Chapter 5. Focus and perspectives

Building on the CropWatch analyses presented in chapters 1 through 4, this chapter presents first early outlook of crop production for 2022 (section 5.1), as well as sections on recent disaster events (section 5.2), and an update on El Niño (5.3).

5.1 CropWatch food production estimates

Methodological introduction

CropWatch production estimates are based on a combination of remote-sensing models combined with CropWatch global agro-climatic and agronomic indicators as well as meteorological data from over 20,000 meteorological weather stations around the world. The major grain crops (maize, rice, wheat) and soybean production of 43 major producers and exporters are estimated and predicted for 2022. The results are as follows.

Global Crop Production Index

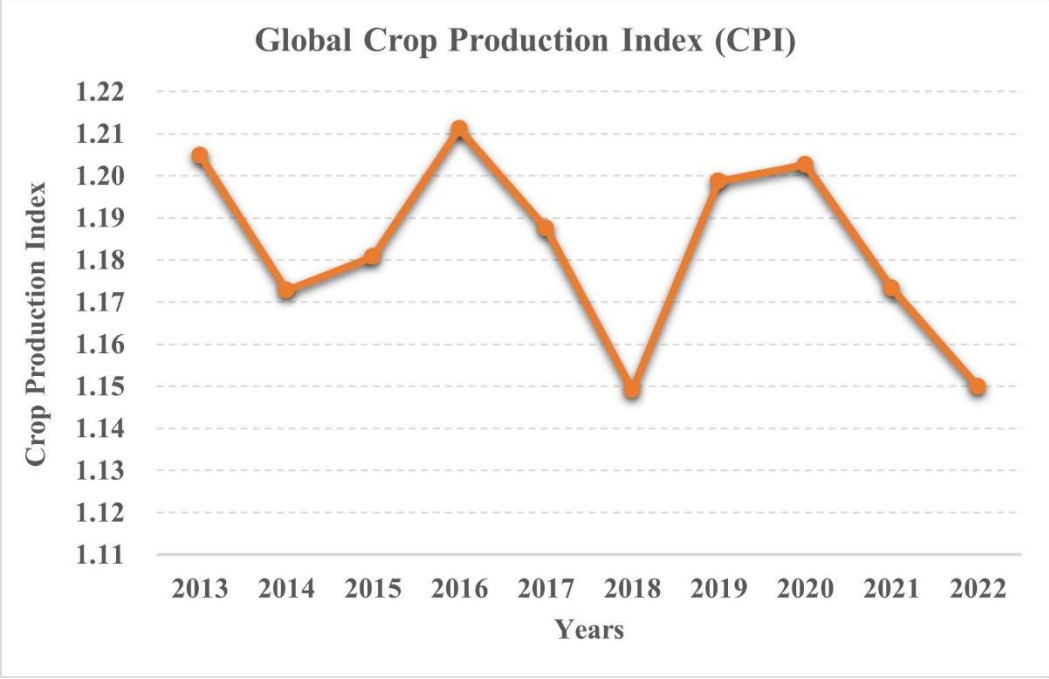

Figure 5.1 Global crop production index from July to October of the past 10 years

The Crop Production Index (CPI) is an indicator that CropWatch is developing and testing to characterize the agricultural production situation in a designated area. The index takes into account the distribution of irrigated and rainfed cropland, VCIx, CALF, land productivity, and crop acreage in a designated area to measure the production situation in a given growing season in a normalized value.

During the monitoring period from July to October, the global crop production index was at the lowest level (CPI=1.15) in the same period of nearly 10 years, which was equivalent to that in

2018. In the past 10 years, the global crop production index has experienced two significantly continuous declines, one in 2017 and 2018, and the other in 2021 and 2022. Although the crop production situation in this monitoring period is worse than that in previous years, a CPI greater than 1 indicates that global crop production is stable on the whole, and there will be no significant reduction in production.

Production estimates

The year of 2022 has been marked by frequent and extreme weather conditions caused by climate change. Heat waves, droughts, floods, regional conflicts, and the continuing COVID-19 pandemic have increased the uncertainty in global food production(Figure 5.1). Total global production of major cereal and oil crops decreased, challenging the goal of reaching Zero Hunger by 2030.

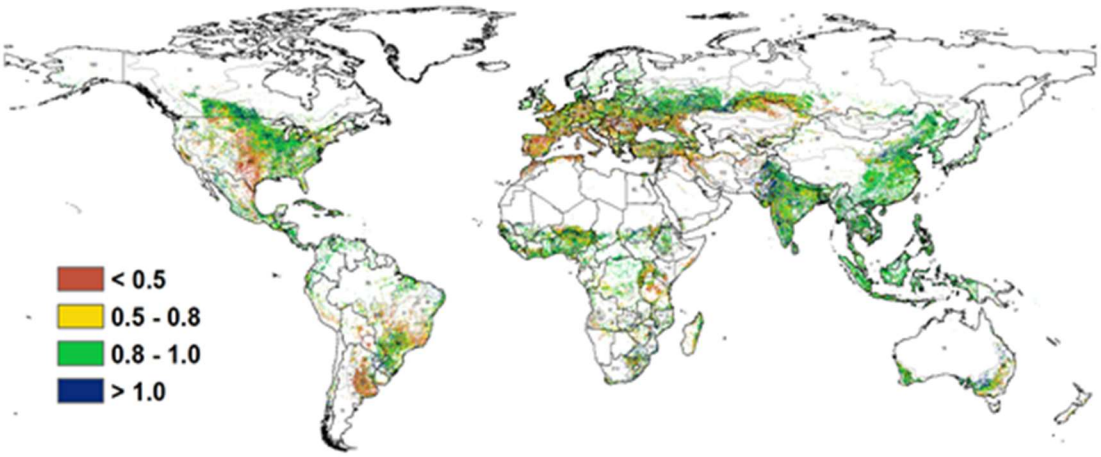

Figure 5.2 Global Maximum Vegetation Condition Index, July-August 2022

The global production of majors crops for 2022 is expected to be 2859.86 million tonnes with a decrease by 44.10 million tonnes (-1.5%) from 2021. Maize production is expected to be 1045.17 million tonnes with a decrease of 32.01 million tonnes (-3.0%), which is the largest reduction in the past five years. Rice production is expected to be 754.57 million tonnes with a decrease of 9.45 million tonnes (-1.2%) from 2021. Wheat production is expected to be 740.07 million tonnes, a reduction of 2.32 million tonnes, a drop by 0.3% from 2021. Soybean production is expected to be 320.05 million tonnes with a decrease of 0.32 million tonnes (-0.1%) from the previous year.

Table 5.1 2022 cereal and soybean production estimates in thousand tonnes. Δ is the percentage of change of 2022 production when compared with corresponding 2021 values.

	Maize		Rice		Wheat		Soybean	
	2022	Δ%	2022	Δ%	2022	Δ%	2022	Δ%
Afghanistan					3,617	-7		
Angola	273,7	4	49	10				
Argentina	54,971	3	1,846	-3	12,738	-29	51,774	0
Australia					32,205	9		
Bangladesh	3,713	-6	48,006					
Belarus					2,991	-1		
Brazil	91,305	10	11,354	-4	7,751	6	95,137	-1

	Maize		Rice		Wheat		Soybean	
	2022	Δ%	2022	Δ%	2022	Δ%	2022	Δ%
Cambodia			9,791	-1				
Canada	11,608	-4			29,936	4	7,585	-3
China	227,191	-3	195,335	-1	134,198		18,185	27
Egypt	6,058	3	6,583	1	11,240	-2		
Ethiopia	5,720	-15			3,412	-5		
France	12,988	-17			33,361	-6		
Germany	4,377	-12			25,095	-4		
Hungary	4,859	-14%			4,452	-10		
India	18,835	3	176,115	-3	93,244		13,535	4
Indonesia	19,152	14	65,272	-2				
Iran			2,590	6	10,974	-13		
Italy	5,086	-19			7,362	-5		
Kazakhstan					12,953	15		
Kenya	1,935	-15			270	-8		
Kyrgyzstan	773	25			744	41		
Mexico	23,146	-6			4,015	17	789	-11
Mongolia					299	-5		
Morocco					6,050	-33		
Mozambique	2,204	5	400	0				
Myanmar	1,935	2	24,607	-1				
Nigeria	9,553	-8	4,090	-4				
Pakistan	5,751	4	10,275	-10	25,573	-3		
Philippines	7,433	5	21,289	4				
Poland					10,292	-5		
Romania	11,270	-13			6,945	-13		
Russia	13,664	1			86,215	14	3,817	7
South Africa	11,861	4			1,595	-12		
Sri Lanka			2,487	-2				
Thailand	4,299	1	38,839	-4				
Türkiye	6,496	2			16,859			
Ukraine	25,374	-29			21,433	-11		
United Kingdom					12,644	-2		
USA	363,601	-5	10,691	-6	51,572	-1	101,705	-3
Uzbekistan					8,336	11		
Vietnam	5,221	-3	46,695	0				
Zambia	3,556	-1			246	10		
Sub-total	**966,672**	**-3**	**676,314**	**-2**	**678,617**	**-1**	**292,527**	
Others	**78,506**		**78,260**	**3**	**61,451**	**3**	**27,519**	**-2**
Global	**1,045,178**	**-3**	**754,574**	**-1**	**740,068**		**320,046**	

Maize

2022 Maize production is expected to be 1045.17 million tonnes with a decrease of 32.01 million tonnes (-3.0%), which is the largest reduction in the past five years, but with significant variations among countries and regions. The major producers in tropical to subtropical regions in the Northern Hemisphere and those in the Southern Hemisphere had expanded their maize cultivation area and their production increased. Other major producers in the Northern Hemisphere were affected by high temperature and dry weather, causing a decline in both cropping area and yield, with overall productions lower than in 2021 for most countries. In the summer of 2022, extreme heat and dry weather had an adverse impact on agricultural production in Europe, damaging maize production in Germany, Romania, Hungary, France, and Italy, with a larger than 10% yield drop from 2021. The Ukraine crisis, combined with significantly lower rainfall in the mid-west part of the country, resulted in a sharp fall of both maize area and average yield. Maize production in Ukraine declined to 25.37 million tonnes, the largest drop of 10.58 million tonnes (-29.4%) from 2021 in agricultural producing countries. In the Horn of Africa, Kenya and Ethiopia suffered from a severe drought, resulting in decreased maize area and yield. Maize production in both countries decreased by 15.3% from 2021. High temperature, as well as flooding conditions also affected Western African countries such as Nigeria, resulting in a reduction of 7.9% maize production. The United States, as the world's top maize producer, experienced a decline in maize area. The maize production is projected at 363.6 million tonnes, down by 17.50 million tonnes, which is the largest reduction of production among the maize producing countries. Thanks to the increase in area and average yield, Kyrgyzstan maize production is projected to be up by 24.2% from last year, the largest increase in terms of percentage of maize production. Maize production in India, Indonesia, Myanmar, Pakistan and the Philippines were slightly increased with the general favorable agro-climatic conditions.

Rice

Global rice production is expected to be 754.57 million tonnes with a decrease of 9.45 million tonnes (-1.2%) from 2021. Most of Southeast Asia experienced favorable rice growth in the dry season, but with an uneven rainfall distribution in the rainy season. Thailand, Indonesia and Cambodia had significantly higher rainfall and some area suffered from flooding, resulting in a reduction of 3.7%, 1.6% and 1.5% in rice production, respectively; Vietnam and Philippines had normal agro-meteorological conditions, with rice production increased by 0.2% and 3.6%, respectively. In Central and North-central India, rainfall was significantly below average during the growing season, India's rice production is expected to decline by 3.2%. Pakistan had experienced significantly above average rainfall, which caused severe flooding in the Sindh and Balochistan provinces, causing a decrease of rice production by 9.5%. Due to the reduced rice planted area in the United States, rice production declined by 5.7%. Benefiting from irrigation systems, rice production in Egypt and Iran increased by 1.5% and 5.6%, respectively. Nigeria suffered from insecurity and floods, resulting in a reduced rice area and yield compared with those of last year, with a decrease of 4.2% in rice production. Argentina and Brazil are the top rice producers in the Southern Hemisphere. Rice planted area in both countries was reduced from 2021, resulting in rice production decreases by 2.9% and 4.2%, respectively.

Wheat

Wheat production is expected to be 740.07 million tonnes, a reduction of 2.32 million tonnes, a drop by -0.3% from 2021. Global wheat cultivated area in 2022 decreased from the previous year. In addition, drought and extreme heat caused unfavorable conditions in some producing regions. The global wheat production has declined for the last two years, tightening wheat supply situation. In autumn of 2021, Northern Hemisphere winter wheat producers experienced overall poor agro-climatic conditions during the sowing period. Drought and lack of soil moisture in Europe, the Middle East, southern part of North America hampered the sowing of winter wheat, resulting in reduced planted area. The temperature in Western and Central Europe was abnormally higher than average since May, leading to a shorter wheat grain-filling period in most European countries. Wheat production was generally lower than in 2021. As the most severely affected country, Romania’s wheat production decreased by 13.2%. Due to continued drought, major wheat-producers, such as Afghanistan and Iran saw declines in wheat yield, with production down by 7.4% and 13.4%, respectively. Although wheat planted area in Ukraine increased, the dry weather negatively affected wheat yield. The Ukraine Crisis resulted in the damage of wheat fields and affected the wheat harvest. The total wheat production in Ukraine is expected to be 21.43 million tonnes, down by 11.1%. Thanks to the increased wheat yield and planted area, wheat production in Kazakhstan, Russia and Uzbekistan increased by 15.3%, 13.5% and 11.0%, respectively. Argentina, South Africa and Kenya in Southern Hemisphere experienced serious droughts, resulting in a decline in wheat yields. Wheat production decreased by 28.7%, 12.4% and 7.5%, respectively; Australia and Brazil wheat yields and planted area have increased, prompting wheat production increases by 8.9% and 5.6%, respectively.

Soybean

Soybean production is expected to be 320.05 million tonnes with a decrease of 0.32 million tonnes (-0.1%) from the previous year, under a generally normal situation of soybean supply. The United States is the world's largest soybean exporter. Due to the slight reduction of cultivated area, the low rainfall and high temperature in its main soybean producing areas in June and July, affecting soybean flowering and podding, production of soybean is estimated at 101.71 million tonnes with a decrease of 2.9%. The soybean planted area increased in Brazil but was affected by persistent drought and continued high temperature in the main production areas, which reduced soybean yields for two consecutive years. Production fell to 95.14 million tons, a decrease of 1.2%. Soybean area in Argentina was reduced, but yield increased by 2.1%, offsetting the impact of reduced area. Production is estimated at 51.77 million tonnes, with an increase of 0.16 million tonnes or up by 0.3%. Soybean production in Canada and India decreased by 0.25 million tonnes (-3.2%) and 0.45 million tonnes (-3.5%), respectively, while Russian soybean production increased by 0.24 million tonnes (+6.7%). It is noteworthy that, China, the largest soybean importer, increased its soybean area significantly in 2022, prompting an increase by 3.84 million tonnes. This increase offsets reductions of soybean production in the United States and Brazil.

5.2 Disaster events

Introduction

Large emissions of greenhouse gases, such as carbon dioxide, methane and nitrous oxide have caused a warming of the atmosphere, which in turn leads to the occurrence of extreme climate-related events such as floods, drought, cyclones, fires, pests, and diseases. They threaten the global food security, which so far has mostly affected the people in the Global South. Conflicts are an additional threat to food security.

This section highlights the July-October disaster events across the globe. It covers the Russia-Ukraine conflict, droughts in Europe and China, and floods in Pakistan West and East Africa. It also highlights the current situation of the desert locust, an agricultural pest that impacts food production, especially in Africa.

Russia-Ukraine conflict

The Russia-Ukraine conflict that began on 24 Feb. 2022 has caused extensive damage and loss of life, spread across rural areas, and sparked massive population displacement. More than 3.6 million people have been forced to abandon their homes and flee across borders to safety. Millions more are internally displaced. It is clear that the crisis has resulted in a massive and more deteriorating food insecurity situation, disrupted food production and farmers' livelihoods during the agricultural growing season in the Ukraine, and has also affected global food security. Nearly 50 countries depend on the Russian Federation and Ukraine for at least 30 percent of their wheat import needs. Out of these countries, 26 source over 50 percent of their wheat imports from these two countries. In that context, this crisis keeps disrupting global markets and food supplies. It has caused a challenge to food security in many countries, especially for low-income food import-dependent countries and vulnerable population groups.

The CropWatch system monitored and evaluated the impact of the Russian- Ukrainian conflict on the output of autumn crops in the Ukraine in 2022, by using the monitoring model of crop yield and planting area, multi-source remote sensing data such as Sentinel1, Sentinel2 and Landsat up to the middle of August 2022, together with the latest agrometeorological information.

Remote sensing monitoring shows that the cropped arable land fraction in the main wheat-corn production area in southeast Ukraine is only 70%, a decrease by 25.5% compared with the same period last year due to the conflict. The states of Kherson, Odessa, Nikolayev, Crimea, Zaporoge, Donetsk and Dnipropetrovsk in the southeast of Ukraine have been significantly affected.

Combined with the drought effects, the Russia-Ukraine conflict has reduced the crop production in the Ukraine to a level that is significantly lower than the historical average. Ukraine's corn production will decline significantly to 25.37 million tonnes, a decrease of 29%; The wheat output will dropp to 21.43 million tons, a decrease of 11%. The other autumn grain crops, including sunflowers, also suffered from yield reduction to varying degrees.

Drought

EUROPE: From early May to mid-September, the European continent recorded the worst drought in almost 500 years, a result of a combination of record-breaking temperatures and low rainfall that led rivers to dry out, wildfires to rage and partial crops failures. In combination with

the crisis in the Ukraine, this caused a sharp increase in food prices. According to the drought map of the Copernicus Global Drought Observatory, which is based on the soil moisture anomaly average from 1 June to 31 August and using 2021 and 2016 as the reference periods, the most affected countries in Europe were Spain, France, Italy, Germany, the United Kingdom, the Netherlands, Hungary and Romania (Figure 5.2).

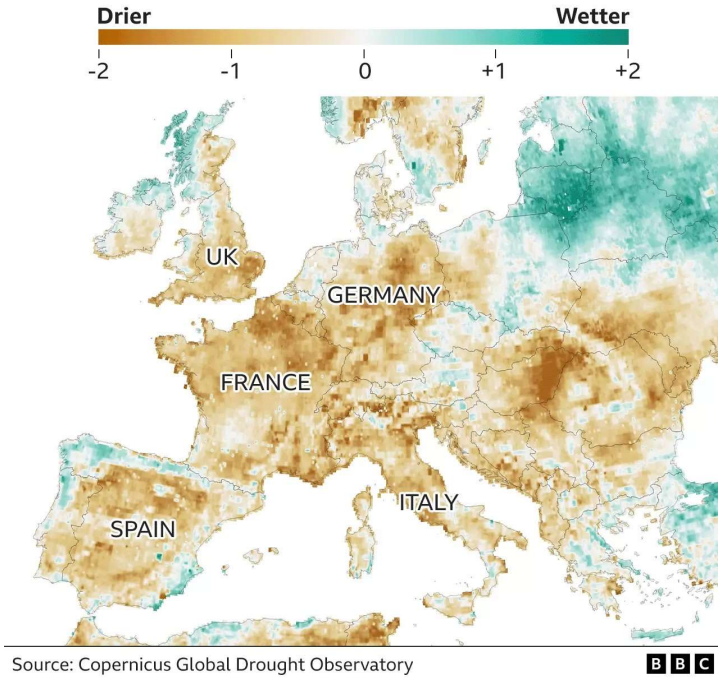

Figure 5.3 Copernicus Global Drought Observatory drought map based on soil moisture anomaly average from 1 June to 31 August. (Source: https://www.bbc.com/news/62751110)

The water and heat stress substantially reduced the yields of summer crops. The most affected crops were maize, soybean and sunflower. Not only the agricultural sector was affected, but also the supply of drinking water was reported as another big issue.

During the first decade of October 2022, the combined drought indicator based on the Standardized Precipitation Index (SPI), Soil Moisture Index (SMI) and Fraction of Absorbed Photosynthetic Active Radiation (fAPAR) shows that 19% of the regions across Europe were in warning conditions, particularly in Spain, France, Germany and the Netherlands and 23% of the continent was in the alert conditions, indicating a deficit in soil moisture and shortage of rainfall, mostly in western France, northern Germany, United Kingdom, Slovenia, Slovakia and Hungary (Figure 5.3).

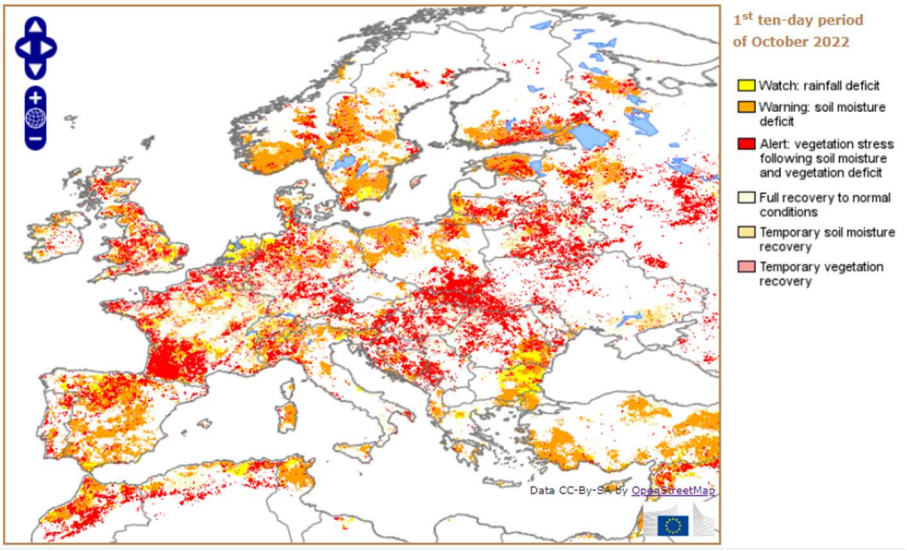

Figure 5.4 Combined drought indicator based on Standardized Precipitation Index (SPI), Soil Moisture Index (SMI) and Fraction of Absorbed Photosynthetic Active Radiation (fAPAR) during the first decade of October 2022. Source: https://edo.jrc.ec.europa.eu/edov2/php/index.php?id=1052

CHINA: Extreme heat and severe lack of rainfall led to a record-breaking drought that caused parts of the Yangtze River, Poyang Lake and Dongting Lake in China to dry up. This affected not only the hydro-power (especially in Sichuan, which receives more than 80% of its energy from hydro-power) and shipping routes but also the drinking water supply. The standardized Drought Severity map for the first decade of August (Figure 5.4) indicates severe to exceptional drought situations across China, especially in the provinces of Hunan, Hubei, Anhui, Sichuan, Shaanxi and Henan.

The heatwave eased in August, but severe drought along the Yangtze River and its tributaries continued in September. During this period, the late-season rice was in the booting stage.

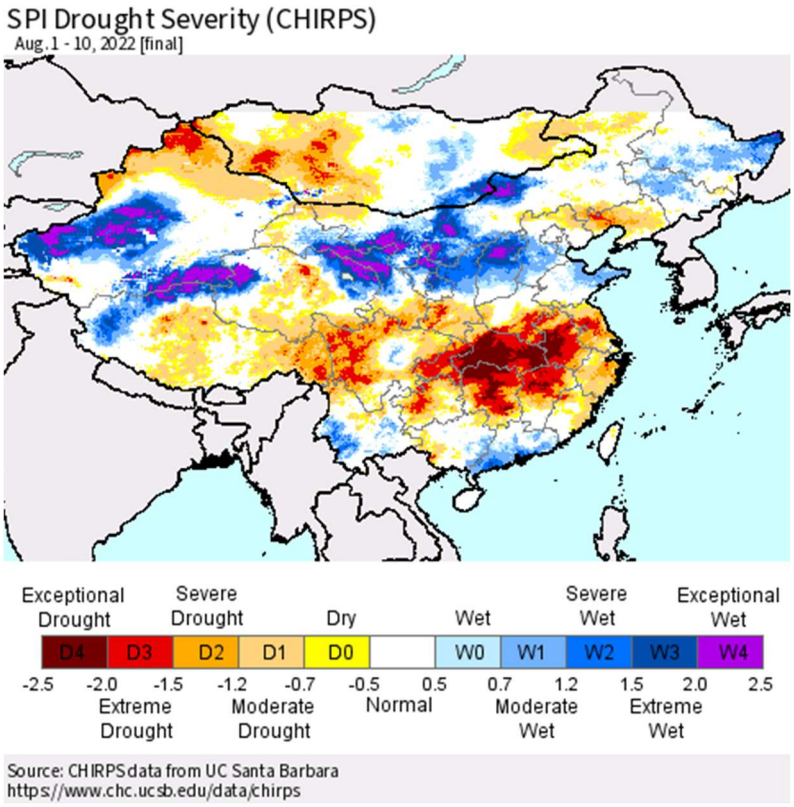

Figure 5.5 Standardized Drought Severity from August 1st to August 10th 2022 in China. (Source: Foreign Agriculture Services, US Department of Agriculture)

UNITED STATES OF AMERICA: In the United States of America, the short-term droughts continued to expand in Ohio, Tennessee, and the central Mississippi Valleys along with parts of the Corn Belt. As the Mississippi river was at its lowest water levels in a decade, it closed off a vital channel to barge traffic at a crucial time of the year for the transport of crops from the nation's heartland. This is due to widespread drought across the Mississippi River basin and its tributaries (the Missouri, Ohio, Tennessee, and Arkansas-White-Red basins) (Figure 5.5).

Figure 5.6 Mississippi river drought. Source: https://www.esquire.com/news-politics/politics/a41806647/mississippi-river-drought/

According to the National Centers for Environmental Information, numerous drought impacts have occurred (Fig 5.6). These impacts include dry soils, low groundwater, dried-out ponds, low

or dried-out streams, low or empty reservoirs (especially in the West), and stressed vegetation. In October, dozens of large wildfires were burning in the Pacific Northwest, and several in Oklahoma. According to the **National Interagency Coordination Center**, over 59,000 fires have burned over 7 million acres in the U.S. as of October 28. These are more than the 10-year average.

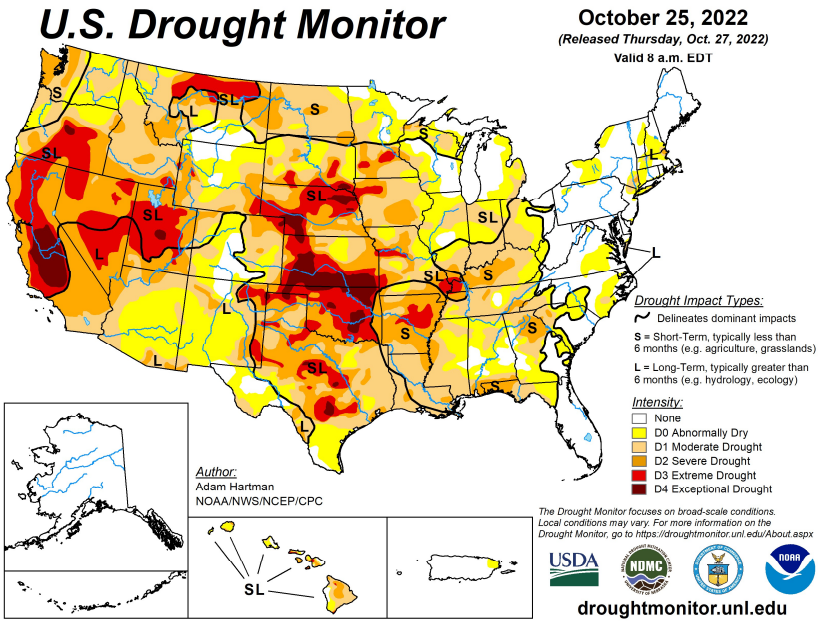

Figure 5.7 US Drought monitoring map (October 25, 2022).
Source: https://droughtmonitor.unl.edu/Summary.aspx

EAST AFRICA: Not only Europe, China and the USA were suffering from severe droughts. The rainy season in Eritrea, Ethiopia, South Sudan and Somalia finished in October. The drought monitoring map (Figure 5.7) indicates the situation in late October. Althought it shows relatively low levels of drought stress, the World Meteorological Organization forecasts high drought conditions for the October-December season. These conditions will worsen the crises that are affecting millions of people in the region. In addition to drought, the conflicts in the region have increased poverty levels and food insecurity, resulting in a weak capacity to cope with the drought crises. According to UN-OCHA, people in need of humanitarian help include 7 million in Ethiopia, 4 million in Kenya, and 5 million in South Sudan.

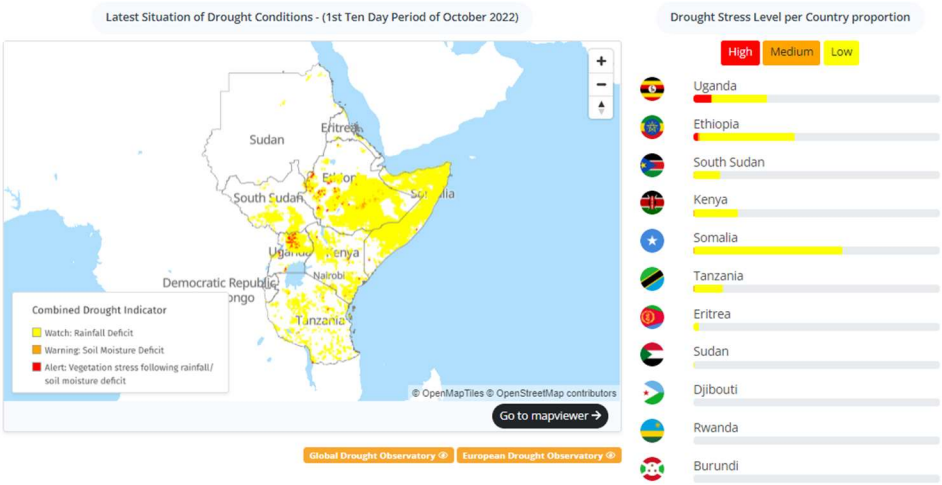

Figure 5.8 Combined Drought Indicator (CDI). Source: https://droughtwatch.icpac.net/

RECORD BURNING OF RAINFOREST IN BRAZIL: With the dry season in the Brazilian Amazon lasting from July through November, a high number of illegal fires had been started. According to the Brazilian Space Agency – INPE, on August 22nd, 2022, about 3358 fires were detected through satellite images in the Brazilian Amazon. This event was considered to be the highest number of recorded fires for any 24 hours since 2007. For the January to August period, the number of fires had increased by 16.7%, as compared to the same period of last year. Apart from storing large amounts of carbon, the Brazilian Amazon Rainforest plays a vital role in regulating and balancing regional and global climate, bringing rains to distant regions. According to the MapBioma – Monitor do Fogo project, a total of 15,203,570 hectares of forest were burned from January to October 2022. The most affected regions were Cerrado and Amazonia (Figure 5.8).

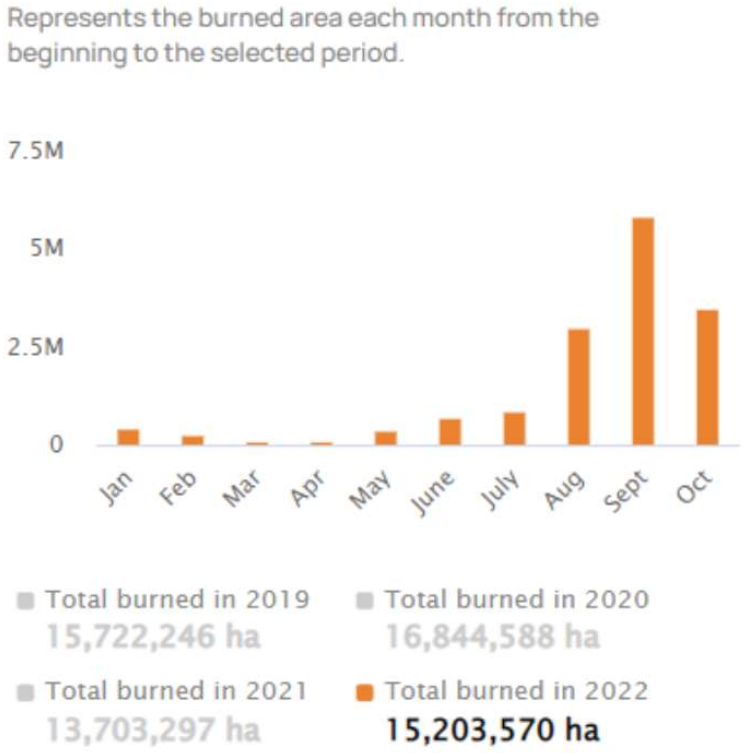

Figure 5.9 Burned area per month in Brazil. Source: https://plataforma.brasil.mapbiomas.org/monitor-do-fogo

Floods and Landslides

PAKISTAN: In Pakistan, the heavy monsoon rains caused flooding on about 10-12% of Pakistan's land. The province of Sindh was most hit. About 33 million people were affected and thousands of hectares of cropland, crops, livestock assets, critical agriculture infrastructure, and households have been destroyed. Following it, acute food security is expected to worsen in many parts of the country.

SUDAN: Reports show that by the first half of August, in 12 provinces, over 8000 houses were destroyed and over 20000 homes were damaged due to floods. In the same period, 52 deaths due to flooding were reported. This situation lasted until September and the number of people affected continued to rise. According to the Government's Humanitarian Aid Commission (HAC), during this period, in 16 of the 18 states, more than three hundred thousand people were affected and 24,860 houses were destroyed. The total number of people affected by the floods has exceeded the number of people affected in 2021 (about 314,500 people).

WEST AFRICA: Food insecurity is a serious, growing problem in Nigeria. In 2021 it was reported that 7 out of 10 Nigerians did not have enough to eat. This problem is worsened by annual flooding. The satellite-based flood analysis detected water in Nigeria using VIIRS between 13 to 17 October 2022 and it was compared to the week before (08 to 12 October 2022). The results from this analysis revealed that on the analyzed cloud-free areas (about 890,000 km^2), approximately 3000 km^2 of land was affected. (Figure 5.9).

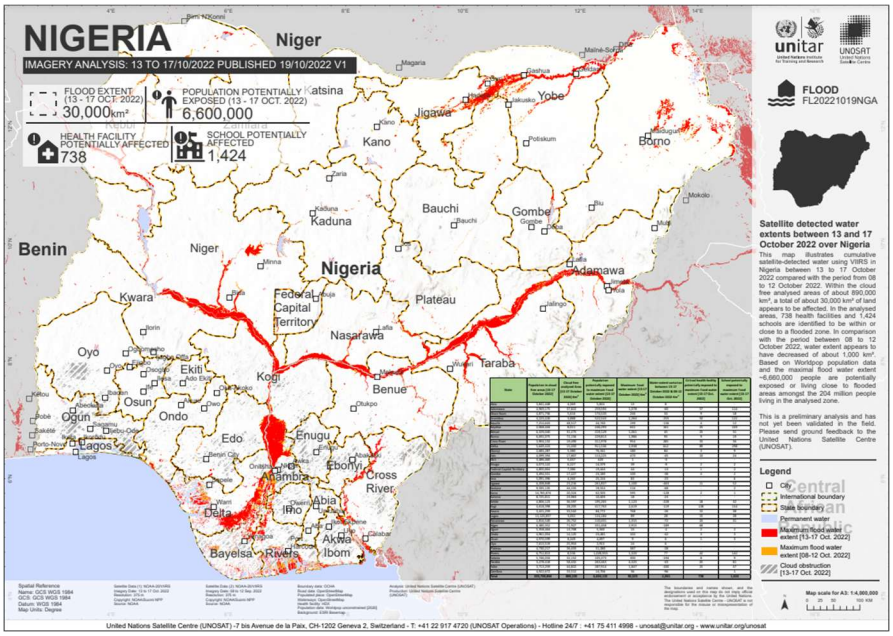

Figure 5.10 Cumulative satellite detected water in Nigeria

This event was considered one of the deadliest events recorded in the region and the worst event in Nigeria in over a decade, killing more than 600 people and displacing more than 1.5 million people as of October 2022. The damages from this event are also measured in terms of lost production area, in which more than 300,000 hectares of cropland were damaged. Other issues related to this flood event are concerns about the increased spread of diseases, and food and fuel supplies have also been disrupted. Food production levels in Nigeria are already below demand, the World Food Programme and the UN's Food and Agriculture Organization reported that Nigeria was among the six countries facing a high risk of catastrophic levels of hunger. To alleviate the impacts, The United Nations released a total of US$ 10.5 million from the Nigeria Humanitarian Fund (NHF) and the Central Emergency Response Fund (CERF) to provide assistance to people affected and left vulnerable by floods across Nigeria.

Desert Locust

Considered the most destructive migratory pest in the world, the Desert Locust (Schistocerca gregaria) situation was calm between July to October 2022, with some isolated cases of scattered immature solitarious adults locusts being reported in Mauritania, Niger, Sudan and Yemen. In addition, during August and September, few hopers were reported in some parts of northwest Mauritania and the red sea coastal plain of Yemen. Although the situation was calm, some control majors were undertaken in Egypt where about 20 ha were treated.

5.3 Update on El Niño or La Niña

According to the Australian Government Bureau of Meteorology, La Niña continues in the tropical Pacific. Atmospheric and oceanic indicators of the El Niño–Southern Oscillation (ENSO) reflect a mature La Niña, including tropical Pacific sea surface temperatures, the Southern Oscillation Index (SOI), and tropical cloud patterns.

Figure 5.10 illustrates the behavior of the standard Southern Oscillation Index (SOI) for the period from October 2021 to October 2022. The SOI has remained positive and high (greater than +7) for the past four months, with a decreasing trend in July and August and a renewed increase in September and October. Much of the persistent positive SOI signal is due to high pressure systems over Tahiti. Overall, the SOI indicates a typical La Niña event during the monitoring period.

Another commonly used measure of El Niño is known as the Oceanic Niño Index (ONI). Figure 5.11 shows several ONIs and their locations. Values of the three key NINO indices for October 2022 were: NINO3 −0.7°C, NINO3.4 −0.7°C, and NINO4 −0.7°C. It implies that the average sea surface temperature in all three regions is significantly lower than the historical average. This indicates that La Niña re-enforces in September and October, consistent with the monthly SOI-BOM time series trend.

Sea surface temperature (SSTs) for October 2022 (Figure 5.12) were cooler than average across the central and eastern tropical Pacific Ocean, extending from around 160°E to the South American coastline and also across a large area south of the equator, particularly in the east of the basin. Warm anomalies extend into the mid-latitudes in the southern Pacific and across the mid to high latitudes in the north—a pattern characteristic of well-developed La Niña.

The southern Pacific Ocean has been locked in its La Niña phase for three winters running which is exceptional and causes extreme drought and flood conditions. It has been recorded just twice before, once in the mid-1970s and again at the turn of the millennium. Its long duration is a problem. The large, persistent mass of cold air and high pressure influences wind patterns known as jetstreams across the Pacific and the Indian Ocean. Where jetstreams that blow over land from the ocean are diverted, that land loses moisture and can suffer from drought. The land to which that jetstream is diverted gets more moisture and can be flooded. Between July and October, La Niña, combined with a warmer planet, causes a series of extreme weather events that vary with geographic region.

North America

The southwestern United States has been in a state of drought for three winters running. The jet stream which blows in from the Pacific, carrying moisture with it, has been forced north by La Niña's high pressure zone in the southern Pacific. That means more rain falls further north too, and less falls in the south. The National Integrated Drought Information System (NIDIS) shows that 70% of Oklahoma is in a state of exceptional or extreme drought, the most serious level that NIDIS reports. September was the driest since 1956, according to Gary McManus, the state's climatologist.

This La Niña-induced drought is stimulating wildfires in Kansas. The state is now so dusty that it is becoming a safety concern for drivers and cattle. The wheat crop is weaker than usual and the state is concerned that it will be too dry for much of it to survive the winter. Losses to cotton crops due to drought in Texas are estimated to be worth some $2bn. The end of La Niña will

bring relief. America's National Weather Service's latest prediction gives a 57% likelihood of ENSO returning to its neutral phase between February and April 2023.

Atlantic Hurricanes

While La Nina is a phenomenon of the Pacific, it also impacts hurricanes in the Atlantic during August, September, and October, the heart of storm season. The changing weather patterns cut off a lot of wind shear in the Caribbean Sea and elsewhere across the basin, allowing more Atlantic hurricanes and tropical storms to form and grow stronger.

Australia

La Niña typically increases the chance of above average rainfall for northern and eastern Australia during spring and summer and the chance of warmer days and nights in northern Australia during spring. Torrential rains have inundated large parts of New South Wales, Queensland, and Victoria.

South America

Typically, La Nina leads to hot and dry conditions for Argentina and southern Brazil as well as a shortened wet season in central Brazil. But in this monitor period, the third La Nina is starting a little benign for southern Brazil because fronts have regularly stalled in the region and produced good rainfall. In central Brazil, there has yet to be seen an effect from La Nina. In Argentina, corn is planted in two phases, the first in September and October, and the second in December and January. La Nina pushed a larger portion of the crop into the second phase than normal. Moreover, the drought has caused poor conditions for wheat, which will reach maturity in December.

South Asia

Flooding in Pakistan killed at least 1,700 people during the summer of 2022, and left 7.6 million homeless, according to the UN-monitoring organization, ReliefWeb. The country's climate minister, Sherry Rehman, said that the worst-affected provinces received between five and seven times their average rainfall in August. The Indus river, which runs the length of Pakistan, burst its banks to swamp thousands of square kilometers of land. Shehbaz Sharif, the prime minister, said they were the worst floods in his country's history (Figure 5.13).

La Niña is partially responsible. Just as the colder southern Pacific equilibrium pushes moisture away from the southern United States, it happens to push moisture right on top of Pakistan. But La Niña is not acting alone. A warmer climate, due to humanity's carbon dioxide emissions, also means a more flood-prone Pakistan. In a paper published in September, a group of climate scientists estimated that rainfall over the worst-impacted provinces was 75% more intense than it would have been without the 1.2 ºC of warming to which the planet has already been subjected.

East Africa

One of the regions most affected by La Niña is East Africa, where a prolonged drought has been experienced. At least one million people in Somalia have been displaced by the worst drought in decades due to climate change, which has also affected the wider Horn of Africa, including Ethiopia and Kenya. Between July and October, when staple food crops such as maize are growing and developing in East Africa, widespread drought brings reduced food production and hunger.

As 2022 shifts to 2023, La Niña is weakening. Its end will bring relief to many places with extreme weather. Unfortunately, climate change will continue to exacerbate the effects of ENSO on local weather conditions in vulnerable regions across the globe.

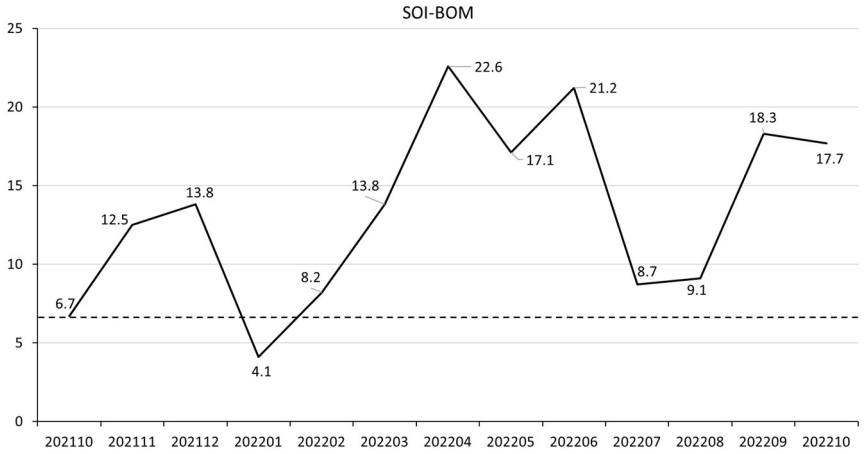

Figure 5.11 Monthly SOI-BOM time series from October 2021 to October 2022

(Source: http://www.bom.gov.au/climate/enso/soi/)

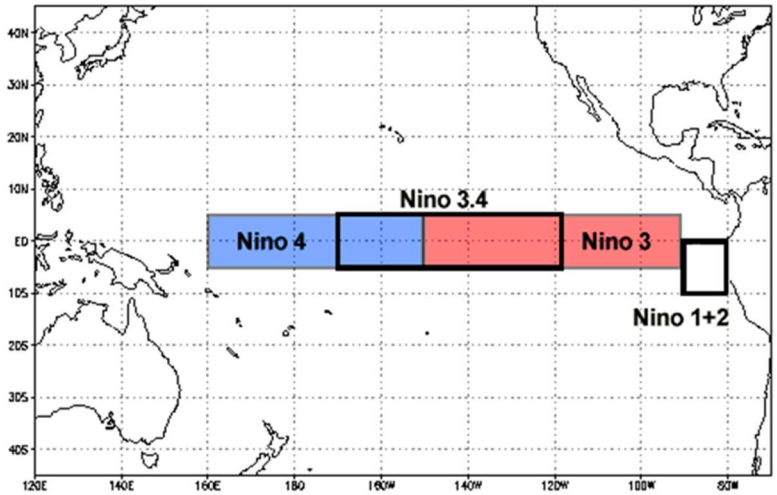

Figure 5.12 Map of NINO Region

(Source: https://www.ncdc.noaa.gov/teleconnections/enso/sst)

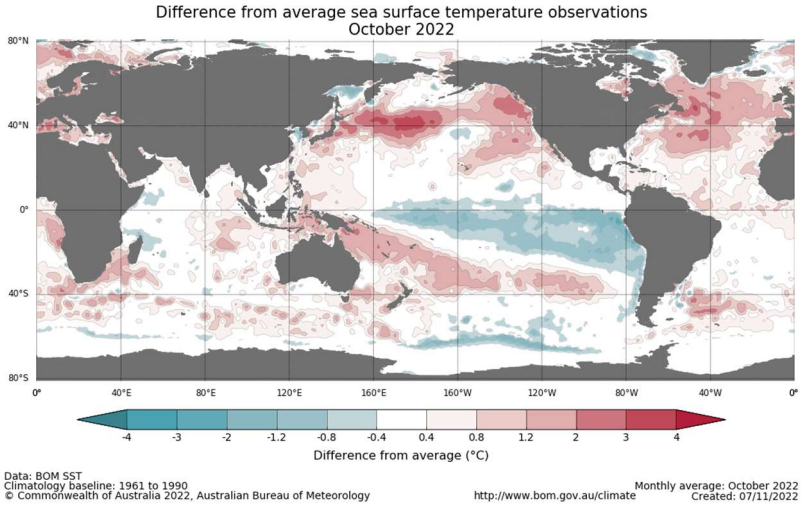

Figure 5.13 Monthly temperature anomalies for October 2022

(Source: http://www.bom.gov.au/climate/enso/index.shtml#tabs=Pacific-Ocean)

Figure 5.14 Heavy monsoon rains flooded residential areas in Dera Allah Yar in Jaffarabad district, Balochistan province, Pakistan, in August.

(source: https://www.bloomberg.com/graphics/2022-la-nina-weather-risk-global-economies/)