Chapter 2. Farming intensity and stress in major production zones

With Chapter 1 presenting a global overview of key environmental indices relevant to agriculture, Chapter 2 provides more detail on agriculture-specific indices—percentage of uncropped arable land (UAL), the vegetation condition index (VCI), and the vegetation health index (VHI)—to describe farming intensity and stress in six Major Production Zones (MPZ) across all continents. For more information about these zones and methodologies used, see the CropWatch online resources Definition of Spatial Units and Methodology, at www.cropwatch.com.cn. Additional information on environmental indices for the MPZs is provided in Annex A, table A.2.

2.1 Overview

Several MPZs have been affected by large spatial weather anomalies. However, several months will still pass before harvest and crop condition will likely change, requiring a reassessment when the crop stage is more advanced. Current weather can also affect the spring and summer crops still to be planted through soil moisture and their effect on pests and diseases.

The north American MPZ, with the exception of Mexico, was affected by abnormally low temperatures (-1.4°C in the United States and -1.3°C in Canada). In comparison with the recent five-year average, uncropped arable land (UAL) values for the current season increased in Canada (+10.7 percentage points) and the United States (+5.9 percentage points), possibly reflecting unfavorable growth conditions, while UAL decreased in Mexico (-4.3 percentage points).

Countries in the South American MPZ currently grow summer crops, mainly soybean and maize; both crops suffered drought in some major agricultural areas, including the core of the soybean producing zone. The situation affected early stages and has been remedied by now, although mixed crop condition continues to prevail in northwest Argentina and southern coastal Brazil.

Central-eastern Europe winter crops (essentially wheat, with some barley) are currently in the vegetative/dormant stage, although complex interactions between above normal temperature, presence/absence of snow, and late hardening may have led to increased winter kill. Most of the MPZ experienced temperatures that were above the recent twelve-year average, decreasing from east to southwest: Russia +1.7°C, Poland +1.2°C, Moldova and Romania +1.1°C, Belarus 1.0°C, and Ukraine 0.7°C. Some of the countries in the west also underwent parallel drought, in particular Ukraine (precipitation 25 percent down compared with the twelve-year average), Poland (-16 percent), and Romania (-8 percent), and -62 percent in Moldova, one of highest absolute rainfall drops of the 173 countries monitored by CropWatch. Uncropped arable land nevertheless decreased in Poland and Romania (-24.2 and -12.5 percentage points, respectively), but increased in Russia (+11.8 percentage points).

Several areas in Western Europe suffered floods (United Kingdom, +43 percent over the recent twelve-year average) or drought (Hungary, -33 percent), with Hungary continuing the spatial pattern already noted for central-eastern Europe. Temperatures were above average east of and including Germany (+1.2°C), reaching increases of 1.4°C in Czechia and 1.7°C in Hungary, resulting in unseasonally high biomass accumulation and VCI (11 percentage points in Germany) and a very large decrease in uncropped arable land (-10.7 percentage points). Overall, based mostly on maximum VCI, crop condition is good in

Germany, Denmark, Czechia, and Northern Italy, but mixed in France, the United Kingdom, Hungary, and particularly in southern Italy and Spain, where high values are interspersed with patches of unusually low values.

In the South and Southeast Asian MPZ, the dominant feature is excess rainfall decreasing from west to east (India +52 percent, Bangladesh +11 percent, Myanmar +27 percent, Thailand +13 percent, Cambodia +5 percent, and Vietnam -1 percent, compared to the twelve-year average). In spite of some unusual drops in temperature, all countries are characterized by increased biomass accumulation in comparison with the twelve-year average. Uncropped arable land decreased in India (-3 percentage points) and more significantly so in Myanmar (-4.8 percentage points). Maximum VCI values are usually high in most of the north western quadrant of India, in close agreement with the VHI clusters, and clearly denote satisfactory rabi crop condition. In the south and east of Bangladesh, there is a larger proportion of low values; the same occurs in the eastern half of the MPZ, indicating mixed crop condition, or sometimes distinctly poor conditions, as in the Red River delta of northern Vietnam.

In the African MPZ, covering the Gulf of Guinea states and adjacent areas of the Sahelian countries, only the southernmost areas harvested a crop, usually maize, during the reporting period. Crop condition is generally satisfactory, especially in the west. In Nigeria, significant areas indicated as uncropped arable land correspond to the main maize growing areas in the center of the country, which were harvested before the current reporting period.

Table 2.1. Agricultural indicators by Major Production Zone, October 2013-January 2014, showing current season values and departure from the 5YA (2008-2013)

	Uncropped arable land		Maximum vegetation condition index (VCI)	
	Current (% of pixels)	Departure (% points)	Current	Departure (absolute difference)
West Africa	7.7	1.9	0.85	0.00
South America	2.6	0.1	0.82	0.01
North America	49.6	8.0	0.80	0.07
South and Southeast Asia	2.5	-2.1	0.88	0.06
Western Europe	1.1	-6.1	0.88	0.08
Central Europe and Western Russia	47.0	-1.9	0.81	0.09

Note: 5YA=the five-year average, which is the average value for the periods October-January between October 2008 and January 2013.

2.2 West Africa

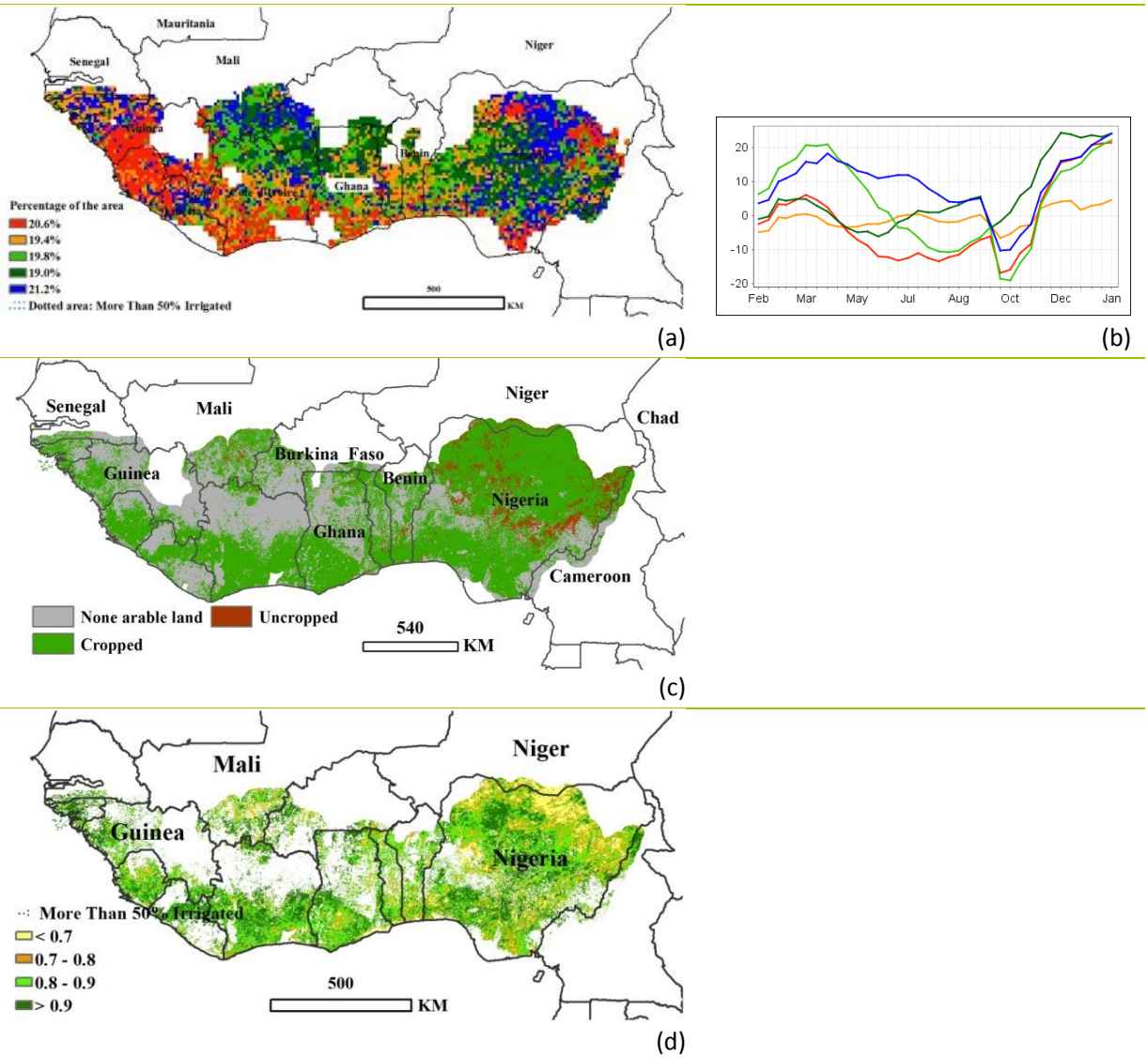
The Gulf of Guinea countries are mostly characterized by one or two rainy seasons in the south and one, much shorter, in the north; in the north, Sahelian conditions prevail with one season of varying length that peaks in August. August is also the time when the "short dry season" occurs in the bimodal rainfall areas. Although the general crop calendar can be modified by altitude, particularly in Guinea, maize and rice are widely grown and usually harvested towards the end of the year, around December. Yams and cassava are important crops in the region, but their phenology is not well defined, particularly in the case of cassava. When conditions permit and the growing season is sufficiently long in the south of the region, a "second" maize crop is usually grown and harvested around September. This “second” crop is usually the main one in terms of production.

Based on VHI profiles, conditions in the MPZ were average (19.4 percent of pixels) or above average throughout the region over the middle and the end of the reporting period, indicating favorable conditions for the maize and rice crops harvested at the end of the year in the southern part of the region.

This is also where maximum VCI values tend to be highest, thereby confirming satisfactory crop condition, particularly in the west where all countries show rather high maximum VCI values of around 0.84, with a slight positive departure over the reference period.

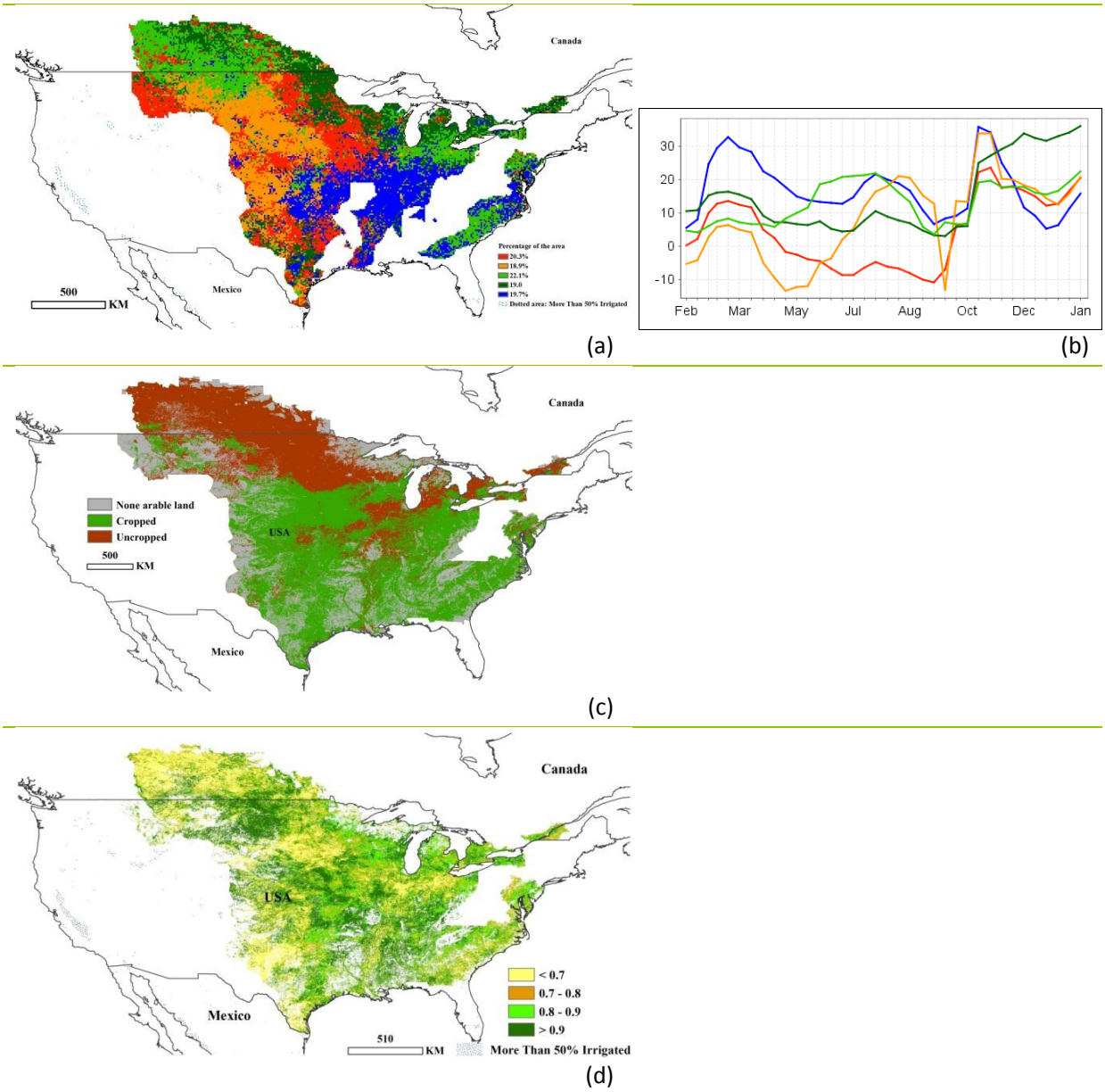
October was characterized by a marked dip in VHI in many areas, particularly west of Nigeria, including most of the MPZ. It is likely that long cycled crops have been affected. Caution is, however, required as the MPZ still enjoys large extension of forest that are not filtered out in the current VHI profile analysis. Uncropped arable land is concentrated in central Nigeria, in the main maize growing areas where it probably corresponds to post-harvest conditions. Maps and graphs for the West Africa MPZ are provided in figure 2.1.

Figure 2.1. West Africa MPZ: Farming intensity and stress



(a) Spatial distribution of VHI profiles between February 2013 and January 2014 (VHI departure from the twelve-year average for 2001-2013); (b) Typical VHI profiles associated with the pixels in (a); (c) Cropped and uncropped arable land; (d) Maximum vegetation health index (VCI).

Figure 2.2. North America MPZ: Farming intensity and stress



(a) Spatial distribution of VHI profiles between February 2013 and January 2014 (VHI departure from the twelve-year average for 2001-2013); (b) Typical VHI profiles associated with the pixels in (a); (c) Cropped and uncropped arable land; (d) Maximum vegetation health index (VCI).

2.3 North America

Compared to the twelve-year average, VHI departure in the North American MPZ (figure 2.2) displays various patterns in the central United States. In Kentucky, Tennessee, Missouri, Kansas, and Oklahoma, VHI in 2013/14 was above average, especially in spring and autumn season; after autumn, VHI decreased sharply to become average. In Canada, the south of Alberta, Saskatchewan, and Manitoba, the Great Lakes, and the east coastal region of the United States (Indiana, Ohio, South Carolina, and Georgia), VHI was slightly above average, increasing sharply after October. In Wisconsin, Iowa, and Montana, as well as in scattered areas in Texas, VHI was abnormally lower than the reference value between May and September; it increased sharply after October. For the major regions of central and western United States (such as Nebraska, Wyoming, Kansas, and Colorado), VHI was below the twelve-year average during the

period from March to July and sharply increased after July. During the period from October 2013 to January 2014, large areas of uncropped arable lands were distributed in Canada and in North Dakota in the United States, resulting from the harvest of summer crops when spring crops have not yet been planted.

Also over the monitoring period, all winter wheat planting has been completed, with the largest VCI values occurring in Kansas, Nebraska, and Kentucky. Maximum VCI is well above normal, due to near normal rainfall, temperature, and PAR. In the east and south regions, maximum VCI is low due to abnormal winter storms.

2.4 South America

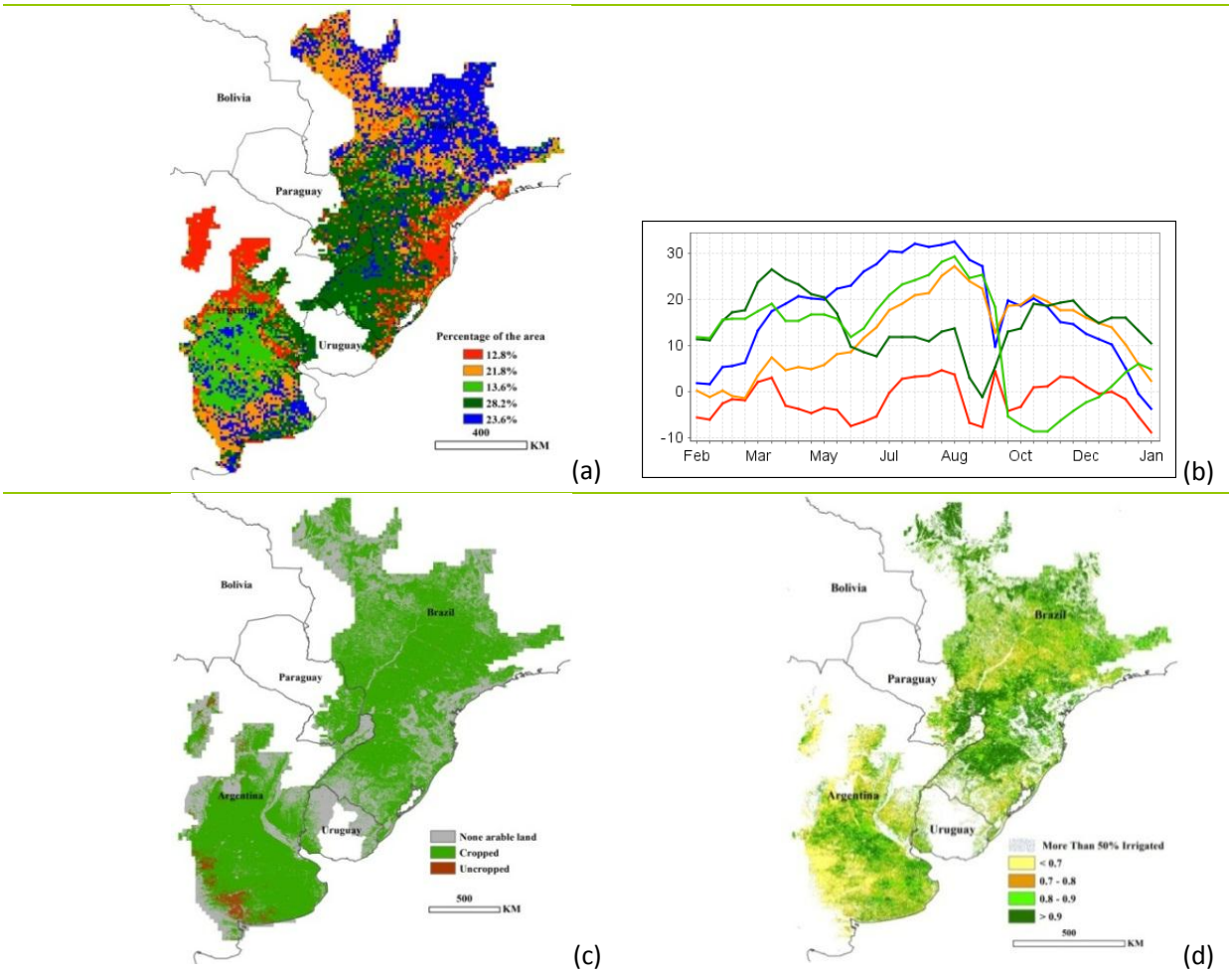
Regarding recent growing conditions in the South America MPZ over the last four months, rainfall was 5 percent less than the previous five-year average for the same period and temperature was above normal. Consistently, PAR increased by 3 percent. Limited precipitation and high temperature stressed crops in central Pampas. The VHI profile indicates that crops in the core soybean producing region (north western Buenos Aries, Córdoba, and south of Santa Fe; regions shown in light green in figure 2.3a) suffered from agricultural drought. Recent rains in January benefitted the crops there and vegetation condition turned normal. In the northern-most parts of Argentina as well as the coastal regions of Santa Catarina and Paraná, lack of radiation hampered crop development. Favorable conditions over other regions in the South America MPZ (mostly in Brazil and adjacent Paraguay) benefited crop growing.

Although growing conditions were unfavorable in the core soybean producing region, the maximum vegetation condition index (VCI) was still relatively high. The rainfall in January boosted soil moisture supplies and soybean and maize crop recovered from the stressed conditions. However, limited rain was recorded in western Buenos Aires and eastern La Pampa and the low soil moisture damaged some crops, as indicated by the low maximum VCI.

Generally, maximum VCI for the whole MPZ was at an average level, although concerns remain for soybean and maize crops; more rainfall is needed so that stressed crops can recover from the hot and dry conditions.

Uncultivated arable land was only 2.6 percent over the last four months, slightly above the previous five-year average, but almost double the twelve-year average reference value. Most cropped arable land is distributed in northwest of Bahía Blanca to Santa Rosa, capital of La Pampa province. The percentage of uncropped arable markedly increased in 2008. One reason is that farmers prefer crop rotation farming systems with one fallow season every two or three years. Another reason is the extreme weather conditions that occurred. Crops in Argentina suffered severe drought during two of the last five years, which delayed crop planting. Some farmers even decided not to plant due to the high risk. In southern Brazil, most arable land is cultivated.

Figure 2.3. South America MPZ: Farming intensity and stress



(a) Spatial distribution of VHI profiles between February 2013 and January 2014 (VHI departure from the twelve-year average for 2001-2013); (b) Typical VHI profiles associated with the pixels in (a); (c) Cropped and uncropped arable land; (d) Maximum vegetation health index (VCI).

2.5 South and Southeast Asia

The South and Southeast Asia MPZ (even after excluding the Maritime Southeast Asia) covers a heterogeneous region. Rice is the dominant crop in the whole MPZ, while wheat and maize are grown mostly in India and Myanmar. Figure 2.4 shows relevant maps and graphs for this MPZ.

All countries in the region cultivate, in one way or another, "summer crops" (Kharif), harvested around the end of the year (with a planting date that varies from February to June) and winter "crops" (Rabi), planted between September and December for harvesting from May to August, depending on cycle length, farming practices, and, to a large extent, local traditions. For all the countries in the MPZ, the reporting period thus includes harvests as well as planting or crops in vegetative stage. Most of the cropped areas are distributed in India, Bangladesh, the dry zone of Myanmar, the Red River delta and the Mekong delta in Vietnam, the Tonle Sap region, and central and northeast Thailand.

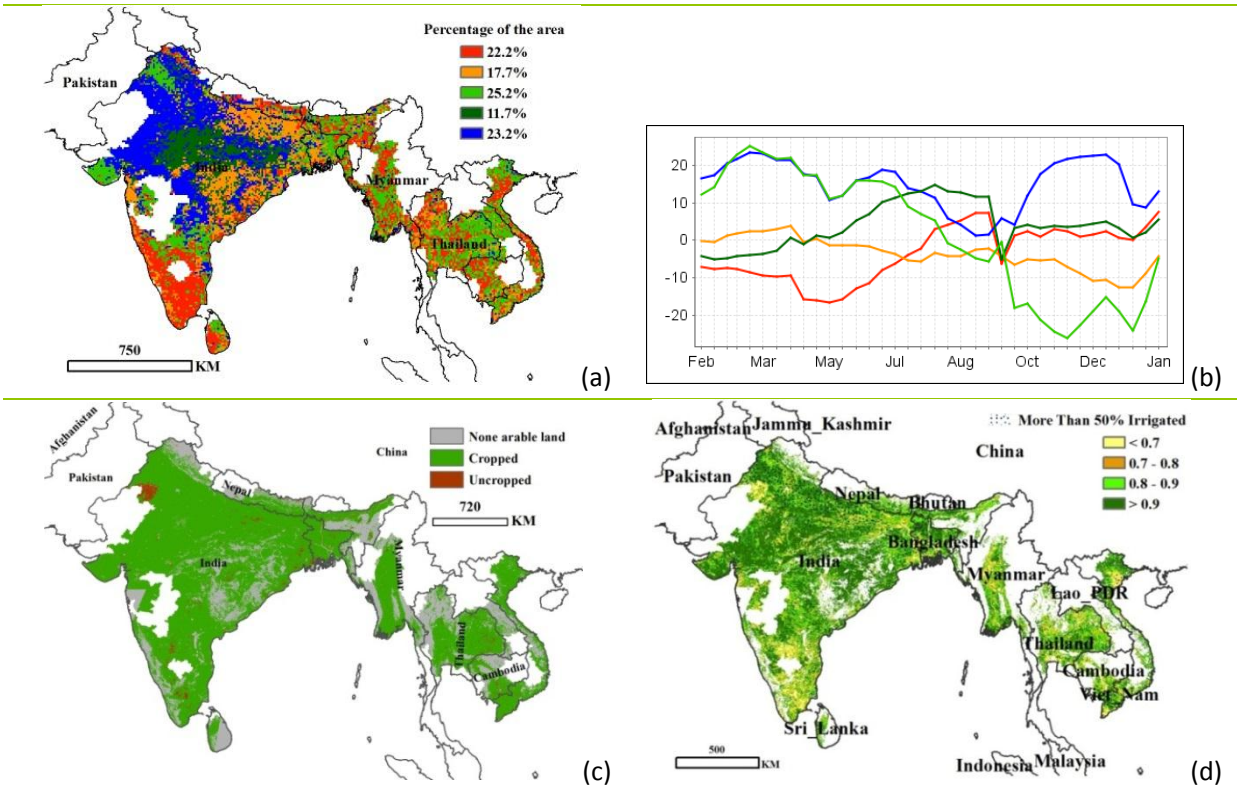
According to the analysis of environmental indices, rainfall was almost 30 percent over both the last five years' average and the twelve-year average, resulting in a biomass accumulation of about 20 percent above the last decade. Of the six MPZs monitored by CropWatch, South and Southeast Asia displays the highest biomass departure over the monitoring period, compared with both the last five years (19 percent) and the twelve-year period (22 percent).

During October to January, uncultivated arable land concerned 2.5 percent of the land pixels, 2.1 percent points down from the average of the previous five years. The uncropped areas are located mostly in north Rajasthan in India.

VHI departures from the twelve-year reference period (2001-2013) show four very distinct types of behavior: (i) Average conditions in about 34 percent of the area's pixels, indicated by dark green and red colors. The pattern occurs in northern central India and in southern India. The absence of fluctuations is typical of harvested crops. (2) Mostly above average conditions, increasing rapidly in October then decreasing in January, covering about 23 percent of the areas (in blue). This corresponds to winter crops, many of them irrigated in northeast India. (iii) Decreasing condition in about 18 percent of pixels; condition decreased almost linearly from October, followed by a slight improvement at the end of January, occurring mostly in north-east India rainfed winter crops. (iv) Well below average conditions during most of the period and recovering in January, while staying below average (25 percent of pixels). This behavior occurs in a patchy pattern mostly intermixed with (i) and (iii) over much of the eastern half of the MPZ; it is tempting to associate the third pattern with excess water, including the impact of the two October cyclones Phailin and Nari (see also section 5.1). In fact, India, Bangladesh, and Myanmar all recorded significantly above average rainfall (+56 percent, +46 percent, +26 percent, respectively), while the other countries in the MPZ are closer to average.

Maximum VCI values are usually high in most of the north western quadrant of India, in close agreement with the VHI clusters and clearly denote satisfactory rabi crop condition. In the south and east and in Bangladesh, there is a larger proportion of low values; the same occurs in the eastern half of the MPZ, indicating mixed crop condition, or sometimes distinctly poor, as in Red River delta of northern Vietnam.

Figure 2.4. South and Southeast Asia MPZ: Farming intensity and stress



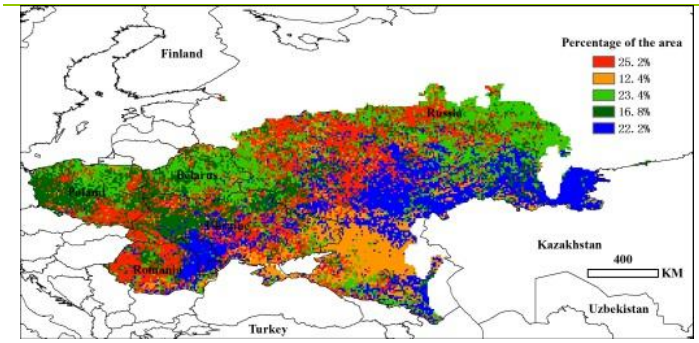
(a) Spatial distribution of VHI profiles between February 2013 and January 2014 (VHI departure from the twelve-year average for 2001-2013); (b) Typical VHI profiles associated with the pixels in (a); (c) Cropped and uncropped arable land; (d) Maximum vegetation health index (VCI).

2.6 Central Europe and Western Russia

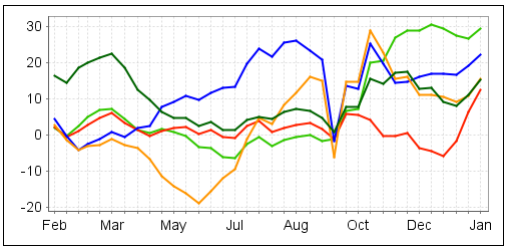
In the region of interest, the reporting period covers the harvest of summer crops (maize, sugar beet, sunflower) and the early vegetative stages of winter crops (winter wheat and winter barley). (See figure 2.5).

Less than half of the arable land is currently cropped (uncropped arable land (UAL) ratio 47 percent). More than 80 percent of the uncropped areas are distributed in Russia with some scattered plots along its border with Belarus and Ukraine (figure 2.5b). At MPZ scale, UAL drops by 1.9 percent compared with the recent five-year average, indicating an overall effort on cropland expansion in the region. However, Russia is the only country that presents an increased UAL compared with the previous year and recent five-year average (see Online resources: C. Time series of indicators). This finding is consistent with the estimation from the Russian Ministry of Agriculture that the winter wheat planted area in 2013 is lower than the planted area last year, according to HGCA crop updates.

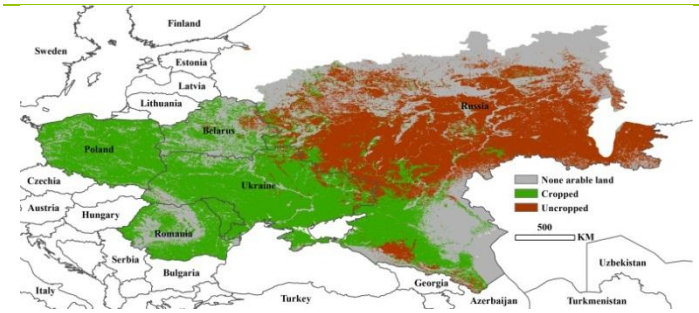
Figure 2.5. Central Europe and Western Russia MPZ: Farming intensity and stress



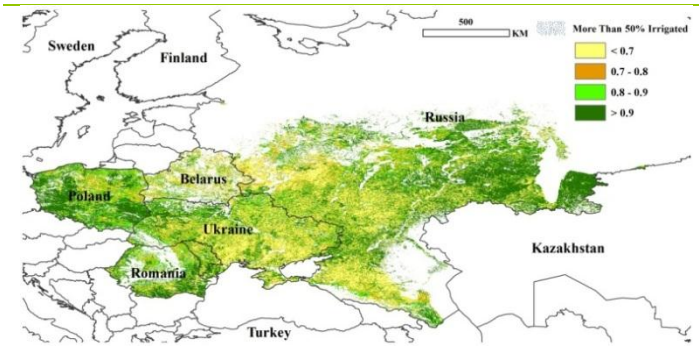
(a)



(b)



(c)



(d)

(a) Spatial distribution of VHI profiles between February 2013 and January 2014 (VHI departure from the twelve-year average for 2001-2013); (b) Typical VHI profiles associated with the pixels in (a); (c) Cropped and uncropped arable land; (d) Maximum vegetation health index (VCI).

A positive departure from the five-year average is observed from table 1.1, for temperature (1.0℃), PAR (1 percent) and biomass (2 percent) in this region, but rainfall is below the five-year average (with -11 percent departure). The VHI cluster profiles (b) show that (from October) the vegetation condition is above average with the exception of scattered areas in the arable land of southeast Poland, west Romania, south of Ukraine, and the central and northern region of Russia (colored red in figure 2.5a). These regions are also captured in the maximum VCI map with low values highlighted in yellow. In addition, the maximum VCI map shows the most promising crops are currently distributed in the west and southeast of Poland, northwest of Ukraine, and the Urals and Siberia region of Russia, compared with other regions. The average maximum VCI at MPZ scale is above the recent five-year average, which is consistent with the increase of biomass in this region. All countries (Poland, Romania, Ukraine, Belarus and Russia) exhibit an increased maximum VCI value over the recent five-year average, but all countries except Russia experienced decreased biomass accumulation. This may result from rather abnormal temperature over the east of the region.

2.7 Western Europe

Wheat is cultivated almost everywhere in the Western Europe MPZ (figure 2.6), while maize is more frequent in the warmer areas of the south, especially in southwest France (Poitou-Charentes, Aquitaine, and Midi-Pyrénées), south-east France (Rhone-Alpes) and the adjacent areas in Italy, starting with Liguria and proceeding along the Po valley through Lombardy and eventually Veneto. In the east, main maize growers include Oberösterreich and Steyermark in Austria and all of Hungary. Rice is grown in the Po valley in Italy and soybean is virtually absent.

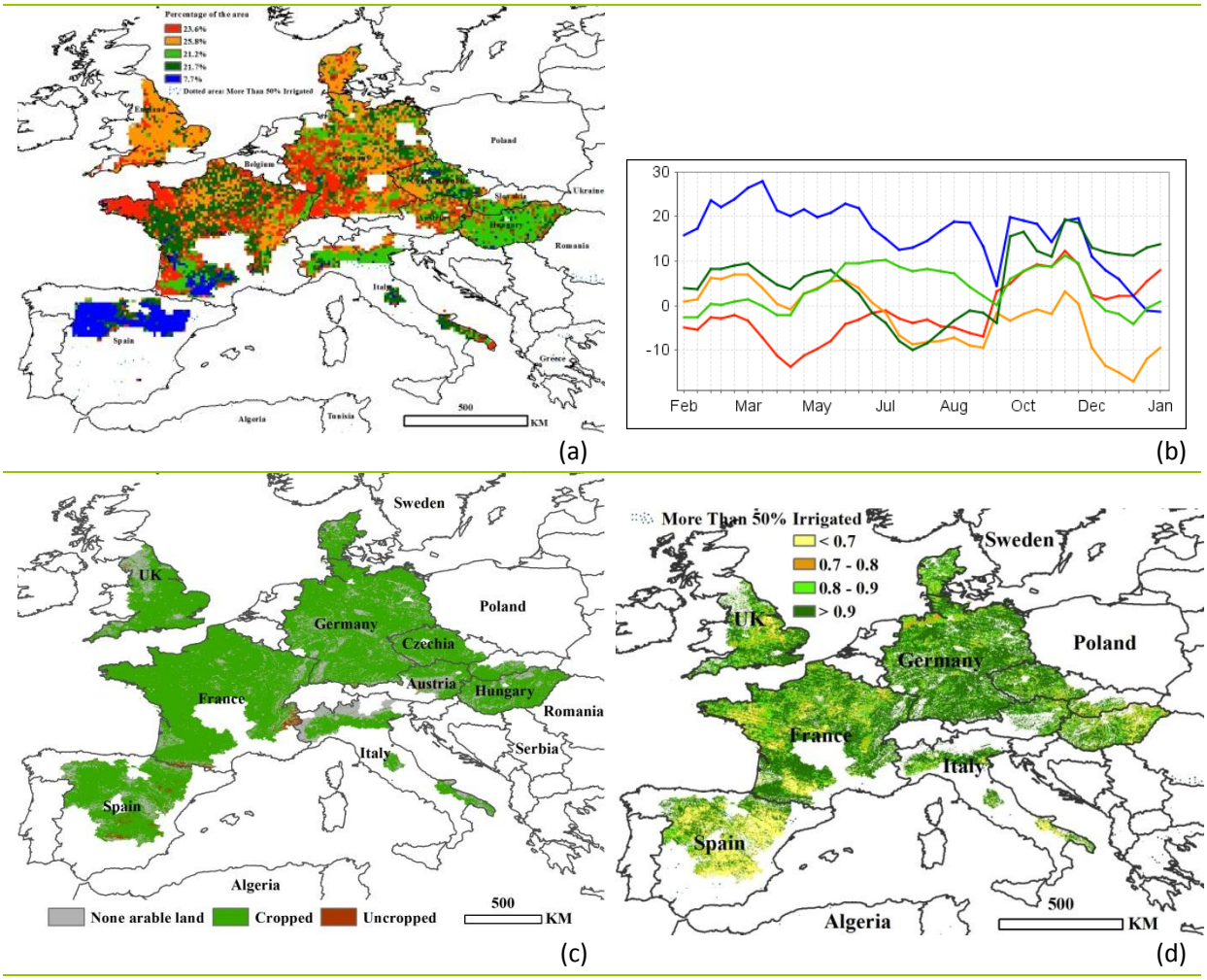
As already mentioned in section 1.1, several areas experienced abnormal environmental conditions, including high rainfall in the United Kingdom (43 percent above the recent 13 year) and Hungary (a drop of 33 percent). But the most spectacular and spatially coherent departures concern temperature, mostly in the northern center and east of the MPZ: a 2.1°C increase in Denmark and close to a 2.0°C increase in Germany, Hungary, Czechia, Slovakia, and Austria (+1.5°C). Abnormal PAR was recorded only in Denmark (-4.5 percent).

Based on VHI clusters, crop conditions in Europe can be described for the three corners and middle area of a triangular area across the continent. In the first (i) point of the triangle—in the United Kingdom and Denmark—the area is characterized by a sharp deterioration in VHI in December and January, associated with floods and possibly low radiation in Denmark. At this stage of the season, the season's final outcome will still very much depend on the conditions that will prevail during February and the following months. The second point (ii) of the triangle covers Spain and the east of south-western France, where VHI was well above expectations for most of 2013, but rapidly deteriorated in December, compared with the reference period, reaching values close to average at the end of January. In a third corner (iii), covering the Po Valley and the eastern part of the MPZ (Hungary), VHI values are about average and then close to average in December and January.

Next, between the three listed "corners," the continent is characterized by a patchwork of the three described behaviors, mostly in areas with high maximum VCI values (above 0.8). Lower values are seen for the peripheral areas, especially south and east Spain (Aragon and Castilla), south-west and north-west France (Central Midi-Pyrénées and east Brittany), the United Kingdom (Cambridgeshire and Lincolnshire), the north of Lower Saxony in Germany, and eastern Hungary. As with VHI, the remaining areas are best described as random patches of high and low VCI, with different mixes of both, approximately 30 low-70 high in France and Hungary, 10-90 in Germany, Denmark, Czechia, and north Italy, and 70-30 in Spain and

southern Italy. The average VCI in the MPZ is nevertheless rather high, 0.88, up 8 percent over the latest season.

Figure 2.6. Western Europe MPZ: Farming intensity and stress



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