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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.

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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 for April-July from 2011 to 2015; one of the standard reference periods.
15YA	Fifteen-year average, the average for the four-month period from April-July from 2001 to 2015; one of the standard reference periods and typically referred to as “average.”
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
OCHA	UN Office for the Coordination of Humanitarian Affairs
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 April 1 and July 31 2016—in this report referred to as the “April-July” period. It is the 102th bulletin produced by the CropWatch group at the Institute of Remote Sensing and Digital Earth (RADI) at the Chinese Academy of Sciences, Beijing.

CropWatch analyses are based mostly on several standard as well as new ground-based and remote sensing indicators, following a hierarchical approach. The analyses cover large global zones; major producing countries of maize, rice, wheat, and soybean; and detailed assessments of Chinese regions. 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, and RADPAR, which describe weather factors; and (ii) agronomic indicators—BIOMSS, VHIn, CALF, and VCIx, describing crop condition and development. 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. For more details on the CropWatch indicators and spatial units used for the analysis, please see the quick reference guide in Annex C, as well as online resources and publications posted at www.cropwatch.com.cn.

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	30 key countries (main producers and exporters)	As above plus NDVI and GVG survey
Chapter 4	China	As above plus high resolution images
Chapter 5	Special topics: Production outlook, drought in Morocco, agriculture in Southwest Asia, and an update on El Niño.	
Online Resources	www.cropwatch.com.cn	

Newsletter and online resources

The bulletin is released quarterly in both English and Chinese. To sign up for the mailing list, please e-mail cropwatch@radi.ac.cn or visit CropWatch online at www.cropwatch.com.cn. Visit the CropWatch Website for additional resources and background materials about methodology, country agricultural profiles, and country long-term trends.

Executive summary

The current CropWatch bulletin is based mainly on remotely sensed data. It is prepared by a team at the Chinese Academy of Sciences (CAS) and focuses on crops that have already been harvested in 2016 as well as those that were growing between April and July, to be harvested later this year. The bulletin covers prevailing weather conditions, resulting crop condition, size of cultivated areas, and global food production, paying special attention to China and the thirty major agricultural countries. Together, they make up at least 80% of the production and exports of maize, rice, wheat, and soybean. The bulletin naturally has specific chapters about China and, starting with this bulletin, includes a section on Chinese trade and prices.

Global agroclimatic conditions

For this reporting period, a rather direct link exists between the performance of crops and some large scale (continental) patterns of agroclimatic anomalies, in particular abundant and sometimes excessive precipitation and drought.

Wet areas essentially include the following four:

- *"Sahel to Central Asia."* The largest positive rainfall anomalies occur in this area, generally implying a timely start of the rainy season from Mauritania to northern Sudan. Abundant rainfall also affected many areas where crop agriculture often plays a minor role in the economy compared to livestock and range-lands, including the Near-East and Central Asia up to Tajikistan, as well as parts of China (Xizang +102% and Xinjiang +186%). Much of the area had below average sunshine of -5% to -10%, with moderate temperature anomalies. Two countries, Ethiopia and Egypt, deserve specific mentioning. The first suffered severe drought conditions last year, while this season, of which the main crops are still to be harvested, underwent a slight rainfall deficit (-5%). According to satellite indices, however, cultivated land nevertheless increased over previous seasons (+5 percentage points) and no specific concerns exist about the agricultural season. In Egypt, almost all crops are irrigated, but CropWatch detected a 9 percentage point drop in summer crop area.
- *Eastern West Asia and South Asia.* Here, abundant rainfall in particular has affected India and Pakistan, leading to decreases in the fraction of cropped arable land of 12 and 8 percentage points respectively, compared to the recent averages. Both countries are characterized by marked spatial variability of crop condition in 2016.
- *Southeastern South America.* Large rainfall anomalies in South America occurred in important agricultural areas of Argentina and Uruguay, damaging summer crops and delaying planting but providing good soil moisture for winter crops, especially wheat.
- *Parts of North America.* In North America, wet conditions prevailed mainly from Texas to North Dakota and neighboring states.

Dry conditions affected some other areas in North America (including parts of the eastern Corn Belt), but mostly southern equatorial Brazil, where temperature and sunshine and the resulting crop water demand were mostly above average, resulting in a nationwide drop in cultivated land of 9 percentage points compared to average. Other drought affected countries include those in the western Mediterranean (Morocco, parts of Algeria, and Spain) and southern Africa. In eastern Asia, the driest region was centered on the Korean Peninsula and extended west as far as the Primorsky Krai in Russia.

2016 global crop production estimates

CropWatch currently estimates the production of 2016 to depart less than 1% from the production of 2015 for wheat (-0.1%), and soybean (+0.1%). For maize, a 1.3% increase is foreseen, while for rice a marked drop of -3.8% is expected mainly as a result of adverse conditions in India. The situation is slightly more favorable when the top five exporters are considered: Maize, wheat, and soybean supply are up by close to or more than 1% (or 0.8%, 2.0%, and 1.0%, respectively). For rice, the drop is 8%, which may result in some tension on international markets. Specific observations for each grain are as follows:

- *Maize.* CropWatch foresees large differences among the performances of national maize productions. The large drops affect South Africa (-32%), India (-13%), and Brazil (-12%). Positive departures worth mentioning include Kazakhstan (+5%) and Uzbekistan (+7%), Ukraine and neighboring Poland (9% and 7%, respectively), as well as Iran (+8%) and Ethiopia (+19%).
- *Rice.* Major rice producers from west to Southeast Asia suffered a production loss compared with the previous season, especially India (-13%), Vietnam (-8%), Thailand (-7%), Cambodia (-6%), Bangladesh (-5%), and Pakistan (-2%). Myanmar (+2%) and the United States (+4%) are worth mentioning among the producers of international relevance.
- *Wheat.* Largest decreases in wheat production are projected for Turkey (-16%) and India (-6%), as well as in Argentina and Brazil (-4% each). Large positive values among the major producers are those of Canada (+11%), Romania (+7%), and Australia (5%).
- *Soybean.* Due to changes in policy, China is forecast to increase production by 1%, the first inter-annual increase in more than a decade. Russia and Ukraine are both consolidating their role as significant soybean producers with respectively 3% and 2% production growths. Among the leading producers, Argentina is put at -1%, due to large excess precipitation, while Brazil and the United States are both estimated to increase their output over 2015, by 2% and 1%, respectively. Significant drops that may affect international markets include, again, India (-11%).

Altogether, CropWatch puts the Indian production deficits at about 1.5 million tons for soybean and respectively 2, 11, and 5 million tons for maize, rice, and wheat.

China crop production estimates

The current CropWatch estimates of 2016 cereal and soybean production in China are about 200 million tons for maize and rice (202.0 and 200.3), 118.6 million tons for wheat, and 13.1 million tons for soybeans. This is between 4% (soybean) and 28% (rice) of world production, with intermediate values for maize (20%) and wheat (16%). Compared with the previous year, this represents a production increase by 0.6% for maize (equivalent to 1.2 million tons) and for soybeans (equivalent to 127 thousand tons), while representing a drop of 1% for both wheat and rice, corresponding to absolute volumes of 1.1 million tons and 2.0 million tons, respectively. Projected import increases over 2015 are currently at 3.8% for maize, 36.1% for rice, 15.6% for wheat, and 6.4% for soybean.

At the regional and provincial scales, variations in production estimates result from a combination of environmental factors, policy changes, some long-term trends such as the conversion of double rice cropping to single rice cropping, as well as pests and diseases—the latter especially on winter wheat for the late stage of the growing season. Severe attacks of powdery mildew have been reported in the Loess region on more than a quarter of fields, as well as aphids on more than 20% of wheat in Huanghuaihai and Southwest China. Significant production variations include maize production in Hebei (+7%, both yield and area increased), Inner Mongolia (-8%, due to reduced planted area), Liaoning (+8%, a recovery from last year's severe drought), and Shandong (+6%, both yield and area increased). Rice production in Jilin, Liaoning, and Yunnan also present significant change (+12%, -10%, and 6%, respectively).

Chapter 1. Global agroclimatic patterns

Chapter 1 describes the CropWatch agroclimatic indicators (CWAIs) for rainfall (RAIN), temperature (TEMP), and radiation (RADPAR), along with the agronomic indicator for potential biomass (BIOMSS) for sixty-five global Monitoring and Reporting Units (MRU). Rainfall, temperature, and radiation indicators are compared to their average value for the same period over the last fifteen years (called the "average"), while BIOMSS is compared to the indicator's average of the recent five years. Indicator values for all MRUs are included in Annex A table A.1. For more information about the MRUs and indicators, please see Annex C and online CropWatch resources at www.cropwatch.com.cn.

1.1 Overview

The current report period was mostly characterized by dry conditions over northern South America, southern Africa, and eastern Asia. Wetter than average conditions prevailed over much of Asia, in particular central Asia (figure 1.1). The global patterns of rainfall anomalies that largely persisted over the previous two CropWatch reporting periods (that is, roughly from October 2015) have now started to fade away, although some features are still noticeable from April to June 2016; these are mentioned below.

For temperature (figure 1.2), a very consistent pattern exists of above average temperature equatorial areas (increasing further in the southern hemisphere) and areas in the northern Mediterranean. Slightly cooler than average conditions prevailed in western North America, the Sahara and its southern border, and parts of eastern Asia. Meanwhile, below average radiation very systematically affects most of North America, Eurasia, maritime Southeast Asia and Oceania, as well as the south of South America (figure 1.3). Finally, BIOMSS (figure 1.4) shows a very large area of favorable conditions stretching from the West-African Sahel to eastern Asia. Unfavorable expectations are assigned to northern South America, the Mediterranean and northern Africa, southern Africa, and the United States Corn Belt. Because the BIOMSS indicator, like all CropWatch agronomic indicators but unlike its agroclimatic indicators, uses the last 5-year period as reference, BIOMSS production potential patterns are not necessarily directly related to the spatial anomaly distribution described for RAIN, TEMP, and RADPAR.

The text below is mostly organized around rainfall patterns.

Figure 1.1. Global map of April-July 2016 rainfall anomaly (as indicated by the RAIN indicator) by MRU, departure from 15YA (percentage)

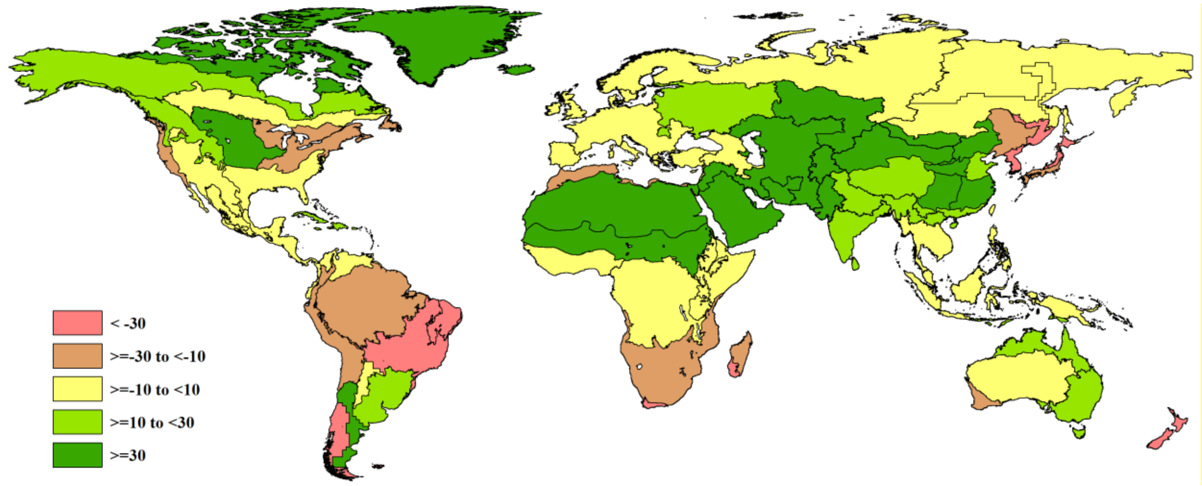


Figure 1.2. Global map of April-July 2016 temperature anomaly (as indicated by the TEMP indicator) by MRU, departure from 15YA (degrees Celsius)

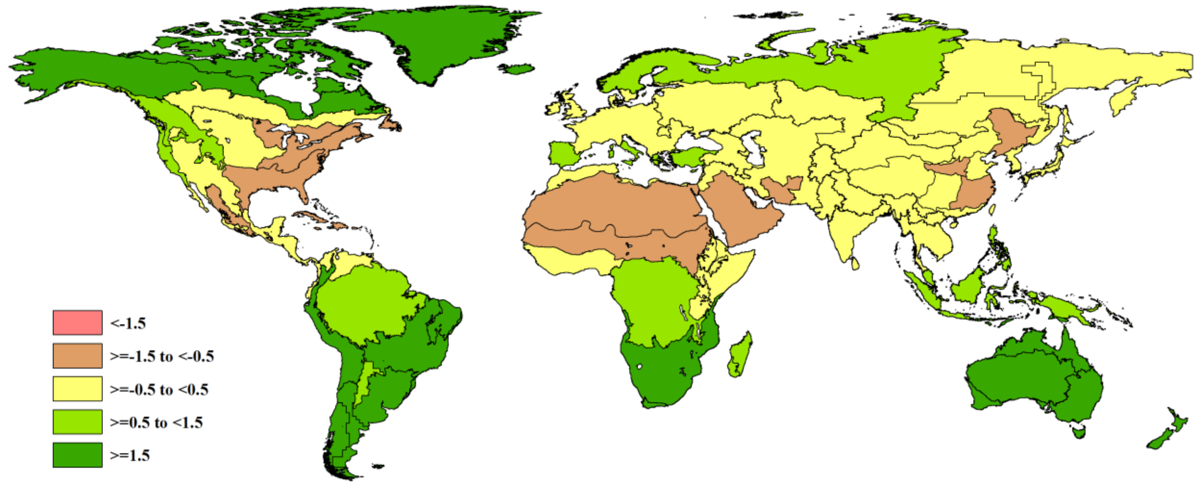


Figure 1.3. Global map of April-July 2016 PAR anomaly (as indicated by the RADPAR indicator) by MRU, departure from 15YA (percentage)

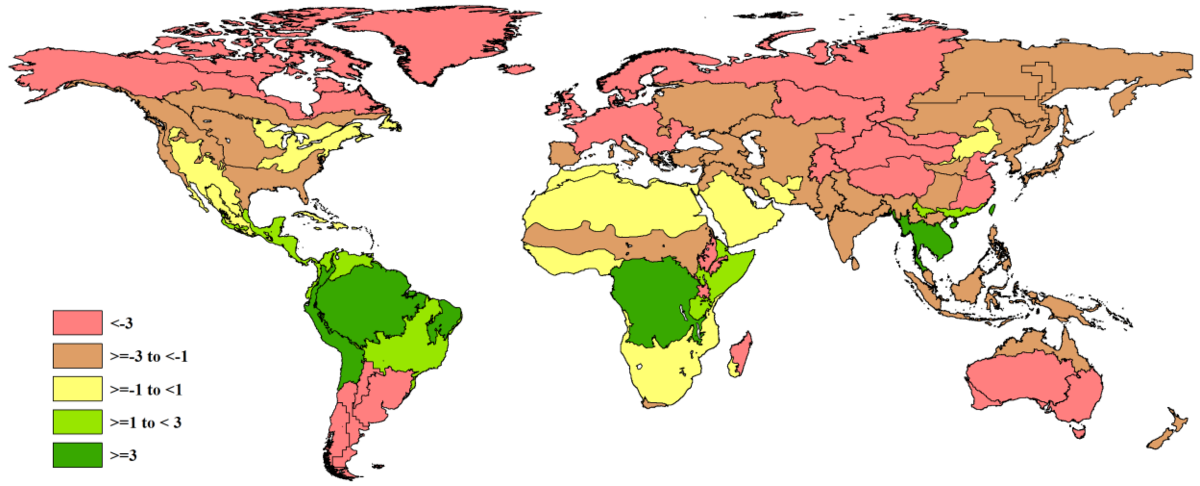
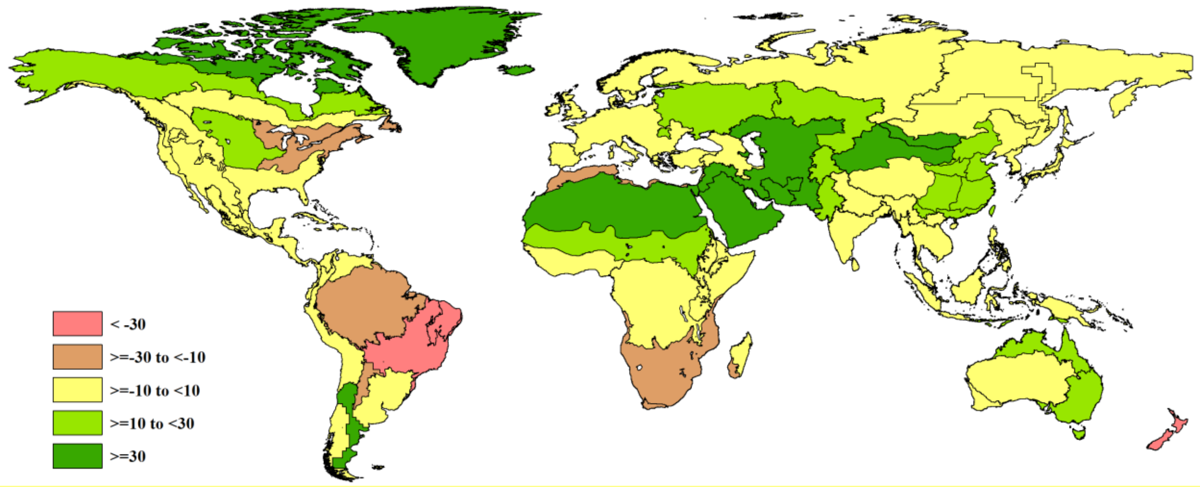


Figure 1.4. Global map of April-July 2016 biomass accumulation (BIOMSS) by MRU, departure from 5YA (percentage)



Northern South America: dry

The areas mostly affected by dry conditions include in particular the Brazilian Nordeste (MRU-22) and central eastern Brazil (MRU-23) with rainfall (RAIN) deficits of 57% and 31%, respectively, compared to average. Both areas were at the late stages of their rainfed growing season. The two MRUs are also characterized by significant positive temperature anomalies of 2.1°C and 1.7°C, respectively, which is expected to result in biomass production drops in excess of 40%. The adjacent Amazon (MRU-24, -11% precipitation; temperature anomaly of +1.3°C) and the central-northern Andes (MRU-21, -18% rainfall, -1.9°C) are less important agricultural areas; they normally record higher rainfall and the deficits were less severe. Expected biomass drops are close to 10%.

Southern Africa: dry and hot

In southern Africa (MRU-09), the largest area underwent the main harvest of maize at the beginning of the reporting period under relatively dry conditions (-13% rainfall) after the growing season (planting from October-November) had started under a very unfavorable water supply. South Africa's Western Cape area (MRU-10), where the season is Mediterranean and peaks around the end of the reporting period, suffered a stronger precipitation deficit (-46%, recording only 83 mm on average). Temperature anomalies vary from +2°C to +3°C. For the third period in a row (that is, since October 2015), Madagascar (MRU-05) witnessed a drop of precipitation of 29% over most of the island, while Madagascar's southwest (MRU-06), which is the driest part of the country, recorded only 34 mm (RAIN, -56%) and also the third consecutive dry period. Rainfall anomalies are the only noteworthy anomalies on the island.

Eastern Asia and North America: dry

With the exception of northeast China (MRU-38, -11% precipitation over the reporting period), much of the area also had dry conditions during early winter, including East Asia (MRU-43, -32% rainfall) and South Korea and Japan (MRU-46, -15%). Temperature and radiation anomalies were moderate, and so were the drops in biomass potential, which did not reach 10%.

In North America, the Corn Belt (MRU-13) recorded only 383 mm of rainfall on average (RAIN, -12%), while rainfall dropped 22% to 93 mm along the West Coast (MRU-16). Only minor or insignificant anomalies of temperature and radiation were recorded.

Other dry areas

The remaining areas all were in their third successive period of rainfall deficit. The effect was particularly marked in New Zealand (MRU-56, -63% with only a 122 mm measure, and a record temperature anomaly of 4.3°C at the beginning of the winter season) and Mediterranean North Africa (MRU-07) where 79 mm constitute a water supply loss of 14% after more severe losses throughout the growing season from late 2015. In Western Patagonia (MRU-27) in South America, the 44% rainfall deficit marks a poor start of the winter season. While MRU-7 had an about average temperature and radiation, MRU-27 recorded a marked positive temperature departure of 3.1°C.

Sahel to Central Asia and west Asia: wet

As mentioned in previous analyses, this large contiguous area has recorded exceptionally favorable conditions over the last 9 months. It includes many Asian range-lands, which have thus benefited from unusually favorable vegetation conditions during winter in the warmer areas, while in spring accumulated soil moisture has favored the development of grasses. In the west African Sahel (MRU-08), the higher than expected water supply (RAIN, +39%) has ensured an early or at least timely start of the cropping season and ensured favorable development of the crops to be harvested in the coming months, unless the higher than average temperature (TEMP, +1.8°C) has resulted in above-average crop water requirements in spite of average sunshine. In the Sahara to Afghan deserts (MRU-64) the recorded average amounts (70 mm or +68%) constitute a sizeable increase of available moisture. In line with the CropWatch TEMP indicator (-0.6°C) and average sunshine conditions, a significant biomass increase (+40%) is conjectured. The combination of factors may have resulted in favorable breeding conditions for migratory pest or, at the very least, improved the greening of grasslands.

In west Asian highlands (Ural to Altai Mountains, MRU-62) moderately above average rainfall was recorded (+33%), accompanied by a minor drop in radiation (RADPAR, -6%). The mentioned rainfall anomalies were exceeded by far in western China (Gansu-Xinjiang MRU-32; RAIN, +143%) and in the southern Mongolian region (MRU-47, +170% equivalent to 430 mm), where a marked biomass increase (>36%) is expected. Lower excesses were noted in Qinghai-Tibet (MRU-39, RAIN, +28%) and Inner Mongolia (MRU-35, +46%). The important adjacent agricultural regions include three areas in China, which are Huanghuaihai (MRU-34, with 446 mm or RAIN, +14%), the Loess Region (MRU-36, +41%), and Southwest China (MRU-41, +31%). Of the five regions listed for China, two (MRU-34 and MRU-37) also record a sunshine anomaly in excess of -5%.

Eastern west Asia and southern Asia: wet

Wet conditions in southern Asia over the reporting period (774 mm or +17% in MRU-45) and in Punjab to Gujarat (MRU-48 with 443 mm or +34%) follow a dry period that prevailed at the beginning of the year. This has provided relief to the rainfed winter crops. Both expect a slight biomass production potential increase (7% to 17%) due to other indicators having remained close to average during the reporting period.

Southeastern South America: wet and warmer than average

The Pampas (MRU-26, RAIN, +23%) and the agriculturally less important semi-arid Southern Cone (MRU-28, +45% with just over 100 mm of rain) have benefited from favorable rainfall for the last 9 months, including the beginning of the ongoing winter season. Excess rainfall was no doubt recorded locally at the harvesting time of soybeans and maize but, altogether, the water supply will benefit the early stages of winter wheat for the major producers of the continent. Both areas underwent a drop in RADPAR (10% and 14%, respectively) and high temperature (+1.6°C, +2.0°C) but, due to normally low rainfall and temperature, only the semi-arid Southern Cone is characterized by a jump in BIOMSS (+46%)

North America: wet

The third consecutive quarter of wet conditions prevailed over the northern Great Plains (MRU-12, 468 mm or +31%). Other agroclimatic variables and BIOMSS are about average.

Chapter 2. Crop and environmental conditions in major production zones

Chapter 2 presents the same indicators—RAIN, TEMP, RADPAR, and BIOMSS—used in Chapter 1, and combines them with the agronomic indicators—cropped arable land fraction (CALF) and maximum vegetation condition index (VCIx)—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 www.cropwatch.com.cn.

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.

Table 2.1. April-July 2016 agroclimatic indicators by Major Production Zone, current value and departure from 15YA

	RAIN		TEMP		RADPAR	
	Current (mm)	Departure from 15YA (%)	Current (°C)	Departure from 15YA (°C)	Current (MJ/m^2)	Departure from 15YA (%)
West Africa	589	-6%	28.4	-0.3	1108	-1%
South America	344	6%	20.7	1.7	766	-4%
North America	455	11%	19.3	-0.3	1300	-1%
South and SE Asia	887	15%	29.5	-0.2	1144	-1%
Western Europe	285	5%	14.8	0.1	1122	-5%
C. Europe and W. Russia	273	11%	16.1	0.1	1134	-1%

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 (April-July) for 2001-2015.

Table 2.2. April-July 2016 agronomic indicators by Major Production Zone, current season values and departure from 5YA

	BIOMSS (gDM/m^2)		CALF (Cropped arable land fraction)		Maximum VCI Intensity
	Current	Departure from 5YA (%)	Current	Departure from 5YA (% points)	Current
West Africa	1655	1%	90	0	0.86
South America	848	-17%	90	-5	0.77
North America	1350	6%	95	1	0.91
South and SE Asia	1553	4%	71	-8	0.74
Western Europe	1092	5%	97	1	0.91
C Europe and W Russia	1100	12%	100	1	0.94

Note: Departures are expressed in relative terms (percentage) for all variables. 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 five-year (5YA) average for the same period (April-July) for 2011-2015.

2.2 West Africa

Most of southern West Africa is under relatively dry conditions from April to July. The planting of paddy, maize, and vegetables started from the beginning of May and June. Figure 2.1 illustrates agroclimatic and agronomic indicators for the MPZ for the reporting period.

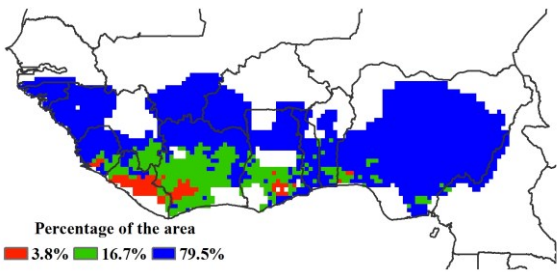
Compared with average conditions, the region suffered a minor rainfall deficit in the order of 6% accompanied by slightly below average temperature (TEMP, -0.3°C) and radiation (RADPAR, -1%). Major countries in West Africa recorded a rainfall deficit, including Ghana (RAIN, -16%), Gambia (-12%), Cote d'Ivoire (-26%), Cameroon (-10%), and Guinea Bissau (-25%). The major country with marked rainfall excess is Burkina Faso (+35%), while Nigeria (+2%) received an average amount.

The rainfall profiles and clusters show that rainfall deficits occurred throughout the region after the month of May up to the last week of June; after July, an increasing trend is observed. About 3.8% of the area in the southern part of the MPZ received excess rainfall up to 30 mm/dekad in May and deficits up to -10mm in the month of June. In 79.5% of the MPZ, in areas east, west, north and central, close to average rainfall occurred up to the last week of June, after which a positive departure (up to 30 mm) occurred. About 16.7% of the area, located in the southern part of the MPZ, underwent dekad rainfall deficits up to 20 mm in June. The whole region experienced slightly below average temperature (TEMP, -0.3°C).

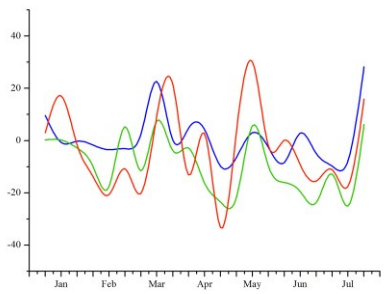
The sudden increase in rainfall in July compared with the average is confirmed by maximum VCI, for which low values occur in the small patch of northern part of Nigeria along the border with Niger. This is also where low VHI values tend to concentrate. The very high VCI values are seen in Nigeria, Ghana, Benin, and Togo. Two additional crop related indicators (fraction of cropped arable land (CALF) and biomass production potential (BIOMSS)) departures, both expressed as the departure from the average of the recent five seasons only, confirm a slight increase (1%) in average production potential. High biomass potentials occur in small patches in north, east, and central parts of Nigeria, north Ghana, and the south part of Burkina Faso (Sahel). Low biomass potential is seen in Cote d'Ivoire, southern Ghana, the southern part of Togo, southern Benin, and in Guinea Bissau.

Altogether the indicators in West Africa show that the crop production is likely to be slightly above average (that is, a 1% increase), and probably well above average in the Sahelian north, which benefited from an early start of the season.

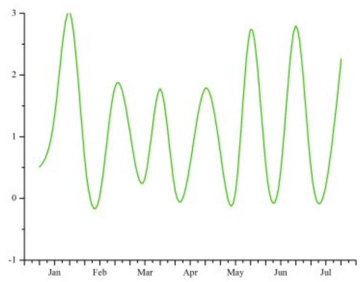
Figure 2.1. West Africa MPZ: Agroclimatic and agronomic indicators, April-July 2016



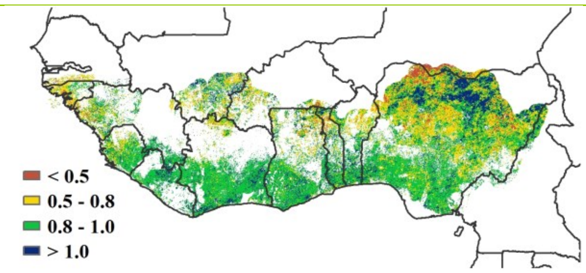
a. Spatial distribution of rainfall profiles



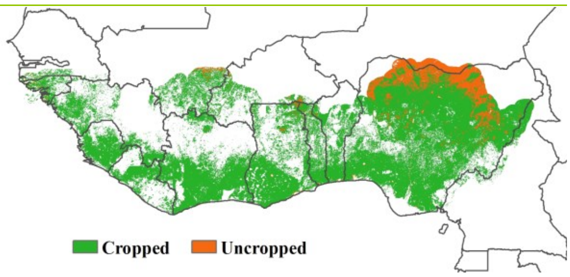
b. Profiles of rainfall departure from average (mm)



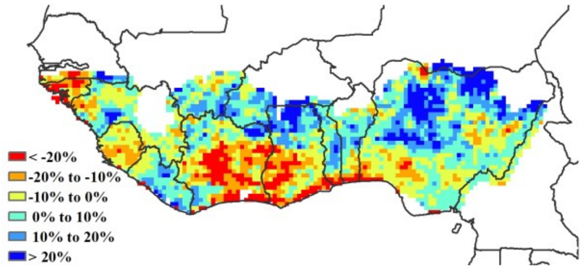
c. Profile of temperature departure from average (°C)



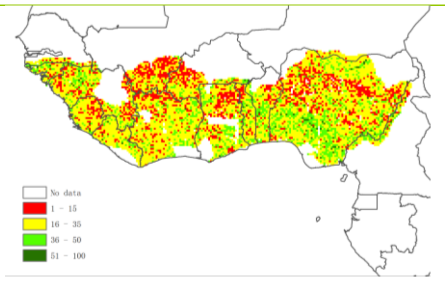
d. Maximum VCI



e. Cropped arable land



f. Biomass accumulation potential departure



g. VHI minimum

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

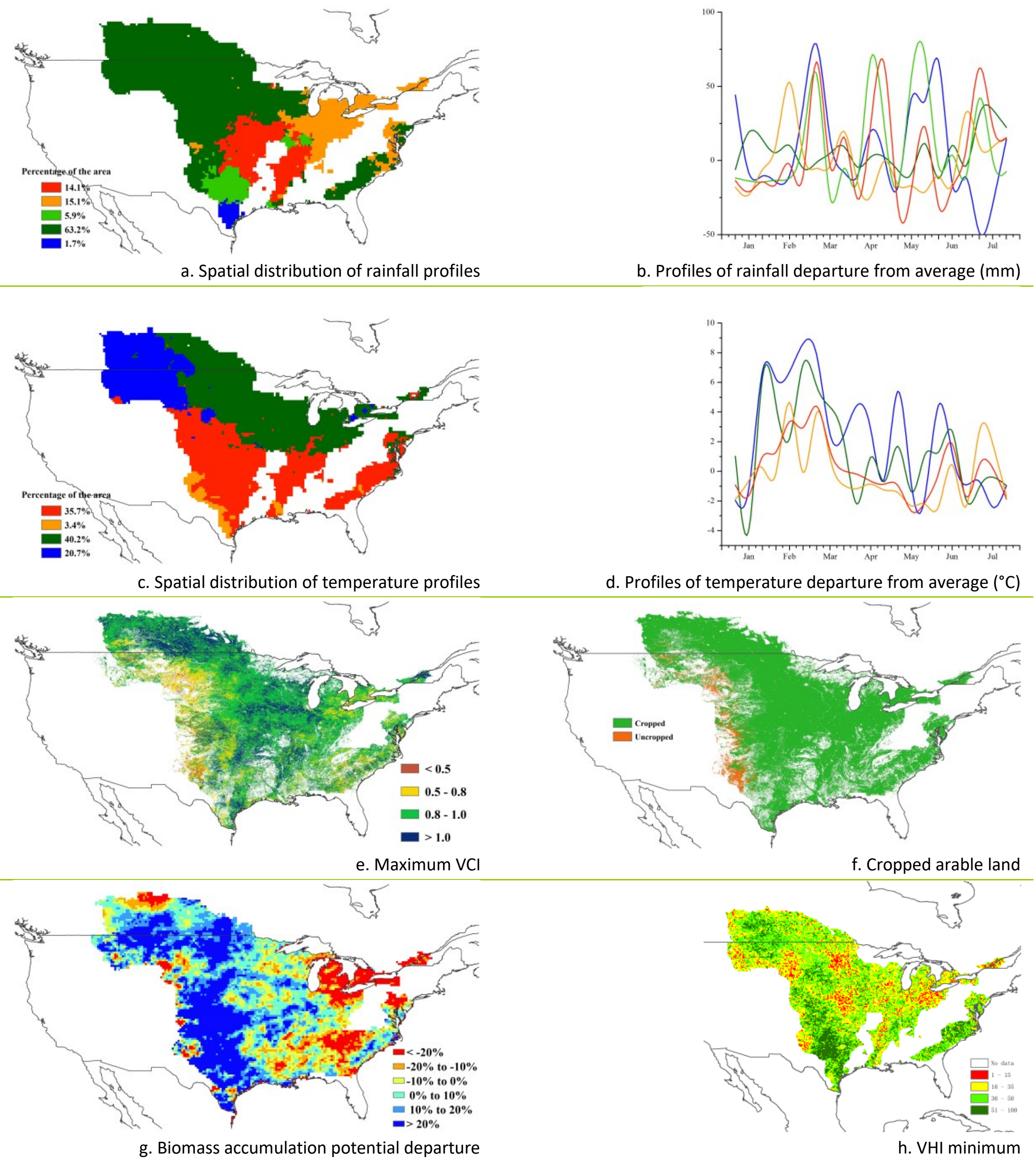
2.3 North America

In general, crop condition is above average in the North American MPZ (figure 2.2). This monitoring period was covering the harvesting season of winter crops and the beginning of the growing season of summer crops.

The agroclimatic indicators show that rainfall was 11% above average, while temperature was below by 0.3°C. Abundant rainfall fell over the major crop production zones, including the Canadian Prairies, Great Plains, Southern Corn Belt, and Mississippi Delta, providing sufficient soil moisture for crops. Compared to the previous year, the Canadian Prairie finally witnessed the end of a serious water deficit as a result of above rainfall in Alberta (RAIN, +16%), Manitoba (+23%), and Saskatchewan (+10%). Abundant rainfall was also recorded across the whole Great Plains, including North Dakota (+55%), South Dakota (+40%), Nebraska (+38%), Kansas (+56%), Oklahoma (+40%), and Texas (+45%), a state where excessive rainfall also caused serious flooding. In the southern Corn Belt, slightly above average RAIN was observed in Illinois (+10%), Iowa (+13%), and Indiana (+4%). In the major rice production zone, Arkansas also recorded slightly above rainfall with an 11% positive departure. Below average rainfall fell over eastern and southern states of the United States, including Georgia (-22%), Ohio (-22%), and Michigan (-27%). After a relatively warm winter, the temperature of the whole region underwent a downward trends after March and reached below average values (-2°C) in July.

The generally above average crop condition in the MPZ is supported by a high average VCIx value (0.91), while in the southern Canadian Prairie and the Corn Belt, VCIx even exceeded 1, indicating very favorable crop condition. Water deficit in the northeast Corn Belt resulted in a biomass accumulation potential drop of 20%. According to the CropWatch CALF indicator over the whole monitoring period, 91% of arable lands were cropped, which is 1 percentage point above the average of the recent five years.

Figure 2.2. North America MPZ: Agroclimatic and agronomic indicators, April-July 2016



a. Spatial distribution of rainfall profiles

b. Profiles of rainfall departure from average (mm)

c. Spatial distribution of temperature profiles

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

e. Maximum VCI

f. Cropped arable land

g. Biomass accumulation potential departure

h. VHI minimum

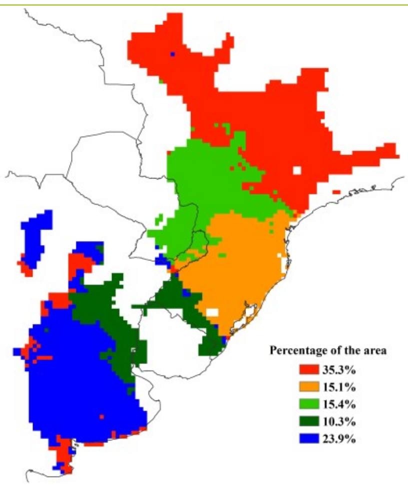
Note: For more information about the indicators, see Annex C.

2.4 South America

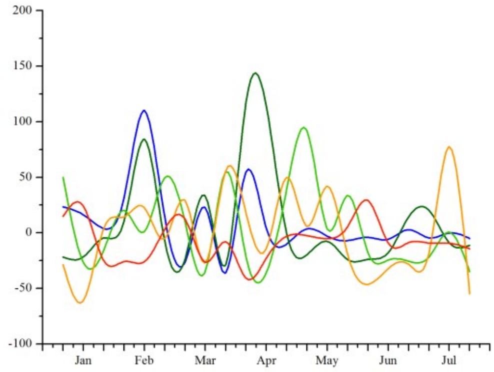
Generally average agroclimatic conditions were observed in the South American MPZ from April to July. Figure 2.3 summarizes the CropWatch agroclimatic and agronomic indicators for the area.

For the MPZ as a whole, rainfall was close to average (RAIN, +6%), but departures were significant for temperature (TEMP, +1.7C) and radiation (RADPAR, -4%). Estimated BIOMSS was 17% below the recent five-year average level. According to the rainfall departure clusters and graphs, rainfall departures fluctuated during the monitoring period. An excess of 50 mm of rainfall was observed in mid-July in the states of Parana, Santa Catarina, and Rio Grande do Sul, and close to 100 mm at the end of April in Mato Grosso do Sul. After relatively cold conditions from the end of April to June, temperature reached 2 degrees above average by the end of July. As a result of these continuously low temperatures from April to the end of June and a shortage of rainfall, vast areas in the northern part of the MPZ show well below average BIOMSS. The minimum VHI map indicates water stress (with VHIn below 0.35) in Goias, Mato Grosso, and Minas Gerais, resulting from both high temperature and low rainfall. The cropped arable land fraction (CALF) for the MPZ was 90% but still 5 percentage points below the five-year average. Most of the uncropped arable land is located in the Argentinian areas of southern Cordoba, southern Santa Fe, and northwestern Buenos Aires, which is one of the major wheat producing areas. Due to the high domestic price—according to national data—it is possible that farmers are still planting winter wheat where weather conditions permit. Average VCIx was 0.77 for the MPZ, with lower values in San Luis, Cordoba, and La Pampa. However, the regions with low VCIx do not coincide with the regions where VHIn is below 0.35, which means that the poor condition is not due to drought. The low VCIx in Argentina mainly resulted from the post-harvest status of the fields.

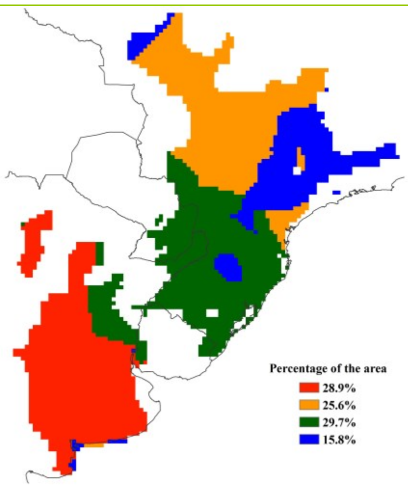
Figure 2.3. South America MPZ: Agroclimatic and agronomic indicators, April-July 2016



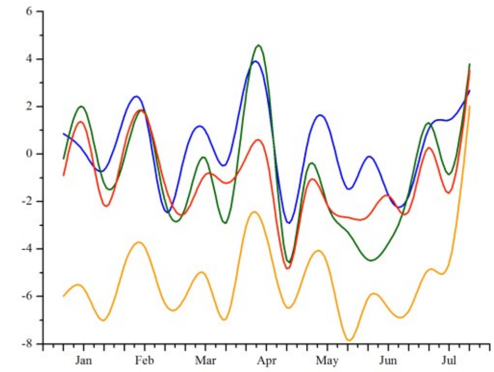
a. Spatial distribution of rainfall profiles



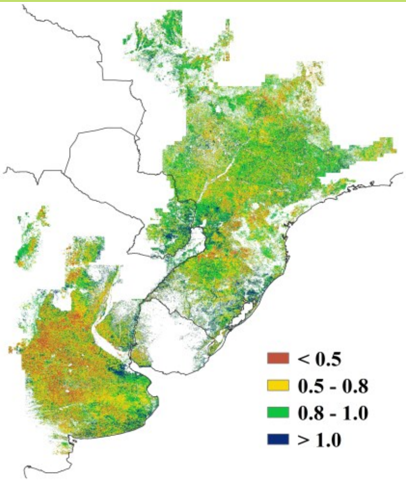
b. Profiles of rainfall departure from average (mm)



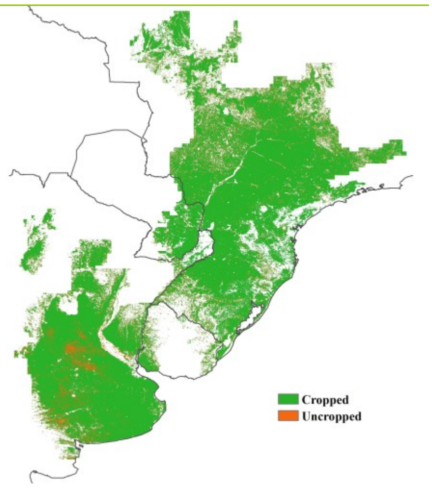
c. Spatial distribution of temperature profiles



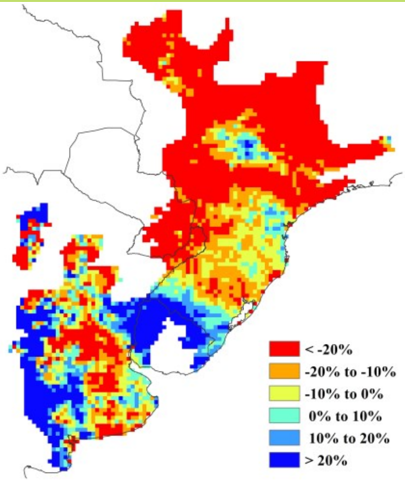
d. Profiles of temperature departure from average (°C)



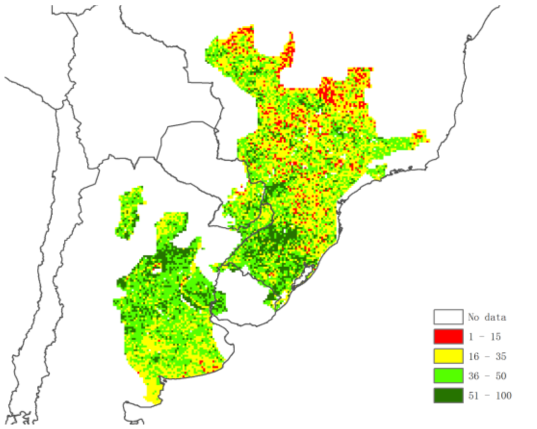
e. Maximum VCI



f. Cropped arable land



g. Biomass accumulation potential departure



h. VHI minimum

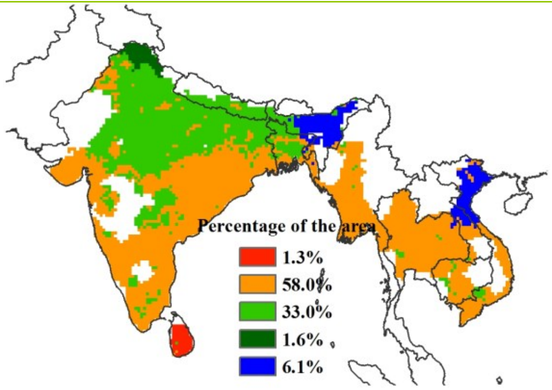
Note: For more information about the indicators, see Annex C.

2.5 South and Southeast Asia

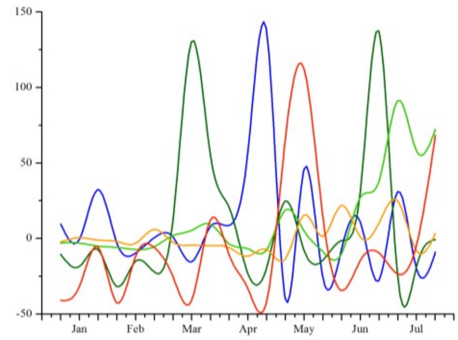
The reporting period is the planting and growing season of rice and maize in the MPZ. Overall, the CropWatch agroclimatic indicators show below average crop condition. The excess monsoon rain caused flood and damaged the standing crops mainly in India, Bangladesh, Thailand, Vietnam, and Myanmar. Rainfall (RAIN) increased 15% over average for the entire zone with individual countries recording values from 6% to 9% (Myanmar, Thailand, Cambodia, and Bangladesh), but as much as 20% in India. The spatial distribution of rainfall profiles indicate 58% of the MPZ experienced evenly distributed average rainfall during the monitoring period. However, excess rainfall occurred during July in northern India covering an area of 33% of the MPZ. Temperature for the MPZ was about average and so was radiation (RADPAR, -1%). The maximum VCI values remained below 0.5 for most of the region including central India, Myanmar, Thailand, and Cambodia, which confirms poor crop condition. Compared to the previous five seasons, the fraction of cropped arable land (CALF) dropped 8 percentage points, primarily in India (-12%), Myanmar (-2%), and Cambodia (-7%). The biomass accumulation potential for the MPZ increased by 4% compared to the previous five-year average, mainly in India (+8%) and Myanmar (+1%). The lowest biomass accumulation potential was recorded in Cambodia (-7%) and Thailand (-1%). Low values of VHI were concentrated over central India, Myanmar, Thailand, Vietnam, and Cambodia, indicating water stress or flooding resulting from excessive rainfall in these areas.

Overall, crop condition is below average. The decreased cultivated land and the damage caused by flood raises concern for the MPZ.

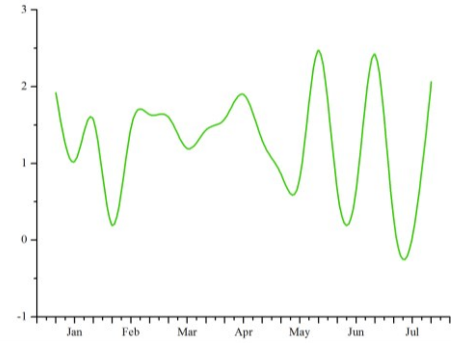
Figure 2.4. South and Southeast Asia MPZ: Agroclimatic and agronomic indicators, April-July 2016



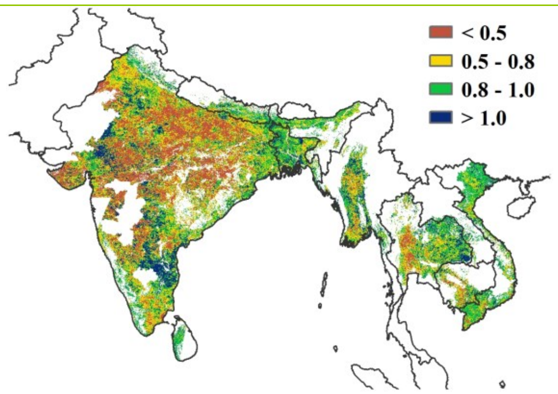
a. Spatial distribution of rainfall profiles



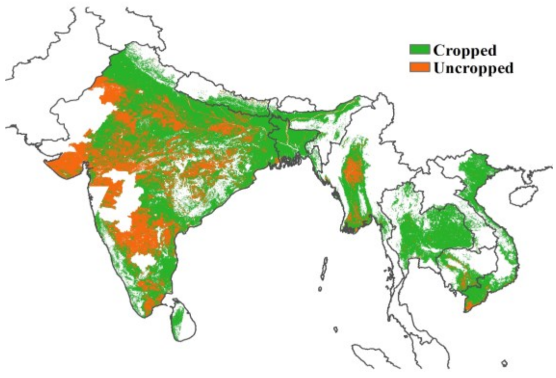
b. Profiles of rainfall departure from average (mm)



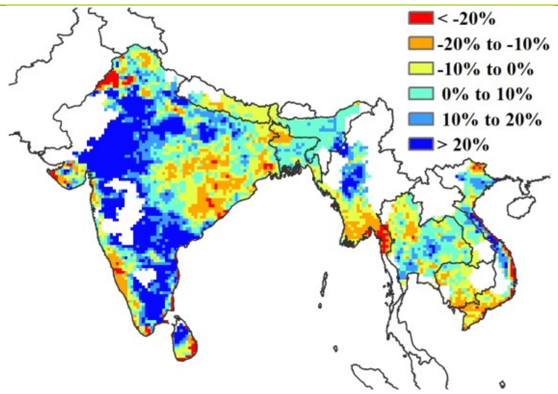
c. Profile of temperature departure from average (°C)



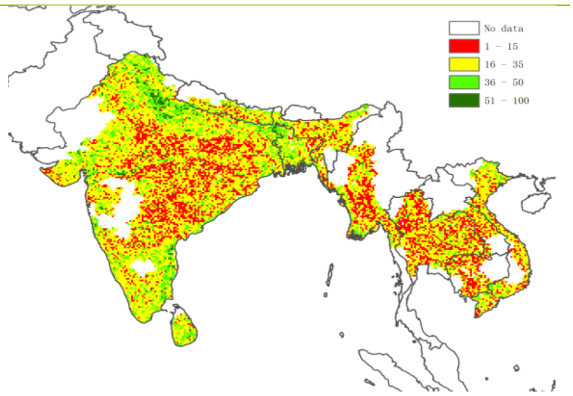
d. Maximum VCI



e. Cropped arable land



f. Biomass accumulation potential departure



g. VHI minimum

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

2.6 Western Europe

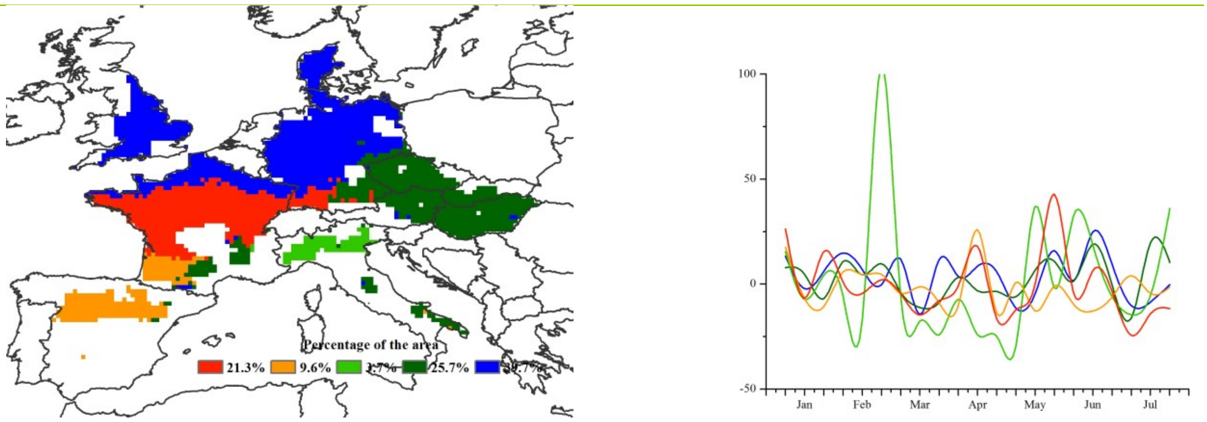
In general, crop condition was above average in most parts of the continental Western European MPZ during this reporting period, favoring winter crop grain filling and spring crops growth, especially maize flowering. Figure 2.5 presents an overview of CropWatch agroclimatic and agronomic indicators for this MPZ.

The total precipitation was 5% above average, with exceptional negative departures in RAIN over most of Spain and southwestern France from the middle of April to mid-June, northern Italy from early April to late April, and most other areas (except Spain and southwest of France) in the middle of June. TEMP was mostly average (+0.1°C departure); below average temperatures were observed in most of Italy and northeast of France from April to early June and again at late June, and in most of the Western Europe MPZ (except Spain and Italy) in the middle of April and May and late June. Sunshine was significantly below average at -5%.

Due to the adequate rainfall and favorable temperature, the biomass accumulation potential BIOMSS was 5% above the recent five-year average. As shown in figure 2.5, the lowest BIOMSS departures (-20% and below) occur over most of Spain, northern Italy, and northeast of Germany, especially in the east of France, which was affected by floods in May. In contrast, BIOMSS in most other regions was 10 percent above average.

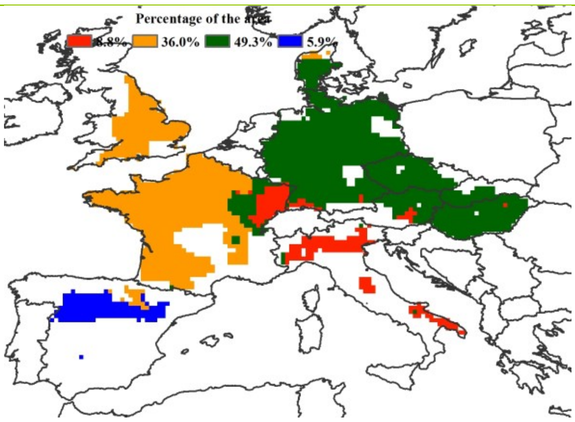
According to the VCIx map, crop condition was below average in the south and east of Spain, northwest France, the northern part of Italy, and north and south Germany. Average VCIx for the MPZ was 0.91. The fraction of cropped arable land was 97% across the MPZ, which is 1 percentage point above the five-year average; most uncropped arable land is concentrated in the southeast and northeast of Spain. Areas with low minimum VHI values were partially scattered in Spain, France, and Germany. Generally, crop condition in Western Europe was favorable.

Figure 2.5. Western Europe MPZ: Agroclimatic and agronomic indicators, April-July 2016

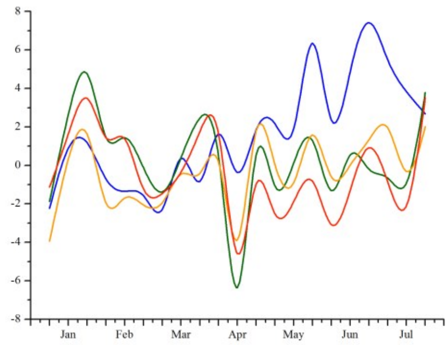


a. Spatial distribution of rainfall profiles

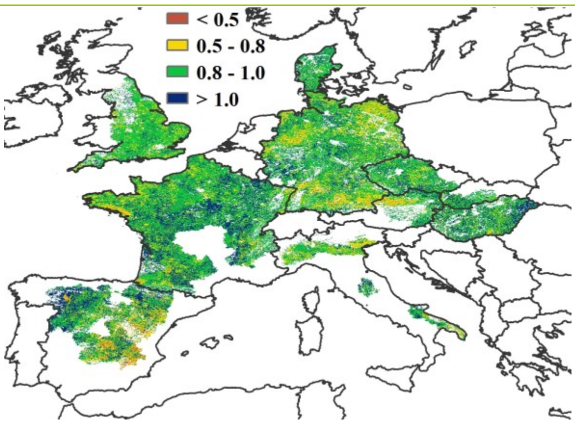
b. Profiles of rainfall departure from average (mm)



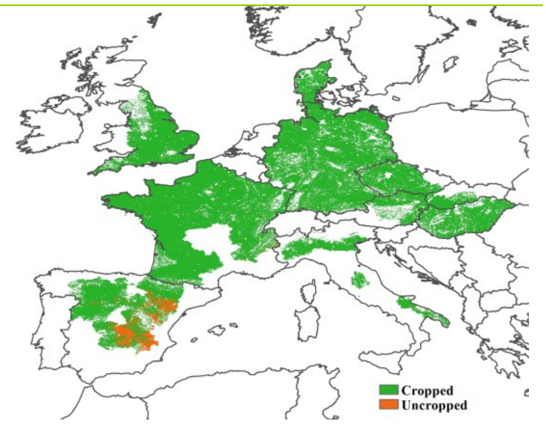
c. Spatial distribution of temperature profiles



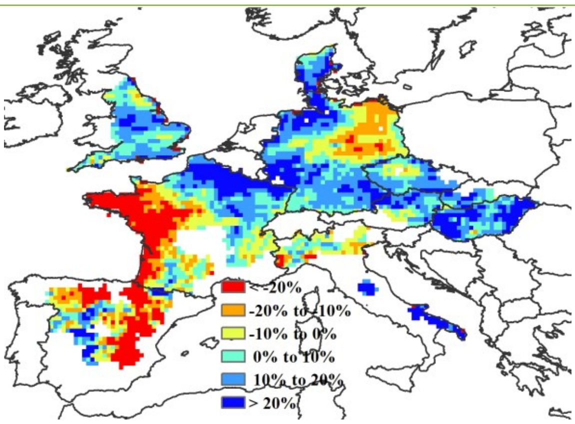
d. Profiles of temperature departure from average (°C)



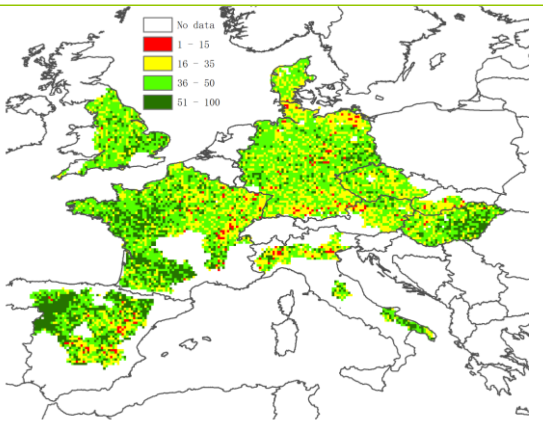
e. Maximum VCI



f. Cropped arable land



g. Biomass accumulation potential departure



h. VHI minimum

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

2.7 Central Europe to Western Russia

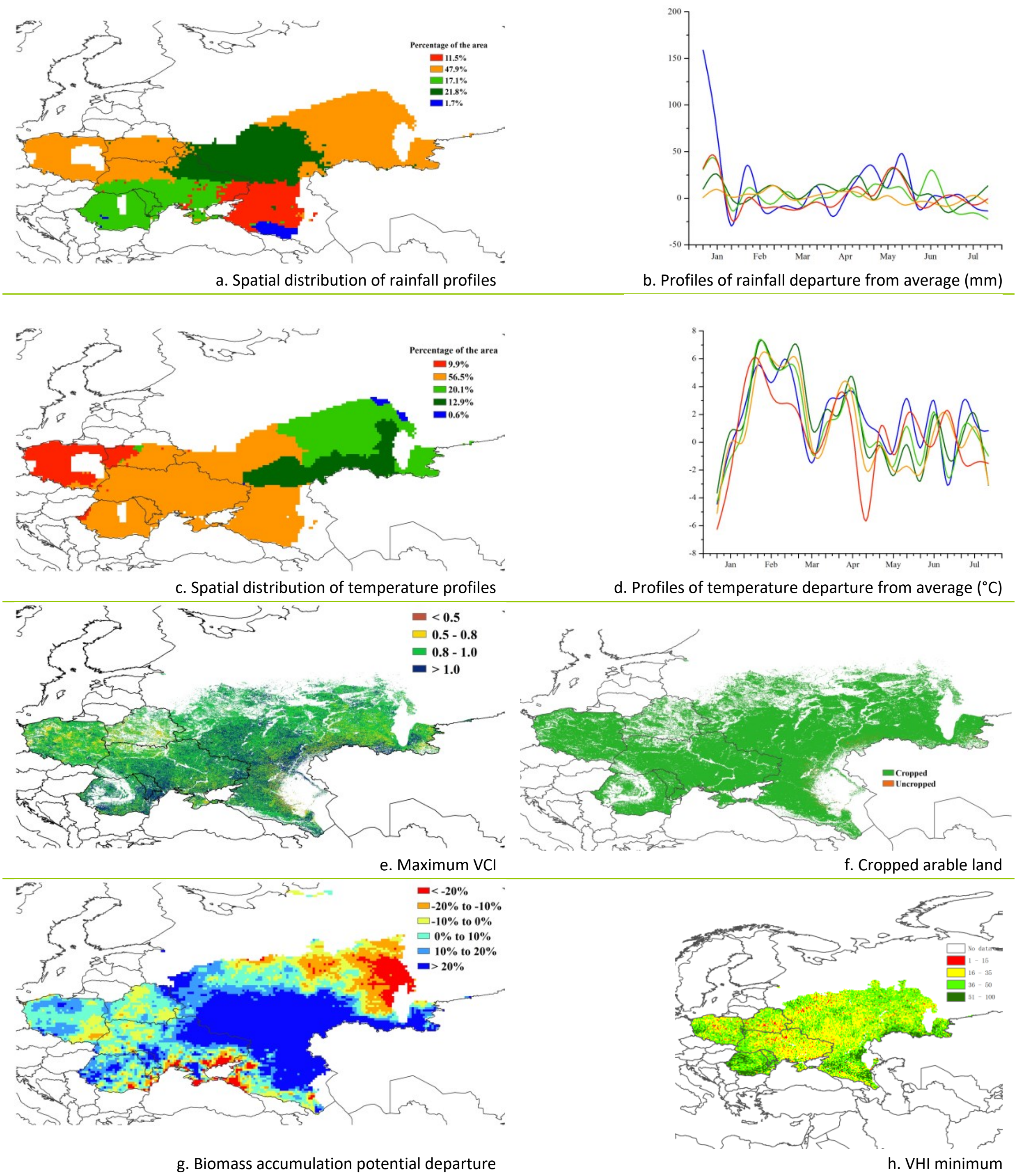
During the current monitoring period, most parts of the Central Europe to Western Russia MPZ presented favorable conditions of winter and summer crop (average VCIx=0.94). The agroclimatic indicators showed favorable condition for crop growing, with an 11% increase of rainfall and a slight 0.1°C increase of temperature compared with the average, while RADPAR was slightly below average by 1%.

As indicated by the rainfall profile analysis, the west and south of Russia and northeastern Ukraine received well above average rainfall since February, with significant rainfall peaks in May. Most regions of the MPZ presented average or below average moisture conditions from June except the southwestern part, including Romania and most parts of south Ukraine. Temperature profiles showed correlated variations among most countries of the MPZ. The whole region experienced high temperatures in

February (as much as 7°C above average in the east part in Russia). However, temperature dropped to average from April, with more than 5°C below average in across Poland in mid-April.

Almost all of the arable land was actually cropped during the reporting period. Due to the favorable moisture condition in the southeastern part of the MPZ, the accumulated potential biomass (BIOMSS) is much above the five-year average (>20%), and many pixels' maximum VCI value were greater than 1 in this region; correspondingly, the BIOMSS of the whole MPZ shows a significant increase of 12%.

Figure 2.6. Central Europe-Western Russia MPZ: Agroclimatic and agronomic indicators, April-July 2016



a. Spatial distribution of rainfall profiles

b. Profiles of rainfall departure from average (mm)

c. Spatial distribution of temperature profiles

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

e. Maximum VCI

f. Cropped arable land

g. Biomass accumulation potential departure

h. VHI minimum

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

Chapter 3. Main producing and exporting countries

Building on the global patterns presented in previous chapters, this chapter assesses the situation of crops in 30 key countries that represent the global major producers and exporters or otherwise are of global or CropWatch relevance. In addition, the overview section (3.1) pays attention to other countries worldwide, to provide some spatial and thematic detail to the overall features described in section 1.1. In section 3.2, the CropWatch monitored countries are presented, and for each country maps are included illustrating NDVI-based crop condition development graphs, maximum VCI, and spatial NDVI patterns with associated NDVI profiles. Additional detail on the agroclimatic and BIOMSS indicators, in particular for some of the larger countries, is included in Annex A, tables A.2-A.11. Annex B includes 2016 production estimates for Argentina, Australia, Brazil, Canada, and the United States.

3.1 Overview

Chapter 1 focused on large climate anomalies that sometimes reach the size of continents and beyond; in contrast, this section offers a closer look at all countries, including the 30 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. Figures 3.1 to 3.4 respectively present global maps for the CropWatch indicators for RAIN, TEMP, RADPAR, and BIOMSS by country and subnational areas for large countries.

Wet areas

Sahel to Central Asia

The largest rainfall anomalies, at the national level, occur in a large area identified in chapter 1 as "Sahel to Central Asia." This includes Mauritania (RAIN, +156%, equivalent to 411 mm) and Niger (+73%, 379 mm) in the western Sahel, as well all other countries that are part of the West African Sahel from Senegal (+16%) to northern Sudan (+58%).

Figure 3.1. Global map of April-July 2016 rainfall (RAIN) by country and sub-national areas, departure from 15YA (percentage)

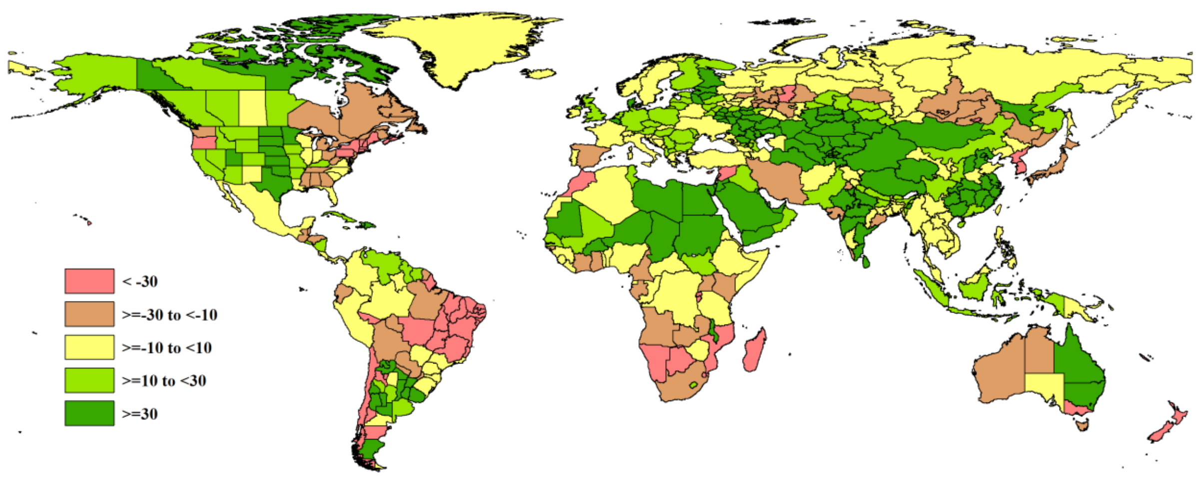


Figure 3.2. Global map of April-July 2016 temperature (TEMP) by country and sub-national areas, departure from 15YA (degrees)

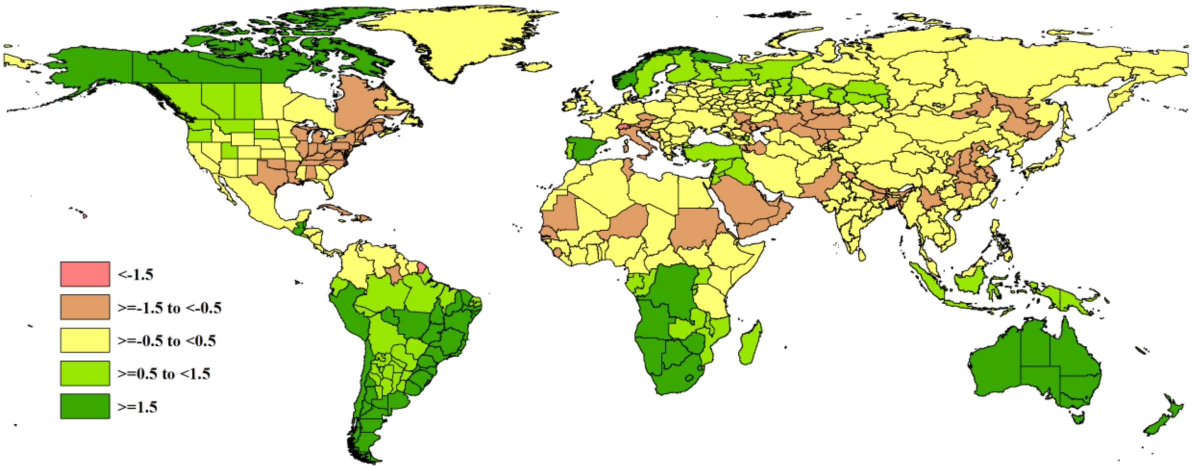


Figure 3.3. Global map of April-July 2016 PAR (RADPAR) by country and sub-national areas, departure from 15YA (percentage)

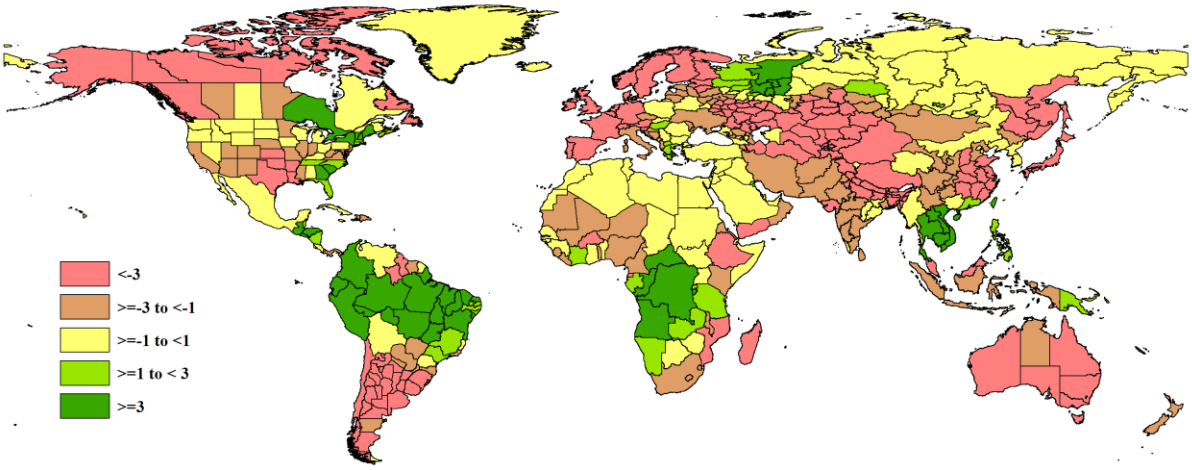
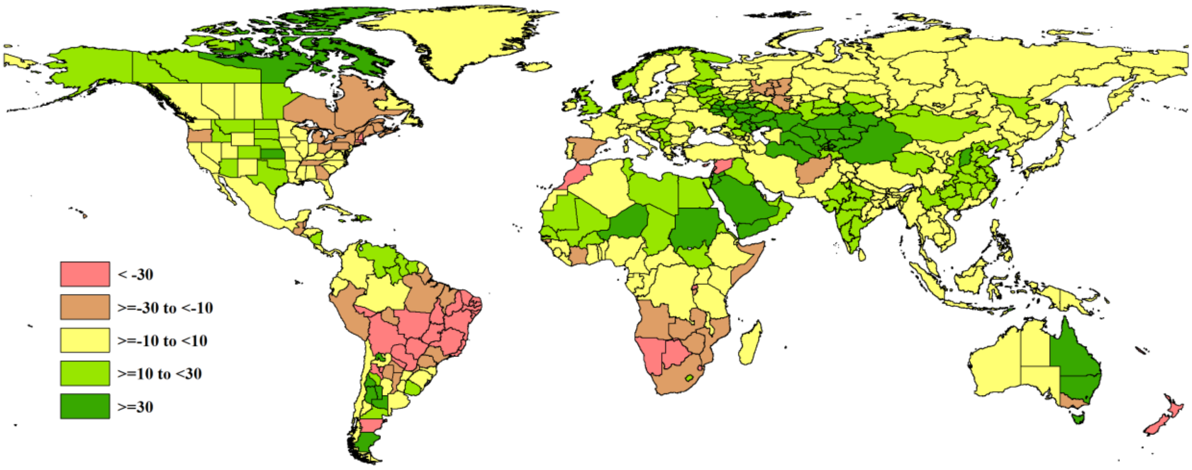


Figure 3.4. Global map of April-July 2016 biomass (BIOMSS) by country and sub-national areas, departure from 15YA (percentage)



For most countries, the rainfall supply marks an early and favorable start of the rainy season. In the very east of the "climatic Sahel," some slightly negative RAIN anomalies can be seen for Somalia (-3%) and Ethiopia (-5%). In Ethiopia, however, a positive CALF (+5%), an average BIOMSS index, and a favorable VCIx indicate that major production areas are recovering.

The Near East (Israel, RAIN, +75% and Jordan, +159%) and the Arabian Peninsula come next with precipitation excesses from 60% to 120% in Qatar, Yemen, Kuwait, and Saudi Arabia. In Egypt, although RAIN is at +71%, there is a marked drop in CALF (-9%) and a moderate VCIx value, no doubt associated with unfavorable irrigation conditions. For almost all listed countries, however, rainfed crop agriculture plays a minor role in their economy, and the rainfall is of relevance mainly for range-lands. The same also applies to Central Asia (less so for Kazakhstan) where the following RAIN anomalies are reported: Tajikistan +47%, Kazakhstan +71% (CALF +5%), Uzbekistan +82%, and Turkmenistan +115%. In Kyrgyzstan, RAIN of +119% over average was recorded, which corresponds to 539 mm of precipitation, an amount that is welcome in the late growth stages of winter crops and a useful supply of water for the Ferghana valley in Kyrgyzstan and neighboring countries. Much of the "Sahel to Central Asia" region had below average sunshine of -5% to -10%, with moderate temperature anomalies in the order of 0.5°C. The biomass production potential is mostly up by at least 40%.

Eastern West, South and East Asia, southeast South America, and parts of North America

Other wet areas were reported in various parts of Asia, southeast South America, and parts of North America. This includes, in particular, much of central eastern China (except Shandong and Henan). For China as a whole, CALF is close to average at -1% and VCIx is favorable at 0.94, while the RAIN departure is +36%. The largest excesses, however, occurred in the western areas bordering Central Asia. In the west, anomalies larger than 60% are reported from Beijing, Qinghai, Shanghai, Hebei, Jiangxi, Shanxi, and Zhejiang. Corresponding RADPAR and TEMP anomalies are modest and the associated BIOMASS increases mostly close to +10%.

In southern Asia, the RAIN index of 798 mm for India (+20%) hides a large disparity of sub-national conditions: Andhra Pradesh (+54%), Madhya Pradesh (+75%), and Rajasthan (+94%), but Gujarat at -18% and Goa at -30%. Bangladesh had above average RAIN of +7% with 1520 mm and Pakistan +15% with 248 mm. The Indian CALF value drops by a spectacular 12%, accompanied by a VCIx of 0.70, indicating the negative impact of excess rainfall. Bangladesh and Pakistan display rather large differences in CALF (0% and -8% respectively) associated, in the case of Pakistan, with large sub-national disparities in crop condition.

The largest RAIN anomalies in South America cover Argentina (311 mm or +46% above average nationwide for the RAIN indicator, with a 5% drop in CALF resulting from water logging) and Uruguay (797 mm or +89%). The area of interest is included in the contour from Uruguay to Salta and Jujuy in the west (+32% and +55%, for moderate rainfall amounts of 82 mm and 73 mm at the end of the summer season), to Mendoza (+158% with 159 mm) and Buenos Aires (+12% with 244 mm), providing good moisture supply for winter crops. One of the main agricultural provinces (Entre Rios) records 652 mm, equivalent to +111%. The other CropWatch agroclimatic indices follow an unusual pattern of high temperature departures associated with low sunshine; this points at high cloudiness, which is often characterized by limited evapotranspiration and water logging. However, altogether, conditions are conducive to winter crops, especially wheat.

In North America (RAIN, +8% in the United States), wet conditions prevailed mainly from Texas (RAIN, +45%) to North Dakota (+55%) and neighboring states, extending west all the way to the Pacific coast except for New Mexico (average with -9%), Washington (-24%), and Oregon (-30%).

Dry areas

Other areas in North America with dry conditions include parts of the eastern Corn Belt (Michigan, RAIN -27%; Ohio -22%), extending also east as far as Maine and Nova Scotia (both at -41%), and south to include Mississippi, Alabama, and Georgia with RAIN deficits between -10% and 20%. Altogether, CropWatch puts the CALF value for the United States at average (+1% with VCIx=0.88).

In South America, southern equatorial Brazil (including the Nordeste) recorded some severe water shortages (RAIN, -50% to -80%), especially in Alagoas, Bahia, Goias, Piaui, Rio Grande do Norte, Sergipe, Ceara, and Espirito Santo. States in the south with marked deficits include Minas Gerais (-42%) and Mato Grosso (-38%). Temperature in Brazil was mostly well above average (+2°C) and more, which was accompanied by a sunshine increase over average around 5%. The resulting CALF variation for the country is a 9% drop nationwide with a moderate VCIx of 0.79.

Among the Mediterranean countries, a strong west-east RAIN anomaly gradient varies from -47% (Morocco) to -1% (Algeria) to +24% (Tunisia), which is thus part of the "Sahel to Central Asia" block, making Morocco and Spain (-24%) stand out as an isolated group of drought affected areas.

Two larger drought affected areas also deserve mentioning:

- *Southern Africa.* In Southern Africa, all countries except Zimbabwe (RAIN, -1%) were dry and hot, in particularly Namibia (-41% and 26 mm) and Botswana (-63% with 17 mm), two countries where livestock plays a much larger role in agriculture than crops. The cropping sector is more relevant in Swaziland (RAIN, -61% with 34 mm) and Mozambique (RAIN -30%, 70mm) and especially Madagascar (RAIN down 30% to 133 mm).
- *Eastern Asia.* In eastern Asia, a region centered around the Korean Peninsula (a 40% or just under 40% RAIN deficit) and extending from the Primorsky Krai in Russia to Heilongjiang and Japan with deficits just short of 20% was affected by drought.

Finally, some isolated areas with unusual conditions include:

- Syria, with a -44% RAIN index and a BIOMSS indicator of 31% below average;
- Iran, a deficit "island" (-23% RAIN) in the rather favorable "Sahel to Central Asia" area. The water shortage is likely to have been compensated in terms of production by a large increase in CALF (+26%);
- Russia, with a dry pocket (recording -30% RAIN) centered around the region of Perm, with this dry area extending to adjacent areas in the south from Sverdlovsk (-11%) and Bashkiria (-26%) to the Kostroma Oblast (-11%);
- Malawi, in Southern Africa with 200 mm rainfall in the late season (RAIN, +45%);
- Continental south-east Asia and the Philippines, with a positive RADPAR anomaly. With the exception of Cambodia where CALF dropped 7 percentage points under just fair conditions, Thailand, Vietnam, Indonesia, and the Philippines all report CALF values identical with the previous five years;
- Much of Western Europe, with a negative RADPAR anomaly. CALF values are average in the region (France, German, and Great Britain) as well as in the eastern areas of the continent (Poland, Romania, and Ukraine), but dropping to -3% in Russia.

Table 3.1. CropWatch agroclimatic and agronomic indicators for April-July 2016, dept. from 5YA and 15YA

Country	Agroclimatic Indicators			Agronomic Indicators		
	Departure from 15YA (2001-2015)			Departure from 5YA (2011-2015)		Current
	RAIN (%)	TEMP (°C)	RADPAR (%)	BIOMSS (%)	CALF (%)	Maximum VCI
Argentina	46	1.3	-14	-3	-5	0.74
Australia	13	3.5	-5	15	4	0.92
Bangladesh	7	-0.6	-4	0	0	0.88
Brazil	-20	1.8	4	-26	-9	0.79
Cambodia	7	-0.1	4	-7	-7	0.75
Canada	-4	0.3	-1	2	1	0.97
China	36	-0.5	-3	13	-1	0.86
Egypt	71	0.5	1	26	-9	0.77
Ethiopia	-5	-0.3	-4	0	5	0.94
France	-9	-0.2	-8	-3	0	0.93
Germany	13	-0.4	-3	8	0	0.87
India	20	-0.2	-3	8	-12	0.70
Indonesia	15	0.7	-3	8	0	0.72
Iran	-23	-0.5	-1	-9	26	0.88
Kazakhstan	71	-0.3	-6	44	5	0.95
Mexico	4	-0.5	0	5	1	0.79
Myanmar	9	-0.4	0	1	-2	0.86
Nigeria	2	-0.5	-1	8	1	0.86
Pakistan	15	-0.7	-1	2	-8	0.74
Philippines	-6	0.0	2	-8	0	0.88
Poland	11	-0.1	0	5	0	0.89
Romania	13	-0.2	-1	8	0	0.98
Russia	12	0.2	-2	12	-3	0.96
S. Africa	-25	3.1	-2	-10	2	0.80
Thailand	6	0.2	7	-1	0	0.81
Turkey	1	0.7	0	-8	-4	0.80
Ukraine	3	0.0	-1	9	0	0.95
United Kingdom	16	0.1	-6	10	0	0.89
United States	8	-0.3	-1	4	1	0.88
Uzbekistan	82	-0.4	-5	93	12	0.92
Vietnam	7	0.1	5	0	0	0.87

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 five-year (5YA) or fifteen-year average (15YA) for the same period (April-July).

3.2 Country analysis

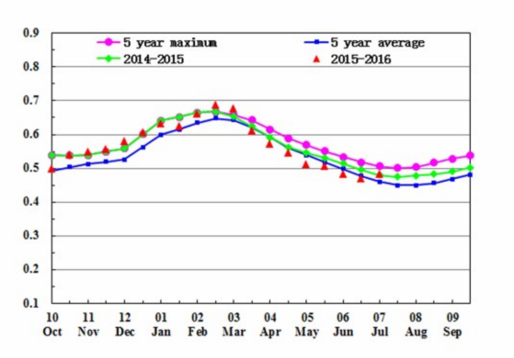
This section presents CropWatch results for each of thirty key countries (China is addressed in Chapter 4). The maps refer to crop growing areas only and include (a) Crop condition development graph based on NDVI average over crop areas, comparing the April-July 2016 period to the previous season and the five-year average (5YA) and maximum; (b) Maximum VCI (over arable land mask) for April-July 2016 by pixel; (c) Spatial NDVI patterns up to July 2016 according to local cropping patterns and compared to the 5YA; and (d) NDVI profiles associated with the spatial pattern under (c). See also Annex A, tables A.2-A.11, and Annex B, tables B.1-B.5, for additional information about indicator values and production estimates by country. Country agricultural profiles are posted on **www.cropwatch.com.cn**.

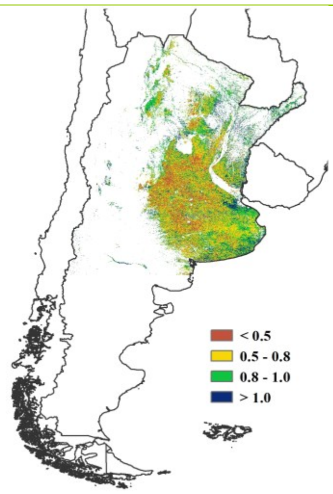
Figures 3.5-3.34. Crop condition individual countries ([ARG] Argentina- [ZAF] South Africa) for April-July 2016

[ARG] Argentina

The harvesting of summer crops (soybean and maize) was completed in May, while June to August is the sowing period for winter wheat. From April to July, excessive rainfall in Argentina dominated agroclimatic conditions, with 46% above average rainfall observed nationally. However, rainfall was unevenly distributed with 20% or more below average RAIN in Missions and Tucuman and almost double of average rainfall in Corrientes, Entre Rios, and Santa Fe. Accordingly, RADPAR is 14% below average for Argentina and 1% to 26% below average for the major agricultural provinces. TEMP is about 1°C above average for the whole nation and each province. The harvesting of summer crops was delayed due to the abundant rainfall in southern Buenos Aires, especially for the late soybean. Outputs of summer crops was not significantly impacted, and yield for maize and soybean remains at the same level as the forecast in the previous bulletin. The excessive precipitation hampered the sowing of winter wheat. By the end of July, winter wheat planted area was 4 percentage points below that of the same time in 2015. The total planted area from April to July was also 5 percentage points below the 5YA. Nevertheless, soil moisture will be beneficial for winter wheat. In general, CropWatch is cautiously optimistic about the prospects of wheat production for the coming season. (See table B.1 in Annex B for production estimates.)

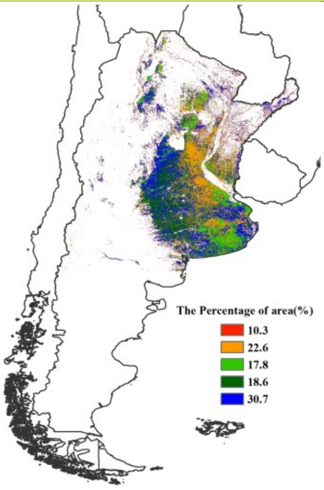
Figure 3.5. Argentina crop condition, April-July 2016

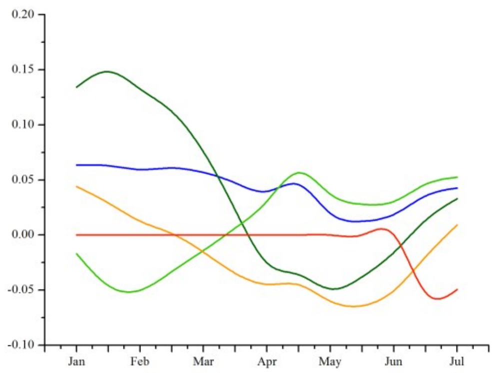




(a) Crop condition development graph based on NDVI

(b) Maximum VCI





(c) Spatial NDVI patterns compared to 5YA

(d) NDVI profiles

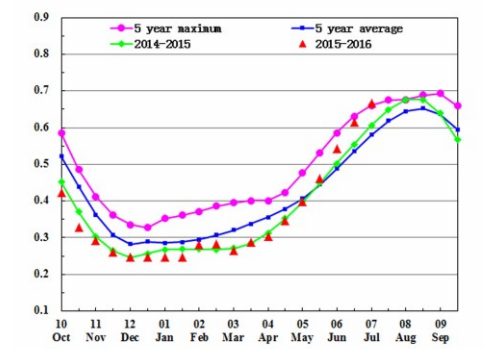
[AUS] Australia

Based on the nationwide NDVI development graph, crop condition was generally above average in Australia compared to the last 5 years, except in April, when it was below average. The maximum VCI attained 0.92 with an increased CALF (+4 percentage points), indicating a possible increased winter crop production.

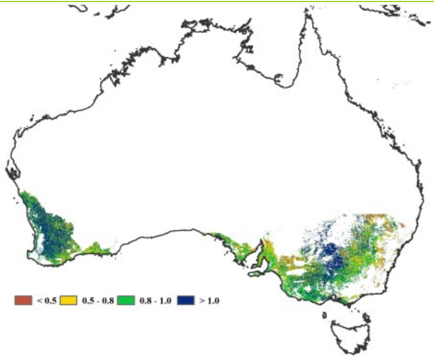
The VCIx in Western Australia shows favorable conditions with a value above 1.0. The Spatial NDVI patterns and profiles in Western Australia also display correspondingly above average conditions.

Although the precipitation in Western Australia shows a decrease of 26% compared to average (with temperature: +2.0°C and RADPAR: -7%) due to the influence of El Niño, the decrease in water has been supplemented by irrigation. The spatial NDVI patterns and profiles in the southern part of South Australia in June were below average, which should be paid attention to in the following months. Nevertheless, crop prospects for Australia are generally favorable. (See table B.2 in Annex B for production estimates.)

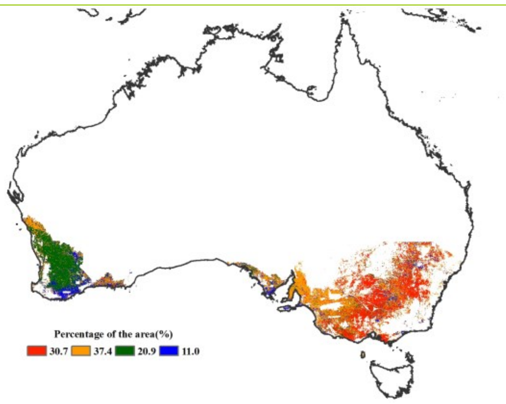
Figure 3.6. Australia crop condition, April-July 2016



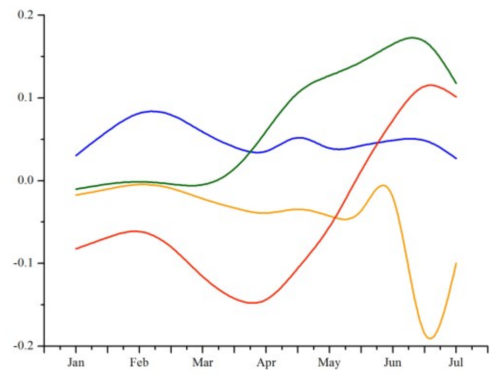
(a) Crop condition development graph based on NDVI



(b) Maximum VCI



(c) Spatial NDVI patterns compared to 5YA



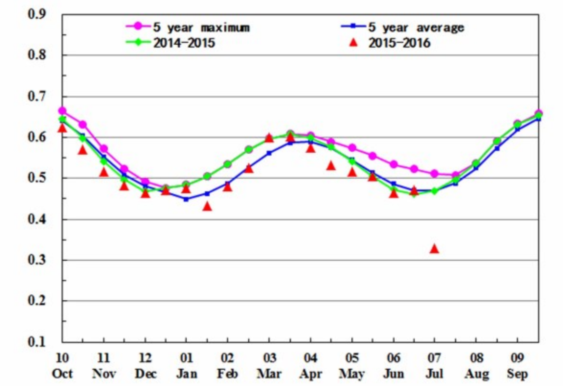
(d) NDVI profiles

ARG AUS **BGD** BRA CAN DEU EGY ETH FRA GBR IDN IND IRN KAZ KHM MEX MMR NGA PAK PHL POL ROU RUS THA TUR UKR USA UZB VNM ZAF

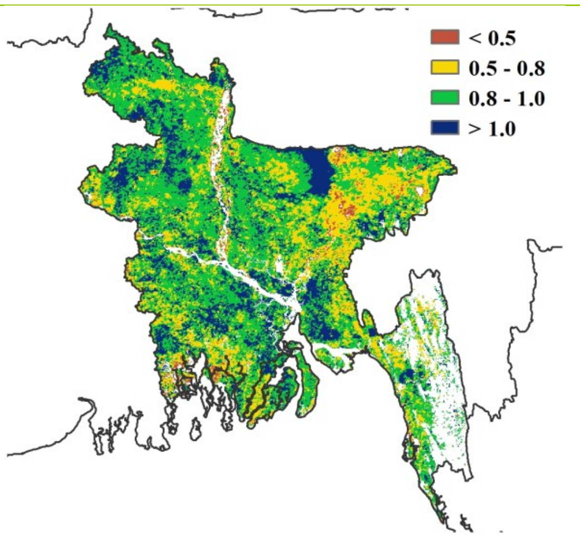
[BGD] Bangladesh

The reporting period corresponds to the growing of Aus rice and the planting of Aman. Overall, CropWatch indicators show below average crop condition for the country. Excess monsoon rainfall (RAIN, +7%) caused flooding and damaged the standing crop mainly in Rangpur, Sylhet, Dhaka, Barisal, and Khulna. The overall biomass accumulation potential (BIOMSS) and the cropped arable land fraction (CALF) remained at the level of the previous five-year average. Temperature (TEMP) remained average as well, while radiation was low (RADPAR, -4%), a very negative factor in a country where sunshine is a dominant limiting factor. The maximum VCI values over the country ranged from 0.5 to 0.8, pointing to average crop condition. In the coastal and the northern regions of the country the spatial NDVI profiles started dropping from early May and continued till the end of the reporting period. The NDVI profiles for the central regions of the country increased from early May to June and started dropping in early July. In Sylhet, the spatial NDVI profiles sharply dropped in early May, then gained for some time and again started dropping till July. Primarily due to flood damage, low photosynthetic activity, and the below average NDVI trend, CropWatch ranks the crop prospects as poor, especially in the northeast.

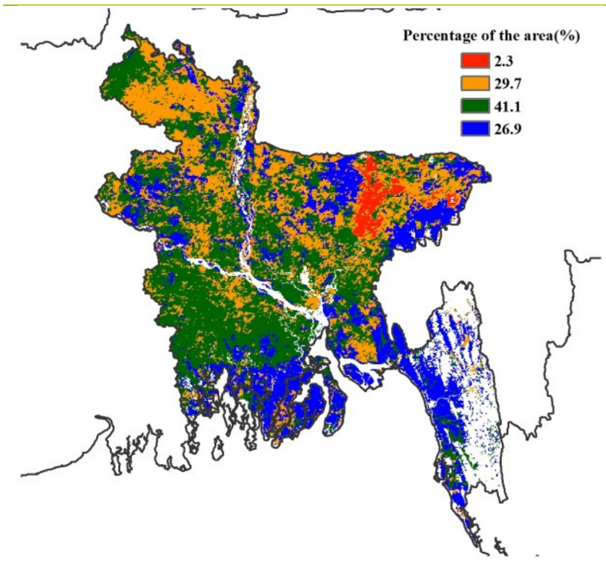
Figure 3.7. Bangladesh crop condition, April-July 2016



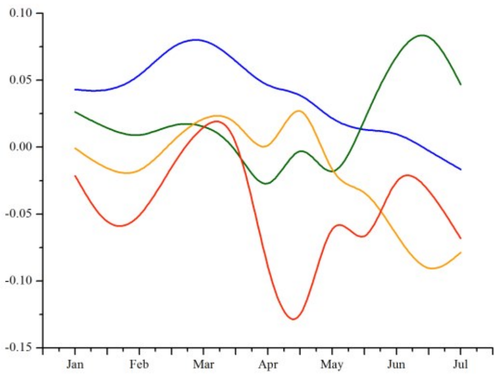
(a) Crop condition development graph based on NDVI



(b) Maximum VCI



(c) Spatial NDVI patterns compared to 5YA

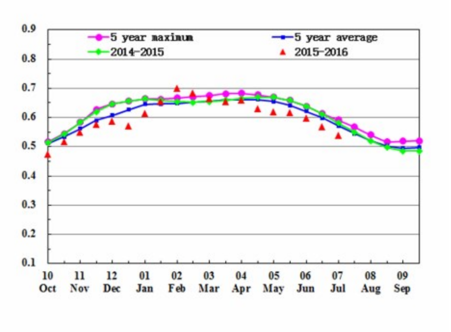


(d) NDVI profiles

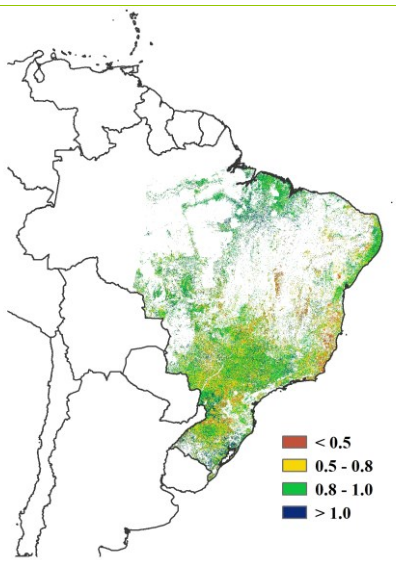
[BRA] Brazil

Overall unfavorable conditions were observed in Brazil from April to July. The harvest of the second maize is ongoing, and wheat is currently in the heading stage. Dry weather conditions were harmful for the second maize and other crops. In central and northern Brazil, 20% below average RAIN with 1.8°C above average temperature resulted in severe drought. Among the eight sub-national regions, the subtropical range-land region in the southernmost part of Brazil is the only region with above average rainfall. In Central Savanna, the Nordeste, East Coast region, and Mato Grosso, rainfall was 69%, 60%, 43%, and 32% below average, respectively, and crops suffered from water stress. In agreement with the unfavorable climatic conditions, BIOMSS was 26% below the five-year average and CALF for Brazil was 9 percentage points below. The crop condition development graph based on NDVI statistics also shows the overall poor crop condition with below average NDVI data since April. NDVI departure clusters present well below average NDVI in Mato Grosso, Goias, and Minas Gerais where rainfall was 38%, 64%, and 42% below average, respectively. Crops in those areas show below average condition with lower than 0.5 VCIx. Due to sufficient rainfall in the two major wheat producing states (Parana and Rio Grande do Sul) prospects are good for the crop if favorable climatic conditions persist. Table B.3 in Annex B presents 2016 production estimates for Brazil.

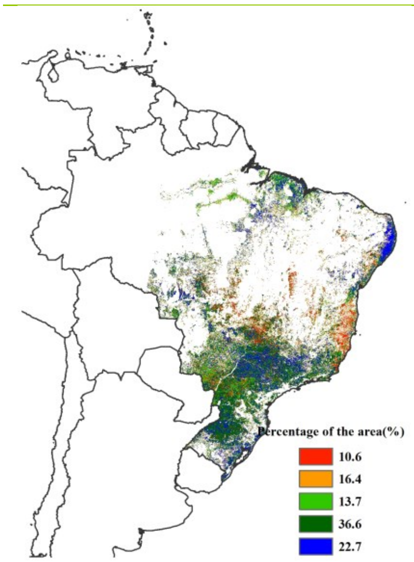
Figure 3.8. Brazil crop condition, April-July 2016



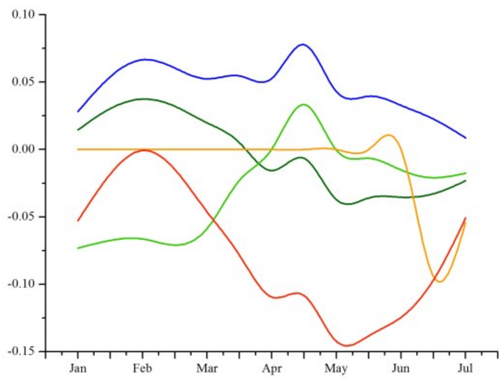
(a) Crop condition development graph based on NDVI



(b) Maximum VCI



(c) Spatial NDVI patterns compared to 5YA

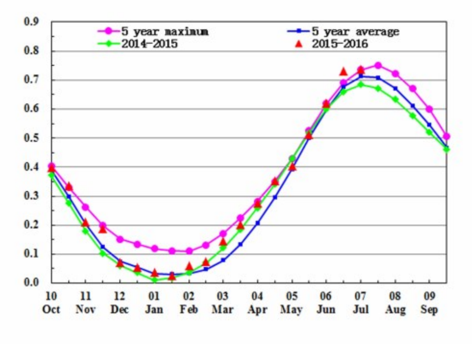


(d) NDVI profiles

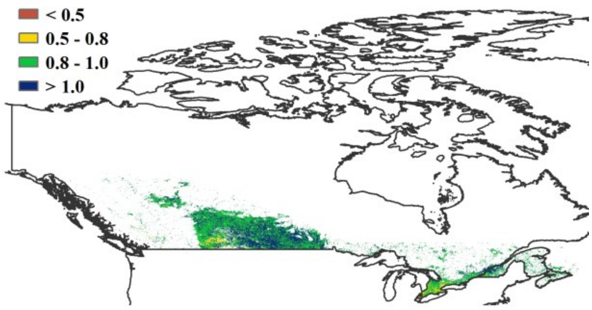
[CAN] Canada

Based on nationwide NDVI development graphs over this monitoring period, significantly above average crop condition prevails in Canada. The period covers the harvesting season of winter crops and early growing season of 2016 summer crops. Three major crop production provinces were dominated by good weather and abundant precipitation: Alberta (RAIN, +16%), Manitoba (RAIN, +23%), and Saskatchewan (RAIN, +16%). On the contrary, insufficient precipitation occurred in eastern provinces, such as Ontario (RAIN, -28%) and Quebec (RAIN, -22%). According to the NDVI profile clusters, favorable summer crop condition prevails in scattered locations in Quebec, southern Ontario, and Alberta, as well as in Southern Manitoba and Saskatchewan, with VCIx greater than one (indicating exceptionally good crop condition). Adequate soil moisture (compared to the five-year average), resulted in a cropped arable land fraction (CALF) increasing 1 percentage point at the expense of fallow land. Crop production is forecast to be above last year's if good weather continues. (See table B.4 in Annex B for Canada's production estimates.)

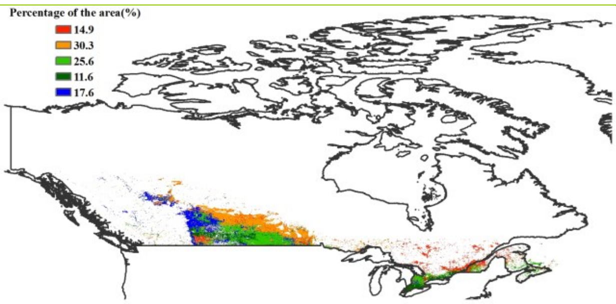
Figure 3.9. Canada crop condition, April-July 2016



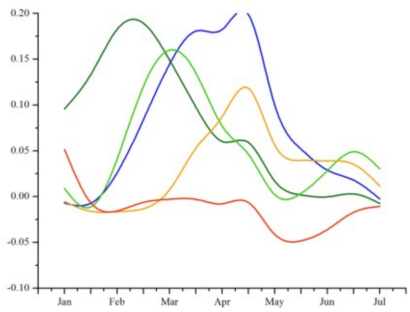
(a) Crop condition development graph based on NDVI



(b) Maximum VCI



(c) Spatial NDVI patterns compared to 5YA



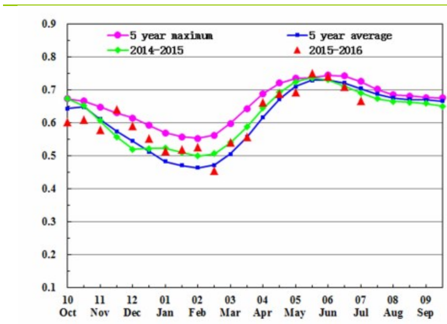
(d) NDVI profiles

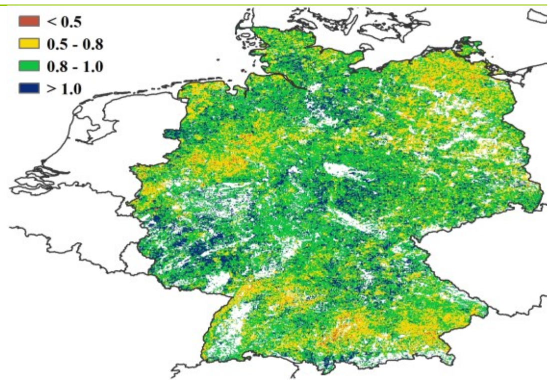
ARG AUS BGD BRA CAN **DEU** EGY ETH FRA GBR IDN IND IRN KAZ KHM MEX MMR NGA PAK PHL POL ROU RUS THA TUR UKR USA UZB VNM ZAF

[DEU] Germany

Overall, mixed crop condition prevails in Germany over the monitoring period. Winter wheat, spring barley, and maize are the main grain crops of Germany; winter wheat has been harvested, while spring barley and maize are in the vegetative stage. The CropWatch agroclimatic indicators show above average rainfall (RAIN, +13%), close to average but cool temperature (TEMP, -0.4°C), and RADPAR at the national level significantly below average (-8%). Above average rainfall occurred throughout the country, with the largest positive departure occurring from late May to June. With favorable moisture and temperature, biomass (BIOMSS) is expected to increase by 8% nationwide compared to the five-year average. As shown by the crop condition development graph, national NDVI values were first above average from April to the middle of May, then below average in May due to floods and low temperature, next above-average in June due to good soil moisture and suitable temperature condition after floods, and finally below average after early July due to a lack of rainfall. National NDVI values started well above average, dropped below that average in early May, and came again close to the five-year maximum from the middle of June to late June, before going below average again. These observations are confirmed by the NDVI profiles. Winter crops had generally favorable or even very favorable condition, with the high VCIx areas and NDVI clusters showing this pattern for Saxony, Sachsen-Anhalt, Thüringen, and northern Bavaria, though with the exception of the northern wheat areas and northeast mixed wheat and sugarbeets areas. Summer crops are about average in most of Germany according to the NDVI profiles, with the exception of an area southwest of the southern highland areas. This spatial pattern is also reflected by the maximum VCI in the different areas, with a VCIx of 0.84 for Germany overall. Generally, the values of agronomic indicators mentioned above indicate favorable condition for most winter and summer crops in Germany.

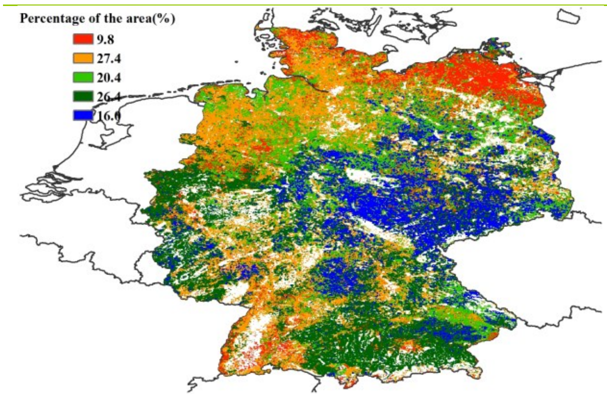
Figure 3.10. Germany crop condition, April-July 2016

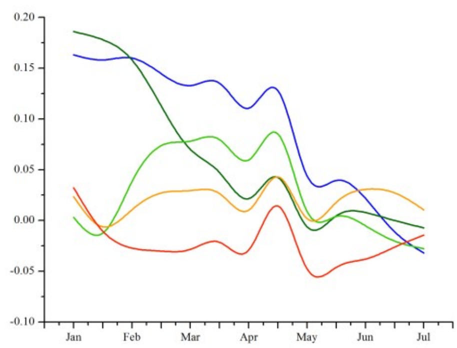




(a) Crop condition development graph based on NDVI

(b) Maximum VCI





(c) Spatial NDVI patterns compared to 5YA

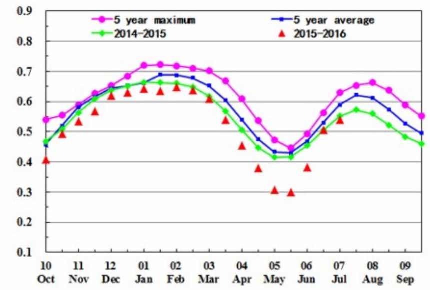
(d) NDVI profiles

[EGY] Egypt

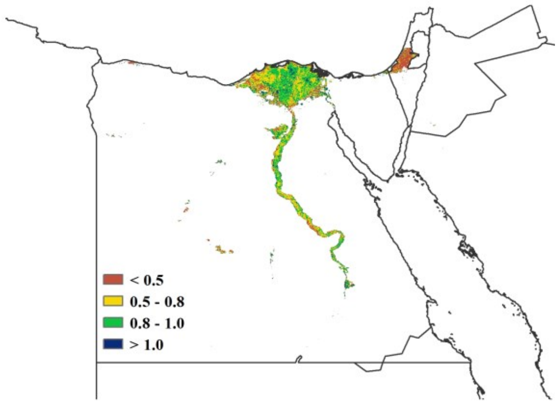
Over the monitoring period, wheat—as one of the major crops in Egypt—has been harvested in early June; the other two major crops, maize and rice, however, are still growing in field. Overall, crop condition in the country was significantly below average from April to early June, but close to average since late June.

The CropWatch agroclimatic indicators show that rainfall was well above average (RAIN, +71%), with about average temperature (TEMP, +0.5°C) and radiation (RADPAR, +1%). The rainfed BIOMSS, hence, increased by 26% compared to average. According to the spatial pattern map of maximum VCI, the values of this indicator were between 0.8 and 1.0 in most cropped areas of Egypt, with lower values below 0.5 only occurring in small regions along the river and in the western and south-eastern Delta. The spatial pattern and NDVI departure profiles show that crop condition was about average throughout the country except in 38% of the areas, mainly in the Delta, where the NDVI was below average by as much as 0.1 at the end of the cycle of wheat. Conditions improved in July when all crops were about average. As the cropped arable land fraction (CALF) decreased by 9 percentage points compared with average, the crop yields in Egypt are estimated to be below average.

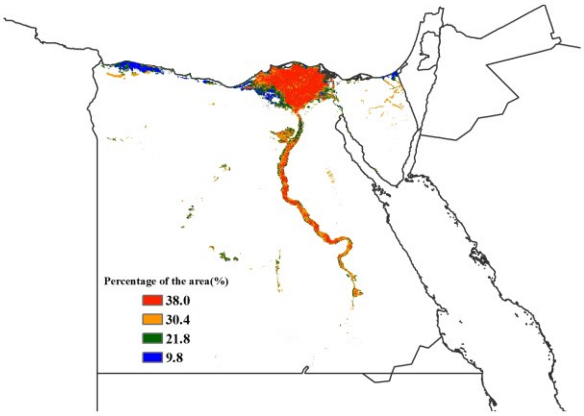
Figure 3.11. Egypt crop condition, April-July 2016



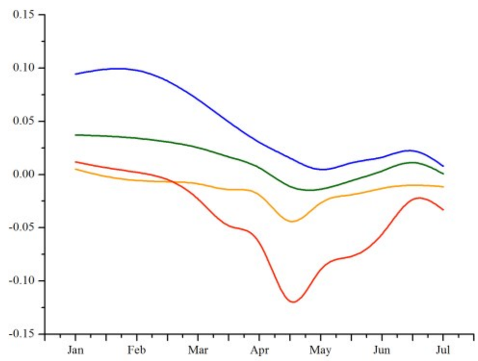
(a) Crop condition development graph based on NDVI



(b) Maximum VCI



(c) Spatial NDVI patterns compared to 5YA



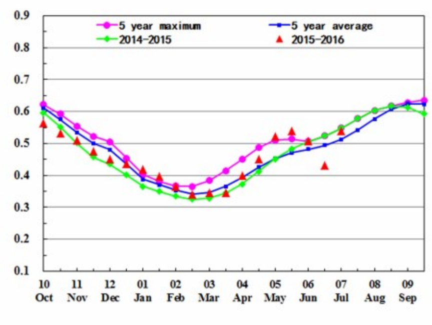
(d) NDVI profiles

ARG AUS BGD BRA CAN DEU EGY **ETH** FRA GBR IDN IND IRN KAZ KHM MEX MMR NGA PAK PHL POL ROU RUS THA TUR UKR USA UZB VNM ZAF

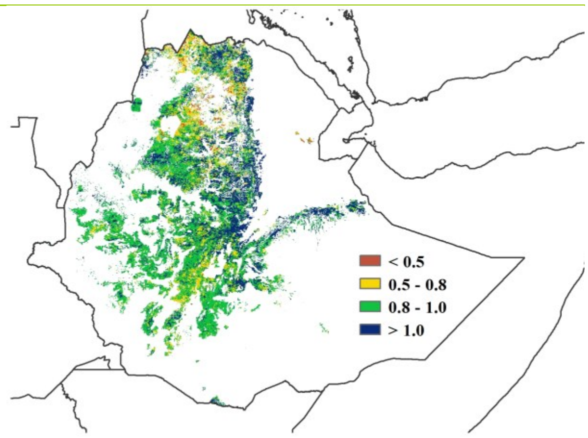
[ETH] Ethiopia

In the main agricultural regions in Ethiopia two rainy seasons exist—the Meher and the Belg, resulting in two crop seasons. Meher is the main crop season. It encompasses crops harvested between Meskerem (September) and Yeaktit (February). Crops harvested between Megabit (March) and Nehase (August) are considered part of the Belg season crop. The most important contribution of the Belg season to total production is maize. In western maize zones, rainfall was 766 mm (RAIN, +8% over average) and the biomass production potential increased 4%, in spite of rather cool temperature (-0.8°C). The southwestern coffee zones recorded decreased RAIN (-21%), BIOMSS (-11%), and TEMP (-0.6°C). Overall, the reporting period, which largely coincides with the planting of Meher and harvest of Belg crops, suffered below average rainfall (RAIN, -5%) and temperature (TEMP, -0.3°C) countrywide. The national average of the VCIx (0.94) was above average, and the cropped arable land fraction (CALF) increased by 5 percentage points compared to its five-year average. As shown in the NDVI crop condition development graph, NDVI was average or above average in this monitoring period. The spatial NDVI patterns show that in some parts of southern Ethiopia, including in Arba Minch and Hosaena and covering 16.2% of the total area, the NDVI is significantly below the five-year average before June and above average thereafter. Altogether, and with the possible exception of the northeastern SNPP, the outlook for Meher crops is favorable.

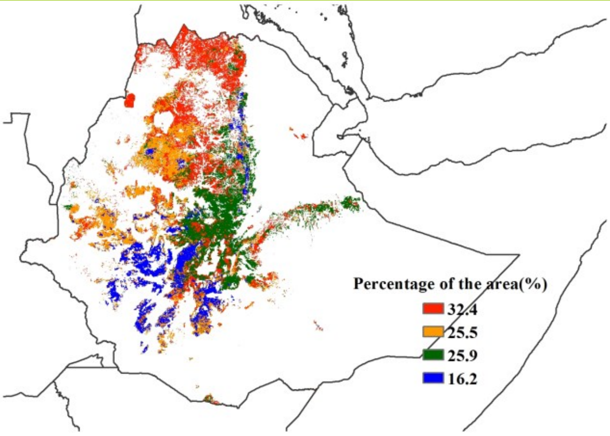
Figure 3.12. Ethiopia crop condition, April-July 2016



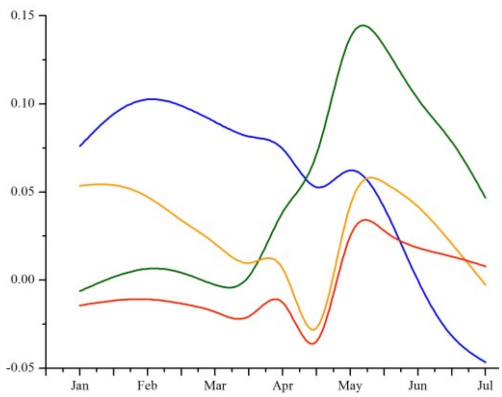
(a) Crop condition development graph based on NDVI



(b) Maximum VCI



(c) Spatial NDVI patterns compared to 5YA

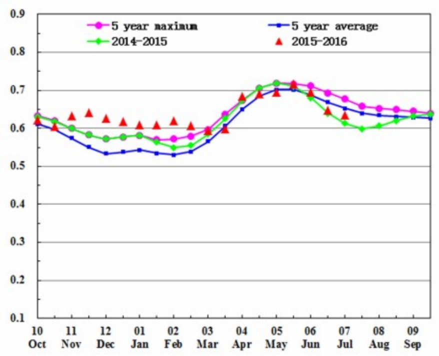


(d) NDVI profiles

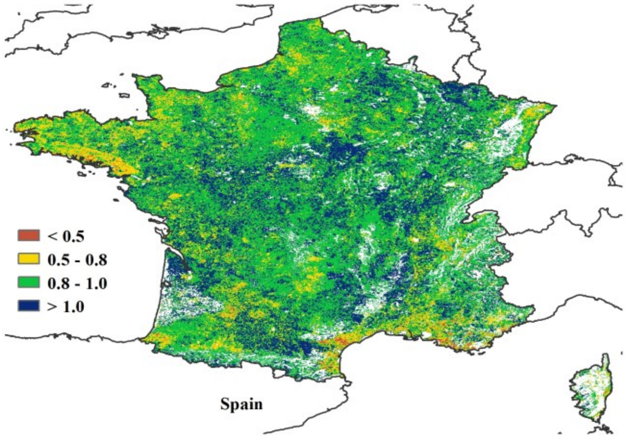
[FRA] France

Crops in France show mixed condition over the reporting period. Currently, winter wheat and spring barley have been harvested, while maize is in the vegetative stage. At the national level, compared with average, CropWatch agroclimatic indicators show that the reporting period recorded a 9% decrease in RAIN, a 0.2°C decrease in TEMP, and a significant 8% below average RADPAR. BIOMSS presents a 3% decrease compared to the five-year average. As shown by the crop condition development graph, national NDVI values were well above average and even above the five-year maximum from early April to late May due to sufficient rainfall and favorable temperature. National NDVI values began to drop below average from June—dropping even below last year's values, which is consistent with the occurrence of sudden flooding from late May to early June. Next to floods in the eastern half of the country (except its very south), drought and high temperature occurred in some areas over the reporting period, such as RAIN values of -23% from Pays de Loire to Poitou-Charentes (maize, barley, and rapeseed zone), -26% in Basse Bretagne to Haute Normandie (maize and barley), -19% from Limousin to the northwest of Rhone-Alpes, and -23% in both the southwestern maize zone (Aquitaine and Midi-Pyrénées) and the Mediterranean area. The spatial NDVI patterns compared to the five-year average and corresponding NDVI departure cluster profiles also indicate that NDVI is above average in winter crop areas and below average from June in summer crop areas. This spatial pattern is reflected by the maximum VCI in the different areas, with a VCIx of 0.93 for France overall. Generally, the agronomic indicators mentioned above show favorable condition for most winter crop areas but less favorable condition for some summer crop areas due to excess water.

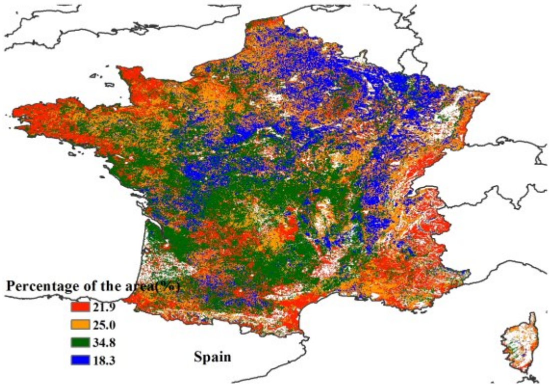
Figure 3.13. France crop condition, April-July 2016



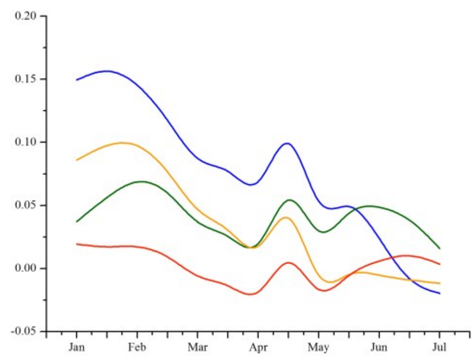
(a) Crop condition development graph based on NDVI



(b) Maximum VCI



(c) Spatial NDVI patterns compared to 5YA



(d) NDVI profiles

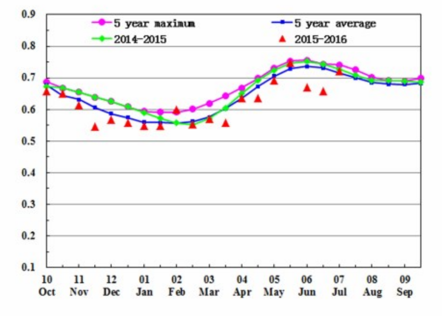
ARG AUS BGD BRA CAN DEU EGY ETH FRA **GBR** IDN IND IRN KAZ KHM MEX MMR NGA PAK PHL POL ROU RUS THA TUR UKR USA UZB VNM ZAF

[GBR] United Kingdom

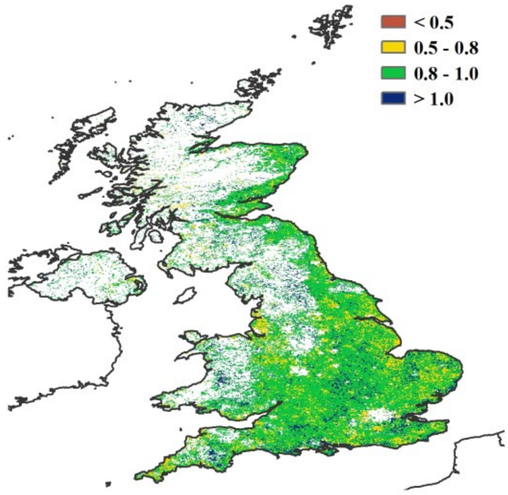
Crops in the United Kingdom showed mostly average conditions during the period from April to July 2016. During this period, most of the winter wheat, oats, and all the winter barley and winter rapeseed have been harvested, while spring barley is in the vegetative stage. Compared to average, the CropWatch agroclimatic indicators show that rainfall was in excess (RAIN, +16%) with average temperature (TEMP, +0.1°C) and well below average radiation (RADPAR, -6%). BIOMSS is expected to increase by 10% compared to the five-year average.

The national average of the VCIx (0.89) was above average, and the cropped arable land fraction remained unchanged compared to its five-year average. According to the crop condition map based on NDVI, close to 27.3% of the country recorded lower than average NDVI from May to July. Nonetheless, overall NDVI values for 72.7% of the region were average by July, with low NDVI values limited to 3.8% of agricultural areas, mostly in north Yorkshire and Humberside.

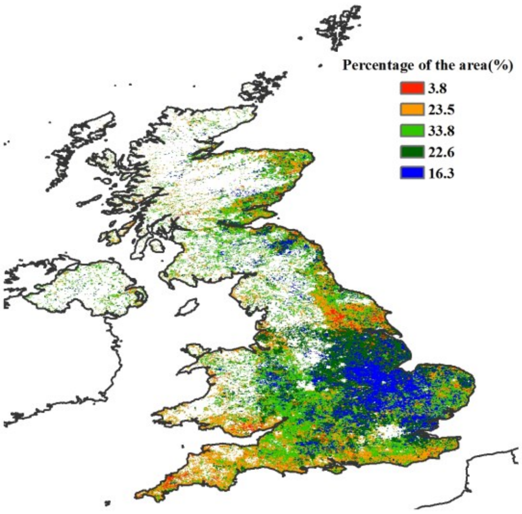
Figure 3.14. United Kingdom crop condition, April-July 2016



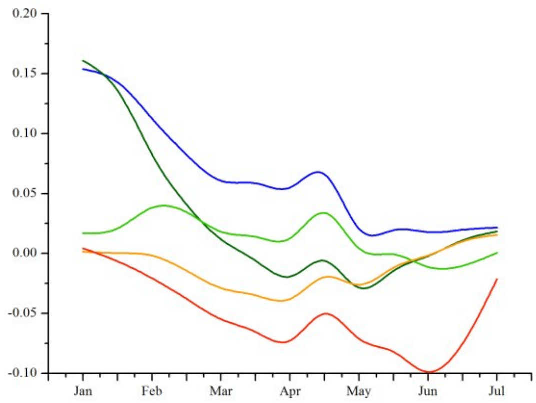
(a) Crop condition development graph based on NDVI



(b) Maximum VCI



(c) Spatial NDVI patterns compared to 5YA

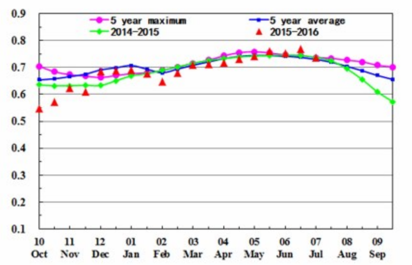


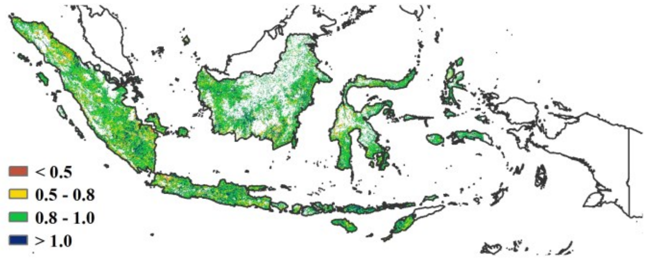
(d) NDVI profiles

[IDN] Indonesia

Crops in Indonesia generally showed average condition between April and July. The monitoring period covers the harvest of the main rice and rainfed maize crop, as well as the growing of secondary rice. Compared with the recent average, rainfall and temperature were above average (RAIN, +15% and TEMP, +0.7°C), while the radiation values were about 3% below. The cropped arable land fraction (CALF) remained stable compared with previous years; and the average VCIx value is 0.72. Due to the favorable temperature and moisture conditions in this period, biomass increased 8% compared to the recent five-year average. According to the NDVI clusters, crop condition in most parts of the nation stayed average to slightly above average, except in Kalimantan Barat in the west of Kalimantan where NDVI was relatively low from late January to March. National NDVI profiles also present overall average NDVI from early July. Altogether, CropWatch estimates that normal yields can be expected for this season's crops.

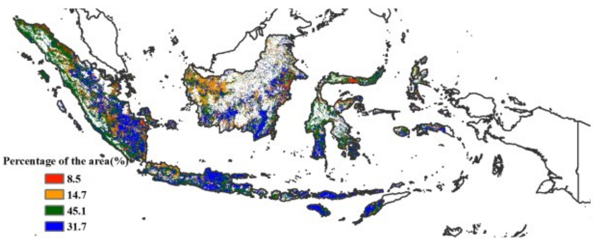
Figure 3.15. Indonesia crop condition, April-July 2016

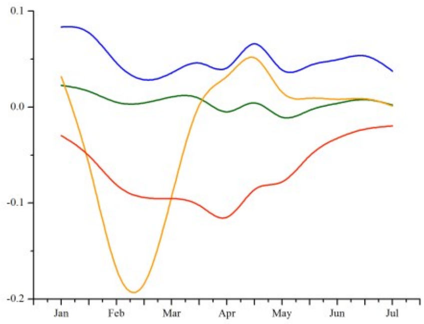




(a) Crop condition development graph based on NDVI

(b) Maximum VCI





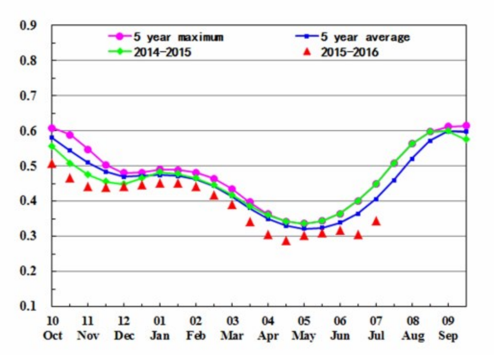
(c) Spatial NDVI patterns compared to 5YA

(d) NDVI profiles

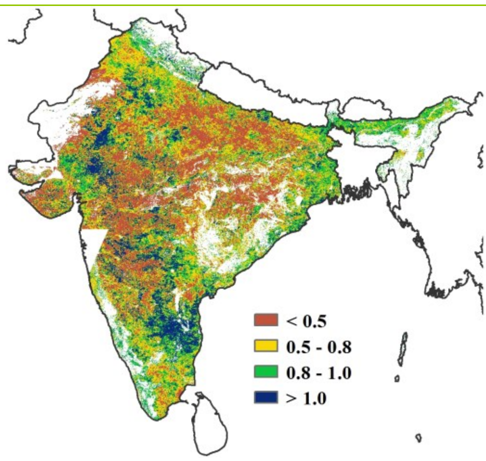
[IND] India

The monitoring period is the harvesting of Rabi and planting of Kharif crops. Severe floods damaged the crops in many states. Mostly affected regions were Assam, West Bengal, Bihar, Madhya Pradesh, Uttarakhand, and Arunachal Pradesh. The crop condition development was below average over the monitoring period. The maximum VCI values were below 0.5 for most of the states, confirming poor crop condition. The NDVI values remained favorable for the Northeast region, Tamil Nadu, Gujarat, Punjab, Haryana, Rajasthan, and West Bengal. Over central India, the NDVI profiles dropped sharply in the end of April and recovered in mid-May, dropping again from early June. In the rest of the regions, the NDVI fell in the end of April and somewhat recovered mid-May. The rainfed biomass accumulation potential was 8% above the five-year average and could be linked to the 20% excess rainfall over the country, mainly in the following states: Assam (RAIN, +20%), Bihar (+17%), Chhattisgarh (+36%), Haryana (+36%), Maharashtra (+31%), Madhya Pradesh (+75%), Manipur (+43%), Nagaland (+25%), Rajasthan (+94%), Arunachal Pradesh (+13%), Tamil Nadu (+36%), Andhra Pradesh (+54%), Tripura (+9%), Uttarakhand (+24%), Uttar Pradesh (+39%), and West Bengal (+5%). However, low rainfall was measured in some states like Gujarat (RAIN, -18%), Goa (-30%), Kerala (-26%), Orrisa (-18%), and Punjab (-20%). The crop arable land fraction (CALF) dropped by -12 percentage points compared to the five-year average. Temperature (TEMP) was average, while radiation (RADPAR) was -3% below. Overall, assessed crop condition is poor and the expected reduced output is mainly due to the excess rainfall, flooding, and decreased area of cultivated land.

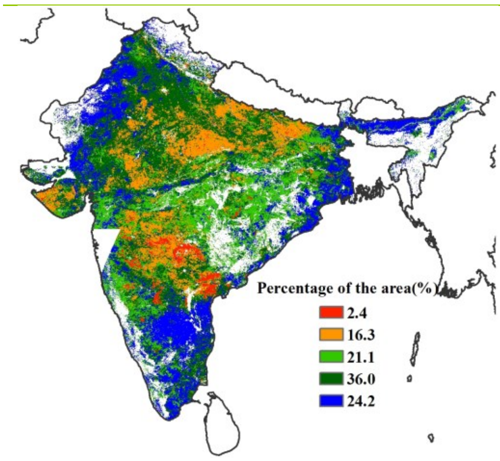
Figure 3.16. India crop condition, April-July 2016



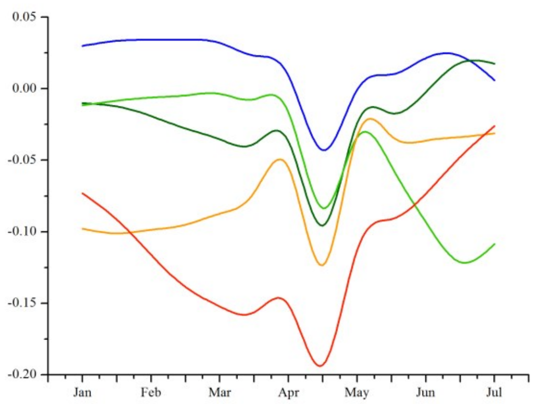
(a) Crop condition development graph based on NDVI



(b) Maximum VCI



(c) Spatial NDVI patterns compared to 5YA



(d) NDVI profiles

ARG AUS BGD BRA CAN DEU EGY ETH FRA GBR IDN IND **IRN** KAZ KHM MEX MMR NGA PAK PHL POL ROU RUS THA TUR UKR USA UZB VNM ZAF

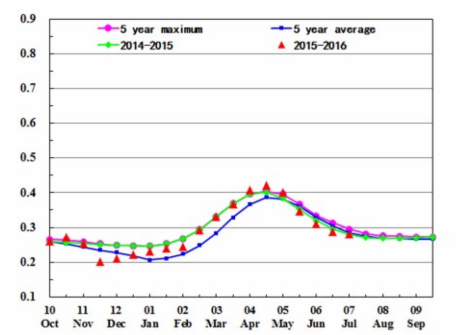
[IRN] Iran

The crop condition from April to July 2016 was generally below average in Iran. Winter wheat was harvested from June to July, and summer crops were planted starting in May. Accumulated rainfall (RAIN, -23%) was far below average during the monitoring period, while temperature (TEMP, -0.5°C) and radiation (RADPAR, -1%) were only slightly below average. The agroclimatic indices for the current season indicate unfavorable weather conditions for crop growth, which is confirmed by the decrease of the BIOMSS index by 9%. The national average of the VCIx (0.88) was above average, and the CALF increased by a spectacular 26 percentage points compared to the five-year average.

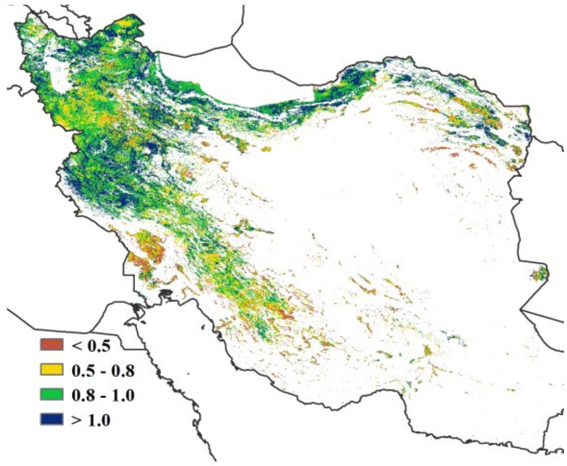
During the whole monitoring period, crop condition above the five-year average occurred in Kermanshah, Llam and surrounding provinces of the western region, and the Mazandaran and Gilan provinces of the central-north region. Khuzestan and Fars provinces in the southwest region, as well as most of the northwest and eastern regions, generally experienced unfavorable crop condition from May to July.

Overall, the total outcome of summer crops is expected to be favorable because of the significant increase of cropped arable land.

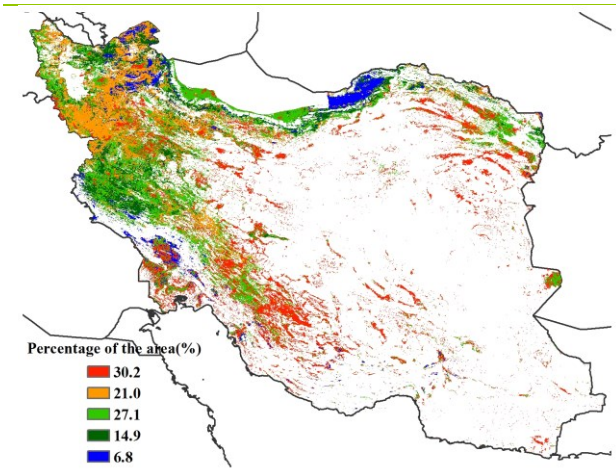
Figure 3.17. Iran crop condition, April-July 2016



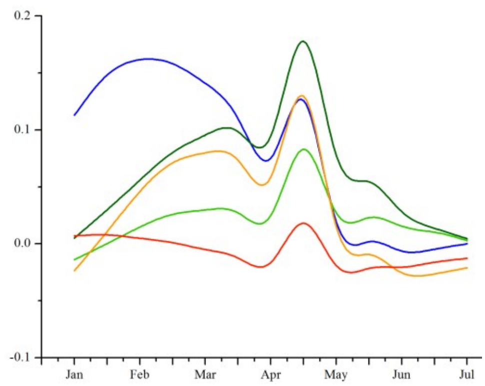
(a) Crop condition development graph based on NDVI



(b) Maximum VCI



(c) Spatial NDVI patterns compared to 5YA



(d) NDVI profiles

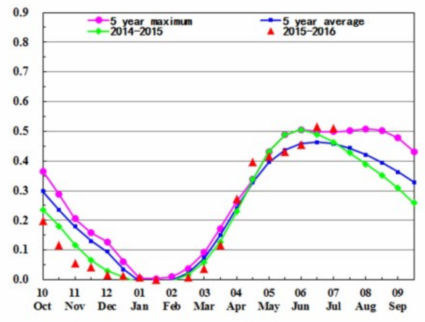
[KAZ] Kazakhstan

Spring wheat and barley were sowed before June and now are growing; other cereals in the country also entered into their vegetative stage. During the reporting period, crop condition in Kazakhstan was generally favorable.

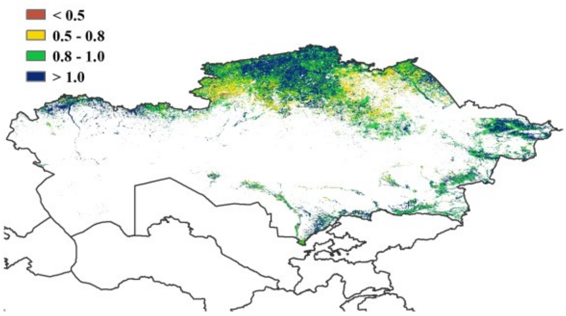
Among the CropWatch agroclimatic indicators, RAIN was very significantly above average (+71%), with close to average temperature (TEMP) and well above average radiation (RADPAR, +6%). This resulted in a marked BIOMSS increase over the five-year average (+44%). Crops developed well and crop condition was above the maximum of the past five years in April. Maximum VCI was above 0.8 in most areas. Considering the current NDVI profiles and spatial NDVI patterns compared to the past five years, most of the areas in Kazakhstan are above average this month. In about 72% of the cultivated areas (mainly in Kustanayskaya, Severo kazachstanskaya, Akmolinskaya, Pavlodarskaya, and Vostochno kazachstanskaya), the condition of crops was slightly below average from early May to early June. Later, the vegetation index gradually increased and reached the maximum of the past five years in late June and July.

During the reporting period, thanks to abundant precipitation, the country enjoyed favorable conditions that will benefit crops and grazing lands.

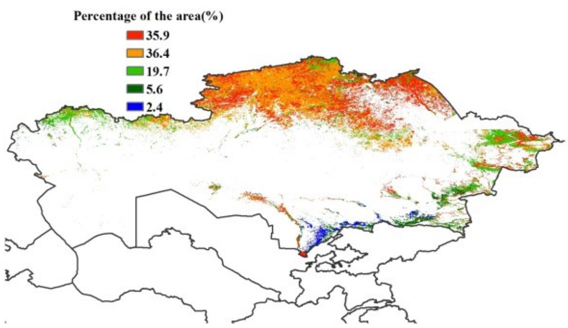
Figure 3.18. Kazakhstan crop condition, April-July 2016



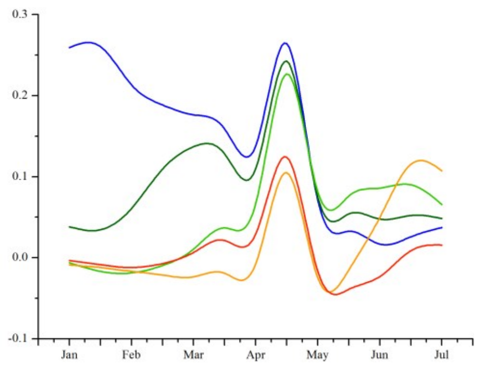
(a) Crop condition development graph based on NDVI



(b) Maximum VCI



(c) Spatial NDVI patterns compared to 5YA

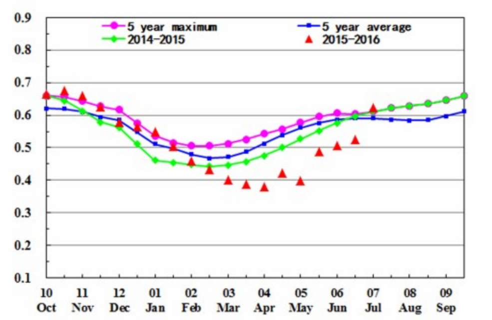


(d) NDVI profiles

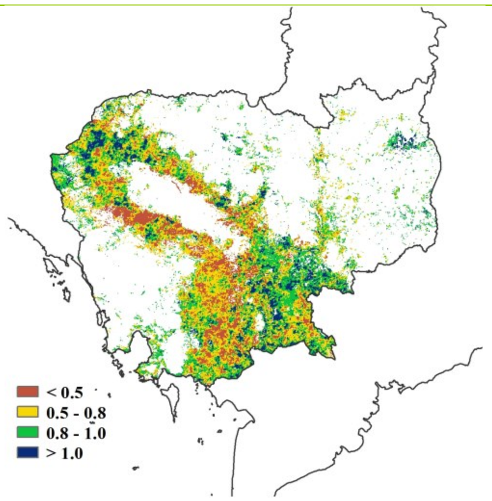
[KHM] Cambodia

The period from April to July 2016 covers the harvest of the second (dry season) rice, the early stage of the main (wet season) rice, and the growing period of maize. Compared to the five-year average, crop condition before July was well below average since April. The CropWatch agroclimatic and agronomic indicators show that Cambodia enjoyed a minor increase in precipitation compared to average (RAIN, +7%), with average temperature (TEMP, -0.1°C). This resulted in a biomass production potential (BIOMSS) drop of 7%. Low vegetation condition indices (VCIx<0.5) occur scattered around Tonle Sap. Average VCIx reaches just 0.75 and the cropped arable land fraction (CALF) dropped by a spectacular 7% compared with the previous five seasons. NDVI of most of the arable land (80%) presents continuous below average condition except for Kampong Chaam, Prey Veaeng, and some other, scattered areas. Overall crop prospects for the country are very poor.

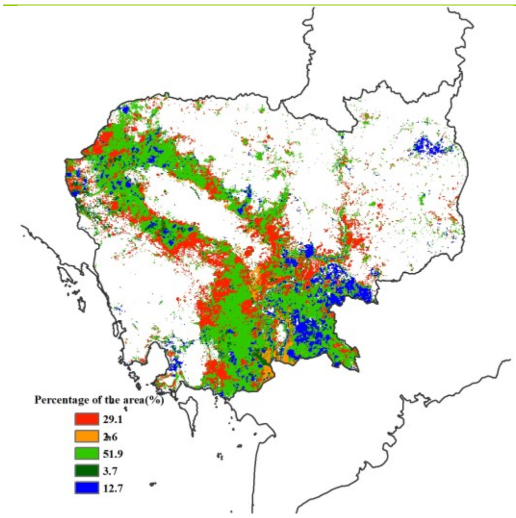
Figure 3.19. Cambodia crop condition, April-July 2016



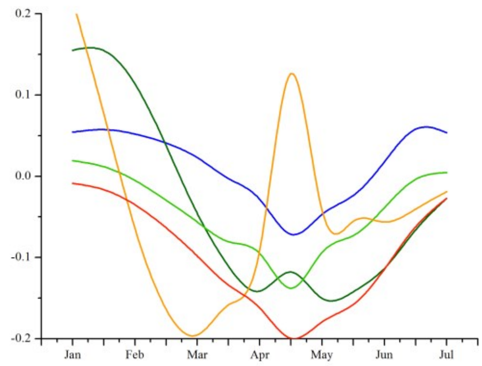
(a) Crop condition development graph based on NDVI



(b) Maximum VCI



(c) Spatial NDVI patterns compared to 5YA



(d) NDVI profiles

ARG AUS BGD BRA CAN DEU EGY ETH FRA GBR IDN IND IRN KAZ KHM **MEX** MMR NGA PAK PHL POL ROU RUS THA TUR UKR USA UZB VNM ZAF

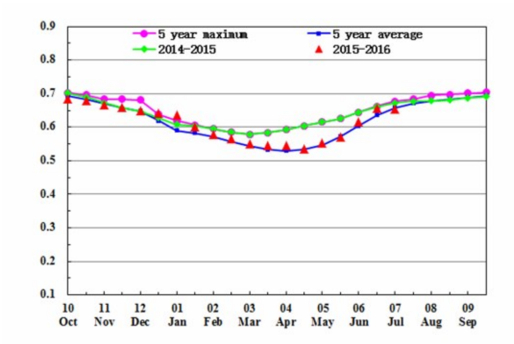
[MEX] Mexico

In Mexico over the reporting period, maize, sorghum (autumn-winter), and wheat have been harvested, while the sowing of maize, sorghum (spring-summer), and rice is underway. In general, crop condition was at the same level as the average of the recent five years.

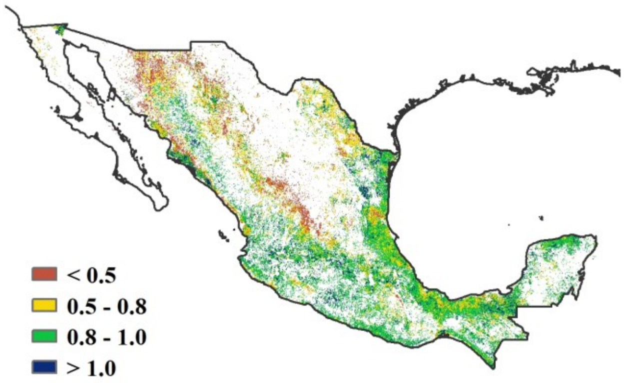
According to the CropWatch agroclimatic indicators, rainfall increased by 4%, whereas temperature dropped by 0.5°C, both compared to average. RADPAR was average. Agronomic indicators for the country show that BIOMSS (+5%) and the cropped arable land fraction (CALF, +1 percentage point) were above average. The average maximum VCI in Mexico was 0.79, with higher values (0.8-1.0) occurring in the south and southeast parts of the country and lower values (<0.5) in northwest and central parts. The spatial pattern and NDVI departure profiles show that crop condition for about 46% of planted areas was above average (mainly in southern and northeastern Mexico), while 40% of cropped areas, located in the northwest and eastern parts of the country, were below average.

Altogether, crop production in Mexico is likely to be average.

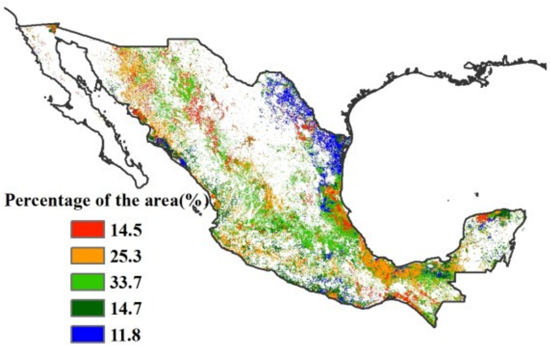
Figure 3.20. Mexico crop condition, April-July 2016



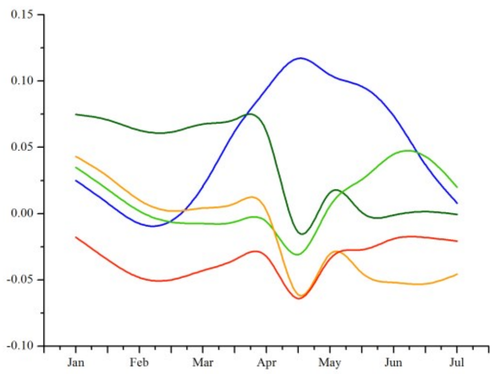
(a) Crop condition development graph based on NDVI



(b) Maximum VCI



(c) Spatial NDVI patterns compared to 5YA

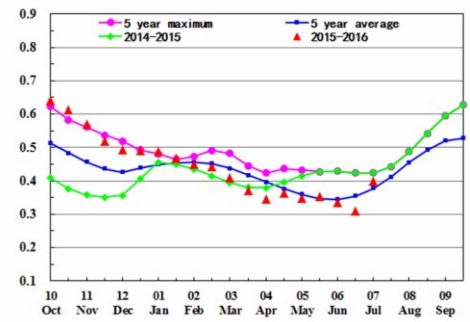


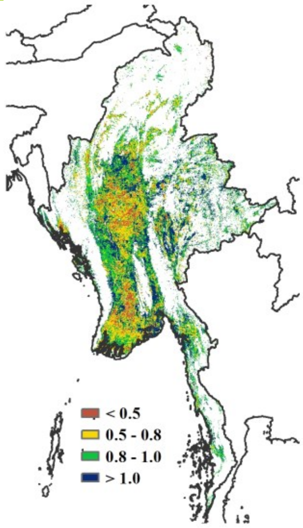
(d) NDVI profiles

[MMR] Myanmar

The reporting period is the main rice season in Myanmar. The harvesting period of the maize, wheat, and second rice crop was completed in mid-April, mid-May, and mid-June respectively, with the main rice crop starting growth in early May. Based on CropWatch indicators, crop condition was average from April to July. The CropWatch agroclimatic and agronomic indicators showed an increases in rainfall (RAIN, +9%) but a slight decrease in temperature (TEMP, -0.4°C). The fraction of cropped arable land (CALF) decreased by 2 percentage points while biomass accumulation potential (BIOMSS) increased by 1% compared to the previous five-year average. Crop condition development was above the five-year average in July, while below average values prevailed from April to June. The spatial NDVI profile values were below average from April to June in the whole country, and recovered in mid-June only for Yangon and part of the center, which is consistent with the maximum VCI map. Overall, CropWatch assesses the crop condition and production outlook as average to below average.

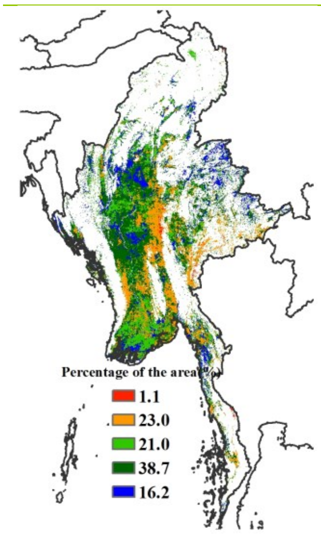
Figure 3.21. Myanmar crop condition, April-July 2016

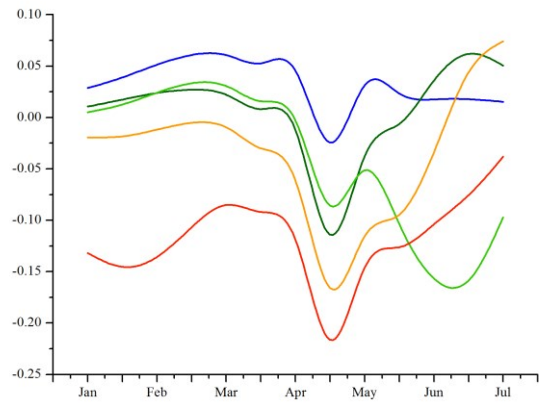




(a) Crop condition development graph based on NDVI

(b) Maximum VCI





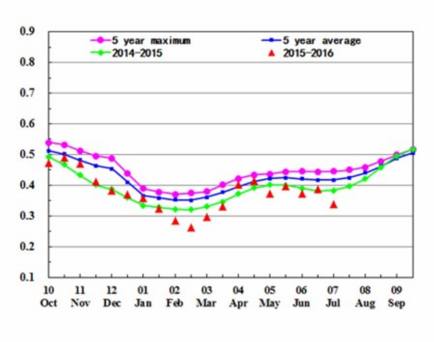
(c) Spatial NDVI patterns compared to 5YA

(d) NDVI profiles

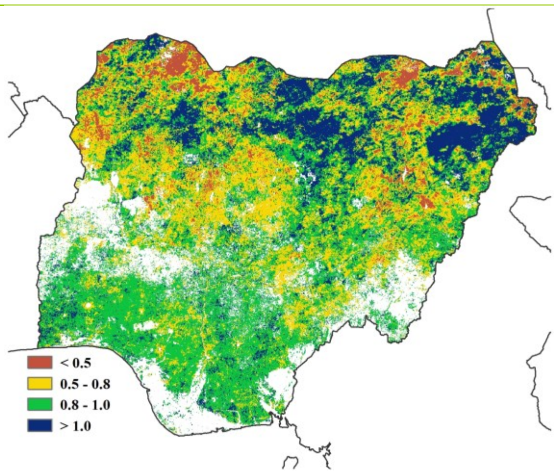
[NGA] Nigeria

Rain, temperature, and sunshine conditions in Nigeria were close to average during the monitoring period. Among all the four ecological zones, the Sudan-Sahelian area had the largest increase in potential biomass (BIOMSS, +24%), resulting from a large increase in rainfall (RAIN, +26%). Considering biomass, only a slight change in biomass production potential occurred in both the Derived Savanna zone and the Humid Forest zone (BIOMSS, +1% and +3% respectively), as these two regions also had only limited changes in rain (RAIN, -4% and -2% respectively), temperature (-0.6°C and 0.0°C), and sunshine (+1% and -3% respectively) in the past few months. A 9% increase in BIOMSS was found for the Guinean Savanna. According to the value for the Cropped Arable Land Fraction (CALF), Nigeria crop land expanded 2 percentage point compared with the five-year average. The NDVI profiles show that most parts of the north were close to average, in an area where VCIx reached record values above 1. The only current area of concern is in the south and especially southwest (Osun, Oyo, Ekiti, covering about 6.5% of arable lands) where NDVI departs from average by more than -0.2. Altogether, crop condition is favorable, especially in the north.

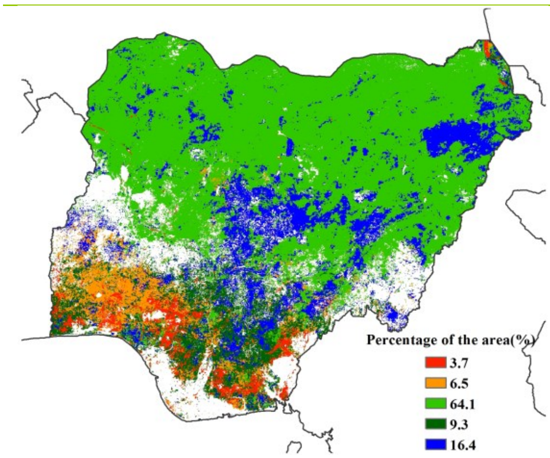
Figure 3.22. Nigeria crop condition, April-July 2016



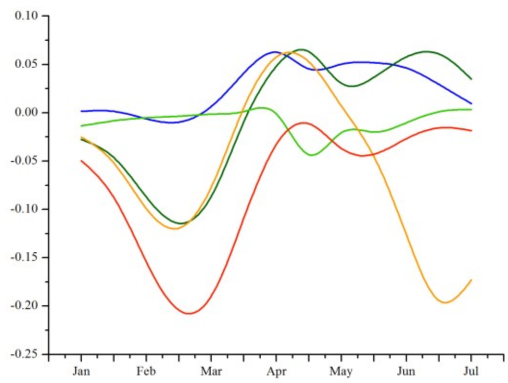
(a) Crop condition development graph based on NDVI



(b) Maximum VCI



(c) Spatial NDVI patterns compared to 5YA

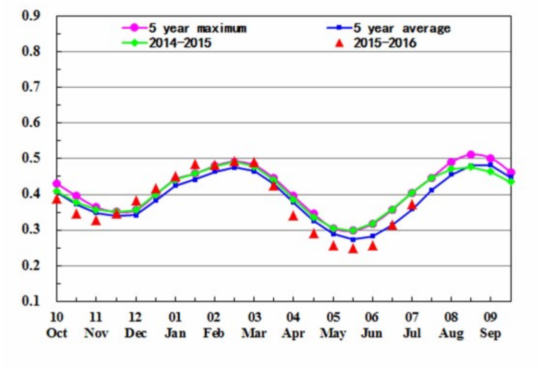


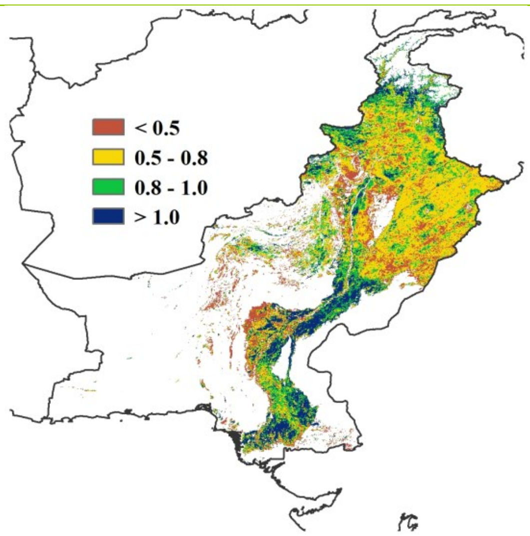
(d) NDVI profiles

[PAK] Pakistan

The reporting period covers the harvest of winter wheat and barley, as well as the sowing and early growth of summer crops (cotton, rice, and maize). Agroclimatic indicators show an increase of rainfall over average (RAIN, +15%) and a decline of radiation (RADPAR, -1%). Temperature was below average (TEMP, -0.7°C), whereas the biomass production potential is close to average (BIOMASS, +2%). CALF diminished (-8 percentage point) below its five-year average. The national NDVI development graph illustrates that crop condition was below average from the start of April till the end of June, after which values turned average. The lowest maximum VCI values (<0.5) arise in Punjab and the Baluchistan provinces, upper Sindh, and southern Khyber Pakhtunkhwa. According to the NDVI profiles, 63.2% of the cropped areas exhibit below average conditions, much of it in Baluchistan province and central-east Punjab. On the other hand, 36.8% of the areas show above average NDVI, mostly in the regions along the lower Indus River or northern Khyber-Pashtun province. Altogether, crop condition is estimated to be average.

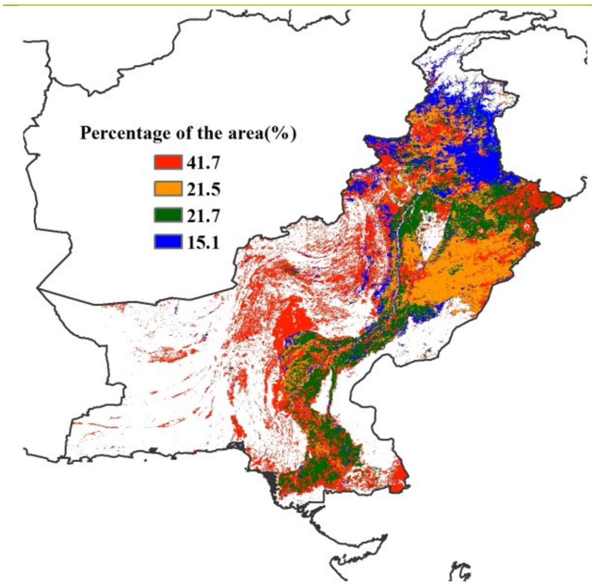
Figure 3.23. Pakistan crop condition, April-July 2016

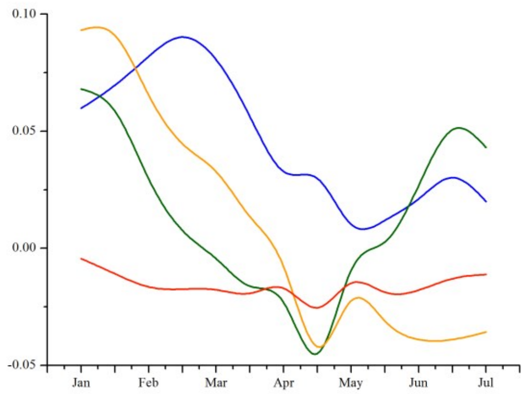




(a) Crop condition development graph based on NDVI

(b) Maximum VCI





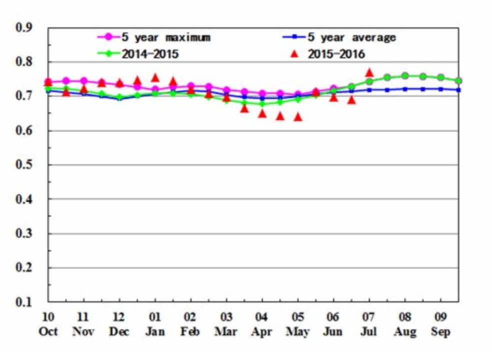
(c) Spatial NDVI patterns compared to 5YA

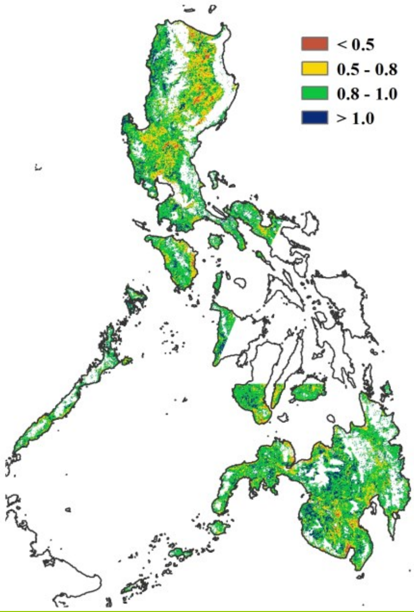
(d) NDVI profiles

[PHL] The Philippines

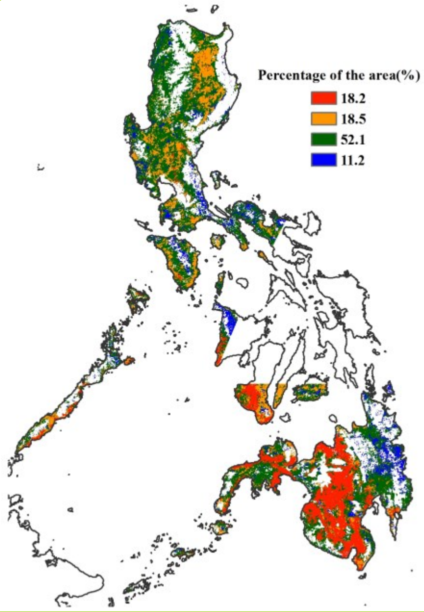
In the Philippines, the main rice crop is currently growing, while maize has reached maturity and is about to be harvested. Nationwide, radiation was slightly above average (RADPAR, +2%), while rainfall (RAIN) was 6% below average, resulting from the recent El Niño impacts in the Asia-Pacific region; the biomass accumulation potential (BIOMSS) shows a significant decrease of 8%. The average national maximum VCI was 0.88 and the cropped arable land fraction (CALF) remained the same as during 2015. Considering the spatial patterns of NDVI profiles, crop condition in Caraga and Bicol region was above average during the whole monitoring period. In Soccsksargen and northern Mindanao, crop condition was much below average due to seasonal rainfall deficits from March to May, then recovered to average in June. NDVI in the beginning of May was significantly below average but returned to the maximum value in late-July. Altogether, the output of the main season rice is expected to be about average or just below.

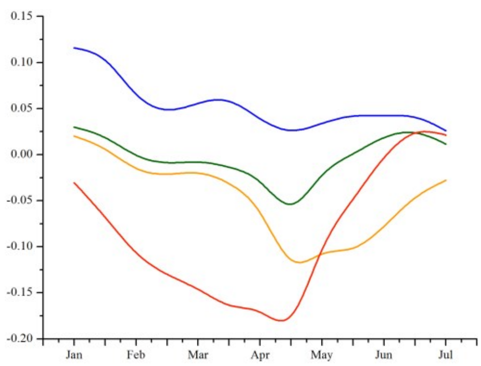
Figure 3.24. Philippines crop condition, April-July 2016





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





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

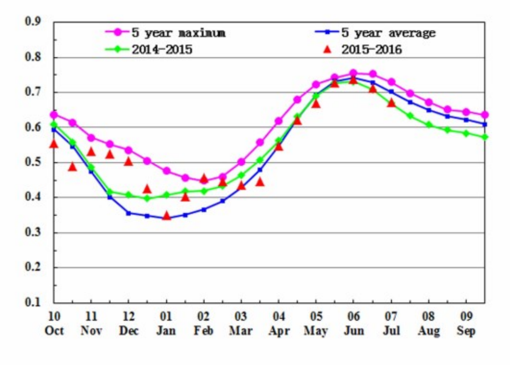
ARG AUS BGD BRA CAN DEU EGY ETH FRA GBR IDN IND IRN KAZ KHM MEX MMR NGA PAK PHL **POL** ROU RUS THA TUR UKR USA UZB VNM ZAF

[POL] Poland

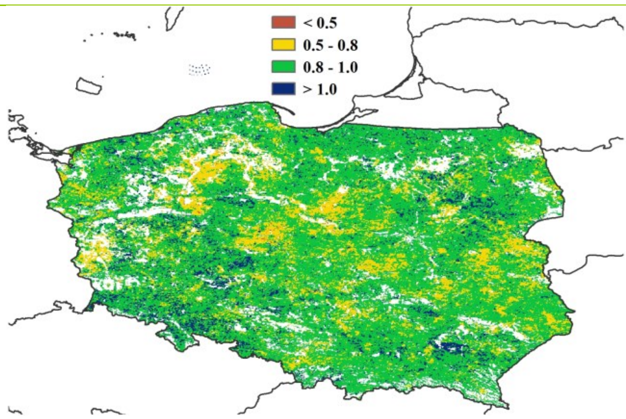
In Poland, maize planting begins in May, while winter wheat harvesting starts in July. Over the reporting period, the cropped arable land fraction (CALF) remained the same as the average of the last five years. During April to July, rainfall (RAIN) was up 11% compared to average. Both temperature (TEMP) and radiation (RADPAR) were near average, while the potential biomass (BIOMSS) increased 5% due to the sufficient rainfall.

As shown in the NDVI crop condition development graph, the NDVI in Poland is below average but comparable to the previous 2014-15 season. In most parts of the country with the exception of the southwest, NDVI was lower than usual until May due to the poor weather conditions early in the season; afterwards, however, NDVI recovered as a result of sufficient rainfall. In the southwest, including Dolnosalaskie and Wielkopolskie, crop development is slightly advanced. Considering the average VCIx of 0.87, the final assessment for Poland is that crop condition is mixed but fair.

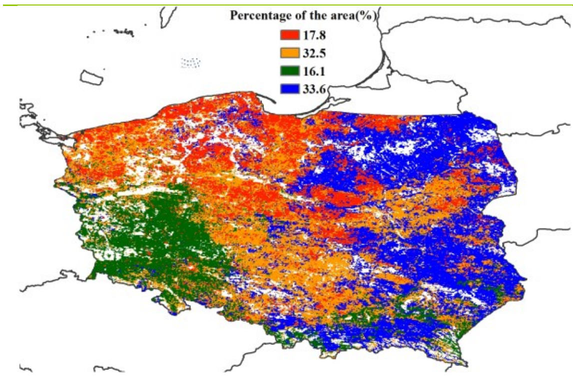
Figure 3.25. Poland crop condition, April-July 2016



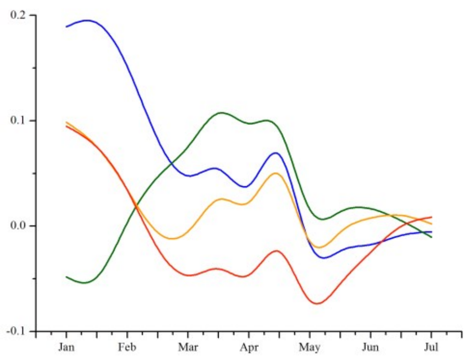
(a) Crop condition development graph based on NDVI



(b) Maximum VCI



(c) Spatial NDVI patterns compared to 5YA



(d) NDVI profiles

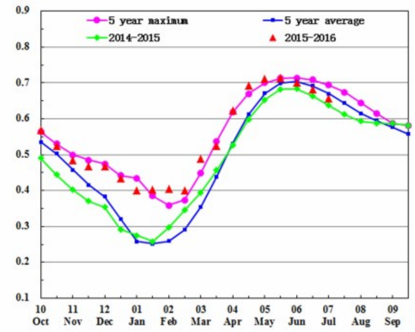
[ROU] Romania

In Romania, the winter wheat harvest starts in July, while summer crops are planted from May. These include maize, sunflower, some fruits and vegetables, fodder, soybeans, rapeseed, potatoes, and pulses; which in the south are mostly irrigated (with the exception of temporary fodder). Romania presented favorable crop condition from April to July (VCIx=0.98). Overall, temperature (TEMP) was average with a minor rainfall anomaly (RAIN, +13%), a positive biomass production potential (BIOMSS, +8%), and lower than average sunshine (RADPAR, -1%).

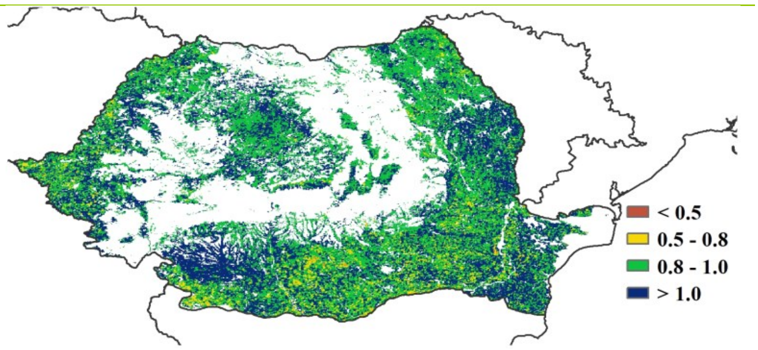
As shown in the national crop condition development graph, NDVI rather closely followed the maximum of the previous five years from April to May, while after May the NDVI suddenly declined compared to both the five-year maximum and five-year average, following the trend of 2014-2015 up to the end of the reporting period. In most parts of southern, southeast, central, and northwest Romania, crop condition is above average (VCIx 0.8-1.0 and >1.0), except for some small patches in southern and northwest Romania which had average condition (VCIx 0.5-0.8). In some parts of the country, for instance in the south and southeast (VCIx 0.8-1.0 and >1.0 range), the NDVI profile is consistently and significantly average (that is, 0.29 since April), while suddenly declining at the end of April up to the start of July, reaching low NDVI values (that is, <0.0) in 10.5% of the cropped area.

In the west and some patches in the south where VCIx is 0.8-1.0, about 32.8% of cropland had a marked drop of NDVI after the end of April, reaching a low but nevertheless positive NDVI departure. This is also the only area, along the Hungarian border, where the biomass production potential shows positive departures from the recent average. Located in parts of the northeast and in the center, about 33.3% of cropped areas had a marked drop of NDVI after the end of April reaching average NDVI until the start of July. Considering the summer conditions, and the fact that CALF remained average, summer crop prospects are average.

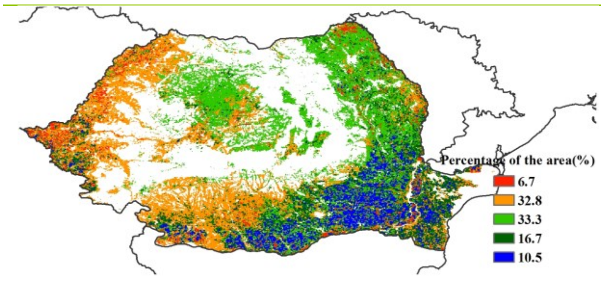
Figure 3.26. Romania crop condition, April-July 2016



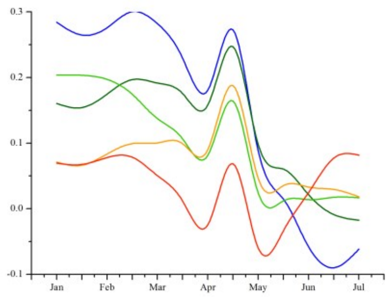
(a) Crop condition development graph based on NDVI



(b) Maximum VCI



(c) Spatial NDVI patterns compared to 5YA



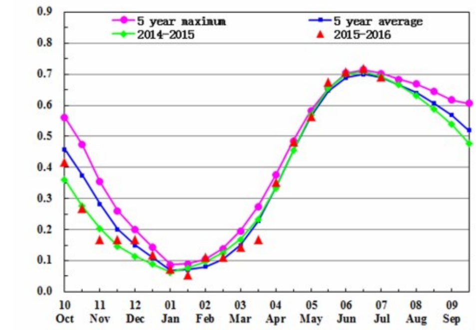
(d) NDVI profiles

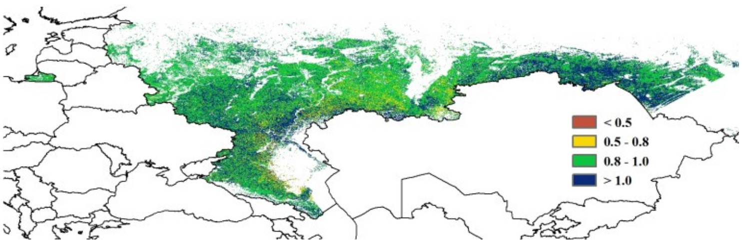
[RUS] Russia

Russia experienced very favorable climate conditions from April to July (VCIx=0.92).The winter wheat harvest in the country began in mid-June, while the planting of maize and spring wheat started in April. The fraction of cropped arable land was 3 percentage points below the five-year average. In general, Russia experienced warm and wet conditions over the recent four months. Precipitation exceeds the recent average (RAIN, +12%) and the temperature was just slightly above average (+0.2°C). Mainly due to weather condition, the BIOMSS indicator rose 12% over the last five-year average.

As shown in the NDVI crop condition development graph, the NDVI is close to last year and last five years' average in this monitoring period, while crop condition is favorable in most parts of Russia's cropland (VCIx>0.8). The spatial NDVI patterns show that most parts of Russia (especially in the northwest, central area, Kalingrad, and Caucasus) benefit from abundant water supply—the RAIN indicator is 20% above average, and the harvest of winter wheat in these areas has been advanced. A dry pocket is centered around the region of Perm (RAIN, -30%), with dry conditions extending to adjacent areas to the south from Sverdlovsk (-11%) and Bashkiria (-26%) to the Kostroma Oblast (-11%). In general, however, the overall outlook of Russia's winter and summer crop is favorable.

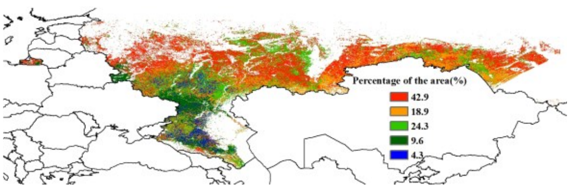
Figure 3.27. Russia crop condition, April-July 2016

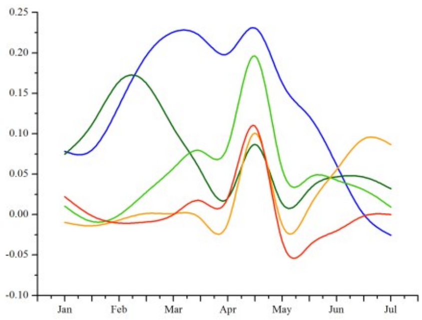




(a) Crop condition development graph based on NDVI

(b) Maximum VCI





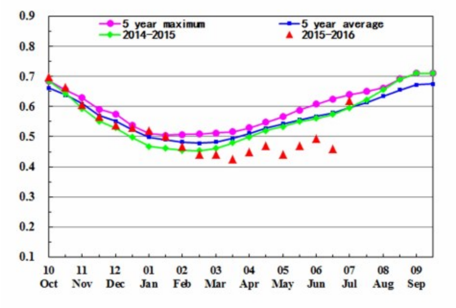
(c) Spatial NDVI patterns compared to 5YA

(d) NDVI profiles

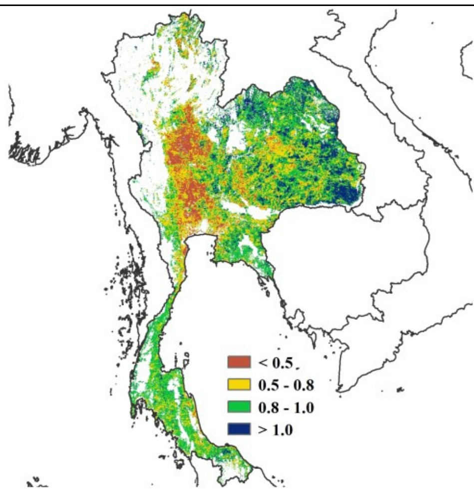
[THA] Thailand

Crop condition from April to July 2016 was below average in Thailand. During the monitoring period, the main rice is at the sowing stage, while the harvest of the country's second rice crop was completed in June. Accumulated rainfall, temperature, and radiation were slightly above the five-year average. Although the agroclimatic indices show good condition, BIOMSS decreased 1% in this period. As shown in the VCIx map, crop condition was poor in western Thailand (VCIx<0.5), which is confirmed by the NDVI. The NDVI profiles show that crop condition in Thailand improved in several areas though remained well below average, except for some areas in the northwest (roughly the single-cropped rice area west of Loei to Buriram) and the area south of Prachuap Khilikhan; these areas make up 42.1% of the arable land in the country. Overall, the condition of the main rice season is generally unfavorable.

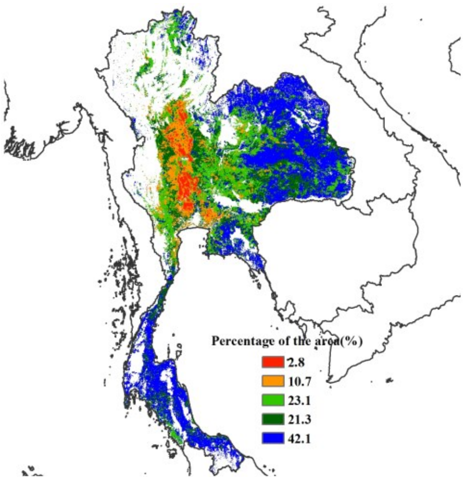
Figure 3.28. Thailand crop condition, April-July 2016



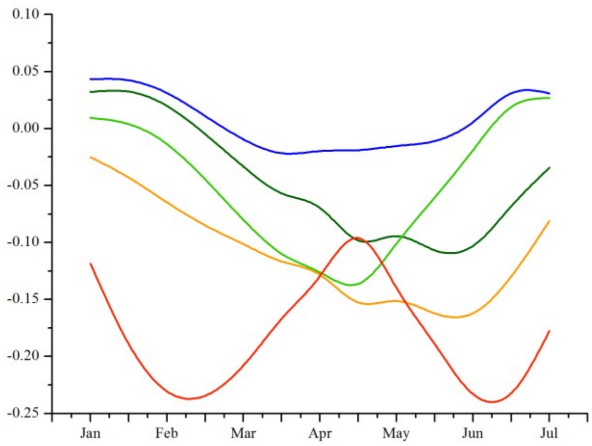
(a) Crop condition development graph based on NDVI



(b) Maximum VCI



(c) Spatial NDVI patterns compared to 5YA



(d) NDVI profiles

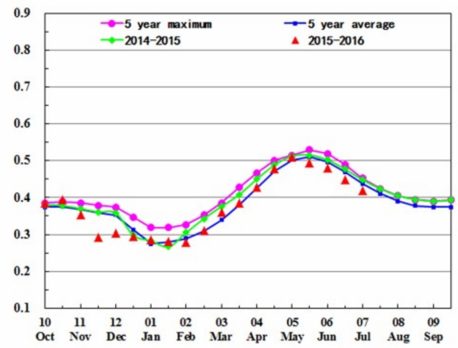
[TUR] Turkey

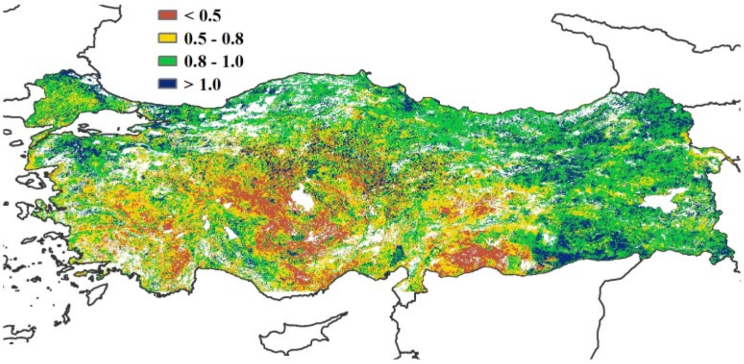
The crop condition from April to July 2016 was generally below average in Turkey. The winter wheat harvest was completed, and summer crops planted since April are still growing. Accumulated rainfall (RAIN, +1%) and radiation were close to average, while the accumulated temperature (TEMP, +0.7°C) was slightly above. The agroclimatic conditions resulted in a decrease of BIOMSS by 8%. The maximum VCI (VCIx=0.8) was above average, and CALF decreased by 4 percentage points compared to the recent five-year average.

The map of maximum VCI presents a pattern consistent with the NDVI cluster map. Crop condition above the recent five-year average prevailed in the Marmara, Black Sea, and Eastern Anatolia regions. Crop condition in most of Aegean and Mediterranean regions was unfavorable over the monitoring period. Poor crop conditions have been continually distributed in most of the central and southeastern Anatolia region since the last monitoring period.

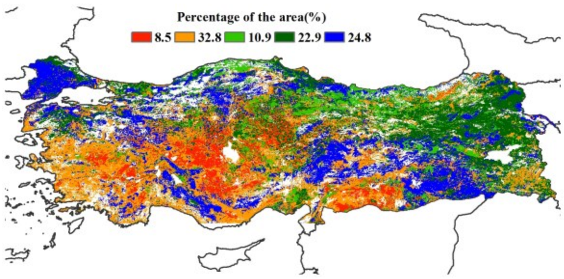
Overall, the outcome for the summer crop season is unfavorable.

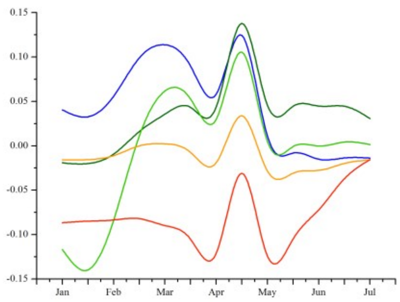
Figure 3.29. Turkey crop condition, April-July 2016





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





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

ARG AUS BGD BRA CAN DEU EGY ETH FRA GBR IDN IND IRN KAZ KHM MEX MMR NGA PAK PHL POL ROU RUS THA TUR **UKR** USA UZB VNM ZAF

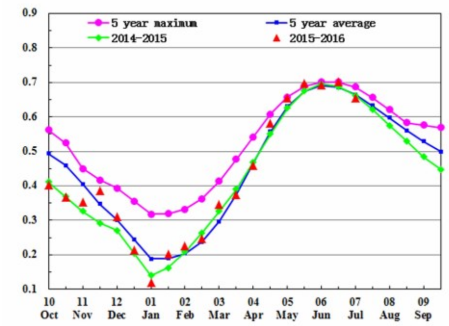
[UKR] Ukraine

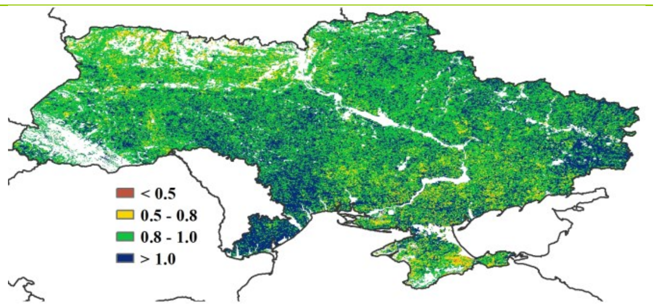
The main crops present in the field during April–July in the Ukraine are barley and maize. Irrigated crops (paddy, vegetables, sunflower, potatoes, pulses, and sugar beet) occur mostly in the south, in the Oblasts of Kherson, Crimea, and Doentsk, as well as in Zaporizhia. While winter crops are harvested in July and August, the harvest of spring crops takes place after August and as late as October for maize.

Agroclimatic conditions were average over the reporting period (RAIN, +3.0%; RADPAR, -1%; TEMP, +0.0°C). As illustrated in the section on the Central Europe to Western Russia MPZ (chapter 2.7), the increase in biomass potential (as described by BIOMSS) is large (>20%) in the northeast part of the country along the Russian border. Limited parts of west, north, central, and southeastern Ukraine have negative to low positive biomass anomalies (<-20% to +10%). Most parts of the country enjoyed favorable conditions: at the national level, a biomass increase (+9%) is expected. According to the national NDVI profile, crop condition in Ukraine is close to the reference five-year average with an average maximum VCI index of 0.95.

Altogether, the production of 2016 spring crops is expected to be slightly below that of last year (2015). With the cropped arable land fraction (CALF) remaining stable, an average season is expected.

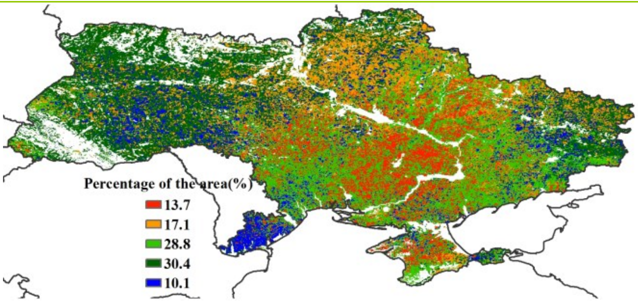
Figure 3.30. Ukraine crop condition, April-July 2016

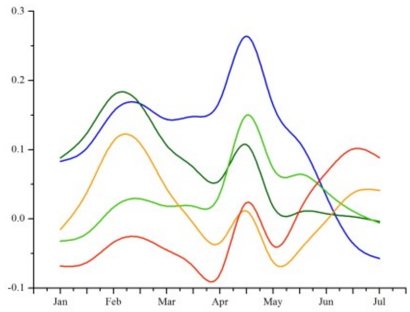




(a) Crop condition development graph based on NDVI

(b) Maximum VCI





(c) Spatial NDVI patterns compared to 5YA

(d) NDVI profiles

[USA] United States

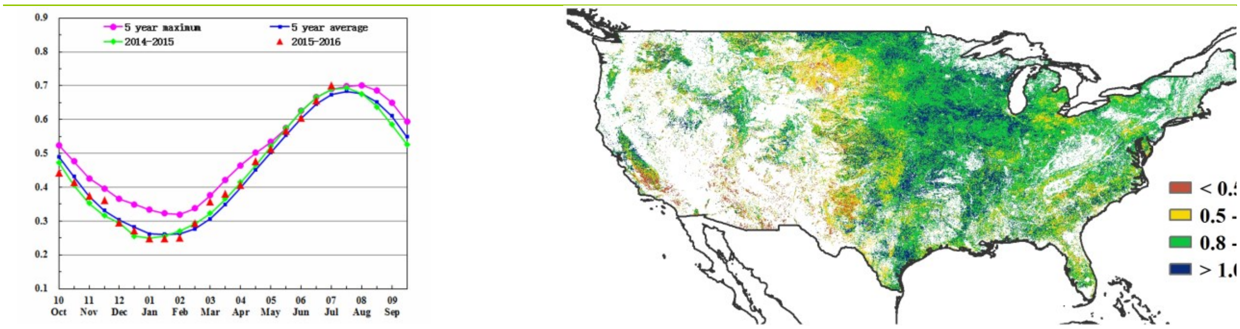
Based on the global NDVI profile, CropWatch conjectures above average crop condition for the United Stated This reporting period covered the harvesting season of winter crops and the core of the growing season of summer crops.

In general, weather was normal in the United States: CropWatch agroclimatic indicators recorded an 8% increase in precipitation, a 0.3°C drop in temperature, and a 1% drop in radiation at the national level. In the major production zones abundant rainfall was recorded. The main production zone for winter crops also received abundant rainfall, including in Kansas (RAIN, +56%), Oklahoma (+40%), and Texas (+45%) where serious floods occurred in June. Plentiful precipitation was also recorded in the northern Plains and western Great Lakes, including Nebraska (+38%), South Dakota (+37%), North Dakota (+55%), and Minnesota (+38%, resulting in floods in July). In the Corn Belt, normal or above average rainfall was recorded in Wisconsin (+7%), Indiana (+4%), Illinois (+10%), and Iowa (+13%), while Ohio (-22%) and Michigan (+27%) suffered a water deficit. As the most important rice producing state, Arkansas received above average rainfall (+11%), which benefited the growth of paddy.

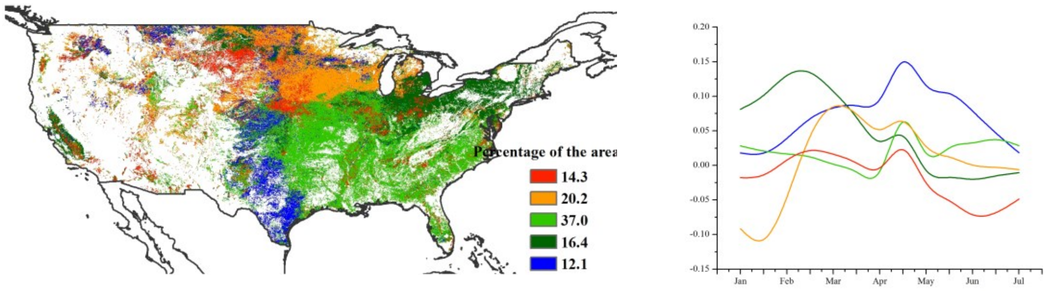
Without doubt, the predominantly humid weather provided enough soil moisture for crop growth. In major parts of the southeastern United Stated (including Arkansas, Louisiana, Alabama, Tennessee, and Florida), good crop condition is confirmed by NDVI cluster profiles and positive departure of crop condition development. Good production of paddy and cotton is to be expected this year. Although the states suffering from some floods, the good crop condition in winter crop states (Kansas, Texas, and Oklahoma) is also supported by positive NDVI departures. In the Corn Belt, crop condition in the south and east (including Illinois, Iowa, and Indiana) shows positive departures, while in the western and northern Corn Belt (Minnesota, Michigan, and Wisconsin) and northern Plains (North Dakota and South Dakota), crop condition was below average, resulting possibly from water deficit or excess.

In this monitoring period, the seeded area also increased 1% compared to the recent five-year average as a result of sufficient soil moisture. Altogether, crop prospect are favorable. (See table B.5 in Annex B for production estimates.)

Figure 3.31. United States crop condition, April-July 2016



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



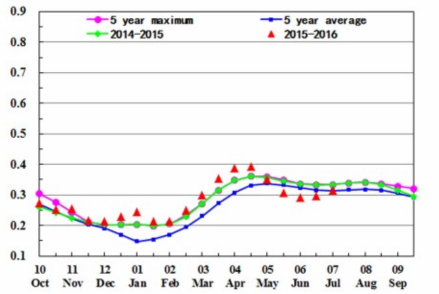
(c) Spatial NDVI patterns compared to 5YA (d) NDVI profiles

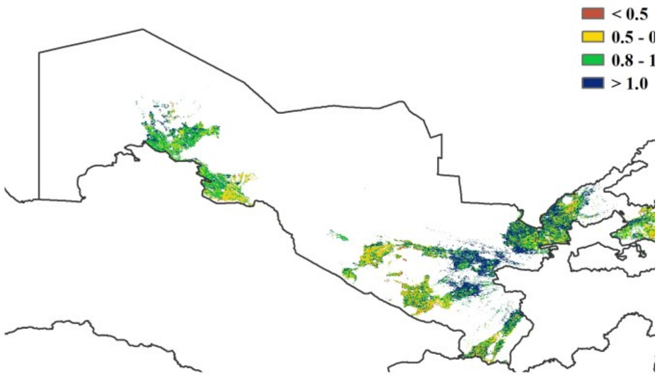
[UZB] Uzbekistan

This analysis covers the growing and harvesting stage of winter cereals, along with the sowing and growth of maize and other coarse grains from April to July. The country as a whole showed a large increase of RAIN (+82%), while TEMP and RADPAR both dropped compared with average (-0.4°C and -5%). The combined effect of the precipitation and temperature was a sharp increase in BIOMSS in the order of +93% compared to the five-year average.

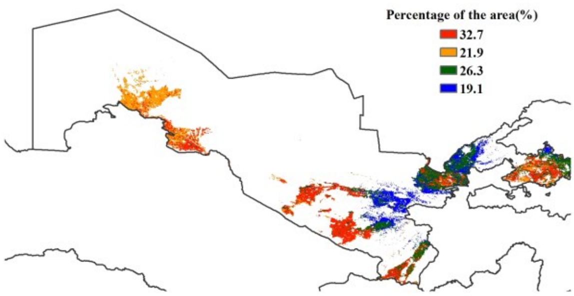
The national NDVI development graph showed that crop condition was above the maximum of the past five years in April, after which it dropped to below average. More precise spatial information is provided by the NDVI profiles and spatial NDVI patterns, which confirm the sudden fall of NDVI in May to average levels. In July, crop condition was a little below average, with about 33% crop lands in poor condition (cotton growing areas of Karakalpakstan, Andijon and Quqon, Navoiy, Kagan, Qarshi, Shakhriabz, Denow, Guliston, Tashkent, Termiz, Fergana, and Namangan). In short, winter crop condition was generally at least fair from April to July, while crop condition was less favorable though nevertheless close to average for summer crops.

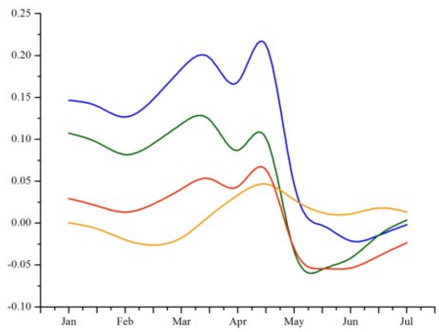
Figure 3.32. Uzbekistan crop condition, April-July 2016





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



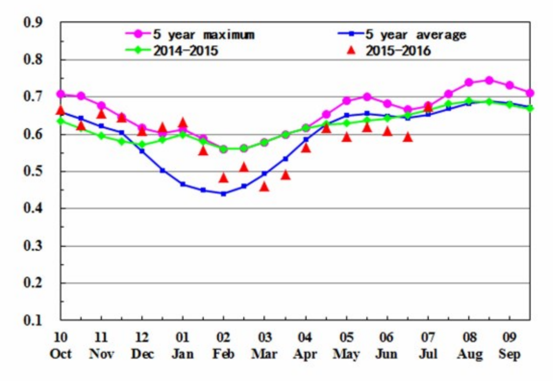


(c) Spatial NDVI patterns compared to 5YA (d) NDVI profiles

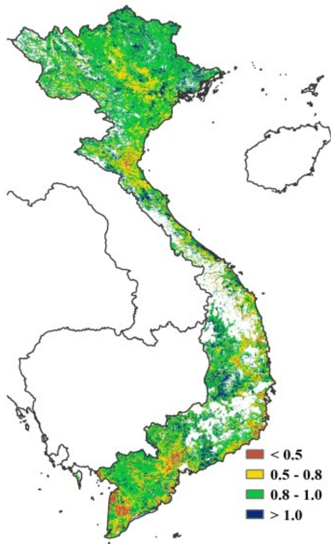
[VNM] Vietnam

The period from April to July mainly covers the harvesting period of winter/spring rice and the sowing of the 10th month or north rice in Vietnam. Crop condition was generally below the average of the previous five years. Crops over more than 27% of the arable land (mainly in the south of the country and including parts of the Mekong Delta) are not in favorable condition. NDVI over the south of the country was continuously below the five-year average during the monitoring period. The maximum VCI of the area is lower than 0.5, indicating less than fair conditions. The NDVI based crop development profile also confirms the overall below average crop condition. The CropWatch agroclimatic and agronomic indicators were above or close to average (RAIN, +7%; TEMP, +0.1°C; and RADPAR, +5%). BIOMSS is average in comparison to the recent five years. Overall crop condition in the country is unsatisfactory.

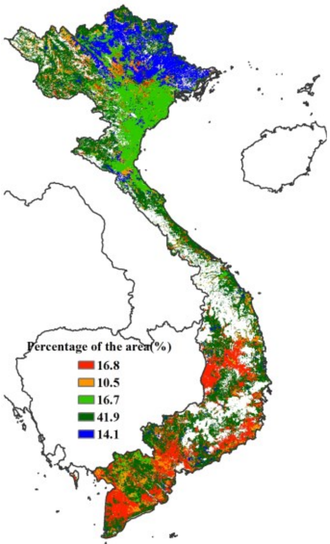
Figure 3.33. Vietnam crop condition, April-July 2016



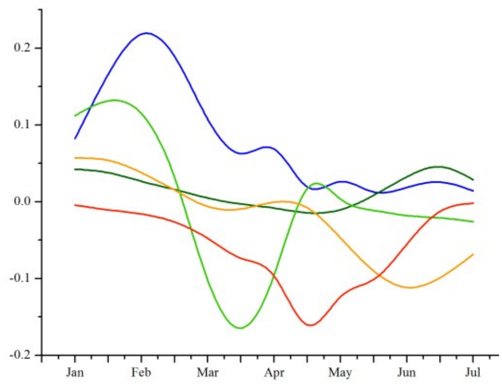
(a) Crop condition development graph based on NDVI



(b) Maximum VCI



(c) Spatial NDVI patterns compared to 5YA

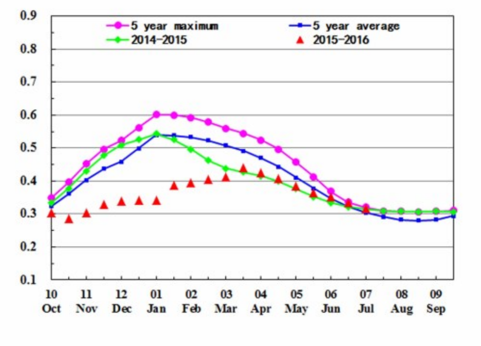


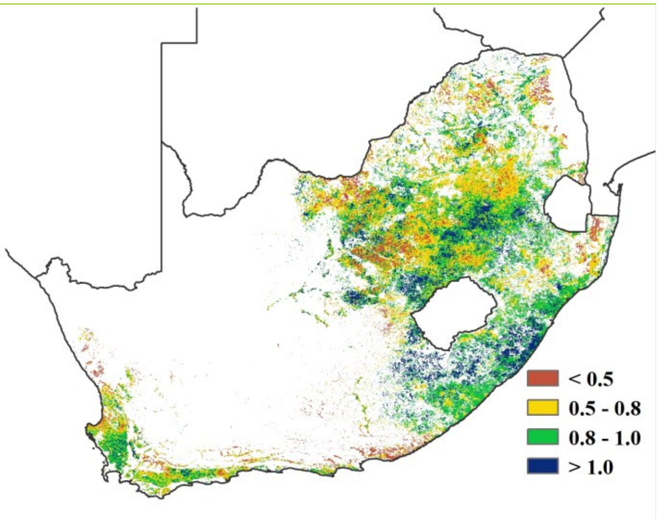
(d) NDVI profiles

[ZAF] South Africa

The monitoring period coincides with the sowing of winter wheat in and around the western Cape, in addition to covering the end of the maize harvest throughout the country. Maize, extensively cultivated in the country's northwest and in Mpumalanga, Free State, and KwaZulu-Natal, is the most significant harvest for South Africa. Compared with average, RAIN was low (-25%), while RADPAR accumulation dropped by a smaller percentage (-2%); temperature was significantly above average at + 3.1°C. The fraction of cropped arable land (CALF) increased (+2 percentage points) while the biomass production potential decreased (BIOMSS, -10%). The national NDVI development graph indicates that NDVI values after May were comparable to the average of the last five years, but that the NDVI peak over the growing season was still well below average and spectacularly delayed. The lowest maximum VCI values (<0.5) occur in the central northern areas, especially in the Free State. According to the NDVI profiles, most areas display average (that is, seasonally dry conditions) at the end of the monitoring period.

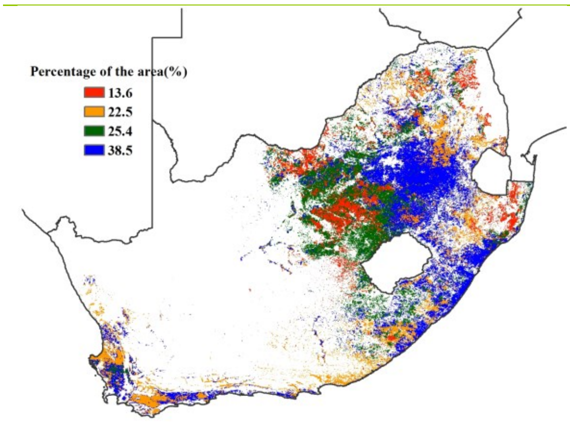
Figure 3.34. South Africa crop condition, April-July 2016

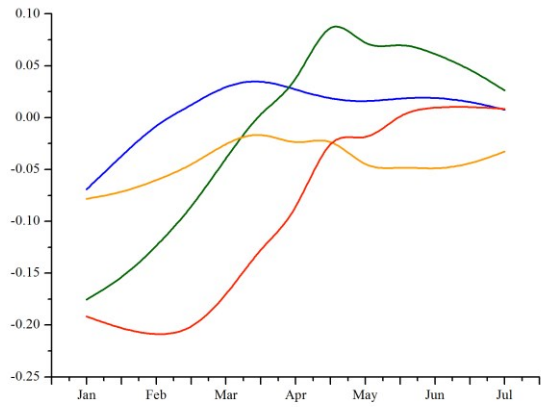




(a) Crop condition development graph based on NDVI

(b) Maximum VCI





(c) Spatial NDVI patterns compared to 5YA

(d) NDVI profiles

Chapter 4. China

Chapter 4 presents a detailed analysis for China, focusing on the seven most productive agro-ecological regions of the east and south. After a brief overview of the agroclimatic and agronomic conditions over the monitoring period (section 4.1), section 4.2 presents CropWatch estimates for 2016 crop production in China. Section 4.3 reports on ongoing pest and diseases monitoring, while the next two sections focus on trade prospects for major crops (4.4) and outlook for domestic prices (4.5). Finally, analysis for individual regions is provided in section 4.6. Additional information on the agroclimatic indicators for agriculturally important Chinese provinces are listed in table A.11 in Annex A.

4.1 Overview

During the monitoring period, winter wheat was harvested and summer crops (maize and soybean) were planted in the north of China. Figures 4.1 to 4.5 illustrate China's spatial distribution of rainfall (figure 4.1) and temperature profiles (figure 4.2), and maps of cropped and uncropped arable land (figure 4.3), maximum VCI (figure 4.4.), and minimum VHI (figure 4.5). Table 4.1 presents an overview of CropWatch indicators for the monitoring period.

Rainfall (RAIN) was 36% above average, while temperature (TEMP) and radiation (RADPAR) decreased by 0.5°C and 3%, respectively, when compared with average. The prevailing agroclimatic conditions lead to above average biomass. In more than 70% of the country, mostly in central and northern China, rainfall in the past seven months was average up to June, while it fluctuated widely in the southeast of China. Temperature also fluctuated across the whole of China during the monitoring period.

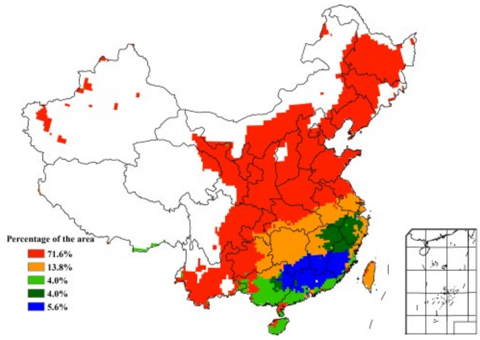
In Huanghuaihai, Loess region, Inner Mongolia, Lower Yangtze, Southern China, and Southwest China, above average RAIN resulted in high BIOMSS. In Northeast China, below average rainfall lead to a potential BIOMSS decrease of 4% compared to the recent five-year average. High VCIx values mostly occur in Southwest China, central Shanxi province, and in Northeast China. Low VCIx values mainly occur in Northwest China and the Huanghuaihai region, in particular the south of Jiangsu and north of Ningxia and Gansu provinces. Crop condition in Southwest China is above average (VCIx is 0.89), as rainfall is higher than average and temperature is just slightly below.

Table 4.1. CropWatch agroclimatic and agronomic indicators for China, April-July 2016, departure from 5YA and 15YA

Region	Agroclimatic indicators			Agronomic indicators		
	Departure from 15YA (2001-2015)			Departure from 5YA (2011-2015)		Current
	RAIN (%)	TEMP (°C)	RADPAR (%)	BIOMSS (%)	CALF (%)	Maximum VCI
Huanghuaihai	14%	-0.5	-5%	20%	0	0.86
Inner Mongolia	46%	-0.4	0%	11%	-3	0.88
Loess region	41%	-0.6	-3%	23%	-7	0.80
Lower Yangtze	60%	-0.7	-7%	16%	0	0.84
Northeast China	-11%	-0.6	-3%	-4%	0	0.87
Southern China	12%	-0.3	2%	12%	-1	0.89
Southwest China	31%	-0.3	-2%	14%	0	0.90

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 five (5YA) or fifteen-year average (15YA) for the same period (April-July).

Figure 4.1. China spatial distribution of rainfall profiles, April-July 2016



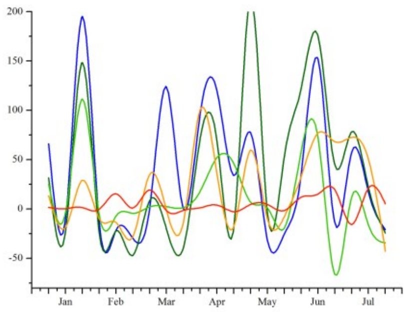
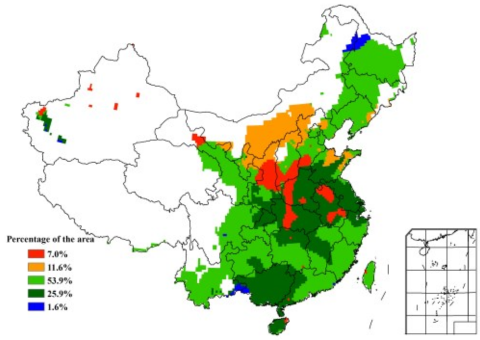


Figure 4.2. China spatial distribution of temperature profiles, April-July 2016



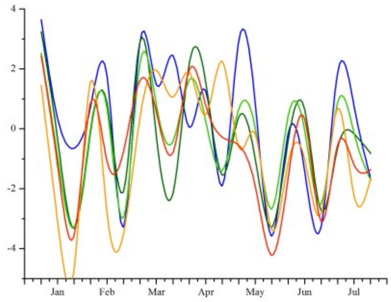


Figure 4.3. China cropped and uncropped arable land, by pixel, April-July 2016

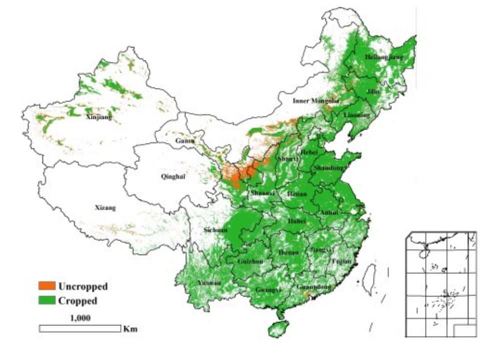


Figure 4.4. China maximum Vegetation Condition Index (VCIx), by pixel, April-July 2016

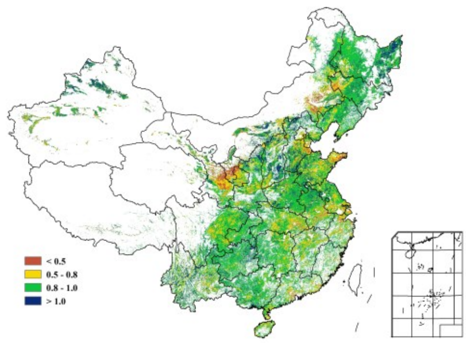
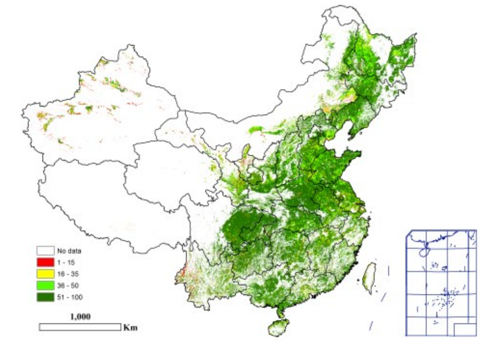


Figure 4.5. China minimum Vegetation Health Index (VHI), by pixel, April-July 2016



During the monitoring period, uncropped arable land was mainly distributed in the northwest of the country, such as central Gansu and Ningxia provinces. In Huanghuaihai, Lower Yangtze, Northeast China, and Southwest China, CALF was average, while in Inner Mongolia, Loess Region, and Southern China, the drop in CALF was 1%, 5% and 1%, respectively, which may be the result of the low temperature. The results for minimum VHI indicate that most areas did not experience water stress. Some major production zones, however, suffered from drought, including the southwest of Yunnan, central Ningxia, and the east of Inner Mongolia province (figure 4.5).

4.2 China's crop production

Unfavorable conditions negatively affected the outcome of the 2015-16 winter crops season (referred to below as "2016"), of which close to 91.3% is winter wheat. Nevertheless, thanks to average conditions from early May up to the time of harvest, in Hebei, Shanxi, and Gansu yields increased compared to previous forecasts. As a result, the total estimated 2016 production of all winter crops for China has been revised to 122 million tons, 2.7% below last year's production (table 4.2).

Table 4.2. China 2015-16 winter crops production (in '000 tons) and variation (%) from 2014-15, by province

	2014-15 production ('000 tons)	2015-16			
		Area change (%)	Yield change (%)	Production change (%)	Production ('000 tons)
Hebei	10989	-1.2	-1.4	-2.6	10825
Shanxi	2184	2.2	-2.2	0.0	2218
Jiangsu	10050	-8.6	8.5	-0.8	9971
Anhui	11764	0.8	1.6	2.4	12044
Shandong	23062	-3.3	-0.2	-3.5	22252
Henan	26139	0.6	-3.8	-3.2	25305
Hubei	5865	0.6	-0.4	0.2	5875
Chongqing	2323	-2.4	-0.8	-3.2	2249
Sichuan	5626	-1.0	-0.5	-1.5	5541
Shaanxi	4395	-5.4	-1.8	-7.1	4085
Gansu	3067	-1.0	-3.0	-3.9	3002
subtotal	**105465**	**-**	**-**	**-2.0**	**103367**
Other provinces	19921	-	-	-6.6	18613
China	**125386**	**-1.8**	**-0.9**	**-2.7**	**121980**

The first 2016 CropWatch forecasts for maize, rice, wheat, and soybean production in China are listed in table 4.3. Detailed production estimates for different types of rice (different growing seasons) are shown in table 4.4. As illustrated in these tables, the production of maize and soybean is 1% above 2015, while overall for rice and wheat, the drop is 1% below 2015 levels.

Reasons for the changes in production include the release, by China's government, of a new policy that encourages farmers to shift from maize to other, more suitable crops in regions where maize cultivation is not well suited because of for example soil fertility or climatic conditions. The policy, however, has not resulted in much change in terms of planted area, with the most significant decreases in maize planted area occurring in Inner Mongolia and Heilongjiang provinces where areas have decreased by respectively 222 and 103 thousand hectares, or 7% and 2% compared to 2015. The expected 1% increase in soybean production stems from a recovery in the soybean planted area, contributing to the first increase in soybean production in China over the last 12 years. Other significant changes in production in China include those for maize in Hebei (+7%, both yield and area increased), Inner Mongolia (-8%, due to reduced planted area), Liaoning (+8%, a recovery from last year's severe drought), and Shandong (+6%, both yield and area increased), while also rice production in Jilin, Liaoning, and Yunnan present significant change (+12%, -10%, and 6%, respectively). The decrease in the estimated production of wheat and rice by 1% each mainly stems from unfavorable conditions. In terms of rice production for different rice types, production of early rice and late rice is 4% and 3% below that of 2015 due to the continuous trend of conversion of double rice cropping to single rice cropping. Although the planted area for single rice increased, conditions were unfavorable for the crop, resulted in a similar output as 2015.

CropWatch puts the total 2016 output of summer crops (including maize, single rice (one rice crop per year), late rice, spring wheat, soybean, minor cereals, and tubers) at 408.3 million tons, only a slight increase (+0.4%) from 2015 but still representing a 1445 thousand tons in production increase. The total annual crop production is at 564.4 million tons, a 0.6% drop from 2015. As late rice is still at an early growing stage, and maize and single rice are at grain filling stage, the production for each crop type as well as total summer crops production and annual outputs will be revised in the November 2016 bulletin using updated remote sensing data.

Table 4.3. China 2016 production of maize, rice, wheat, and soybean, and % change from 2015, by province

	Maize		Rice		Wheat		Soybean	
	2016	Change (%)	2016	Change (%)	2016	Change (%)	2016	Change (%)
Anhui	3457	-4	16639	-4	11340	2	1067	-4
Chongqing	2137	-1	4733	-3	1110	-1		
Fujian			2847	-1				
Gansu	4795	0			2562	-3		
Guangdong			10819	-2				
Guangxi			10911	-3				
Guizhou	5105	3	5404	4				
Hebei	18485	7			10832	0	189	5
Heilongjiang	26800	-3	20290	0			4519	-1
Henan	17102	2	3937	0	25160	-3	789	2
Hubei			15397	-4	4330	0		
Hunan			24868	-2				
Inner Mongolia	15969	-8					1041	26
Jiangsu	2162	-4	16691	-2	9729	1	766	-3
Jiangxi			16979	-3				
Jilin	24931	4	5685	12			712	6
Liaoning	16339	8	4359	-10			399	-23
Ningxia	1681	-3	538	-1				
Shaanxi	3810	5	1071	2	4011	1		
Shandong	19999	6			21893	-4	715	6
Shanxi	8692	-1			2132	1	169	-3
Sichuan	7196	0	14954	0	4646	-1		
Xinjiang	6977	5						
Yunnan	5986	3	5642	6				
Zhejiang			6252	-3				
Sub total	**191623**	**2**	**188014**	**-1**	**101041**	**-1**	**10365**	**1**
Other provinces	10393	-15	12333	7	17550	1	2775	2
China	**202016**	**1**	**200347**	**-1**	**118591**	**-1**	**13141**	**1**

Table 4.4. China 2016 early rice, single rice, and late rice production and percentage difference from 2015, by province

	Early rice		Single rice		Late rice	
	2015	Change (%)	2015	Change (%)	2015	Change (%)
Anhui	1782	-3	13195	-4	1662	-7
Chongqing			4733	-3		
Fujian	1712	-1			1135	-1
Gansu						
Guangdong	5224	-2			5595	-2
Guangxi	5418	-3			5493	-3
Guizhou			5404	4		
Hebei						
Heilongjiang			20290	0		
Henan			3937	0		
Hubei	2273	-2	10453	-4	2671	-5
Hunan	8243	0	8444	-1	8181	-5
Jiangsu			16691	-2		
Jiangxi	7284	-1	2871	0	6824	-5
Jilin			5685	12		
Liaoning			4359	-10		
Ningxia			538	-1		
Shaanxi			1071	2		
Sichuan			14954	0		
Yunnan			5642	6		
Zhejiang	791	-4	4625	-3	836	-6
Sub total	**32728**	**-1**	**122891**	**-1**	**32395**	**-4**
China	**34087**	**-3**	**132021**	**0**	**34239**	**-4**

4.3 Pests and diseases monitoring

Over the reporting period, several pests and diseases affected crops in China. This section presents an overview of pests and diseases affecting wheat, rice, and maize.[1]

Wheat

During late May and early June 2016, the main wheat regions of China were severely affected by wheat diseases and pests. South of the Yellow River (including southern Huanghuaihai, Lower Yangtze, and most of Southwest China), the crop had generally reached maturity, while it was still at the grain filling stage in areas north of the Yellow River (including northern Huanghuaihai and the Loess region). The development of the crop canopy after winter was conductive to the occurrence of powdery mildew and aphids. Due to abundant precipitation in May, especially in Northwest China where rainfall exceeded the average by 20% to 50%, the humidity created ideal conditions for diseases and pests dispersal.

The distribution of winter wheat aphid in late May 2016 is shown in figure 4.6 and table 4.5. In China, the total wheat area exposed to aphids reached 6.7 million hectares, severely affecting most of Hebei, northern Henan, and northern Shandong, and, to a lesser extent, southern Gansu and central Shaanxi. Powdery mildew (figure 4.7 and table 4.6) damaged around 4.7 million hectares in the main winter wheat

[1] This section has been contributed by Wenjiang Huang, Yingying Dong, Yue Shi, Linyi Liu, Fang Xu, and Wenjing Liu.

region of China, severely affecting wheat in southern Gansu, central Shaanxi, and southern Shanxi, and moderately in most of Hebei and northern Shandong areas. For winter wheat sheath blight (figure 4.8 and table 4.7) the infection area is about 2.7 million hectares, with the disease moderately occurring in northern Henan and most of Hebei, and slightly in other regions.

Figure 4.6. Distribution of winter wheat aphid in China (late May 2016)

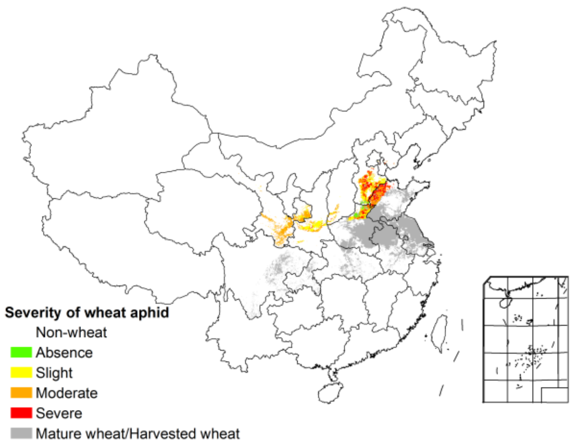


Figure 4.7. Distribution of winter wheat powdery mildew in China (late May 2016)

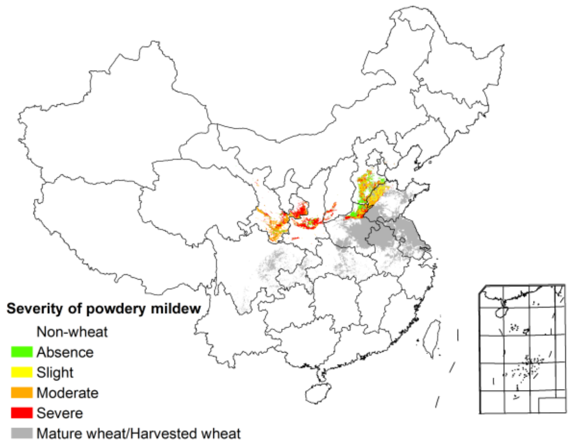


Figure 4.8. Distribution of winter wheat sheath blight in China (late May 2016)

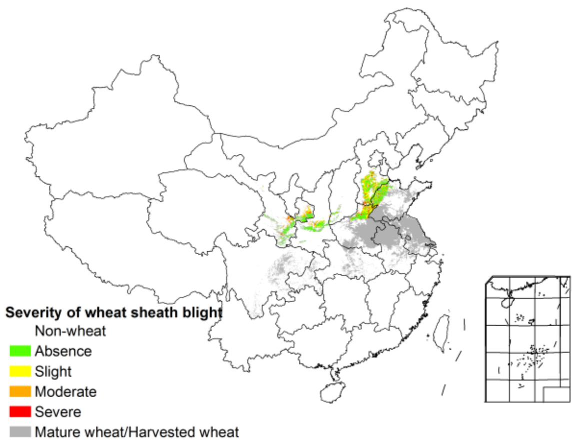


Table 4.5. Occurrence of winter wheat aphid in China, late May 2016

Region	Occurrence ratio (%)				Total area (thousand hectares)
	Absence	Slight	Moderate	Severe	
Huanghuaihai	30%	21%	29%	20%	6661
Loess region	27%	29%	31%	13%	2709
Southwest China	30%	21%	29%	20%	416

Table 4.6. Occurrence of winter wheat powdery mildew in China, late May 2016

Region	Occurrence ratio (%)				Total area (thousand hectares)
	Absence	Slight	Moderate	Severe	
Huanghuaihai	59%	16%	15%	10%	6661
Loess region	31%	16%	27%	26%	2709
Southwest China	39%	7%	40%	14%	416

Table 4.7. Occurrence of winter wheat sheath blight in China, late May 2016

Region	Occurrence ratio (%)				Total area (thousand hectares)
	Absence	Slight	Moderate	Severe	
Huanghuaihai	73%	10%	12%	5%	6661
Loess region	77%	12%	7%	4%	2709
Southwest China	79%	6%	9%	6%	416

Rice

The impact of pests on rice was relatively severe during late July and early August 2016 in the main rice regions of China. In Huanghuaihai and Northeast China, single cropped rice[2] was in its jointing and booting stage; for the lower Yangtze River area, late rice was in its full-tillering stage, while for Southwest China, most of the rice was in booting and heading stage. Rainfall in July exceeded the long-term average, especially in the east of Southwest China, Huanghuaihai, and lower Yangtze River; high temperature and high humidity were conducive to planthopper and rice leaf roller reproduction.

The distribution of rice planthopper in late July 2016 is shown in figure 4.9 and table 4.8. The total area plagued by rice planthopper reached 8.6 million hectares, with the pest severely damaging most of Jiangsu, central Anhui, northern Jiangxi, and western Heilongjiang; central Hubei, most of Hunan, central Yunnan, and northern Guangdong areas were only moderately affected.

Rice leaf roller (figure 4.10 and table 4.9) damaged around 4.7 million hectares in the country, most severely in extensive areas of Jiangsu, central Anhui, and northern Jiangxi, and only moderately in most of Hunan, eastern Sichuan, and northern Guangdong.

Figure 4.9. Distribution of rice planthopper in China (late July 2016)

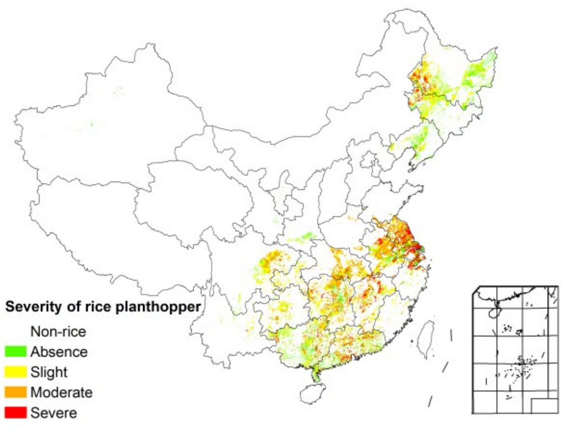
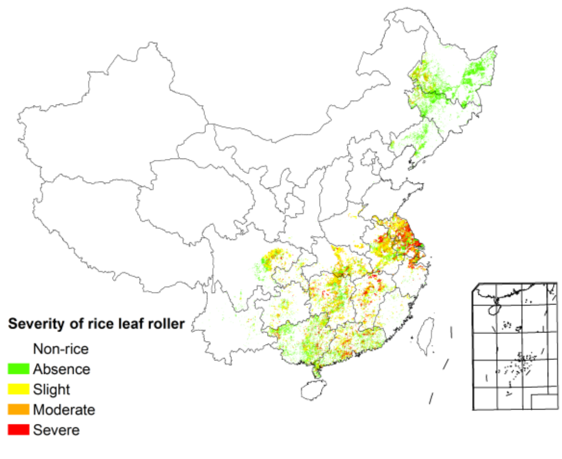


Figure 4.10. Distribution of rice leaf roller in China (late July 2016)



[2] Single cropped rice refers to areas where only one rice crop is grown per year.

Table 4.8. Occurrence of rice planthopper in China, late July 2016

Region	Occurrence ratio (%)				Total area (thousand hectares)
	Absence	Slight	Moderate	Severe	
Huanghuaihai	47%	7%	44%	2%	1618
Inner Mongolia	65%	16%	14%	5%	291
Loess region	56%	19%	24%	1%	143
Lower Yangtze	55%	12%	24%	9%	9480
Northeast China	69%	21%	7%	3%	4261
Southern China	67%	16%	12%	5%	2257
Southwest China	65%	22%	11%	2%	4821

Table 4.9. Occurrence of rice leaf roller in China, late July 2016

Region	Occurrence ratio (%)				Total area (thousand hectares)
	Absence	Slight	Moderate	Severe	
Huanghuaihai	72%	16%	10%	2%	1618
Inner Mongolia	81%	9%	6%	4%	291
Loess region	75%	14%	10%	1%	143
Lower Yangtze	72%	12%	11%	5%	9480
Northeast China	89%	6%	3%	2%	4261
Southern China	82%	9%	6%	3%	2257
Southwest China	85%	10%	4%	1%	4821

Maize

Maize was doing well during late July and early August 2016 in its main production areas; the crop suffered only slightly from pest and disease attacks. In mid and late July, heavy rainfalls and high humidity in Northeast China, Huanghuaihai, and lower Yangtze were conducive to armyworm reproduction and northern leaf blight dispersal.

Figure 4.11. Distribution of maize armyworm in China (late July 2016)

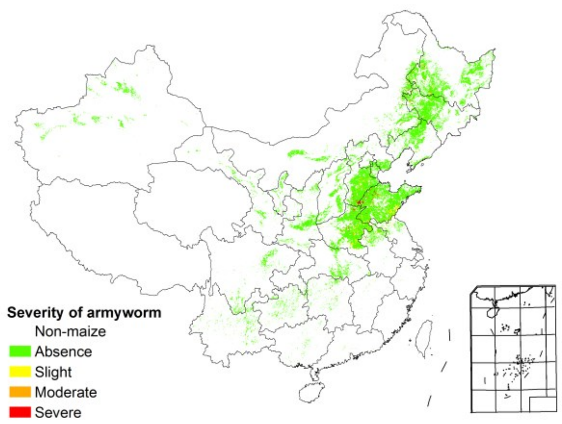
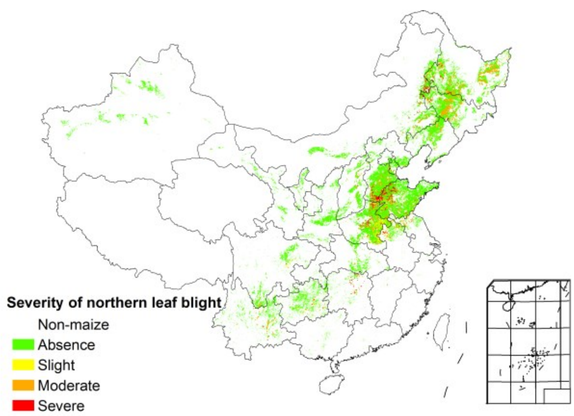


Figure 4.12. Distribution of northern leaf blight in China (late July 2016)



The distribution of maize armyworm in late July 2016 is shown in figure 4.11 and table 4.10. Nationwide, the total area affected by armyworms reached 3.3 million hectares, moderately affecting areas in some parts of Northeast China, Huanghuaihai, and the lower Yangtze region, and slightly in the other regions. Finally, northern leaf blight (figure 4.12 and table 4.11) damaged around 6 million hectares, severely so in eastern Inner Mongolia, southern Hebei, and northern Shandong, and moderately in most of Heilongjiang and Jilin.

Table 4.10. Occurrence of maize armyworm in China, late July 2016

Region	Occurrence ratio (%)				Total area (thousand hectares)
	Absence	Slight	Moderate	Severe	
Huanghuaihai	85%	9%	3%	3%	16098
Inner Mongolia	96%	1%	1%	2%	2426
Loess region	98%	1%	1%	0%	2289
Lower Yangtze	96%	2%	1%	1%	2009
Northeast China	96%	1%	2%	1%	9916
Southern China	100%	0%	0%	0%	103
Southwest China	99%	1%	0%	0%	2136

Table 4.11. Occurrence of northern leaf blight on maize in China, late July 2016

Region	Occurrence ratio (%)				Total area (thousand hectares)
	Absence	Slight	Moderate	Severe	
Huanghuaihai	77%	14%	5%	4%	16098
Inner Mongolia	92%	3%	3%	2%	2426
Loess region	97%	2%	1%	0%	2289
Lower Yangtze	92%	5%	2%	1%	2009
Northeast China	82%	8%	9%	1%	9916
Southern China	98%	1%	1%	0%	103
Southwest China	88%	6%	4%	2%	2136

4.4 Trade prospects for major crops

Grain import and export in China in the first half of 2016

Maize

During the first half of 2016, China has imported 2.9 million tons of maize, an increase of 9.6% over the same period in 2015. Ukraine (91.1%), the United States (6.6%) and Russia (2.2%) were the main sources for the maize imports, the value of which reached US$560 million--11.9% below the value for the first semester in 2015. Maize exports over this year's first half (1,320.75 tons) decreased by 80.8% and went primarily to the Democratic People's Republic of Korea (75.7%), Russia (22.8%), and the Republic of Korea (ROK, 1.5%). The export earned US$ 471,300, down 75.0%.

Rice

In the first half of 2016, the total import of rice in China was 2.006 million tons, an increase of 40.4% compared to the previous year. The imported rice mainly stems from Vietnam, Thailand, and Pakistan, respectively accounting for 42.7%, 27.0%, and 25.1% of imports. The expenditure for rice import was US$909 million, reflecting a year-on-year growth of 36.9%. Total rice export over the period was 127,100 tons, up by 8.9%, mainly exported to the ROK, Japan, and Hong Kong (48.1%, 19.5%, and 6.9%, respectively). The value of the export was US$129 million, an increase of 14.5% over 2015.

Wheat

During the first semester of 2016, Chinese wheat imports reached 1.79 million tons, an increase of 26.6% over 2015. The main sources include Australia (45.3%), Canada (27.5%), the United States (14.2%), and neighboring Kazakhstan (12.5%). Notwithstanding the increase in volume, the total expenditure of US$431 million was a decrease of 4.7% compared with 2015. Wheat exports over the same period rose

9.4% to reach 55,800 tons. Hong Kong (2.4%), Ethiopia (18.9%), and Macao (5%) were the main destinations of Chinese wheat exports.

Soybean

The total import of soybean was up by 9.7% to 38,562,300 tons in China during the first half of 2016. Brazil, the United States, and Argentina respectively contributed 54.1%, 40.9%, and 2.3%, for a total value of US$14.836 billion, down 6.5% compared to the first six months of 2015. Soybean exports of 70,800 tons (-16.7%) earned US$62.205 million (-24.9%).

Import prospects for major grains in China in 2016

Based on the latest monitoring results, China grain imports are projected to increase. The projections below (see also figure 4.13) are based on remote sensing data and the Major Agricultural Shocks and Policy Simulation Model, which derived from the standard GTAP (Global Trade Analysis Project).

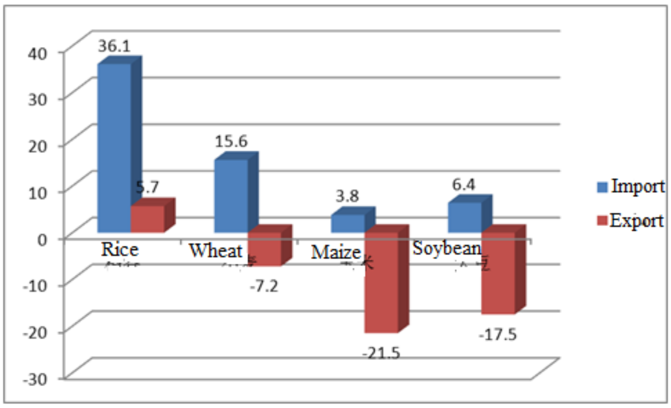
Maize

According to the projections, national maize imports will go up 3.8%, while exports will decrease by 21.5% in 2016. In July, a drop in international maize price enlarged the gap between domestic and international prices, which will result in an increase of imports. However, because little difference exists between domestic supply and demand, the volume of imports is unlikely to exceed the quota of 7.2 million tons. Significant volumes of maize alternatives will also be imported.

Rice

China's 2016 rice imports are expected to increase by 36.1% compared to 2015, while exports will go up 5.7%. As the recent Cost, Insurance and Freight (CIF) price for rice was consistently lower than domestic prices, a substantial increase of imports occurred in the first half of 2016. With the gradual decrease of the difference between international and domestic prices, imports will decrease as well in the second half of this year. 2016 rice imports are expected to increase later in the year, but will be within the limits imposed by prevailing quotas.

Figure 4.13. Rate of change of imports and exports for rice, wheat, maize, and soybean in China in 2016 compared to those for 2015 (%)



Source: Authors based on CropWatch remote sensing data and results from the Major Agricultural Shocks and Policy Simulation Model.

Wheat

China's wheat imports will increase by 15.6 percent, but exports are projected to drop 7.2% compared with those of 2015. The rate of increase for wheat imports, however, is expected to slow down in the second half of the year because: (i) the rate of decline for the international wheat price was larger than for domestic prices since the second half of this year, and (ii) the price gap of quality wheat between domestic and abroad also narrowed in July.

Soybeans

Soybean imports will increase by 6.4% while exports will be reduced by 17.5% in 2016, according to the projections. Because the gap between domestic and international prices narrowed since July and because the share of sorghum among Chinese crops changed in China recently, the imported amount of soybean will be only slightly greater than that for the previous year.

4.5 Outlook for the domestic price of four major crops

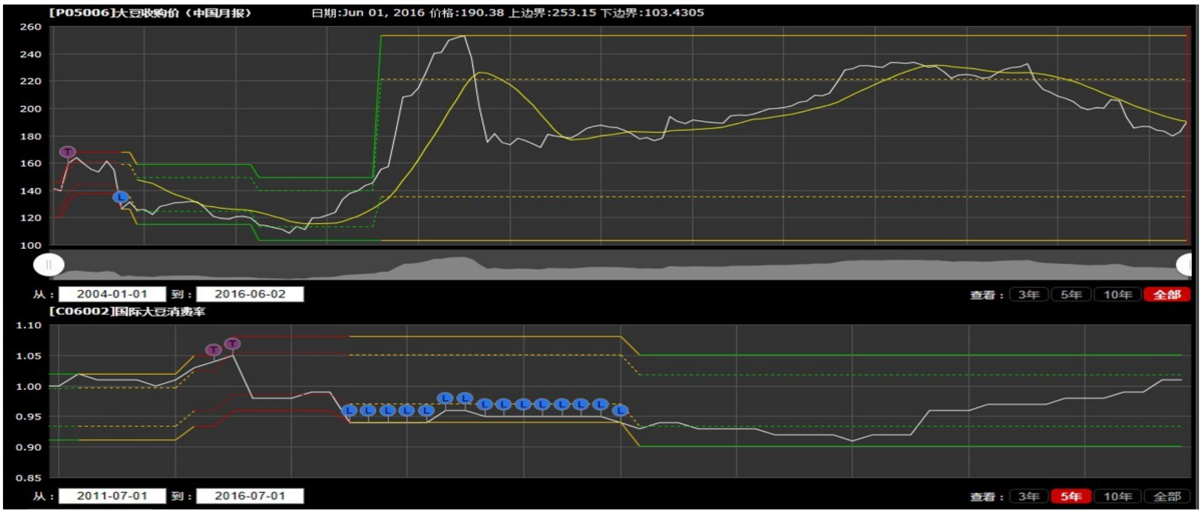
The following analysis of domestic prices for maize, hybrid wheat, rice, and soybean in China is based on the following three sources: (i) nationwide monthly grain price data between January 2004 and June 2016 provided by the price information center of China's National Development and Reform Commission (NDRC); (ii) China's grain production, inventory, and consumption predicted by USDA's monthly world agricultural supply and demand estimates (WASDE) reports;[3] and (iii) price trend forecasts and early warning obtained by Fang Jingxin's price-spiral model.

The statements below describe China's domestic prices—paid to the farmer—as of June 2016; all listed prices refer to 50 kg. Current prices and outlook for the four crops are as follows:

- *Maize price.* The average price of maize in June was unsatisfactory at 87.17 Yuan. The consumption rate (use/production) has broken away from the "non-boom" interval to an equilibrium range.
- *Hybrid wheat price.* The price of hybrid wheat at 113.41 Yuan represented a decrease as a result of reduced consumption. At its lowest, the price of hybrid wheat is expected to drop to 104.66 Yuan.
- *Rice price.* The average purchase price of rice was 136.09 Yuan. A large price increase is expected, with prices likely reaching 143.73 Yuan; price monitoring continues.
- *Soybean.* On average, soybean was bought at 190.38 Yuan, with price and consumption rates in equilibrium; the crop is estimated to be in a boom state. Since the consumption rate has been approaching the equilibrium interval, the price is close to the drop trend line, which means the price can go up or down.

[3] http://www.usda.gov/oce/commodity/wasde/

Figure 4.14. Fluctuations in soybean price, July 2011 to June 2016



Note: The graph illustrates the price of soybean for the last 12.5 years since January 1 2004 (upper graph) and for the last five years from July 1 2011 to July 1 2016 (lower graph).

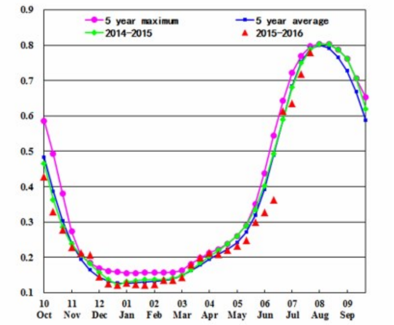
4.6 Regional analysis

Figures 4.15 through 4.21 present crop condition information for each of China's seven agricultural regions. The provided information is as follows: (a) Crop condition development graph based on NDVI, comparing the current season up to July 2016 to the previous season, to the five-year average (5YA), and to the five-year maximum; (b) Spatial NDVI patterns from April to July 2016 (compared to the (5YA); (c) NDVI profiles associated with the spatial patterns under (b); (d) maximum VCI (over arable land mask); and (e) biomass for April to July 2016. Additional information about agroclimatic indicators and BIOMSS for China is provided in Annex A, table A.11.

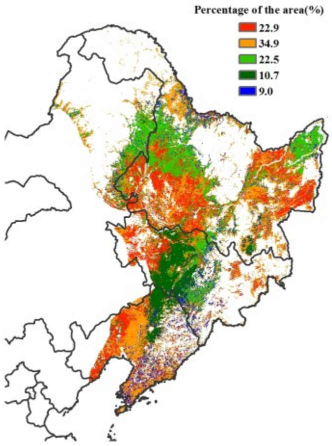
Northeast region

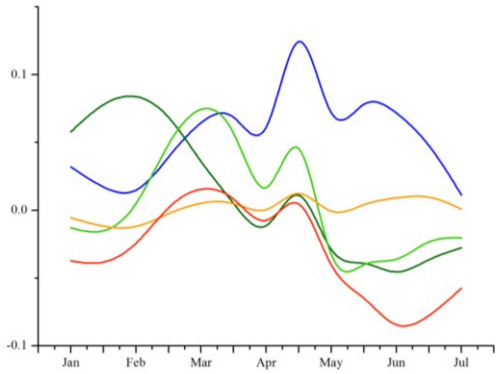
In China's Northeast, the monitoring period from April to July mainly covers the cultivation of spring maize, spring wheat, one-season rice, and soybean. Overall and over most of the monitoring period, crop condition was below the recent five-year average. Besides, the NDVI clusters and profiles show that in the west of Liaoning, Jilin, and the west of Heilongjiang, the crop condition was constantly lower than the average. It should be noted that, in these areas, the biomass (BIOMSS) is 20% lower than average with low VCIx, showing poor crop conditions because of the shortage of rain. The CropWatch agroclimatic and agronomic indicators show that overall the region suffered an 11% drop in rainfall (RAIN) compared to average, while temperature (TEMP) and PAR (RADPAR) accumulation were just below average. Biomass accumulation (BIOMSS) was 4% below the five-year average. Crop condition is mixed and the area needs close monitoring this year.

Figure 4.15. Crop condition China Northeast region, April-July 2016

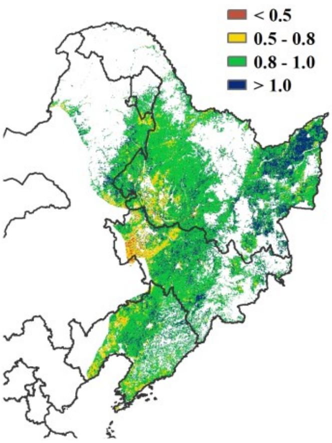


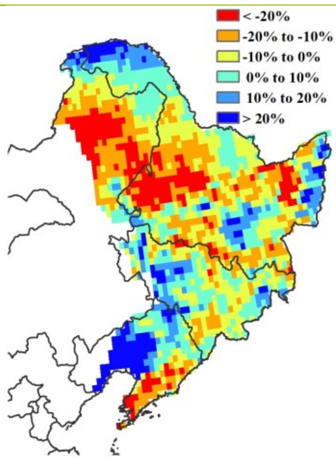
(a) Crop condition development graph based on NDVI





(b) Spatial NDVI patterns compared to 5YA (c) NDVI profiles





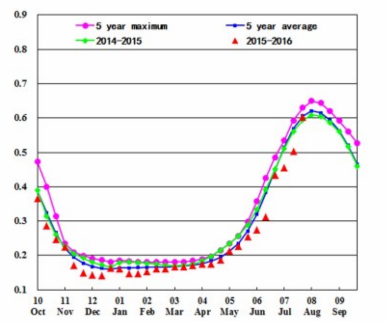
(d) Maximum VCI (e) Biomass

Inner Mongolia

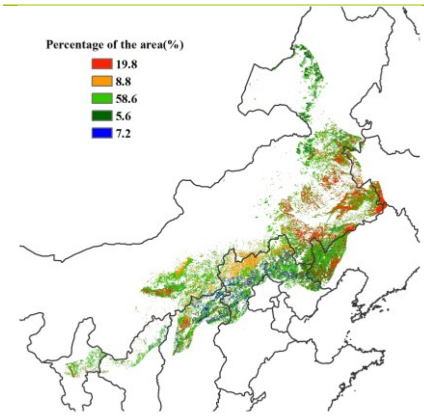
The condition of spring crops was generally unfavorable in Inner Mongolia for the current reporting period. Among the CropWatch agroclimatic indicators, RAIN was well above average (+46%), but its temporal and spatial distribution was not homogeneous; temperature was below average (TEMP, -0.4°C) with no change in radiation, which resulted in an increase of the biomass accumulation potential (BIOMSS) of about 11%.

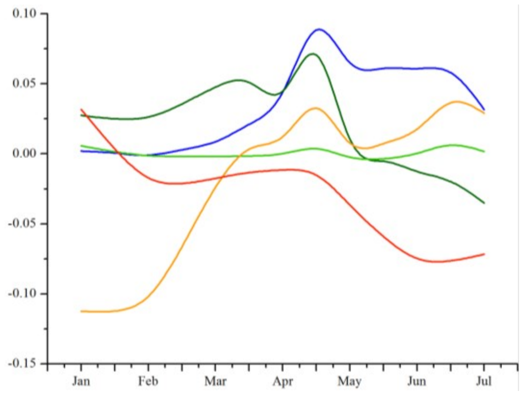
As a result, conditions were almost average for the sowing and growing of spring crops, as illustrated in the crop development graph from April to early May. Since late May, however, reduced rainfall affecting crop growth is clearly shown by decreasing NDVI profiles, and detailed information is displayed in spatial NDVI patterns and profiles. Until late July, crop condition was close to average. Southeast of Inner Mongolia (mainly in Chifeng) and central Ningxia suffered unfavorable vegetation condition according to spatial NDVI patterns and the VCIx map (the maximum value was below 0.5). The potential biomass was poor as well in the area mentioned above. Generally, crop condition was unfavorable from April to July. If unfavorable conditions are maintained over the whole cycle, crop growth will be restricted and the outcome may be a poor season.

Figure 4.16. Crop condition China Inner Mongolia, April-July 2016



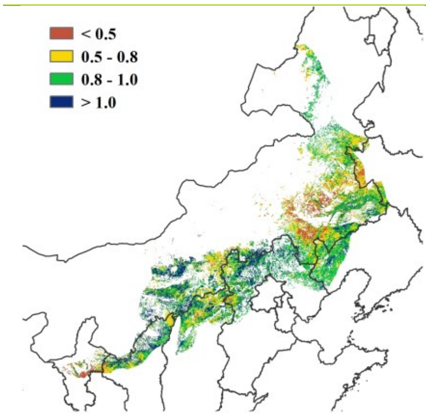
(a) Crop condition development graph based on NDVI

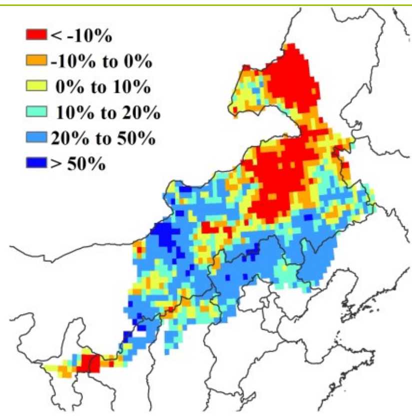




(b) Spatial NDVI patterns compared to 5YA

(c) NDVI profiles





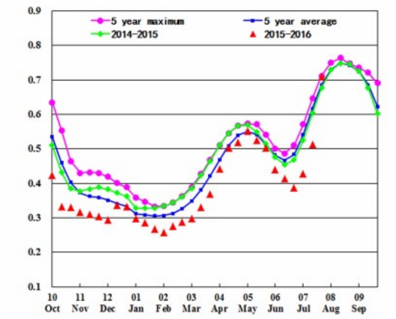
(d) Maximum VCI

(e) Biomass

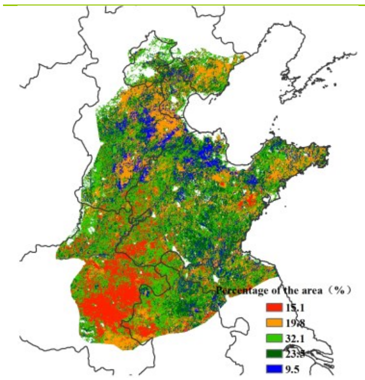
Huanghuaihai

Crop condition in Huanghuaihai was below the recent five-year average. Currently, crops in the region are mainly winter wheat, which was harvested in June, while maize was planted in April and is still growing. As shown by the NDVI development graph, crop condition was generally average during April and May, but sharply declined in early June and up to July (when compared with both the five-year average and the previous year), which may be related to the low radiation (RADPAR, -5%). In spite of this, favorable climatic conditions with 14% above average precipitation provided adequate soil moisture for crops and led to an increase in the biomass potential (BIOMSS, +20%). BIOMSS was favorable across the region with the exception of eastern Shandong. Over the last four months, crop conditions were below average in Henan, western Shandong, and other scattered regions around Bohai bay where VCIx values consistently below 0.5 were observed. Prospects for winter crops are mixed.

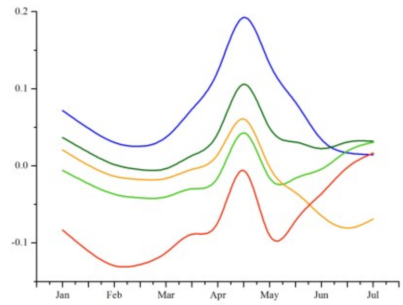
Figure 4.17. Crop condition China Huanghuaihai, April-July 2016



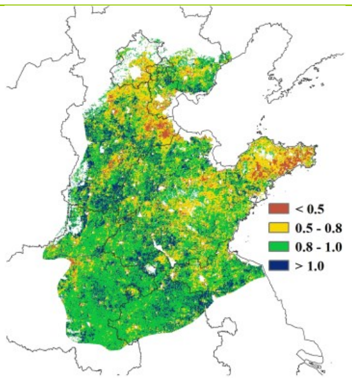
(a) Crop condition development graph based on NDVI



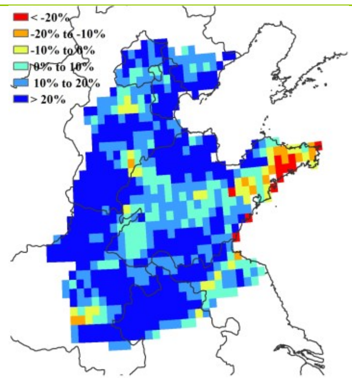
(b) Spatial NDVI patterns compared to 5YA



(c) NDVI profiles



(d) Maximum VCI

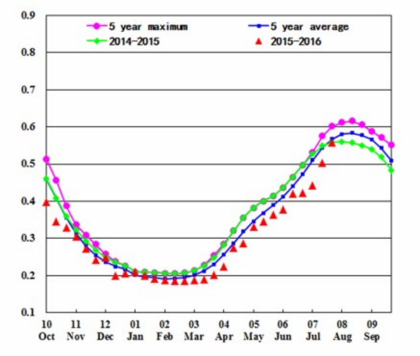


(e) Biomass

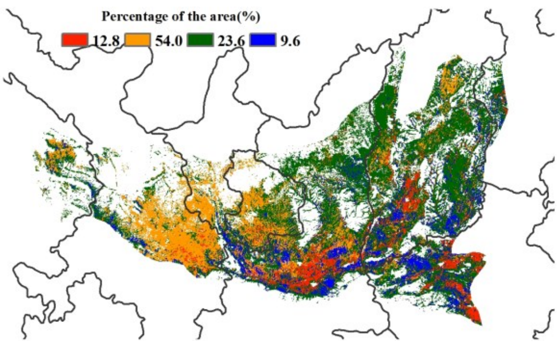
Loess region

In the Loess region, winter wheat was harvested from early to mid-June, while summer maize has been planted during the monitoring period. When compared to average, RAIN increased 41%, PAR accumulation (RADPAR) dropped by 3%, and temperature (TEMP) by 0.6°C. The BIOMSS production potential was 23% above the average as a result of ample rainfall. Up to June, condition of crops was below the five-year average and last year's level, with a VCIx value of 0.80. The spatial NDVI clusters and profiles indicate that crop condition fluctuated widely over time and according to areas. Condition was unfavorable in Fen-Wei Plain, central-eastern Gansu, and southern Ningxia, coinciding with a low VCIx in those regions. The fraction of arable land actually cropped decreased 5 percentage points, which leads to a pessimistic crop production outlook for the region.

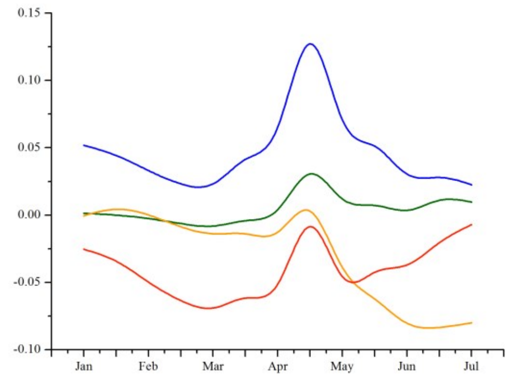
Figure 4.18. Crop condition China Loess region, April-July 2016



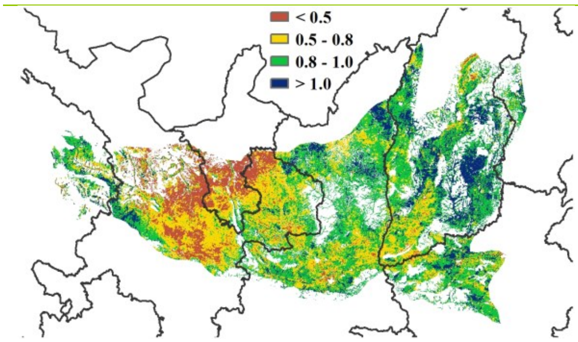
(a) Crop condition development graph based on NDVI



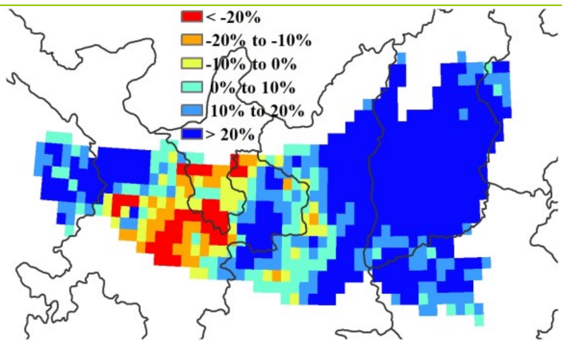
(b) Spatial NDVI patterns compared to 5YA



(c) NDVI profiles



(d) Maximum VCI

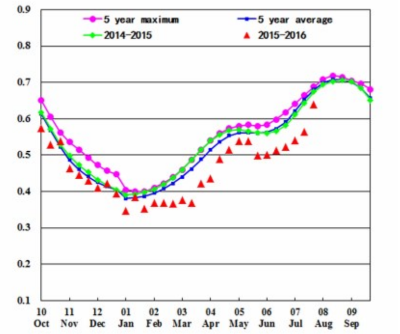


(e) Biomass

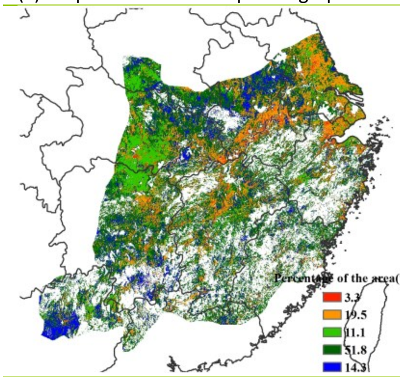
Lower Yangtze region

Crop condition was below the average of the past five years in the Lower Yangtze region. During the monitoring period, the winter wheat harvest was completed in the north of the region including Henan, Jiangsu, and Anhui provinces. Early rice was also harvested, while the semi-late and late rice is still growing in the south and center (including Fujian, Jiangxi, Hunan, and Hubei provinces). Accumulated rainfall was significantly above average (RAIN, +60%), but radiation and temperature were below (RADPAR, -7% and TEMP, -0.7°C respectively). Although most of the region suffered from floods, the biomass production potential was above the recent five-year average (BIOMSS, +16%). According to the VCIx map, crop condition was usually fair, while the BIOMSS map shows that biomass was above or close to the average in most of the region. Finally, NDVI profiles show that crop condition was mostly poor in 33.9% of the region's cropped areas, in south of Jiangsu, middle of Hubei, north of Zhejiang, and regions along the Yangtze river. Based on the above analysis, the yield of crops in this region is expected to be below but close to the average.

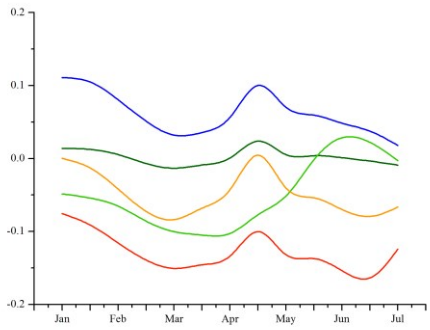
Figure 4.19. Crop condition Lower Yangtze region, April-July 2016



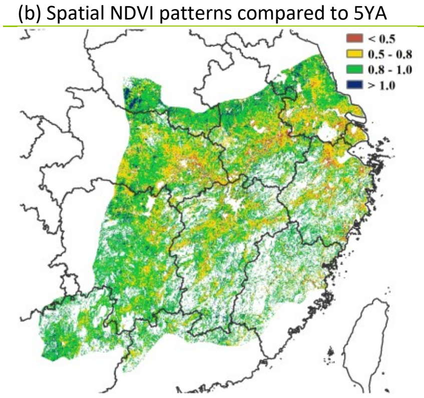
(a) Crop condition development graph based on NDVI



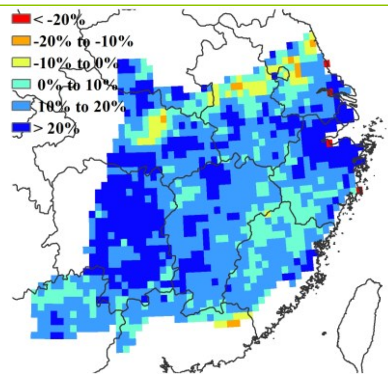
(b) Spatial NDVI patterns compared to 5YA



(c) NDVI profiles



(d) Maximum VCI



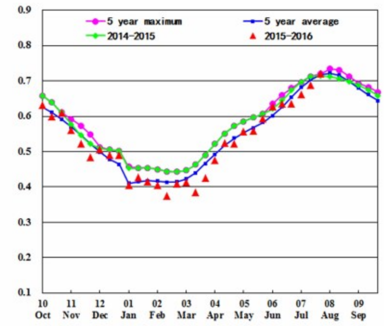
(e) Biomass

Southwest China

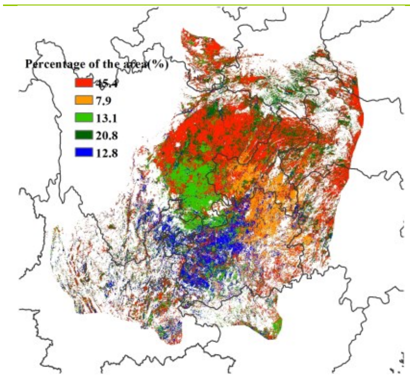
Precipitation exceeded the average by 31% with average temperature (TEMP, -0.3°C) and decreased radiation (RADPAR, -2%). This led to a small increase in the potential biomass accumulation (BIOMSS, 14%) compared to the recent five-year average. Few differences existed among the provinces for rainfall: Guizhou RAIN, +38%, Chongqing +46%, Sichuan +28%, Hubei +54%, and Hunan +53%.

The spatial NDVI pattern and profiles both show average to slightly above average condition for southwestern regions. The potential biomass map indicates that eastern Sichuan was below average condition. All indicators point at average to slightly above average crops.

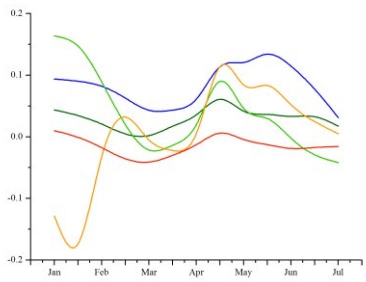
Figure 4.20. Crop condition Southwest China region, April-July 2016



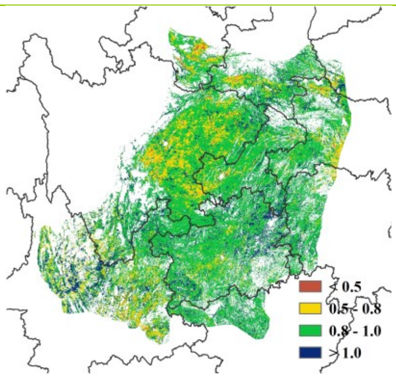
(a) Crop condition development graph based on NDVI



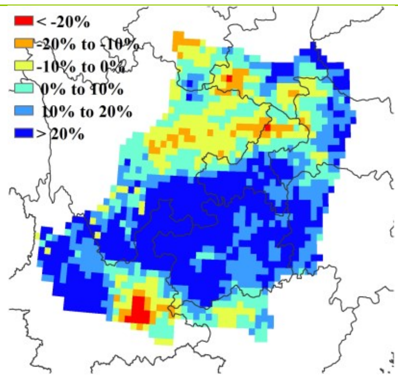
(b) Spatial NDVI patterns compared to 5YA



(c) NDVI profiles



(d) Maximum VCI



(e) Biomass

Southern China

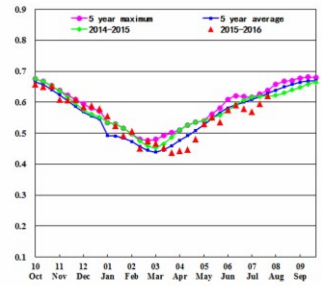
Crop condition was generally average in southern China during the entire period. Precipitation (RAIN) was 12% above average, with the following values at the provincial level: Fujian RAIN, +55%, Guangxi +36%, and Guangdong +19%. Temperature (TEMP) dropped by 0.3°C, while radiation (RADPAR) increased by 2%. As a result, potential accumulated biomass BIOMSS increased by 12% on the whole, compared to the five-year average.

The crop condition development graph based on NDVI shows crop condition in the region was below average in April but recovered in May. Although condition dropped again to below average in June, it generally returned to average in July. Nearly all arable land was actually cropped over the region, with the cropped arable land fraction (CALF) decreasing by only 1 percentage point compared to its average.

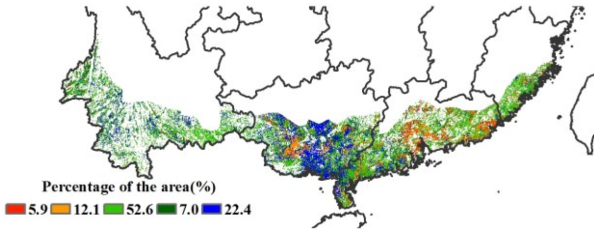
The spatial NDVI pattern and profiles indicate overall average condition, except for the central and eastern parts of southern Guangdong and some limited areas in Guangxi, where the crop condition was below average with a somewhat lower VCIx of 0.5-0.8. The affected area makes up about 12.9% of arable land in the region.

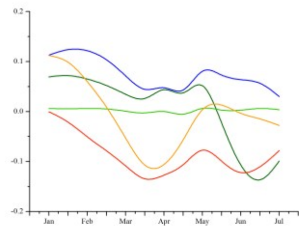
Overall, with the maximum VCI reaching 0.89, crop prospects for the region are at average level.

Figure 4.21. Crop condition Southern China region, April-July 2016



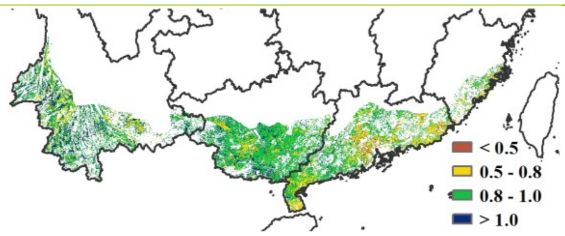
(a) Crop condition development graph based on NDVI



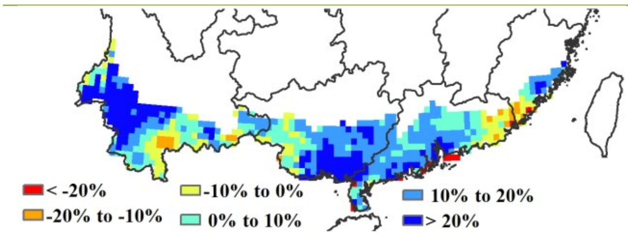


(b) Spatial NDVI patterns compared to 5YA

(c) NDVI profiles



(d) Maximum VCI



(e) Biomass

Chapter 5. Focus and perspectives

This focus section complements CropWatch analyses presented in chapters 1 through 4 by presenting additional information about topics of interest to global agriculture. This issue includes an updated production outlook for 2016 (5.1), a closer look at the situation in Morocco (5.2), a focus on agriculture in Southwest Asian countries (5.3), and an update on El Niño (5.4).

5.1 Production outlook

Tables 5.1 and 5.2 present the current CropWatch estimate of 2016 crop production, based on a combination of remote-sensing and trend-based projections. The information will be updated in the next quarterly bulletin in November, including more actual information as it becomes available. Except for wheat, of which the largest share is produced in the northern hemisphere as a winter crop, approximately 80 percent of the total 2016 production has been harvested recently or is still growing.

Table 5.1. Summary of 2016 production estimates by major aggregates (thousand tons) and variation (%, compared with 2015) of maize, rice, wheat, and soybean

	Maize		Rice		Wheat		Soybean	
	2016	**Δ%**	**2016**	**Δ%**	**2016**	**Δ%**	**2016**	**Δ%**
Major producers	874897	0.8	639141	-4.3	622361	-0.6	287619	0.9
Minor producers	114783	5.1	74943	1.5	101099	3.2	21636	-8.7
All countries	**989679**	**1.3**	**714084**	**-3.8**	**723460**	**-0.1**	**309255**	**0.1**
Top 5 exporters	498413	0.8	254600	-8.0	248835	2.0	264606	1.0

Note: Major producers include China and the 30 countries listed in Chapters 3 (and table 5.2) for which CropWatch carries out a detailed qualitative and quantitative assessment of crop condition and production. Together, they represent more than 80% of the production and about 80% of exports of maize, rice, wheat and soybean. Refer to the note in table 5.2 for additional methodological detail. Minor producers include the 151 countries (from Afghanistan and Angola to Zambia and Zimbabwe). Country-wide productions for those minor producers are computed for each country based on trends derived from FAOSTAT data but aggregated in the table. "All countries" combines major and minor producers. The top-5 exporters are the countries listed by http://www.indexmundi.com/agriculture based on USDA data. The totals are based on table 5.2, except for soybean and Uruguay (the fifth largest producer), which is based on trends derived from FAOSTAT.

As illustrated in table 5.1, CropWatch currently estimates the production of 2016 to depart less than 1.5% from the production of 2015 for maize (+1.3%), wheat (-0.1%), and soybean (+0.1%), while for rice a marked drop of -3.8% is expected mainly as a result of adverse conditions in India. When considering only the major producers, the situation is less favorable, as the bulk of the minor producers significantly outperforms the major ones. The situation is slightly more favorable when the top five exporters are considered: maize, wheat, and soybean supply is up by close to or more than 1% (0.8%, 2.0%, and 1.0%, respectively). For rice the drop is 8%, which may result in some tension.

Large differences are sometimes observed between countries (for one crop) or between crops (within one country). In general, between-country variability is largest for maize (-32 to +19%) and about comparable for the three remaining crops (about -32% to +9%). For between-crop variability at the national level, the size of the country, the number of seasons, and the diversity of eco-climatic conditions play a major part. China is a perfect illustration with maize and soybean up 1% and rice and wheat down 1%. Other countries with low between-crop variability include Australia, Indonesia, Pakistan, Russia, and the United States. High values occur in South Africa (-32% for maize and +9% for soybean, a relatively minor crop in the country), Turkey (-16% for wheat, a winter crop, and +8% for soybean, a summer crop), Canada (-5% for maize and +11% for wheat), and Myanmar where maize production increased 3% but rice dropped 17%, following a common behavior of rice production in Southern Asia. The pattern is the result of the global agroclimatic patterns noted in Chapter 1 and section 3.1.

Table 5.2. 2016 national production estimates (thousand tons) and variation (%, compared with 2015) of maize, rice, wheat, and soybean of the maize producers

	Maize		Rice		Wheat		Soybean	
	2016	Δ%	2016	Δ%	2016	Δ%	2016	Δ%
Argentina	**25710**	1	**1695**	0	**11630**	-4	**51080**	-1
Australia	460	2	946	4	**26631**	5	93	6
Bangladesh	**2377**	6	**48049**	-5	**1300**	-1	71	2
Brazil	**70433**	-12	**11055**	-7	**6713**	-4	**91774**	2
Cambodia	852	2	**8917**	-6				
Canada	**11205**	-5			**34049**	11	**4995**	-8
China	**202016**	1	**200347**	-1	**118591**	-1	**13141**	1
Egypt	**5702**	-4	**6291**	-4	**10207**	3	26	-5
Ethiopia	**7784**	19	136	8	**4743**	12	81	12
France	**14619**	-1	87	-5	**37984**	-3	149	2
Germany	**4586**	0			**28106**	3	15	18
India	**16444**	-13	**144225**	-7	**86099**	-6	**10843**	-11
Indonesia	**18316**	2	**67906**	0			891	1
Iran	**2692**	8	**2763**	9	**16073**	15	194	2
Kazakhstan	651	5	377	2	**16852**	5	247	10
Mexico	**22335**	-6	201	0	**3550**	-2	352	10
Myanmar	**1776**	3	**23034**	-17	197	3	159	-4
Nigeria	**11597**	11	**4588**	1	89	-2	680	5
Pakistan	**4679**	-4	**9249**	-2	**24638**	-1		
Philippines	**7565**	0	**19104**	-2			1	3
Poland	**3681**	9			**10418**	0		
Romania	**11491**	7	58	4	**7675**	7	164	3
Russia	**12337**	3	**1017**	3	**53747**	-1	**2099**	3
South Africa	**9018**	-32	3	0	**1704**	0	954	9
Thailand	**5080**	1	**36644**	-7	1	4	207	-3
Turkey	**5920**	0	943	3	**19222**	-16	168	8
Ukraine	**30774**	9	103	-7	**23877**	2	**3799**	2
United Kingdom					**14076**	-5		
United States	**359159**	3	**10340**	4	**57900**	2	**107362**	1
Uzbekistan	405	7	377	7	**6576**	-2		
Vietnam	**5234**	1	**41448**	-8			143	-10
Major producers	874897	0.8	639141	-4.3	622361	-0.6	287619	0.9
Minor producers	114783	5.1	74943	1.5	101099	3.2	21636	-8.7
All countries	989679	1.3	714084	-3.8	723460	-0.1	309255	0.1

Notes: See the note for table 5.1 for a definition of major (those listed in this table) and minor producers. **Boldfaced numbers** given for a country above are CropWatch estimates based on national statistics and remote sensing data. Other numbers are trends-based and computed from FAOSTAT data. The CropWatch estimates are based in part on current information and enjoy a larger degree of confidence than the trend-based projections. The last three lines are similar to those in table 5.1.

Maize

As mentioned, CropWatch foresees large differences among the performances of national maize productions. The very large drop (-32%) in South Africa can clearly be assigned to the prevailing drought, which was already mentioned in previous CropWatch bulletins. Similarly, the poor performance in India (-

13%) and Brazil (-12%) can be assigned to unfavorable agroclimatic conditions, specifically floods and drought. Positive departures worth mentioning include those in Bangladesh (+6%), where the production has been growing fast over several years now, Kazakhstan (+5%), and Uzbekistan (+7%), Ukraine and neighboring Poland (9% and 7%, respectively), as well as Iran (+8%) and Ethiopia (+19%). If the increase can be confirmed for the latter country by later estimates, it will provide welcome relief after a previous season badly affected by drought.

Rice

Major producers from west to Southeast Asia suffered a drop in rice production largely associated with a combination of drought and excess precipitation, either locally or through the discharge of rivers that respond to rainfall in distant areas. In addition to India (-13%), which was already mentioned above, the following countries show marked estimated production drops: Vietnam -8%, Thailand -7%, Cambodia -6%, Bangladesh -5%, Pakistan and the Philippines, -2% and China, -1%. Myanmar and Indonesia stand out with +3% and no change with 2015, respectively. Increases are noted for the United States (+4%) and Iran (+9%).

Wheat

The largest decrease is estimated in Turkey (-16%), India (-6%), as well as in Argentina and Brazil (-4% each). Large positive values among the major producers are those of Canada (+11%), Romania (+7%), and Australia (+5%). Similar to the situation with rice and maize noted above, Iran and Ethiopia are also expected to have good harvests of wheat (+15% and +12%, respectively).

Soybean

Due to changes in policy, China is forecast to increase soybean production by 1%, the first positive departure in more than a decade. Russia and Ukraine are both consolidating their role as significant soybean producers with 3% and 2% production growth. Among the leading producers, Argentina is put at -1%, due to large excess precipitation, while Brazil and the United States are both increasing their output over 2015, by 2% and 1%, respectively. Significant drops that may affect international markets include Canada (-8%) and India (-11%). When considering population growth, the Indian soybean production deficit is about 1.5 million tons. Added to the production drops of maize (2.4 million tons), rice (10.6 million tons), and wheat (5.3 million tons), the shortfall is significant.

5.2 Local stories: Drought in Morocco

R. Balaghi[4]and R. Gommes

Introduction

Chapters 1 and 3.1 (figures 1.1 and 3.1) have mentioned the overall pattern of excess precipitation that has affected a huge mass of land, extending from the northern half of Africa across the Middle East to central Asia and adjacent areas in southern and eastern Asia. Good indications exist of links between the Moroccan climate, the North Atlantic Oscillation (NAO), and El Niño (Ward et al. 1999, Knippertz 2003, Knippertz et al. 2003), but the connection between such a continent-wide anomaly and the latest El Niño

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is not ascertained. The pattern, however, is very compatible with global warming as Petit-Maire and other researchers have observed an association between warmer conditions in the semi-arid areas from Africa to Asia and warming at all time scales, from geological to daily scales (Petit-Maire 1992, 1999; Guo et al. 2000).

Morocco normally enjoys a relatively uniform Mediterranean climate with mild and wet winters, well suited for winter crops. Interestingly, during the current season, the western Mediterranean experienced a marked precipitation shortfall centered on Spain and Morocco, where the deficit reached 68% between July 2015 and July 2016. The pattern identified by Petit-Maire thus did not apply to Morocco this season. In fact, Morocco's climate has been known to be very variable and somewhat deviant compared with the central and eastern Mediterranean.

This case study presents a closer look at the reported drought in Morocco as assessed by both CropWatch and the Moroccan cereal crop Monitoring and forecasting system, CGMS-Morocco.

The current drought as assessed by CropWatch indices

CropWatch national indices (RAIN, TEMP, RADPAR, and BIOMSS) have clearly identified the current Moroccan drought starting from the early stages of the latest growing season (table 5.3).

Table 5.3. Variations of CropWatch agroclimatic indices in Morocco since July 2015

Year	Months	CropWatch agroclimatic or agronomic indicator (value and departure from reference value)			
		RAIN in mm (%Δ15)	TEMP (°C, °CΔ15)	RADPAR (Wm^{-2}, %Δ15)	BIOMSS ($gDMm^{-2}$, %Δ5)
2015	JASO	66 (-15%)	22.8 (+0.1°C)	1300 (-1%)	327 (+5%)
2016	ONDJ	79 (-74%)	14.6 (+0.9°C)	640 (+3%)	245 (-57%)
	JFMA	60 (-65%)	12.4 (+0.4°C)	1004 (0%)	228 (-56%)
	AMJJ	41 (-47%)	20.2 (-0.1°C)	1533 (-1%)	189 (-47%)

Note: Months are shown by the first letter of the month, e.g., JASO refers to the four-month period of July-October. Values for RAIN, TEMP, and RADPAR are compared to the average of the last 15 years, while for BIOMSS the reference value is the average of the last five years for the same season.

Morocco's cropping season generally starts in October and ends in June of the following calendar year. Rainfall in the country peaks between October and February, depending on latitude, orography, and regional circulation patterns. The 2015-16 deficit has been most severe at the middle phases of the growing season with a RAIN deficit of 74% between October and January. For the season as a whole, the deficit is estimated at 68%, which is significant for mostly rainfed and semiarid agriculture. Interestingly, other climate variables such as TEMP and RADPAR remained close to average, with the relative exception of warm temperatures and a positive sunshine anomaly during the October-January (ONDJ) period. The biomass production potential BIOMSS, on the other hand, reacts directly to rainfall and temperature variations, to the extent that the total production potential derived from table 5.3 reaches 549 grams of dry matter per square meter ($gDMm^{-2}$) from October 2015 to July 2016, which (with some simple assumptions about harvest index) corresponds to about 0.5 tons per hectare, well below average wheat and barley yields in Morocco.

The Moroccan drought in the global and regional context

Table 5.4 illustrates the relative ranking of the dry condition of Morocco and four neighboring countries for 2015-16, listing the percentage of global countries with rainfall departures more severe than the listed country. The table illustrates that indeed Morocco, with the exception of the pre-season July-October (JASO) period, experienced relatively severe rainfall departure from average, especially during late 2015 (October 2015-January 2016) and the spring of 2016 (April-July) when only respectively 0.6% and 0.4% of global countries had rainfall departures larger than those recorded for Morocco.

Table 5.4. Percent rank precipitation in Morocco and neighboring countries

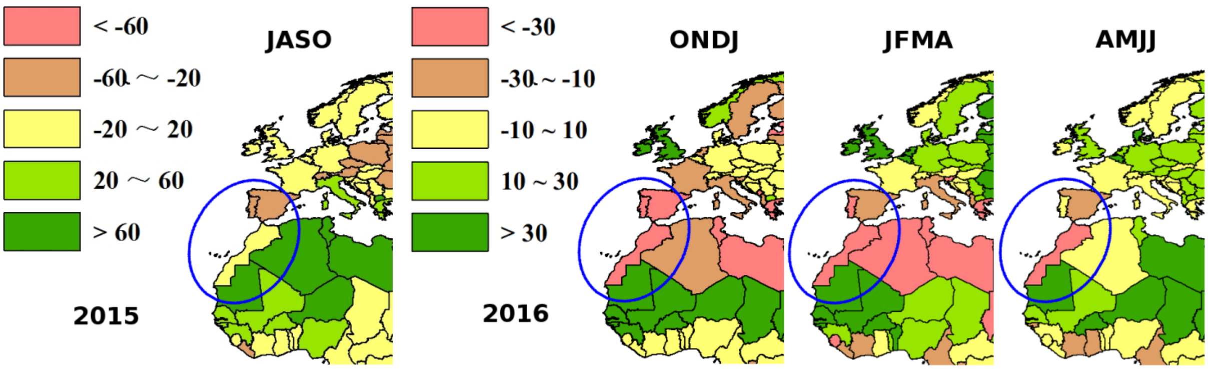
		Mauritania	Morocco	Portugal	Spain	Algeria
2015	JASO	93.4	41.0	7.2	15.7	91.0
2016	ONDJ	90.8	**0.6**	4.9	6.7	22.7
	JFMA	96.3	4.3	17.7	21.3	10.4
	AMJJ	99.3	**0.4**	26.5	13.2	39.1

Note: Table lists the percentage of 173 countries worldwide with relatively drier conditions than the listed country (that is, Mauritania, Morocco, Portugal, Spain, or Algeria). For example, a percent rank of 5.0% for a given country means that 95.0% of countries worldwide had rainfall departures less severe than the listed country.

None of the neighboring countries reached any comparable situation for the same duration, even if Portugal and Spain were also among the world's driest (in relative terms) between October and January. Strikingly, Mauritania, which belongs to the West African Sahelian group of countries, was one of the wettest countries.

Although correlations between anomalies in Morocco and in neighboring countries are weak (figure 5.1), even between Morocco and Algeria or Spain and Portugal, it appears that the variability is even larger between the western Mediterranean and neighboring areas, in particular Europe.

Figure 5.1. CropWatch RAIN indicator departure from the fifteen-year average for Morocco and neighboring countries for overlapping four-month periods between July 2015 and July 2016 (percentage)



Note: Maps are extracted from the current and previous CropWatch bulletins. Different color coding is used for 2015 July-October (JASO) (left) and 2016 October-January (ONDJ), January-April (JFMA), and April-July (AMJJ) periods (right).

A closer look at rainfall variability over space and time in Morocco

Figure 5.2 illustrates the spatial distribution of rainfall (figure a) and temperature (b) departures by municipality from September 2015 to May 2016, as interpolated from a national network of ground weather stations and by the Moroccan cereal crop Monitoring and Forecasting System, CGMS-Morocco.[5] Most of the country was confronted with a severe rainfall deficit (over 30%), especially in northern zones where agricultural areas are located. Rainfall was above normal only in mountainous zones and some parts of the eastern high plateaus. However, in these latter areas rainfall is generally not well spatialized, since very few stations exist. Temperature departure from the long term average was very high across the country and especially in mountainous zones and southern agricultural areas, which had consequences for crop tree cultivation, in particular of rosaceae (such as apples, pears, and medlars). The combination of rainfall deficit and temperature increase has led to a significant water balance deficit all over the country. Moroccan agriculture has been confronted with similarly severe conditions repeatedly over its history,[6] corresponding to 20 dry years over the last 70 years or 1 dry year every third.

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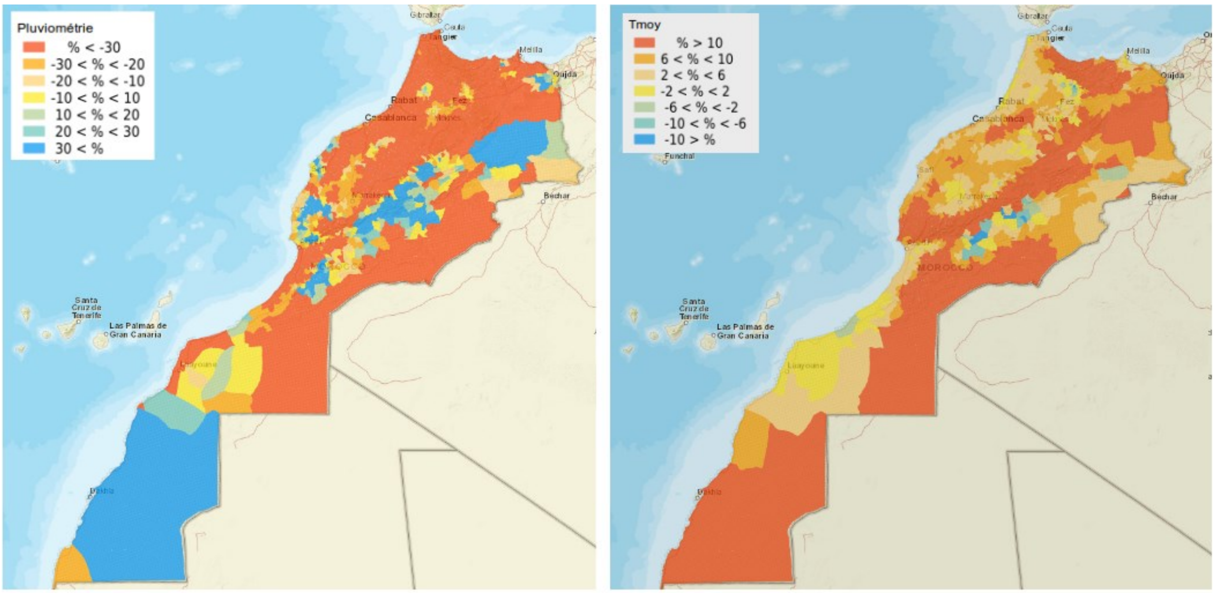
[5] The detailed data in this section and figures 5.2-5.4 are generated using the Moroccan cereal crop Monitoring and forecasting system, CGMS-Morocco. See www.cgms-maroc.ma and refer to Balaghi et al. 2013 for details.

[6] For instance in 1944-45, 1948-49, 1949-50, 1960-61, 1965-67, 1972-73, 1974-75, 1980-81, 1982-83, 1983-84, 1986-87, 1991-92, 1992-93, 1994-95, 1996-97, 1998-99, 1999-2000, 2004-2005, 2006-2007 et 2007-2008.

Figure 5.2. Rainfall (mm) departure (a) and temperature (°C) departure (b) from long term average (%) by municipality, September 2015 to May 2016



a b

Source: CGMS Morocco, R. Balaghi.

As shown in figure 5.3, the 2015-16 season was the driest since at least 1990 (top figure) as well as the hottest (bottom); it was actually drier than the “drought of the century” of 1994-1995. Rainfall and climate indicators exceeded the historical extremes of the last 30 years. The ground-based precipitation total from September 2015 to May 2016 reached 204 mm in agricultural areas while the average temperature over the same period was close to 17°C. For rainfall, this is comparable with the satellite-based rainfall estimates in table 5.3, although satellite-based temperatures are probably lower and, therefore, probably underestimate the actual water deficit that affected the whole country. Vegetation monitoring using NDVI shows the strong impact of drought over all major cereal producing areas in the country.

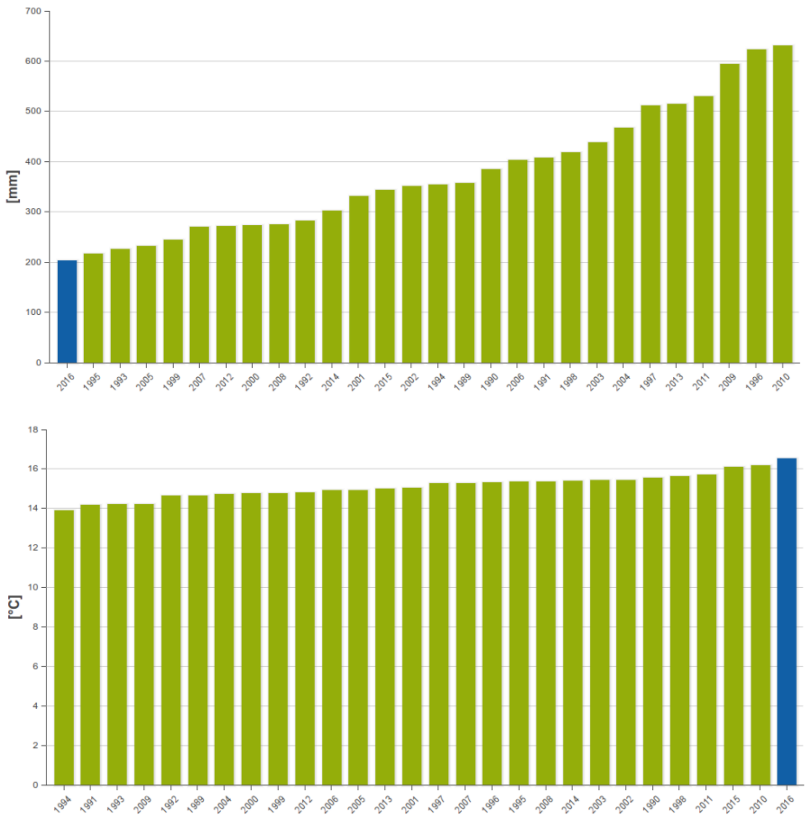
Impact on crop production

The combined effect of the rainfall deficit and heat wave in Morocco was worsened by the late onset of the season, which led to a reduction in the area cultivated with winter cereals (wheat and barley). This area dropped to 3.6 million hectares (of which 10% is irrigated), as opposed to close to 5 million during a normal year. Only 60% of the area did actually produce an output.

According to the Ministry of Agriculture and Maritime Fisheries (Ministère de l’Agriculture et de la Pêche Maritime), the cereal production is estimated to reach 3.35 million tons, a drop of almost 70% compared with 2014-2015. In a drought of that magnitude, no country in the world—even the most developed or technically most advanced—can possibly produce sufficient cereals. It is even stressed that the effect could have been worse, had it not been for the important developments that have taken place in Morocco to improve the resilience of the agricultural sector against climatic variability and change, in particular thanks to a new 2008-2020 agricultural strategy known as “Plan vert” or green strategy.[7]

[7] See Jacobs and van t’ Klooster 2012 for an overview.

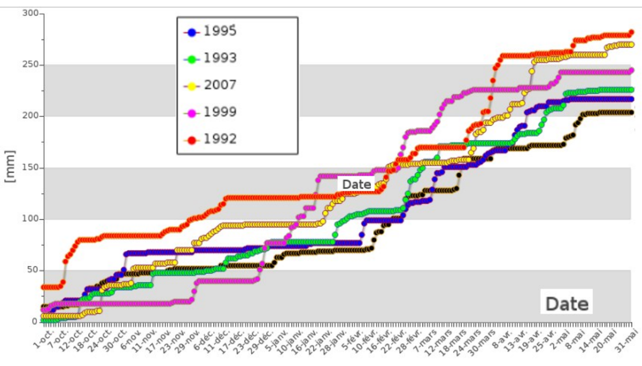
Figure 5.3. Comparison of 2015-16 (September to May) rainfall (top) and temperature (bottom) in blue, compared to all other years (in green) since 1990-91



Note: The blue bar indicates the amount of rainfall (in mm, top figure) and temperature (in °C, bottom) between September 2015 and May 2016. Green bars represent all other years since 1990-91.
Source: CGMS Morocco, R. Balaghi.

Finally, the rainfall accumulation similarity graph (figure 5.4) compares 2015-16 with the previous driest years on record since 1990, which are 1995-96, 1992-93, 2006-2007, 1998-99, and 1991-92. It appears that from the end of December, 2015-16 overtook the previously most severe drought year 1998-99. From February to March the current season was similar to 1994-95, and from March 2015-16 remained drier than any previous season on record since 1990-91.

Figure 5.4. Rainfall accumulation similarity graph comparing 2015-16 (black, lowest curve) with the 5 previous driest cropping seasons, since 1991 (year of the harvest)



Conclusions

Morocco is not one of the countries that monitored in detail by CropWatch. Nevertheless, the CropWatch indicators correctly picked out Morocco as one of the most severe droughts cases of 2015-16, probably more severe than South Africa where CropWatch has put the maize production drop at 32%. The RAIN indicator, in particular, performs particularly well, while TEMP is less efficient in capturing the heat wave that accompanied the drought. This case study also stresses that the large anomalies which CropWatch has been stressing as important global monitoring features also hide the fact that neighboring countries sometimes behave rather differently, resulting in isolated food deficit spots which deserve close scrutiny. Finally, the case study nicely illustrates the complementarity between global crop monitoring systems such as CropWatch and the Moroccan Crop Growth Monitoring System.

5.3 Focus: Southwest Asia

Introduction

Southwest Asia (figure 5.5) is spatially organized around India (IND) and includes the countries from Pakistan (PAK) to Bangladesh (BGD) as well as Nepal (NPL) and Bhutan (BHU) in the north and Sri Lanka (LKA) in the south. Most of the north of India, Nepal, and Bhutan belongs to the Indo-Gangetic plain, named after the Indus (Pakistan) and Ganges (India) rivers, where elevation rarely exceeds 250 meter. The common delta of three of Asia's largest rivers (the Ganges, the Brahmaputra, and the Meghna)—and one of the largest deltas in absolute terms[8]—is where Bangladesh is located, resulting in the country's rather peculiar lithology in which sediments predominate and "hard stone" is a rare occurrence (except in some peripheral areas such as the Chittagong Hills in the southeast). Punjab (meaning, "land of five rivers"[9]) constitutes the west of the low-lying areas of the Indo-Gangetic plain, which is delimited to the west by the Baluchistan plateau along the Iranian (IRN) border. Beyond the Indo-Gangetic crescent, elevation rises rapidly to the north in the Himalayan foothills and to the south of India, centered around the Deccan Plateau at elevations around 500 meter. In Sri Lanka, elevations are highest in the south, which markedly affects and conditions climate and agricultural patterns.

Just over one-fifth of the world population lives in southwest Asia, where India, Pakistan, and Bangladesh are among the eight most populated countries in the world. Together with Europe and the eastern Gulf of Guinea, southwestern Asia also includes some of the highest national population densities (table 5.5): With more than 1100 people per square kilometer, Bangladesh has the record of the most densely populated non-urban country in the world. The high density also accounts for the country's large fraction of arable land (60%, followed by India at 53% and, to a lesser extent, by Pakistan with 39%). In all three countries, the values point at a relative shortage of land when compared with other countries in the region.

With the exception of Pakistan, where 2015 population growth rates remain close to 2% (2.1%), all other countries in the region now have rates close to 1% (1.2% in Bangladesh, India, and Nepal) or below (0.9% in Sri Lanka.[10] For the sake of comparison with some agricultural production statistics, table 5.5 shows the increase of population over the last 12 years or so (percentage change between the averages of 1998-2002 and 2010-2014). Among all countries, Pakistan shows the largest population growth (31%) and Sri Lanka the smallest (9%). The contradiction between the World Bank growth rates and the FAO data reflects a well-known debate about Bhutanese population statistics,[11] involving population movements from neighboring countries and cultural issues.

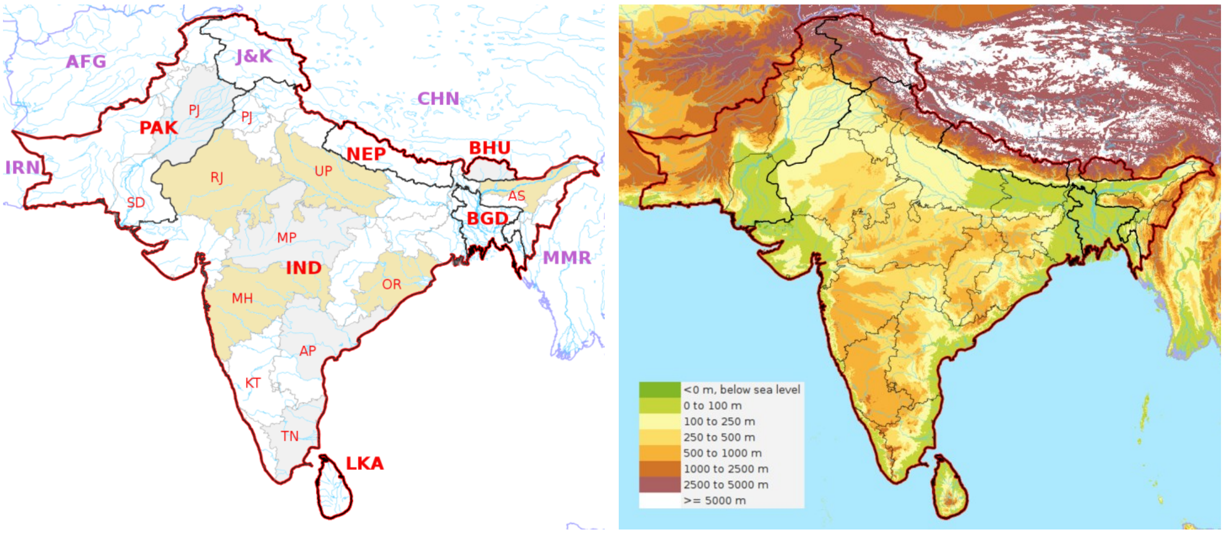
[8] https://en.wikipedia.org/wiki/Bangladesh

[9] https://en.wikipedia.org/wiki/Punjab_(region)

[10] World Bank, http://data.worldbank.org/indicator

[11] http://worldpopulationreview.com/countries/bhutan-population/ and http://countrystudies.us/bhutan/18.htm.

Figure 5.5. General setting (a) and topography (b) of Southwest Asia



(a) (b)

Note: The map demonstrates Southwest Asia's neighbors (Iran, IRN; Afghanistan, AFG; China, CHN; Myanmar, MMR) as well as some major subdivisions for India (IND) and Pakistan (PAK): SD, Sind; PJ, a province of Punjab in Pakistan and an Indian state; AP, Andhya Pradesh; AS, Assam; KT, Karnataka; MP, Madhya Pradesh; MH, Maharashtra; RJ, Rajasthan; UP, Uttar Pradesh; and TN, Tamil Nadu. The sovereignty of J&K, Jammu, and Kashmir, is unsettled.

Altogether, in spite of its very high population densities, Bangladesh is doing well in terms of food supply, with cereal production growing faster than population (44% vs 20%) and the highest per capita cereal production (343 kg per year). In India, values are comparable (25% vs 21%), while the situation is most favorable in Sri Lanka (49% vs 9%). This last country, which has often been used to illustrate a successful family planning policy[12] (Abeykoon, 2011), also displays increases in agricultural production that well exceed population growth, especially for soybean and maize (in terms of under-nutrition levels (25%), however, the country is comparable with other countries in the region). Bangladesh too has massively switched to maize, mostly at the expense of pulses and in particular spring wheat, which is a traditional crop in the region but with a lower production potential than maize under the prevailing climate.

Agricultural environment

Most areas of Southwest Asia suffer from large rainfall deficits when compared with potential evapotranspiration (PET), particularly for some water demanding crops such as maize or rice for which water requirements exceed PET by 20% to 50% (figure 5.6(a)). As shown in the same figure, the region is also characterized by some of the wettest climates in the world (e.g., in northeast India and the western Ghats bordering the Deccan Plateau on the southwestern coast of India) where low temperature due to elevation contributes to low PET. Capture of monsoon rainfall by the Himalayan relief constitutes the main source of water for the Indo-Gangetic plain. Particularly for southern Pakistan, where near-desert prevails in most of Sind province, the combination of high sunshine with a usually reliable water supply and a pest and disease adverse low air moisture, constitute a very favorable environment for crops. Together, India, Pakistan, and Bangladesh make up the largest contiguous area of irrigated agriculture in the world. If central Asia and China (Yangtze) are also considered, the rivers that flow from the Himalayas contribute to feeding about 20% of the global population (Allison, 2012). Because of this, however, and as illustrated in recent CropWatch bulletins, floods are among the major hazards affecting the region. Some traditional varieties of rice (e.g., the floating rice type known as B-aman in Bangladesh) are adapted to

[12] http://archives.dailynews.lk/2003/12/02/new18.html

floods with stem elongations that can sometimes reach 20 cm per day, but they cannot easily accommodate modern farming techniques, including the development of high yielding varieties.

Table 5.5. Some basic statistics for Bangladesh (BDG), Bhutan (BHU), India (IND), Nepal (NPL), Pakistan (PAK) and Sri Lanka (LKA)

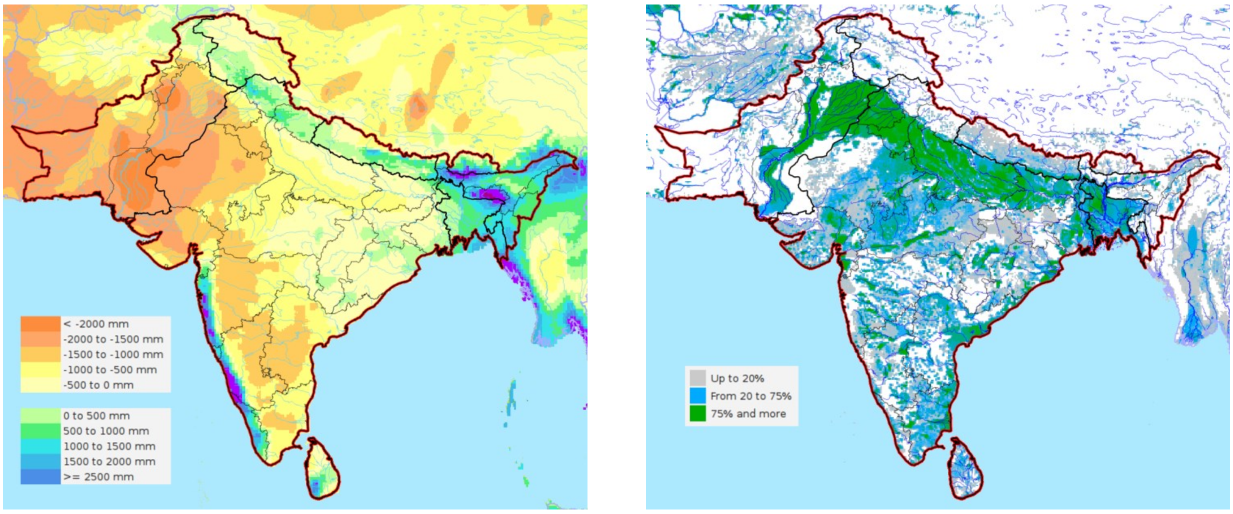
		BGD	BHU	IND	NPL	PAK	LKA	Source
Population	Million in 2015	155	0.743	1263	28	177	20	(1)
	% change	20	33	21	17	31	9	(1)
	Density (people/km2)	1117	20	394	180	241	309	(5)
GDP/capita	2011-2015 US$	3123	7816	6020	2374	4811	11739	(2)
Males employed in agriculture (2014)	% of labor force	42	33	49	n.a.	38	29	(2)
Females employed in agriculture (2014)	% of labor force	68	63	71	n.a.	67	35	(2)
Agricultural production	% GDP in 2014	16-	18-	17-	34-	25=	9-	(2)
Agricultural land	% total land area	70-	14+	61=	29+	47=	44+	(6)
Arable land	% total land area	60	3	53	15	39	21	(6)
Land equipped for irrigation (LEI, 2007)	% agricultural land	55	3	32	28	70	24	(3)
Land actually irrigated, 2011	% of LEI	100	28	94	100	100	84	(4)
Water used for agriculture, 2011	% renewable water available	2	0.5	36	4	70	21	(4)
Cereal production (2009-2013)	1000 tons	53323	165	287384	8797	35864	4206	(7)
	% change	44	25	25	28	28	49	(7)
	Kg/person	343	222	227	320	202	206	(7)
Rice production	% change	45	62	22	15	−5	44	(1)
Rice area	% change	9	−16	−2	−4	11	30	(1)
Wheat Production	% change	−39	−50	26	54	29	n.a.	(1)
Maize production	% change	3029	15	91	46	162	528	(1)
Soybean production	% change	n.a.	−63	106	59	−99	771	(1)
Oilcrops production	% change	15	−46	56	32	30	9	(1)
Pulses production	% change	−34	62	34	29	−8	3	(1)
Potato production	% change	216	41	90	119	104	39	(1)

Notes: Population % change refers to the % change between the 1998-2002 average and the 2010-2014 average when available (otherwise, the second period was taken as 2009-2013); -, + and = signs after numbers indicate that the variable is decreasing, stable or increasing; n.a. stands for "not available" or "meaningless."

Sources: (1) FAOSTAT or computed based on FAOSTAT (http://faostat3.fao.org/); (2) World Bank, http://data.worldbank.org/indicator; (3) http://data.un.org/Data.aspx; (4) FAO/Aquastat http://www.fao.org/nr/water/aquastat/maps/World-Map.ww.trwr_eng.htm and http://www.fao.org/nr/water/aquastat/water_use_agr/ IrrigationWaterUse.pdf; (5) https://en.wikipedia.org/wiki/List_of_countries_and_territories_by_population_density; (6) World Bank (same as 2). Agricultural land includes rangeland and forests, while arable land is normally cultivated with temporary crops (i.e., field crops as opposed to trees); (7) same source as (1); 2010-14 averages were used instead of 2009-2013 when available.

The annual water balance of the region undergoes marked seasonal changes from the temperate mountains in the north to the equatorial highlands in Sri Lanka. In India, Nepal, and Pakistan, seasons are often referred to as either Rabi or Kharif, with Rabi including mostly rainfed winter crops grown from October to March (wheat, sesame, various Brassicas, and temperate legumes) and Kharif describing rainfed summer crops in monsoon areas or irrigated crops, from May to November (rice, sugarcane, cotton, maize, soybean, and tropical legumes). In Bangladesh, rice is grown throughout the year under different scenarios of water control in three seasons: early monsoon Aus season (March-July), late monsoon Aman (July-December), and mostly irrigated Boro season (January -June) (Dey and Norton 1992). In Sri Lanka, cropping seasons tend to be similar to those in maritime Southeast Asia; they are commonly referred to as Maha (greater monsoon), sown between August and October and harvested five or six months later, and Yala, sown between April and May and harvested about four or five months later.[13]

Figure 5.6. Difference (mm) between annual rainfall and potential evapotranspiration (Rain-PET) (a) and percentage of crops in each pixel irrigated (b)



(a) (b)

Source: (a) Maps prepared based on Climond rainfall (Hijmans et al., 2005) and on PET computed from New_locClim (Grieser et al, 2006); (b) Based on GMIA data (FAO, 2016).

Cropping patterns in Southwest Asia are also very diverse, conditioned by factors such as the level of water control (for example, flooded but rainfed lowland rice, river or ground-water irrigated rice, upland rice, or aerobic rice), the period of limiting river and precipitation water or temperature conditions, and the period of rainfall availability (from 0 months per year in Sind, Pakistan to 12 months in southern Sri Lanka).

With the exception of Pakistan, countries use a moderate amount of their renewable water resources for agriculture (less than 5% in Bangladesh, Bhutan, and Nepal; 21% in Sri Lanka; and 70% in Pakistan), under land availability constraints in most countries. Cropping intensities can be high as in Indian and Pakistani Punjab and Bangladesh, locally exceeding two crops per year. According to Wu et al (2015), room still exists to increase production by reducing cropping intensity gaps, currently in the range of 0.1 to 0.5 in Southwest Asia.

Production patterns and some trends

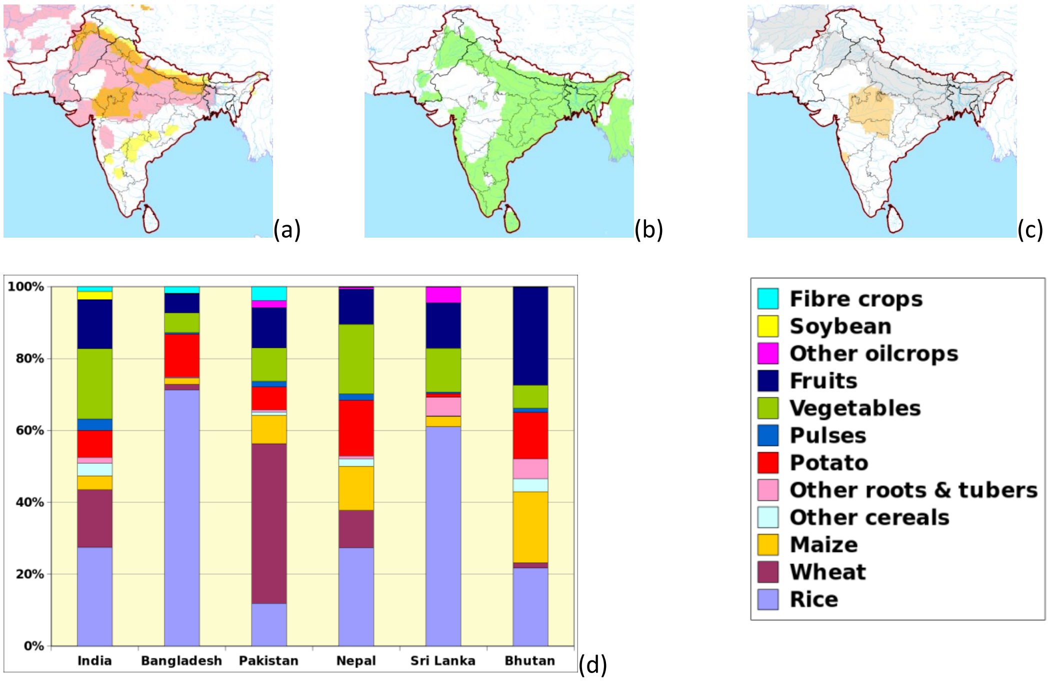
Production patterns in the region show large variations between countries, with wheat playing a major role in India, Pakistan, and Nepal, and rice dominating the agricultural landscape in Bangladesh and Sri Lanka (figure 5.7). Vegetables, fruits, and potatoes are ubiquitous. Due to the vegetarian tradition, pulses occupy a larger, but still limited share of the food basket in India; a sizeable fraction is for export. In general, crop distributions are more climate-conditioned than policy or market driven. India and Pakistan are similar in many respects; the level of undernutrition is close to 20% in both, and the level of mechanization is comparable too, with 15 to 20 tractors/1000 ha.[14] For instance, both countries produce large quantities of sugarcane (their main production in terms of fresh weight, even if the corresponding amounts of sugar are well below the national cereal production levels) and import large amounts of oil,

[13] http://countrystudies.us/sri-lanka/51.htm
[14] FAOSTAT, http://faostat3.fao.org/faostat-gateway/go/to/home/E

mostly from Southeast Asia. Milk, and milk products, are high in the diet. India and Pakistan differ mainly in the relative importance of rice and wheat in their diet, and trade wheat (as well as potatoes) play a larger role in Pakistan while India relies more on rice. For the remaining countries, rice plays a dominant role, stressing the fact that Pakistan is the country of transition from western Asian and middle-eastern culture, diets, and agriculture (starting with Iran), to southern Asian.

An interesting feature is the limited share of maize in Bangladesh and Sri Lanka when considering (see table 5.5) that the crop is currently undergoing a remarkable increase in production. Soybean is growing fast in India and Sri Lanka but decreasing in Pakistan where, according to M. Hanif (personal communication), the crop is suffering from competition with new varieties of maize, as well as potatoes (increasing everywhere), which produce a significantly higher income for farmers than soybeans. This is not unlike the situation in China, Korea, and Japan where soybean appeals little to farmers in a context where ample international supply of the crop is available.

Figure 5.7. Distribution of maize and wheat (a), rice (b), and potato and soybean (c), and national production patterns of main crop groups (d) in Southwest Asian countries



Note: Figure (a) illustrates main maize (yellow), wheat (pink), and maize + wheat (orange) production areas; Figure (b) includes main rice production areas; and (c) shows main potato (grey) and soybean (orange) producing areas. Figure (d) presents the relative share of various crop groups (excluding sugar) in Southwest Asia. See also the note for table 5.6.
Source: Crop distribution maps are based on JRC crop masks, Vancutsem et al 2013; Figure (d) is based on FAOSTAT data.

Imports and exports

The southwestern Asian countries are no major exporters of primary agricultural commodities (rice, wheat, maize, other cereals, potatoes, other roots-tubers, pulses, vegetables, fruits, soybean and other oil crops, and textile fibers; table 5.6), with the exception of rice, animal feeds, and maize in India, and wheat, potatoes and, to a lesser extent, rice in Pakistan. The most populated countries have also become importers of pulses (India) and wheat (Bangladesh). One of the main exports of Bangladesh is fiber crops, which is actually mostly jute and some cotton products. All countries, especially the larger ones, are importers of oil. Due to its equatorial climate, Sri Lanka differs markedly from other countries by the role of tea and rubber among its exports. Finally, due to the large Bhutan National Potato Program (Roder et al, 2007), the crop has become a dominant export item in the country.

Table 5.6. Amounts (million tons) of agricultural imports and exports

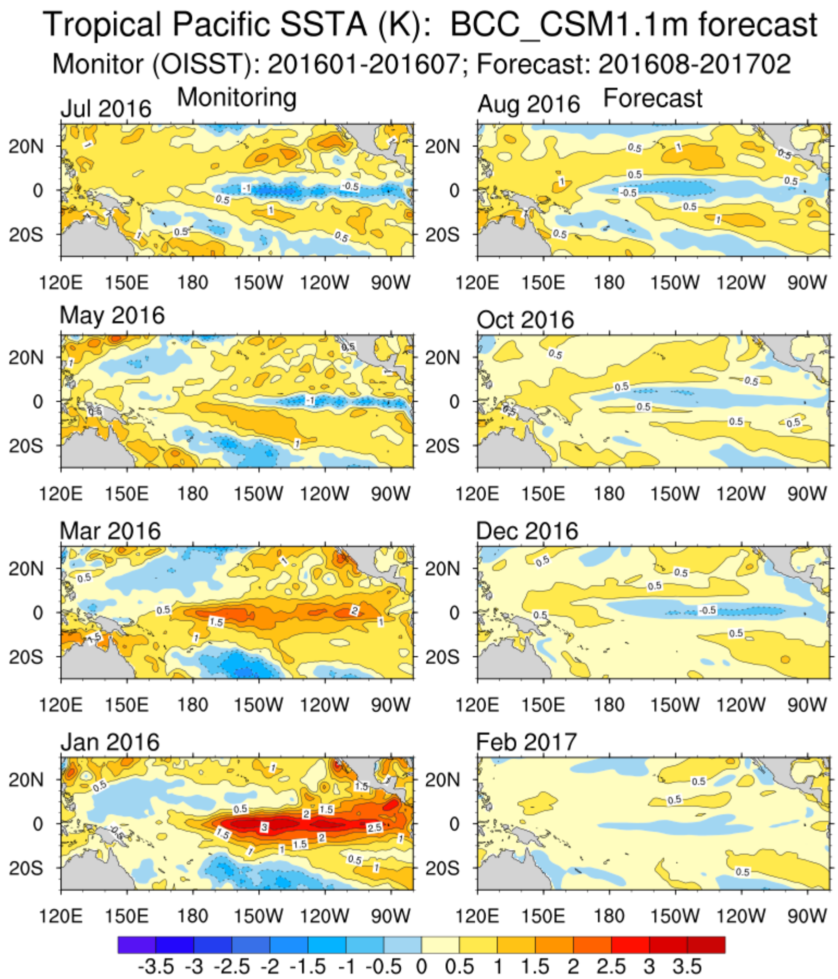
	Imports						Exports					
	IND	BGD	PAK	NPL	LKA	BHU	IND	BGD	PAK	NPL	LKA	BHU
List 1	5.24	6.22	3.25	0.94	1.77	0.09	19.67	0.44	6.6	0.1	0.83	0.07
List 2	0.8	1.22	0.98	0.15	1.26	0.03	9.24	0.01	0.71	0.09	0.2	0.01

Note: List 1 includes the crops (fiber crops to rice listed in figure 5.7; list 2 includes beverages, milk products, animal feeds, meat and sugar. In list 1, wheat includes wheat products as wheat equivalent; other cereal= total cereals less rice, wheat and maize; other roots-tubers = total roots and tubers minus potatoes; fruits include nuts; other oil crops computed from total primary oil crops (main oil crops) less soybeans. According to http://www.fao.org/es/faodef/fdef06e.htm#6.01, soybeans are part of primary oil crops but soybean values exceed oil crops some years.

5.4 El Niño

EI Niño has continued decaying during the second quarter of 2016. The eastern tropical Pacific sea surface temperatures have cooled rapidly between January and July 2016 based on the Optimum Interpolation Sea Surface Temperature (OISST), and temperatures are predicted to remain cool but average until the first quarter of 2017 according to forecasting models[15] at the Beijing Climate Center (figure 5.8).

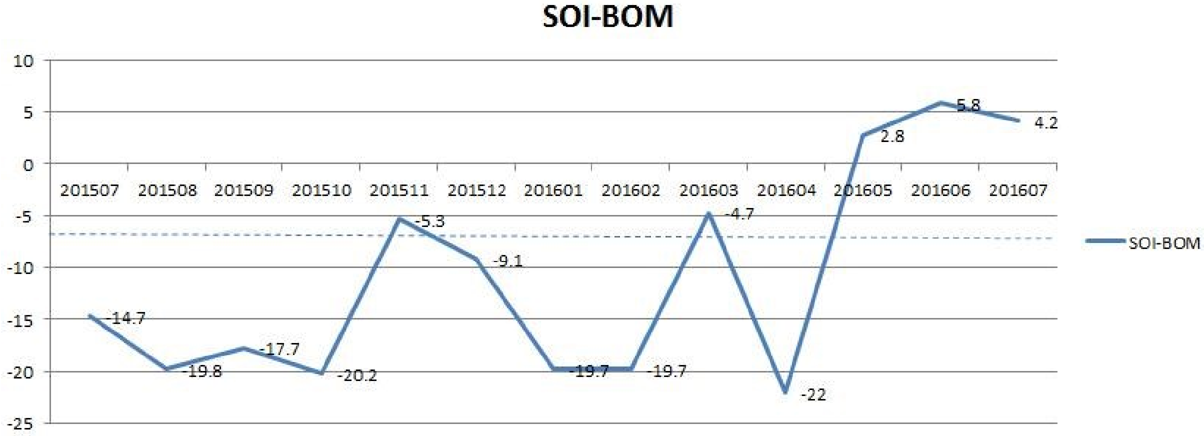
Figure 5.8. Tropical Pacific SSTA (Forecasted and Monitored datasets)



Source: http://cmdp.ncc-cma.net/download/ENSO/Variables_evolution/ENSO_SSTA_Patterns_O7P7_20160501.png

[15] Climate System Model version 1.1 (BCC_CSM1.1).

Figure 5.9. Monthly SOI-BOM time series for July 2015 to July 2016

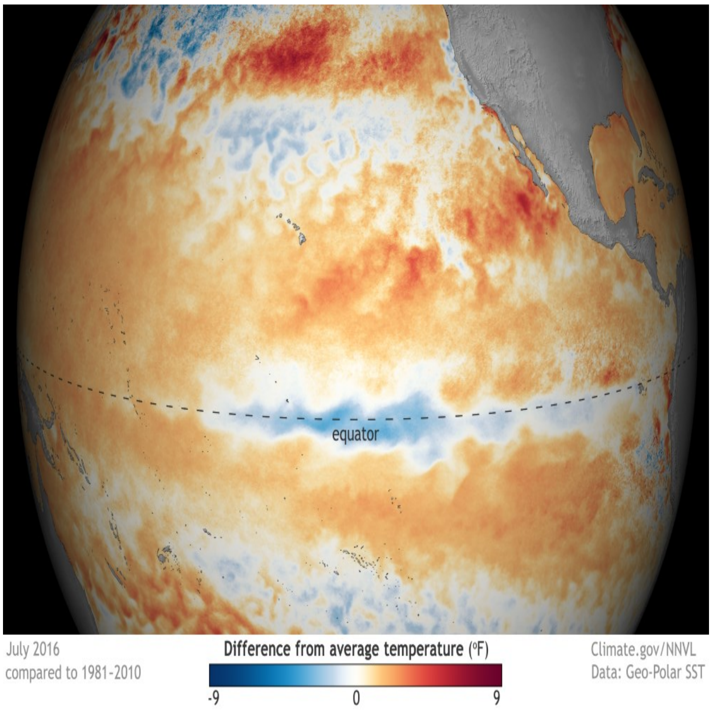


Source: http://www.bom.gov.au/climate/current/soi2.shtml

Figure 5.9 illustrates the behavior of the standard Southern Oscillation Index (SOI) of the Australian Bureau of Meteorology (BOM) from July 2015 to July 2016. During the current season, SOI has increased rapidly from -22.0 in April to +2.8 in May and kept a positive value in June and July, indicating neutral conditions of EI Niño and the possibility of a weak La Niña in 2017. NOAA confirms both this neutral condition and that La Niña is slightly favored to develop with the cool tropical Pacific waters (figure 5.10).

Both BOM and NOAA issued a La Niña watch, stating conditions are weak for La Niña to emerge in late 2016 and early 2017. In the next few months, CropWatch will keep a close eye on the development of La Niña and the regions that show sensitivity to this event.

Figure 5.10. Sea surface temperature difference from average temperature, July, 2016



Source: Climate.gov.

Annex A. Agroclimatic indicators and BIOMSS

Table A.1. April-July 2016 agroclimatic indicators and biomass by global Monitoring and Reporting Unit

65 Global MRUs		RAIN		TEMP		RADPAR		BIOMSS	
		Current (mm)	15YA dep. (%)	Current (°C)	15YA dep. (°C)	Current (MJ/m²)	15YA dep. (%)	Current (gDM/m²)	5YA dep. (%)
1	Equatorial central Africa	357	-7	26.0	1.3	1122	4	1057	-2
2	East African highlands	500	-7	20.8	-0.2	1118	-3	1390	-1
3	Gulf of Guinea	598	-7	28.2	-0.3	1083	-1	1686	0
4	Horn of Africa	200	7	24.2	0.1	1158	1	572	-4
5	Madagascar (main)	149	-29	23.1	0.6	889	-4	515	-2
6	Southwest Madagascar	34	-52	22.9	0.7	956	-1	172	-14
7	North Africa-Mediterranean	79	-14	21.2	-0.3	1511	-1	319	-15
8	Sahel	459	39	31.5	-0.5	1339	-2	1231	26
9	Southern Africa	83	-13	21.9	1.8	968	0	249	-13
10	Western Cape (South Africa)	95	-46	16.0	3.0	675	-1	422	-23
11	British Columbia to Colorado	234	15	11.0	0.5	1392	-2	883	7
12	Northern Great Plains	468	31	17.1	0.2	1322	-1	1360	15
13	Corn Belt	383	-12	16.0	-0.6	1242	0	1231	-11
14	Cotton Belt to Mexican Nordeste	470	5	23.1	-0.7	1304	-2	1380	3
15	Sub-boreal America	306	5	11.2	0.4	1174	-2	1195	3
16	West Coast (North America)	93	-22	15.7	0.5	1481	-1	356	-10
17	Sierra Madre	403	3	20.8	-0.5	1446	0	1091	6
18	SW U.S. and N. Mexican highlands	128	6	20.7	-0.2	1564	-1	502	7
19	Northern South and Central America	797	4	27.8	0.1	1148	2	1747	4
20	Caribbean	798	19	26.6	-0.6	1311	-1	1744	3
21	Central-northern Andes	332	-18	17.0	1.9	1012	4	771	-8
22	Nordeste (Brazil)	93	-57	28.3	2.1	1058	4	318	-47
23	Central eastern Brazil	172	-31	25.9	1.7	964	3	522	-40
24	Amazon	574	-11	28.9	1.3	999	6	1366	-12
25	Central-north Argentina	116	5	18.2	0.5	633	-10	370	-13
26	Pampas	499	23	17.5	1.6	607	-10	1056	-6
27	Western Patagonia	279	-44	10.1	3.1	462	-4	855	-5
28	Semi-arid Southern Cone	104	45	11.8	2.0	582	-14	395	46
29	Caucasus	235	0	17.0	0.0	1333	-1	839	-1
30	Pamir area	286	42	17.4	-0.4	1427	-4	852	21
31	Western Asia	120	37	23.2	-0.2	1432	-3	461	35
32	Gansu-Xinjiang (China)	314	143	17.7	-0.2	1358	-3	899	49
33	Hainan (China)	867	23	27.8	-0.3	1276	10	1718	-4
34	Huanghuaihai (China)	446	14	22.2	-0.5	1200	-5	1253	20
35	Inner Mongolia (China)	382	46	16.1	-0.4	1282	0	1200	11
36	Loess region (China)	381	41	18.0	-0.6	1247	-3	1252	23
37	Lower Yangtze (China)	1346	60	23.2	-0.7	994	-7	2178	16
38	Northeast China	312	-11	15.7	-0.6	1156	-3	1138	-4
39	Qinghai-Tibet (China)	880	28	11.2	-0.4	1155	-4	1265	4
40	Southern China	1008	12	24.2	-0.3	1035	2	2087	12
41	Southwest China	793	31	20.5	-0.3	1006	-2	1783	14
42	Taiwan (China)	985	7	24.5	-0.2	1173	4	1928	15
43	East Asia	329	-32	15.2	-0.1	1117	-2	1203	-3
44	Southern Himalayas	998	17	26.7	-0.4	1119	-2	1648	4
45	Southern Asia	774	17	30.1	0.0	1133	-2	1445	7
46	Southern Japan and Korea	642	-15	19.6	0.2	1074	-3	1545	-9
47	Southern Mongolia	430	170	16.1	-0.3	1399	-3	1019	36

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. (%)
48	Punjab to Gujarat	433	34	32.3	-0.3	1328	-2	875	17
49	Maritime Southeast Asia	1001	9	27.0	0.6	981	-2	2112	5
50	Mainland Southeast Asia	959	6	28.9	0.1	1141	5	1890	-3
51	Eastern Siberia	224	-6	9.8	0.0	1123	-3	990	0
52	Eastern Central Asia	251	8	10.5	-0.5	1232	-1	1009	5
53	Northern Australia	288	24	26.8	2.3	984	-2	842	28
54	Queensland to Victoria	200	21	16.5	3.8	648	-5	738	19
55	Nullarbor to Darling	161	-28	15.9	1.8	620	-8	672	-7
56	New Zealand	122	-63	13.5	4.3	468	-2	532	-43
57	Boreal Eurasia	305	7	10.4	1.2	1034	-4	1151	7
58	Ukraine to Ural mountains	270	13	15.5	0.2	1115	-2	1111	14
59	Mediterranean Europe and Turkey	154	-7	17.9	1.2	1395	-2	609	-8
60	W. Europe (non-Mediterranean)	309	6	14.9	-0.2	1120	-4	1166	5
61	Boreal America	335	20	8.3	2.1	990	-6	1119	16
62	Ural to Altai mountains	281	33	14.5	0.2	1165	-4	1087	22
63	Australian desert	101	5	16.8	2.4	674	-6	473	4
64	Sahara to Afghan deserts	70	68	29.1	-0.6	1538	-1	255	40
65	Sub-arctic America	166	98	-4.5	1.8	534	-5	588	71

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 five-year (5YA) or fifteen-year average (15YA) for the same period between April and July.

Table A.2. April-July 2016 agroclimatic indicators and biomass by country

31 Countries		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	311	46	15.8	1.3	568	-14	653	-3
[AUS]	Australia	190	13	17.3	3.5	673	-5	711	15
[BGD]	Bangladesh	1520	7	29.0	-0.6	981	-4	2160	0
[BRA]	Brazil	293	-20	26.4	1.8	970	4	752	-26
[CAN]	Canada	290	-4	11.3	0.3	1195	-1	1124	2
[CHN]	China	828	36	20.5	-0.5	1087	-3	1519	13
[DEU]	Germany	323	13	14.7	-0.4	1063	-3	1243	8
[EGY]	Egypt	11	71	24.6	0.5	1610	1	54	26
[ETH]	Ethiopia	558	-5	21.7	-0.3	1124	-4	1508	0
[FRA]	France	255	-9	14.4	-0.2	1113	-8	998	-3
[GBR]	U. Kingdom	335	16	11.6	0.1	963	-6	1270	10
[IDN]	Indonesia	1047	15	27.0	0.7	947	-3	2138	8
[IND]	India	798	20	30.0	-0.2	1165	-3	1355	8
[IRN]	Iran	66	-23	21.6	-0.5	1480	-1	264	-9
[KAZ]	Kazakhstan	287	71	15.9	-0.3	1201	-6	1049	44
[KHM]	Cambodia	896	7	29.8	-0.1	1167	4	1997	-7
[MEX]	Mexico	452	4	24.5	-0.5	1403	0	1048	5
[MMR]	Myanmar	1120	9	27.0	-0.4	1038	0	1883	1
[NGA]	Nigeria	636	2	29.0	-0.5	1142	-1	1685	8
[PAK]	Pakistan	248	15	28.0	-0.7	1437	-1	589	2
[PHL]	Philippines	857	-6	27.3	0.0	1167	2	1832	-8
[POL]	Poland	298	11	15.1	-0.1	1092	0	1218	5
[ROU]	Romania	364	13	16.6	-0.2	1205	-1	1257	8
[RUS]	Russia	265	12	14.6	0.2	1135	-2	1078	12
[THA]	Thailand	783	6	29.1	0.2	1171	7	1858	-1
[TUR]	Turkey	192	1	17.8	0.7	1423	0	750	-8
[UKR]	Ukraine	259	3	17.2	0.0	1158	-1	1076	9
[USA]	United States	409	8	18.9	-0.3	1324	-1	1159	4

31 Countries		RAIN		TEMP		RADPAR		BIOMSS	
		Current (mm)	15YA Departure (%)	Current (°C)	15YA Departure (°C)	Current (MJ/m²)	15YA Departure (%)	Current (gDM/m²)	5YA Departure (%)
[UZB]	Uzbekistan	188	82	21.9	-0.4	1382	-5	664	93
[VNM]	Vietnam	876	7	27.4	0.1	1155	5	1941	0
[ZAF]	South Africa	69	-25	16.9	3.1	830	-2	301	-10

See note table A.1.

Table A.3. Argentina, April-July 2016 agroclimatic indicators and biomass (by province)

	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	15YA Departure (%)	Current (°C)	15YA Departure (°C)	Current (MJ/m²)	15YA Departure (%)	Current (gDM/m²)	5YA Departure (%)
Buenos Aires	244	12	13.6	1.9	478	-20	770	-4
Chaco	390	55	18.9	0.6	667	-4	769	-14
Cordoba	149	24	14.8	1.1	537	-22	479	6
Corrientes	794	102	18.8	1.0	645	-6	1144	0
Entre Rios	652	111	16.3	1.1	541	-18	974	9
La Pampa	229	82	13.4	1.9	463	-26	800	48
Misiones	526	-21	20.2	1.9	705	-1	1418	-21
Santiago Del Estero	101	0	17.5	0.6	626	-10	351	-16
San Luis	159	61	13.2	1.2	530	-22	595	64
Salta	82	32	17.9	0.8	686	-9	270	9
Santa Fe	431	96	16.9	1.2	576	-15	676	-13

See note table A.1.

Table A.4. Australia, April-July 2016 agroclimatic indicators and biomass (by state)

	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	15YA Departure (%)	Current (°C)	15YA Departure (°C)	Current (MJ/m²)	15YA Departure (%)	Current (gDM/m²)	5YA Departure (%)
New South Wales	237	51	16.1	3.9	663	-6	812	35
South Australia	175	4	16.1	3.2	572	-5	721	8
Victoria	142	-32	14.8	3.9	508	-8	610	-16
W. Australia	157	-26	16.8	2.0	653	-7	651	-7

See note table A.1.

Table A.5. Brazil, April-July 2016 agroclimatic indicators and biomass (by state)

	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	15YA Departure (%)	Current (°C)	15YA Departure (°C)	Current (MJ/m²)	15YA Departure (%)	Current (gDM/m²)	5YA Departure (%)
Ceara	159	-55	29.0	1.7	1137	5	541	-40
Goias	56	-64	26.4	2.0	1073	5	223	-66
Mato Grosso Do Sul	317	2	24.8	0.9	878	-2	832	-33
Mato Grosso	134	-38	29.1	2.2	1072	5	495	-43
Minas Gerais	79	-42	24.6	2.5	961	3	268	-50
Parana	575	3	21.1	2.0	772	-1	1412	-13
Rio Grande Do Sul	642	9	18.2	1.7	632	-6	1474	-4
Santa Catarina	533	-9	18.3	2.0	680	-2	1478	-8
Sao Paulo	277	-1	23.4	2.1	886	2	803	-25

See note table A.1.

Table A.6. Canada, April-July 2016 agroclimatic indicators and biomass (by province)

	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	15YA Departure (%)	Current (°C)	15YA Departure (°C)	Current (MJ/m²)	15YA Departure (%)	Current (gDM/m²)	5YA Departure (%)
Alberta	299	16	12.2	1.3	1229	-2	1165	8
Manitoba	374	23	12.4	0.2	1197	-3	1367	17
Saskatchewan	287	10	12.5	1.0	1242	-1	1147	7

See note table A.1.

Table A.7. India, April-July 2016 agroclimatic indicators and biomass (by state)

	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	15YA Departure (%)	Current (°C)	15YA Departure (°C)	Current (MJ/m²)	15YA Departure (%)	Current (gDM/m²)	5YA Departure (%)
Arunachal Pradesh	1813	13	20.7	-1.5	752	-14	2133	-1
Andhra Pradesh	624	54	31.2	-0.4	1164	-2	1382	19
Assam	1847	20	28.0	-0.6	832	-9	2604	6
Bihar	780	17	31.1	-1.1	1180	-4	1475	4
Chandigarh	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Chhattisgarh	643	-5	31.0	0.0	1161	0	1409	-7
Daman and Diu	398	-47	30.0	-0.1	1219	-1	874	1
Delhi	450	48	32.7	-0.4	1311	-4	1190	32
Gujarat	375	-18	31.8	0.1	1256	-3	792	16
Goa	948	-30	26.5	-0.3	1007	-1	1620	-3
Himachal Pradesh	600	3	15.6	-0.8	1336	-5	1287	1
Haryana	417	36	31.7	-0.5	1333	-3	1147	17
Jharkhand	677	2	30.7	0.0	1214	0	1534	0
Kerala	864	-26	27.0	0.4	949	0	1907	-7
Karnataka	661	3	27.4	-0.1	1083	-2	1436	10
Meghalaya	2326	0	24.9	0.1	869	-9	2457	3
Maharashtra	852	31	30.3	0.2	1147	-2	1353	15
Manipur	1421	43	22.9	-0.1	942	-6	2357	15
Madhya Pradesh	954	75	32.0	0.0	1208	-2	1280	10
Mizoram	1510	10	24.0	-0.5	1006	-3	2382	7
Nagaland	1516	25	21.9	-0.2	876	-11	2305	5
Orissa	622	-18	30.5	-0.1	1152	1	1582	-9
Puducherry	358	0	31.0	-0.6	1241	-2	802	0
Punjab	264	-20	30.6	-0.4	1347	-2	847	-10
Rajasthan	531	94	33.1	-0.3	1343	-2	957	26
Sikkim	1148	-1	12.8	-1.5	1077	-14	1293	-6
Tamil Nadu	453	36	30.1	0.0	1200	-2	1194	20
Tripura	1844	9	28.1	-0.3	941	-4	2585	7
Uttarakhand	865	24	20.4	0.1	1234	-6	1461	8
Uttar Pradesh	684	39	32.1	-0.3	1242	-4	1301	13
West Bengal	1099	5	30.4	-0.4	1112	-1	1808	-7

See note table A.1.

Table A.8. Kazakhstan, April-July 2016 agroclimatic indicators and biomass (by oblast)

	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	15YA Departure (%)	Current (°C)	15YA Departure (°C)	Current (MJ/m²)	15YA Departure (%)	Current (gDM/m²)	5YA Departure (%)
Akmolinskaya	227	37	14.6	-0.5	1158	-5	984	21
Karagandinskaya	258	50	14.2	-0.7	1194	-4	1084	36
Kustanayskaya	205	33	15.5	-0.6	1164	-5	865	23
Pavlodarskaya	258	59	15.7	0.0	1170	-4	1005	45
Severo	265	33	14.9	0.2	1122	-4	1099	16
Vostochno	369	82	13.8	0.0	1258	-4	1197	41
Zapadno	181	64	18.1	-0.4	1150	-8	820	95

See note table A.1.

Table A.9. Russia, April-July 2016 agroclimatic indicators and biomass (by oblast, kray and republic)

	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	15YA Departure (%)	Current (°C)	15YA Departure (°C)	Current (MJ/m²)	15YA Departure (%)	Current (gDM/m²)	5YA Departure (%)
Bashkortostan	164	-26	14.6	0.4	1160	-1	788	-14
Chelyabinskaya	201	-10	14.2	0.0	1131	-2	918	0
Gorodovikovsk	384	35	19.7	-0.2	1201	-3	1343	21
Krasnodarskiy	256	-6	15.2	-0.1	1194	0	1058	-1
Kurganskaya	253	18	14.5	0.2	1115	-4	1075	9
Kirovskaya	207	-15	13.9	0.5	1138	3	903	-12
Kurskaya	345	52	16.0	-0.3	1103	-4	1414	57
Lipetskaya	314	47	15.8	-0.2	1092	-5	1293	53
Mordoviya	287	31	15.4	0.1	1100	-4	1235	37
Novosibirskaya	265	22	14.0	0.8	1144	-2	1112	25
Nizhegorodskaya	227	-3	14.9	0.3	1112	-1	1036	6
Orenburgskaya	149	-6	16.0	-0.1	1151	-6	729	21
Omskaya	247	12	14.4	1.1	1107	-4	1054	7
Permskaya	182	-30	13.7	0.9	1150	4	843	-26
Penzenskaya	323	59	15.6	0.0	1088	-7	1317	63
Rostovskaya	264	30	18.7	-0.2	1175	-4	1038	21
Ryazanskaya	277	20	15.5	0.1	1079	-5	1185	26
Stavropolskiy	342	33	19.3	-0.1	1193	-2	1321	26
Sverdlovskaya	227	-11	13.9	0.9	1096	-1	1001	-7
Samarskaya	190	7	16.2	0.4	1133	-5	904	26
Saratovskaya	228	48	17.2	-0.1	1135	-6	972	62
Tambovskaya	348	71	16.0	0.0	1078	-7	1347	62
Tyumenskaya	269	14	14.3	0.9	1105	-3	1101	1
Tatarstan	177	-14	15.4	0.4	1163	0	849	0
Ulyanovskaya	223	14	15.8	0.3	1122	-4	1026	36
Udmurtiya	195	-18	14.2	0.6	1158	3	900	-11
Volgogradskaya	262	77	18.1	-0.6	1148	-6	1046	67
Voronezhskaya	292	53	17.0	0.2	1116	-5	1177	48

See note table A.1.

Table A.10. United States, April-July 2016 agroclimatic indicators and biomass (by state)

	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	15YA Departure (%)	Current (°C)	15YA Departure (°C)	Current (MJ/m²)	15YA Departure (%)	Current (gDM/m²)	5YA Departure (%)
Arkansas	538	11	22.8	-0.5	1262	-4	1507	2
California	89	14	17.0	0.4	1594	-1	297	6
Idaho	179	19	12.8	0.5	1496	0	750	17
Indiana	510	4	18.6	-0.9	1258	-2	1494	1
Illinois	524	10	19.3	-0.5	1279	-2	1574	7
Iowa	575	13	18.1	-0.3	1296	0	1580	5
Kansas	653	56	20.7	-0.5	1347	-3	1623	34
Michigan	263	-27	14.2	-0.6	1279	1	1013	-19
Minnesota	535	38	15.1	-0.2	1229	-2	1423	5
Missouri	604	15	20.7	-0.4	1300	-2	1673	9
Montana	268	21	13.8	0.6	1379	-1	1087	16
Nebraska	532	38	18.2	0.0	1353	-2	1544	18
North Dakota	450	55	14.8	0.4	1284	-1	1397	24
Ohio	347	-22	18.0	-0.6	1253	0	1236	-18
Oklahoma	641	40	22.5	-0.9	1332	-3	1633	18
Oregon	103	-30	14.2	0.7	1419	0	483	-15
South Dakota	447	37	17.2	0.6	1359	1	1393	11
Texas	472	45	24.4	-1.0	1325	-4	1213	26
Washington	112	-24	14.5	0.6	1351	-1	555	-6
Wisconsin	460	7	15.0	-0.5	1252	0	1388	0

See note table A.1.

Table A.11. China, April-July 2016 agroclimatic indicators and biomass (by province)

	RAIN		TEMP		RADPAR		BIOMSS	
	Current (mm)	15YA Departure (%)	Current (°C)	15YA Departure (°C)	Current (MJ/m²)	15YA Departure (%)	Current (gDM/m²)	5YA Departure (%)
Anhui	1093	58	22.5	-1.2	1027	-11	1897	16
Chongqing	941	46	21.0	-0.2	981	-2	1919	14
Fujian	1437	55	23.2	0.0	1002	-3	2241	9
Gansu	1276	19	25.7	-0.1	1015	2	2286	9
Guangdong	281	9	15.7	-0.2	1242	-2	991	1
Guangxi	1340	36	25.3	-0.1	983	1	2262	12
Guizhou	949	38	21.1	-0.1	945	-2	2030	26
Hebei	492	63	19.5	-0.5	1258	-1	1348	26
Henan	459	7	22.5	-0.7	1158	-6	1353	20
Heilongjiang	262	-18	14.9	-0.8	1122	-5	1065	-7
Hubei	1006	54	21.7	-1.0	1031	-7	1903	14
Hunan	1225	53	22.7	-0.9	959	-6	2247	22
Jilin	355	-4	16.3	-0.5	1169	-2	1222	1
Jiangsu	710	31	22.1	-0.7	1067	-10	1553	12
Jiangxi	1559	62	24.1	-0.5	994	-6	2395	16
Liaoning	412	3	18.2	-0.1	1206	-1	1320	10
Inner Mongolia	315	22	15.3	-0.4	1272	1	1096	2
Ningxia	164	2	17.4	-0.3	1343	-1	726	-3
Sichuan	713	28	19.2	-0.2	1030	-1	1643	8
Shandong	421	10	21.9	-0.2	1215	-4	1153	14
Shaanxi	425	23	19.0	-0.5	1187	-3	1338	15
Shanxi	481	82	17.4	-0.8	1261	-3	1399	36
Yunnan	629	5	19.5	-0.6	1066	-2	1666	15
Zhejiang	1363	74	22.5	-0.4	983	-9	2278	18

See note table A.1.

Annex B. 2016 production estimates

Tables B.1-B.5 present 2016 CropWatch production estimates for Argentina, Australia, Brazil, Canada, and the United States.

Table B.1. Argentina, 2016 maize and soybean production, by province (thousand tons)

	Maize		Soybean	
	2016	Δ%	2016	Δ%
Buenos Aires	7104	-1	14067	-1
Córdoba	7044	0	12107	1
Entre Rios	1143	3	3597	6
San Luis	1116	0		
Santa Fe	4299	2	10541	1
Santiago Del Estero	1215	0		
Sub total	**21920**	**0**	**40312**	**1**
Others	3790	9	10769	-8
Argentina	**25710**	**1**	**51080**	**-1**

Δ% indicates percentage difference with 2015.

Table B.2. Australia, 2016 wheat production, by state (thousand tons)

	Wheat	
	2016	Δ%
New South Wales	7338.3	4.2
South Australia	3976.7	-4.6
Victoria	3724.7	10.4
Western Australia	11587.2	8.4
Sub total	**26626.8**	**5.4**
Others	561.0	5.2
Australia	**27187.9**	**5.4**

Δ% indicates percentage difference with 2015.

Table B.3 Brazil, 2016 maize, rice, wheat, and soybean production, by state (thousand tons)

	Maize		Rice		Wheat		Soybean	
	2016	Δ%	2016	Δ%	2016	Δ%	2016	Δ%
Goias	6366	-25					9802	-2
Mato Grosso	17592	-10					26810	3
Mato Grosso Do Sul	6587	-14					6388	1
Minas Gerais	6027	-18					3512	-3
Parana	14099	-6			2094	-6	17227	0
Rio Grande Do Sul	4613	-5	8493	-2	3899	-4	13529	-1
Santa Catarina	2810	-8	1021	-3	278	-4	1708	0
Sao Paulo	3589	-6					2172	0
Sub total	**61683**	**-12**	**9514**	**-2**	**6271**	**-5**	**81148**	**1**
Others	8749	-8	1541	-28	443	0	10678	12
Brazil	**70433**	**-12**	**11055**	**-7**	**6713**	**-4**	**91826**	**2**

Δ% indicates percentage difference with 2015.

Table B.4. Canada, 2016 wheat production, by province (thousand tons)

	Wheat	
	2016	Δ%
Alberta	9380	13.2
Manitoba	3777	3.4
Ontario	1725	0.0
Saskatchewan	14330	9.8
Sub total	**29212**	**9.3**
others	4837	22.5
Canada	**34049**	**11.0**

Δ% indicates percentage difference with 2015.

Table B.5. United States, 2016 maize, rice, wheat, and soybean production, by state (thousand tons)

States	Maize		Rice		Wheat		Soybean	
	2016	**Δ%**	**2016**	**Δ%**	**2016**	**Δ%**	**2016**	**Δ%**
Alabama	1176	0					504	-2
Arkansas	2559	6	5174	3	644	-6	4437	3
California			1784	7	664	13		
Colorado	3340	-11			2433	-1		
Georgia	1423	-1			311	0		
Idaho					2692	0		
Illinois	57789	4			1226	0	15120	2
Indiana	26331	4			747	8	8360	2
Iowa	59182	6					13899	1
Kansas	14581	9			8453	8	3871	1
Kentucky	5936	-2			994	-1	2248	-1
Louisiana	1729	5	1488	5			2237	6
Maryland					474	-1	620	-2
Michigan	9107	-2			1055	7	2433	-3
Minnesota	28285	0			1770	-3	8290	0
Mississippi	2370	7	664	7	343	0	3191	5
Missouri	16603	7	689	4	1192	1	6961	6
Montana					5445	-2		
Nebraska	43029	3			2106	2	7630	-2
New York	2567	-7			164	-1		
North Carolina	2699	1			1209	-1	1914	2
North Dakota	7671	2			9505	2	5470	1
Ohio	13085	-2			1202	8	6609	-3
Oklahoma	1104	-11			1373	-5		
Oregon					981	-15		
Pennsylvania	3877	-5			265	-1	762	-6
South Carolina					281	-11		
South Dakota	16969	-4			3724	15	5670	-9
Tennessee	3825	3			762	-12	2064	3
Texas	6533	-11	498	2	2137	3		
Virginia	1413	-2			489	1	694	-1
Washington					2918	1		
Wisconsin	12963	1			450	0	2219	0
Sub total	**346145**	**2**	**10297**	**4**	**56011**	**2**	**105203**	**1**
United States	**359159**	**3**	**10340**	**4**	**57878**	**2**	**107362**	**1**

Δ% indicates percentage difference with 2015.

Annex C. Quick reference to CropWatch indicators, spatial units, and production estimation methodology

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**.**

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/m^2, pixel or CWSU	An estimate of biomass that could potentially be accumulated over the reference period given the prevailing rainfall and temperature conditions.	Biomass is presented as maps by pixels, maps showing average pixels values over CropWatch spatial units (CWSU), or tables giving average values for the CWSU. Values are compared to the average value for the last five years (2011-15), 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 (2011-15), 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, 31 countries, and 7 regions for China. Values are compared to the average of the previous five years, with departures expressed in percentage.

INDICATOR			
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 (2011-15), and as spatial patterns compared to the average showing the time profiles, where they occur, and the percentage of pixels concerned by each profile.
RADPAR			
CropWatch indicator for Photosynthetically Active Radiation (PAR), based on pixel based PAR			
Weather/Satellite	W/m^2, CWSU	The spatial average (for a CWSU) of PAR accumulation over agricultural pixels, weighted by the production potential.	RADPAR is shown as the percent departure of the RADPAR value for the reporting period compared to the recent fifteen-year average (2001-15), 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 and satellite	Liters/m^2, CWSU	The spatial average (for a CWSU) of rainfall accumulation over agricultural pixels, weighted by the production potential.	RAIN is shown as the percent departure of the RAIN value for the reporting period, compared to the recent fifteen-year average (2001-15), 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 (2001-15), 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	Low VHI values indicate unusually poor crop condition, but high values, when due to low temperature, may be difficult to interpret. VHI is

INDICATOR			
		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).	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.

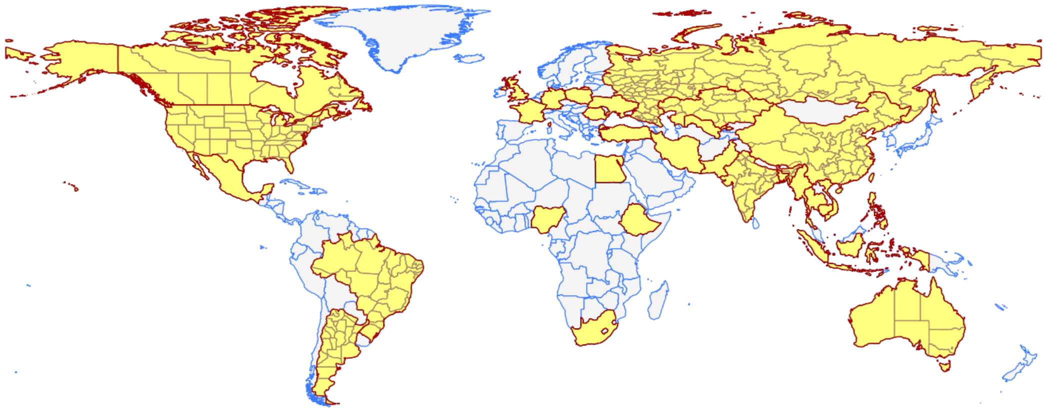
Note: Type is either "Weather" or "Crop"; source specifies if the indicator is obtained from ground data, satellite readings, or a combination; units: in the case of ratios, no unit is used; scale is either pixels or large scale CropWatch spatial units (CWSU). Many indicators are computed for pixels but represented in the CropWatch bulletin at the CWSU scale.

CropWatch spatial units (CWSU)

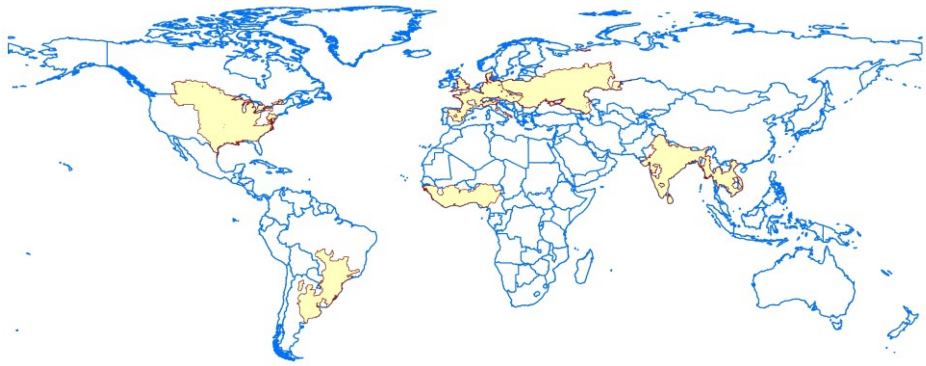
CropWatch analyses are applied to four kinds of CropWatch spatial units (CWSU): Countries, China, Major Production Zones (MPZ), and global crop Monitoring and Reporting Units (MRU). The tables below summarize the key aspects of each spatial unit and show their relation to each other. For more details 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.

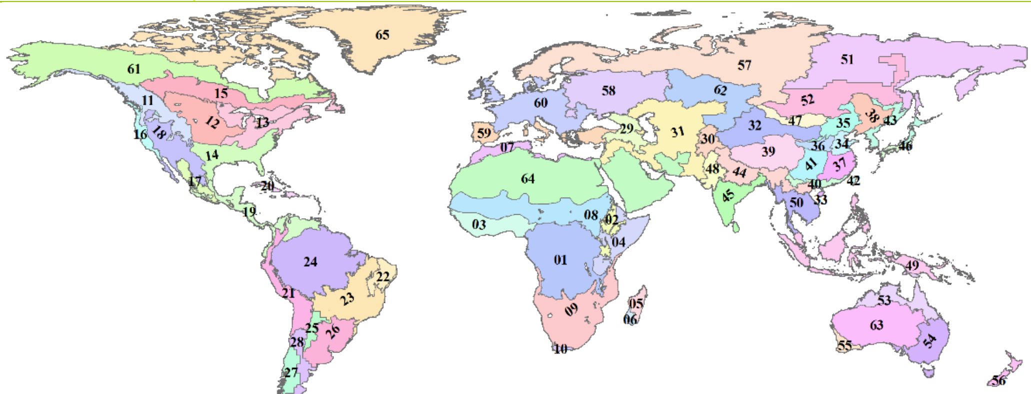
Countries (and first-level administrative districts, e.g., states and provinces)	
Overview	*Description*
"Thirty plus one" countries to represent main producers/exporters and other key countries.	CropWatch monitored countries together represent more than 80% of the production of maize, rice, wheat and soybean, as well as 80% of exports. Some countries were included in the list based on criteria of proximity to China (Uzbekistan, Cambodia), regional importance, or global geopolitical relevance (e.g., four of five most populous countries in Africa). The total number of countries monitored is "thirty plus one," referring to thirty countries 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** .



01:Equatorial central Africa
02:East African highlands
03:Gulf of Guinea
04:Horn of Africa
05:Madagascar (main)
06:Southwest Madagascar
07:North Africa Mediterranean
08:Sahel
09:Southern Africa
10:Western Cape (South Africa)
11:British Columbia to Colorado
12:Northern Great Plains
13:Corn Belt
14:Cotton Belt to Mexican Noreste
15:Sub-boreal America
16:West Coast (North America)
17:Sierra Madre
18:Southwest U.S. and north Mexican highlands
19:Northern South and Central America
20:Caribbean
21:Central-northern Andes
22:Nordeste (Brazil)
23:Central eastern Brazil
24:Amazon
25:Central-north Argentina
26:Pampas
27:Western Patagonia
28:Semi-arid Southern Cone
29:Caucasus
30:Pamir area
31:Western Asia
32:Gansu-Xinjiang (China)
33:Hainan (China)
34:Huanghuaihai (China)
35:Inner Mongolia (China)
36:Loess region (China)
37:Lower Yangtze (China)
38:Northeast China
39:Qinghai-Tibet (China)
40:Southern China
41:Southwest China
42:Taiwan (China)
43:East Asia
44:Southern Himalayas
45:Southern Asia
46:Southern Japan and Korea
47:Southern Mongolia
48:Punjab to Gujarat
49:Maritime Southeast Asia
50:Mainland Southeast Asia
51:Eastern Siberia
52:Eastern Central Asia
53:Northern Australia
54:Queensland to Victoria
55:Nullarbor to Darling
56:New Zealand
57:Boreal Eurasia
58:Ukraine to Ural mountains
59:Mediterranean Europe and Turkey
60:W. Europe (non Mediterranean)
61:Boreal America
62:Ural to Altai mountains
63:Australian desert
64:Sahara to Afghan deserts
65:Sub-arctic America

Production estimation methodology

The main concept of the CropWatch methodology for estimating production is the calculation of current year production based on information about last year's production and the variations in crop yield and cultivated area compared with the previous year. The equation for production estimation is as follows:

$$Production_i = Production_{i-1} * (1 + \Delta Yield_i) * (1 + \Delta Area_i)$$

Where i is the current year, $\Delta Yield_i$ and $\Delta Area_i$ are the variations in crop yield and cultivated area compared with the previous year; the values of $\Delta Yield_i$ and $\Delta Area_i$ can be above or below zero.

For the 31 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 2014 of aggregated FAOSTAT data (using aggregated world production minus the sum of production by the 31 CropWatch monitored countries).

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Online resources

This bulletin is only part of the CropWatch resources available. Visit www.cropwatch.com.cnfor access to additional resources, including the methods behind CropWatch, country profiles, and other CropWatch publications. For additional information or to access specific data or high-resolution graphs, simply contact the CropWatch team at cropwatch@radi.ac.cn.

Online Resources posted on www.cropwatch.com.cn:

- ✓ **Definition of spatial units**
  A description of the four spatial levels of analysis: Monitoring and Reporting Units (MRU), Major Production Zones (MPZ), selected countries, and the use of sub-national administrative areas.
- ✓ **Methodology**
  Overview of CropWatch data sources and methods.
- ✓ **Time series of indicators**
  Background data on agroclimatic indicators presented in a series of tables.
- ✓ **Country profiles**
  Short profiles for each of the 30 countries and China highlighting key facts of interest to agriculture.
- ✓ **Country long term trends**
  Quick overview of average crop area, yield, and production values for maize, rice, soybean, and wheat for recent years, along with long-term (2001-12) trends (based on FAOSTAT data).

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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