
Hill region	1707	0	22.5	0.1	1001	5	596	-1

Table 3.50 Myanmar's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2019

Region	Cropped arable land fraction		Cropping Intensity		Maximum VCI
	Current (%)	Departure from 5YA (%)	Current (%)	Departure from 5YA (%)	Current
Coastal region	95	1	181	20	0.97
Central plain	97	1	116	-2	0.96
Hill region	99	0	158	8	0.99

[MNG] Mongolia

Summer wheat is normally harvested in September, but due to cold conditions (less than 5°C) in May planting was delayed and the harvest took place in October. In addition, the Selenge-Onon region, which is main agricultural area, experienced a 26% drop in precipitation in June, which has further contributed to the late harvest. TEMP was 3.0°C higher than average at mid- September. VCIx was generally above 2018 values. Low values (<0.5) occur in around 5% of cropped areas, 0.5-0.8 in 15%, 0.8 to 1.0 in more than half of the cropped areas (55%) and >1.0, indicating unusually good crop condition, in 25% of cropland. The national average VCIx was 0.99.

RAIN was above average (+47%) and TEMP was average (up 0.2°C). RADPAR was just below average (-1%). The combination of factors resulted in a small BIOMSS drop (-2%). NDVI was above 5YA from July to October except at mid of September. Spatial NDVI clusters and profiles show above average crop condition from late July to September mostly in Khentii, Selenge, Tuv, Bulgan, Hovsgol, eastern parts of Dornod and patches in some cropped western provinces, for a total of 87% of arable land.

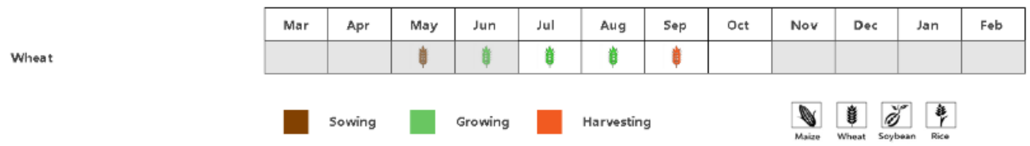
Regional analysis

In the **Khangai Khuvsgul region**, crop condition was close to the five-year maximum from June to July. Accumulated rainfall was above average (RAIN +50%). TEMP and RADPAR were above by 0.6°C and 1%, respectively. The BIOMSS index decreased by -1% compared to the five-year average. The maximum VCI index was 1.01 and the cropped arable land increased by 2% compared to the five-year average. Overall crop prospects were favorable in this region.

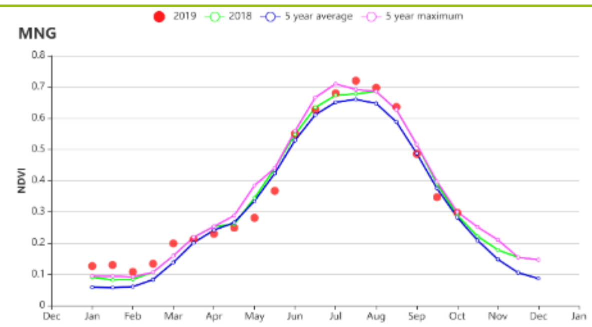
NDVI was above the five-year average from June to July in the **Selenge-Onon region.** RAIN was up 46%, while TEMP was average and RADPAR was slightly low (-1%). The BIOMSS index decreased by 3% below average. The maximum VCI index was 1.00 and the cropped arable land increased by 2% compared to the five-year average. Overall crop outcome was normal.

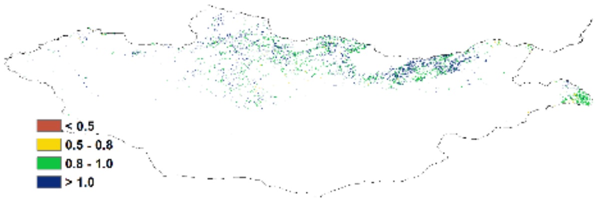
The **Central and Eastern Steppe Region** had above average crop condition, according to the NDVI development graph. Other meteorological variables were above average: RAIN +39%, TEMP +0.6°C, BIOMSS +5%. RADPAR dropped 4% below average. The maximum VCI index was 0.92 and cropped arable land increased by 3% compared to the five-year average.

Figure 3.30 Mongolia's crop condition, July - October 2019



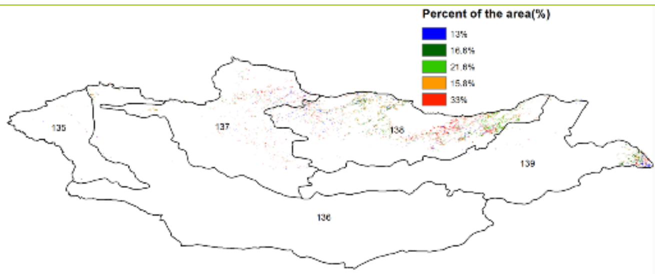
(a). Phenology of major crops

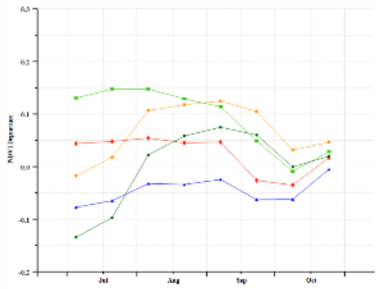




(b) Crop condition development graph based on NDVI

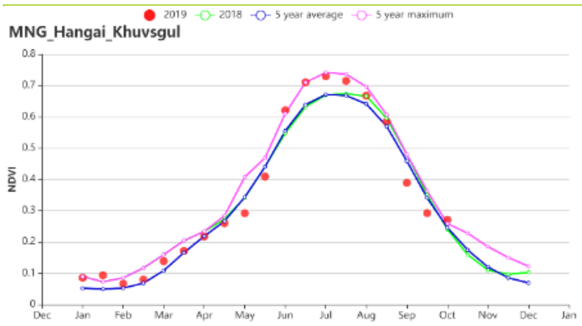
(c) Maximum VCI

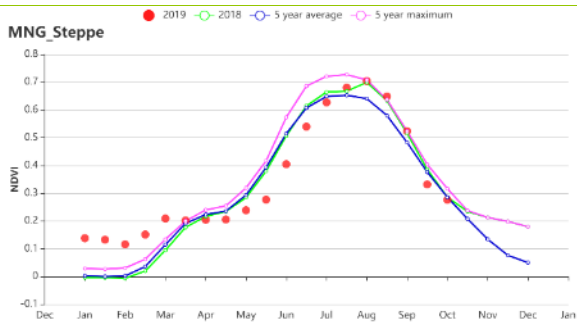




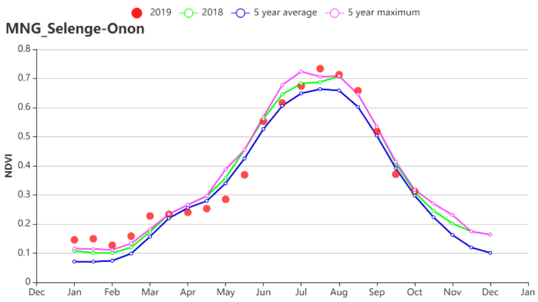
(d) Spatial NDVI patterns compared to 5YA

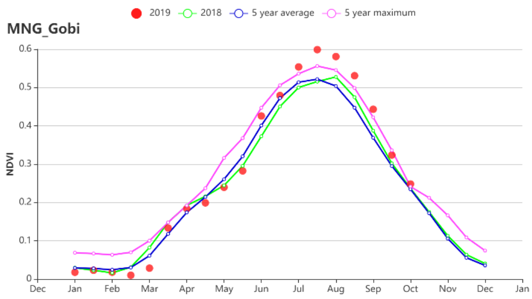
(e) NDVI profiles



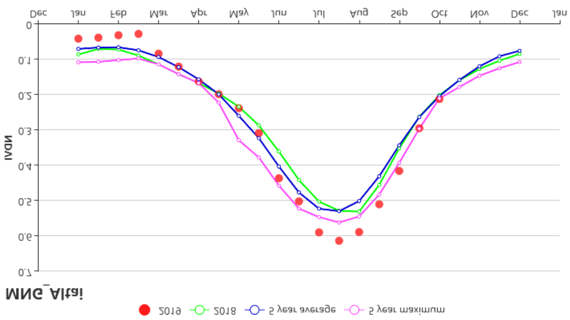


(f) Crop condition development graph based on NDVI (Hangai Khuvsgul Region (left) andSteppe Region (right))





(g) Crop condition development graph based on NDVI (Selenge-Onon Region (left) and Gobi Region (right))



(h) Crop condition development graph based on NDVI (Altai Region)

Table 3.51 Mongolia's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2019

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Altai	342	8	8.9	0.3	1032	-3	335	-4
Gobi Desert	126	27	11.4	0.7	1125	-2	392	-3
Hangai Khuvsgul Region	385	50	7.5	0.6	1075	1	301	2
Selenge-Onon Region	327	46	10.4	0.0	1044	-1	357	-3

Table 3.52 Mongolia's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2019

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
ltai	92	26	85	30	1.10
Gobi Desert	88	54	76	28	1.11
Hangai Khuvsgul Region	100	2	101	6	1.01
Selenge-Onon Region	100	2	101	5	1.00

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

[MOZ] Mozambique

The agricultural season started with land preparation and sowing of rice and maize in parts of Maputo and coastal areas of Gaza and Inhambane Provinces, where rainfall started mid-October. In the central and northern regions, the sowing season normally lasts from mid-November to mid-December.

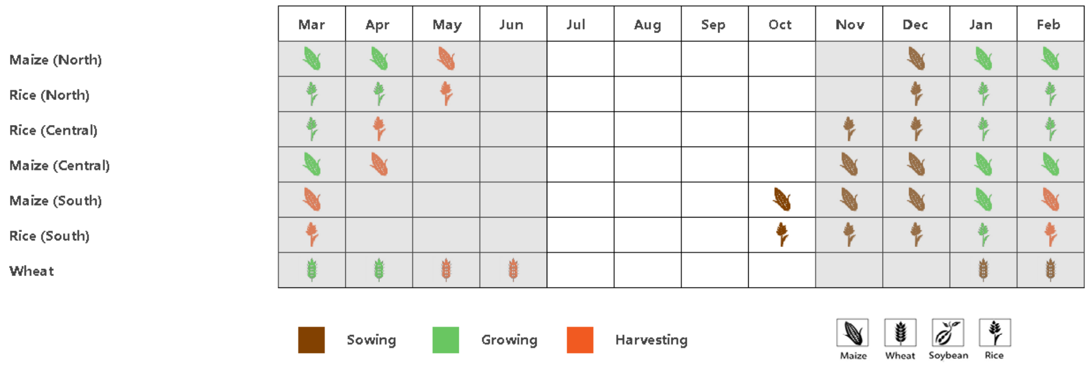
Nationwide RAIN was down 10%, with just about average TEMP and RADPAR up 3%, resulting in a slight drop in BIOMASS (-1%). Cropped arable land fraction (CALF) reached 90%, with average VCIx at 0.90 and the cropping intensity up 1% to 5%

Clear spatial patterns emerge for NDVI and VCIx, with below average crop condition currently concentrated in the south of the Provinces of Gaza and Inhambane and a small patch in Tete and Zumbu Districts in Tete Province. VCIx is relatively low (0.76) in the Southern region, but between 0.85 and 0.95 in other AEZs. Altogether about 70% of the arable land in the country had average or above average NDVI, essentially in the Center and North, including the Provinces of Tete, Sofala and Manicaland all the way to the Tanzanian border. Rather high NDVI throughout the monitoring period (up to 0.15 units above average) even occurred in 5.8% of cropped areas.

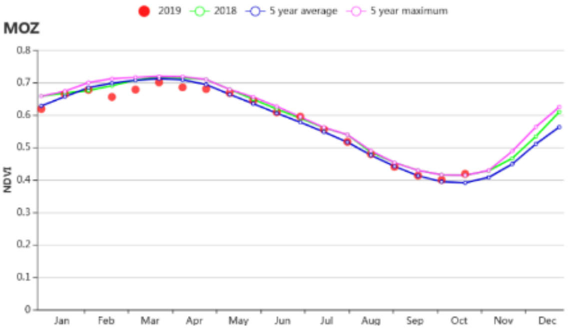
The Southern region recorded low precipitation (RAIN -26% below average) while the temperature increased 0.1°C; it decreased in the Central region (0.3°C). In contrast, the best rainfall was recorded in the Northern High Altitude area with RAIN up 20%. And the area recorded a significant increase in sunshine (+6%) which has led to a 3% increase of BIOMSS. The largest BIOMSS deficits correspond to the Buzi Basin (-6%) and the Lower Zambezi basin (-2%).

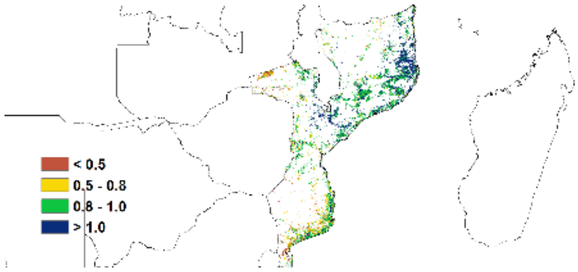
Considering the early stage of the season, fair crops can still be expected in the country, even in some southern areas.

Figure 3.31 Mozambique's crop condition, July - October 2019

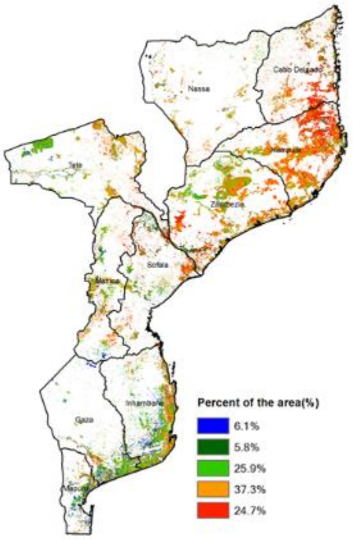


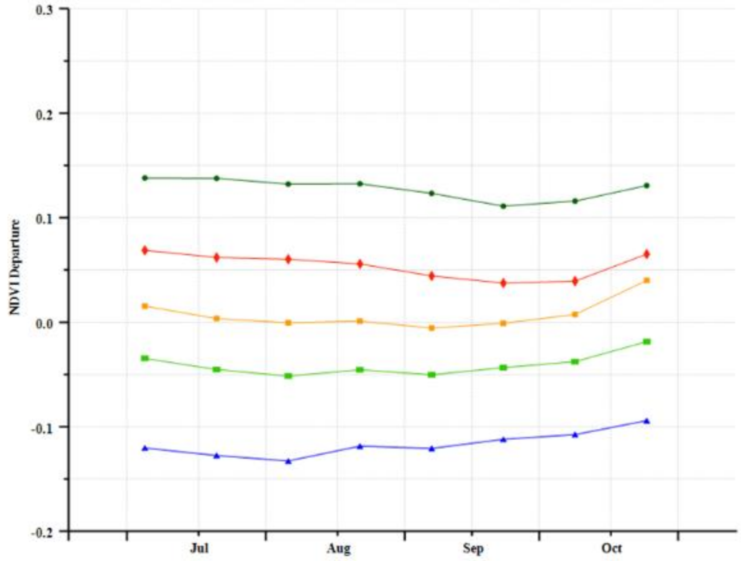
(a). Phenology of major crops



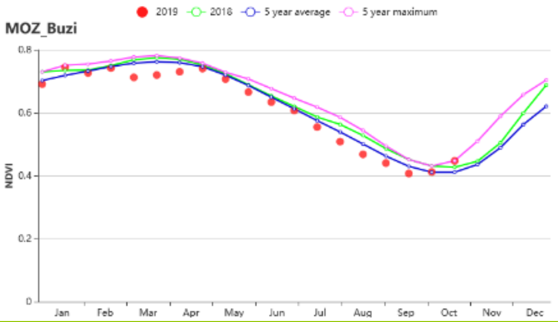


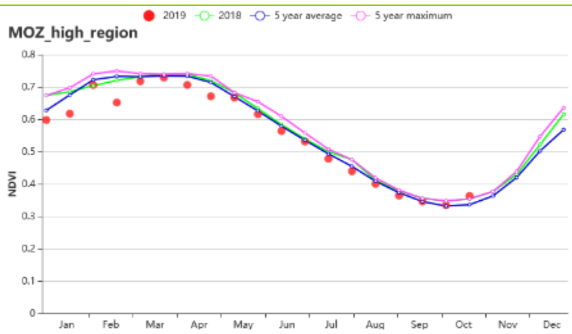
(b) Crop condition development graph based on NDVI (c) Maximum VCI



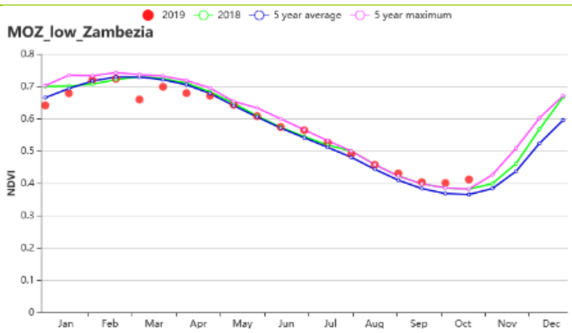


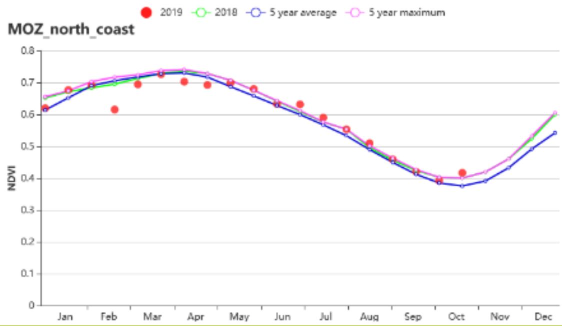
(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles



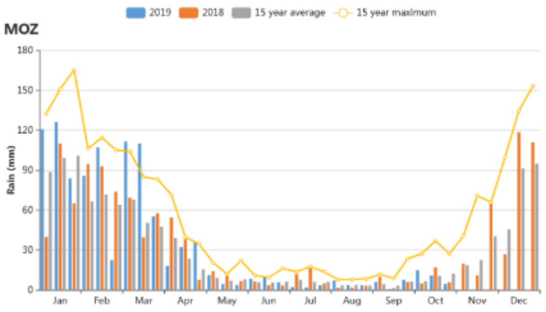


(f) Crop condition development graph based on NDVI- Buzi basin (g) Crop condition development graph based on NDVI- Northern high altitude areas

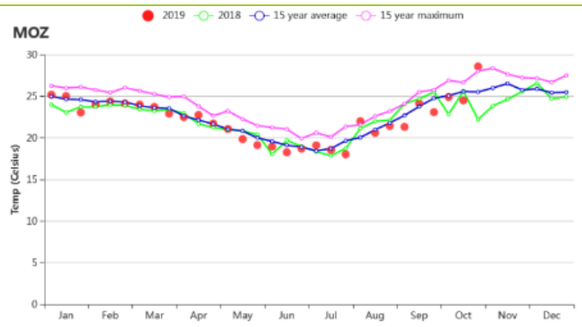




(h) Crop condition development graph based on NDVI- Lower Zambezi River basin (i) Crop condition development graph based on NDVI- Northern coast region



(j) Rainfall index



(k) Temperature index

Table 3.53 Mozambique's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2019

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure from 15YA (%)	Current (°C)	Departure from 15YA (°C)	Curren t (mm)	Departure from 15YA (°C)	Departure from 15YA (%)	Current (°C)
Buzi Basin	60	-16	19.6	-0.3	1262	3	560	-6
Northern High-altitude Areas	53	20	21.7	0.1	1254	6	617	3
Low Zambezia River basin	58	-17	22.4	-0.3	1234	3	595	-2
Northern coast	75	2	22.9	-0.1	1208	4	654	0
Southern region	66	-26	22.0	0.2	1064	0	590	-0

Table 3.54 Mozambique's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2019

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure from 5YA (%)	Current (%)	Departure from 5YA (%)	Current
Buzi Basin	97	-3	103	3	0.85
Northern High-altitude Areas	70	-8	105	1	0.86
Low Zambezia River basin	74	0	102	5	0.91
Northern coast	99	1	101	0	1.00
Southern region	88	0	102	5	0.76

[NGA] Nigeria

Nationwide the period was marked by high rainfall (1029 mm, 8% departure above average), temperature at 24°C (down 0.4°C from average) and radiation at 1068 MJ/m2 (-1%). The maximum vegetation condition index VCIx was 0.94. Biomass production potential rose by 3% and cropped area was at 94 % of CALF with 1% increase compared to five year average. Except in October, the NDVI development graphs show values below average. Based on the maximum vegetation condition index (VCIx), condition was favorable across the country but improved a lot compared to the previous period especially in the northwest and north-eastern region (in States like Borno, Yobe Zamfara, Sokoto and Katsina).

This period was mostly marked by crop harvesting for main season and second sowing for irrigated crops. In north-eastern part, there was harvesting for rice and maize, millet, sorghum whereas sowing was taking place in lowland for second season of maize and irrigated rice. North-east Sahel crops like millet sesame and cow-peas were at harvesting stage too. In Chad basin a second sowing of both irrigated maize and rice season took place. Northwest and central rain fed maize, rice and sorghum soybean were also at harvesting stage. On the other hand, important crops like groundnuts, sesame, sweet potatoes and vegetable were still in the at growing stage in this region.

In the south-east of the country harvest of main season and sowing for the second season were ongoing for both irrigated rice and maize and planting of dominant tubers like cassava among others. In south west rain fed rice and maize were being harvested and sweet potatoes yams and groundnuts were still in the field.

Regional analysis

Nigeria agro-ecological zones (AEZ) are characterized by rainfall gradient from north to south; first comes the Sudano-Sahelian zone in north, Guinean savanna then Derived savanna in the center and finally the wet Humid forest zone.

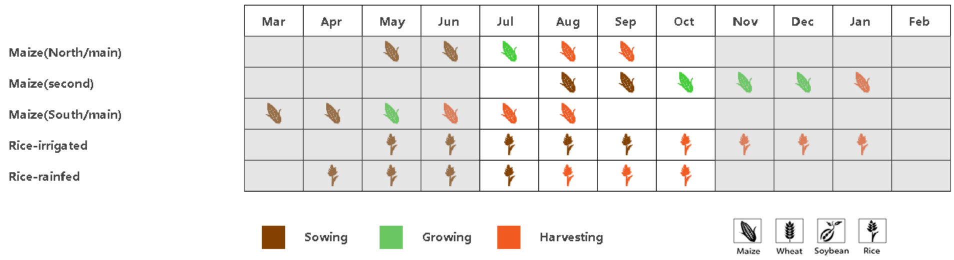
The **Sudano-Sahelian zone** recorded average rainfall (RAIN at 452 mm), and temperature (TEMP) was 27.5°C with a -0.4°C departure. The radiation was 1185 (MJ/m2), down 1% from the average. The total estimated biomass production increased by 10 % while CALF at 85% rises by3%; the cropping intensity was 67%. Generally vegetation condition was favorable and improved compared to last year.

The **Guinean savanna** zone recorded average rainfall of 833 mm; both temperature and radiation dropped below average (0.5°C and 2% respectively). The biomass was 728 gDM/m2, up 1% above the average and the cropped land remained constant (CALF 99 %) the same value as in the previous period of April up to July. The maximum VCI for this region was 0.94 but NDVI values were down below average. Cropping intensity was 106% (double cropping) with a 2% increase over 5YA.

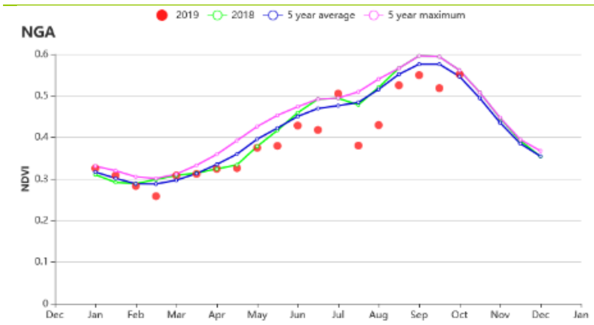
The **Derived savanna** received 1174 mm of rainfall, up 12% over average, and recorded TEMP at 23.9°C, a decline of 0.3°C. The radiation was 1031 (MJ/m2), 1 % less than average. Despite of 12% increase of rainfall the total biomass production 669 (gDM/m2) fell by -2%, and CALF remained constant (99 %, referred to the five-year average) and maximum VCI reached 0.97. The AEZ is known as maize belt: there was sowing for irrigated maize and harvest of rainfed maize for the main season. In this AEZ, the current Cropping intensity was 144% with a decrease of 4%. Concerning other important crops in this zone, there was harvesting of Yams, soybean cassava and sesame which were still at greening stage.

The **Humid forest zone** recorded 1756mm of rainfall, almost 9% above average and the temperature was about average at 24.0ºC. Radiation was down by 1% whereas the biomass was increased by 9%. The CALF and VCI were both high (97% and 0.95, respectively). NDVI below average throughout the period does not reflect poor vegetation condition as long as VCIx is high. In this AEZ, it was harvesting time for main season of rain-fed maize and sowing in irrigated rice and maize for second season. We can mention also planting time of important tubers like cassava in the South-east and the harvest of rainfed rice and maize in the South-west. Other important crops like sweet potatoes yams and groundnuts were still growing. High rainfall and the equatorial climate allow double cropping: 182 % with a slight 1% drop.

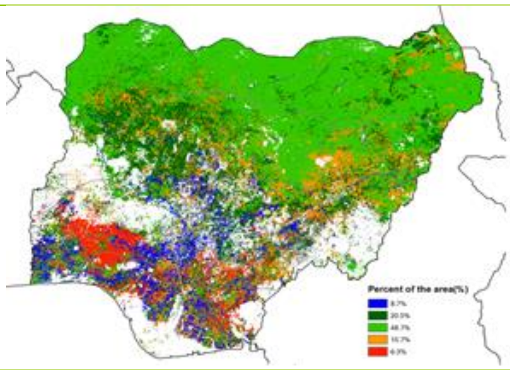
Figure 3.32 Nigeria's crop condition, July - October 2019

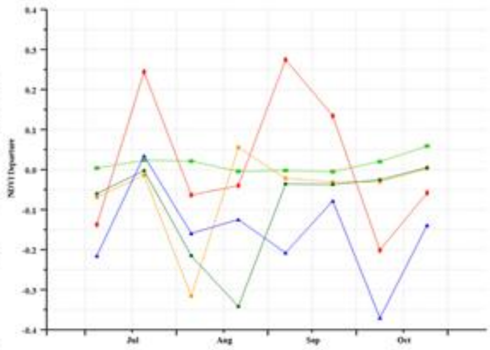


(a) Phenology of major crops

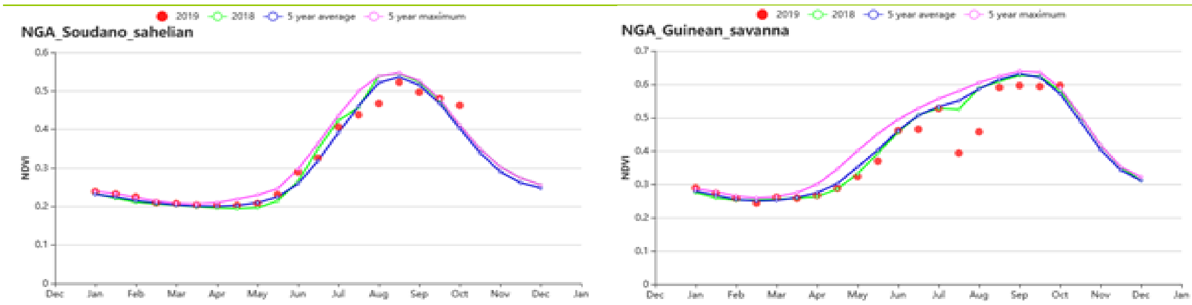


(b) Crop condition development graph based on NDVI (c) Maximum VCI

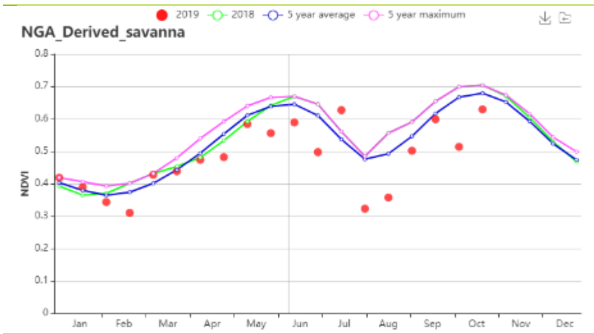


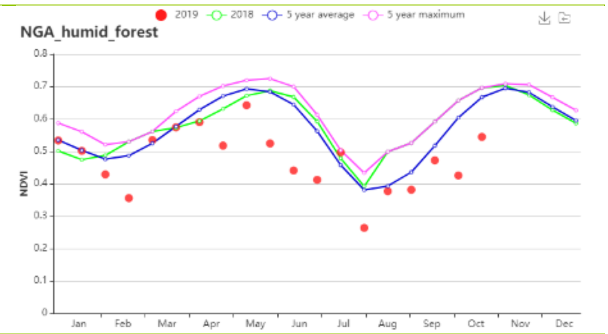


(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles



(f) Crop condition development graph based on NDVI (Soudano-sahelian region (left) and Derived savanna zone region (right))





(g) Crop condition development graph based on NDVI (Humid forest zone region (left) and Guinean savanna region (right))

Table 3.55 Nigeria's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2019

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 (%)
Derived_savanna	1174	12	23.9	-0.3	1031	-1	669	-2
Guinean_savanna	833	1	24.3	-0.5	1118	-2	728	1
humid_forest	1756	9	24.0	-0.1	916	-1	604	-2
Soudano_sahelian	452	0	27.5	-0.4	1185	-1	781	10

Table 3.56 Nigeria's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2019

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Current (%)	Current (%)	Departure from 5YA (%)	Current
Derived_savanna	99	0	144	-4	0.97
Guinean_savanna	99	0	106	2	0.94
humid_forest	97	1	182	-1	0.95
Soudano_sahelian	85	3	67	3	0.92

[PAK] Pakistan

The monitoring period covers the late growth and harvest of maize and rice, as well as the sowing of winter barley and wheat. Crop condition was generally favorable from July to October. RAIN was well above average (+98%), TEMP and RADPAR were below (-0.2°C and-3% respectively). The BIOMSS increased significantly (+29%). The national average of VCIx (0.97) was above average while the fraction of cropped arable land (CALF) increased by a significant 14%.

As shown by the crop nationwide NDVI development graph, crop condition was below average in July but later reached and even exceeded the five-year maximum. According to the spatial NDVI patterns and profiles, 27.4% of the cropped areas were below average from August to October. The maximum VCI map with a lower-than-0.5 value confirms the situation. From September to October, only 5.2% of the cropped areas were lower than average. Cropping Intensity by agro-ecological regions ranged from 81% in Northern highland to 157% at Northern Punjab. All are above average by 18% to 34%.

Regional analysis

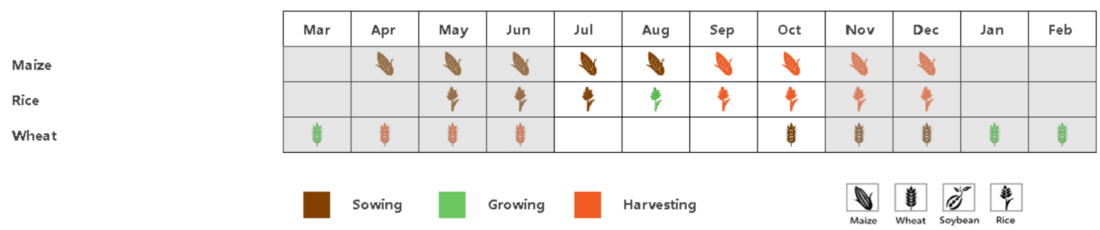
For a more detailed spatial analysis, CropWatch subdivides Pakistan into three agro-ecological regions based essentially on geography and agroclimatic conditions: **the Lower Indus basin, the Northern highlands,** and **the Northern Punjab region**.

RAIN was greatly above average (166%, 339mm) and TEMP equaled the average in the **Lower Indus basin**; RADPAR was below average by 3% to the extent that the estimated BIOMSS departure of 33% above average is probably optimistic, considering that the vast majority of crops are irrigated. NDVI was below average in July, and later markedly above. The CALF value of 66% exceeds the 2018 value by 18% and a VCIx of 1.05 also indicates excellent crop condition. Overall, the situation for the region is assessed as very good.

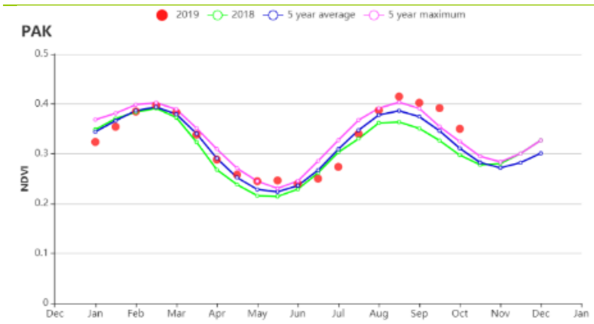
Compared to average, in the **northern highland** region, RAIN was up 76% and RADPAR and TEMP were low (-3% and -0.7°C respectively). BIOMSS increased 5% over average. The region also showed a low CALF of 61%, but still higher than5YA by 15%. The NDVI profile stayed above average except for July. Overall, the situation for the region is assessed as average or below.

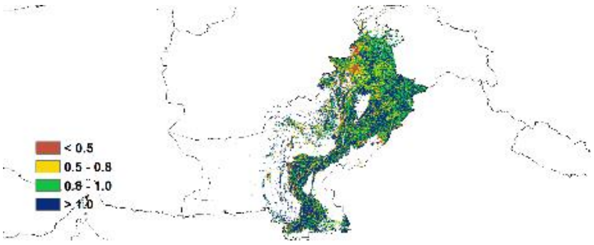
The main agricultural region in Pakistan, **Northern Punjab** recorded above average RAIN (+65%).TEMP and RADPAR were below average (-1.0°C and -2% respectively). The resulting BIOMSS is 13% above average. CALF in this area reached 83%, which was 7% up compared to 2018, and VCIx was at 1.00. Overall, the crop production potential for the region is deemed to be at least average.

Figure 3.33 Pakistan's crop condition, July - October 2019



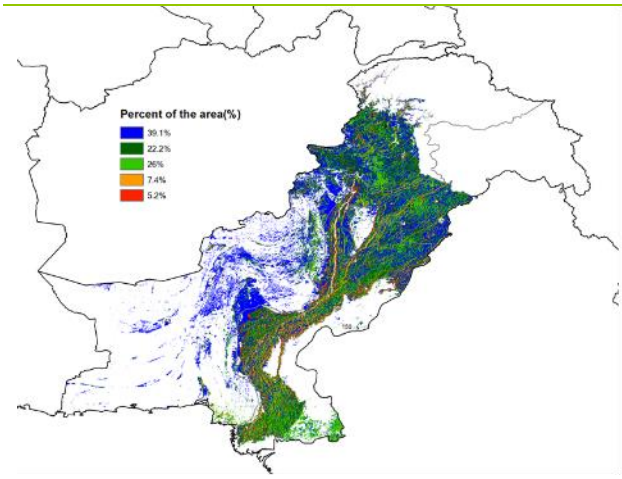
(a). Phenology of major crops

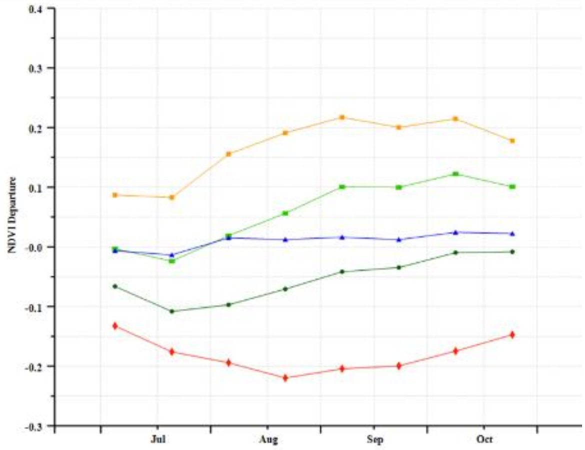




(b) Crop condition development graph based on NDVI

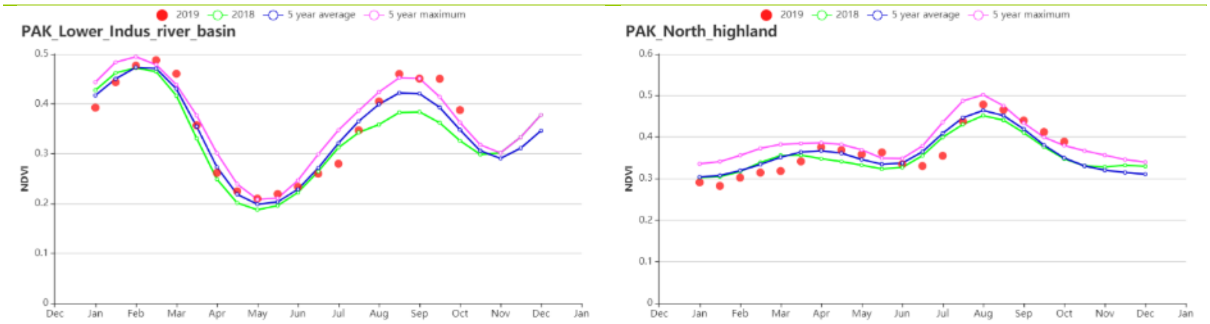
(c) Maximum VCI



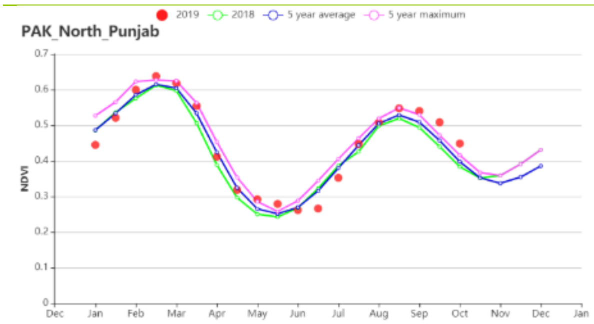


(d) Spatial NDVI patterns compared to 5YA

(e) NDVI profiles



(f) Crop condition development graph based on NDVI (Lower Indus river basin (left) and Northern highland Region (right))



(g) Crop condition development graph based on NDVI (Northern Punjab Region)

Table 3.57 Pakistan's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2019

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 (%)
Lower Indus river basin	339	166	33.0	0.0	1272	-3	743	33
Northern highland	611	76	20.9	-0.7	1347	-2	623	5
Northern Punjab	514	65	30.1	-1.0	1235	-2	830	13

Table 3.58 Pakistan's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2019

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Current (%)	Current (%)	Departure from 5YA (%)	Current
Lower Indus river basin	66	18	117	34	1.05
Northern highland	61	15	81	21	0.93
Northern Punjab	83	7	157	18	1.00

[PHL] Philippines

In the Philippines, harvesting of the main season crop is currently underway, while the second maize and second rice were at sowing at the end of the monitoring period. According to the NDVI profiles for the country, crops generally experienced below average conditions. Nationwide, precipitation (RAIN) presents a negative departure of 9% compared with average, accompanied by above average radiation (+3%) and average temperature. The higher radiation resulted in above average BIOMSS (+3%) estimates.

The cropped arable land fraction (CALF) was almost 100% in all regions. The spatial patterns of NDVI profiles show that: (1) 62.1% of the cropped areas experienced average conditions in most of the country; (2) 14.2% had a marked drop in June, and recovered to slightly below average conditions after July, mainly in the Center and South; (3) 11% experienced fluctuating conditions (average-below average) from July to October, then recovered to average conditions, mostly in Luzon; (4) 12.8% had average condition before a marked drop in mid-July, and recovered to average conditions in mid-August, mostly from Luzon to Negros. The behavior of NDVI can be explained mainly clouds and low radiation, and partially by several tropical storms that affected the Philippines, starting with Danas（Falcon）in July.

In spite of the below average rainfall and NDVI, the assessment of the crop situation in Philippines is less straightforward than it seems, especially when considering that solar radiation often is a limiting factor for crop production in tropical areas. Solar radiation was above average, CALF reached 100% and VCIx was unusually high in all agro-ecological zones. We therefore conclude that overall, crop condition is favorable.

Regional analysis

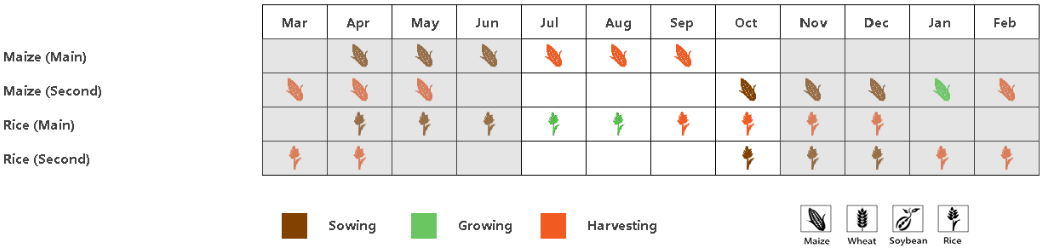
Based on cropping systems, climatic zones and topographic conditions, three main agro-ecological regions can be distinguished for the Philippines. They are the Northern lowlands of Mindanao to western Visayas region, the Negros and central Visayas Islands region and the Forest islands region (mostly southern and western islands). All regions recorded full cropping and VCIx above 0.97, confirming the positive assessment provided above. All regions had full cropping (CALF at 100%) and VCIx just under 1.00.

The **Northern lowlands of Mindanao to western Visayas** region experienced a rainfall deficit (RAIN -6%), average temperature, and above average radiation (RADPAR +2%). This region is cultivated with a mixture of single and double cropping systems, and cropping intensity was above the 5-year average (+16%). BIOMSS was slightly above the 5-year average (+1%). Altogether, the outputs of secondary maize and second rice are expected to be above average.

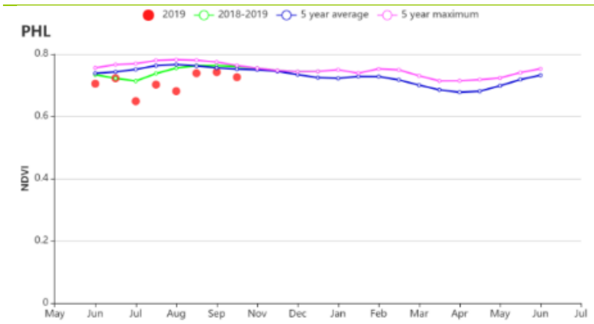
The **Negros and central Visayas Islands region** had the largest rainfall deficit (RAIN -17%), slightly above average temperatures (TEMP +0.2°C) and the largest positive departure of radiation (RADPAR +10%). This region is cultivated with a mixture of single and double cropping systems, and cropping intensity was below the 5-year average (-2%). BIOMSS was 10% above average. Altogether, the outputs of secondary maize and second rice are expected to be above average as well.

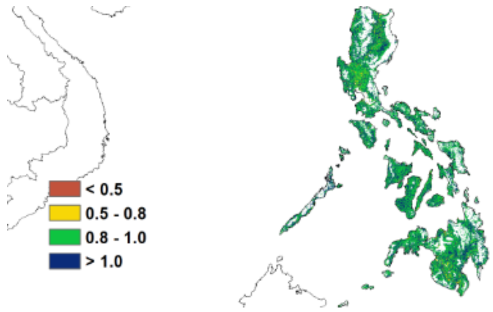
The **Forest islands** region experienced a rainfall deficit (RAIN -12%), average temperatures and above average radiation (RADPAR was up 4%). This region is cultivated with a mixture of single and double cropping systems, and cropping intensity was above the 5-year average (+4%). BIOMSS was up 4% over the average. Altogether, the outputs of secondary maize and second rice are expected to be above average as well.

Figure 3.34 Philippines's crop condition, July - October 2019

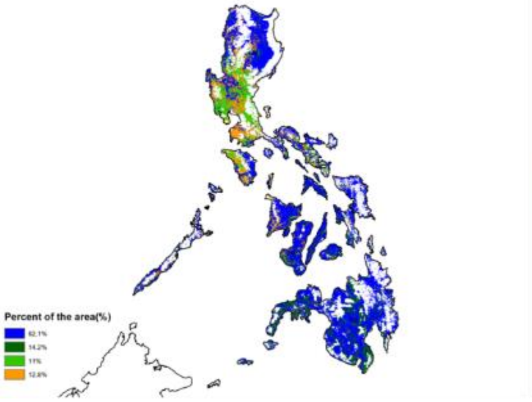


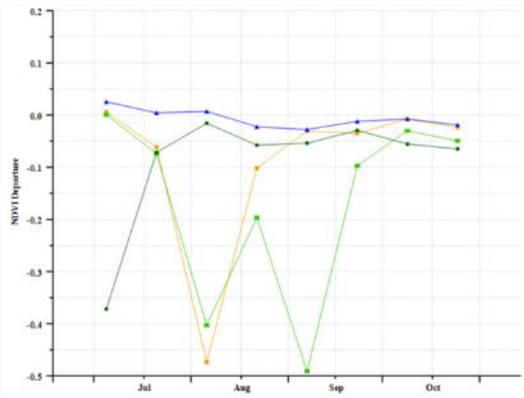
(a). Phenology of major crops



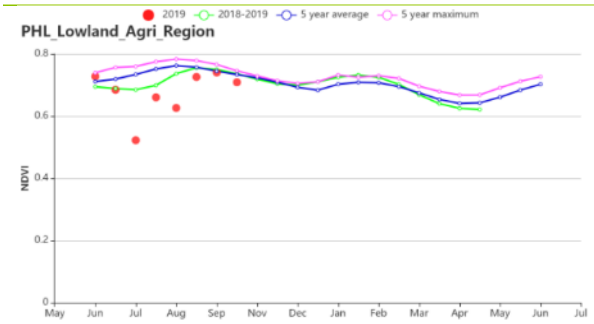


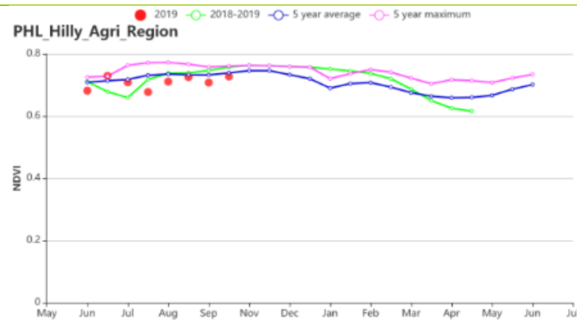
(b) Crop condition development graph based on NDVI (c) Maximum VCI



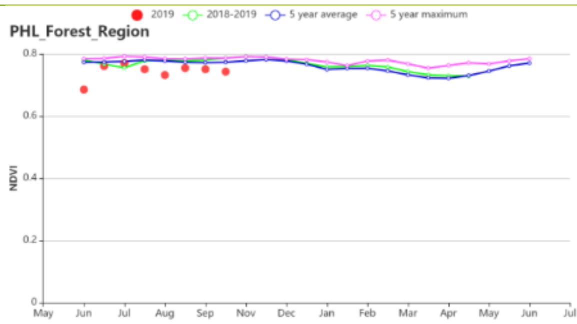


(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles

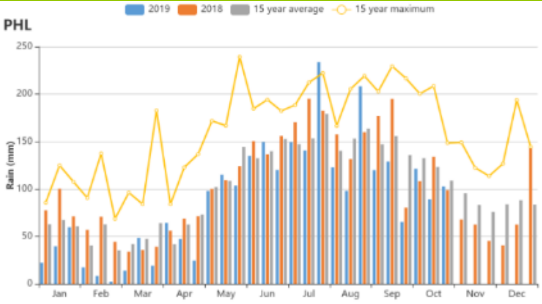


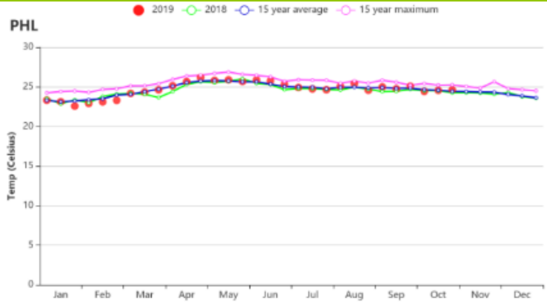


(f) Crop condition development graph based on NDVI (Northern lowlands of Mindanao to western Visayas region (left)， Negros and central Visayas Islands region (right))



(g) Crop condition development graph based on NDVI(Forest islands region)





(h)Rainfall index (i)Temperature index

Table 3.59 Philippines's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July - October 2019

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 (%)
Lowlands region	1840	-6	24.8	0	1154	2	757	1
Hills region	1534	-17	26.3	0.3	1313	10	892	10
Forest region	1317	-12	24.6	0	1241	4	813	4
Lowlands region	1840	-6	24.8	0	1154	2	757	1

Table 3.60 Philippines's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July - October 2019

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure from 5YA (%)	Current (%)	Departure from 5YA (%)	Current
Lowlands region	100	0	165	16	0.98
Hills region	100	0	139	-2	0.98
Forest region	100	0	129	4	0.98
Lowlands region	100	0	165	16	0.98

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

[POL] Poland

The monitoring period covers the harvest of spring and winter wheat, the late growth stages of maize and the planting period of the 2019-20 winter crops. Agro-climatic conditions were close to the average throughout the monitoring period and early stages of the winter crop are satisfactory.

Compared with the average, precipitation was 7% lower, with temperature and radiation slightly higher by 0.3°C and 3%, respectively; potential biomass (BIOMSS) was close to the average. In terms of agronomic indicators, compared with the average of the past five years, CALF was close to average (nearly 100%), but VCIx was just fair at 0.79.

Nationwide NDVI from July to August was lower than the average of the past five years, but recovered to close to average levels after August. After the drought in the previous monitoring period, the precipitation in July and August was still lower than the average. However, from September to October, the precipitation increased and significantly higher than average RAIN was recorded. Temperature fluctuated a lot: there were two heat waves in late August and late October, which exceeded 15 years maximum.

As shown in the spatial NDVI profiles, about 55.3% of the cropland condition was below average before October mainly distributed in the northeast and central parts of the country, and almost 64.4% of cropland condition was above average in October. Only 12.2% of cropland was above average scattered all over the country during the entire period due to the drought from previous period and heat waves in the period. From VCIx maps, value below 0.5 was observed mainly in east and center of the country.

In spite of the initial drought, crop condition is assessed as average.

Regional analysis

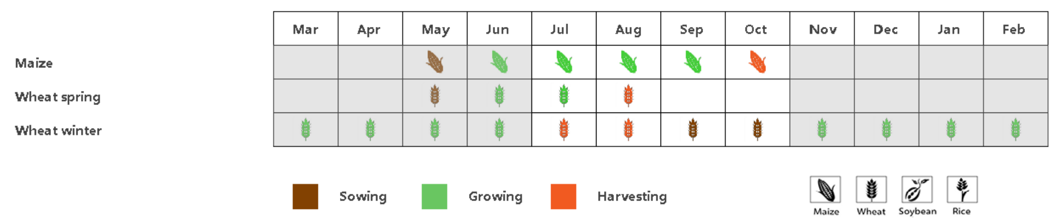
CropWatch sub-divides Poland into four zones according to agro-ecological and farming characteristics, including: (a) **the Northern oats and potatoes area** covering the northern half of West Pomerania, eastern Pomerania and Warmia-Masuria; (b) the **Northern-central wheat and sugar-beet area** (Kuyavia-Pomerania to the Baltic sea); (c) the **Central rye and potatoes area** (Lubusz to South Podlaskie and northern Lublin), and (d) the S**outhern wheat and sugar-beet area** (Southern Lower Silesia to southern Lublin and Sub-carpathia along the Czech and Slovak borders).

In all four AEZs CALF was close to 100%, and cropping intensity ranged from 142% to 145%.

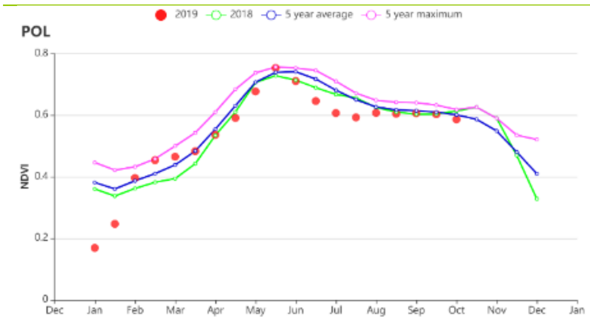
Agro-climatic variables of the **Northern oats and potatoes area** and the **Northern-central wheat and sugar-beet area** were very close to average (RAIN +4% and +1%, TEMP +0.2°C in both; RADPAR +1% and BIOMSS +1%). NDVI was lower than the average until October in the first region, but close to average from September to October in the second.

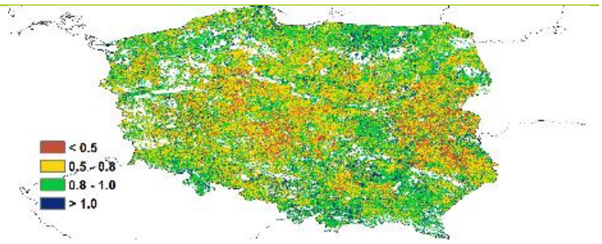
In the **Central rye and potatoes area** and **Southern wheat and sugar-beet area**, crop conditions were slightly below the average, due to the continued shortage of rainfall (-9% and -10% respectively). However, with the precipitation picking up in in September and October, the coming season's crop growth conditions are close to average.

Figure 3.35 Poland's crop condition, July-October 2019



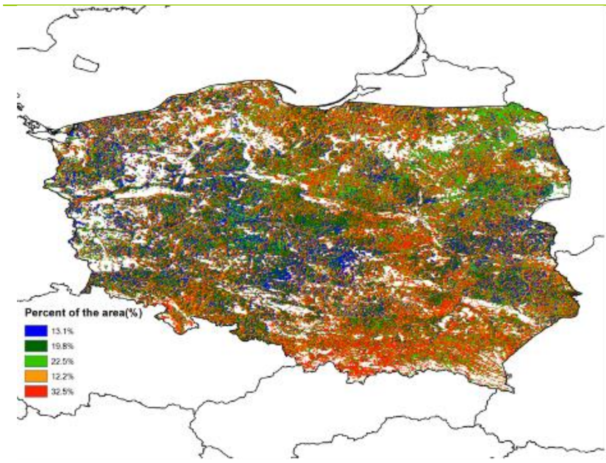
(a). Phenology of major crops

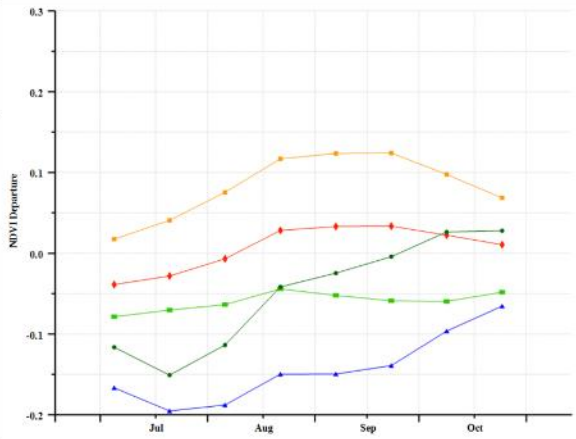




(b) Crop condition development graph based on NDVI

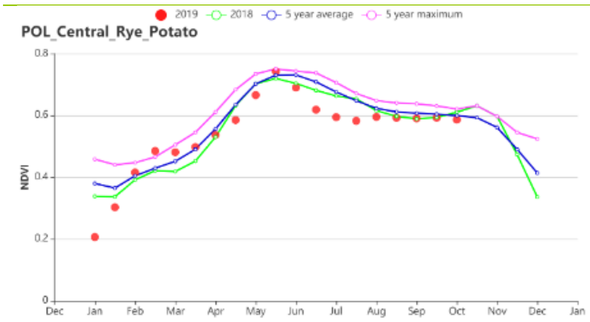
(c) Maximum VCI

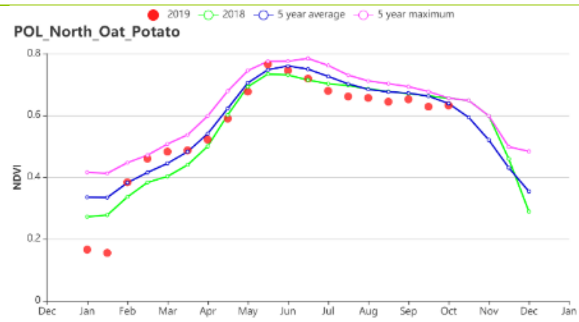




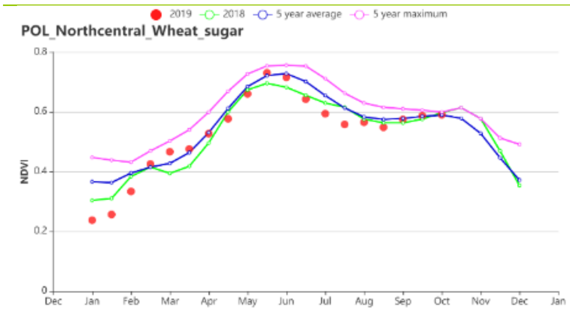
(d) Spatial NDVI patterns compared to 5YA

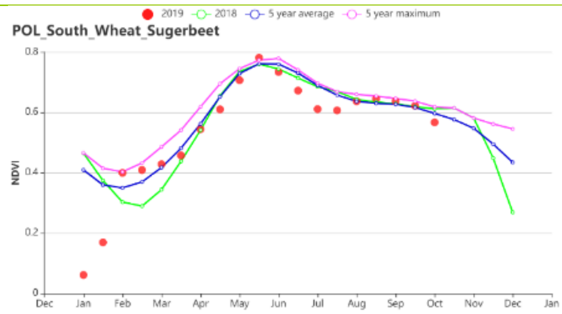
(e) NDVI profiles



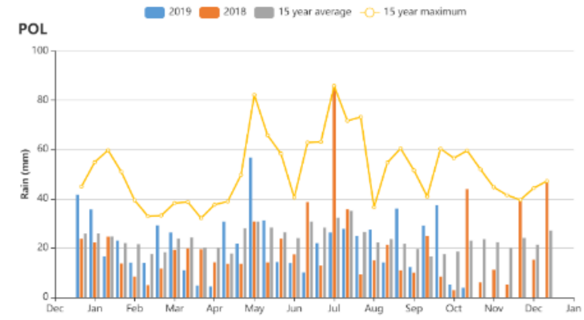


(f) Crop condition development graph based on NDVI, Central rye and potatoes area (left) and Northern oats and potatoes area (right).

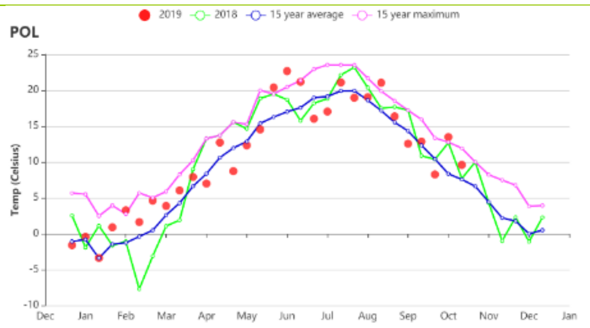




(g) Crop condition development graph based on NDVI, Northern-central wheat and sugar beet area (left) and Southern wheat and sugar beet area (right).



(h) Rainfall index



(i) Temperature Index

Table 3.61 Poland's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July-October 2019

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 (%)
Northern oats and potatoes area	334	4	14.9	0.2	801	1	349	1
Northern-central wheat and sugarbeet area	279	1	15.3	0.2	832	1	373	1
Central rye and potatoes area	246	-9	15.9	0.3	852	1	391	2
Southern wheat and sugarbeet area	269	-10	15.3	0.5	945	5	404	1

Table 3.62 Poland's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July-October 2019

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure from 5YA (%)	Current (%)	Departure from 5YA (%)	Current
Northern oats and potatoes area	100	0	145	11	0.86
Northern-central wheat and sugarbeet area	100	0	143	2	0.77
Central rye and potatoes area	100	0	145	2	0.76
Southern wheat and sugarbeet area	100	0	142	-1	0.82

[ROU] Romania

The reporting period includes the harvest of the 2018-19 winter wheat (which started in July), the sowing of the 2019-20 winter wheat (which started in September) and also the harvesting of spring wheat, maize and other summer crops in September. Overall, crop condition was fair. The maximum VCI reached 0.92 and the current cropped arable land fraction was around average. Rainfall was 35% lower than average; TEMP, RADPAR and BIOMSS were higher by 0.6°C, 6% and 4%, respectively. The nationwide NDVI profile shows that crop condition was better than average in July and August, but below average from September. The temperature fluctuated around the average and rainfall was close to average in July (which covers the final stages of spring wheat and maize) but below in August, which was the last month of growing season.

In the NDVI profiles, summer crops have suffered, except in limited areas. The only place where VCIx and NDVI completely agree is around Vaslui.

Regional analysis

More spatial detail is provided below for three main agro-ecological zones: Western and central maize, wheat and sugar beet plateau (106), the Central mixed farming and pasture Carpathian hills (104) and the Eastern and southern maize, wheat and sugar beet plains (105).

The CALF index of three sub-regions was close to 100% during the reporting period while the maximum VCIx varied in sub-regions, indicating that planting was satisfactory in all three regions but the growth conditions were different.

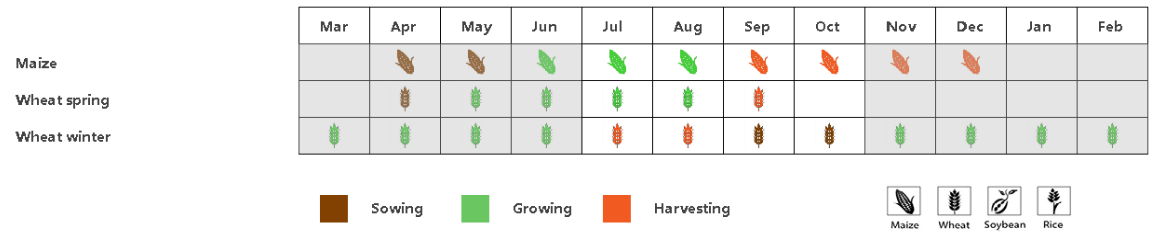
For the **Western and central maize, wheat and sugar beet plateau**, rainfall was lower than average by 37%, temperature and radiation were somewhat higher (TEMP +0.7℃, RADPAR +6%) and biomass increased 9%. Spatial NDVI profiles show that crop condition was higher than average before September and decreased ever since, which could be due to the decrease of rainfall (-37%). Maximum VCI of this region was 0.88, a bit low and the spatial distribution was between 0.8 and 1.0. Also the NDVI development decreased from July to October, consistent with the VCI values.

For the **Central mixed farming and pasture Carpathian hills**, rainfall decreased by as much as 29% below average while temperature and radiation were both up (TEMP +0.5℃ , RADPAR +6%) and BIOMSS increased 5%. According to NDVI development, crop condition was better than average in July and lower from August. The maximum VCI map shows values above 0.8 , with the regional average at 0.94. The NDVI spatial distribution shows that NDVI was fair throughout the reporting period. As the central mixed farming and pasture Carpathian hills occupies only a small fraction of cropland in Romania, a small patch of irrigated land in Transylvania, this region's fair NDVI cannot represent much of Romania crop production.

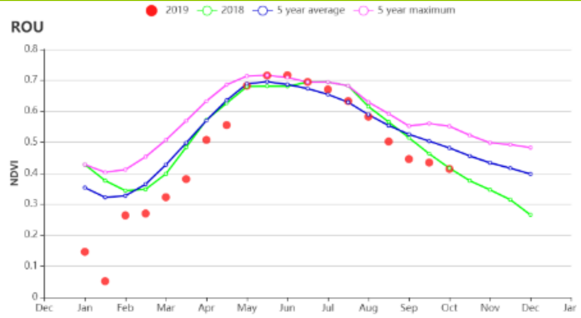
For the **Eastern and Southern maize, wheat and sugar beet plains**, rain decreased 36%, temperature increased 0.6℃, radiation increased 1% and biomass increased 1%. The NDVI development graph shows that crop condition was higher than average during July to August and fell below average thereafter. VCI max value of this region was 0.93 and according to the distribution map, VCI values were higher than 1.0 in most of the central and middle region but below 0.8 in the south-eastern area of this sub-region (counties of Tulcea and Constanta), representing about 14.3% of national cropland.

Overall, crop condition was fair in Romania, with the exception of the extreme south-east (Dobrogea). Low rainfall impacted the final stages of summer crop and reduced production is likely in 2019.

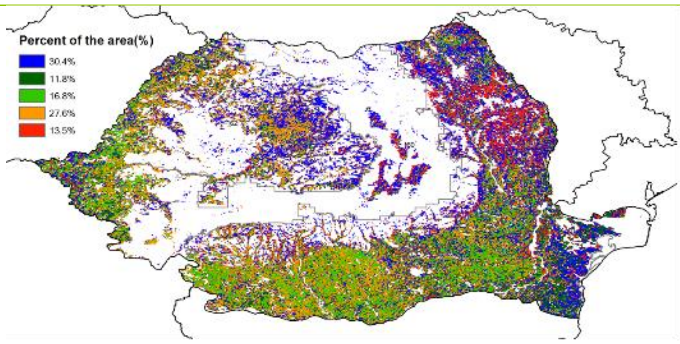
Figure 3.36 Romania's crop condition, July-October 2019

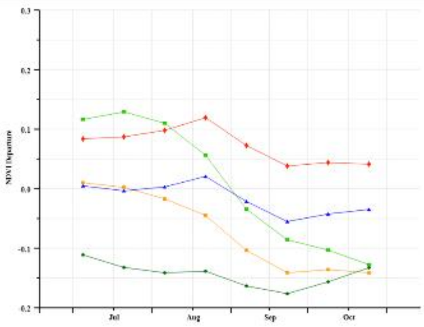


(a). Phenology of major crops

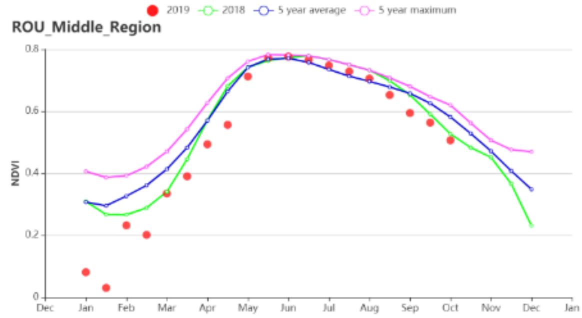


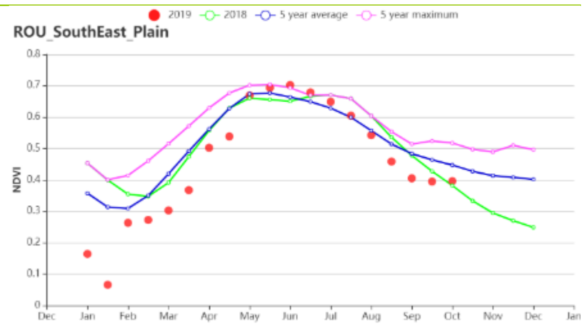
(b) Crop condition development graph based on NDVI (c) Maximum VCI



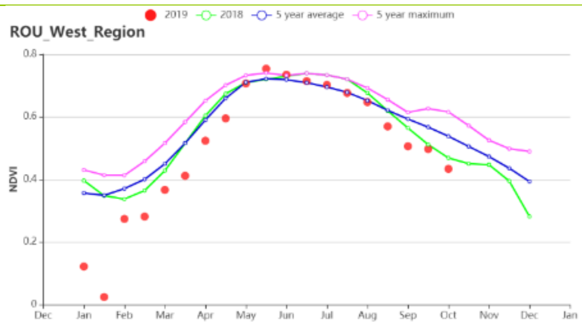


(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles

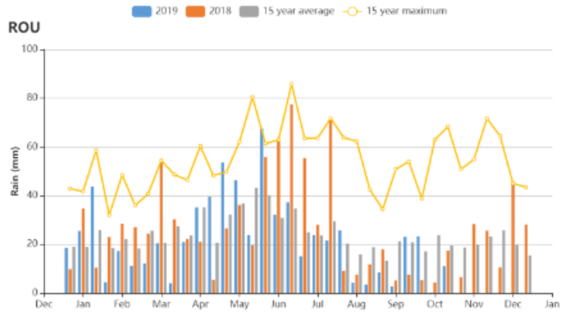




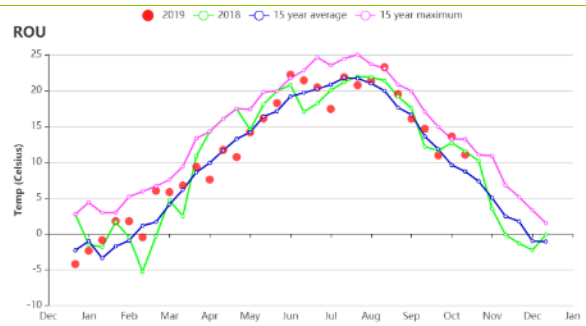
(f) Crop condition development graph based on NDVI (Central mixed farming and pasture Carpathian hills (left) and Eastern and southern maize, wheat and sugarbeet plains (right))



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



(h) Rainfall index



(i) Temperature index

Table 3.63 Romania's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July-October 2019

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Western and central maize wheat and sugarbeet plateau	158	-37	17.1	0.7	1105	6	516	9
Central mixed farming and pasture Carpathian hills	223	-29	14.7	0.5	1091	6	431	5
Eastern and southern maize wheat and sugarbeet plains	141	-36	19	0.6	1111	5	545	1

Table 3.64 Romania's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July-October 2019

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Central mixed farming and pasture Carpathian hills	100	0	107	-1	0.88
Eastern and southern maize, wheat and sugar beet plains	100	0	103	-1	0.94
Western and central maize, wheat and sugar beet plateau	98	-1	103	-11	0.93

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

[RUS] Russia

July to October is the main harvesting time in Russia: winter crops are harvested from the end of June to the middle of July; spring grain crops have their peak season in July and are mainly harvested at the end of August-beginning of September. September is also the time for the sowing of winter crops. Weather conditions are crucial in this period as they affect not only the state of spring grain crops but also the harvest and the germination of newly sowed winter crops.

According to CropWatch national data, NDVI was below both the 5-year average and the previous year's level during the monitor period. In September and October, it reached the level of the previous year which coincided with the 5-year average.

Precipitation was above average for most of the period. From July to September it was lower than last year's level, but above the 15-year average. In August, rainfall reached a 15-year maximum. In late August and early September, rainfall began to decline and approached 15-year average.

Temperature was below average and last year's level at the beginning of the period. By the end of July, there was a sharp drop in temperature. In early August and early September, the temperature was average and comparable to 2018 values. In mid-September, the temperature decreased drastically, but by the end of September and the end of October, it exceeded the average and was close to the level of 2018.

Above average crop condition with VCIx above 0.8 were observed in Middle Volga and Siberia regions as well as in the central part of North Caucasus, where areas with positive NDVI departure prevail. However, in main grain producing regions (Central, Central black soil, most of North Caucasus), crop condition was average or below average with VCIx below 0.8 or even below 0.5, with average NDVI or negative departures.

National CropWatch data show that there can be a drop in the yield due to unfavorable weather conditions in peak season. Moreover, abundant rainfall may have hindered the harvesting of both winter and spring grain crops and resulted in some additional yield loss.

Regional analysis

According to regional CropWatch data, the Southern Caucasus recorded a slight drop in temperature (-0.4°C compared to average) and a larger decrease in rainfall (27% below average). RADPAR was 4% above average. As the likely result of favorable sunshine, the region showed an increase in biomass (+2%) compared to the 5-year average. VCI was 0.76. CALF was 72%. Cropping intensity was 106%. NDVI declined in early June relative to the 5-year average and the level of the last year. By mid-July, the NDVI had reached the 5-year average, which was followed by a sharp decline again that lasted until mid-September and early October, when the NDVI index values reached last year's value and the 5-year average. A decrease in yield of grain crops is expected in this region.

In the **Northern Caucasus** rainfall was 5% below average. The temperature was down 0.9°C below average. Despite a slight increase in sunshine (RADPAR up 1% compared to average), large amounts of precipitation and lower temperature, BIOMSS lost 2% compared to average. VCI was 0.81, CALF was 81% and Cropping intensity was 95%. NDVI exceeded the 5-year average and last year's level in July and August. It declined only in early September, but at mid-September it rose again. At the end of October, NDVI exceeded the average for 5 years and became equal to the 2018 values. Yield is expected to be higher than in the previous year.

In **Central Russia**, compared to average, rainfall was up 8%, TEMP fell 1.3°C and RADPAR lost 7%. The resulting sharp drop in BIOMSS (-22%) is not confirmed by VCIx (0.94), CALF (99%) and Cropping Intensity (101%). In late July and mid-August, NDVI values were equal to their 2018 levels and the 5-year average. In mid-September, there was a sharp decline in the NDVI, which returned to the 5-year average at the beginning of October. Due to unfavorable weather conditions, decrease in yield can be expected in this region.

In the **Central black soils area**, there was a drop-in rainfall (-7%) and a decrease in temperature (-0.8°C) relative to the 15-year average. At the same time, RADPAR was 2 % higher compared to average. However, due to rainfall deficit and cool temperature, biomass decreased by 11%. below average. CALF was 99 %, VCI 0.81 and Cropping intensity, 102% At the beginning of July, NDVI was below the 5-year average, but at the end of August, it reached last year's values and the 5-year average. In mid-August, NDVI dropped below 5-year average. Due to unfavorable weather conditions, a decrease in yield can be expected in this region.

In the **Middle Volga region**, precipitation exceeded average by 22%, with TEMP down 1.4°C and RADPAR down 10%. As a result, there was a drop of 20% in biomass compared to the 5-year average. VCI was 0.85, CALF 93 %. and the cropping intensity was 99%. After a decrease in early July, NDVI stayed essentially near the 5-year average. In September, it fell below 2018 values but at the middle of August and at the beginning of October it reached 5-year maximum. Due to unfavorable weather conditions, decrease in yield can be expected in this region.

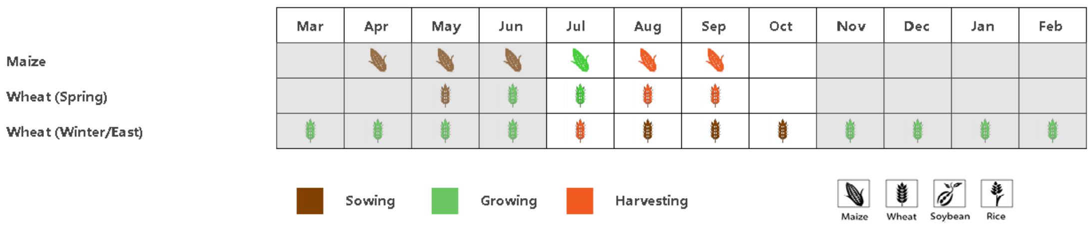
In the **Ural and Western Volga region** there was an increase in precipitation by 14% relative to the 15-year average. The temperature decreased by 0.2°C while RADPAR and BIOMSS were essentially average. CALF was about 97%. VCI was 0.89. Cropping intensity was 106. NDVI was below the 5-year average and last year's values till the end of August. In early September, it reached 5-year average and stayed close to this level. Yield is likely to be reduced due to unfavorable weather conditions.

In **Eastern Siberia**, rainfall exceeded average by 29%. The temperature was about average while RADAR was down 3%. Due to abundant precipitation and low temperature and RADPAR, BIOMSS decreased by 7% compared to average. As to the agronomic indicators, CALF was about 99 %, VCI reached was 0.97 and the Cropping intensity was at 106%. In July, NDVI was below the level of last year. In August it dropped even lower. In early September, NDVI increased and exceeded last year's level but was still below the 5-year average. In mid-September and October, NDVI dropped again below the level of last year. A decrease in yield is expected due to unfavorable weather conditions.

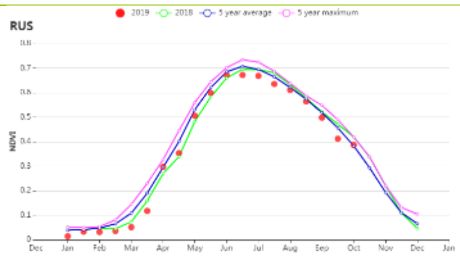
Rainfall was 4% above average in Middle Siberia while TEMP was only slightly higher (+0.5°C). RADPAR increased 3%. Biomass rose 5% and all agronomic indicators all recorded fair values: CALF 99 %, VCIx 0.97 and Cropping intensity 107%. In July, NDVI reached the 5-year maximum. At the beginning of August, it was below the 5-year maximum but above the 5-year average. Since mid-August, the NDVI stayed close to 5-year maximum. Increase in yield is expected in this region.

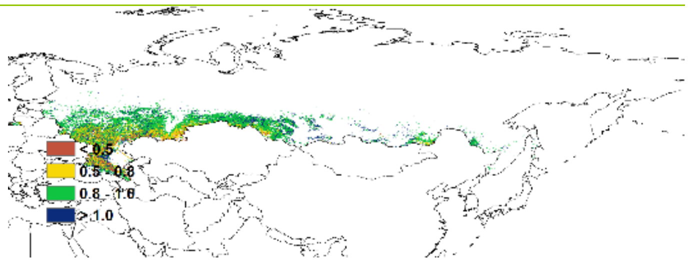
In **Western Siberia**, there was a decrease in rainfall by 8% relative to average. The temperature rose relative to average by 1.0°C and RADPAR was up 7% relative to the 15-year average. Despite the lack of rainfall, higher temperature and RADPAR resulted in biomass increase of 14%. CALF was 99 %, VCIx 0.93 and Cropping intensity was 104%. NDVI values stayed close the 5-year average and Yield is expected to be close to those of the previous season

Figure 3.37 Russia's crop condition, July-October 2019

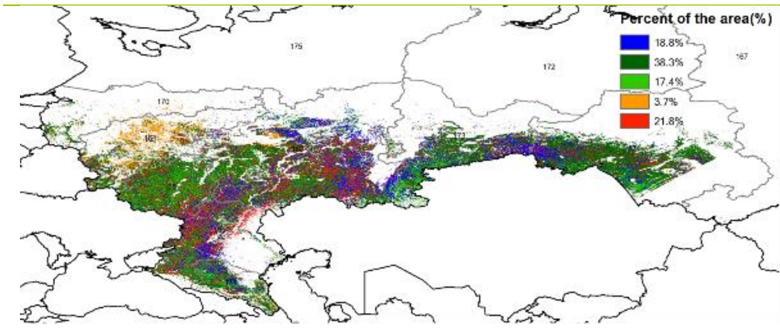


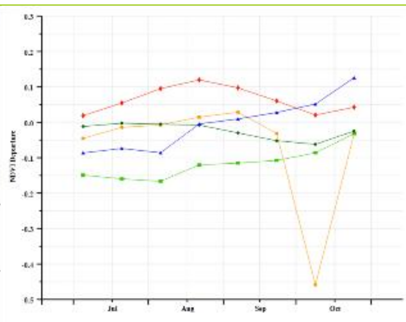
(a). Phenology of major crops



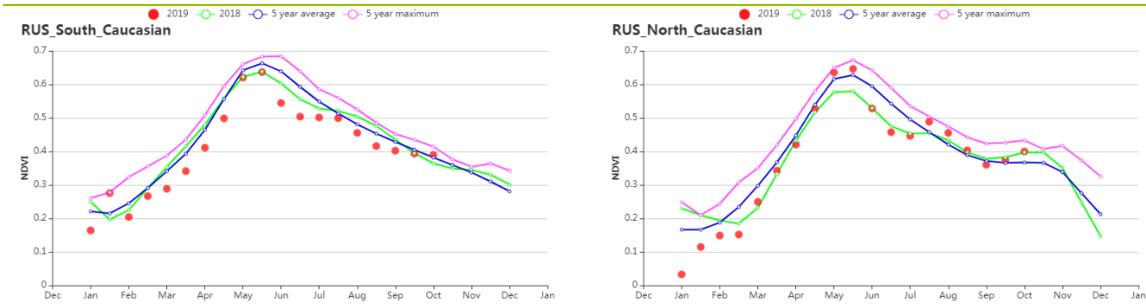


(b) Crop condition development graph based on NDVI (c) Maximum VCI

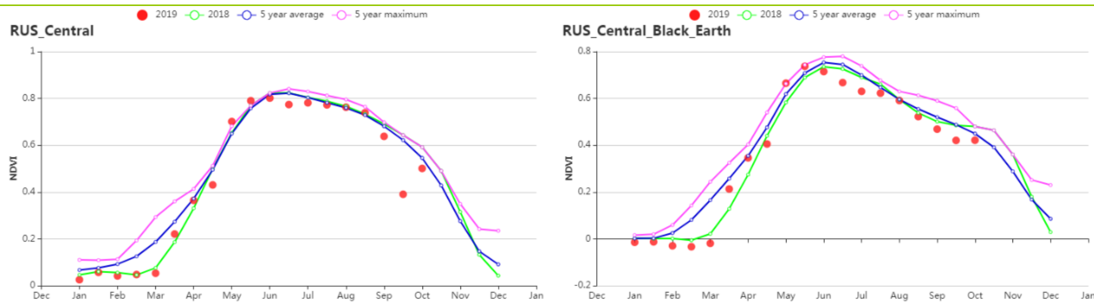




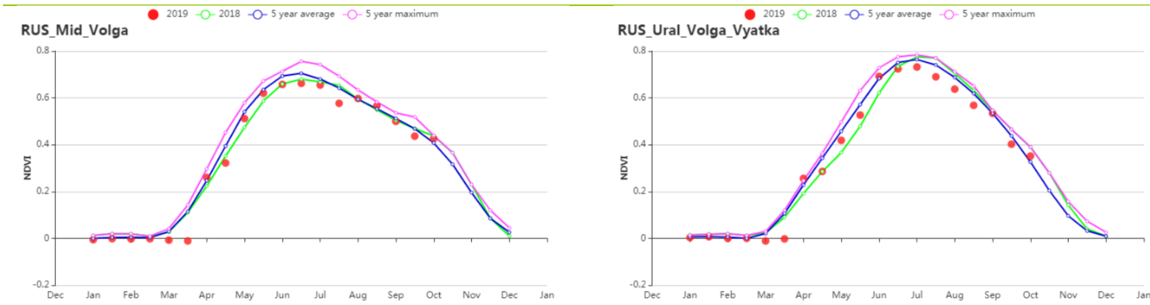
(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles



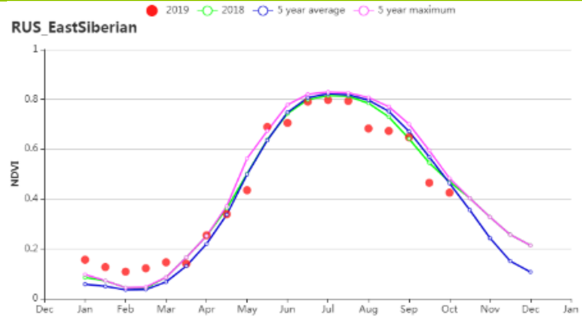
(f) Crop condition development graph based on NDVI (Southern Caucasus (left) and Northern Caucasus (right))

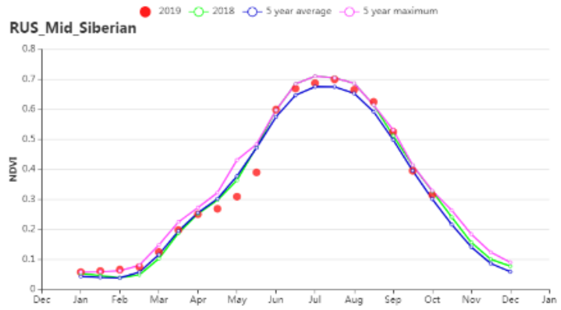


(g) Crop condition development graph based on NDVI (Central Russia (left) and Central black soils area (right))

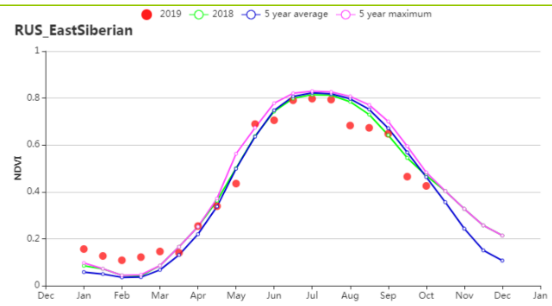


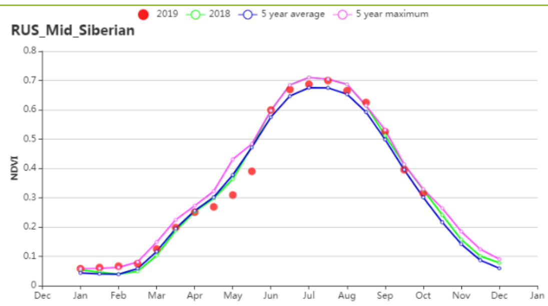
(h) Crop condition development graph based on NDVI (Middle Volga (left) and Ural and western Volga region (right))



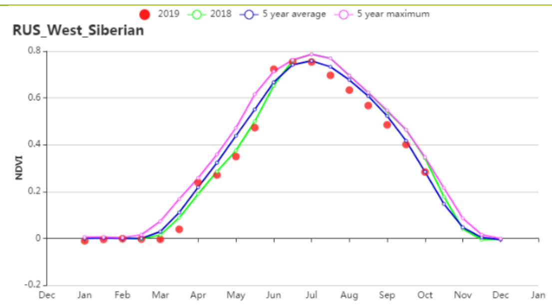


(i) Crop condition development graph based on NDVI in the Eastern Siberia (left) and the Middle Siberia (right)

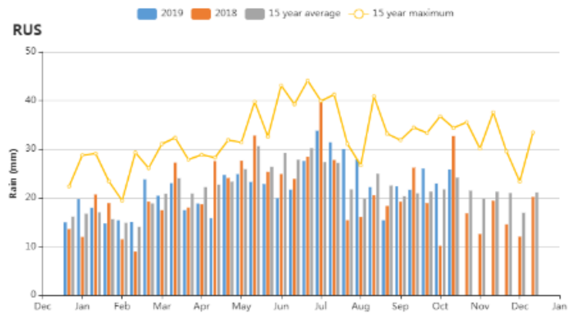


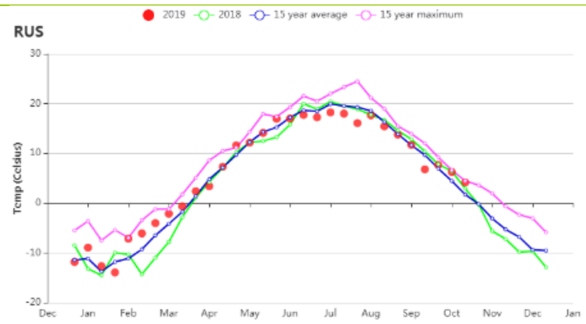


(i) Crop condition development graph based on NDVI (Eastern Siberia (left) and Middle Siberia (right))



(g) Crop condition development graph based on NDVI (Western Siberia)





(h) Rainfall index

(i) Temperature index

Table 3.65 Russia's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July-October 2019

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 Russia	342	8	11.7	-1.3	676	-7	243	-22
Central black soils area	226	-7	14.0	-0.8	862	2	346	-11
Eastern Siberia	604	29	12.9	-0.1	831	-3	326	-7
Middle Siberia	291	4	10.1	0.5	944	3	331	5
Middle Volga	333	22	12.1	-1.4	711	-10	282	-20
Northern Caucasus	197	-5	18.0	-0.9	1050	1	518	-2
Southern Caucasus	252	-27	16.5	-0.4	1117	4	515	2
Ural and western Volga region	299	14	11.8	-0.2	737	0	305	0
Western Siberia	247	-8	12.9	1.0	862	7	367	14

Table 3.66 Russia's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July-October 2019

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure from 5YA (%)	Current (%)	Departure from 5YA (%)	Current
Central Russia	99	0	101	1	0.94
Central black soils area	99	0	102	0	0.81
Eastern Siberia	99	0	106	-3	0.97
Middle Siberia	99	0	107	6	0.97
Middle Volga	93	0	99	7	0.85
Northern Caucasus	81	0	95	-5	0.81
Southern Caucasus	72	0	106	3	0.76
Ural and western Volga region	97	0	106	14	0.89
Western Siberia	99	0	104	8	0.93

[THA] Thailand

This reporting period is the critical growth season of the main rice crop of Thailand, one of the top rice exporters in the world. It is also harvesting time for maize. Crop condition was below last year's and the last 5 years average because of drought.

The rain season starts in May and ends in October. The major water source for rice grown as a lowland crop is rainfall, with limited irrigation. Compared to average, RAIN was significantly down (17%) due to reduced precipitation in July, September and October. TEMP and radiation where both above average (0.3℃ and 7%, respectively), with TEMP peaks (July, September and October) reaching the 15-year maximum, which obviously contributed to the water stress.

The negative affect of drought is displayed in the spatial distribution of NDVI profiles, especially in the central plain and the North-east, which together contribute more than 70% rice of the national rice output. 22.6% of cropland (including the area around Bangkok, Ubon Ratchathani and Nakhon Ratchasima) suffered deteriorating crop growing condition, with the worst situation observed in early September. 31.4% of cropland, mainly in the east of Ubon Ratchathani, also experienced unfavorable conditions, particularly in mid-August; although the crop has been recovering, it is still below average.

As an important indicator, VCIx reached 0.94, indicating acceptable crop condition with, as mentioned, severe crop impact in specific locations. CropWatch assesses crop condition in Thailand as below average, with reduced rice output expectations.

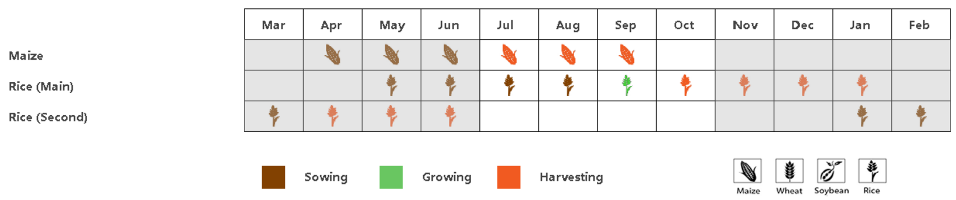
Regional analysis

The Central double and triple-cropped rice lowlands is the major rice production zone of Thailand and was suffered from a serious drought during the monitoring period. The agro-climatic indicators indicate that Rain was well below average (28%), paralleled by rising temperature (+0.2℃) and sunshine (+4%). The NDVI development graph shows crop condition staying consistently below average since the sowing of rice in May, which will lead to unfavorable production.

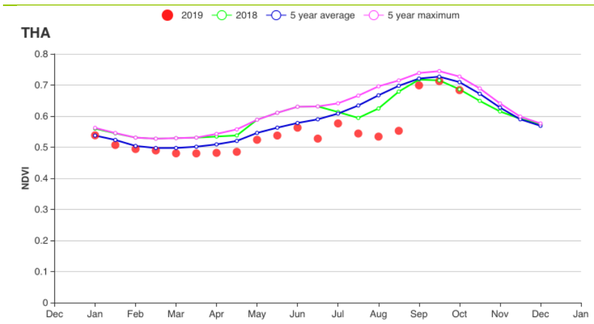
As the whole, the agro-climatic conditions were normal in the **South-eastern horticulture area**, with slightly below average precipitation (-6%), close to average temperature and a slight reduction in sunshine (-1%).

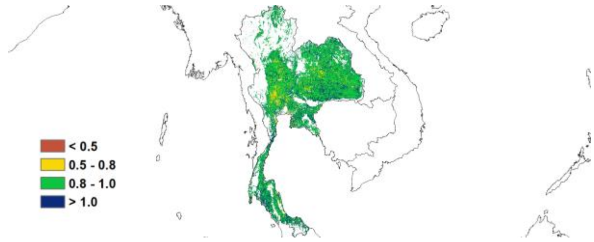
In the S**ingle-cropped rice north-eastern region**, another rice production zone, precipitation was down 8% while sunshine was abundant (up 7%). Crop condition was unfavorable, as reflected by the crop condition development graph based on NDVI. The bad situation started in May but reached its peak in late August.

Figure 3.38 Thailand's crop condition, July-October 2019

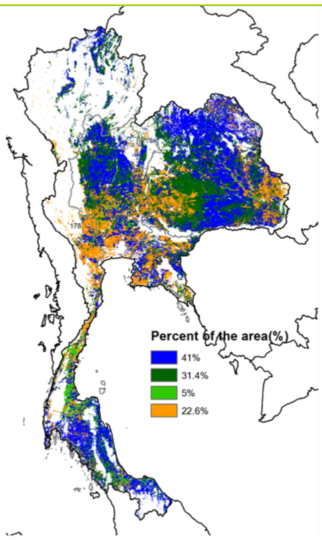


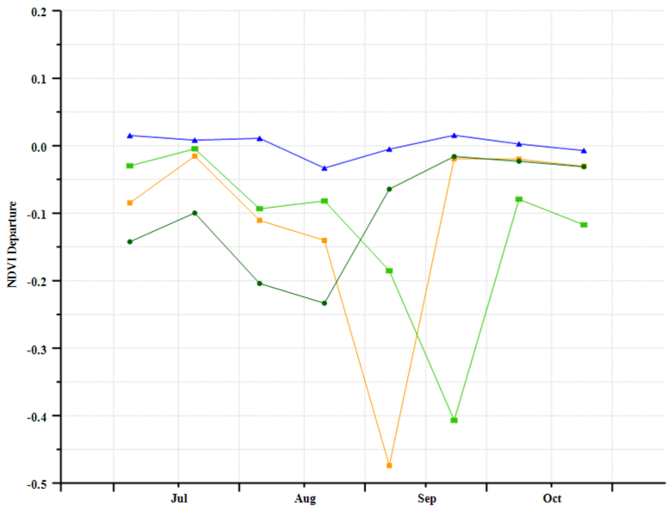
(a). Phenology of major crops



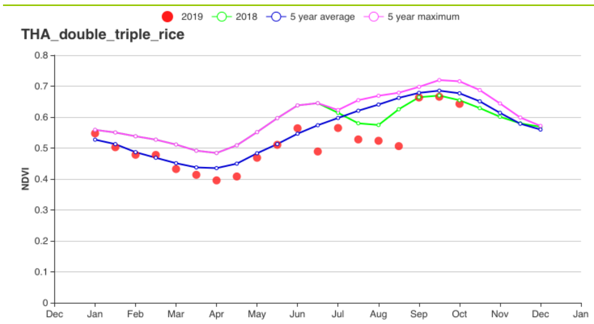


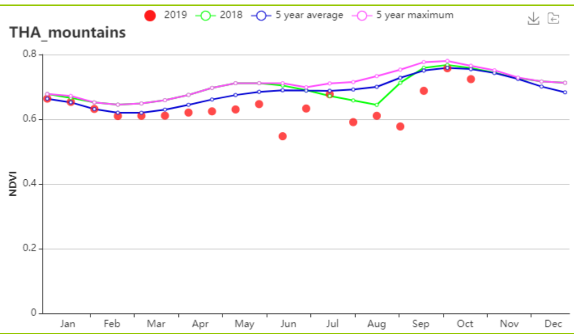
(b) Crop condition development graph based on NDVI (c) Maximum VCI



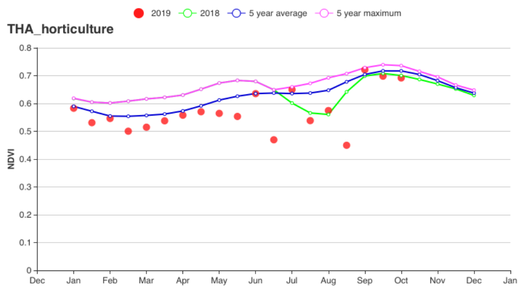


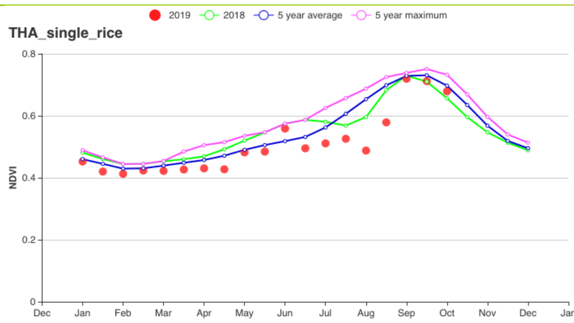
(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles



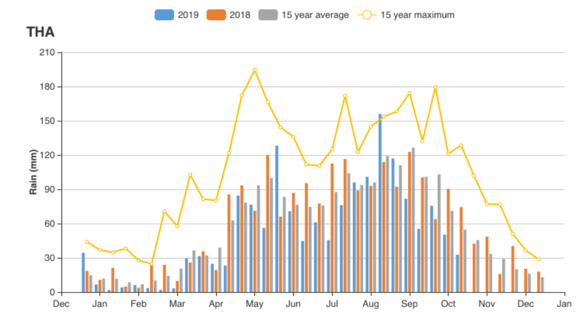


(f) Crop condition development graph based on NDVI (Central double and triple-cropped rice lowlands (left) and Western and southern hill areas (right))

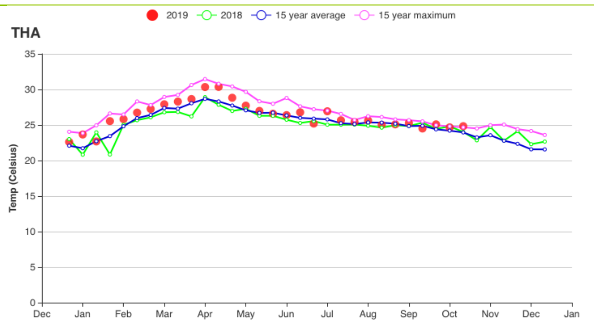




(f) Crop condition development graph based on NDVI (South-eastern horticulture area (left) and Single-cropped rice north-eastern region (right))



(h) Rainfall profiles



(i) Temperature profiles

Table 3.67 Thailand's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July-October 2019

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 double and triple-cropped rice lowlands	771	-28	26	0	1,112	4	745	5
South-eastern horticulture area	1,170	-6	26	0	1,126	-1	765	0
Single-cropped rice north-eastern region	1,150	-8	26	0	1,160	7	774	8

Table 3.68 Thailand's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July-October 2019

Region	Cropped arable land fraction		Cropping Intensity		Maximum VCI
	Current (%)	Departure from 5YA (%)	Current (%)	Departure from 5YA (%)	Current
Central double and triple-cropped rice lowlands	99	0	153	13	0.92
South-eastern horticulture area	100	0	140	8	0.96
Single-cropped rice north-eastern region	100	0	134	6	0.94

[TUR] Turkey

The reporting period covers the harvest of winter wheat, growth and harvest of maize and rice, and the planting of winter wheat from September to October. During the monitoring period, the NDVI was above the previous five-year average until mid-September. This shows favorable conditions in Turkey. Nonetheless, weather condition were not very favorable. Rainfall was only approximately two thirds of the average (RAIN -30%), temperature was also slightly below the average (TEMP -0.2℃), while more radiation was received (RADPAR, +2%). Due to the shortage of rainfall, biomass was below the average (BIOMSS, -4%). The Cropped Arable Land Fraction increased 3% comparing to the average and the maximum VCI reached 0.81. Cropping intensity indices indicates high crop land utilization in 2019, with increases between 6% and 18%, according to region). According to the spatial NDVI patterns map, 44.4% of the area enjoyed above average NDVI, mainly in the provinces or Mardin, Sanli Urfa, Malatya, Konya, Aksaray and Karaman.

Regional analysis

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

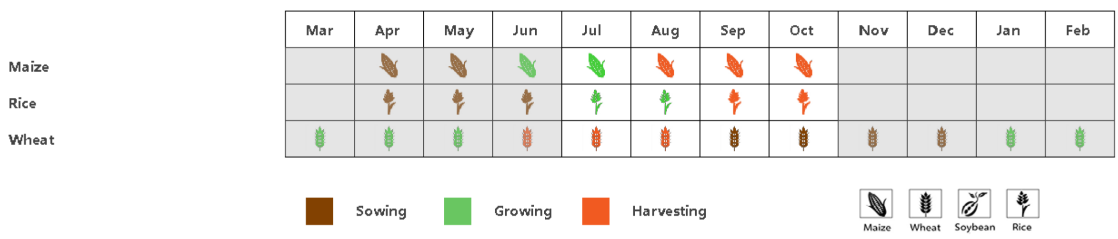
In the **Black Sea zone**, crop condition was generally close to average for all agro-climatic indicators (RAIN +2%, RADPAR +2%, TEMP down 0.5°C). The cropped arable land fraction (CALF) was 95%, roughly at the average level. The VCIx was 0.89. CropWatch estimates the output of crops to be satisfactory in this zone.

The **Central Anatolian region** had below average NDVI after mid-September only, with earlier months above average. Radiation was slightly above average (RADPAR, +1%) while rainfall and temperature were below (RAIN -38%, TEMP -0.2°C). Based mainly on the NDVI profile and the spatial NDVI patterns in this zone, CropWatch estimates crop conditions was close to average for winter and summer crops.

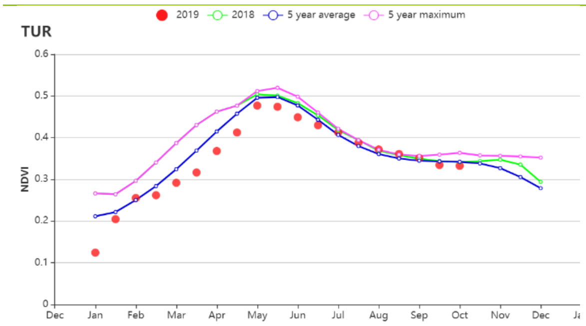
In the **Eastern Anatolian plateau**, crop condition was below or close to average. The VCIx map shows that some parts of this region suffered from low VCIx values, which was also confirmed by the spatial NDVI patterns map. The biomass and cropped arable land fraction were both below average (BIOMSS, -11%; CALF, -6%). The production of crops is generally expected to be unfavorable.

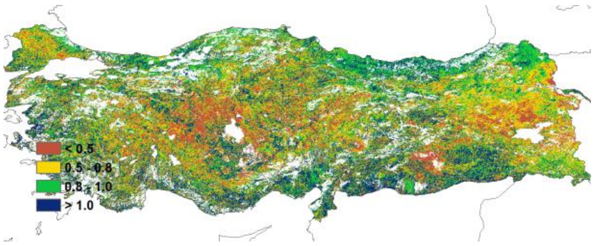
As indicated by the NDVI profile in the **Marmara Aegean Mediterranean lowland zone**, the crop condition was above or close to average during the reporting period. The lack of rainfall (RAIN, -41%) resulted in decreased biomass (BIOMSS, -1%). But the cropped arable land fraction increased 10% (CALF, +10%), meaning more land was cultivated during the monitoring period. In this region, the VCIx was 0.89. Crop prospect of this region is favorable.

Figure 3.39 Turkey's crop condition, July-October 2019

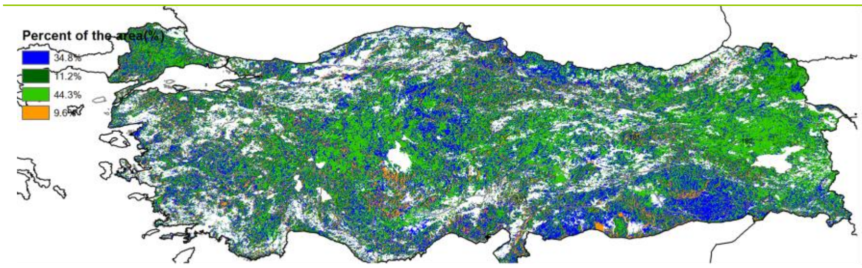


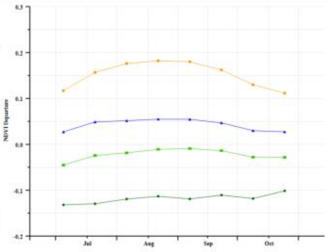
(a). Phenology of major crops



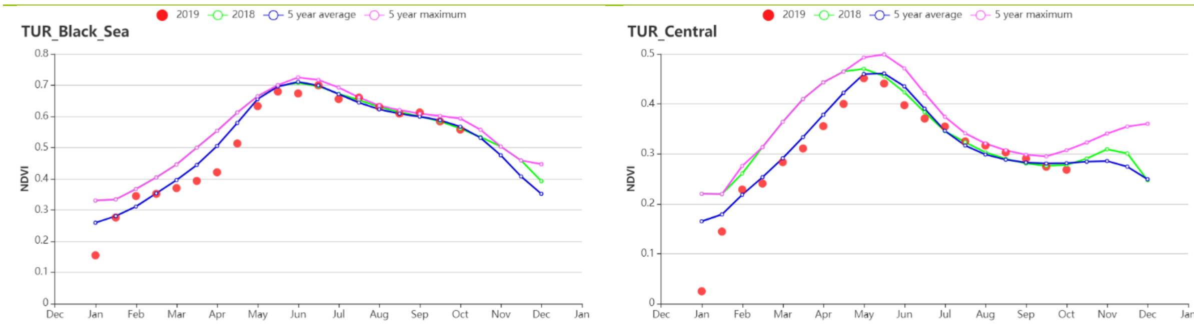


(b) Crop condition development graph based on NDVI (c) Maximum VCI

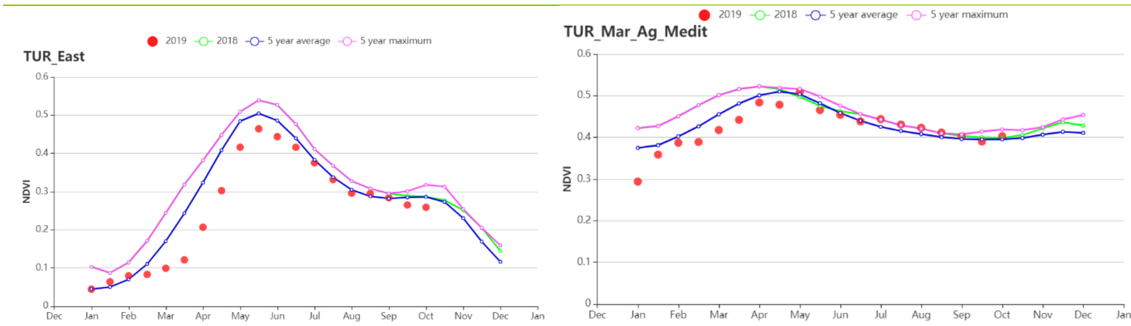




(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles



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



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

Table 3.69 Turkey's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July-October 2019

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	286	2	14	-0.5	1125	2	444	-2
Central Anatolia region	62	-38	18	-0.2	1300	1	492	-3
Easternl Anatolia region	80	-41	17	-0.2	1376	4	340	-11
Marmara Agean Mediterranean lowland region	72	-41	22	0	1344	2	458	-1

Table 3.70 Turkey's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July-October 2019

Region	Cropped arable land fraction		Cropping Intensity		Maximum VCI
	Current (%)	Departure from 5YA (%)	Current (%)	Departure from 5YA (%)	Current
Black Sea region	95	0	125	14	0.89
Central Anatolia region	34	2	55	15	0.75
Easternl Anatolia region	44	-6	69	6	0.75
Marmara Agean Mediterranean lowland region	60	10	90	18	0.89

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

The harvest of maize began in September and winter wheat was sown in August. The national NDVI development curve was slightly lower than the 5-years average from mid-August to October. Rainfall totaled 166 mm over the monitoring period, which was 44 mm below average. The average temperature reached 17.0°C, and the photosynthetically active radiation was 6% higher than average at 1002 MJ/m2. The potential biomass production was up 3% above average and the maximum VCI at the national scale reached 0.80. As a result, despite a decrease in rainfall, crop condition is assessed as average.

Regional analysis

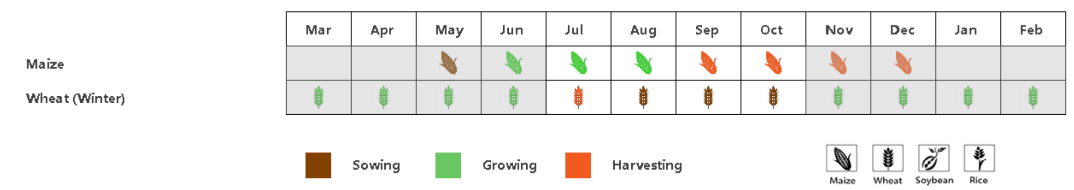
Regional analyses are provided for three agro-ecological zones (AEZ) defined by their cropping systems, climatic zones and topographic conditions. They are referred to Northern wheat area with Rivne; Eastern Carpathian hills with Lviv, Zakarpattia and Ivano-Frankivsk Oblasts, Central wheat area with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

In the Central wheat area, rainfall was short by 19% compared with average, with normal temperature (TEMP -0.2°C) and higher than average radiation (RADPAR +6%), which led to slightly below-average NDVI. BIOMSS was 1% above average and VCIx was satisfactory (0.82).

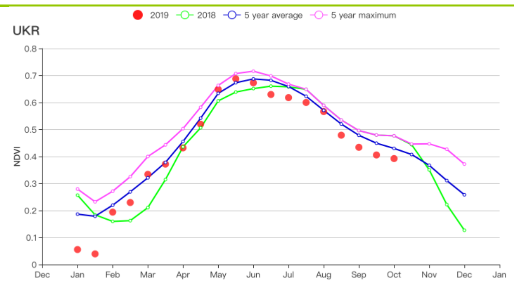
Similar conditions prevailed in the Northern wheat area and in the Eastern Carpathian hills where VCIx was 0.89 and 0.90, respectively.

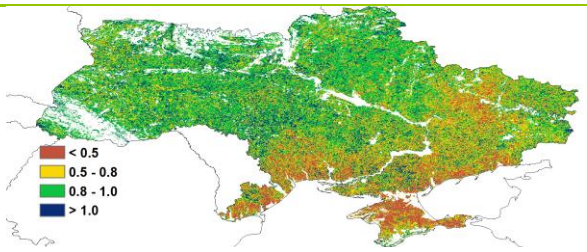
The Southern wheat and maize area showed average condition during the monitoring period. Weather was favorable: rainfall and temperature were average and radiation increased by 4% compared to average. The AEZ coincides almost perfectly with one of the areas identified by the spatial NDVI clusters for 21.9% of Ukrainian arable land, where NDVI was rather low in July, but then increased gradually to reach average values in August and above-average values for emerging winter wheat. This is also the area where most low VCIx values occur, to the extent that the average maximum VCI was 0.72, lower than other AEZs.

Figure 3.40 Ukraine's crop condition, July-October 2019



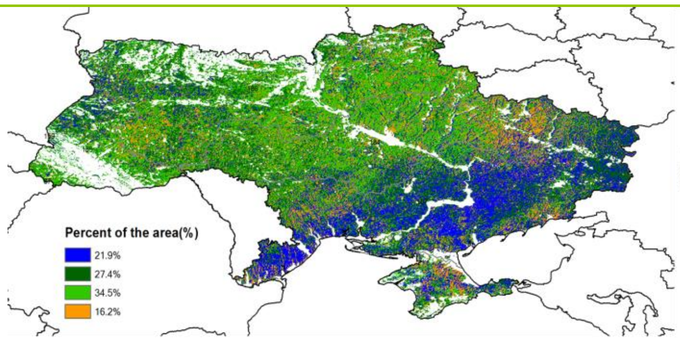
(a). Phenology of major crops



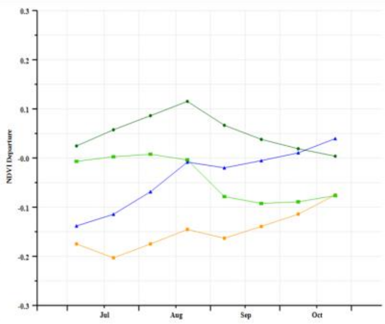


(b) Crop condition development graph based on NDVI

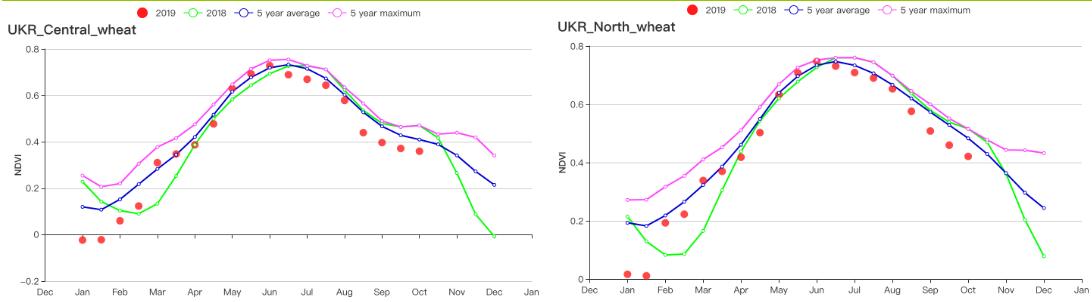
(c) Maximum VCI



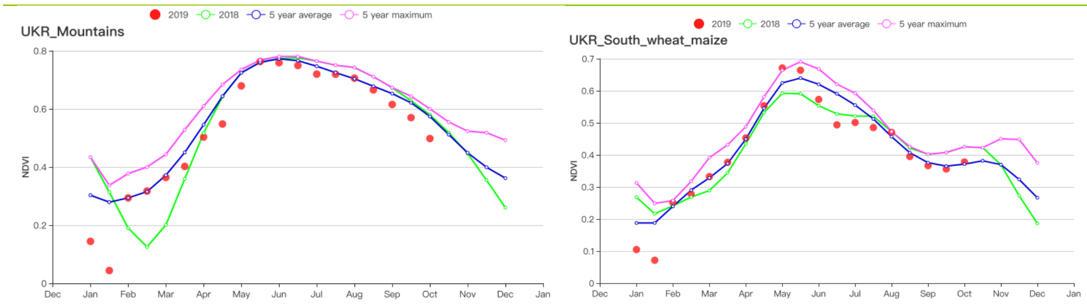
(d) Spatial NDVI patterns compared to 5YA



(e) NDVI profiles



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



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

Table 3.71 Ukraine's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July-October 2019.

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Central wheat area	156	-19	16.6	-0.2	998	6	459	1
Eastern Carpathian hills	201	-33	15.2	0.6	1015	7	430	6
Northern wheat area	173	-27	15.5	0	953	8	424	5
Southern wheat and maize area	163	-1	18.1	-0.4	1049	4	520	2

Table 3.72 Ukraine's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July-October 2019.

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Central wheat area	99	-1	104	-4	0.82
Eastern Carpathian hills	100	0	115	-8	0.90
Northern wheat area	100	0	110	-6	0.89

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure (%)	Current (%)	Departure (%)	Current
Southern wheat and maize area	85	-5	116	12	0.72

[USA] United States

The monitoring period covers the harvest of winter wheat, the late growth and harvest of spring wheat, maize, rice and soybean and the early growth of winter wheat.

Nationwide, weather was somewhat cooler and slightly sunnier than average (TEMP 0.2°C down and RADPAR up 1%) but much wetter (RAIN 24% above average). Large differences were recorded among States, with the largest precipitation excesses affecting South Dakota (+127%) and North Dakota (+109%), with TEMP 2°C to 3°C below average and a marked drop in sunshine (-8%), resulting in a biomass potential drop of 11% and 7%, due to cool weather and poor solar radiation respectively. At the same time, below average rainfall affected California (20 mm, 67% down below average) and resulted in a decrease in the biomass potential (-8%) because of water shortage. Other states enjoyed more favorable conditions and recorded BIOMSS increases, some of them after they had experienced unfavorable conditions during the previous AMJJ monitoring period. For example, in Washington and Oregon, BIOMSS was up by 13% and 7%, respectively. The diversity of situations resulted in nationwide BIOMSS being close to average (+1%) and a generally favorable maximum VCI of 0.93. The CALF was 3% above the five-year average and the cropping intensity was 11% above the average.

Altogether, CropWatch estimates the production of soybean and possibly maize to be below average, while production of winter wheat will stay average and the production of rice will increase. Considering that this monitoring period covers the early sowing of winter wheat, the production of 2019/20 winter wheat is still open.

Regional Analysis

In the **Corn Belt**, the major production zone of maize and soybean, precipitation was in large excess (52% above average). The temperature and sunshine were lower than average (TEMP down 0.7℃, RADPAR down 3%), resulting in a BIOMSS drop of 4%. NDVI values over the Corn Belt were lower than average until July but slightly above average thereafter. The pattern may have resulted from delayed maize and soybean planting because very wet soil conditions, and cooler temperatures in spring and early summer. CALF was average. The production of maize and soybean will be down in North and south Dakota, especially in the eastern regions of the corn belt, and Minnesota.

The **Northern Plains** are a major production zone for spring wheat and maize. The monitoring period covered the late harvest seasons of spring wheat. The area recorded almost double the average rainfall (+99%), with a temperature drop (2.4℃ below average) and low sunshine (RADPAR down 4%). The potential biomass decreased 10%. NDVI in the Northern Plain was higher than average after Jun and VCIx reached 0.99, indicating good crop condition. The cropped land fraction was significantly above average by 19%. CropWatch analyses indicate a normal production in the Northern Plains.

The **Northwest** is an important regions for winter wheat and spring wheat. Although the weather was cooler than average (temperature down 1.6°C and RADPAR down 3%), the increased rainfall resulted in increased biomass by 4%. The NDVI profile was lower than average before Jun but above average after that. CALF increased 13% and favorable growing conditions are confirmed by VCIx at 0.99. Crop condition and likely output is assessed as average, i.e. normal for local conditions.

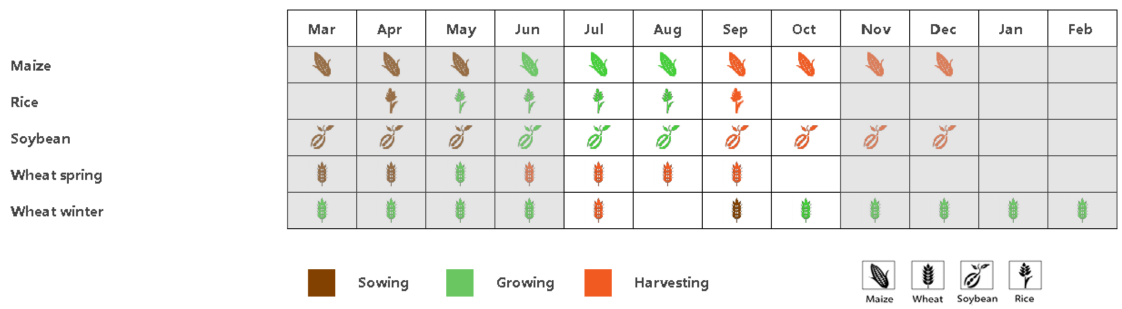
The **Southern Plains** are the major production region of winter wheat, cotton, and sorghum. Favorable precipitation (up 24%), normal temperature and good sunshine (RADPAR up 2%) contributed to an increased biomass (5%). The NDVI profiles fluctuated around the average. As CALF (86%) was at the five years' average and VCIx reached 0.97, satisfactory yields and average production are expected.

The **South-east** is the major production region of cotton and maize. The NDVI profiles were just below average. However, the warm weather (TEMP up 1°C), increased sunshine (RADPAR up 2%) and abundant rainfall (up 12%) provided favorable growing conditions, which is confirmed by VCIx (0.90). With the BIOMSS index up 7%, crops production is expected to be at least average.

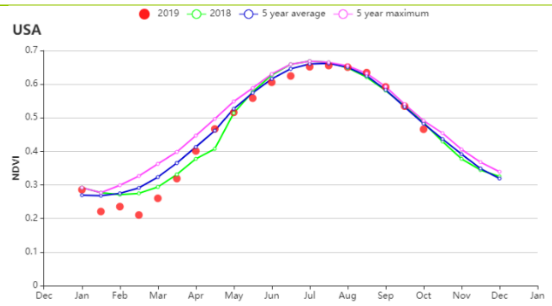
The **Lower Mississippi** is a major production area for rice, maize and soybeans. The temperature (up 0.2 °C) and RADPAR (+2%) were close to average and higher rainfall (up 29%) created good growing condition; BIOMSS increased 6%. Both the NDVI profiles and a good VCIx value of 0.94 point at fair crop output.

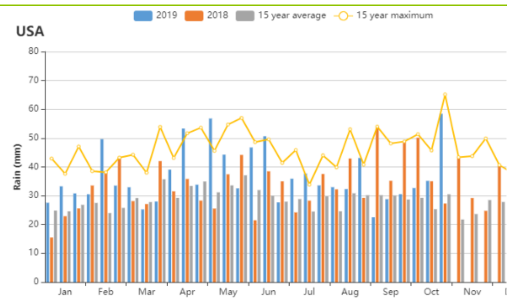
California had an 8% drop in BIOMSS due essentially to low rainfall (-64% compared to average). Although only half of the arable land was cropped (CALF at 49%), the index is nevertheless up 25% compared with the average of recent five years.

Figure 3.41 United States's crop condition, July-October 2019

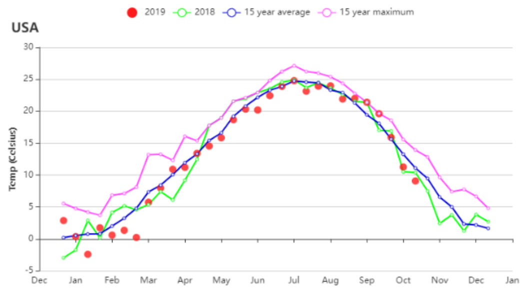


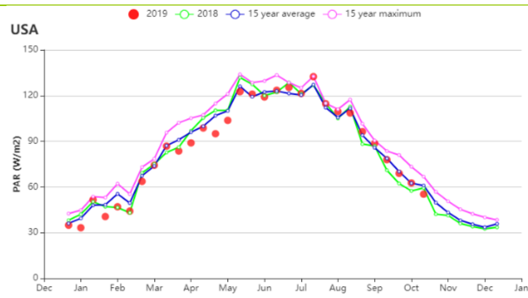
(a). Phenology of major crops



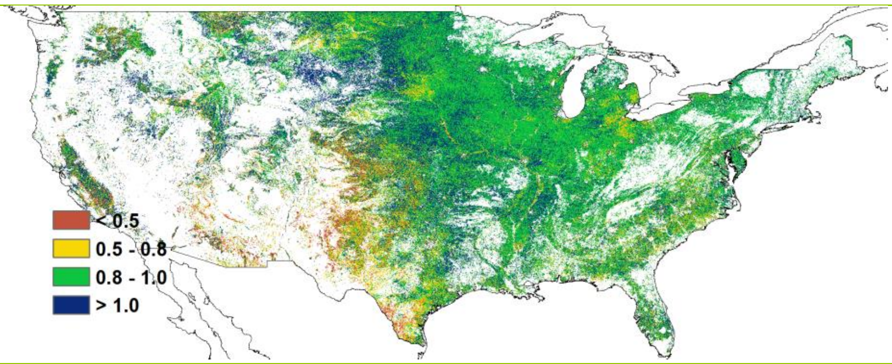


(b) Crop condition development graph based on NDVI (c) Rainfall profiles

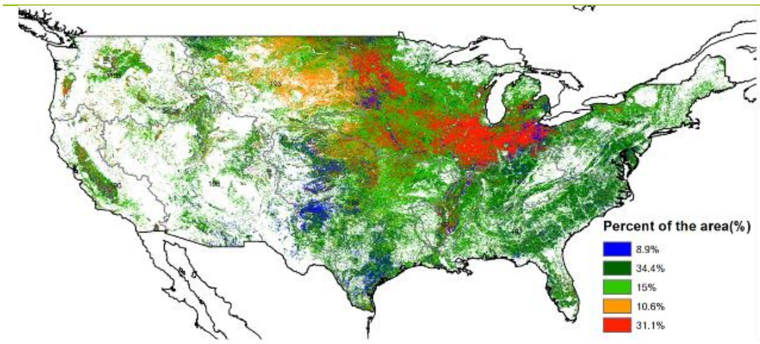


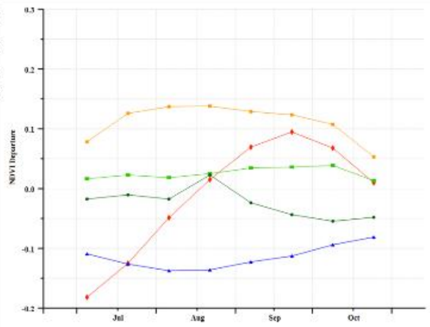


(e) Temperature profiles (f) Profiles of photosynthetic active radiation

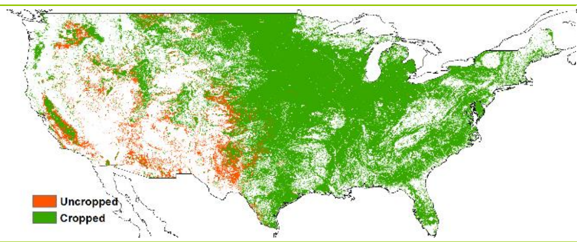


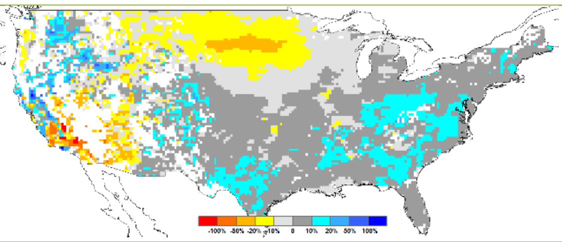
(g) Maximum VCI



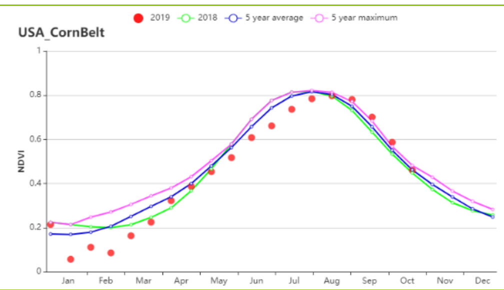


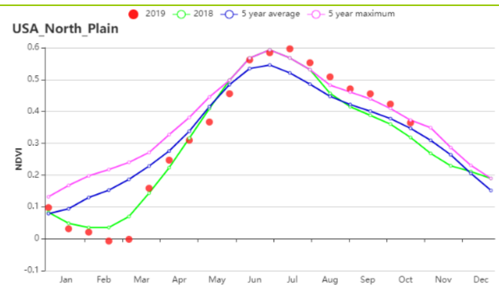
(h) Spatial NDVI patterns compared to 5YA (i) NDVI profiles



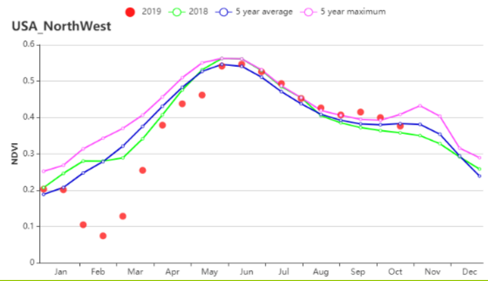


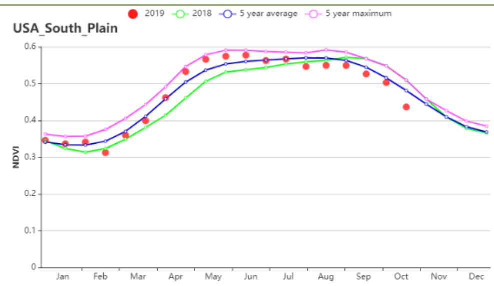
(j) Cropped and uncropped arable land (k) Potential biomass departure from 5YA



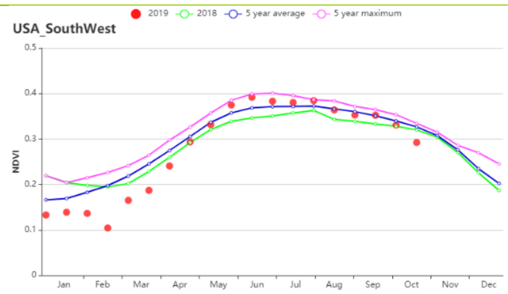


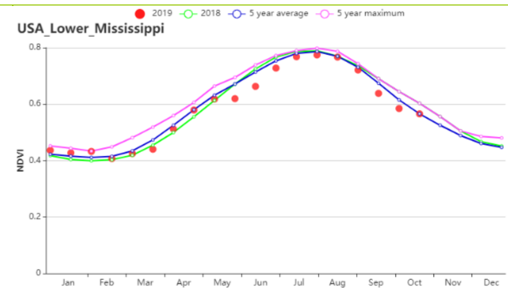
(L) Crop condition development graph based on NDVI (Corn Belt (left) and North Plain (right))



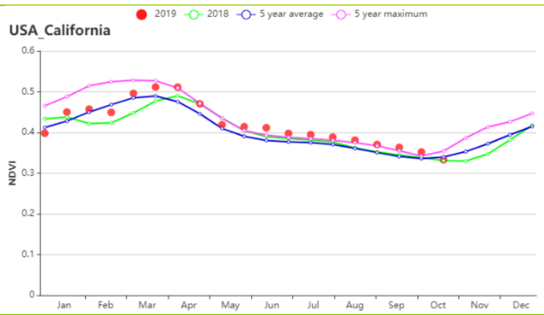


(i) Crop condition development graph based on NDVI (North West (left) and South Plain (right))





(i) Crop condition development graph based on NDVI (South West (left) and Lower Mississippi (right))



(i) Crop condition development graph based on NDVI for California

Table 3.73 United States's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July-October 2019.

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 (%)
Northern Plains	386	99	14.6	-2.4	1114	-4	512	-10
California	22	-64	19.5	-0.6	1436	2	391	-8
Corn Belt	451	52	17.9	-0.7	1055	-3	544	-4
Southwest	242	-6	18.9	-0.4	1358	5	593	-2
Northwest	197	20	13.7	-1.6	1150	-3	497	4
Southern Plains	423	24	24.0	0.0	1242	2	765	5
Lower Mississippi	624	29	24.7	0.2	1203	2	770	6
Southeast	581	12	24.9	1.0	1218	2	787	7
North-eastern areas	386	-2	18.2	0.5	1079	4	548	7
Blue Grass region	391	14	21.4	0.8	1205	5	700	9
Alaska and Hawaii	556	-1	10.2	2.0	684	15	221	35

Table 3.74 United States's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July-October 2019.

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Current (%)	Current (%)	Departure from 5YA (%)	Current
Northern Plains	94	19	90	22	0.99
California	49	25	94	20	0.95
Corn Belt	100	0	106	5	0.95
Southwest	42	9	42	19	0.85
Northwest	73	13	92	16	0.99
Southern Plains	86	0	95	9	0.87
Lower Mississippi	100	0	116	9	0.94
Southeast	100	0	121	9	0.90
North-eastern areas	100	0	121	9	0.94
Blue Grass region	100	0	115	9	0.93

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Current (%)	Current (%)	Departure from 5YA (%)	Current
Alaska and Hawaii	100	1	107	-2	0.95

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[UZB] Uzbekistan

The report covers the harvest of maize in August and September as well as the harvest of winter wheat (up to August) and the subsequent planting of the crop for the 2019-20 season. The national average of VCIx reached 1.00 and CALF increased by 19%. TEMP and RADPAR were above average (by 0.4°C and 1%, respectively) with precipitation down 17%. BIOMSS fell 2% compared to the five-year average. The NDVI development curve shows below average crop condition in July and October, and positive departures in other months. According to the NDVI profile maps 71.9% of agricultural land was on or above average throughout the reporting period. This includes mainly part of the following provinces: Jizzakh, Guliston, Almalyk, Termez, Denau, Altynkul, Qunghirot, Chimbay, Urganch, Mubarek, Kasan, Samarqand, Kattakurgan, Nawoiy, Bukhoro, Gizhduvan and the eastern four provinces (Quqon, Namangan, Andijon, Farghona). In other regions, crop condition was below average. Overall, crop yield is assessed as average.

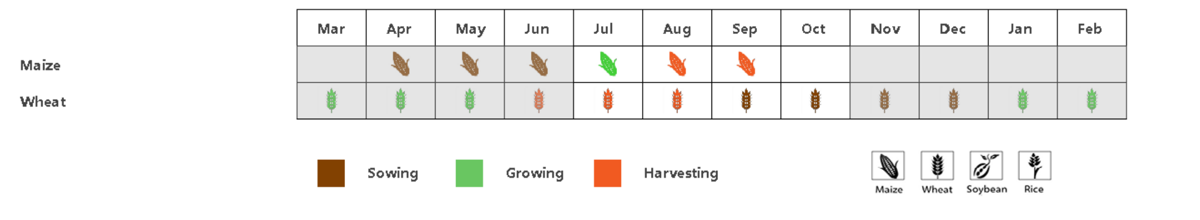
Regional Analysis

Additional information is provided below for two agro-ecological zones: the Eastern hilly cereals zone and the Aral Sea cotton zone.

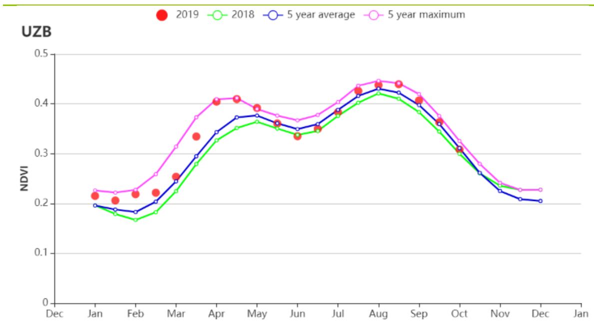
In the **Eastern hilly cereals zone**, NDVI was below and close to the five-year average in July and October, and above average from August to September. TEMP and RADPAR were above average (by 0.4°C and 1%, respectively) while RAIN and BIOMSS were below average (-14% and-8%, respectively). The maximum VCI index was 0.99. The cropped arable land fraction and crop intensity increased by 21% and 76% compared to the last five years. The crop condition was favorable.

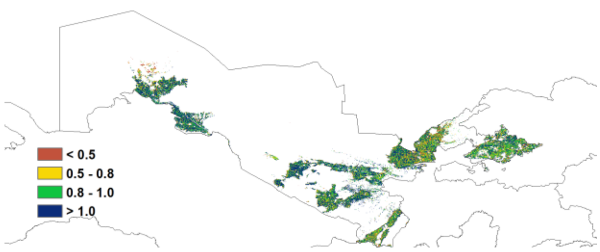
In the **Aral Sea cotton zone**, crop condition was above average in July to late August and below in September and October. Precipitation was well below average during the monitoring period(RAIN -55%) but temperature and radiation were slightly above (TEMP 0.4°C and RADPAR 1%). The BIOMSS index increased by 14%. The maximum VCI index was 1.02.The cropped arable land fraction and cropping intensity increased by 14% and 46% over the 5YA. Overall, the crop condition is assessed as favorable.

Figure 3.42 Uzbekistan's crop condition, July - October 2019



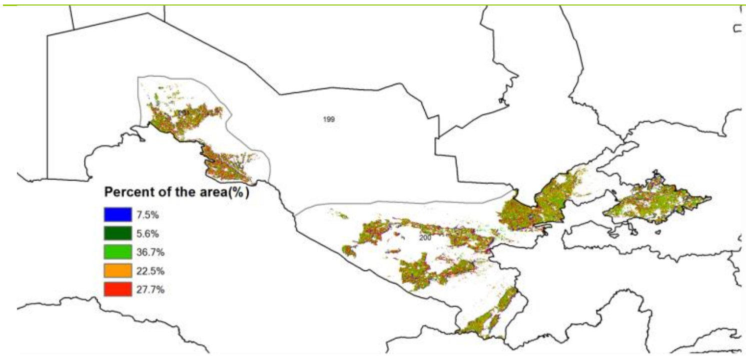
(a). Phenology of major crops

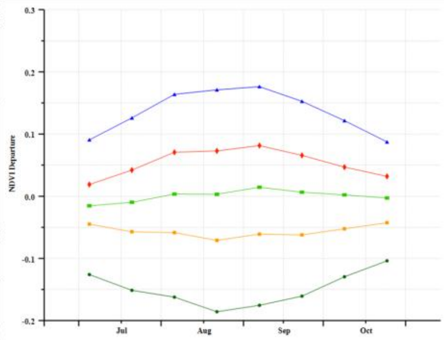




(b) Crop condition development graph based on NDVI

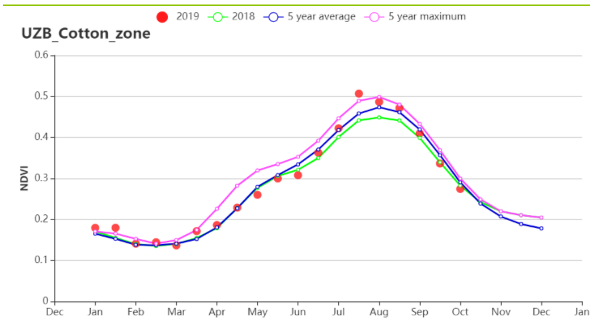
(c) Maximum VCI

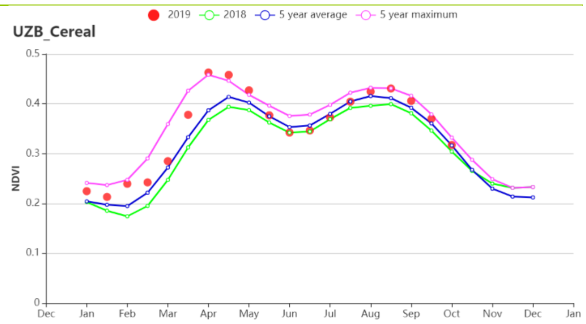




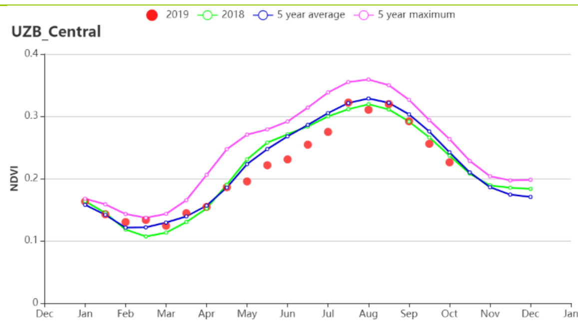
(d) Spatial NDVI patterns compared to 5YA

(e) NDVI profiles





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



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

Table 3.75 Uzbekistan's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July-October 2019

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 (%)
Eastern hilly cereals zone	26	-14	22.8	0.4	1398	1	238	-8
Aral Sea cotton zone	7	-55	23.5	0.4	1300	1	370	14
Central region with sparse crops	13	3	23.8	0	1305	0	343	9

Table 3.76 **Uzbekistan's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July-October 2019**

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Current (%)	Current (%)	Departure from 5YA (%)	Current
Eastern hilly cereals zone	60	21	83	76	0.99
Aral Sea cotton zone	76	14	63	46	1.02
Central region with sparse crops	20	150	10	317	0.8

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[VNM] Vietnam

Summer and autumn rice harvesting has been completed, while late rice is still in its growing season. Generally, compared with the average of the past five years and the last year, the crop condition in Vietnam was rather low, but increased over the 5YA after September. About 32.6% of cropped areas in the south and north showed favorable crop condition throughout the monitoring period, an improvement during this period, which is in agreement with the high VCIx in this area.

High rainfall fell over the country in August, but low precipitation set in after September, so that total rainfall (1310 mm) was below average by -5%. The temperature profile shows heat peak in July. CropWatch agro-climatic indicators also show globally average temperature (0.1°C), abundant sunshine (RADPAR up 6%), high CALF at 98%, VCIx at 1.0 and slight increase in BIOMSS (+2%). Overall current crop condition in the country is average.

Regional analysis

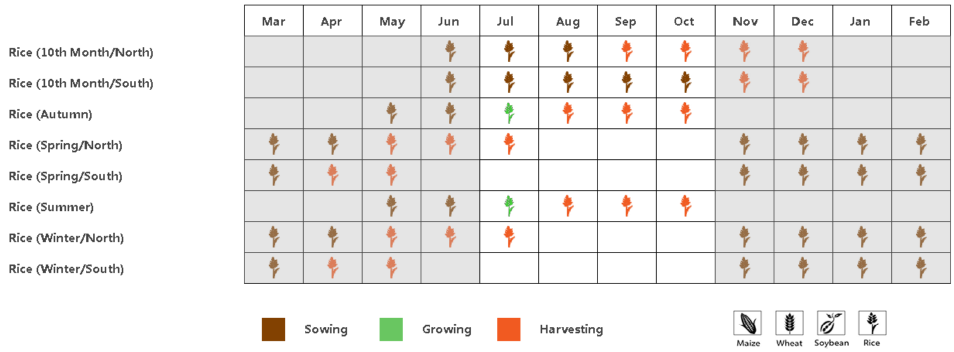
Based on cropping systems, climatic zones, and topographic conditions, several agro-ecological zones (AEZ) can be distinguished for Vietnam, among which three are most relevant for crops cultivation: Northern zone with Red river Delta, the Central coastal areas from Thanh Hoa to Khanh Hoa and Southern zone with the Mekong Delta.

The **Northern zone with the Red river Delta** recorded just above average precipitation (RAIN +3%) with abundant sunshine (RADPAR +7%). With average temperature (TEMP +0.3°C anomaly), above average cropping intensity (+10%), CALF at 99% and VCIx at 0.98, the BIOMSS increased 1% compared to the average. The NDVI development graph showed values were around the 5 years average. Based on the agro-climatic indicators and NDVI development graph, output is likely to be at least average.

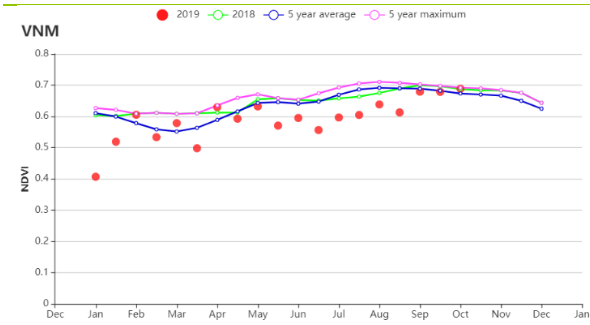
The situation in the **Central coastal areas** from Thanh Hoa to Khanh Hoa is conditioned by low precipitation (RAIN -13%) and a mixture of single and double cropping (CI -5%), about average temperature (TEMP +0.2°C) and abundant sunshine (RADPAR +8%). BIOMSS is about average. VCIx (0.95) and CALF (+0.9%) describe fair to good condition. The crop condition development graph based on NDVI showed that crop condition was below the 5 years average from July to September, but surpassed the 5 years maximum of 5 years in October. Output is likely to be about the average.

The **Southern zone with the Mekong Delta** recorded low RAIN (-8%), above average RADPAR (+5%) and cropping intensity (+12%), and average TEMP (-0.1°C). As a result BIOMSS increased by 3% compared with averages. VCIx was high (0.96) with CALF up 2.5% above the average. The crop condition development graph of NDVI indicates below average crop condition from July to September, but above average and the last year after September. CropWatch expects slightly increased production, especially for late crops.

Figure 3.43 Vietnam's crop condition, July - October 2019

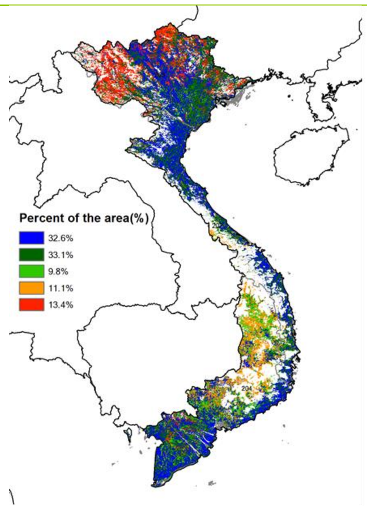


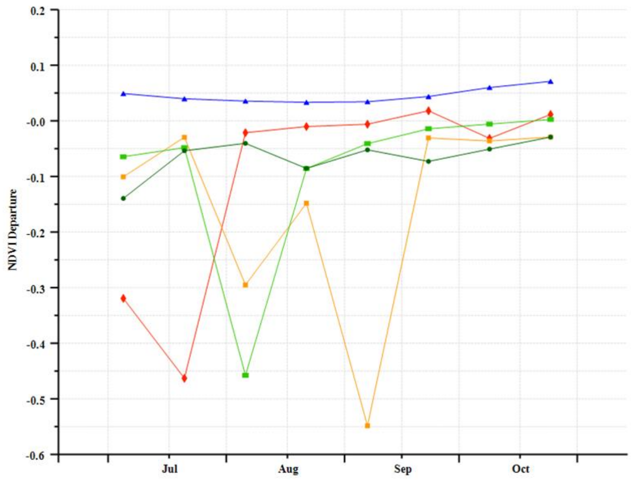
(a). Phenology of major crops



(b) Crop condition development graph based on NDVI

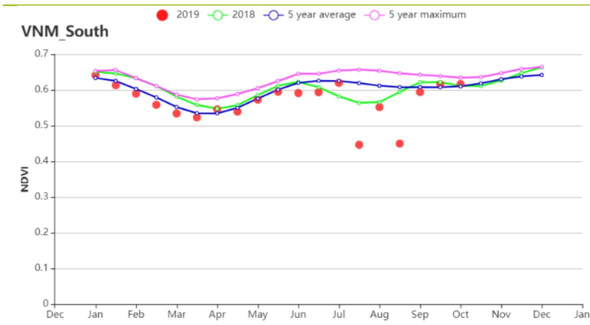
(c) Maximum VCI

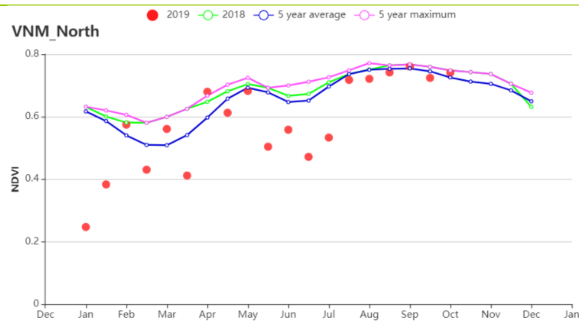




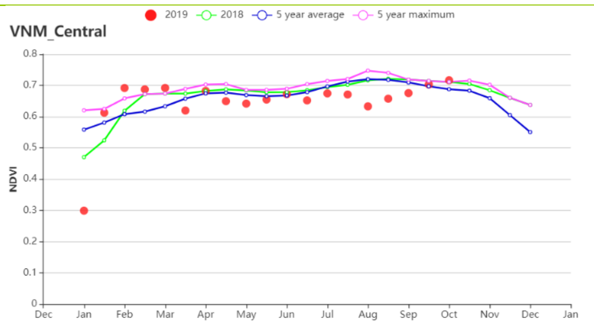
(d) Spatial NDVI patterns compared to 5YA

(e) NDVI profiles





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



(g) Crop condition development graph based on NDVI (Central Vietnam).

Table 3.77 Vietnam's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, January -April 2019

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Central coastal areas from Thanh Hoa to Khanh Hoa	1119	-13	24	0.2	1157	8	740	1
Northern zone with Red river Delta	1419	3	24	0.3	1169	7	717	1
Southern zone with Mekong Delta	1326	-8	24	-0.1	1165	5	759	3

Table 3.78 Vietnam's agronomic indicators by sub-national regions, current season's values and departure from 5YA/15YA, January -April 2019

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Current (%)	Current (%)	Departure from 5YA (%)	Current
Central coastal areas from Thanh Hoa to Khanh Hoa	98	0.9	130	-5	0.95
Northern zone with Red river Delta	99	0.0	173	10	0.98
Southern zone with Mekong Delta	95	2.5	158	12	0.96

[ZAF] South Africa

During the reporting period, winter wheat was growing in the Mediterranean climate areas in the South-west in July to September, to be harvested from October. Summer crops such as soybeans and maize are cultivated in the summer monsoon areas which encompass the eastern half of the country. They are mostly sown from October.

Nationwide, rainfall reached just 56 mm, down 52% from average. The average temperature was 15.1 °C (up 0.5 °C).The resulting biomass is 6% below average, as available water was insufficient to utilize the increased sunshine (RADPAR up, 6% above average).

Only 25% of the total cropland area was cultivated, a 7% decline compared with average conditions, and the likely result of low rainfall and a possibly delayed onset of the summer/monsoon season. Crop condition dropped below the average until the end of the reporting period, especially for cropped regions in the winter wheat areas of Eastern Cape province. Crop condition was just above average throughout the JASO period in 43.4% of cropped area, mainly located in the Free State and North West Province, which are important maize growing areas. 39.1% of cropped area, mainly located in Gert Sibande, Sedibeng and West Rand districts, was slightly below average over the whole reporting period. The conditions for 6.8% of cropped area, mainly located in Overberg and Garden Route Districts, were significantly below average. The condition in the remaining 7.3% of cropped areas was above average only before mid-August, in the northern coastal areas of Eastern Cape Province and adjacent southern coast of Kwazulu-Natal, indicating poor conditions or a slow onset of the maize season. The situation is roughly confirmed by the Maximum VCI map with the poorest crops (VCI < 0.5) in the eastern and north-eastern Provinces (Kwazulu-Natal, Mpumalanga and Limpopo). Overall, the nationwide crop conditions could be described as somewhat delayed and just moderate (average VCIx at 0.7). The final outcome will crucially depend on rainfall over the coming months.

Regional analysis

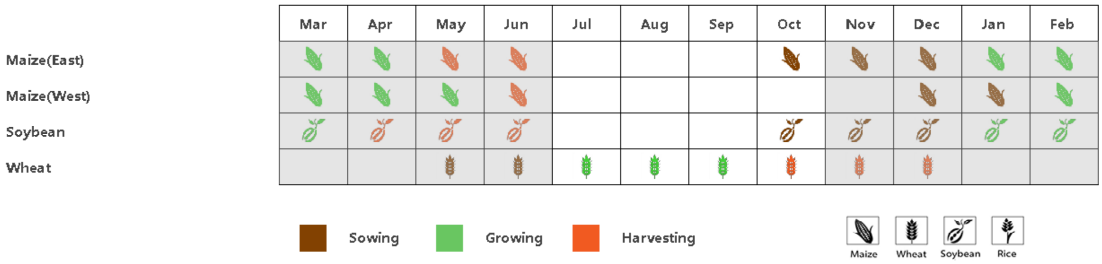
CropWatch adopts three agro-ecological zones (AEZs) relevant for crop production in South-Africa. The first zone is the Mediterranean zone, the second is the Humid Cape Fold mountains while the third zone is the Dry Highveld and Bushveld maize areas, by far the most relevant zone in terms of the food supply.

In the **Mediterranean zone**, rainfall was 2% above average and the temperature was up by 0.3℃. Both RADPAR and BIOMSS were above average (+4% and +6%, respectively). This region is known for the wide cultivation of winter wheat. 84% of the cropland was cultivated (single cropping). Crop conditions turned to be below average in August, corresponding to the mid of growing period of wheat. The maximum VCI also confirms the unfavorable crop conditions (0.42) which will negatively impact the wheat production.

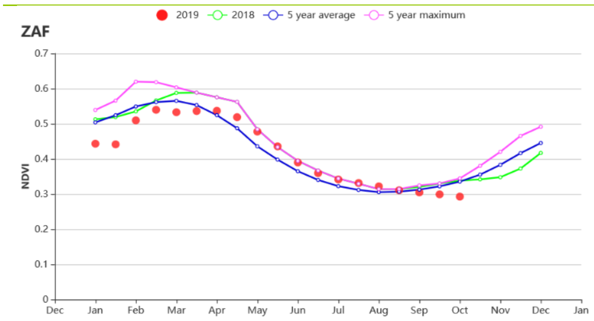
In the **Humid Cape Fold mountains**, the average rainfall was 47% below average and with TEMP 0.7℃ above the average. Both RADPAR and BIOMSS were above average (+8% and +10%, respectively) despite the high reduction in rainfall. The cropped arable land fraction was 69% with a mix of single and double cropping. The crop condition was above the average until mid-August, before it fell below average until the end of October. Overall, the maximum VCI indicated moderate conditions (0.56).

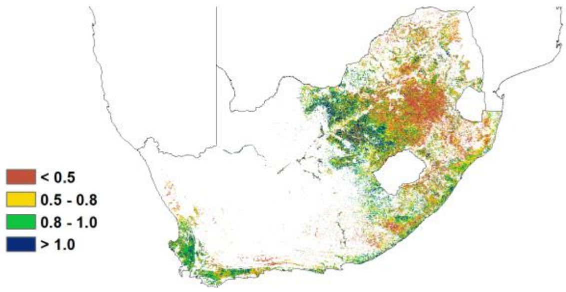
In **Dry Highveld and Bushveld maize areas**, the rainfall was 65 % below average with temperature up 0.4℃. The RADPAR was 6% above the average, while the BIOMSS was 10% below the average. Only 10% of cropland was cultivated with a single crop, and the NDVI-based graph for crop conditions indicated similar conditions to the other two zones; however, the maximum VCI was higher (0.7). The conditions indicate a slower than usual northward movement of the inter-tropical convergence zone, which delayed the onset of the rainy season. If rain picks up in November, little harm will have been done to crops.

Figure 3.44 South Africa’ s crop condition, July - October 2019



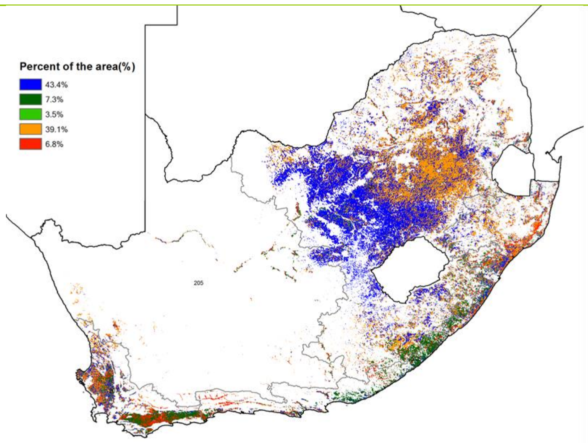
(a). Phenology of major crops

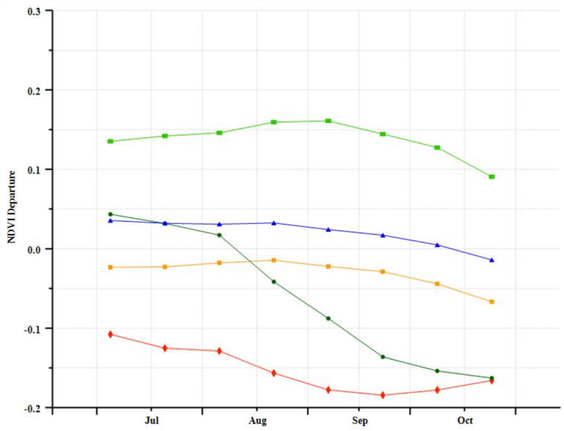




(b) Crop condition development graph based on NDVI

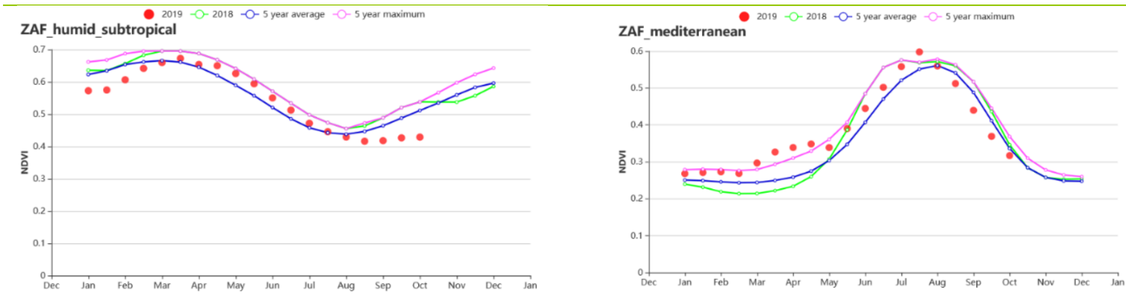
(c) Maximum VCI



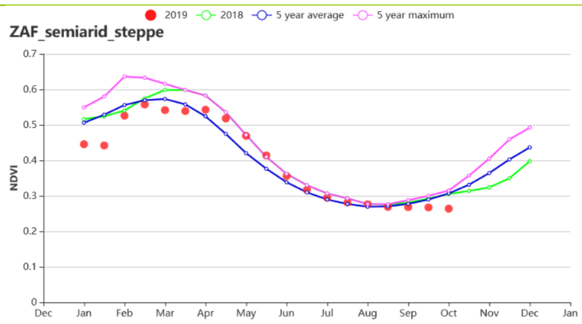


(d) Spatial NDVI patterns compared to 5YA

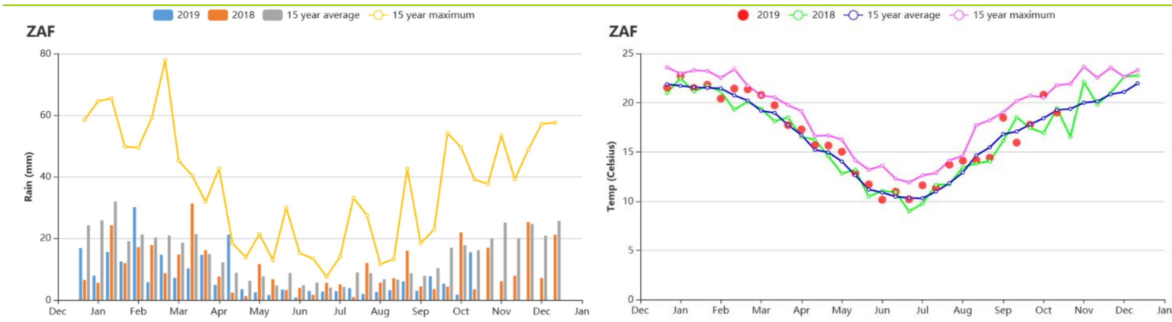
(e) NDVI profiles



(f) Crop condition development graph based on NDVI (Humid Cape Fold Mountains (left) and Mediterranean wheat zone (right))



(f) Crop condition development graph based on NDVI (Dry Highveld and Bushveld maize zone)



(g) Time series profiles of precipitation (left) and temperature (right)

Table 3.79 South Africa's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July -October 2019

Region	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	Departure (%)	Current (°C)	Departure (°C)	Current (MJ/m²)	Departure (%)	Current (gDM/m²)	Departure (%)
Humid Cape Fold mountains	114	-47	16.5	0.7	1027	8	431	10
Mediterranean zone	226	2	13.1	0.3	988	4	362	6
Dry Highveld and Bushveld maize areas	30	-65	15.0	0.4	1244	6	354	-10

Table 3.80 South Africa's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July -October 2019

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Current (%)	Current (%)	Departure from 5YA (%)	Current
Humid Cape Fold mountains	69	-7	106	8	0.56
Mediterranean zone	84	-1	79	2	0.42
Dry Highveld and Bushveld maize areas	10	-13	87	15	0.70

[ZMB] Zambia

The monitored reported covers the end of the irrigated dry-season crops and the onset of the rainfed season. This period is key to irrigated crops (mainly wheat, green maize and vegetables) but also the preparation of the main rainfed season. Irrigated wheat was harvested in late September into October with an estimated national production of 150,000 MT, higher than the previous year.

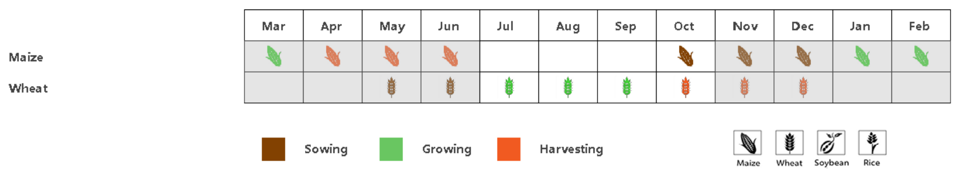
The monitoring period, as part of the dry season, recorded 14 mm (down 17%). Temperature was average (21.5°C) and favorable to winter cropping, and so was the average radiation of 1396 MJ/m2 (+1% compared with average). These climatic conditions led to a rise in biomass production of 15% to 384 gDM/m2, a decrease in area under cultivation (CALF at 8%, down -77% from 5YA) representing mainly irrigated areas and a somewhat late onset of the rainy season, and maximum VCI of 0.43. The rain-fed cropping season begins in November with the field crops to be ready for harvesting end of April into May the following year. Seasonal forecasts currently indicate that average to above-average precipitation is likely to support field crop establishment.

Regional analysis

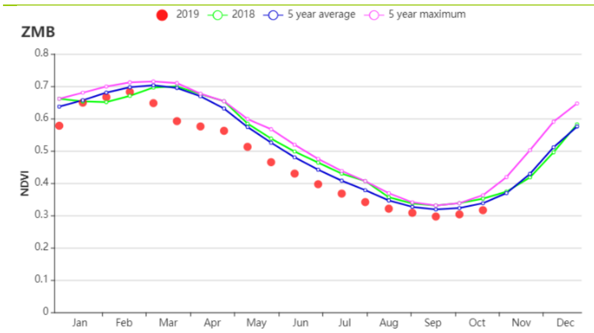
The agro-ecological region analysis indicates that rainfall received in all the agro-ecological zones was less than the 15 year average (below -32%) except for the **Northern high rainfall zone** where the deviation was positive (+15%). The temperature varied from 21.2°C to 22.0°C with negligible departure from average. The radiation across all the three agro-ecological zones was more than 1380 MJ/m2 (1% above average) and resulted in positive BIOMSS departures in the **Lungwa-Zambezi Rift Valley** (+24%) and the **Northern High Rainfall zone** (+13%). The same pattern is reflected by decreases in the Cropped Arable Land Fraction (CALF) with highest CALF for Northern High Rainfall zone (72%, down 9% from 5YA) and lower values in the three other zones: Luangwa-Zambezi Rift Valley (8%, down 77%), Central-Eastern & Southern Plateau (20%, down -32%) and **Western Semi-Arid Plateau** (32%, down 46%]. The NDVI showed a strong departure from 5YA, indicating reduced potential agricultural production in the three southern AEZs due mainly to reduced rainfall in these regions.

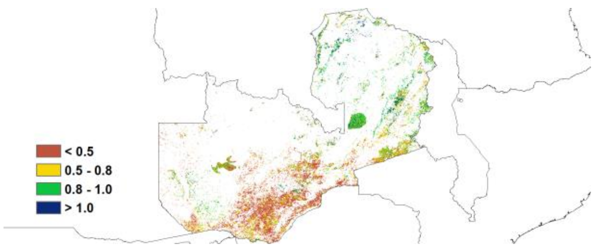
The rainfall during this quarter was below normal and it is hoped that, as the season builds up, it will turn to above normal.

Figure 3.45 Zambia's crop condition, July - October 2019

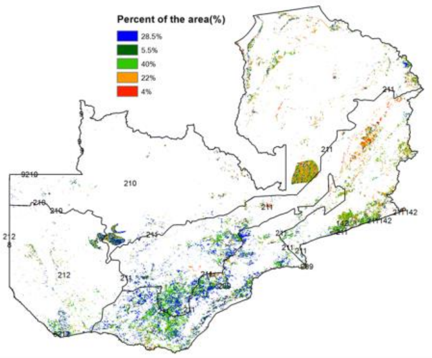


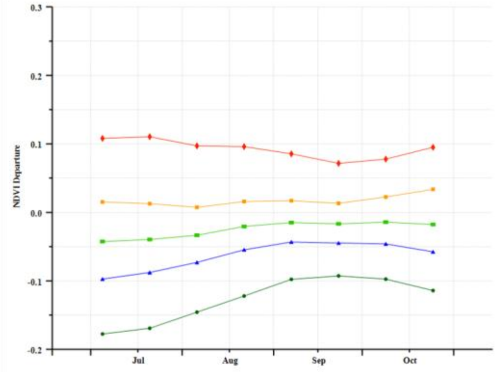
a). Phenology of major crops



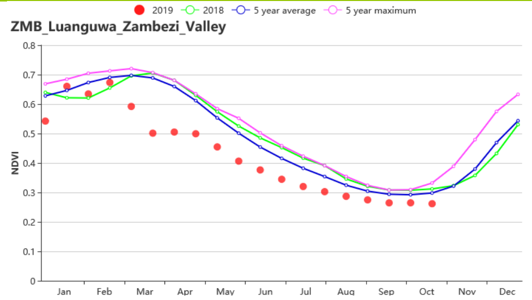


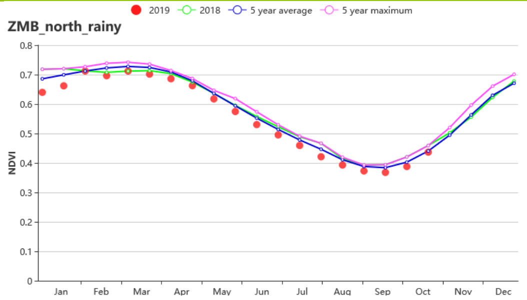
(b) Crop condition development graph based on NDVI (c) Maximum VCI



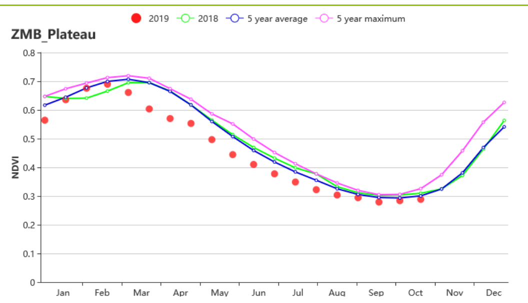


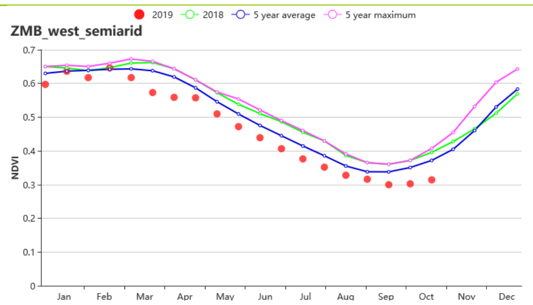
(d) Spatial NDVI patterns compared to 5YA (e) NDVI profiles





(f) Crop condition development graph based on NDVI (Luangwa Zambezi rift valley (left) and Northen high rainfall zone (right))





(g) Crop condition development graph based on NDVI (Central-eastern and southern plateau (left) and Western semi-arid plain (right))

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

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 (%)
Luanguwa Zambezi rift valley	6	-37	21.4	0.0	1404	1	361	24

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 (%)
Northern high rainfall zone	32	15	21.2	-0.1	1404	1	424	13
Central-eastern and southern plateau	5	-61	21.7	0.1	1385	1	411	15
Western semi-arid plain	7	-34	22.0	0.0	1395	0	264	4

Table 3.82 **Zambia's agronomic indicators by sub-national regions, current season's values and departure from 5YA, July -October 2019**

Region	Cropped arable land fraction		Cropping intensity		Maximum VCI
	Current (%)	Departure from 5YA (%)	Current (%)	Departure from 5YA (%)	Current
Luanguwa Zambezi rift valley	8	-77	101	2	0.43
Northern high rainfall zone	72	-9	104	1	0.79
Central-eastern and southern plateau	20	-32	102	3	0.58
Western semi-arid plain	32	-46	99	4	0.61

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] Zambia

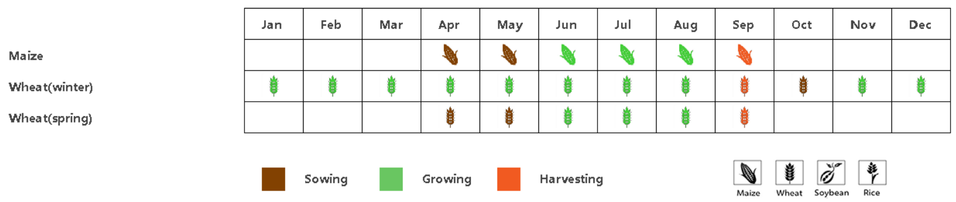
The reporting period includes the harvest of all crops in September as well as the planting of spring wheat and summer crops until June, and the planting of winter wheat in October.

In spite of deficits in July and October, the nationwide rainfall amount reached 201 mm, which was just average. July was warm with mid-July temperature exceeding average by as much as 4.0℃. As a result, for the July-October period temperature was 0.3℃ above average; sunshine (RADPAR) was 3% higher than average. BIOMSS decreased by a spectacular -7% below average. As shown by the NDVI development graph, crop condition was generally below the five-average during the entire monitoring period, except at the end. The NDVI spatial patterns shows that 10.8% of the agriculture areas had above the 5-year average crop condition mostly west of and including Jalal-Abad, Osh and Talas Regions; 33.3% fluctuated around the 5-year average and 40.5% where below average, of which 10.7% with a departure close to 0.1 in the lowlands of northern Chuy Region. 15.5% of the agricultural areas had below the 5-year average crop condition until September, but then rose above the 5-year average, possibly in relation to the maize harvest.

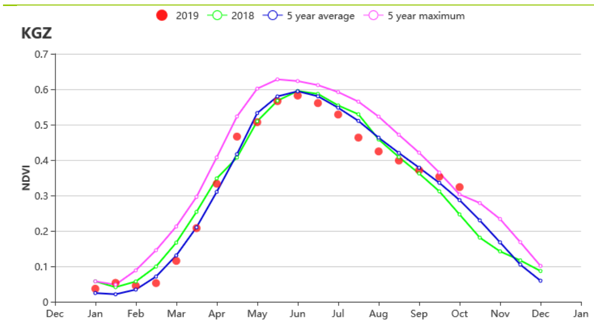
The situation is largely confirmed by the VCIx map which shows high values (>0.8) in the west while low values in Chuy Region and the eastern part of Issyk-Kul. The average nationwide VCIx average was 0.85, which confirms the favorable condition assessed based on NDVI profiles.

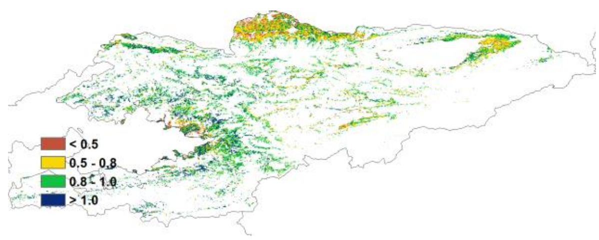
Agro-climatic and agronomic conditions were mixed. With CALF at 88%, satisfactory VCIx but BIOMSS down 7%, summer crop output is assessed as just average.

Figure 3.46 Kyrgyzstan's crop condition, July - October 2019



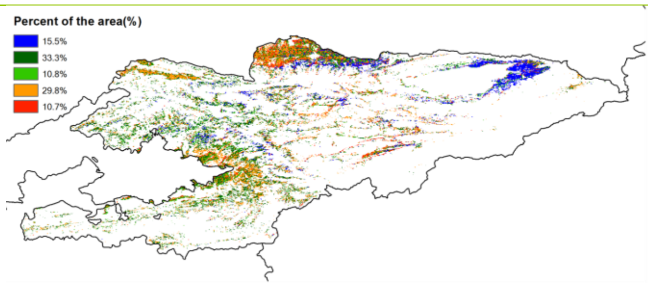
a). Phenology of major crops



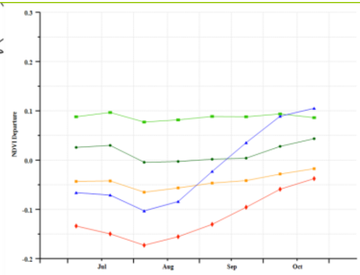


(b) Crop condition development graph based on NDVI

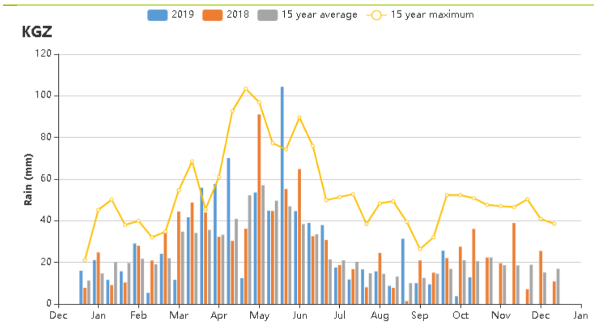
(c) Maximum VCI



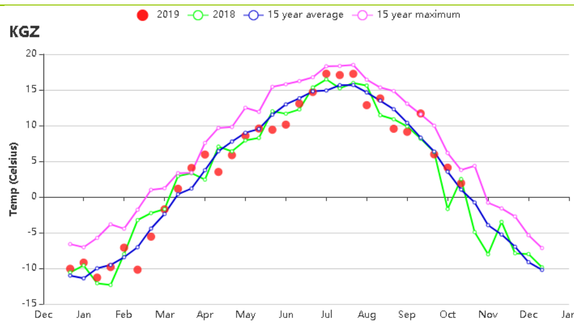
(d) Spatial NDVI patterns compared to 5YA



(e) NDVI profiles



(f) Rainfall profiles



(g) Temperature profiles

Table 3.83 Kyrgyzstan's agroclimatic indicators by sub-national regions, current season's values and departure from 15YA, July to October 2019

Region	RAIN		TEMP		RADPAR	
	Current (mm)	Departure from 15YA (%)	Current (°C)	Departure from 15YA (°C)	Current (MJ/m²)	Departure from 15YA (%)
Kyrgyzstan	201	0	11.2	0.4	1342	3

Table 3.84 Kyrgyzstan's agronomic indicators by sub-national regions, current season's values and departure, July to October 2019

Region	BIOMSS		Cropped arable land fraction		Maximum VCI
	Current (%)	Departure from 15YA (%)	Current (%)	Departure from 5YA (%)	Current
Kyrgyzstan	377	-7	88	1	0.85

Chapter 4. China

After a brief overview of the agro-climatic and agronomic conditions in China over the reporting period (section 4.1), Chapter 4 presents an updated estimate of major cereals and soybean production at provincial and national level as well as summer crops production and total annual outputs (4.2) and describes the situation by region, focusing on the seven most productive agro-ecological regions of the east and south: Northeast China, Inner Mongolia, Huanghuaihai, Loess region, Lower Yangtze, Southwest China, and Southern China (4.3). Section 4.4 presents the results of ongoing pests and diseases monitoring, while sections 4.5 describe trade prospects (import/export) of major crops . Additional information on the agro-climatic indicators for agriculturally important Chinese provinces are listed in table A.11 in Annex A.

4.1 Overview

Weather was generally favorable in China from July to October 2019, with temperature and radiation increasing above average by 0.3℃ and 4%, respectively, and rainfall down by 4%. As a result, the maximum VCI was rather high at 0.95 with the nationwide CALF average 2% above average. These results indicate favorable crop condition in China during this season.

At the regional scale, rainfall was above average by 8% and 36%, respectively, in Inner Mongolia and Northeast China. As shown by Figure 4.1, 9% of planted areas experienced excess rainfall (about 210 mm above average) in early July, including the middle part of Southern China, eastern part of south-western China, and some parts in the Lower Yangtze Region (southeast Guizhou Province, northern Guangxi Province, southern part of Hunan Province, northern part of Fujian, and most parts of Jiangxi and Zhejiang Provinces).

Rainfall was below average in Huanghuaihai (26%), the Loess region (6%), Lower Yangtze Region (13%), and Southern China (2%) which thus suffered from water deficits to varying extents (Table 4.1), mainly around middle August and late September.

In all regions temperatures were close to average, with the positive anomalies not exceeding 0.8°C. However, temperature departures fluctuated widely in most of China over the monitoring period (Figure 4.2). Temperature was more than 2.0°C above average during early and late September, and more than 1.5°C below average in mid-August for 34.8% of planted areas, mainly located in some parts of the Loess Region, Huanghuaihai and North-east China. In addition, temperature in the central part of China and some parts in the Loess Region, accounting for 26.4% of cropped areas, was more than 1.7°C above average during early and late September but more than 0.7°C below average during mid-September and mid-October.

As shown in Figure 4.3, almost all the arable land was cropped, mainly because this monitoring period is the peak of farming in China. According to the maximum VCI map (Figure 4.4), very high values (greater than 1) occurred in north-eastern China and some parts of the Loess Region. The maximum VCI in other regions was also relatively high, with the values between 0.5 and 1. The VHIn map shows that high values (51-100) were mainly located in South-west and North-east China, with moderate values (16-50) appearing in most other regions (Figure 4.5). However, low values (1-15) sporadically occurred in the central part of China (northern Anhui, eastern Hubei province, Shandong province, Jiangsu province and southern Hebei province), implying these areas might have been exposed to drought. The Cropping Intensity (CI) map shows the expected spatial distribution, and all mentioned AEZs have increased CI values relative to the 5YA.

Table 4.1 CropWatch agroclimatic and agronomic indicators for China, July - October 2019, 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	-26	0.8	4	-1	-1	3	0.89
Inner Mongolia	8	0.3	0	-1	8	4	0.97
Loess region	-6	0	2	2	9	4	0.9
Lower Yangtze	-13	0.4	8	5	-1	5	0.94
Northeast China	36	0.1	-1	-5	0	1	0.99
Southern China	-2	0.2	6	2	0	17	0.97
Southwest China	0	0.1	1	0	0	6	0.97

Figure 4.1 China spatial distribution of rainfall profiles, July - October 2019

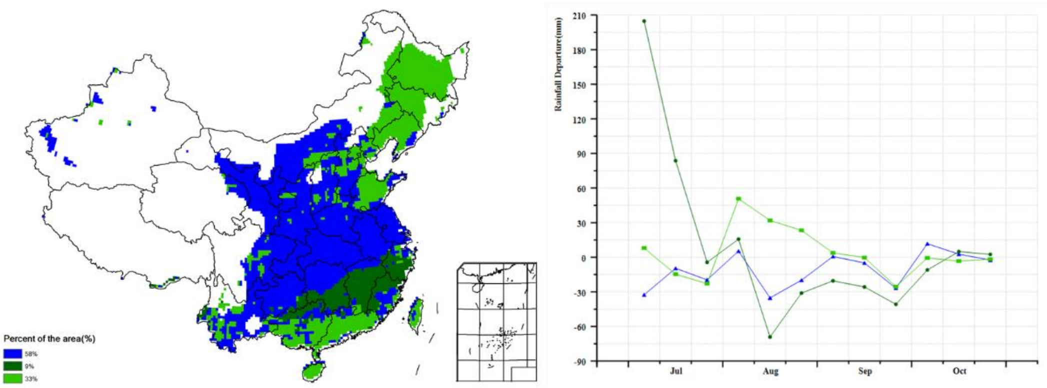


Figure 4.2 China spatial distribution of temperature profiles, July - October 2019

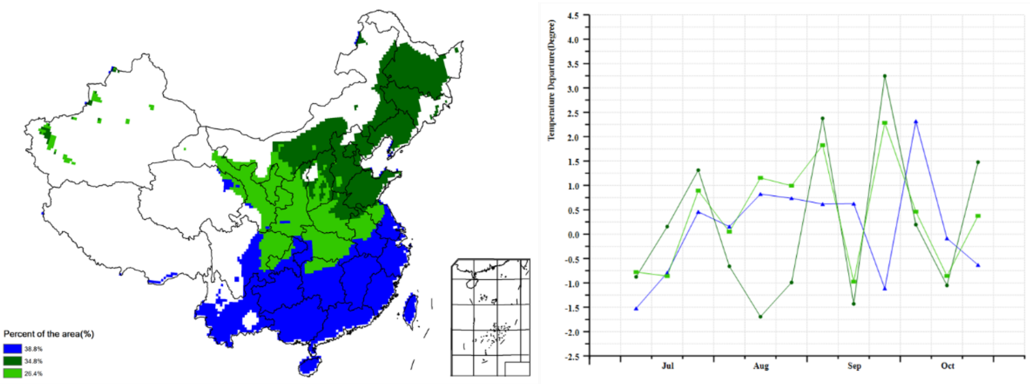


Figure 4.3 China cropped and uncropped arable land, by pixel, July - October 2019

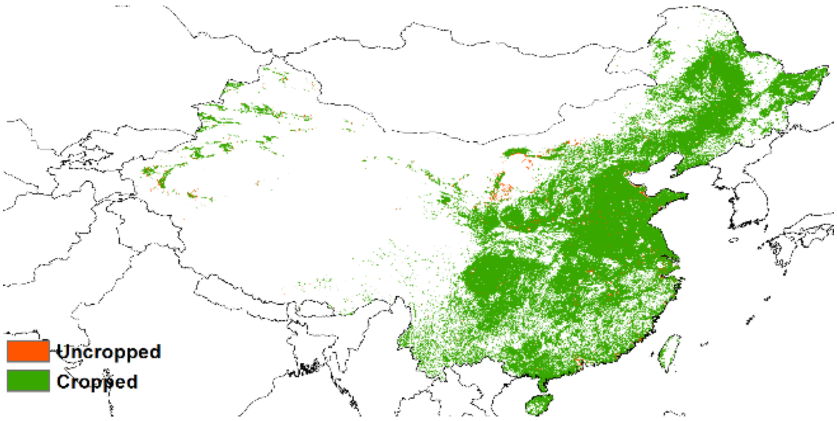


Figure 4.4 China maximum Vegetation Condition Index (VCIx), by pixel, July - October 2019

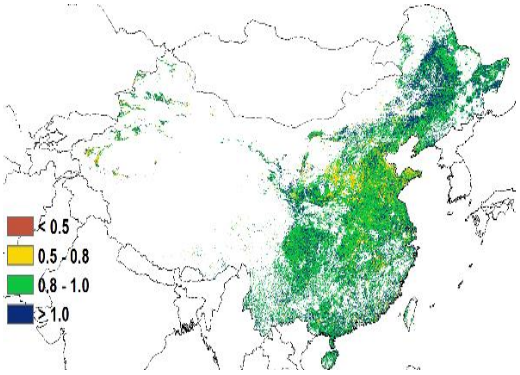


Figure 4.5 China minimum Vegetation Health Index (left), by pixel, July - October 2019

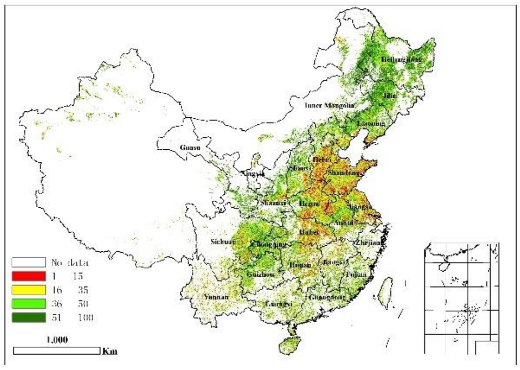
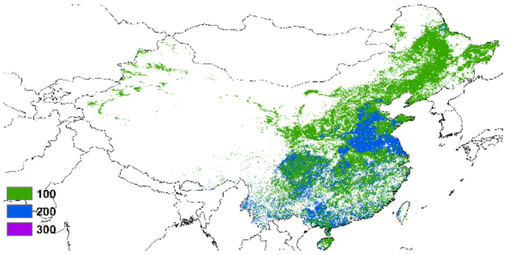


Figure 4.6 China cropping intensity, by pixel, in 2019 China Vegetation Health Index Minimum (VHIn), by pixel, July - October 2019



4.2 China's winter crops production

Based on the comprehensive utilization of multi-source remote sensing data as well as the latest agrometeorological information and a large number of field measurements, the yield of maize, rice, wheat and soybean in China in 2019 was revised by integration of remote sensing index model, agrometeorological yield model and crop planting and crop type proportion method.

The final CropWatch estimates for maize, rice, wheat, and soybean production in China are listed in Table 4.2 by province. Additional estimates for different types of rice (grouped by growing seasons) are shown in table 4.3.

Table 4.2 China 2019 production of maize, rice, wheat, and soybean, and percentage change from 2018, by province.

	Maize		Rice		Wheat		Soybean	
	2019	Change (%)	2019	Change (%)	2019	Change (%)	2019	Change (%)
Anhui	3553	3	17422	3	10807	1	1052	0
Chongqing	2087	3	4699	3	1064	-3		
Fujian			2786	-2				
Gansu	5543	4			3064	12		
Guangdong			11123	-1				
Guangxi			10446	-2				
Guizhou	5149	5	5644	6				
Hebei	18108	0			10550	-4	180	-4
Heilongjiang	41920	3	21512	3	434	0	5172	8
Henan	15047	-2	3716	-2	26309	3	777	2
Hubei			15644	0	3868	-10		
Hunan			25355	0				
Inner Mongolia	23512	2			1994	2	1186	6

Jiangsu	2164	2	16455	2	10053	2	747	-2
Jiangxi			16829	-1				
Jilin	30943	5	5804	1			798	10
Liaoning	17474	3	4364	1			408	2
Ningxia	1594	-5	412	-7	795	-4		
Shaanxi	3775	5	1050	5	3934	-6		
Shandong	18308	-2			22450	5	658	-1
Shanxi	8528	-5			2273	-6	149	-9
Sichuan	7130	2	14735	2	5016	9		
Xinjiang	6355	-5						
Yunnan	6370	1	5875	3				
Zhejiang			6498	2				
Sub total	217560	1	190367	1	102612	2	11127	5
China*	224345	1	203084	3	123516	2	14441	3

* Production of Taiwan province is not included.

Maize

The final revision of the production of maize at the national level was at 224.3 million tons, 1% above 2018. Early forecasts in August presented 1.7% year-on-year yield drop of maize while agroclimatic conditions over major maize producing regions were favorable for maize and revised maize yield was 1.4% above 2018. The Typhoon "Likima" in early August brought heavy rainfall to the eastern coastal provinces (Shandong, Jiangsu, etc.), alleviating drought and causing floods at local areas. Maize production drop in percentage in Henan and Shandong narrowed to 2% thanks to the rainfall since August. “Likima” also brought sufficient rainfall for Northeast China (Heilongjiang, Jilin and Liaoning) which are beneficial for summer crops. Maize yield in Heilongjiang, Jilin, Liaoning and Inner Mongolia were 2.6%, 5.0%, 3.1%, and 1.9% above 2018. Ningxia, Shanxi and Xinjiang also present large drop in maize yield mainly due to the unevenly distributed rainfall at spatial and temporal scale.

Rice

The total output of rice in China was revised t0 203.1 million tons, 3% above last year. The planting area of rice in China was 32472.6 thousand hectares, an increase of 29.8 thousand hectares, or 0.1% increase over 2018. Increased production of single rice and late rice contributed to a bumper production of all rice with different cropping practices. The yield of semi-late rice/single rice was up by 3% to 133.19 million tons, an increase of 4392 thousand tons. It is mainly due to the 2.8% increment of yield from 2018 thanks to the overall favorable agrometeorological conditions since peak growing season to maturity stage. It is noteworthy that late rice production increased by 6% to 36.66 million tons because of increasement of both yield and cultivated area. Although many farmers intend to reduce the double cropping rice (early rice followed by late rice), single cropping late rice cultivated also become more popular in several provinces such as Zhejiang and Guangdong.

Table 4.3 China 2019 early rice, single rice/semi-late rice, and late rice production and percentage difference from 2018, by province.

	Early rice		Single rice/Semi-late rice		Late rice	
	2019	Change (%)	2019	Change (%)	2019	Change (%)
Anhui	1851	1	13832	3	1739	3
Chongqing			4716	3		
Fujian	1512	-6			1273	2
Guangdong	4860	-6			6263	3
Guangxi	4891	-5			5555	2
Guizhou			5369	1		
Heilongjiang			21443	3		
Henan			3923	3		
Hubei	2346	1	10455	0	2877	0
Hunan	8315	4	8768	1	8548	0
Jiangsu			16704	4		
Jiangxi	7342	-5	3007	4	6480	1

Jilin			5926	4		
Liaoning			4316	0		
Ningxia			473	6		
Shaanxi			1038	4		
Sichuan			14799	2		
Yunnan			5781	1		
Zhejiang	794	-3	4822	2	882	6
Sub total	31911	-2	125372	2	33616	1
China*	33237	-2	133190	3	36657	6

* Production of Taiwan province is not included.

Wheat

Wheat production stays at the same level as August estimates at 123.5 million tons, increased 2% compared with that in 2018. Minor revision was done for some spring wheat producing provinces such as Heilongjiang and Inner Mongolia to a lower production compared with August estimates mainly due to the insufficient radiation during flowering stage.

Soybean

The national soybean cultivated area and production output remained at same level as August prediction. Soybean production is estimated at 14.44 million tons, with a year-on-year increase of 2.9%. As already pointed out in August Bulletin, this has been the fourth consecutive years for the increasement of soybean planted area and soybean production. The November Bulletin revised the yield prediction for all major soybean producing provinces and inter-annual production changes. The sufficient rainfall after the peak growing season not only alleviated drought during previous monitoring period especially in Huang-Huai-Hai region but also provide favorable moisture conditions for soybean. As the major soybean producing areas, soybean performed well in Northeast China with 8.1% increased of production in Heilongjiang, the No. 1 soybean producer in China. At the same time, Inner Mongolia and Jilin produced 5.8% and 10.2% more soybean compared with 2018 as a result of both increased planted area and yield. The largest drop in soybean produced was observed in Shanxi province where irrigation is a big issue. Soybean production in Jiangsu and Hebei decreased by different ranges.

Total food production

CropWatch puts the total 2019 output of summer crops (including maize, semi-late rice / single rice, late rice, spring wheat, soybean, tuber crops, and other minor summer crops) 466.78 million tons, 2.4% above that in 2018. This is mainly due to the revised up in maize and rice production. The total annual crop production is estimated at 628.06 million tons, up 1.9% from 2018. The total annual output is listed by province in table 4.4. It is worth mentioning that the top three crop producing provinces, Heilongjiang, Henan, and Shandong, all presented good performance with 1% to 3% above 2018.

Table 4.4 China 2019 winter crops, summer crops and total annual crop production and percentage difference from 2018, by province

	Winter crops		Summer crops		Total#	
	2019	Change (%)	2019	Change (%)	2019	Change (%)
Anhui	11852	0	20607	3	34310	2
Chongqing	2259	-3	8144	3	10402	2
Fujian			4771	2	6284	0
Gansu	3590	12	6618	4	10208	6
Guangdong			8121	3	12981	-1
Guangxi			9961	2	14853	-1
Guizhou			12456	3	12456	3
Hebei	12297	-3	20632	0	32929	-1
Heilongjiang			70642	3	70642	3
Henan	26952	3	25594	-1	52546	1

Hubei	5380	-7	17882	0	25608	-1
Hunan			20153	1	28467	1
Inner Mongolia			29899	2	29899	2
Jiangsu	10280	1	20496	3	30776	3
Jiangxi			10517	2	17859	-1
Jilin			38434	5	38434	5
Liaoning			22687	2	22687	2
Ningxia			2884	-2	2884	-2
Shaanxi	4001	-6	6710	4	10711	0
Shandong	24916	5	20127	-2	45043	2
Shanxi	2311	-4	9252	-5	11563	-5
Sichuan	5866	7	27231	2	33097	3
Yunnan			14873	1	14873	1
Zhejiang			6396	3	7190	2
Sub total	109702	1.5	435994	1.7	577607	1.4
China*	128044	1.4	466776	2.4	628057	1.9

4.3 Regional analysis

Figures 4.7 through 4.13 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 2019 to the previous season, to the five-year average (5YA), and to the five-year maximum; (c) Spatial NDVI patterns for July - October 2019 (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 - October 2019. Additional information about agro-climatic indicators and BIOMSS for China is provided in Annex A.

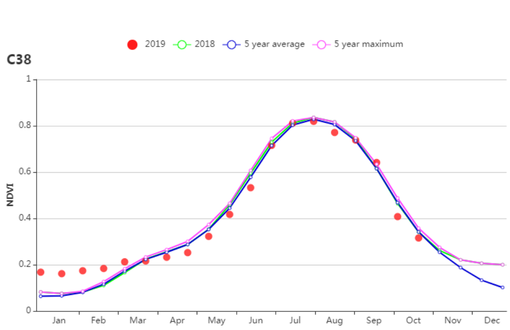
Northeast region

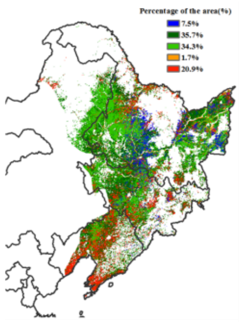
The current monitoring season (July to October) covers the harvest of all spring crops in North-east China. Maize, rice and soybeans reached maturity in August and September in Heilongjiang, Jilin and Liaoning Provinces, and the harvest will be over by the end of October.

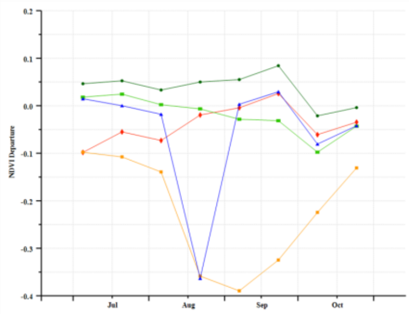
Precipitation was 35% higher than average, temperature was 0.1℃ lower, and the photosynthetic active radiation was 1% down. Temperatures from July to October were basically average throughout the monitoring period, except for a cold and very wet spell in August brought by Typhoon Lekima (section 5.2 for details). Altogether, agro-climatic conditions resulted in 5% below average potential biomass, reaching 10% in the North-east and West of Heilongjiang. Although Heilongjiang province was affected by several typhoons, they also brought excessive precipitation which are beneficial for crop development and grain-filling.

According to the spatial clusters of NDVI departure from average, the major rice producing areas in the north-eastern Heilongjiang and western Jilin Provinces had above average crop condition. However, in the southern and western Liaoning Province, NDVI was below average before August and recovered to average in early September. The VCIx map shows that higher VCIx values were mostly located in the western and northern parts of the region, with values above 1.0. This is an indication of favorable crop condition at peak growing season. VCIx exceeds 0.8 over almost the whole region. In general, crops did well in North-east China with overall good prospects for crop yield.

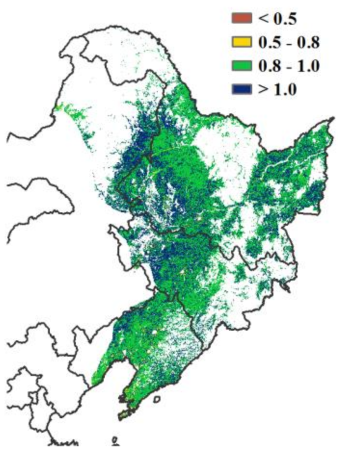
Figure 4.7 Crop condition China Northeast region, July - October 2019

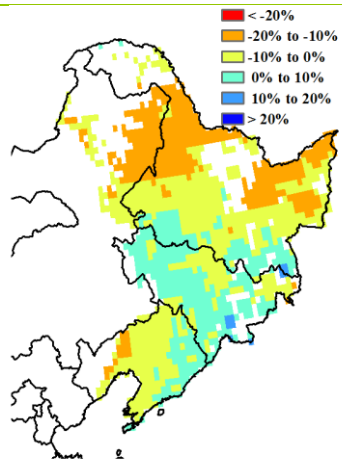






(a) Crop condition development graph based on NDVI (b) Spatial NDVI patterns compared to 5YA (c) NDVI profiles



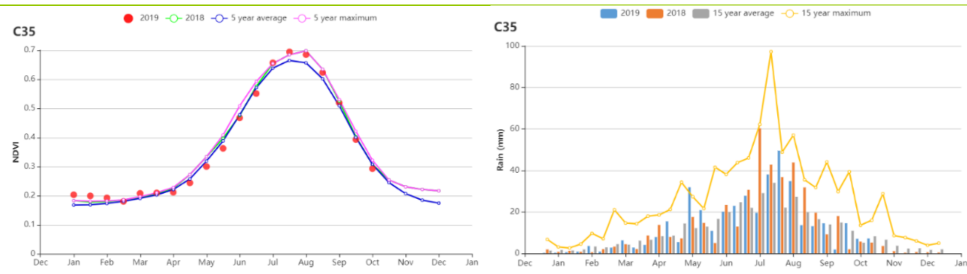


(d) Maximum VCI (e) Biomass departure

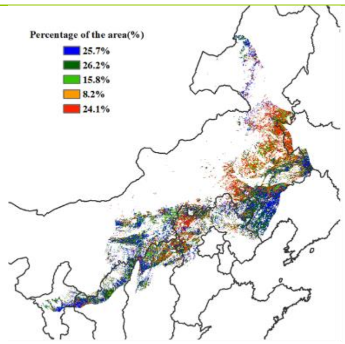
Inner Mongolia

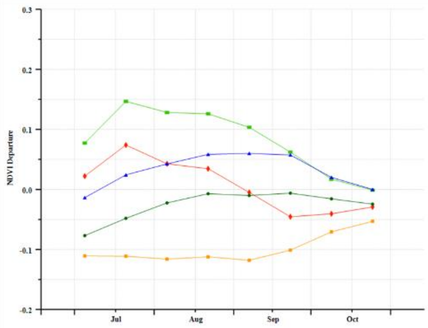
During the reporting period, the main summer crops in Inner Mongolia were maize and soybean. Generally, their condition was favorable. Rainfall was above average (RAIN +8%), TEMP was slightly higher than average by 0.3°C, and RADPAR was just average. The resulting BIOMSS was close to average as well (-1%). The NDVI development graph indicates good crop condition from June to August, almost at the same level as the maximum of the 5YA. This is also confirmed by high maximum VCI values in the whole region. National VCIx averages 0.97. In July, about 34.4% of the region was below average, in particular central and eastern Inner Mongolia, northern Hebei, northern Shanxi and western Liaoning, which suffered from moderate drought. Thereafter, crop condition improved and reached— and sometimes exceeded — the maximum of the 5YA from July to August. Favorable rainfall boosted crop growth, as clearly shown by above-average NDVI and confirmed by the spatial NDVI patterns and profiles in the area mentioned above. After September, as crops were reaching ripeness, weather conditions had limited effects on crop yield. CALF in this region was above average by 8% compared to the 5YA. At the same time, cropping intensity was 4% above average at 94%. On the whole, good production is expected from Inner Mongolia.

Figure 4.8 Crop condition China Inner Mongolia, July - October 2019



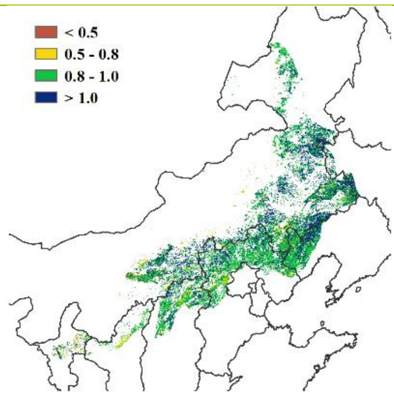
(a) Crop condition development graph based on NDVI (left) and rainfall profiles (right)

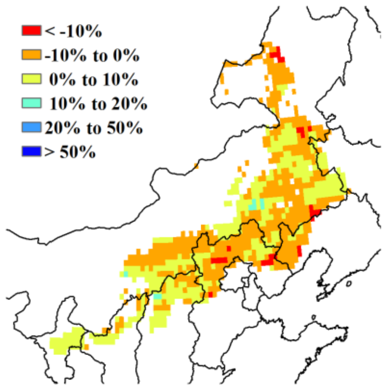




(b) Spatial NDVI patterns compared to 5YA

(c) NDVI profiles





(d) Maximum VCI

(e) Biomass departure

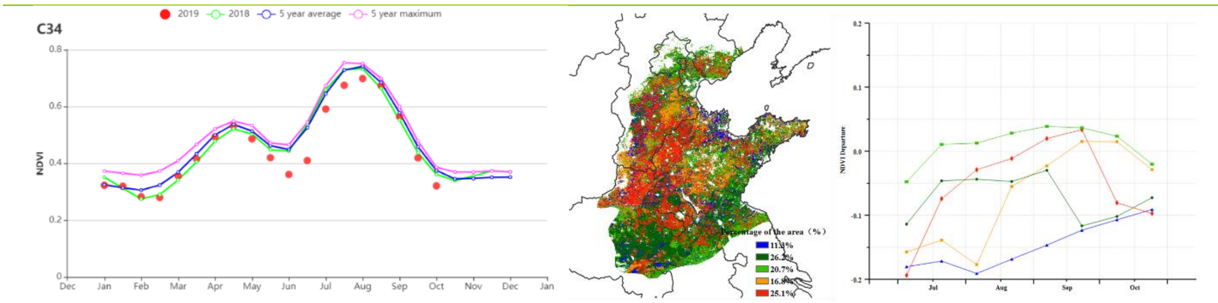
Huanghuaihai

The monitoring period covers the whole cycle of summer maize from July to late September, as well as the sowing and early growing season of winter wheat from early October. The NDVI development graph displays generally slightly below-average crop condition.

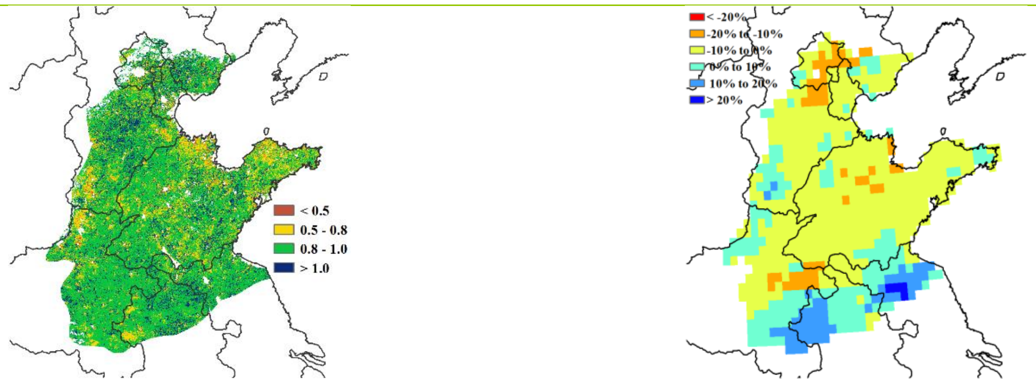
The NDVI values were below 5YA from July to early August, but then improved to 5YA until harvesting. For early October, coinciding with early stage of winter wheat, NDVI values fell slightly to below 5YA again. Agro-climatic conditions include a 26% decline in precipitation compared to average, affecting mainly early growth of maize. The temperature and the radiation rose by 0.8℃ and 4% compared to 15YA, respectively. The slight drop in NDVI during the growing season of maize may be influenced mainly by poor precipitation, which led directly to a 1% drop in BIOMSS. Besides, low NDVI values in early October had no effect on the BIOMSS index. The maximum VCI value for Huanghuaihai was 0.89.As shown by NDVI clusters and profiles, 20.7% of cropland over northern Anhui and Jiangsu, as well as some scattered areas across the whole region, displays average condition during almost the whole period. 41.9% of cropland over southern Hebei, western Shandong and northern Henan suffered below-average condition before August and recovered to average during September. Remaining areas had negative NDVI departure values all the time. The spatial distribution of biomass departures displays a drop not exceeding 10%; more significant reductions are noted in Beijing and some scattered areas in Shandong and Henan. Increases only occur in eastern Henan and northern Anhui and Jiangsu.

In general, crop condition in Huanghuaihai was below average due to severe water stress at early growing stage, but recovered to average level since mid-August.

Figure 4.9 Crop condition China Huanghuaihai, July - October 2019



(a) Crop condition development graph based on NDVI (b) Spatial NDVI patterns compared to 5YA (c) NDVI profiles

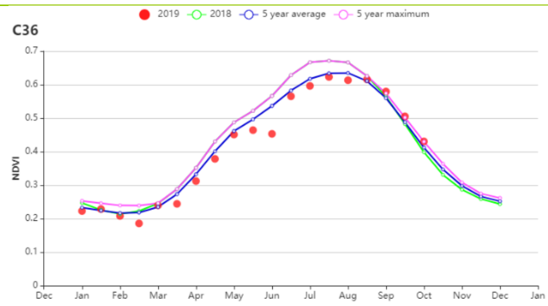


(d) Maximum VCI (e) Biomass departure

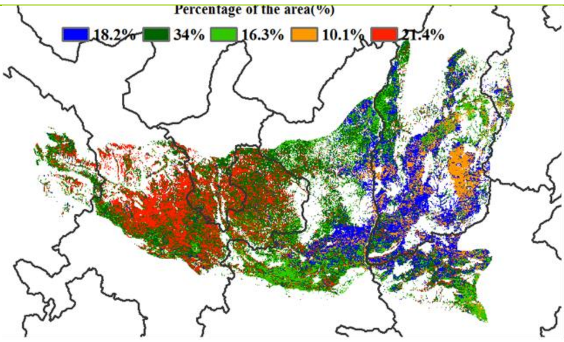
Loess region

Maize was harvested in late September and early October, and winter wheat has been planted at the end of the monitoring period. According to the NDVI development graph, crops started maturing from August to early September, after which they were harvested from mid-September to the end of the monitoring period. The temperature was average while precipitation was below average (RAIN -6%). Slightly above average radiation (RADPAR +2%) resulted in potential biomass production (BIOMSS) being above average as well (2%). In most of the area, the analyses based on spatial NDVI clusters and profiles are consistent with VCIx. The most favorable crop condition (compared to the five-year average) occurred mainly in the southern part of Ningxia, most of Gansu, the south-central part of Shaanxi and some regions in the South-west and North-east of Shanxi, and in western of Henan from July to October. In contrast, because of drought during the monitoring period (as confirmed by the maps of potential biomass)—crops were in inauspicious condition in north-east Shaanxi and central Shanxi. Altogether, with the cropped arable land fraction (CALF) up 9% compared with recent years, the crop production outlook for the region is positive.

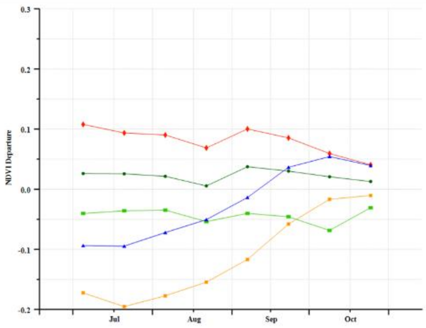
Figure 4.10 Crop condition China Loess region, July - October 2019



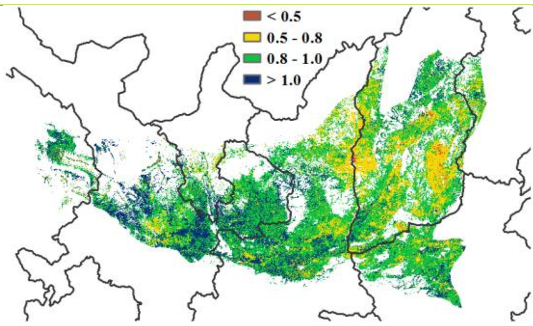
(a) Crop condition development graph based on NDVI



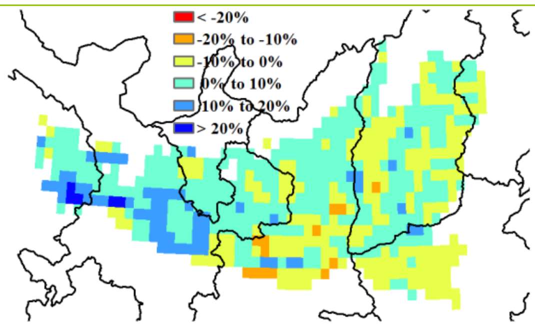
(b) Spatial NDVI patterns compared to 5YA



(c) NDVI profiles



(d) Maximum VCI



(e) Biomass departure

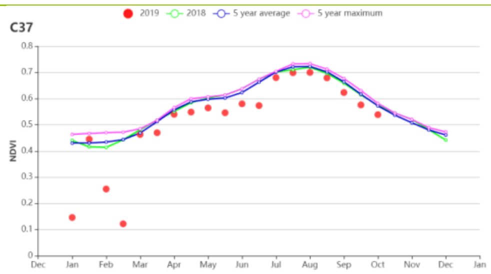
Lower Yangtze region

Maize was harvested in late September and early October, and winter wheat has been planted at the end of the monitoring period. According to the NDVI development graph, crops started maturing from August to early September, after which they were harvested from mid-September to the end of the monitoring period.

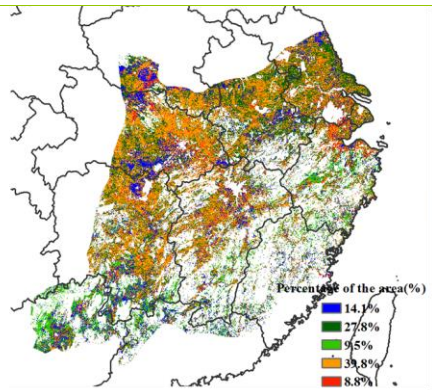
The temperature was average while precipitation was below average (RAIN -6%). Slightly above average radiation (RADPAR +2%) resulted in potential biomass production (BIOMSS) being above average as well (2%). In most of the area, the analyses based on spatial NDVI clusters and profiles are consistent with VCIx. The most favorable crop condition (compared to the five-year average) occurred mainly in the southern part of Ningxia, most of Gansu, the south-central part of Shaanxi and some regions in the South-west and North-east of Shanxi, and in western of Henan from July to October. In contrast, because of drought during the monitoring period (as confirmed by the maps of potential biomass)—crops were in inauspicious condition in north-east Shaanxi and central Shanxi.

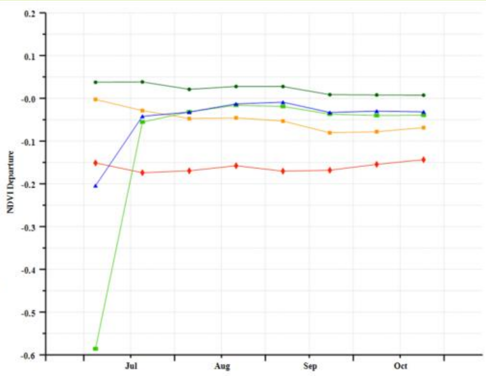
Altogether, with the cropped arable land fraction (CALF) up 9% compared with recent years, the crop production outlook for the region is positive.

Figure 4.11 Crop condition Lower Yangtze region, July - October 2019



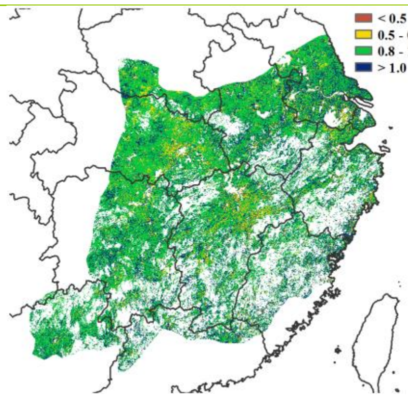
(a) Crop condition development graph based on NDVI

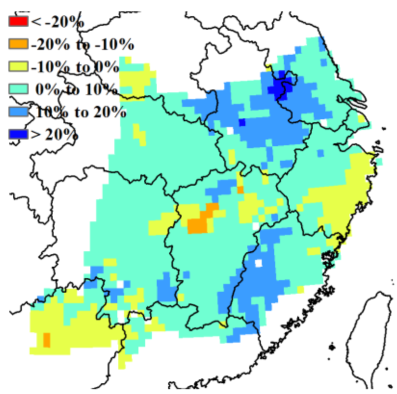




(b) Spatial NDVI patterns compared to 5YA

(c) NDVI profiles





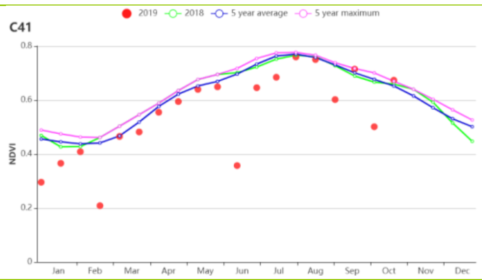
(d) Maximum VCI

(e) Biomass departure

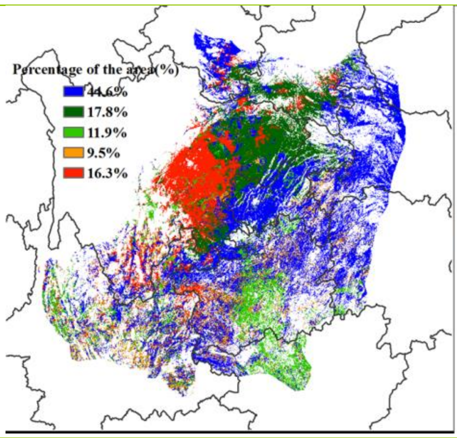
Southwest China

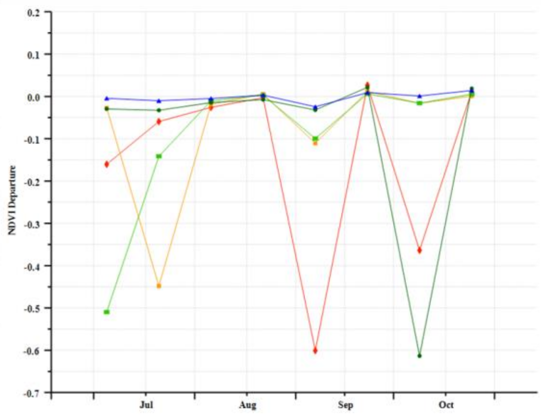
The reporting period covers the sowing of winter wheat in southwestern China, at a time when summer crops (including semi-late rice and maize) have reached maturity. According to the regional NDVI profile, crop condition was generally below the 5-year average, but close to average in late-August and October. On average, rainfall remained at the same level as the previous fifteen years and radiation was slightly below average (RADPAR -1%). Temperature was close to average as well (TEMP + 0.1 °C). The resulting BIOMSS was 7% below average. Even the cropped arable land fraction remained at the same level as the previous five years. According to the spatial NDVI profiles, values were close to average in July, except in Northern Yunnan and neighboring areas in south-eastern Guizhou. In mid-August, the overall NDVI in the region was close to the average level. In eastern Sichuan, NDVI was below average in September and October. Average NDVI throughout the monitoring period was observed in Chongqing, in spite of both precipitation and radiation being significantly above average (Annex A.11). The maximum VCI reached 0.97 at the peak of the growing season. The value is comparable with the previous five years. The mixture of positive and negative departures of indicators show generally unfavorable crop condition.

Figure 4.12 Crop condition Southwest China region, July - October 2019



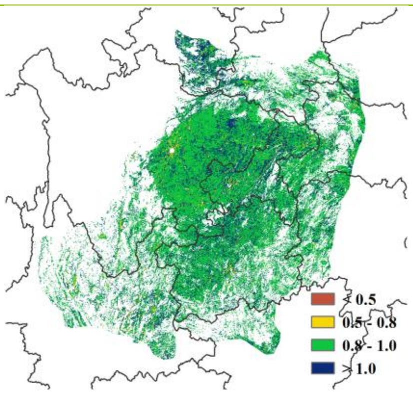
(a) Crop condition development graph based on NDVI

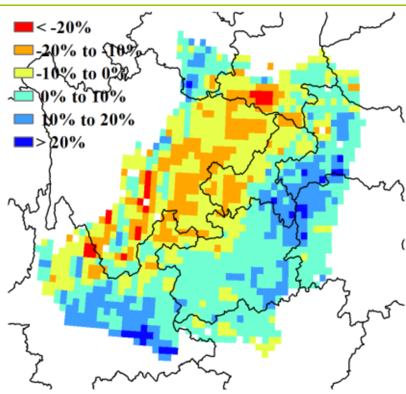




(b) Spatial NDVI patterns compared to 5YA

(c) NDVI profiles





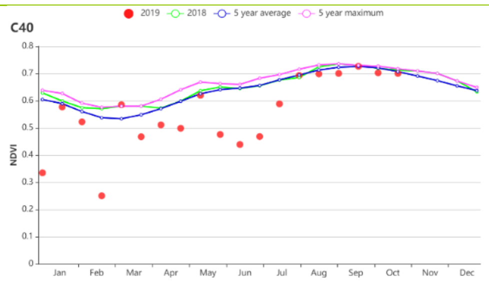
(d) Maximum VCI

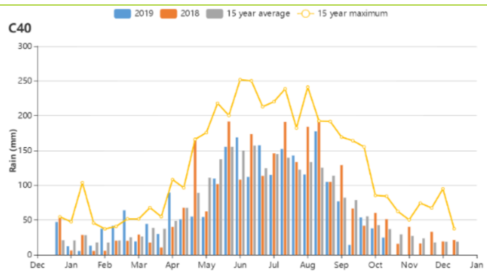
(e) Biomass departure

Southern China

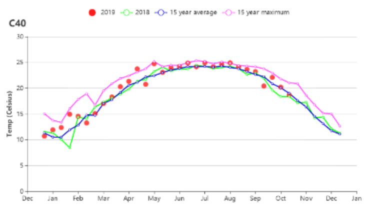
Late rice completed its complete cycle from sowing to harvesting in southern China during the monitoring period. The condition of the crop was generally close to but below average, according to the NDVI development curves. Regionally, rainfall reached 1172 mm, which was 2% lower than the average; provincial departures were the following: +4% in Guangdong, +3% in Yunnan, -5% in Fujian, and +5% in Guangxi. In Guangdong and Guangxi, RAIN exceeded 1100 mm, while in Yunnan and Fujian it exceeded 900 mm. The average temperature during the monitoring period in South China was 22.3 ° C, which was above average by 0.2° C. BIOMSS was 2% higher than average. The biomass index of Fujian, Guangdong and Yunnan increased by 8%, 1% and 8%, respectively, while Guangxi recorded a 3% drop. At the provincial level, biomass changes are consistent with sunlight (RADPAR), which is the dominant limiting factor for crop growth when water supply is sufficient. The average VCIx of the South China region during the monitoring period was 0.90, and almost all regions presented above 0.80 VCIx during this monitoring period. NDVI departure clustering analysis revealed the continuous below average condition crops were mostly located in south-western Guangdong Province, covering 17.2% of the total cropland area. Overall, the crops in Southern China was slightly below average.

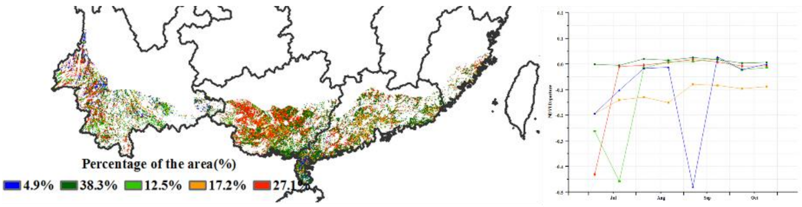
Figure 4.13 Crop condition Southern China region, July - October 2019



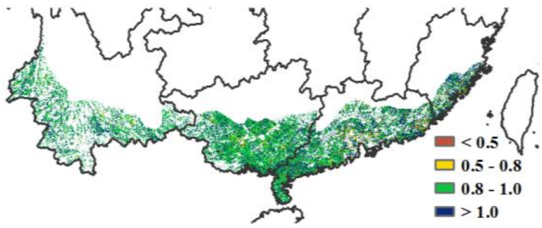


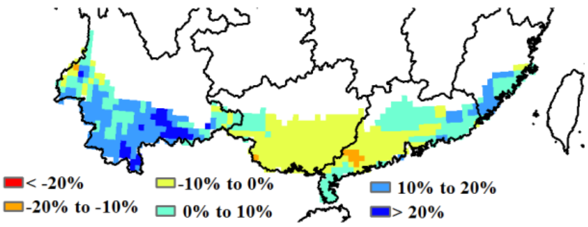
(a) Crop condition development graph based on NDVI (b) Rainfall profiles





(c) Temperature profiles (d) Clustering analysis of NDVI departure from 5 years average





(d) Maximum VCI (e) Biomass departure

4.4 Pest and diseases monitoring

1. Rice pests and diseases

The impact of pests and diseases was moderate during mid-late September 2019 in the main rice regions of China. The temperature of most cropland equaled or exceeded values of previous years and so did precipitation in Northeast China, South China and Southwest China. This provided suitable conditions for rice plant-hopper (Nilaparvata lugens) and rice leaf roller (Cnaphalocrocis medinalis) migration, and rice sheath blight (Rhizoctonia solani) dispersal.

Rice plant hopper

The distribution of rice plant-hopper during the second half of September 2019 is shown in Figure 4.14 and Table 4.5. The total area affected reached 6.1 million hectares, with severe occurrence in Heilongjiang, North Zhejiang, central Anhui, North Hunan and central Guizhou. Moderate occurrence affected East Jiangsu, South Anhui, South Hubei, central Hunan and North Guangxi, and slight occurrence in central Jiangxi, central Hubei, South-west Liaoning and South-east Henan.

Figure 4.14 Distribution of rice plant hopper in China (mid-late September 2019)

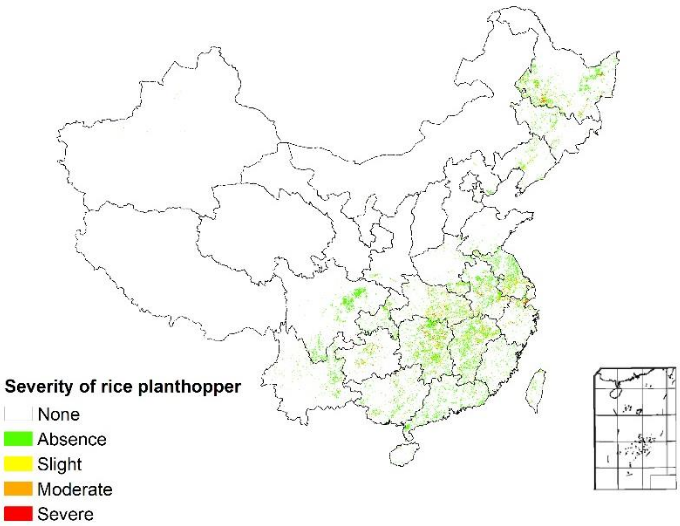


Table 4.5 Statistics of rice plant hopper in China (mid-late September 2019)

Region	Occurrence ratio / %			
	None	Slight	Moderate	Severe
Huanghuaihai	87	8	3	2
Inner Mongolia	66	29	4	1
Loess region	82	14	3	1
Lower Yangtze	74	15	7	4
Northeast China	77	13	6	4
Southern China	92	4	3	1
Southwest China	89	6	3	2

Rice leaf roller

Rice leaf roller (Figure 4.15 and Table 4.6) damaged around 5.2 million hectares, severely in South-west Heilongjiang, North Hunan, central Anhui and North Zhejiang, moderately in North-east Heilongjiang, central Jiangsu, central Guizhou and North Guangxi, and only slightly in South Hunan, central Hubei, central Jiangxi and South Henan.

Figure 4.15 Distribution of rice leaf roller in China (mid-late September 2019)

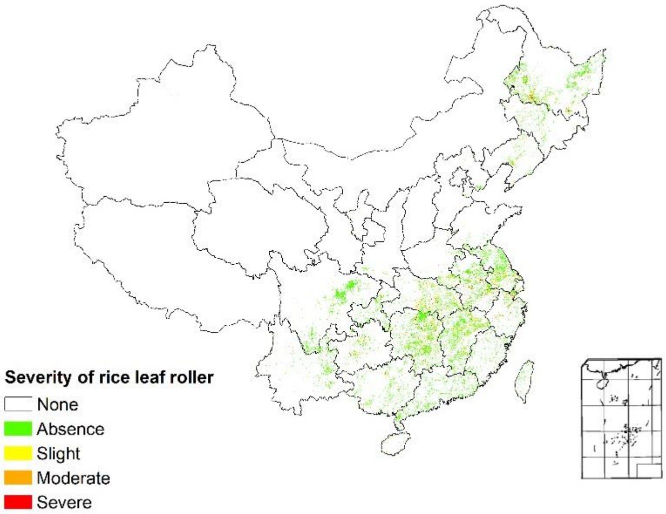


Table 4.6 Statistics of rice plant hopper in China (mid-late September 2019)

Region	Occurrence ratio/%			
	None	Slight	Moderate	Severe
Huanghuaihai	91	6	2	1
Inner Mongolia	72	24	3	1
Loess region	87	10	2	1
Lower Yangtze	77	13	6	4
Northeast China	81	11	5	3
Southern China	93	4	2	1
Southwest China	91	5	2	2

Rice sheath blight

Of the 3.9 million hectares damaged by Rice sheath blight (Figure 4.16 and Table 4.7) South-west Heilongjiang, South Henan, North-east Zhejiang, North Hunan, central Hubei and North-west Jiangxi suffered severely. Moderate impact occurred in North-east Heilongjiang, central Anhui, central Jiangsu, central Guizhou and North-west Chongqing, while slight incidence occurred in West Hunan, North Fujian, central Jiangsu, South Anhui, central Hubei and central Chongqing.

Figure 4.16 Distribution of rice sheath blight in China (mid-late September 2019)

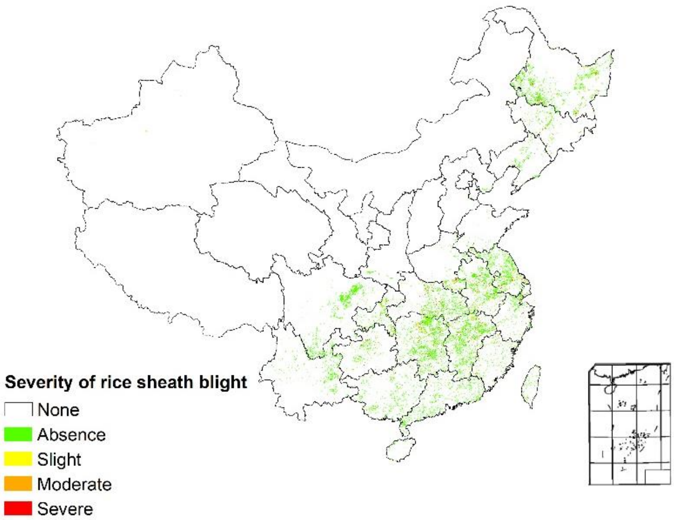


Table 4.7 Statistics of rice sheath blight in China (mid-late September 2019)

Region	Occurrence ratio/%			
	None	Slight	Moderate	Severe
Huanghuaihai	92	4	2	2
Inner Mongolia	94	2	1	3
Loess region	95	2	1	2
Lower Yangtze	87	6	4	3
Northeast China	86	7	4	3
Southern China	94	3	2	1
Southwest China	90	7	2	1

2. Maize pests and diseases

Maize suffered moderate pest and disease attacks during mid-late September 2019 in the main production regions. Heavy rains and high humidity in Southwest China, Northeast China, North China and eastern China were conducive to maize armyworm (Mythimna separata) reproduction and maize northern leaf blight (Setosphaeria turcica) dispersal.

Maize armyworm

The distribution of maize armyworm in mid-late September 2019 is shown in Figure 4.17 and Table 4.8. Heilongjiang, central Jilin, East Inner Mongolia, North Shandong, central Shaanxi and East Hebei suffered severely, with more moderate impacts in North Jilin, South-west Liaoning, North Henan, North Jiangxi, South Shanxi and North Hunan, and only slight incidence in central Liaoning, South Hebei, central Henan and East Shandong. The total area affected by armyworm is estimated to have reached 3.2 million hectares.

Figure 4.17 Distribution of maize armyworm in China (mid-late September 2019)

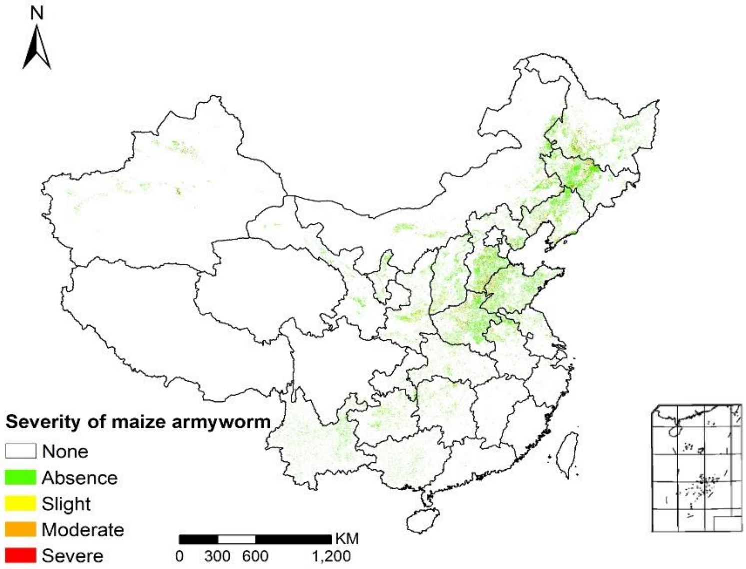


Table 4.8 Statistics of maize armyworm in China (mid-late September 2019)

Region	Occurrence ratio/%			
	None	Slight	Moderate	Severe
Huanghuaihai	90	5	2	3
Inner Mongolia	87	5	5	3
Loess region	87	7	4	2
Lower Yangtze	84	10	4	2
Northeast China	89	4	4	3
Southern China	97	1	1	1
Southwest China	93	4	2	1

Maize northern leaf blight

Maize northern leaf blight (Figure 4.18 and Table 4.9) damaged around 1.8 million hectares, with the disease severely occurring in Heilongjiang, South Jilin, central Liaoning, North Shandong, central Shaanxi and East Hebei. Moderate impact is assessed for North Jilin, West Liaoning, East Inner Mongolia, West Hebei and North Anhui. Central Hebei, North Shanxi, South-west Henan, central Guizhou and North-west Hunan were only slightly impacted.

Figure 4.18 Distribution of maize northern leaf blight in China (mid-late September 2019)

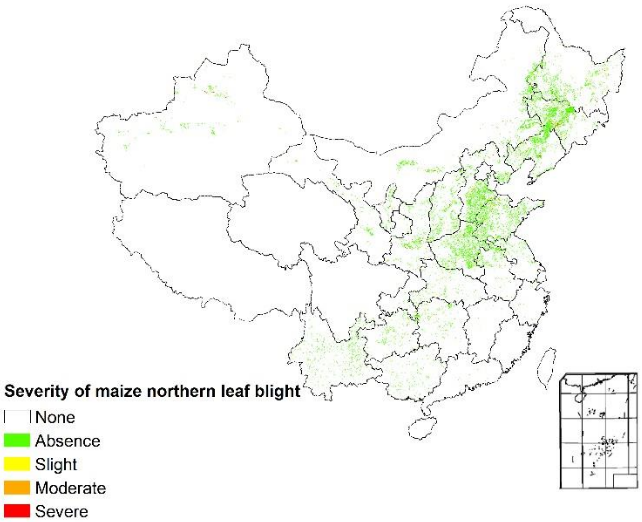


Table 4.9 S Statistics of maize northern leaf blight in China (mid-late September 2019)

Region	Occurrence ratio/%			
	None	Slight	Moderate	Severe
Huanghuaihai	95	3	1	1
Inner Mongolia	92	3	3	2
Loess region	94	3	2	1
Lower Yangtze	95	3	1	1
Northeast China	93	3	2	2
Southern China	97	2	1	0
Southwest China	93	5	1	1

4.5 Major crops trade prospects

This section analyzes the import and export situation of maize, rice, wheat, and soybean in the first three quarters of 2019 in China.

In the first three quarters of 2019, the total imports of rice in China were 1.7288 million tons, a decrease of 22.8% compared to the previous year. The imported rice mainly stems from Thailand, Pakistan, Vietnam and Myanmar, respectively accounting for 25.1%、25.0%、21.9% and 15.2% of imports. The expenditure for rice import was US$889 million. Total rice exports over the period were 2,153,700 tons, an increase of 58.5% compared to the last year, mainly exported to Egypt, Côte d'Ivoire and Turkey (accounting for 20.7%, 13.0% and 9.9%, respectively). The value of the exports was US$813 million.

In the first three quarters of 2019, Chinese **wheat** imports totaled 2.2603 million tons, down by 9.7% year-on-year. The main sources include Canada (64.4%), Kazakhstan (14.2%), and France (5.8%). Imports amounted to US$664 million. Wheat exports (225,100 tons), up 3.8% compared to the last year, went mainly to the Democratic People's Republic of Korea (71.0%), Hong Kong (22.4%) and Ethiopia (3.3%). The generated income was US$89 million.

Maize imports reached 3,867,400 tons, an increase of 33.1% over 2018. The main suppliers were Ukraine, the United States, Myanmar and Russia, accounting for 90.9%、5.1%、2.2% and 1.1% of imports respectively. Imports amounted to US$843 million. Maize exports (15,400 tons), went mainly to the

Democratic People's Republic of Korea (88.3%), Hong Kong (7.1%) and Ethiopia(3.2%). The generated income for **Maize** export was US$4.2177 million.

In the first three quarters of 2019, the total imports of **soybean** in China were down 7.8% to 64,582,700 tons. Brazil, the United States and Argentina respectively contributed 70.0%, 16.0% and 7.9%, for a total value of US$2.5814 million. Soybean exports were 85,000 tons, down by 17.2%.

Trade prospects for major cereals and oil crop in China for 2019

Based on the remote sensing data of grain crop monitoring in major countries in the world in 2019, according to the major impact of agriculture and policy simulation model, it is predicted that the import of major grain crop varieties will increase slightly in 2019. The details are as follows:

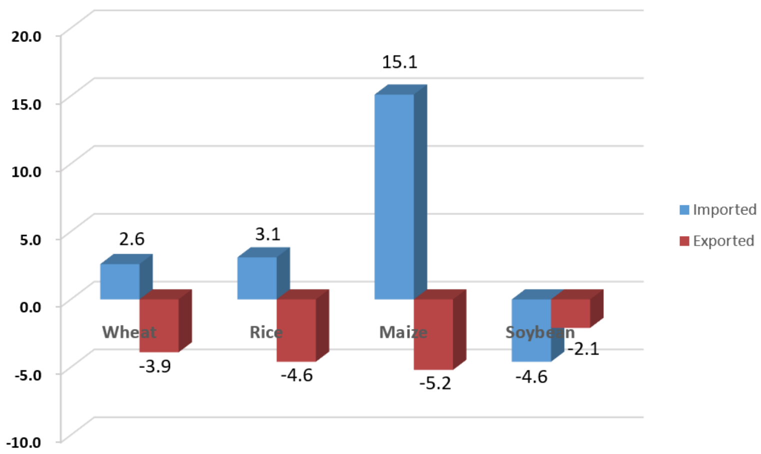
According to the result of the model, **rice** imports will increase by 3.1%, while exports will decrease by 4.6% in 2019. The supply and demand of the global rice market is basically balanced. The CIF price of international rice is lower than that of domestic rice, and the price gap is further expanding. It is expected that the rice import will maintain a slight increase in 2019.

According to the forecasts, **wheat** imports are projected to increase by 2.6%, while exports will decrease by 3.9%. It is expected that the global wheat output will increase steadily, the international wheat price will rise, the price gap between home and abroad will continue to narrow, and the wheat import is expected to increase slightly in 2019.

Maize imports are forecast to increase (+15.1%) in 2019, while exports should decrease 5.2%. Global maize production has increased slightly, inventory has been further reduced, international maize prices have rebounded slightly, and China's maize import growth is expected to slowdown in 2019.

Soybean imports and exports will decrease by 4.6% and 2.1%, respectively. Global soybean production is slightly reduced, but stocks are still high. China-US economic and trade consultations have made positive progress, boosting the international market, but uncertainty still exists. It is expected that China's soybean import will decrease in the year.

Figure 4.19 Rate of change of imports and exports for rice, wheat, maize, and soybean in China in 2019 compared to those for 2018(%).



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 2019 (section 5.1), as well as sections on recent disaster events (section 5.2), and an update on El Niño (5.3).

5.1 CropWatch food production estimates

Methodological introduction

Table 5.1 presents the final revision by the CropWatch team of the global maize, rice, wheat and soybeans production estimates for 2019. It is issued at a time when all 2018-2019 winter crops and 2019 summer crops in the temperate northern hemisphere have been harvested; in the southern hemisphere winter crops are growing and the planting of the summer season/monsoon season is underway or about to start. The planting of the second crop is ongoing or about to start in equatorial areas.

CropWatch production estimates differ from most other global or regional estimates by the use of near-real time geophysical data and models. They are based on a combination of remote-sensing models (for major commodities at the national level) and statistical trend-based projections for minor producers and for those countries which will harvest their crops in the two last months of 2019, for which no directly observed crop condition information is as yet available. In Table 5.1 below, modeled outputs are in red bold font. The percentage of modeled global production varies according to crops: 85% for maize, 94% for rice, 89% of wheat (most of it being northern hemisphere winter wheat) and 82% for soybeans.

The 42 countries for which production estimates are provided are described in detail in chapter 3 while a whole chapter is devoted to China (Chapter 4). Kyrgyzstan was added for the first time in this bulletin. The 42 + 1 countries are referred to conventionally as the “Major producers”. “Others” include the 141 countries from Albania, Algeria, Armenia [...] to Venezuela, Yemen and Zimbabwe. The total output for “other” countries was obtained by adding national projections for 2019 rather than projecting the sum.

The red bold estimates in the present chapter are calibrated against national agricultural statistics (as opposed to FAOSTAT). This means that (1) sub-national statistics are used at least for the largest countries and (2) 2018 information in included in the calibration. It is also stressed that the calibration is crop-specific, i.e. based on different crop masks for each crop and that, for each crop and country, and both yield variation and cultivated area variation are taken into account when deriving the production estimates. The major producers represent at least 90% of production and 80% of exports. “Others” and the countries shown in black in the production table were extrapolated to 2019 based on a combination of two linear trends from 2009 to 2017 and 2014 to 2018.

Production estimates

CropWatch estimates the global 2019 production of the major commodities at 1055 million tonnes of maize, up 0.5% from 2018, 754 million for rice (as paddy; up 4.2%), 716 million tonnes of wheat (a 0.9% increase) and 324 million tonnes of soybeans, 1.0% lower than last year's output. The major producers contribute 975 million tonnes of maize (+0.9%), 684 million for rice (+4.6%), 646 million tonnes of wheat (+0.9%) and 305 million tonnes of soybeans (-0.7%). Compared with the final CropWatch estimates for 2018, the relative importance of "others" did not change. Major producers outperform all "others" for cereals (maize, 0.9% vs. -4.5%; rice, +4.6% vs. -0.1% and wheat, 0.9% vs. 0.4%) as well as for soybeans (-0.7% vs. -5.0%), increasing the dominance of large exporters. For the major producers, the current production estimate is below the trend .

In China, the comprehensive CropWatch estimates in table 5.1 and chapter 4 assess variations of all crops as positive, including maize (+1%), rice and soybean (+3%) and wheat (+2%); some estimates were revised upward due to favorable summer crop growing conditions. This puts China together with Egypt, Pakistan and the United States in the group of countries where the three cereals did well in 2019, corresponding to output growth of 10.6 million tons, 2.0 million tons, 5.2 million tons and 9.7 million tons, respectively.

The largest net cereal production increases occurred in India (13.3 million tons, in spite of a drop in wheat output), China, United States, Pakistan (as mentioned), followed by Bangladesh (3.7 million tons), Argentina (3.3 million tons), Myanmar (2.6 million tons) and several central and western Asian countries (Afghanistan, Iran, Uzbekistan; 2.0 million tons to 2.4 million tons) where wheat did well after several years of poor performance.

The largest net cereal production decreases in excess of 1 million tons affected Australia (-5.4 million tons, wheat), Kazakhstan (-3.5 million tons, wheat), South Africa (-1.7 million tons, maize), Indonesia (-1.6 million tons, rice) and Ukraine (-1.4 million tons, maize and wheat). As described in the country narratives in Chapter 3, the listed situations are directly related to prevailing environmental conditions.

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Table5.1 2019 cereal and soybean productions estimates in thousands tonnes. Numbers in black are trend-based while red bold numbers corresponds to modeled crops that have been harvested or were growing at the time of reporting. Rice is expressed as paddy. Δ is the percentage of change of 2019 production when compared with corresponding 2018 values.

	Maize		Rice		Wheat		Soybean	
	2019	Δ%	2019	Δ%	2019	Δ%	2019	Δ%
Afghanistan	197	−23	220	−25	**6,630**	**+98**		
Angola	**2,776**	**−1**	77	+12	3	+3	19	+3
Argentina	**53,154**	**+7**	**1,849**	**+9**	**18,207**	**−2**	**51,459**	**+9**
Australia	470	0	768	−13	**19,370**	**−21**	62	−11
Bangladesh	**2,368**	**+8**	**48,239**	**+8**	1,467	−2	97	−8
Belarus	763	+15			**2,927**	**+6**		
Brazil	**85,390**	**0**	**11,650**	**+0**	**4,076**	**−4**	**100,744**	**+3**
Cambodia	702	+24	**8,081**	**−8**			173	+1

	Maize		Rice		Wheat		Soybean	
	2019	Δ%	2019	Δ%	2019	Δ%	2019	Δ%
Canada	11,889	−1			32,338	+4	7,660	−1
China	224,345	+1	203,084	+3	123,516	+2	14,441	+3
Egypt	5,958	+8	6,664	+9	11,800	+9	50	+2
Ethiopia	7,222	−2	150	+1	3,884	−3	107	−1
France	14,591	+2	69	+7	35,586	−2	475	+17
Germany	4,790	+1			27,768	+3	72	+34
Hungary	5,942	+5	11	+9	4,886	−3	200	+12
India	18,415	+3	168,141	+9	90,267	−1	11,307	−1
Indonesia	16,356	−3	64,196	−2			1,102	+1
Iran	1,054	−15	2,820	+14	16,076	+16	185	+15
Italy	6,312	+3	1,626	+7	7,713	+6	1,585	+4
Kazakhstan	877	+5	524	+10	12,744	−22	289	+2
Kenya	2,735	−21	98	−16	161	−15	2	−13
Kyrgyzstan	670	0	43	+10	589	0	4	+48
Mexico	22,177	−6	265	+7	4,188	+17	767	+25
Mongolia					271	+7		
Morocco	91	+39	65	+16	6,655	−6	1	−15
Mozambique	2,084	0	383	+2	15	−16		
Myanmar	1,859	+9	27,607	+10	94	−27	170	+20
Nigeria	11,474	−2	4,584	−2	47	−15	767	+4
Pakistan	5,230	+16	10,885	+24	26,409	+10		
Philippines	6,982	−6	20,452	+4			1	0
Poland	4,674	−4			10,145	+0	25	+72
Romania	13,266	+3	36	−1	7,747	+3	445	+22
Russia	13,283	+4	1,031	−3	53,336	+1	3,630	+1
South Africa	11,647	−12	3	+0	1,367	−13	1,286	+7
Sri Lanka	216	−11	2,400	−1			15	+23
Thailand	4,264	−11	39,557	+3	1	−2	17	+59
Turkey	6,882	+5	960	+2	18,608	−6	181	−6
Ukraine	27,674	−4	49	+28	20,933	−1	4,786	−2
United Kingdom					13,464	−2		
United States	368,548	+2	11,514	+4	54,700	+4	102,572	−9
Uzbekistan	465	−5	377	−6	8,170	+37		
Vietnam	5,179	+1	45,916	+2			81	−14
Zambia	1,873	−22	26	−13	90	−21	396	+15
Total	974,843	+0.9	684,420	+4.6	646,250	+0.9	305,171	−0.7
Others	80,268	−4.5	69,261	-0.1	69,887	+0.4	18,903	−5.0
Global	1,055,111	+0.5	753,681	+4.2	716,136	+0.9	324,074	−1.0

Maize

Countries that experienced large production rises include Morocco, a minor producer of maize (91 thousand tonnes), but nevertheless with a marked increase of 39%, and Pakistan, which passes the 5 million tons bar with a 16% percent increase. Increases between 7 and 9% occurred in Argentina, Egypt and Myanmar and several countries recorded a 5% rise: Turkey, Hungary and Kazakhstan. Large drops exceeding 10% affected some significant producers, including Thailand and South-Africa (-11% and -12%) as well as two African countries in the Horn of Africa (Kenya, -21%) and in Southern Africa (-22%).

Among the main exporters (Table 5.2) the top three countries (United States, Brazil and Argentina) increased their output by 9.6 million tons, or 1.9%, while the top ten are up only 10.9 million tons, meaning that the bulk of the increase is available from the United States and Argentina, as Brazilian production is Unchanged. Among the top three importers (Japan, Mexico and South Korea) only Mexico is also a significant producer (22 million tons during 2019). With a drop in the volume of production of the three listed countries reaching 1.5 million tonnes (6.2%), increased flows should be expected to Mexico.

Rice

In 2019, the situation of rice production in South and Southeast Asian countries is generally good. Among them, rice production in Pakistan, Myanmar, India, Thailand, China, Vietnam and other countries all increased year-on-year, with yield increases of 24.4%, 8.5%, 10.2%, 3.2%, 2.9% and 2.4% respectively. Rice production in Iran, the United States, Egypt, Argentina and other countries has also increased; although the two major rice producing countries in Cambodia and Indonesia have reduced their output by 8.3% and 1.6%, the total global rice output has still increased significantly by 4.2%.

The global rice supply situation is loose. Rice production in the top five rice exporting countries (India, Thailand, Vietnam, Pakistan, and the United States) increased by 18.2 million tons year-on-year, an increase of 7.0%. At the same time, the output of major rice importing countries increased overall, and rice supply in exporting countries increased and imports The increase in domestic rice production in China can meet the increase in demand from rice importing countries. It is expected that the supply and demand situation in the international rice market will be loose.

Wheat

In addition to China, a dozen of countries are estimated to have increased their wheat production by 3% or more, including several semi-arid central and western Asian countries such as Afghanistan (+98%), Uzbekistan (+37%), Iran (+16), Pakistan (+10), and Mongolia (+7%). In most cases, the large increase results from a poor 2018 crop. In Europe, the list includes Belarus and Italy (+6%), Germany and Romania (+3%). Egypt (+9%) was already mentioned above for generally favorable production of all Cereal. Finally, the three northern American neighbors need to be mentioned: Mexico (+17%), Canada and the United States (+4% each).

Several wheat producers of the general Mediterranean and central European area had low production, for instance Ukraine (-1%) and France (-2%) but larger drops compared with the previous season occurred in Hungary (-3%), Morocco and Turkey (both at -6%). Ethiopia is mentioned too with -3%. Among the important producers and exporter, we need to mention Argentina (-2%), Brazil (-4%), South Africa (-13%) and Australia (-21%).

Among the top 10 exporters, 5 had production drops. In addition to the already mentioned ones (Argentina, Australia, France and Ukraine) also Kazakhstan underwent a drop in production compared with 2018 that reached 22%. As a result, the wheat output of the top 10 producers is down 1.7%, equivalent to 5.0 million tons. Among the top wheat importers, only Indonesia is not at the same time a producer. They did generally well in 2019 as they increased their production by 3.4 million tons, or 3.6%. The amount is more than half of the production shortfall of the main exporters (5.0 million tons, as mentioned).

Soybean

Soybean production is up by 25% in Mexico, a minor producer (less than 1 million tons) and one of the top importers. Among the important producers, production is up 9% in Argentina, 3% in China and in Brazil. Both Russia and Indonesia increased their production by 1% over 2018 output. Production is slightly down in India (-1%) which not a major player in international soybean trade is.

The most spectacular drop is the one assessed for the Unites States (-9%) as a result of unfavorable weather and policy. A consequence is that the output of the top ten producers is down 1.4%, equivalent to 4.2 million tons. Importers, whose volume of production is about 15 times lower than that of the exporters, increased their output by 0.6 million tons (top 10), up 3.9% compared with 2018. No tension should affect markets.

Table5.2 Comparison of 2019 and 2018 production of major importers and exporters as well as the change in the offer and demand between 2018 and 2019. The table lists percent changes as well as absolute amounts based on table 5.1.

Main exporters								
	Change in production volume in 1000 tonnes				Change in production in %			
	Maize	**Rice**	**Wheat**	**Soybean**	**Maize**	**Rice**	**Wheat**	**Soybean**
Top1	6,044	13,221	2,043	−10,102	1.7	8.5	3.9	−9.0
Top3	9,594	15,548	3,873	−2,996	1.9	6.5	2.8	−1.2
Top 10	10,897	21,031	−4,956	−4,190	1.8	7.0	−1.7	−1.4
1 to 5	8,550	18,155	−2,110	−3,113	1.6	7.0	−1.1	−1.1
6 to 10	2,347	2,876	−2,845	−1,077	4.3	7.0	−3.2	−7.3

Importers								
	Change in production volume in 1000 tonnes				Change in production in %			
	Maize	**Rice**	**Wheat**	**Soybean**	**Maize**	**Rice**	**Wheat**	**Soybean**
Top1	0	5,759	1,010	405	−5.3	2.9	9.4	2.9
Top3	−1,471	5,652	984	577	−6.2	2.8	7.4	3.9
Top 10	−2,014	4,907	3,435	588	−4.8	1.8	6.9	3.6
1 to 5	−1,596	5,918	1,214	578	−4.7	2.9	4.9	3.9
6 to 10	−418	−1,012	2,221	11	−5.2	−1.5	8.8	0.7

Note: About 154 countries that are not covered in Table 5.1 are part of the top ten importers or exporters. They include Bolivia, Paraguay and Uruguay among the exporters and, among the importers, Algeria, Benin, Colombia, Côte d'Ivoire, Iraq, Japan, *Korean Republic, Netherlands, Nigeria, Saudi Arabia, Senegal, Spain We stress that some numbers in table 5.2 are based on extrapolations.*

5.2 Disaster events

Introduction

Some food deficit areas listed by FAO south of the Equator (Zimbabwe, Malawi, Madagascar and Mozambique) now grapple with drought, but they badly suffered from floods when they were hit by cyclone Idai in March. They still struggling to recover from the cyclone to the extent that, on 23 October, the UN Economic Commission for Africa (UNECA) stated that "overUS$4 billion is needed to help Malawi, Mozambique and Zimbabwe recover."

Mozambique, which bore the brunt of the cyclone's impact, suffered a second though less severe impact at the end of April (cyclone Kenneth), which was followed by drought. By mid-September close to 2 million people were estimated to be seriously food insecure, with many living in tented camps, a situation that is estimated to last at least until the end of the year. In Malawi, according to the Southern African Development Community (SADC), 1.1 million people will be in IPC phase 3 (crisis) until March 2020, especially in the districts of Karongo, Balaka and Mchinji where malnutrition rates are above 10%, in spite of a nationwide mostly favorable 2018/19 crop. In Zambia 2.3 million people are projected to be severely food insecure (IPC Phase 3 or 4) in March 2020. ReliefWeb, quoting the UN Office for the coordination of Humanitarian Affairs (OCHA) indicated that, at the end of September, "More than 9.2 million people across the region are now severely food insecure, and this figure is expected to grow to 12 million at the peak of the lean season (October 2019-March 2020)."

Extreme conditions by type

Drought and fires

Drought and resulting fires have received wide media coverage during the current JASO reporting period. In several countries huge bush and forest fires resulted from initial indifference, climate change denial and unpreparedness, frequently leading to local and international tensions! Fires not only absorb vital national resources but also affect infrastructure, living conditions and the health of people. Examples include power cuts in California, closed schools in Malaysia (due to fires in Indonesia) in Bolivia and Brazil, respiratory problems, severe impacts on biodiversity and direct crop loss.

Fires were mainly observed at high latitudes in Asia (Siberia) and America (Canadian Arctic and Alaska), California, the Amazon (Peru and Paraguay, but mostly Brazil and Bolivia), Indonesia and Australia.

Siberian fires occurred mainly in July and August. 3 million hectares were burning at the end of July, with a total of 12 million destroyed in 2019. Unusually high temperature and strong winds are listed as main factors. Similarly, the fires which affected south-central Alaska in August were also assigned to "unprecedented temperatures."

In California, the 2019 "fire season" is reported to have been one of the most destructive in history with 6200 incidents destroying about 80000 hectares. More than 100 people lost their lives and thousands of houses were lost. In addition to heat and wind, reduced snow and an increase of the snow-fewer periods in the Sierras by 75 days are given as contributing factors.

Contrary to semi-arid areas such as California and Australia, fires in rain-forest areas in south-east Asia and south America are mostly due to human activities, such as logging and deforesting to expand agricultural land for grazing and soybean cultivation (Brazil). In 2019, about 900000 hectares of forest were lost due to fire, which represents about 0.1% of the total Amazonian forest area. At the end of August, INPE, the national Brazilian Remote sensing research institution reported 80000 fires across the country, a 77% increase over average, and including 40000 fires in nine core Amazonian states. Bolivian Amazon fires, which lasted from late August to September, were eventually reduced by rain. The department of Santa Cruz was severely affected, with 521 thousand hectares of forest and grassland and hundreds of hectares of crops burnt. Amid lots of national and international tension, the fires eventually led to international assistance and legislation aiming at reducing future fires.

Toxic smoke from Indonesian fires in Sumatra and Kalimantan in September were monitored closely by the ASEAN Specialized Meteorological Centre (ASMC) that provided detailed regional maps of haze over Sumatra, Borneo and peninsular Malaysia, Singapore and Brunei Darussalaam. The smoke has affected much of the region and has led to some tension among neighboring countries.

Bush fires in Australia, which started in September and continued into November destroyed 700000 Ha especially in the south-east (New South Wales and Queensland); they even locally moved into rainforest areas in Queensland, which is exceptional. Several hundred houses were lost. Australia suffered from the worst drought in 100 years; many catchment basins in New South Wales (Macquarie River, Lachlan River, the fourth-longest in Australia) recorded less than 10 % of their average water inflow.

Figure 5.1 Track of cyclone Idai: the beginning of a fire in Sherman Oaks, California, fills the skyline with smoke. Photograph: John Fredricks/NurPhoto via Getty Images. Source:

https://www.theguardian.com/world/2019/oct/25/a-special-kind-of-hell-fires-smoke-and-heat-turn-la-into-a-deadly-paradise.

Drought

The Central American "dry corridor" has been experiencing drought for the last five seasons. This has resulted in the loss of staple crops, mostly maize and beans in many areas, including the Honduran Departments of Choluteca, Valle, La Paz, El Paraíso and Francisco Morazán. According to FEWSNET, subsistence farmers were the most affected, with drought occurring at advanced phenological stages between flowering and ripeness. Temperature anomalies during August and early September exceeded 2.5°C in most of western Nicaragua, eastern Honduras, as well as central and northern Guatemala. El Salvador deplored the greatest losses (40 to 60%) while they reached 15% in the center and west, although rainfall improved in September. For many people, emigration is seen as the only way to cope with repeated crop failures. The Honduran government declared an emergency in August 2018 when it became clear that the crisis situation would last throughout 2019. In early August 2019 more than 1.4 million people were in need of urgent assistance in Guatemala, Honduras, El Salvador and Nicaragua, with a total of 2 million affected. At the end of September the Guatemalan government has taken steps to assist 6.7 million people (almost 40% of the population) at risk of malnutrition. According to the World Food Programme 25% of households in the region have insufficient income to cover their basic food needs and 8% indicated that migration was their only hope.

In the Horn of Africa, the spring rainy season was among the top three driest on record, just one year after the end of a major drought in 2016-2017. Households had no time to recover, nor pastures and herds to regenerate in areas where livestock is the basis of livelihoods. As a result food prices are high in the entire region, further reducing access to basic food supplies. In Somalia the cereal harvest is the poorest since 2011, according to FAO. Delayed spring rains (the "Gu" season from April to June), and insignificant river flow have resulted in yields not exceeding a third of normal values. Around 2.6 million people are estimated to be severely food insecure, falling under IPC phases 3 and 4. The situation is not likely to improve until the "Deyr" crop (starting in October) will be available from December. The Somali drought has even received a name ("Sima") and has claimed 250000 lives since 2011. In the Sudan 6.3 million people (14% of the population) are experiencing a food crisis, the largest since 2007.

Floods

Floods were reported in August on all continents. In parts of the lower Mississippi Delta, about 220000 hectares had been under water since February (Yazoo backwater area). Floods also affected Asia, including India, Myanmar and Pakistan. In India, parts the south (Kerala and Karnataka) and west (Gujarat and Maharashtra) were hit, leaving 224 people dead in some areas where floods returned in October. At the end of the month torrential rain destroyed shelters for displaced people in northeast Nigeria, severely flooding temporary camps and leaving vulnerable families homeless, about 7000 people in Maiduguri and 500 people in Dikwa. Relief organizations have reported that displaced people are living in sub-human conditions across the region, but several international Donors are focusing their assistance to the north-eastern States of Borno and Yobe, strengthening recovery and building conflict resilience.

In September, parts of eastern Spain have received the heaviest rainfall on record, which killed several people. At the end of the month, floods brought misery to India in northern states (e.g.

Bihar and Uttar Pradesh) and in the east, where the casualties exceeded 100 after the delayed monsoon rains eventually started. In the north (Uttar Pradesh), 93 people have died as the rains caused homes to collapse. In neighboring Bihar, dozens of people died.

October brought excessive precipitation to eight south-western French departments in the Regions of Languedoc-Roussillon, Gard and Pyrénées Orientales. Abundant rain also fell in most of the Horn of Africa (except in northern and western south Sudan and south-west Uganda) potentially improving prospects for the ongoing or starting crop seasons and range-land, referred to as "Deyr" in Somalia (as mentioned above), "Meher" in Ethiopia, “short rains” in bimodal rainfall areas in the east and southern areas. The current rain corresponds to the main season in northern Tanzania and western Kenya. The region is currently under the influence of the “Indian Ocean Dipole”, sometimes referred to as the “Indian Ocean El Niño”, which is likely to boost precipitation until the end of the year. However, the region was affected by the “tail” of cyclone Kyarr which originated on 24 October off the western Indian Coast in the southeastern Arabian Sea, first moving east and affecting the western Indian coast (Maharashtra, Karnataka, and Goa). It then turned westwards, moving south of the Arabian Peninsula and eventually reaching Somalia on 3 November. Although the cyclone had lost its super cyclonic storm features, it lead to additional abundant precipitation affecting about 1 million people through floods in 27 counties in South Sudan, but also in Somalia and Kenya. In Somalia, 180000 people were displaced and crops were destroyed in areas where moderate to severe drought had affected crops earlier in the season. 38 people died in Kenya. At the very end of October landslides due to heavy rain killed about 35 people in Cameroon and made hundreds homeless. The abundant rains created damage, but most of it was lost in runoff.

Figure 5.2 Floodwaters between Bor and Pibor (South Sudan) on 20 October 2019. Source: Médecins sans frontières, published by https://www.spokesman.com/stories/2019/nov/01/flooding-in-east-africa-affects-more-than-1-million

Cyclones

In addition to the above mentioned Kyarr, the most notable cyclones were Dorian (Caribbean) and, In Asia. Lekima, Faxai and Hagibis.

Heavy rain exceeding 200 mm fell over eastern China after Typhoon Lekima (known as Hanna in the Philippines) made landfall late on 9 August, affecting Zhejiang - where the impact was strongest -, Jiangsu, Shandong, Anhui and Fujian Provinces. Wind peak speed reached 240km/h. Daily rainfall as high as 291 mm was recorded in Beilun district in Zhejiang Province. The highest precipitation fell in Linqu County (Shandong Province) at 387 mm. A second landfall occurred on 11 August in Shandong province (Qingdao). More than 1.7 million people had to be evacuated (including from parts of Shanghai) and about 13 million people were affected in nine provinces, with casualties exceeding 60 deaths. Lekima is the third strongest typhoon in East China since 1949, and the worst in 13 years. Total damage is estimated at 9.3 billion US$, including damage to just under 1000000 Ha of agricultural lands. Thousands of trees were uprooted or broken, the price of vegetables increased by 9% in some areas. According to Xinhua news agency, the government has released relief material and 86 million US$ (665 million RMB) for recovery operations to Liaoning, Zhejiang and Shandong Provinces.

(13) Hurricane Dorian very slowly (1.5 to 8 km/hour) crossed the Bahaman islands of Grand Bahama and Abaco in 1 September, with wind gusts reaching 320 km/h and a storm surge of close to 7.5 m. 67 people were left dead and more than 600 were still missing at the beginning of October. According to the International Red Cross and Red Crescent Federation as many as 13,000 houses have been severely damaged or destroyed and drinking water was contaminated by saltwater. 76000 people were affected out of a total population just under 400000. The Hurricane subsequently moved along the eastern American coast and died off the Canadian coast, resulting in broken trees and power cuts in Canada.

Typhoon Faxai, the worst storm in Japan in 60 years, just browsed Wake Island in the east of the country on 9 September. Damage is estimated at 7 billion US$ but only three deaths occurred. After affecting Guam and the Mariana Islands, a second cyclone, Hagibis, brought havoc to much of Japan, after making landfall on Izu Peninsula and then near Yokohama on 11 October. It also brought rainfall to the Korean Peninsula, eastern China, Russia and Alaska as it circled off northern Kamchatka up to 20 October. In central and eastern Japan at least 25 rivers burst their banks. About 90 died and some are still missing; 3560 were injured. At least 25000 Ha were flooded. Insured losses exceed 9 billion US$. The combined damage to the agricultural sector of cyclones Faxai and Hagibis in 38 Prefectures reaches 2.3 billion US$, with 350 million US$ assigned to Hagibis, of which about one third results from direct crop damage to horticultural crops and rice. As a result, some prices of particularly affected vegetables rose between 30% and 80% in Tokyo. Agricultural infrastructure losses (including irrigation) are estimated at 1 billion US$.

Figure 5.3. The site of the landslide on 11 August 2019 in Shanzao Village of Yantan Township in Yongjia County, Zhejiang Province. (Xinhua/Han Chuanhao). Source: http://www.ecns.cn/hd/2019-08-12/detail-ifzmwwnr7045884.shtml#1

5.3 Update on El Niño

Neutral El Nino condition prevails across the Pacific Ocean. Figure 5.4 illustrates the behavior of the standard Southern Oscillation Index (SOI) of the Australian Bureau of Meteorology (BOM) from October 2018 to October 2019. 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 the current season, SOI increased gradually from -5.6 in July to -4.4 in August, then decreased sharply to -12.4 in September, then increased to -5.6 in October 2019 again, indicating a neutral El Nino situation. The sea surface temperature anomalies in October 2019 for NINO3, NINO3.4, and NINO4 regions were +0.3°C, +0.6°C, and +1.0°C, respectively, somewhat warmer than the 1961-1990 average according to BOM (see Figure 5.5-5.6).

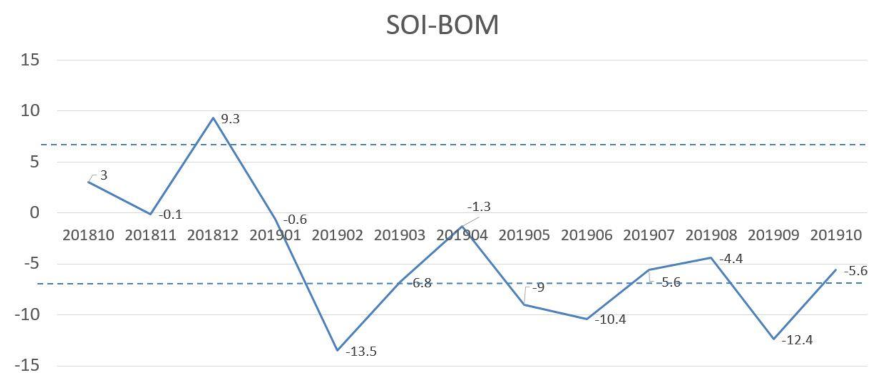


Figure 5.4. Monthly SOI-BOM time series from October 2018 to October 2019

The sea surface temperature anomalies in April 2019 for NINO3, NINO3.4, and NINO4 regions are +0.7°C, +0.7°C, and +0.6°C in sequence, a litter warmer than the 1961-1990 average according to BOM (see Figure 5.8-5.9). Both of BOM and NOAA conjecture that the warmer condition indicates a weak El Niño trend. CropWatch will keep monitoring the situation.

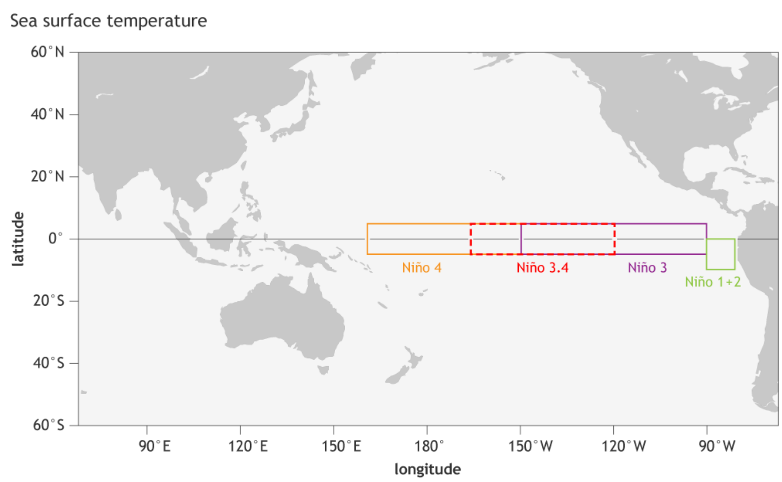


Figure 5.5 Map of NINO Region

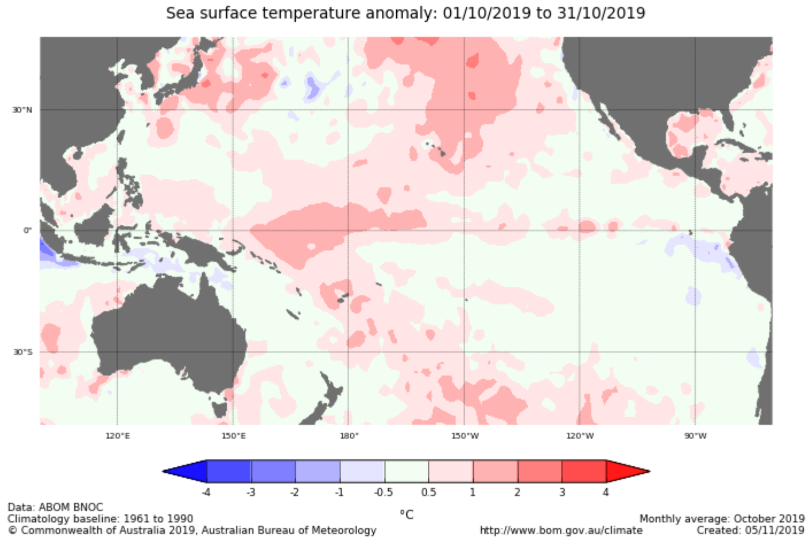


Figure 5.6. July 2019 sea surface temperature departure from the 1961-1990 average

Annex A. Agroclimatic indicators and BIOMSS

Table A.1 July 2019 - Oct 2019 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 5YA dep. (%)
C01	Equatorial central Africa	534	-11	22.4	-0.1	1166	3	592	3
C02	East African highlands	755	-3	18.6	0.0	1185	-1	539	1
C03	Gulf of Guinea	567	-10	27.0	0.0	1189	2	765	2
C04	Horn of Africa	254	26	21.6	0.2	1142	-1	584	1
C05	Madagascar (main)	279	17	19.7	0.4	935	1	481	9
C06	Southwest Madagascar	50	-24	21.8	0.4	993	3	525	27
C07	North Africa-Mediterranean	87	-12	20.3	-0.4	1587	2	622	-2
C08	Sahel	261	-1	30.4	-0.1	1316	1	701	9
C09	Southern Africa	112	0	17.7	0.2	1023	3	338	-3
C10	Western Cape (South Africa)	177	-23	13.3	0.1	693	4	249	4
C11	British Columbia to Colorado	380	17	9.2	-0.5	1345	-2	405	-4
C12	Northern Great Plains	456	33	15.9	-1.3	1303	-3	574	-8
C13	Corn Belt	508	17	15.4	-0.5	1199	-3	516	-3
C14	Cotton Belt to Mexican Nordeste	547	30	23.1	-0.2	1394	0	845	3
C15	Sub-boreal America	302	-16	10.1	-0.4	1189	3	382	0
C16	West Coast (North America)	219	20	15.4	-0.1	1454	-2	473	-2
C17	Sierra Madre	690	-2	19.9	-0.3	1518	4	580	-5
C18	SW U.S. and N. Mexican highlands	182	12	19.7	-0.6	1573	-1	644	4
C19	Northern South and Central America	900	-18	25.0	0.3	1261	3	778	3
C20	Caribbean	461	-27	25.7	0.1	1424	4	945	5
C21	Central-northern Andes	484	-7	12.8	0.2	1050	0	306	2
C22	Nordeste (Brazil)	227	4	24.1	0.3	1084	5	667	7
C23	Central eastern Brazil	287	2	21.4	0.4	984	4	484	4
C24	Amazon	607	-6	24.4	0.4	1086	3	622	4
C25	Central-north Argentina	238	43	15.2	-0.4	654	-9	257	-8
C26	Pampas	433	6	15.0	0.5	585	-6	231	-2
C27	Western Patagonia	639	-23	7.1	0.0	477	3	112	2
C28	Semi-arid Southern Cone	83	-27	10.5	0.4	705	1	161	-4

C29	Caucasus	318	1	15.9	0.2	1464	1	536	3
C30	Pamir area	460	44	16.1	-0.8	1517	-2	516	0
C31	Western Asia	127	50	22.8	-0.3	1541	-1	522	7
C32	Gansu-Xinjiang (China)	221	6	16.7	-0.3	1412	-2	639	-2
C33	Hainan (China)	804	-14	27.3	0.9	1412	10	943	9
C34	Huanghuaihai (China)	172	-50	22.9	0.5	1347	2	745	1
C35	Inner Mongolia (China)	207	-1	16.5	0.3	1399	2	608	2
C36	Loess region (China)	231	-15	17.3	-0.2	1335	-2	610	-1
C37	Lower Yangtze (China)	1096	-1	21.8	-0.1	1062	-2	620	-3
C38	Northeast China	288	-14	15.5	0.1	1295	3	543	1
C39	Qinghai-Tibet (China)	985	-8	10.2	0.3	1175	-1	339	2
C40	Southern China	1192	-13	23.4	0.6	1128	2	682	3
C41	Southwest China	809	-6	18.8	0.1	1011	-7	503	-7
C42	Taiwan (China)	834	-23	25.3	0.5	1192	-3	760	0
C43	East Asia	437	-22	14.2	0.1	1220	4	459	0
C44	Southern Himalayas	831	-17	26.9	0.4	1285	3	726	9
C45	Southern Asia	675	-10	29.9	0.5	1254	3	705	4
C46	Southern Japan and Korea	781	-9	17.7	-0.3	1177	1	548	-2
C47	Southern Mongolia	84	5	15.4	0.0	1547	1	642	9
C48	Punjab to Gujarat	305	-12	32.7	0.0	1426	0	671	11
C49	Maritime Southeast Asia	1145	-9	24.1	0.1	1120	4	719	4
C50	Mainland Southeast Asia	907	-20	27.2	0.6	1258	8	810	6
C51	Eastern Siberia	273	-15	9.9	0.2	1130	2	363	0
C52	Eastern Central Asia	263	5	10.8	-0.1	1306	1	431	0
C53	Northern Australia	258	-31	22.6	-0.2	1028	0	513	-6
C54	Queensland to Victoria	129	-34	13.1	0.6	669	4	217	-1
C55	Nullarbor to Darling	192	-15	13.4	-0.5	649	5	239	2
C56	New Zealand	261	-32	9.0	0.3	460	7	125	7
C57	Boreal Eurasia	264	-22	9.7	-0.1	1086	2	337	0
C58	Ukraine to Ural mountains	281	-10	14.2	0.1	1171	2	482	3
C59	Mediterranean Europe and Turkey	226	10	16.7	-0.4	1454	0	599	2
C60	W. Europe (non Mediterranean)	341	-5	14.5	0.0	1235	2	517	6
C61	Boreal America	282	-20	7.7	1.5	1050	6	295	18
C62	Ural to Altai mountains	252	-7	12.6	-0.8	1223	2	461	-4
C63	Australian desert	86	-27	14.4	0.0	719	6	261	2
C64	Sahara to Afghan deserts	47	89	28.6	-0.1	1606	-1	455	30
C65	Sub-arctic America	113	-7	-3.2	1.0	1218	-1	183	9

Table A.2 July 2019 - Oct 2019 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 5YA Departure (%)
ARG	Argentina	296	20	13.5	0.0	572	-9	206	-5
AUS	Australia	138	-29	13.9	0.4	691	3	231	-1
BGD	Bangladesh	1263	-15	28.8	0.0	1298	4	867	4
BRA	Brazil	387	-2	22.1	0.5	1004	3	524	4
KHM	Cambodia	825	-19	27.1	0.2	1222	7	834	8
CAN	Canada	352	-9	10.4	-0.4	1186	1	382	-1
CHN	China	744	-8	19.6	0.1	1160	-1	591	-1
EGY	Egypt	7	12	23.8	0.3	1573	-1	251	-13
ETH	Ethiopia	733	-5	19.4	0.0	1232	0	569	3
FRA	France	334	-11	14.7	0.0	1295	5	542	9
DEU	Germany	283	-18	14.1	0.2	1221	4	494	8
IND	India	644	-13	30.2	0.4	1293	3	688	7
IDN	Indonesia	1056	-11	24.0	0.0	1094	4	693	3
IRN	Iran	135	63	21.1	-0.2	1609	-1	473	12
KAZ	Kazakhstan	226	3	15.0	-0.7	1342	2	542	-4
MEX	Mexico	523	-13	23.4	0.1	1512	3	695	-2
MMR	Myanmar	1020	-23	26.1	0.8	1225	7	717	2
NGA	Nigeria	545	-12	27.8	0.1	1194	0	727	1
PAK	Pakistan	254	53	28.2	-0.7	1555	-1	737	18
PHL	Philippines	1314	-9	25.5	0.1	1289	4	854	4
POL	Poland	251	-22	15.1	0.6	1199	5	517	11
ROU	Romania	404	8	15.9	-0.1	1298	0	590	2
RUS	Russia	272	-13	13.0	-0.2	1175	2	450	-1
ZAF	South Africa	64	-30	13.3	0.4	908	4	232	-10
THA	Thailand	694	-23	27.5	0.7	1257	8	836	8
TUR	Turkey	266	17	15.9	-0.2	1479	0	540	0
GBR	United Kingdom	349	-10	11.3	-0.1	976	2	318	2
UKR	Ukraine	338	15	16.4	0.3	1243	1	584	6
USA	United States	481	29	18.3	-0.5	1335	-2	625	-1
UZB	Uzbekistan	208	105	22.4	-0.5	1522	-3	576	3
VNM	Vietnam	926	-18	25.6	0.6	1253	7	822	8
AFG	Afghanistan	248	67	18.6	-0.6	1578	-2	405	8
AGO	Angola	192	15	19.7	0.1	1218	1	326	9
BLR	Belarus	305	-3	14.6	0.6	1155	5	478	9
HUN	Hungary	351	35	17.1	-0.3	1289	-1	628	1
ITA	Italy	405	13	17.0	-0.3	1366	-3	644	4
KEN	Kenya	584	5	19.7	0.2	1115	0	572	0
LKA	Sri_Lanka	689	-20	27.2	0.6	1255	0	821	1
MAR	Morocco	74	-16	19.4	-0.9	1634	3	551	-13
MNG	Mongolia	291	28	10.4	-0.2	1366	-1	430	-3
MOZ	Mozambique	135	-2	19.9	-0.3	965	1	492	-1
ZMB	Zambia	109	69	18.3	0.1	1138	1	319	-10

*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 July and October.*

Table A.3 Argentina, July - Oct 2019 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 5YA Departure (%)
Buenos Aires	177	-19	11.9	0.4	568	1	188	5
Chaco	462	51	16.1	-0.6	473	-24	202	-23
Cordoba	130	7	12.8	-0.3	646	-5	222	0
Corrientes	645	38	16.1	0.3	479	-19	207	-17
Entre Rios	451	31	13.9	0.0	508	-13	195	-8
La Pampa	77	-43	11.9	0.4	607	2	205	15
Misiones	621	-1	17.1	0.8	602	-7	274	-2
Santiago Del Estero	262	60	15.1	-0.7	575	-15	220	-16
San Luis	64	-29	11.6	0.1	699	2	227	15
Salta	268	47	14.0	-0.2	723	-10	257	-9
Santa Fe	348	41	14.3	-0.4	511	-17	197	-14
Tucuman	150	41	12.5	0.4	795	-6	268	4

Table A.4 Australia, July - Oct 2019 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 5YA Departure (%)
New South Wales	89	-49	12.8	0.7	710	6	207	-6
South Australia	166	-18	13.8	0.3	564	3	223	8
Victoria	228	-13	11.1	0.3	483	3	162	4
W. Australia	181	-16	14.2	-0.5	683	5	241	1

Table A.5 Brazil, July - Oct 20192019 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 5YA Departure (%)
Ceara	421	8	25.0	-0.2	1166	2	771	2
Goias	228	16	21.7	0.3	1088	3	440	-4
Mato Grosso Do Sul	237	-12	21.1	0.4	880	5	449	6
Mato Grosso	247	3	23.7	0.4	1100	3	473	-1
Minas Gerais	225	4	19.4	0.5	957	5	471	8
Parana	421	-21	17.4	0.9	760	3	345	9
Rio Grande Do Sul	619	7	15.9	1.1	588	-6	248	-2
Santa Catarina	536	-9	15.6	1.2	658	-2	272	4
Sao Paulo	322	1	19.1	0.6	863	5	400	4

Table A.6 Canada, July - Oct 2019 2019 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 5YA Departure (%)
Alberta	304	-13	10.8	-0.3	1249	0	409	-4
Manitoba	272	-26	11.9	-0.1	1277	8	459	6
Saskatchewan	252	-24	11.8	-0.2	1269	4	447	0

Table A.7 India, July - Oct 2019 2019 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 5YA Departure (%)
Andhra Pradesh	535	19	31.3	0.4	1213	2	737	8
Assam	2156	-1	25.1	-0.4	1095	-1	720	-1
Bihar	711	3	32.4	0.4	1343	1	873	17
Chhattisgarh	592	-12	30.9	0.4	1239	2	715	8
Daman and Diu	875	-27	29.5	0.5	1439	1	375	-26
Delhi	102	-61	33.7	0.3	1475	2	918	22
Gujarat	460	-25	31.5	0.3	1390	2	429	-7
Goa	1980	-14	27.1	0.0	1332	2	685	1
Himachal Pradesh	497	-18	19.0	-0.6	1440	-1	619	7
Haryana	104	-52	33.6	0.3	1480	2	822	12
Jharkhand	549	-15	30.9	0.4	1293	3	812	19
Kerala	1499	-9	26.3	0.5	1226	5	817	5
Karnataka	518	-26	27.4	0.8	1147	4	711	7
Meghalaya	1930	-15	24.4	0.4	1135	7	722	9
Maharashtra	711	-5	30.1	0.6	1298	6	566	-5
Manipur	1313	-27	21.9	0.1	1174	6	683	7
Madhya Pradesh	451	-26	32.0	0.8	1327	4	569	3
Mizoram	1234	-15	23.9	0.2	1283	5	800	6
Nagaland	1527	-24	20.7	-0.3	1145	4	622	3
Orissa	691	-7	30.4	0.2	1211	0	790	11
Puducherry	143	-57	31.5	0.4	1344	4	740	-8
Punjab	279	14	32.4	-0.6	1450	1	892	11
Rajasthan	221	-20	33.6	0.4	1400	0	646	13
Sikkim	546	-19	15.5	-0.1	1374	4	509	8
Tamil Nadu	307	-21	29.7	0.7	1246	3	777	2
Tripura	1099	-32	27.6	0.1	1334	9	911	10
Uttarakhand	299	-48	22.7	0.1	1481	5	645	7
Uttar Pradesh	350	-27	33.7	0.6	1404	3	782	14
West Bengal	307	-21	29.7	0.7	1246	3	777	2

Table A.8 Kazakhstan, July - Oct 2019 2019 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 5YA Departure (%)
Akmolinskaya	187	0	13.9	-1.2	1296	4	453	-15
Karagandinskaya	177	1	13.5	-1.0	1383	4	477	-11
Kustanayskaya	161	-21	15.2	0.0	1279	4	565	4
Pavlodarskaya	194	-5	13.6	-1.7	1286	3	496	-8
Severo kazachstanskaya	233	-7	12.7	-1.1	1207	4	437	-7
Vostochno kazachstanskaya	256	-3	13.1	-1.0	1397	1	501	-10
Zapadno kazachstanskaya	172	4	18.0	0.0	1361	4	682	7

Table A.9 Russia, July - Oct 2019 2019 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 5YA Departure (%)
Bashkortostan Rep.	286	-15	12.4	-0.4	1175	3	432	-3
Chelyabinskaya Oblast	213	-26	12.9	-0.1	1181	4	462	3
Gorodovikovsk	301	12	19.1	0.5	1278	-4	681	2
Krasnodarskiy Kray	295	-19	14.3	0.0	1246	2	499	2
Kurganskaya Oblast	204	-22	12.6	-0.6	1133	2	441	1
Kirovskaya Oblast	230	-30	11.0	-0.9	980	-6	333	-15
Kurskaya Oblast	324	8	15.0	0.4	1218	5	520	7
Lipetskaya Oblast	249	-19	14.8	0.3	1203	3	502	4
Mordoviya Rep.	242	-25	13.6	0.2	1198	6	464	3
Novosibirskaya Oblast	249	-10	11.3	-1.2	1125	1	400	-6
Nizhegorodskaya O.	256	-21	12.9	-0.1	1102	1	415	-3
Orenburgskaya Oblast	174	-32	15.3	0.1	1294	5	573	5
Omskaya Oblast	289	8	11.4	-1.2	1104	2	400	-4
Permskaya Oblast	334	2	10.5	-1.1	964	-7	319	-17
Penzenskaya Oblast	232	-24	14.2	0.3	1211	6	490	5
Rostovskaya Oblast	280	3	18.0	0.3	1287	-1	645	2
Ryazanskaya Oblast	270	-15	14.1	0.0	1148	2	462	0
Stavropolskiy Kray	283	-32	18.3	0.9	1310	0	672	7
Sverdlovskaya Oblast	222	-30	11.3	-0.5	1061	2	375	-2
Samarskaya Oblast	232	-24	14.5	-0.1	1203	2	496	-2
Saratovskaya Oblast	207	-17	16.0	0.2	1287	4	587	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 5YA Departure (%)
Tambovskaya Oblast	200	-33	15.0	0.4	1227	3	523	5
Tyumenskaya Oblast	292	8	11.5	-0.8	1078	3	393	-2
Tatarstan Rep.	235	-27	12.7	-0.6	1113	0	415	-5
Ulyanovskaya Oblast	209	-34	13.9	0.0	1186	4	472	1
Udmurtiya Rep.	271	-13	11.2	-1.0	1009	-4	348	-14
Volgogradskaya O.	248	14	17.3	0.2	1285	1	627	5
Voronezhskaya Oblast	305	3	15.8	0.3	1251	3	558	5

Table A.10 United States, July - Oct 2019 2019 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 5YA Departure (%)
Arkansas	632	53	22.0	-0.7	1345	-2	795	-1
California	142	45	17.1	-0.3	1575	-3	475	-2
Idaho	302	28	11.6	-0.6	1437	-2	513	0
Indiana	570	25	18.1	-0.5	1227	-6	626	-7
Illinois	618	46	18.3	-0.9	1242	-6	640	-8
Iowa	565	40	16.8	-1.2	1186	-9	575	-13
Kansas	493	50	19.9	-1.7	1397	-1	750	-6
Michigan	447	16	13.2	-1.0	1158	-6	463	-8
Minnesota	512	30	13.8	-1.1	1168	-5	479	-10
Missouri	554	45	19.8	-0.9	1334	-2	724	-4
Montana	422	32	11.6	-1.3	1319	-4	478	-11
Nebraska	536	66	16.7	-2.1	1327	-5	629	-13
North Dakota	377	7	13.7	-1.0	1247	-2	506	-8
Ohio	471	8	17.7	0.1	1240	-3	619	-2
Oklahoma	503	48	21.8	-1.6	1383	-2	795	-3
Oregon	288	20	12.7	-0.1	1353	-1	487	0
South Dakota	619	89	14.7	-2.3	1235	-9	540	-17
Texas	412	31	24.3	-0.8	1414	-1	882	3
Washington	219	-12	13.7	0.1	1332	-1	532	6
Wisconsin	493	21	13.8	-0.9	1169	-5	487	-7

Table A.11 China, July - Oct 2019 2019 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 5YA Departure (%)
Anhui	450	-40	22.1	0.0	1209	4	672	0
Chongqing	708	-11	20.0	-0.2	1009	-8	548	-10
Fujian	1412	5	21.4	0.1	978	-6	571	-6
Gansu	323	-7	13.8	-0.2	1286	-2	512	-2
Guangdong	1503	-7	24.6	0.4	1086	-2	711	0
Guangxi	1433	0	23.7	0.4	1024	-5	652	-4
Guizhou	1054	1	19.1	0.2	871	-10	449	-10
Hebei	175	-25	20.1	0.3	1398	1	676	-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 5YA Departure (%)
Heilongjiang	335	9	14.8	-0.2	1246	1	508	-3
Henan	226	-43	22.9	0.3	1292	1	735	2
Hubei	511	-34	20.8	-0.2	1158	1	647	0
Hunan	1122	5	21.4	-0.3	1021	-4	594	-5
Jiangsu	305	-53	21.9	0.0	1232	4	669	-1
Jiangxi	1388	11	22.2	-0.1	1023	-3	610	-3
Jilin	266	-29	16.3	0.5	1350	6	603	9
Liaoning	183	-47	18.0	0.7	1367	6	653	8
Inner Mongolia	218	5	15.7	0.2	1375	2	578	1
Ningxia	173	9	16.9	-0.4	1382	-2	644	-3
Shaanxi	369	-11	17.9	-0.4	1223	-6	604	-6
Shandong	163	-52	22.3	0.5	1362	2	759	3
Shanxi	209	-13	17.3	-0.1	1374	0	631	2
Sichuan	778	-3	17.2	-0.1	1034	-10	463	-11
Yunnan	819	-12	18.9	1.0	1129	6	525	7
Zhejiang	1032	0	20.3	-0.5	1012	-4	548	-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.com.cn**.**

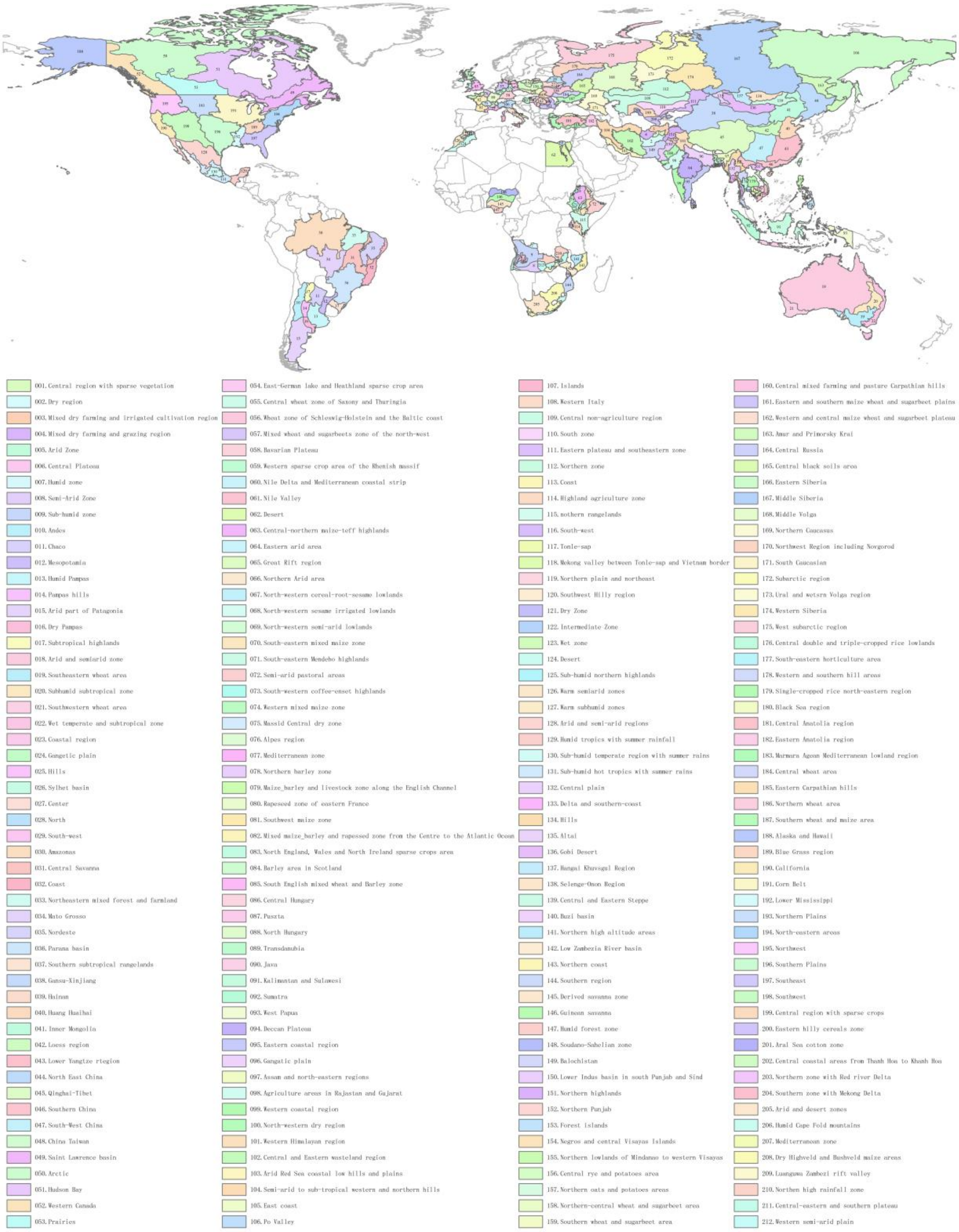
Agroecological zones for 42 key countries

Overview

212 agroecological zones for the 42 key countries across the globe

Description

42 key agricultural countries are divided into 212 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 42 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/ Ground and 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 (2014-2018), 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 (2014-2018), 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, 42 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 (2014-2018), 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 (2004-2018), 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 /Ground	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			
and satellite		pixels, weighted by the production potential.	the recent fifteen-year average (2004-18), 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 /Ground	°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 (2004-18), 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.

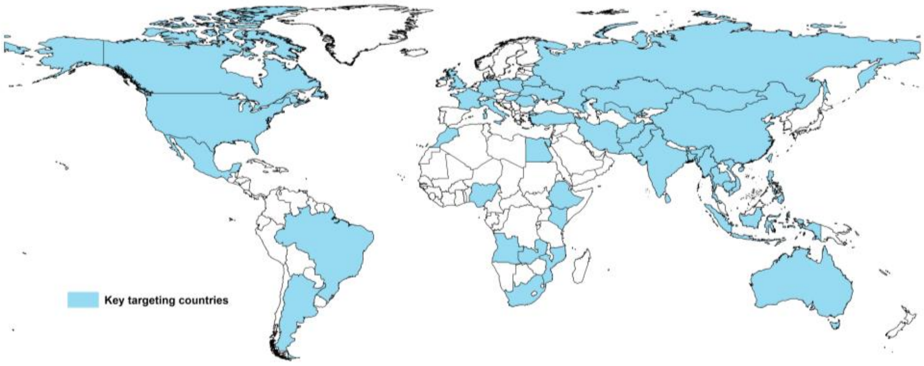
Note: Type is either "Weather" or "Crop"; source specifies if the indicator is obtained from ground data, satellite readings, or a combination; units: in the case of ratios, no unit is used; scale is either pixels or large scale CropWatch spatial units (CWSU). Many indicators are computed for pixels but represented in the CropWatch bulletin at the CWSU scale.

CropWatch spatial units (CWSU)

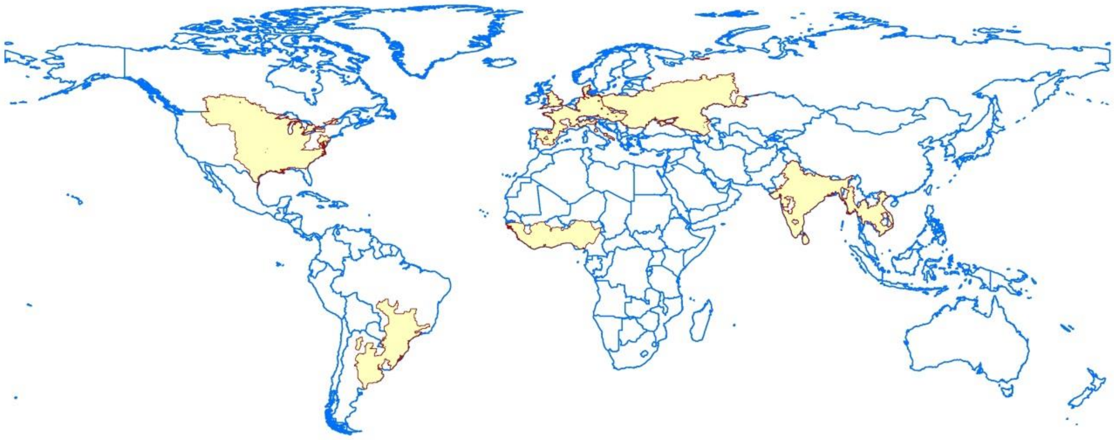
CropWatch analyses are applied to four kinds of CropWatch spatial units (CWSU): Countries, China, Major Production Zones (MPZ), and global crop Monitoring and Reporting Units (MRU). The tables below summarize the key aspects of each spatial unit and show their relation to each other. For more details 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.

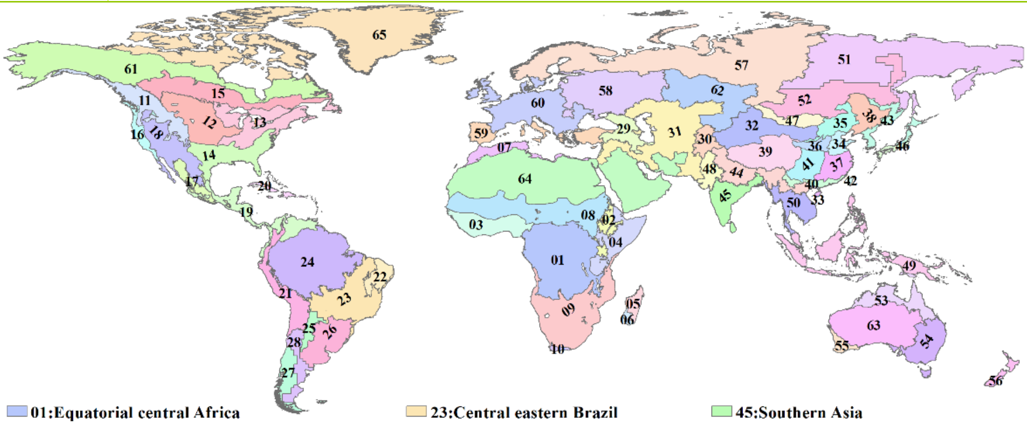
Countries (and first-level administrative districts, e.g., states and provinces)	
Overview	*Description*
43 countries to represent main producers/exporters and other key countries.	CropWatch monitored countries together represent more than 80% of the production of maize, rice, wheat and soybean, as well 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.com.cn**.



Major Production Zones (MPZ)	
Overview	*Description*
Seven 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.com.cn** .



Production estimation methodology

The main concept of the CropWatch methodology for estimating production is the calculation of current year production based on information about last year's production and the variations in crop yield and cultivated area compared with the previous year. The equation for production estimation is as follows:

$$Production_i = Production_{i-1} * (1 + \Delta Yield_i) * (1 + \Delta Area_i)$$

Where i is the current year, $\Delta Yield_i$ and $\Delta Area_i$ are the variations in crop yield and cultivated area compared with the previous year; the values of $\Delta Yield_i$ and $\Delta Area_i$ can be above or below zero.

For the 42 countries monitored by CropWatch, yield variation for each crop is calibrated against NDVI time series, using the following equation:

$$\Delta Yield_i = f(NDVI_i, NDVI_{i-1})$$

Where $NDVI_i$ and $NDVI_{i-1}$ are taken from the time series of the spatial average of NDVI over the crop specific mask for the current year and the previous year. For NDVI values that correspond to periods after the current monitoring period, average NDVI values of the previous five years are used as an average expectation. $\Delta Yield_i$ is calculated by regression against average or peak NDVI (whichever yields the best regression), considering the crop phenology of each crop for each individual country.

A different method is used for areas. For China, CropWatch combines remote-sensing based estimates of the crop planting proportion (cropped area to arable land) with a crop type proportion (specific type area to total cropped area). The planting proportion is estimated based on an unsupervised classification of high resolution satellite images from HJ-1 CCD and GF-1 images. The crop-type proportion for China is obtained by the GVG instrument from field transects. The area of a specific crop is computed by multiplying farmland area, planting proportion, and crop-type proportion of the crop.

To estimate crop area for wheat, soybean, maize, and rice outside China, CropWatch relies on the regression of crop area against cropped arable land fraction of each individual country (paying due attention to phenology):

$$Area_i = a + b * CALF_i$$

where a and b are the coefficients generated by linear regression with area from FAOSTAT or national sources and CALF the Cropped Arable Land Fraction from CropWatch estimates. $\Delta Area_i$ can then be calculated from the area of current and the previous years.

The production for "other countries" (outside the 31 CropWatch monitored countries) was estimated as the linear trend projection for 2017 of aggregated FAOSTAT data (using aggregated world production minus the sum of production by the 31 CropWatch monitored countries).

Data notes and bibliography

Notes

[1] Although Yemen is not part of the Horn of Africa (HoA), it is geographically close and maintains close links to the region. The countries of the HoA are grouped in the regional development association IGAD (Inter-governmental Authority on Development, with headquarters in Djibouti). IGAD has recently established the IGAD Drought Disaster Resilience and Sustainability Initiative (IDDRSI, 2016).

[2] Under-investment in agriculture was one of the main drivers of the 2008 crisis of high food prices (Mittal 2009, ATV 2010), even if several other local and global triggering factors can be identified (Evans 2008).

[3] Previous large humanitarian crises were those of the West African Sahel (from the early sixties to the mid eighties), the Ethiopian droughts of the mid-eighties, the Indian Ocean tsunami of 2004, several large earthquakes (for example, Haiti, 2010), and floods and medical emergencies (such as the West African Ebola outbreak, 2013-16).

[4] http://www.agrhymet.ne/eng/index.html

[5] http://www.icpac.net/

[6] Belg is harvested before or during July.

[7] "Purely man-made disasters" is, however, a concept that deserves a closer look, as many wars and insurgencies are partially triggered by shortages of natural resources, including land. As such, most "man-made disasters" do have an environmental component.

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Acknowledgments

This bulletin is produced by the CropWatch research team at the Institute of Remote Sensing and Digital Earth (RADI), at the Chinese Academy of Sciences in Beijing, China. The team gratefully acknowledges the active support of a range of organizations and individuals, both in China and elsewhere.

Financial and programmatic support is provided by the Ministry of Science and Technology of the People's Republic of China, National Natural Science Foundation of China, and the Chinese Academy of Sciences. We specifically would like to acknowledge the financial support through The National Key Research and Development Program of China, Grant No:2016YFA0600300; National Natural Science Foundation, Grant No: 41561144013; the Strategic Priority Research Program of Chinese Academy of Sciences Grant No: XDA1903020.

The following contributions by national organizations and individuals are greatly appreciated: China Center for Resources Satellite Data and Application for providing the HJ-1 CCD data; China Meteorological Satellite Center for providing FY-2/3 data; China Meteorological Data Sharing Service System for providing the agro-meteorological data; and Chia Tai Group (China) for providing GVG (GPS, Video, and GIS) field sampling data.

The following contributions by international organizations and individuals are also recognized: François Kayitakire at FOODSEC/JRC for making available and allowing use of their crop masks; Ferdinando Urbano also at FOODSEC/JRC for his help with data; Herman Eerens, Dominique Haesen, and Antoine Royer at VITO, for providing the JRC/MARS SPIRITS software, Spot Vegetation imagery and growing season masks, together with generous advice; Patrizia Monteduro and Pasquale Steduto for providing technical details on GeoNetwork products; and IIASA and Steffen Fritz for their land use map.

Online resources

Online Resources posted on **www.cropwatch.com.cn** , **http://cloud.cropwatch.com.cn/**

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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:

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