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Foreword

Food security is essential for national security. For many years, agriculture and food security have been a key focus of China's national economic and social development plans as well as its science and technology research programs. Over the last twenty years, a team of scientists led by professor Bingfang Wu at the Chinese Academy of Sciences' Institute of Remote Sensing and Digital Earth (RADI) has developed unique satellite remote sensing based methodology and a system—CropWatch—for operational monitoring of crop conditions and crop production at both national and global levels. As one of its key outputs, the team issues a periodic crop assessment bulletin, which is a vital source of information about crop conditions and production for decision makers and planners in China's government, as well as researchers and analysts in China.

With technological advances, a wider range of satellite remote sensing data, from both China and abroad, is becoming accessible and affordable. In China, high quality data from the Chinese meteorological (FY-3) and environmental (HJ-1) satellites is now available for crop condition assessments, increasing China's contributions to the international community. Taking advantage of the opportunities provided by these data, the CropWatch team set out to use these new data sources and develop new hierarchical indicators and operational methodology for global crop monitoring. The bulletin in front of you is a product of this effort and the first of its kind since the CropWatch bulletin was launched more than a decade ago. The bulletin presents the latest comprehensive results of the team's work, covering assessments of global main crop producing zones and major producing countries, as well as sub-national crop conditions in large countries, including China.

For the first time also, this CropWatch bulletin is presented in both Chinese and English at the same time. I am confident the bulletin will not only provide a solid assessment of the current global major crop conditions, but also serve as a science-based Chinese voice on global food security perception, contribute to the global effort to provide more reliable, transparent, and up-to-date information on agricultural production to fight against hunger and ensure sustainable agricultural development across the world.

I hope that this bulletin—the result of an exciting and ambitious undertaking by the team—will not only be well-received by China's domestic readers, but also have a strong impact on the broader international user community.



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Director General of RADI

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Abbreviations

5YA	Five-year average (2008-12), or 'medium term', 'recent past'
11YA	Eleven-year average (2002-12), or 'long term'
12YA	Twelve-year average (2001-12), or 'long term'
AMIS	Agricultural Market Information System
CAS	Chinese Academy of Sciences
CPSZ	Crop production system zone
EI	Environmental index
IGBP	International Geosphere Biosphere Programme
JRC	European Commission Joint Research Centre
kHa	Kilohectares (thousand hectares)
kkm2	Thousand square kilometers (million acres)
kT	Kiloton (thousand metric tons)
NCDC	National Climatic Data Center
NPPP	Net primary productivity potential
PAR	Photosynthetically active radiation
Ton	Thousand kilograms
W/m ²	Watt per square meter
FAO	Food and Agriculture Organization of the United Nations
G20	Group of 20
GAUL	Global Administrative Units Layer
GEO	Group on Earth Observations
GeoGLAM	GEO/GEOSS Global Agricultural Monitoring
GEOSS	Global Earth Observation System of Systems
GIS	Geographic Information System
GPS	Global Positioning System
GSOD	Global Surface Summary of the Day
GVG	GPS, Video and GIS data
MPZ	Major crop production zones
PBR	Potential biomass ratio
RADI	Institute of Remote Sensing and Digital Earth
TRMM	Tropical rainfall measuring mission
UAL	Uncropped arable land ratio
UN	United Nations
VASClimO	Variability Analysis of Surface Climate Observations
VHI	Vegetation Health Index

Introduction

All major food producers and consumers crucially depend on timely and accurate information on production and markets. For this and a variety of other commercial, statistical, governance and humanitarian reasons, many countries and intergovernmental as well as international organizations actively monitor national, regional, or global crop production.

China's global crop monitoring began in 1998 with the development of CropWatch, a system designed to assess national and global crop production and related information using remote sensing and ground based indicators. CropWatch is also one of the global components in the GeoGLAM (GEO/GEOSS Global Agricultural Monitoring) initiative set up by the G20 in 2011 (1) to improve access to consensual global information about the worldwide availability (production and trade) of major cereals and soybean. The present bulletin is China's first systematic contribution to GeoGLAM and the G20 Agricultural Market Information System (AMIS); it focuses on maize, rice, wheat, and soybeans.

This bulletin is prepared by the CropWatch research team in the Institute of Remote Sensing and Digital Earth (RADI), Chinese Academy of Sciences. It is in fact Vol. 13, No. 7, or the 91st installment in the series of CropWatch bulletins that have been published in the Chinese language in a variety of formats (ten-day updates as well as monthly bulletins) since 1998. In a departure from previous issues, the bulletin from now on will be published in both English and Chinese, and change from a monthly publication to a quarterly. Moreover, additional data not covered in the report will be available online on the CropWatch Website (<http://www.cropwatch.com.cn/en>).

Over the years, the CropWatch bulletins have been updated regularly as new data or methodologies became available and matured. The current issue again takes advantage of multiple new remote sensing data sources and presents new hierarchical indicators and an operational methodology for global crop monitoring. A methodological brief is provided in chapter 6, along with descriptions of—mostly national—sources of crop information. Because of the relative newness of some of the methods and data, further adjustments of the methodologies are expected for future bulletins, to incorporate ongoing research on the data and experimental methodologies, as well as feedback on these initial approaches.

The bulletin provides assessments of global main crop producing zones and major producing countries, as well as sub-national crop conditions in large countries, including China. The bulletin also pays a lot of attention to environmental and agricultural trends, which will contribute to the understanding of the global food security situation.

This being the first English language edition, the bulletin attempts to cover a rather long time period of about one year, while subsequent issues will focus on shorter time intervals to cover recent and ongoing cropping seasons. The current bulletin is based mostly on historical information starting in 2001, with the cut-off time for the ongoing season at the end of September 2013.

The report is organized in six chapters to present the results for different spatial scales as well as necessary background information. Following the executive summary, the first chapter (chapter 1) presents prevailing environmental conditions—essentially rainfall, temperature and solar radiation—for 60 Crop Production Systems Zones that were identified based on climate, ecological zones, and cropping patterns. The main indicators are satellite-based environmental indices.

In chapter 2, a more detailed analysis of cropping activities is presented for four major crop production zones (MPZ), paying attention to the environmental indices along with a focus on cropping intensity, biomass, and a measure of non-cropped arable land.

Chapter 3 zooms into the thirty major producer countries that account for 80 percent of global production and exports, starting with a section (3.1) that provides the CropWatch estimate of current 2013 production. Section 3.2 provides information of cropland use intensity, starting with cropping intensity (the number of times land is used per year), uncropped arable land, and the potential biomass ratio, i.e., an indicator of the performance of the current season's plant biomass accumulation compared with optimal conditions.

Section 3.3 constitutes a major part of this report as it describes, by country grouped by continent, several major indicators of the recent cropping season. It starts with a reference map showing average NDVI, together with the areas where the crops of interest (maize, rice, soybean and wheat) are cultivated, as well as major irrigated areas. In addition, two sets of information are provided to assess crop condition in each of thirty countries. In the first, a map shows crop condition by comparing the current NDVI with the average of the previous five years, at a time that is meaningful for the local crop calendar. Whenever a crop is currently growing, the crop condition map is presented for September 2013. In other cases, a time period just before the harvest of the main crop was selected. This crop condition map is accompanied by a graph showing the development of the season over time, together with a comparison with the previous year and the five previous years. While these crop condition maps and profiles show average national behavior over time at a detailed pixel-resolution, in the second set of information, another map shows spatial NDVI clusters, i.e., areas that underwent similar growing conditions, together with the profiles themselves. To maintain some balance between countries of very different sizes, the largest ones have been analyzed at the scale of the first sub-national administrative unit.

While the previous chapters rely a lot on remote sensing and ground data, chapter 4 discusses two subjects by providing overview information mostly based on international databases and general information, with less systematic reference to remote sensing indicators. The first section focuses on rice in Southeast Asia and the second on extreme factors that have affected the countries of interest, more specifically crops, over the last year.

Chapter 5 focuses on China, where CropWatch experience is greatest and where data sources are most easily available. The structure largely follows the one adopted in chapter 3, starting with section 5.1 which provides the CropWatch estimate of the 2013 production. Section 5.2 similarly provides information of cropland use intensity, but also adds cropping structure, i.e., the relative share of cropland cultivated under various crops. Section 5.3 makes up the bulk of the chapter: it provides an overview of recent crop performance and conditions for China's provinces, grouped into six geographic zones.

The last chapter of the report, chapter 6, is technical and presents relevant background information for the results presented in the previous chapters. Section 6.1 describes the spatial units of analysis, in particular the Crop Production System Zones adopted for chapter 1 and the Major Production Zones described in chapter 2. Chapter 6 also gives a detailed account of the raw data used (6.2) as well as other methodological details (6.3). In the final section of the report, the annexes contain a number of maps and tables that complement those shown in other parts of the bulletin.

Executive Summary

The CropWatch bulletin provides a comprehensive overview of the 2012-13 global production of wheat, rice, maize, and soybean. It is based on a thorough analysis of environmental conditions and a quantitative assessment of their impact on crops, focusing on some of the major production areas as well as the major producing countries. China, a major food producer, consumer, and importer, closely monitors food commodity markets. CropWatch, however, not only covers key crop producing regions, but also pays due attention to the situation in areas where trade considerations play a subordinate role to food security concerns.

This bulletin also tries to gain a deep and nuanced insight into the dynamics of food production systems by introducing new spatial units of analysis, new methods and several innovative remote sensing-based indicators. Their ambition is to move away from purely environmental descriptions to value-added agronomic indicators. While the increased diversity of sources sometimes leads to conflicting information, it nevertheless better reflects the complexity of global food production systems and provides a broader and more robust basis for the overall analyses presented in this bulletin.

According to CropWatch estimates, the 2012-13 season is best described as globally average for rice and soybean, while wheat and maize (which is the most produced cereal) did generally better. The CropWatch estimate for the production of main crops is as follows: wheat, 705 million tons, up 4.1 percent over 2012 estimates; rice as paddy, 739 million tons, up 1.6 percent; maize, 944 million tons, up 0.3 percent; and soybean, 202 million tons, an increase of 1.2 percent compared with 2012. For the thirty major producers and exporting countries, increases are more modest for wheat (+2.3 percent) and for rice (+0.8 percent), while they exceed those of the “rest of the world” for maize (+1.7 percent) and for soybean (+1.6 percent). Production change estimates for those other countries (outside the thirty main producers) amount to +13.4 percent for wheat, +8.4 percent for rice, -6.1 percent for maize and -0.8 percent for soybean).

Considering the major wheat exporters, significant changes occurred this year in their relative contributions to the global output: Russia, which normally ranks 5th among the wheat exporters, this year rose to the 2nd place due to poor performance of the United States, France, Canada, and Australia, who all suffered significant production decreases (-5.9 percent, -2.8 percent, -3.2 percent and -4.2 percent, respectively).

Similarly, the traditional main rice exporters all underwent a production decrease compared to the previous season (Thailand: -4.3 percent; Vietnam: -1.5 percent; Pakistan: -1.1 percent, and the United States: -3.6 percent). The next exporter is India (+1.7 percent). As the country experienced a poor wheat crop (-4.2 percent), the rice production increase may be absorbed by the domestic market. This would lead to a relative shortage of marketable rice.

The Chinese contribution to the global production amounts to 118 million tons of wheat, a modest decrease over last year's output (-1.3 percent, and accounting for 17 percent of world output). With 200 million tons, rice production increased slightly (up 0.6 percent, and representing 27 percent of total production) but maize did so more substantially, reaching 194 million tons (+3.1 percent, and more than one fifth—21 percent—of world production). Finally, soybean production dropped by 6.8 percent to reach

13 million tons, just below 5 percent of world production. A detailed breakdown of national production as well as a crop distribution by province is provided in the bulletin.

Most of the listed variations in production can, directly or indirectly, be associated with environmental conditions, in particular weather: a persistent cold wave across much of the northern hemisphere and a series of tropical storms in Southeast Asia.

The cold wave happened in the early months of 2013. The cold occurred in several waves, including in spring, when it was most harmful to winter wheat just after dormancy. It was associated with lower than normal solar radiation reaching the ground, thereby reducing photosynthesis and crop yield. This factor affected large areas in Eurasia, including northwest India, parts of China, central Asia and Europe and North America. A cold wave during the southern hemisphere winter (August) also created havoc in the main production zone, including south Brazil, north Argentina, and parts of Uruguay and Paraguay.

The series of tropical storms affected the countries bordering the Bay of Bengal and the Pacific Ocean in eastern, southern and South-East Asia. China suffered from both the cold spell and some of the tropical storms.

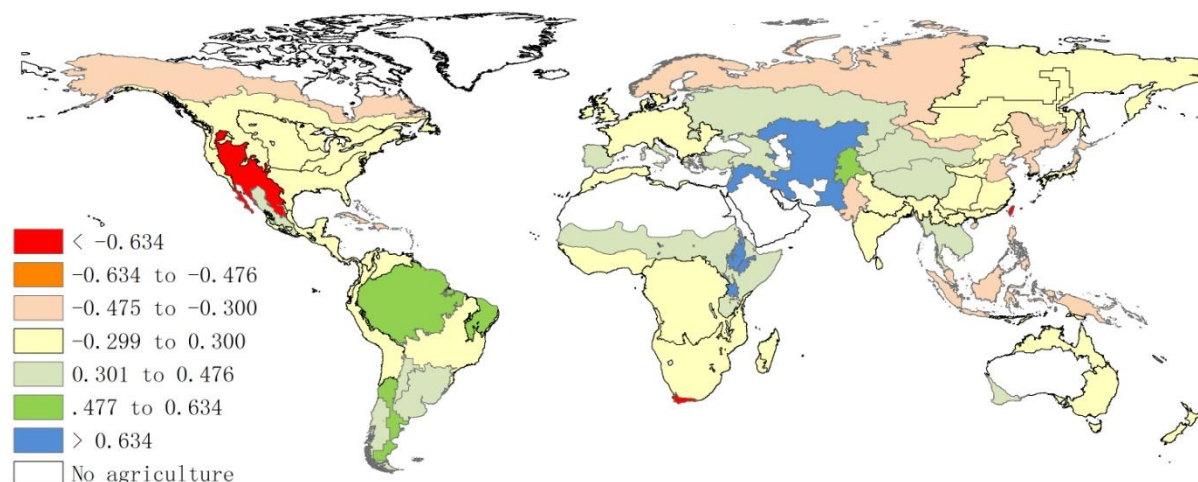
Chapter 1 Crop Production System Zones: Environmental Indices

Values and trends for key environmental factors—rainfall, temperature, and radiation—can be used to capture some of the basic global environmental changes that are currently taking place. In this chapter three relevant indicators for rainfall (accumulated rainfall), temperature (temperature accumulation), and radiation (accumulated photosynthetically active radiation (PAR)) are presented for each of sixty Crop Production System Zones (CPSZ). These zones are defined based on prevailing ecological conditions, which are associated with typical climate and cropping patterns. By limiting the total number of zones, use of the CPSZs provides a meaningful yet manageable approach to agricultural monitoring of diverse agricultural areas. While large units are not necessarily exposed to the same environmental factors, they nevertheless provide a convenient approach for qualitative impact assessments. Further detail on the CPSZs is provided in annex A. (For more information on the Environmental Indices, see section 6.3.1).

The three environmental factors basically represent the supply of water (rainfall), heat and light (temperature and radiation). All three are measured as environmental indices, defined over the crop growing areas only and covering the whole period from October 2012 to September 2013. The three indices also use a spatial weighting approach that gives a high weight to areas with high primary production potential, thus in essence measuring “agricultural rainfall,” “agricultural temperature,” and “agricultural radiation.” Selected results for the environmental indices for the CPSZ are presented in this chapter, while detailed information is provided in the figures and tables in annex B. The tables in the annex provide several derived statistics, such as time trends and a comparison with the recent twelve-year average (2001-12) and the most recent five years (2008-12).

Naturally, the three indices are inter-related in several ways. The first inter-relation regards major geographic variations, which are well known, such as high temperatures in tropical areas. The second covers correlations between variables within the CPSZs. For instance, temperature and PAR vary in parallel. This is particularly well marked in the American continent (U.S. cotton belt and Mexican coastal plains), most of South America, and in Asia, Gansu-Xinjiang and the North China plain, along with adjacent areas in Korea and Japan. Rainfall and PAR as well as rainfall and temperature vary in opposite directions.

Figure 1.1 illustrates global temperature trends. Only few areas show a significant trend towards increasing temperatures (in blue), including the Eastern African Highlands, parts of western Asia, and some areas in South America, most notably the Brazilian Nordeste. Marked decreasing trends (in red) affect parts of the western United States and Mexico, South Africa, and Taiwan. The observation is in line with the current apparent “global warming slow-down,” which is receiving a lot of attention in the scientific literature and in the media (2) (3) (4).

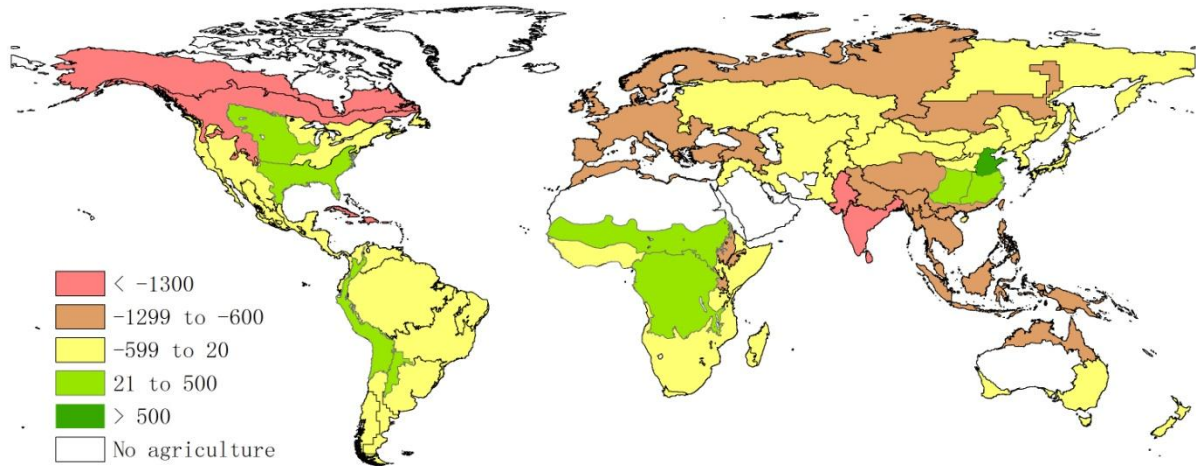
Figure 1.1 Global temperature trends

Note: The Intensity of the temperature trend is expressed as the coefficient of correlation of the time trend line. Values larger than $|0.476|$ are significant below $p < 0.05$ and those larger than $|0.634|$ are significant below $p < 0.01$. For non-significant trends, only the direction of the change is shown by the color coding.

For temperature, most of the northern hemisphere experienced average conditions, with some areas undergoing below average conditions over the period from October 2012 to September 2013. The same region was affected by below average conditions when only the early months of 2013 are included (see among others section 4.2). The southern hemisphere was generally warmer than the last five years. Exceptions to the above-mentioned patterns include (i) an area extending from Mongolia to Punjab, southern India and Sri Lanka (but skipping Gansu-Xinjiang) with below average temperatures; (ii) the eastern United States, also with below average temperatures, and (iii) three areas in the southern hemisphere: south Madagascar and South Cape in South Africa, and south-west Southern Cone in South America (see also figure B.2a).

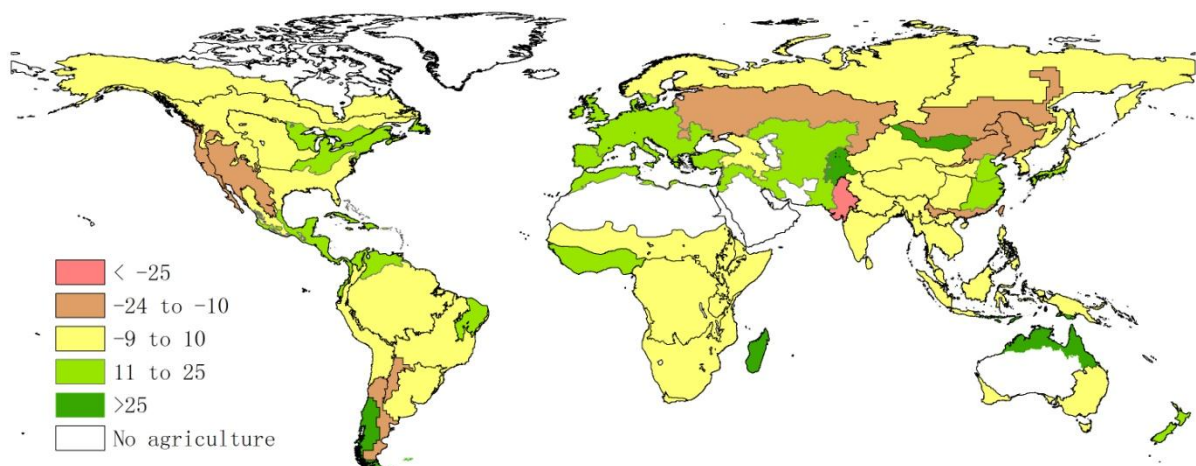
In another example of global short-term changes, figure 1.2 compares the current season with the recent five years for PAR. Because PAR very directly relates to both rainfall (negatively) and temperature (positively), it is a key parameter. Importantly, the comparison of 2013 PAR with the five-year average (figure 1.2) differs only little from the comparison of 2013 PAR with the twelve-year average (figure B.3b in annex B). Most of Eurasia experienced less than average PAR conditions, which was particularly the case in Southern Asia, including Bangladesh, Punjab and Gujarat. The same observation applies to the Caribbean islands. Particularly favorable PAR conditions affected central Africa, north-western South America, the U.S. cotton belt and the Mexican coastal plain, as well as the northern Great Plains. In Asia, the south-west and the lower Yangtze regions and in particular the North China plain received ample PAR in 2013.

In Africa, the broader Sahel region similarly benefited from favorable PAR conditions. The Sahel usually is a water-stressed region where—consistent with the observation that PAR and rainfall are negatively related—more sunshine typically means less rainfall. As shown in figures B.1a (rainfall) and B.3a (PAR) in annex B, this was not the case this season.

Figure 1.2 Accumulated PAR (W/m^2) for October 2012-September 2013, compared with five-year average

CropWatch results further show that several regions suffered a significant shortage of rainfall (figure 1.3). These include northern South America and Central America, the south-west Southern Cone in South America, central eastern Asia (Japan and Korea), and north Australia (annex B, table B.1 and figure B.1). Rainfall was abundant in Madagascar, the U.S. cotton belt and the Mexican coastal plain, as well as in the southern region in China (see also section 4.2.1). Among the areas with favorable but less abundant precipitation, the region from the Ukraine to central Asia (Kazakhstan) can be singled out.

In the interpretation of the environmental indices, it is important to consider they cover a whole calendar year and impacts often depend on weather conditions during a specific time of the year. As a result, the annual indices presented are more meaningful for areas with one clear growing season only (see section 3.2, cropping intensity), for instance the Sahel. Where a winter crop and a non-irrigated summer crop are cultivated (as in most of Europe), the interpretation of the index requires additional attention data narrowing down the spatial and temporal window. For example, figure 1.3 shows the April to September rainfall anomaly. Unusually wet summer conditions occurred in the region of Mongolia, Pamir and surroundings while wet winter months occurred in Madagascar, North Australia and south-west South America. A negative departure from the recent mean occurred in the area from Punjab to Gujarat.

Figure 1.3 Accumulated rainfall index anomaly, April to September 2013 (percent)

Chapter 2 Major Production Zones: Cropping Activities and Stress

This chapter describes four among the world's major production zones (MPZ). Chosen mainly because of their contribution to world exports, the four zones are located in South and South-East Asia, North America, South America, and Central Europe-West Russia. In addition to the environmental indicators used in chapter 1, four additional indicators have been used to analyze cropping activities and stress in the four MPZs: uncultivated arable land (UAL), cropping intensity, potential biomass ratio (PBR), and the Vegetation Health Index (VHI), a drought indicator. Results for each MPZ are presented in figures 2.1-2.5, along with additional data in Annex C. Section 6.3 provides technical briefs about the indices.

2.1 South and Southeast Asia

The South and Southeast Asia MPZ covers a rather large and inhomogeneous region. The time profiles in figure 2.1 basically show two seasons. The first is a season of winter crops and irrigated dry-season crops planted around October-November 2012 in the north of the area, where rainfall seasonality and winter is well marked. The second is the monsoon period during the summer of 2013.

Table 2.1 South and Southeast Asia MPZ: Cropping intensity, uncultivated arable land, and potential biomass ratio

	2013 value	11-year average (2002-12)	5-year average (2008-12)	2002-13 normalized trend	Coefficient of correlation	Significance level of trend	Difference between 2013 and 11-year average	Difference between 2013 and 5-year average
Cropping intensity (%)	202	200	201	0.67	0.148	-	1.3	0.9
Uncultivated arable land (%)	0.52	1.24	0.59	-18.98	-0.722	**	-0.72	-0.08
Potential biomass ratio	0.874	0.878	0.892	0.000	0.671	**	-0.004	-0.018

Note: The normalized trend is the 2002-2013 trend normalized by dividing it by the eleven-year average. Significance level of the trend is * for $p < 0.05$ and ** for $p < 0.01$.

Both UAL and the PBR undergo statistically significant changes at the medium-range scale in the region, decreasing for UAL and increasing for PBR, indicating the dynamic nature of agriculture. Compared with the average of the last five years, the decreasing trend continues this season, while a minor deterioration is observed for the PBR (average 0.874, this year -0.018). Cropping intensities in South and South-East Asia are among the highest in the world, with many areas *on average* growing two crops on the same land; this mainly occurs in the southernmost areas, which benefit from favorable temperature and (usually) rainfall conditions throughout the year. Compared with the previous five years, cropping intensity increased almost 1 percentage point. As shown in table 2.1 and figure 2.1a, showing cropped and uncropped arable land, areas where land is left uncultivated are negligible.

Analysis of environmental indices indicates rainfall and PAR have respectively increased 'very significantly' and 'significantly' over the last twelve years, while no temperature trend is discerned. For the current season, rainfall and temperature are generally about average, while PAR decreased by about 10 percent.

Rainfall conditions were close to average in India and continental Southeast Asia during the winter season and slightly above average during the monsoon, except in large areas of Thailand and Myanmar

where August was characterized by a marked unseasonal drop in rainfall. The southernmost part of the MPZ was characterized by large rainfall variability. A very wet winter season was recorded in southern Thailand and Luzon.

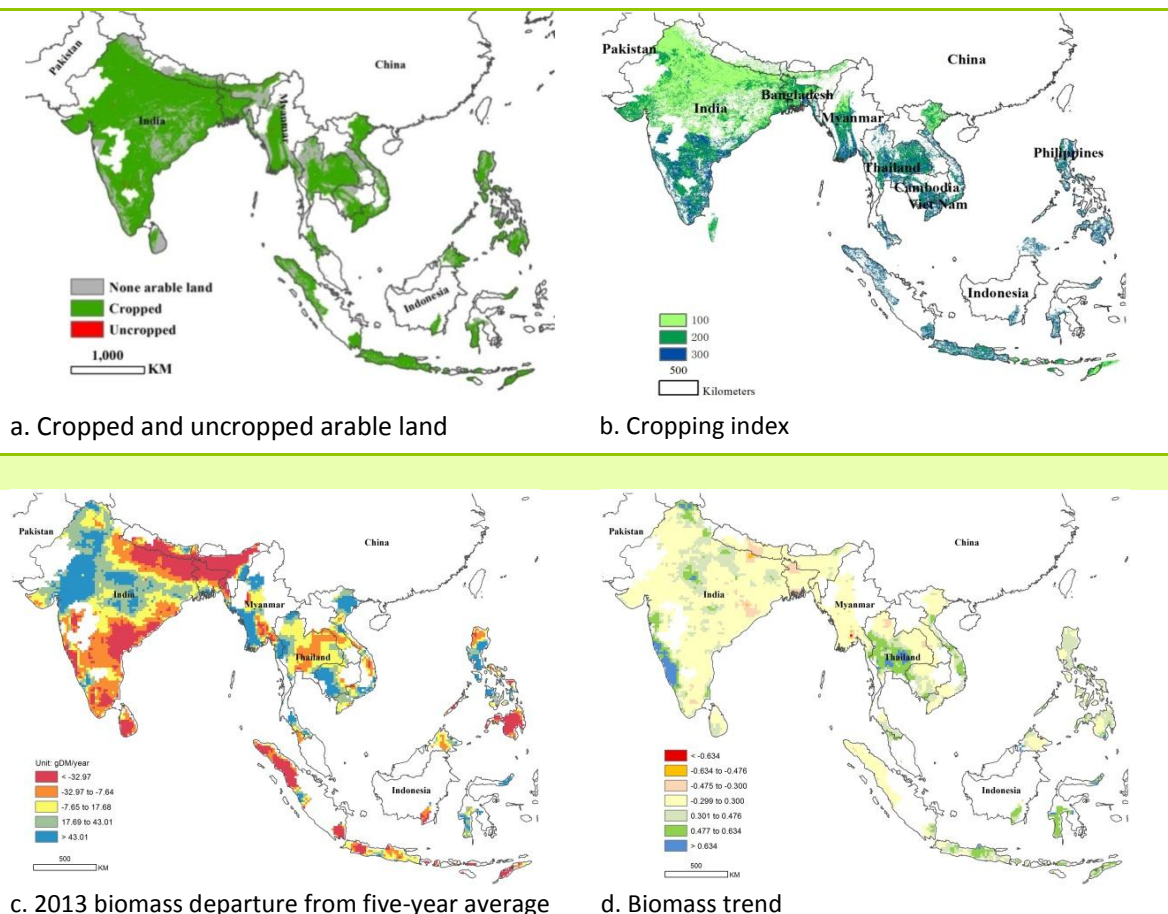
Temperature was significantly above average in continental Southeast Asia during most of last year, while winter was cold north of northern Rajasthan and an area centered on Bihar and West Bengal. Madhya Pradesh and Uttar Pradesh suffered unseasonably high temperatures in May.

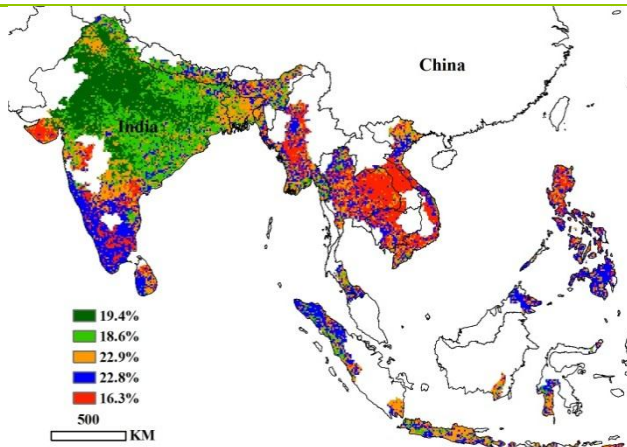
Biomass, which integrates most of the factors above, shows mostly stable conditions over the medium term, with local improvements in central Thailand, northern central India, and particularly in western coastal India.

The VHI and biomass indicators describe similar situations for areas in both central and northwest India and areas in central continental South-East Asia for the current season. For the first region, both indicators point to favorable conditions, while for the second region both indicate conditions are unfavorable. The biomass index associates a drop in productivity in northeast India with below-average temperatures during the first season.

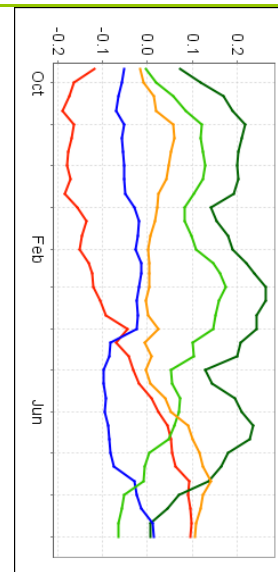
In the southernmost equatorial areas, regions that benefit from rainfall throughout the year (e.g., south Sumatra and part of the Philippines) show higher cropping intensities. In this area, seasonality patterns are blurred by local conditions (including topography).

Figure 2.1 Environmental and crop production indices for South and South-East Asia MPZ

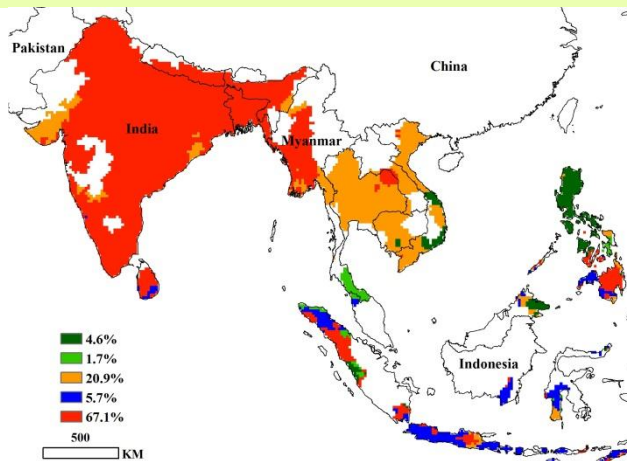




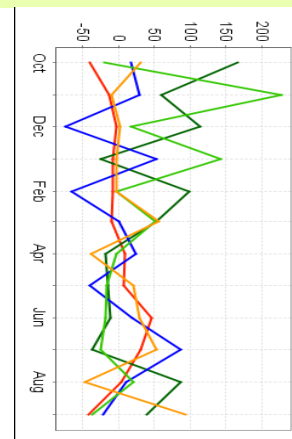
e. VHI departure from the previous five years for period indicated in f.



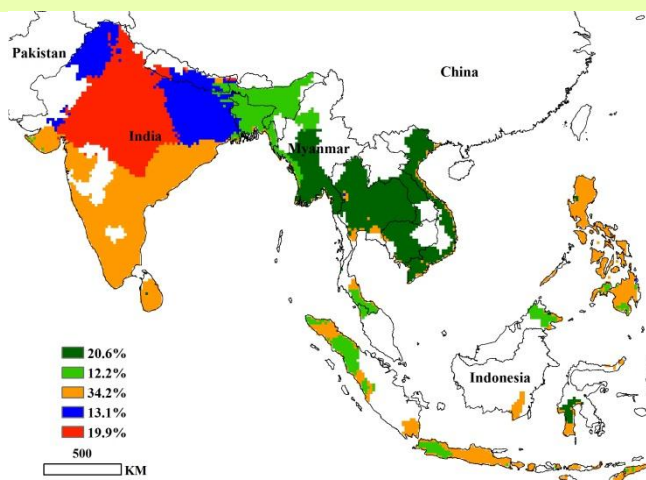
f. VHI profile



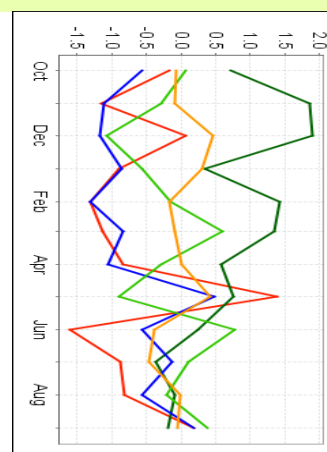
g. Rainfall departure from the previous five years for period indicated in h.



h. Rainfall profile



i. Temperature departure from the previous five years for period indicated in j.



j. Temperature profile

2.2 North America

Compared to the other major production zones, the potential biomass ratio in the North American MPZ is rather stable and high, with a value of 0.92, about 5 percent above the other MPZs, an indicator of the efficiency of the food production systems (table 2.2). Table 2.2 also illustrates uncultivated arable land decreased by about 1 percentage point (0.72) this year, compared with the recent past (the last five years). Logically, cropping intensities also decreased during the same time frame, by about 2.5 percentage points. According to figure 2.2a the uncropped arable land is mostly located in the southern and central mid-west.

Table 2.2 North America MPZ: Cropping intensity, uncultivated arable land, and potential biomass ratio

	2013 value	11-year average (2002-12)	5-year average (2008-12)	2002-13 normalized trend	Coefficient of correlation	Significance level of trend	Difference between 2013 and 11-year average	Difference between 2013 and 5-year average
Cropping intensity (%)	135	136	137	-0.94	0.108	-	-1.3	-2.5
Uncultivated arable land (%)	1.80	2.21	2.52	1.09	0.045		-0.41	-0.72
Potential biomass ratio	0.917	0.907	0.902	0.000	-0.071		0.010	0.015

Note: The normalized trend is the 2002-2013 trend normalized by dividing it by the eleven-year average. Significance level of the trend is * for $p < 0.05$ and ** for $p < 0.01$.

As far as environmental variable trends are concerned, PAR increased significantly over the last twelve years. As shown in table C.1 in the Annex, compared with last year and the recent past, rainfall increased and temperature decreased by approximately the same percentage (5 percent compared with recent five years).

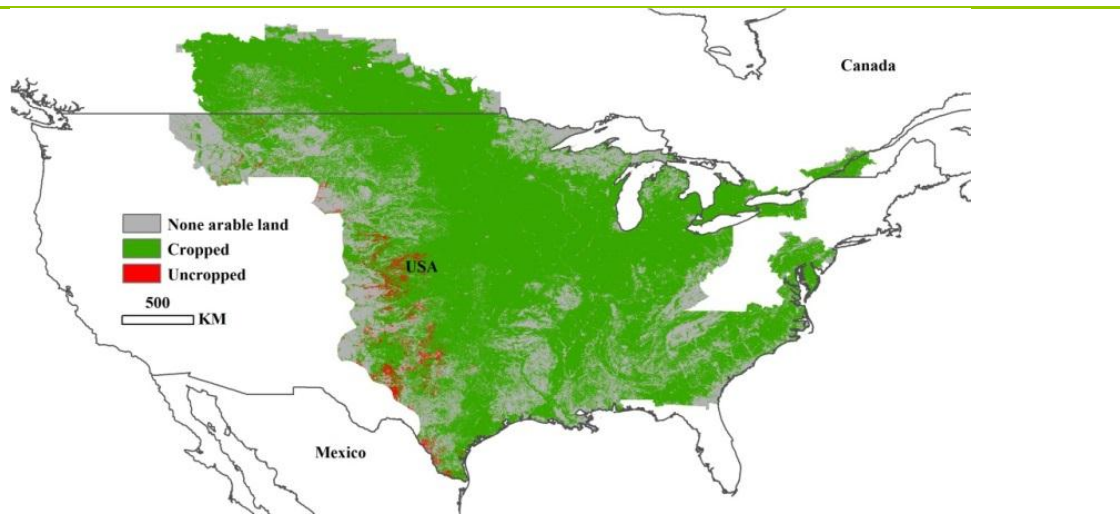
For the two recent seasons (winter and summer crops) the most notable features for this MPZ include a wet early winter (November 2012) in the south-west of the zone (Louisiana and Texas) followed by very variable rainfall in Louisiana. Temperature was significantly below average in (i) parts of the mid-west wheat growing areas (Colorado) during much of the winter wheat season up to April, as well as in (ii) North and South Dakota and southern Saskatchewan during March and April. The first area is also where uncropped arable land patches are concentrated. The area from Wyoming to South Alberta was also affected by the cold spell, though less markedly; the area experienced warmer than average temperatures in January and February.

Long-term biomass trends for this MPZ indicate a decrease in biomass for an area from the southern Great Lakes area (Indiana and Ohio) along a south-west oriented line into the cotton belt (Louisiana and Arkansas), then along the coast in Texas as far as the Mexican border. Compared with the last five years, the biomass index is generally favorable in the south (except along the eastern coast) and unfavorable in two areas: (i) in an area centered on Iowa, Illinois and Missouri, and (ii) in the northeastern part of the MPZ.

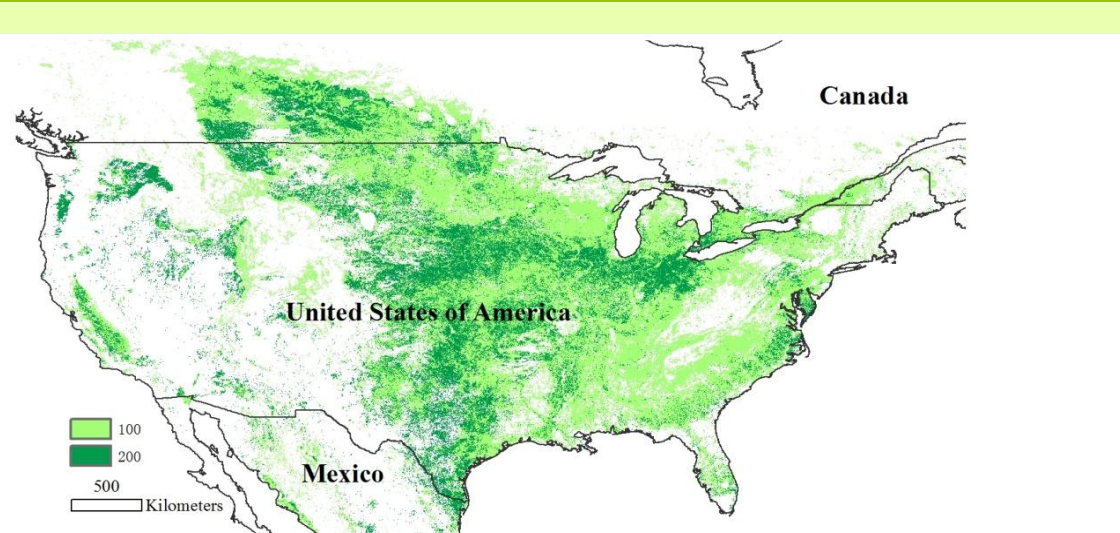
VHI-based drought profiles show average to better than average conditions over most of the MPZ from October 2012 to September 2013, with the exception of drought conditions from February to June in part of the western MPZ, covering about 20 percent of its area. Favorable conditions were recorded in most of the southeast from March.

Overall, winter wheat temperature and rainfall planting conditions appear to be favorable. Planting was now completed and the crop is at early stages.

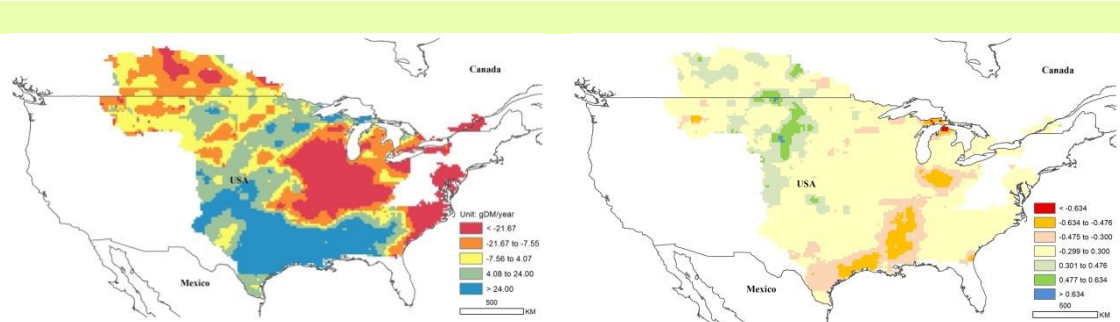
Figure 2.2 Environmental and crop production indices for the North America MPZ



a. Cropped and uncropped arable land

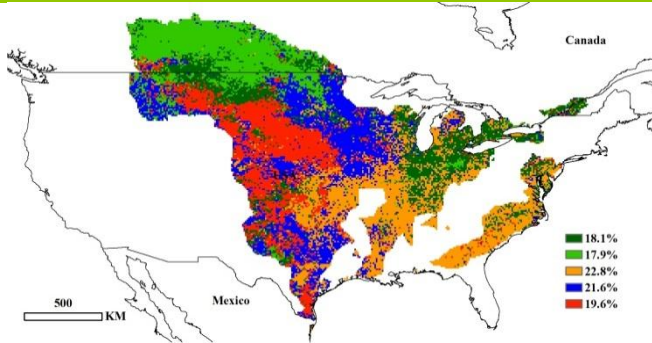


b. Cropping index

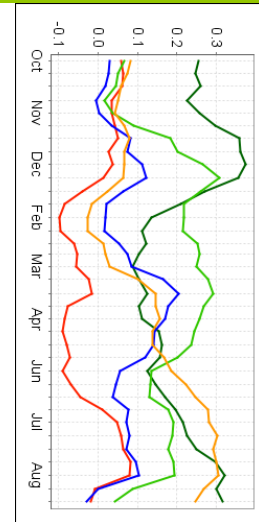


c. Biomass 2013 departure from five-year average

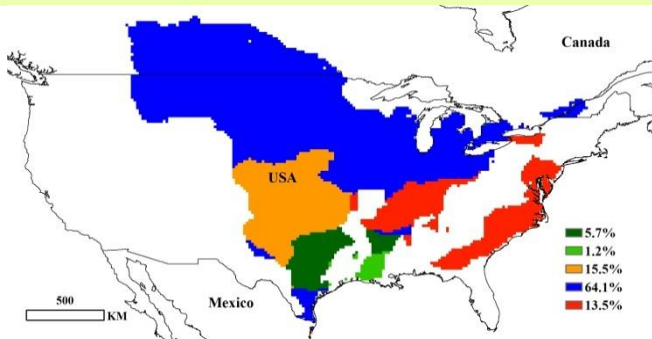
d. Biomass trend



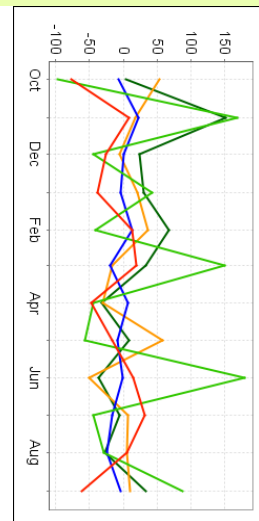
e. VHI departure from the previous five years for period indicated in f.



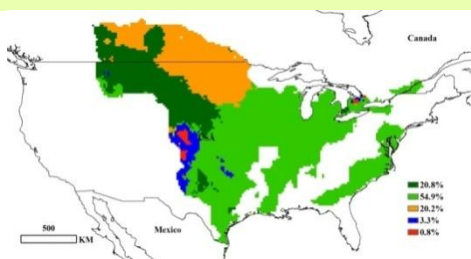
f. VHI profile



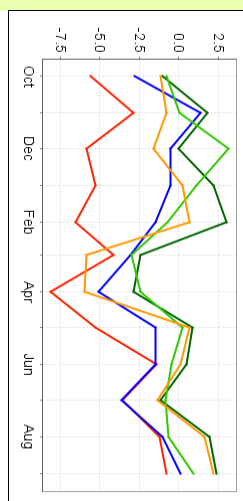
g. Rainfall departure from the previous five years for period indicated in h.



h. Rainfall profile



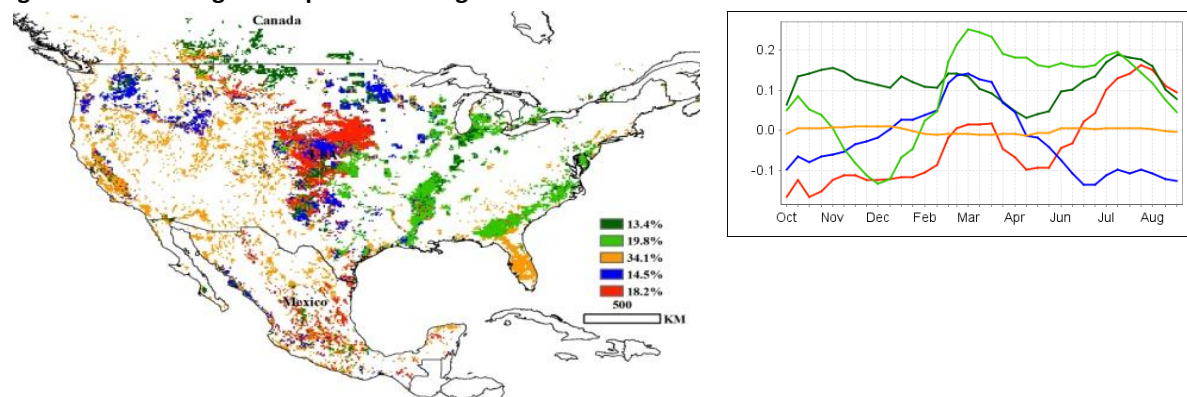
i. Temperature departure from the previous five years for period indicated in j.



j. Temperature profile

Figure 2.3 shows that irrigation is actually very widespread in the MPZ, even if it may be of very marginal importance locally. Poor crop condition (marked in red) coincides with the April cold spell. Rice growing areas in the Mississippi valley appear to have enjoyed rather good conditions from March to September.

Figure 2.3 Clustering of VHI profiles of irrigated areas in North America since October 2012



Note: Included areas are those where at least one percent of the arable land is irrigated, according to FAO information on irrigation areas (5).

Finally, about 34 percent of the irrigated areas exhibit a “flat” profile at the value of 0, indicating conditions coinciding almost exactly with the average of the last five years. The areas where this behavior is observed include Florida and a number of micro-areas scattered over the western United States and Canada and northern Mexico.

2.3 South America

Uncultivated arable land was very low this season, further decreasing over the already very low values of the recent past. This is in contrast to the potential biomass ratio which decreased as well, indicating a somewhat reduced efficiency of farming systems in the MPZ. Altogether, however, trends are positive, as illustrated by the significantly increasing trend of cropping intensity, up 8.3 percent over the recent medium term, most of the increase being achieved over the last five years.

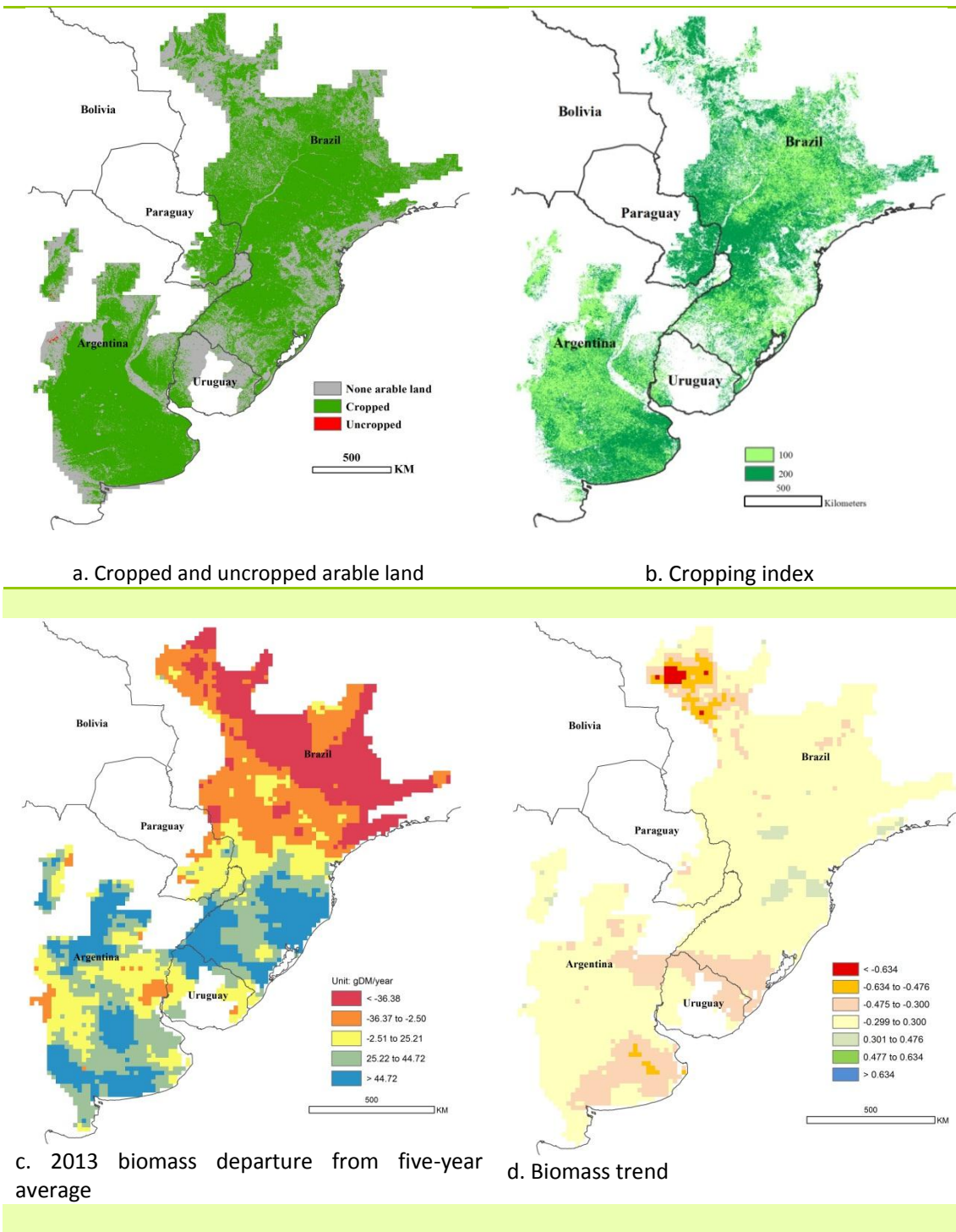
Table 2.3 South America MPZ: Cropping intensity, uncultivated arable land, and potential biomass ratio

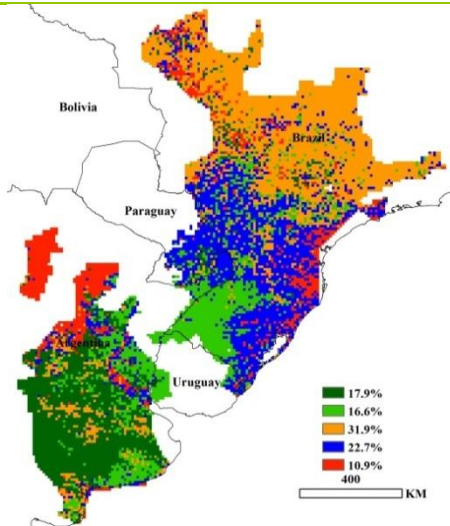
	2013 value	11-year average (2002-12)	5-year average (2008-12)	2002-13 normalized trend	Coefficient of correlation	Significance level of trend	Difference between 2013 and 11-year average	Difference between 2013 and 5-year average
Cropping intensity (%)	144	136	137	6.10	0.583	*	8.3	6.9
Uncultivated arable land (%)	0.14	0.17	0.25	6.49	0.182		-0.02	-0.11
Potential biomass ratio	0.865	0.880	0.885	0.000	0.135		-0.016	-0.021

Note: The normalized trend is the 2002-2013 trend normalized by dividing it by the eleven-year average. Significance level of the trend is * for $p < 0.05$ and ** for $p < 0.01$.

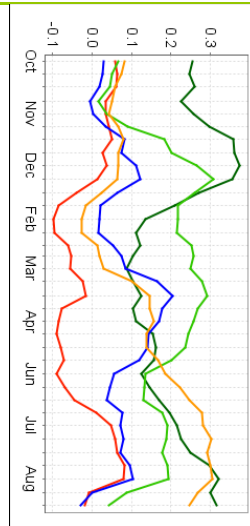
Few significant long-term environmental trends affect the region, with the exception of PAR trends which parallel those in the northern part of the continent: PAR increased significantly, by about 5 percent since 2001. Other variations worth mentioning include temperature and rainfall, which both increased over last year.

Figure 2.4 Environmental and crop production indices for the South America MPZ

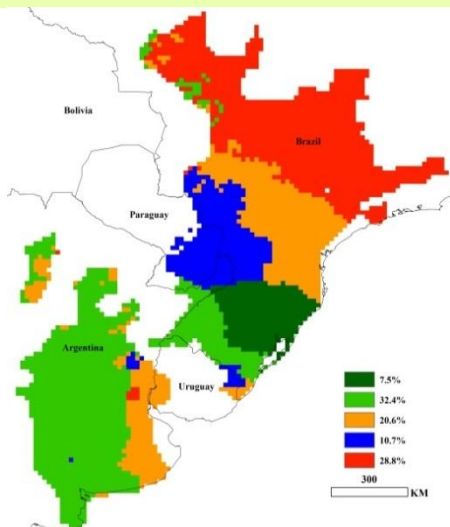




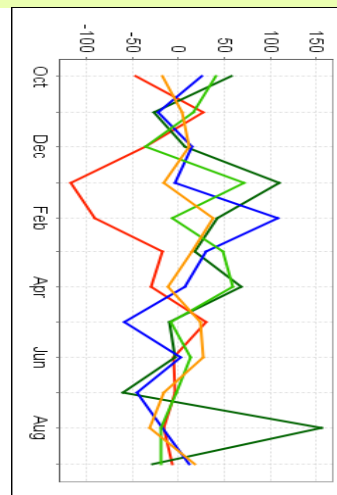
e. VHI departure from the previous five years for period indicated in f.



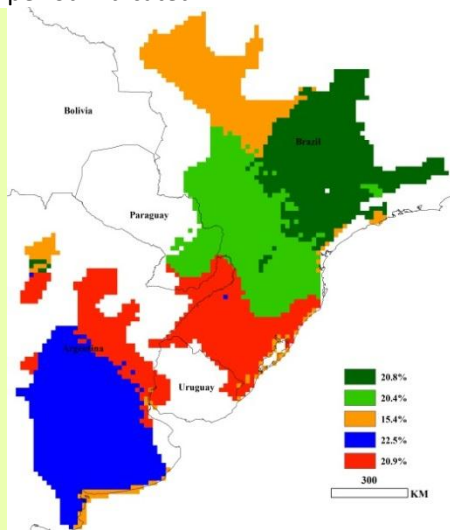
f. VHI profile



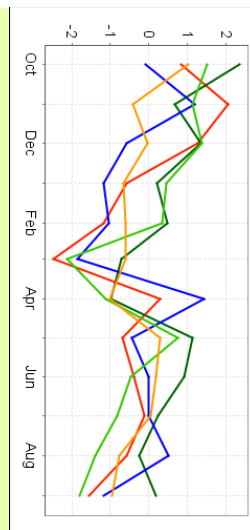
g. Rainfall departure from the previous five years for period indicated in h.



h. Rainfall profile



i. Temperature departure from the previous five years for period indicated in j.



j. Temperature profile

Regarding recent growing conditions in the South America MPZ, rainfall was generally satisfactory for the two last summer and winter seasons, except for below average rainfall during most of the season in the northern MPZ in Brazil (north of and including São Paulo state and northern Mato Grosso do Sul), affecting the soybean crop, and above average rainfall in August in Rio Grande do Sul and Santa Catarina States, creating unfavorable conditions for wheat. South of the same area, the whole region (which represents about 60 percent of the MPZ) suffered from low temperatures in March. In particular Uruguay and the adjacent Brazilian states and Argentinean provinces were affected. Another cold spell set in recently, starting in June and persisting into September, affecting most seriously southern Brazil and southeast Paraguay.

As far as water availability is concerned, VHI profiles indicate mostly favorable conditions, except during February to June in north Santiago del Estero, southwest Chaco, and parts of Salta provinces.

Although biomass production shows some interesting regional patterns—decreasing in southern Rio Grande do Sul, northern Uruguay, Entre Rios, and south Buenos Aires—marked and significant decreases are observed only in southwest Mato Grosso.

Rather consistently with the above observations, compared with the average of the recent years, biomass estimates are very low in the northern third of the MPZ and mostly average or favorable in remaining areas, except for central Entre Rios and west Cordoba provinces.

Altogether, prospects for the current wheat crops are favorable, significantly more so than for the previous summer crop season, especially the Brazilian harvest.

2.4 Central Europe-West Russia

Two statistically significant long-term trends are affecting the Europe-West Russia MPZ: uncultivated arable land (UAL) and the potential biomass ratio (PBR). UAL underwent an increase over the last twelve years; the current absolute value is low (under 1 percent) and decreased compared with the average of the last five years. According to figure 2.5a, the areas where most uncultivated arable land occurs are situated in a crescent-shaped area in the southeast of the MPZ, including the areas of Orenburg, Saratov, west Volgograd, and west Rostov. The two last oblasts belong to the area of the highest cropping intensities in the MPZ.

Table 2.4 Europe-W. Russia MPZ: Cropping intensity, uncultivated arable land, and potential biomass ratio

	2013 value	11-year average (2002-12)	5-year average (2008-12)	2002-13 normalized trend	Coefficient of correlation	Significance level of trend	Difference between 2013 and 11-year average	Difference between 2013 and 5-year average
Cropping intensity (%)	104	106	107	1.63	0.255	-	-1.7	-2.8
Uncultivated arable land (%)	0.59	0.58	0.86	11.60	0.606	*	0.01%	-0.27
Potential biomass ratio	0.888	0.900	0.890	0.000	-0.542	*	-0.012	-0.002

Note: The normalized trend is the 2002-2013 trend normalized by dividing it by the eleven-year average. Significance level of the trend is * for $p < 0.05$ and ** for $p < 0.01$.

The potential biomass ratio for this MPZ has been decreasing systematically over the last 12 years. The current season is no exception to this, even if the drop is minimal compared with the average of the last five seasons. Cropping intensity, on the other hand, remained rather stable over the last 12 years, increasing from 104 to 107 percent only. More recently, the indicator started decreasing, with almost 3 percentage points lost this year compared with the recent past.

No noteworthy or significant trends in environmental weather indices (rainfall, temperature and PAR) could be observed for this MPZ. However, compared with both five-year and twelve-year averages, 2013 experienced an increase in rainfall and a decrease in both temperature accumulation and PAR.

In 2013, temperature profiles underwent two marked drops compared with average conditions, with a first drop in December and a second one in March. Both affected the recent 2012-13 winter wheat crop, especially in the central and eastern northern MPZ (a drop of -5°C). Though less severely (-2.5°C), the cold period also affected the south of the region, from eastern Romania and most of Ukraine, the Kursk oblast, and through the Mordovyan Republic up to the Chelyabinsk oblast, including as well most of the Russian "southern triangle" up to the border of Azerbaijan. The second cold peak affected the same areas, but was more severe than the first in western Romania, western Ukraine, and Poland.

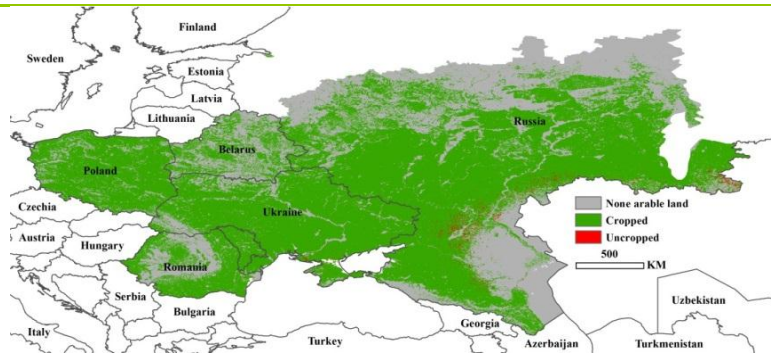
Slightly above average temperatures were recorded during early summer, which according to the VHI index can be associated with drought conditions in the northeastern Black Sea area, an area covering about one fifth of the MPZ and including an area delimited by Kherson (Ukraine) to the Volgograd oblast, Dagestan and back to Krasnodar (Russia). Rainfall conditions turned normal in August and slightly below expected seasonal values again in September, which coincided with above average rainfall and much wetter conditions than normal only in the northeastern Black Sea areas (Krasnoyarsk and adjacent areas to the east).

The potential biomass ratio (now at 0.888) is decreasing as well (and significantly so) at the long-term scale, but it remained basically unchanged compared with the average of the last five years. A positive and significant biomass production trend is observed in eastern Belarus and adjacent areas in Russia.

Biomass production for 2013 compared with the recent past shows two contrasting zones, one zone covering the "peripheral" areas, and one covering the eastern-central MPZ, centered around the Ryazan oblast (41N, 54E) and including the area from Poland, southeast Belarus to Yaroslavl in the north and Bashkortostan in the east, Volgograd in the south and from there across northern Ukraine to southeast Belarus (figure 2.5c). The peripheral areas with poor biomass production potential include western Poland, most of Belarus, northeast Russia, the northwest, the Russian "southern triangle" with Stavropol and the Kalmyk Republic and from there, along the black sea to Romania. Not surprisingly, the southeastern crescent of the MPZ also includes the areas of the MPZ where uncropped arable land is located.

There is little doubt that low values in the north are associated with winter wheat, while low values in the southeast (Black Sea area) are linked with summer drought and affect most summer crops, especially maize.

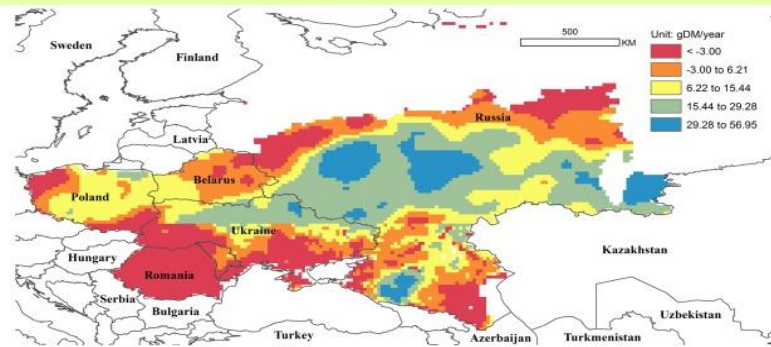
Figure 2.5 Environmental and crop production related indices for the Europe-W. Russia MPZ



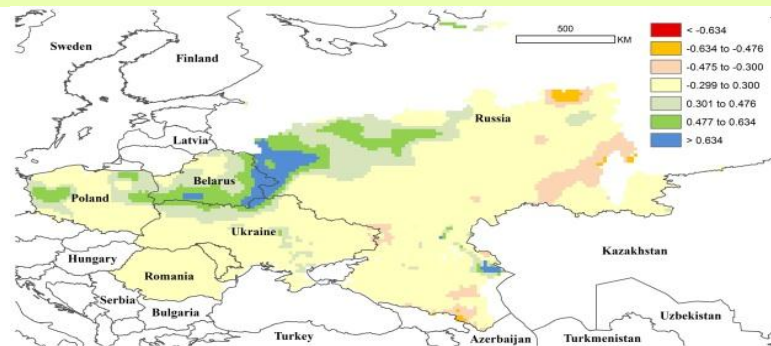
a. Cropped and uncropped arable land



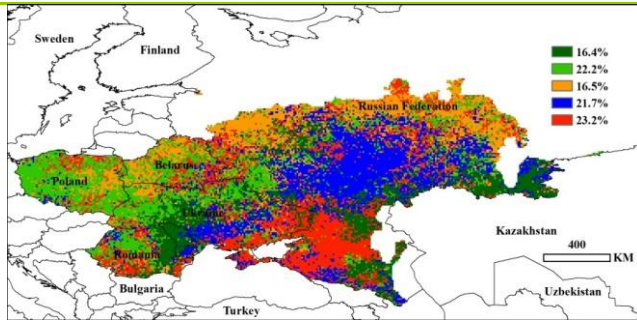
b. Cropping index



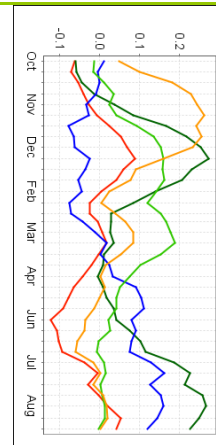
c. 2013 biomass departure from five-year average



d. Biomass trend



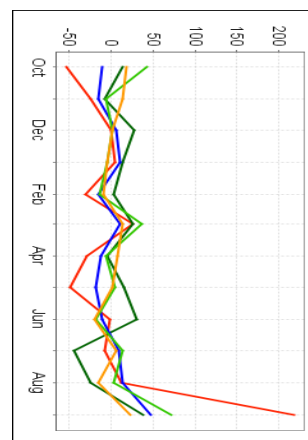
e. VHI departure from the previous five years for period indicated in f.



f. VHI profile



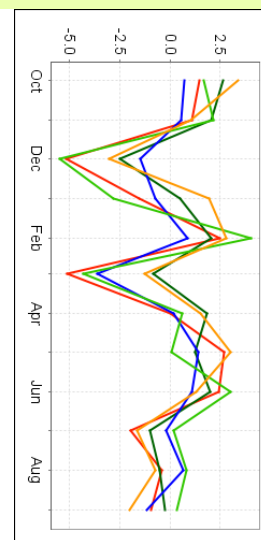
g. Rainfall departure from the previous five years for period indicated in h.



h. Rainfall profile



i. Temperature departure from the previous five years for period indicated in j.



j. Temperature profile

Chapter 3 Key Countries: Production and Crop Conditions

3.1 Summary of production estimates by country

The CropWatch estimate for the 2013 production of main crops is as follows: wheat, 705 million tons, up 4.1 percent over preliminary 2012 FAOSTAT estimates; rice as paddy, 739 million tons, up 1.6 percent; maize, 944 million tons, up 0.3 percent; and soybean, 282 million tons, an increase of 1.2 percent compared with 2012 (table 3.1). For the thirty one major producers and exporting countries, increases are more modest for wheat (+2.3 percent) and for rice (+0.8 percent), while they exceed the rest of the world for maize (+1.7 percent) and for soybean (+1.6 percent). The “rest of the world,” usually regarded as of little relevance, has achieved spectacular trend-based increases (+13.4 percent for wheat, +8.4 percent for rice) and decreases (-6.1 for maize). Soybean stagnates at about -0.8 percent, resulting from the behavior of the many countries that attempt to join the very small group of soybean exporting countries, but usually give up after some years of experimenting with the crop.

Major exporters

Considering only the nine countries (from the United States to Argentina) that normally contribute 80 percent of world wheat exports, the variation over 2012 is +3.8 percent. However, Russia, which normally ranks 5th, thanks to a spectacular +24.5 percent increase in production rises to the second position this year as the first four exporters (United States, France, Canada, and Australia) all suffered decreases, sometimes significant ones (-5.9 percent, -2.8 percent, -3.2 percent and -4.2 percent, respectively).

Although their accumulated rice production remained virtually unchanged over last year (252 million tons), the five major rice exporters show a situation that is not unlike the one described for wheat, as the first four exporters all underwent a production decrease (Thailand: -4.3 percent; Vietnam: -1.5 percent; Pakistan: -1.1 percent and the United States: -3.6 percent). The production increase in India (+ 1.74 percent) is relatively modest and represents about 2.6 million tons of paddy (about 1.8 million tons of milled rice equivalent), which is of the same order of magnitude as the population-based increase in demand. Considering that wheat production decreased by about 4 million, the increased domestic demand for rice may lead to a reduction in Indian rice exports.

Considering maize, the four major exporters (United States, Argentina, Brazil, and France) jointly increased their production by 3 percent, with an increase in the United States (+7.3 percent) compensating decreases in Argentina (-3.7 percent) and especially Brazil (-11.0 percent). For soybean, the United States, Brazil and Argentina increased their joint output by 2.2 percent, again with one country (Brazil, +6.9 percent) making up for the reduction in another (Argentina, -2.5 percent).

Other notable changes

For wheat, the decrease in U.S. production is this year’s most negative change compared with 2012, as estimated by CropWatch. It is followed by India (-4.2 percent) and by Australia (-4.2 percent). On the American continent, Mexico performed significantly better than last year (+30.3 percent) followed by both Brazil and Argentina at about +14 percent. In Eurasia, four neighbors hold the records with +17.3 percent in Romania, +20.8 percent in the Ukraine, +25.0 percent in Russia, and as much as +35 percent in Kazakhstan.

Table 3.1 2013 production (maize, rice, soybean, wheat), by country (thousand tons)

	Maize		Rice (paddy)		Soybean		Wheat	
	2013	Δ%	2013	Δ%	2013	Δ%	2013	Δ%
AFRICA								
Egypt	6938	-0.9	6088	-6.3	31	-3.5	8602	-2.2
Ethiopia	5528	-9.0	90	1.0	26	-28.0	2886	-1.0
Nigeria	9295	-1.2	4700	-2.7	507	12.7	133	32.5
S-Africa	11430	-8.6			780	-8.2	1899	5.9
WEST ASIA								
Iran	1259	2.9	2350	-2.1	185	-7.5	13650	-1.1
Turkey	4400	-4.3	890	1.1	109	-5.5	20950	4.2
Central Asia								
Kazakhstan	295	175.1	284	28.0	152	-10.9	18019	35.4
Uzbekistan	232	11.6	120	0.1				
EAST ASIA								
China	194178	3.1	200145	0.6	13245	-6.8	118178	-1.3
SOUTH ASIA								
Bangladesh	1529	-25.0	42414	24.0	64	3.1	1001	-2.8
India	21410	1.7	155250	1.7	11857	3.1	90877	-4.2
Pakistan	3903	10.4	9297	-1.1			24365	3.6
SE ASIA								
Cambodia	754	-4.6	9040	-2.8	117	-2.3		
Indonesia	18503	-4.5	67393	-2.4	848	-0.5		
Myanmar	1492	-0.5	31005	-6.1	221	7.8	179	-3.6
Philippines	7189	-2.9	17358	-3.7				
Thailand	4815	0.04	36194	-4.3	178	-1.1		
Vietnam	4819	0.3	43030	-1.5	221	26.0		
EUROPE-RUSSIA								
France	15764	1.0	126	2.1	113	8.7	39161	-2.8
Germany	5088	1.9			2	0.0	22616	0.8
Poland	2731	-19.8					8975	4.3
Romania	8835	48.4	58	14.1	123	18.4	6215	17.3
United Kingdom							14259	7.5
Ukraine	21900	4.5	165	3.2	2337	-3.0	19043	20.8
Russia	7588	-7.6	1054	0.2	1781	-1.4	46980	24.5
N. AMERICA								
Canada	11196	-4.3			4558	-6.4	26137	-3.2
Mexico	19852	-10.1	176	-1.2	226	-8.5	2943	30.3
United States	293890	7.3	8719	-3.6	83123	1.3	58084	-5.9
S. AMERICA								
Argentina	24750	-3.7			50189	-2.5	12547	14.1
Brazil	63478	-11.0	12434	9.1	70258	6.9	5035	14.9
OCEANIA								
Australia	403	-10.4	821	-10.6	57	-32.7	28957	-4.2
Sub-total	773444	1.7	649201	0.8	241308	1.6	591691	2.3
Other countries	171021	-6.1	89831	8.4	40772	-0.8	113777	13.4
Overall total	944465	0.3	739032	1.6	282080	1.2	705468	4.1

Note: Δ% indicates difference with 2012 FAO estimates. For some of the major producers sub-national data are provided in section 3.3. The production for "other countries" is extrapolated from FAOSTAT data using a regression technique based on the two previous years (2010 and 2011) but calibrated against the latest twelve years. Empty cells indicate "no or insignificant production," basically below 1000 tons.

Two significant rice producers, Egypt (-6.3 percent) and Myanmar (-6.1 percent) decreased their productions compared with last year, albeit for different reasons; Thailand suffered a 4.3 percent reduction, while Argentina and Brazil saw increased outputs (5.7 percent and 9.1 percent, respectively).

Among the countries that normally produce more than 1 million tons of maize, significant decreases are computed by CropWatch in Bangladesh (-25.0 percent), Poland (-19.8 percent), Brazil, and Mexico (both countries close to -10 percent) and South Africa, a major producer in the African region (-8.6 percent). Pakistan (+10 percent) and Romania (+48 percent) are the best performers this season.

China and Argentina, two of the major soybean producers, underwent a reduction in their output this year, amounting to -6.8 percent in the first and -2.5 percent in the second country. Improved soybean production was recorded in India (+3.1 percent) and particularly in Brazil (+6.9 percent).

3.2 Cropland use intensity

Table 3.2 lists several indicators for land use and land use intensity for the countries covered by CropWatch, including cropping intensity (number of crops), the area of uncropped arable land (percentage), and the potential biomass ratio (as a fraction of 0 to 1).

The highest values for cropping intensity are recorded in the mostly equatorial countries in Southeast Asia. They are followed by African countries and countries in Central Asia, North and South America, and Australia, which have intensities around 150 percent. European countries are generally characterized by low cropping intensities of close to 100 percent, as they usually practice one winter crop, a rainfed spring crop, and sometimes a summer crop (maize), which is sprinkler or gravity irrigated (mostly rice in Italy, France and Spain).

Compared with the average of the previous five years, changes in cropping intensities are usually in the range of -5 percent to +5 percent, with most of the changes negative. The extreme values constitute marked changes when they occur at the national scale, and negative departures are in all likelihood associated with adverse crop and environmental conditions, such as in Ethiopia (-4.2 percent) with a poor belg season. Other changes seem to be associated with changes in agricultural policy. The largest variation is found in Uzbekistan (-10.2 percent). Significant positive long-term trends are observed in China, Nigeria, the Philippines, Vietnam, and Argentina. Long-term negative trends can be associated with shortages of resources (land, water, inputs) or environmental degradation. The only significant negative trends affecting cropping intensity are noted in Egypt and could be associated with government efforts to limit rice cultivation, to reduce Nile water consumption under international pressure of fellow Nile Basin countries. The long term trends in general all indicate that the countries are undergoing concerted efforts, or efforts by individual farmers, to keep pace with demand.

Similar to the situation of decreasing cropping intensities, increasing uncropped arable land can result from a variety of factors that can be assessed only based on detailed analysis of national data on policies and environment driven farm dynamics. When the variable itself (UAL) is low, changes are naturally of little interest and the risk of observational errors is high. Conjectural effects are clearly at work as well, when environmental stresses such as drought or frost artificially depress NDVI. The countries with the highest UAL values include Egypt, Iran, and Pakistan. In the two last countries, the UAL is associated with a large percent decrease. Significant long term trends affecting UAL are particularly interesting. Significant negative trends signal countries that make efforts to more efficiently use their land; this includes China, Bangladesh, Thailand, Vietnam and the Philippines (trend significant), as well as some

countries where the trend is very significant: Pakistan, India, Egypt, and Cambodia. Positive trends affect Brazil (*significant) and Russia (**very significant).

Table 3.2 Cropping intensity (number of crops), uncropped arable land (percentage), and potential biomass ratio (fraction), by country

	Cropping Intensity			Uncropped arable land			Potential biomass ratio		
	2013	Δ%	Trend	2013(%)	Δ%	Trend	2013	Δ%	Trend
AFRICA									
Egypt	134	-2.5	-0.560*	21.37	-3	-0.807**	0.872	1.889	0.643**
Ethiopia	140	-4.2	-0.226	0.42	-65	0.036	0.881	0.138	-0.761**
Nigeria	133	4.5	0.758**	1.61	-45	0.067	0.867	-0.159	-0.586 *
S-Africa	123	2.3	-0.156	6.18	+359	-0.290	0.812	-7.393	0.377
WEST ASIA									
Iran	140	-3.6	-0.195	16.44	-46	0.090	0.738	7.266	-0.014
Turkey	159	5.3	-0.425	0.85	-89	-0.332	0.881	7.116	0.664**
Central Asia									
Kazakhstan	100	-3.4	0.253	3.01	-78	0.470	0.834	13.825	-0.527*
Uzbekistan	111	-10.2	-0.291	3.16	-80	0.300	0.804	0.742	-0.341
EAST ASIA									
China	169	-3.0	0.773**	1.07	-29	-0.593*	0.902	0.117	0.796 **
S. Asia									
Bangladesh	180	0.8	0.250	1.27	+16	0.542*	0.858	-3.407	0.116
India	165	1.9	-0.011	0.74	-48	-0.712**	0.854	-0.893	0.771**
Pakistan	153	0.9	0.072	12.45	-23	-0.786**	0.798	4.476	0.688**
SOUTHEAST ASIA									
Cambodia	256	-3.3	-0.007	0.17	-46	-0.657**	0.805	-6.929	-0.042
Indonesia	296	0.9	0.219	0.08	+30	0.320	0.918	-0.858	0.026
Myanmar	204	-4.2	-0.010	0.98	+47	0.258	0.848	-5.450	-0.410
Philippines	293	0.1	0.531*	0.04	+40	-0.633*	0.910	-1.518	0.398
Thailand	260	-0.7	0.066	0.03	-41	-0.602*	0.862	-3.662	0.308
Vietnam	230	-4.8	0.442*	0.29	-16	-0.488*	0.891	-2.421	0.324
EUROPE-RUSSIA									
France	101	-2.1	0.090	0.12	-55	0.244	0.905	-0.646	-0.149
Germany	101	-4.4	0.284	0.03	+15	-0.204	0.916	0.100	-0.209
Poland	100	-4.8	0.260	0.01	0	-0.092	0.926	1.053	0.045
Romania	100	-1.7	0.084	0.04	-37	-0.205	0.899	0.067	-0.066
United Kingdom	100	-3.3	0.016	0.03	+31	0.257	0.882	-4.195	-0.206
Ukraine	101	-2.5	0.438	0.20	-23	0.332	0.885	-0.538	-0.084
Russia	106	-0.7	0.161	0.69	-44	0.649**	0.884	1.088	-0.677 **
NORTH AMERICA									
Canada	127	-0.9	-0.366	0.18	-76	-0.426	0.942	3.979	0.629 *
Mexico	130	-1.2	-0.388	3.49	-2	0.225	0.849	-1.485	-0.282
United States	135	-1.4	-0.011	3.54	-1	0.117	0.889	-0.023	-0.250
SOUTH AMERICA									
Argentina	153	2.4	0.600*	0.51	-18	0.278	0.802	-7.481	-0.367
Brazil	135	4.0	0.043	0.62	+388	0.491*	0.892	-1.121	0.266
Oceania									
Australia	141	-6.2	0.324	2.17	-52	-0.443	0.854	8.116	0.298

Note: For each variable, Δ% indicates the difference between the current year and the average of the last five years (2008-2012). The trend is the 2001-2013 trend, expressed by the coefficient of correlation accompanied by the level of significance (if significant: * for $p < 0.05$ and ** for $p < 0.01$).

Finally, the lowest potential biomass ratios (PBR) are observed in Iran, Pakistan and Argentina, while values are particularly high in Poland, Indonesia and Canada, thereby describing extreme situations of realization of the local potential yield during 2013. In Argentina, the mentioned low PBR results from a recent drop compared with the last five years, but in Cambodia and South Africa the low values seem to

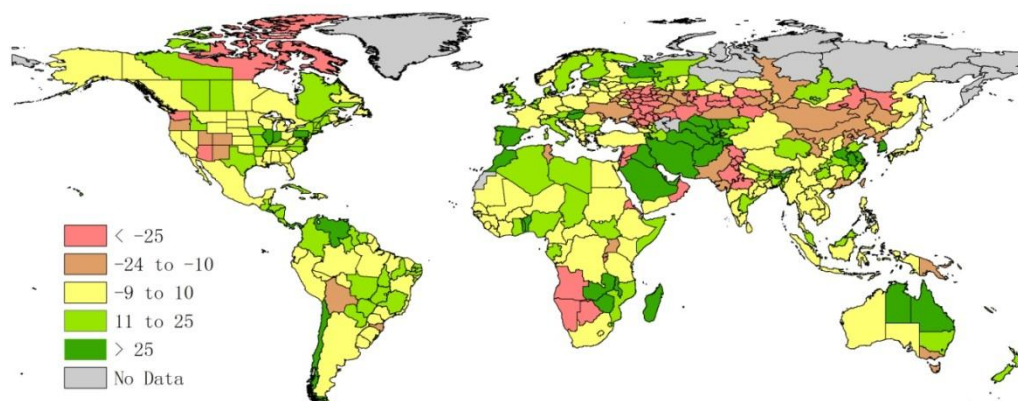
be more structural. Together with Myanmar, Argentina is one of several countries with long-term drops in PBR. Among the countries with positive PBR trends, the following deserve mentioning: Canada (*), China (**), Egypt (**), Ethiopia (**), India (**), Kazakhstan (*), Nigeria (*), Pakistan (**), Philippines (*), S-Africa (*), Turkey (**) and Russia (*), describing the efforts undertaken by the respective countries to improve their farming efficiency.

Finally, it is stressed that the above indicators are not mutually independent: both the intensity (2013 value) and the direction of the trends associated with PBR and UAL tend to vary in a coherent way as efficiency gains are associated with decreases in unproductive land. Cropping intensity, on the other hand, is only loosely correlated with UAL and PBR; only a weak association exists between the cropping intensity value and the PBR trend.

3.3 Country narratives and figures

For each of the thirty countries covered, CropWatch analyses include a comprehensive array of variables and indicators. The environmental indices—rainfall, temperature, and PAR—are presented in annex D, covering October 2012 to September 2013 or, as shown in figure 3.1, for selected months that are more relevant to the recent and ongoing cropping seasons.

Figure 3.1 Accumulated rainfall index anomaly, April to September 2013 (percent)

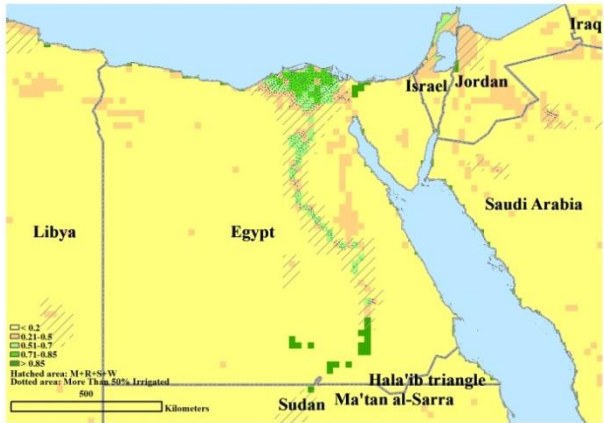


On the subsequent pages, results are presented for each of the thirty key countries. For each, a short narrative is provided, along with maps and graphs showing (a) General setting, provided by a NDVI background showing combined maize, rice, soybean, and wheat cultivation area, and areas where more than 50 percent of the land is irrigated; (b) Crop condition map compared with the average of the previous five years; (c) Crop condition development graph: a comparison of NDVI of the current year with the previous year and the average of the previous five years; (d) Spatial NDVI patterns of the latest or ongoing season; and (e) NDVI profiles associated with the spatial patterns. In addition, production tables are provided for some of the major countries.

Additional information for all countries is provided in annex D, including CropWatch estimates of 2013 yield and the area cultivated by crop. Annex F provides additional background information for the countries covered, while annex G presents basic agricultural statistics and an overview of longer term trends derived from international data.

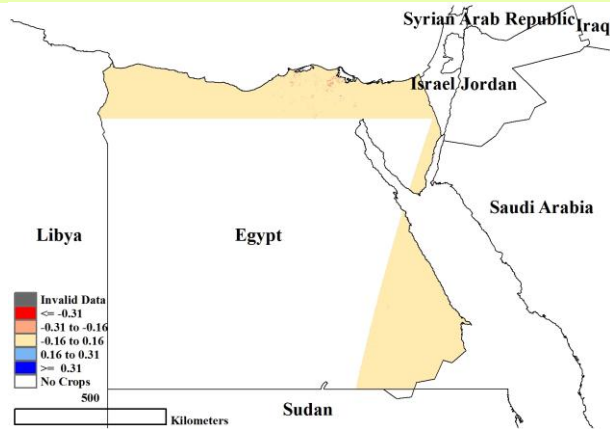
Africa

Egypt

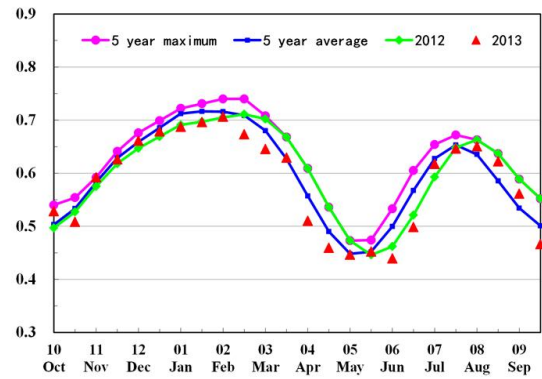


(a)

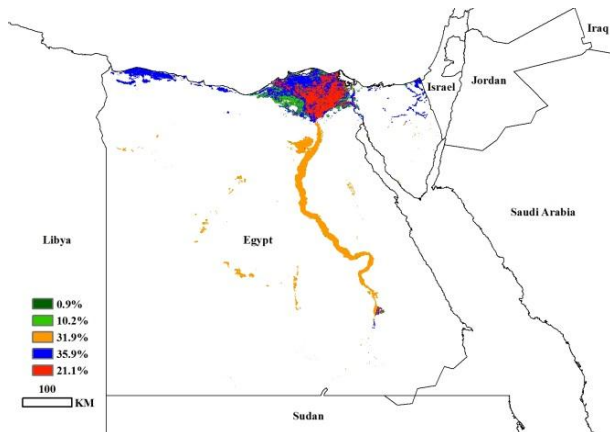
The NDVI profile of the recent summer crop in Egypt is comparable with the recent past (last five years) in about 80 percent of the country, in particular in the Nile Valley. Condition was below average in the south-eastern delta in July and particularly in August, but recovered in September. Altogether, the country enjoyed favorable crop conditions in contrast with declining production estimates.



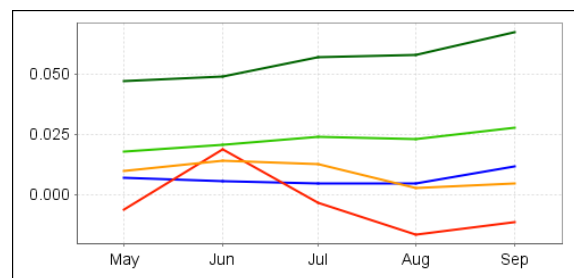
(b)



(c)



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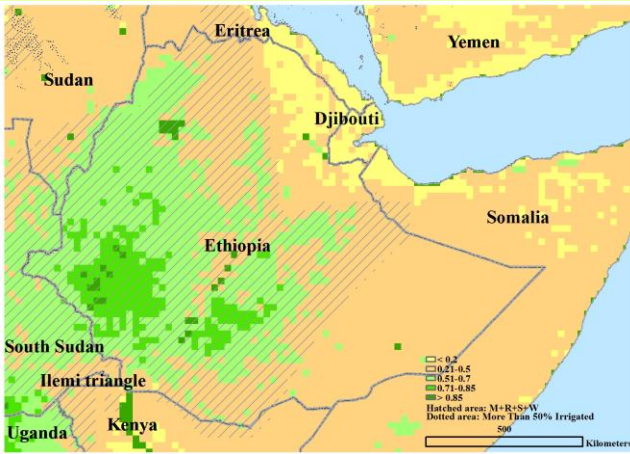
(e)

Figure 3.2 Crop condition Egypt

(a) General setting, provided by a NDVI background showing combined maize, rice, soybean, and wheat cultivation area, and areas where more than 50 percent of the land is irrigated; (b) Crop condition map compared with the average of the previous five years; (c) Crop condition development graph: a comparison of NDVI of the current year with the previous year and the average of the previous five years; (d) Spatial NDVI patterns of the latest or ongoing season; and (e) NDVI profiles associated with the spatial patterns.

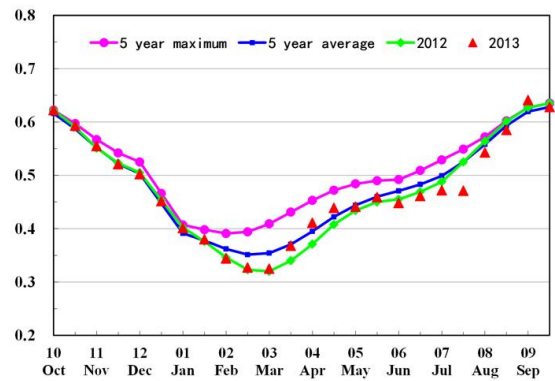
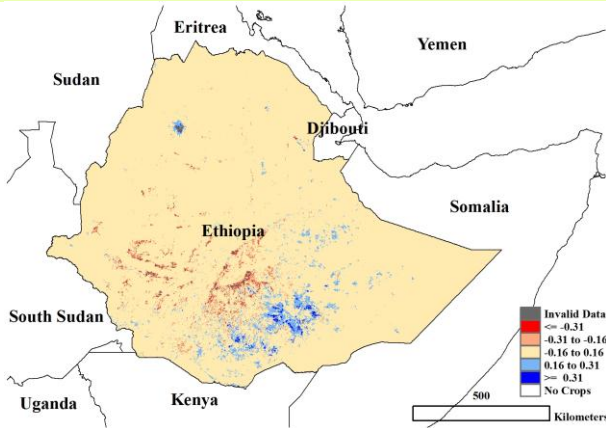
Africa

Ethiopia



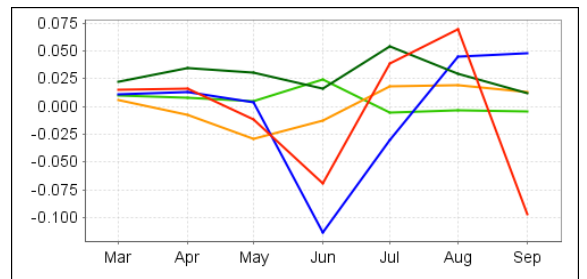
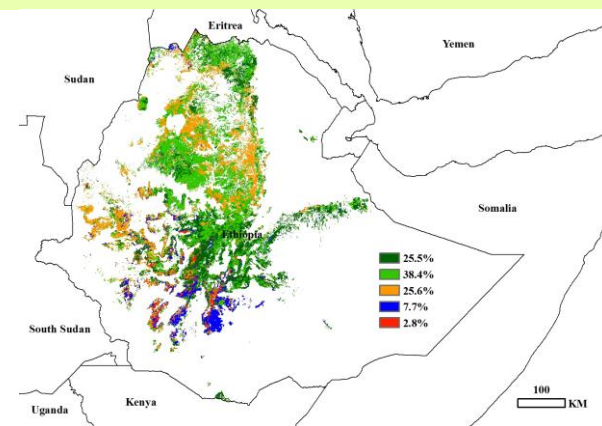
Crop condition was and is close to the average of the previous five years in most of the country, except in southern-central Oromyia, where unfavorable conditions were experienced in June, to recover thereafter. In June, July, and August, crop condition was below average in many parts of southern-central Ethiopia (3.3b).

(a)



(b)

(c)



(d)

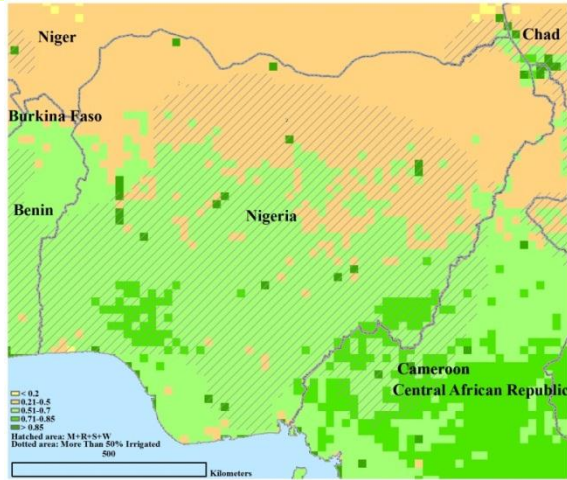
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Figure 3.3 Crop condition Ethiopia

For descriptions of figures a-e, see figure 3.2 for Egypt.

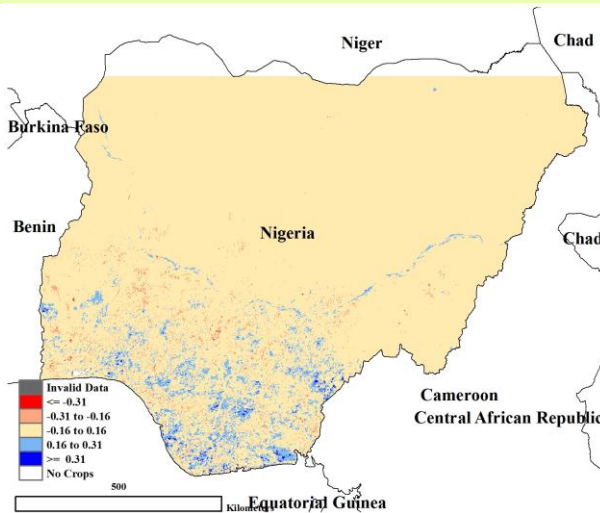
Africa

Nigeria

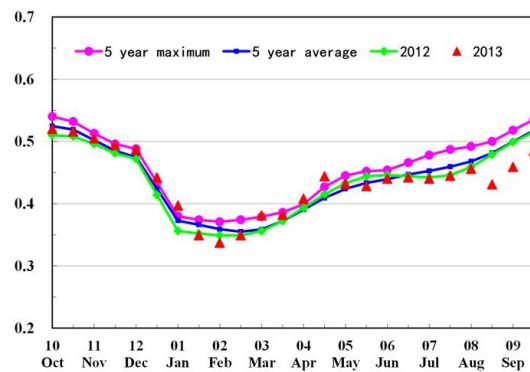


(a)

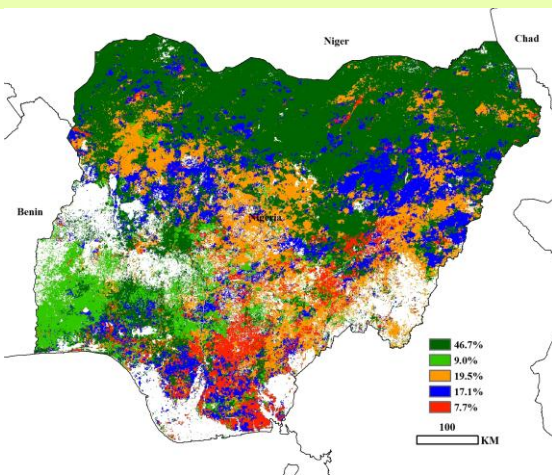
Nigeria has satisfactory crop condition on a level comparable with recent years in about 50 percent of the country, mostly in the northern Sahelian parts. Main maize producing areas in Plateau, Kaduna or Bauchi suffered poor condition particularly in August; this occurred somewhat earlier (July) in more southern areas. The situation improved but remained generally poor in September. Below average output is likely.



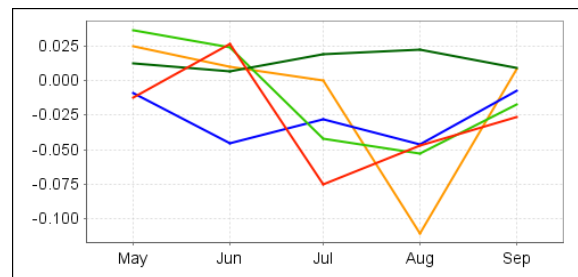
(b)



(c)



(d)



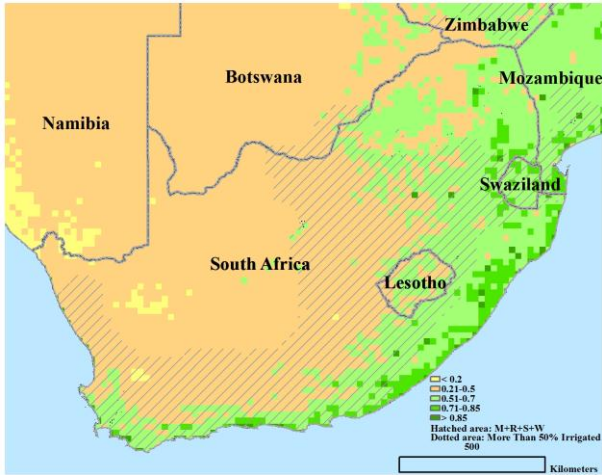
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Figure 3.4 Crop condition Nigeria

For descriptions of figures a-e, see figure 3.2 for Egypt.

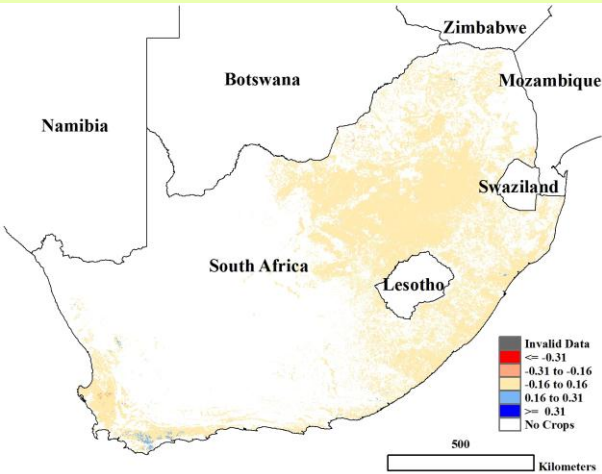
Africa

South Africa

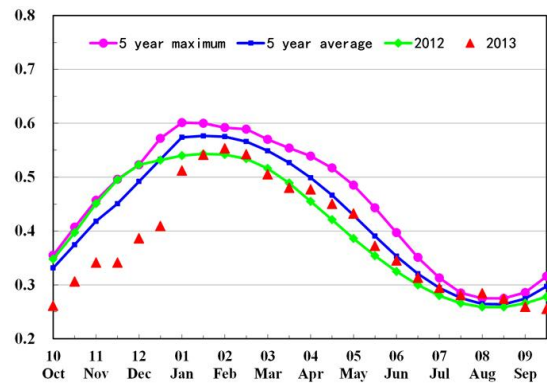


(a)

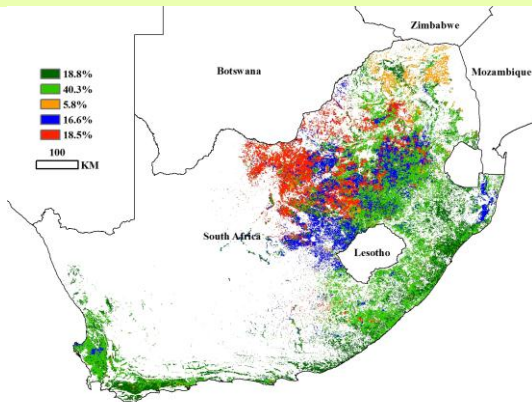
In South Africa, conditions in winter crop areas in Southern Cape province were mostly satisfactory up to June for wheat. The 2012-2013 harvest suffered poor conditions in maize areas, particularly during the early parts of the season in the North-West Province, while the east experienced average or above-average conditions.



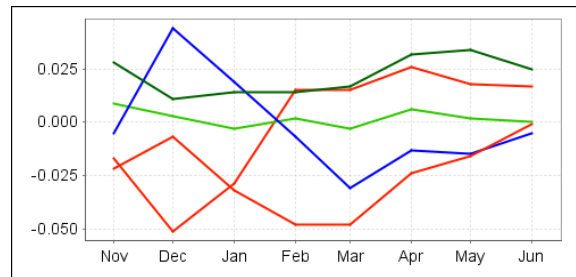
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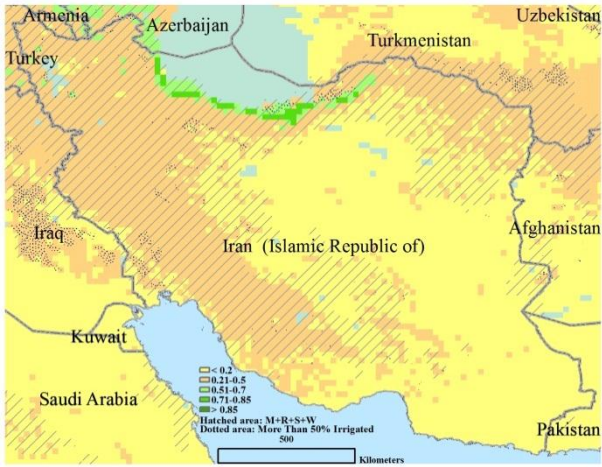
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Figure 3.5 Crop condition South Africa

For descriptions of figures a-e, see figure 3.2 for Egypt.

Asia - West and Central

Iran

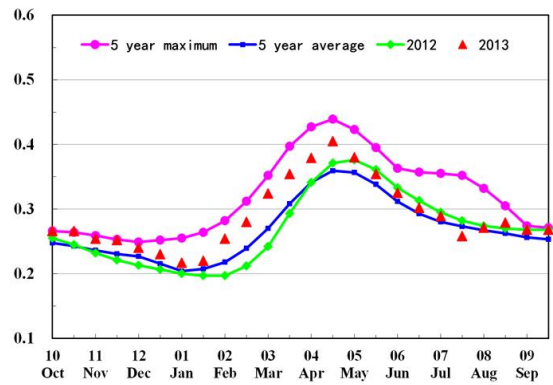


(a)

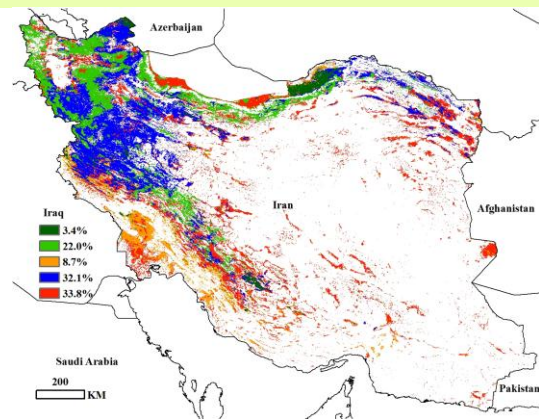
Conditions are above the five-year average in most of the country for the development of the recent 2012-13 wheat crop, in particular in the east and north of the country. Unfavorable conditions affected Golestan in June.



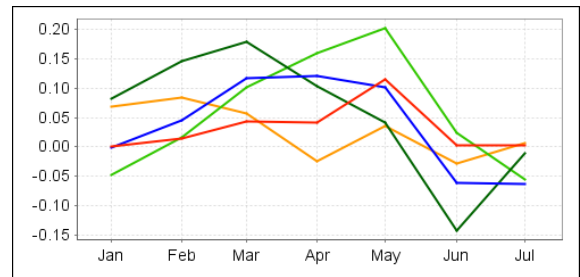
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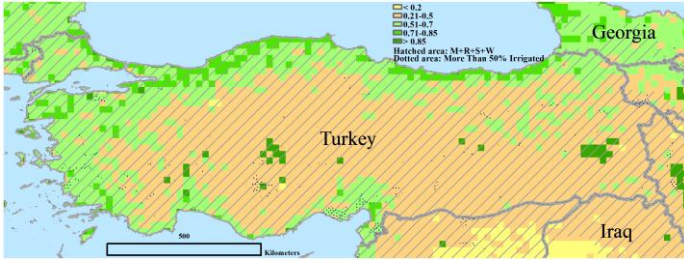
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Figure 3.6 Crop condition Iran

For descriptions of figures a-e, see figure 3.2 for Egypt.

Asia - West and Central

Turkey

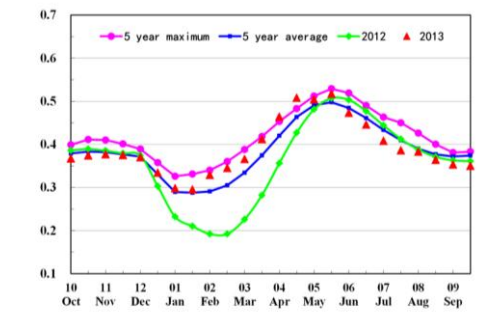


(a)

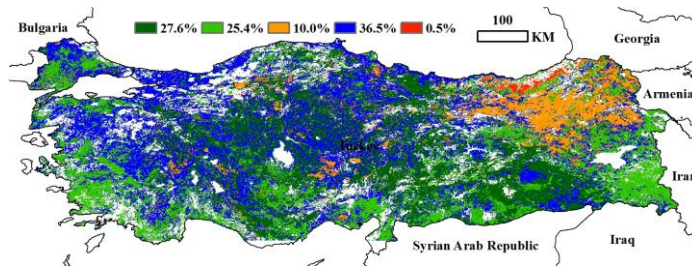
Turkey's latest 2012-13 winter crop generally underwent favorable conditions, particularly so in the south, in an area from Mugla to Van. The northeast also experienced close-to-average crop conditions, better than average in April and May, but slightly below average in July. The only areas where conditions were definitely below expectations are located in Rize and Trabzon near the Black Sea coast.



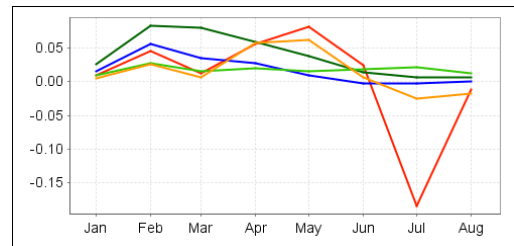
(b)



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(e)

Figure 3.7 Crop condition Turkey

For descriptions of figures a-e, see figure 3.2 for Egypt.

Asia - West and Central

Kazakhstan-Uzbekistan

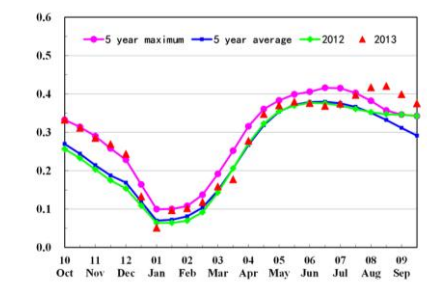


(a)

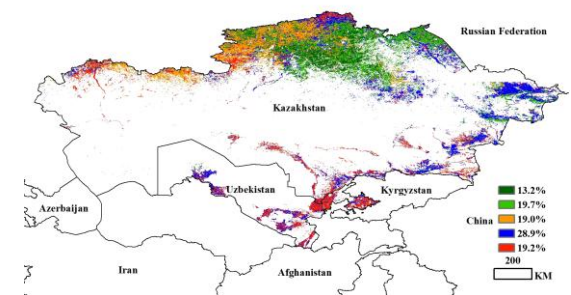
Kazakhstan and Uzbekistan experienced mostly close to average conditions at the end of the winter wheat cycle (March to June), which was followed by a marked improvement from July, affecting particularly the central northern areas of Kazakhstan: most of the provinces of Akmolinsk, north Kazkhstan (former Severo-Kazhstanskaja oblast), the northern part of Kostanay, and most of Pavlodar.



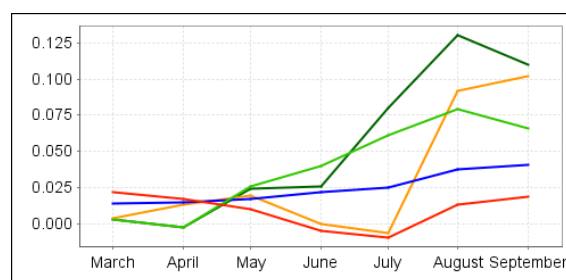
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(c)



(d)



(e)

Figure 3.8 Crop condition Kazakhstan and Uzbekistan

For descriptions of figures a-e, see figure 3.2 for Egypt.

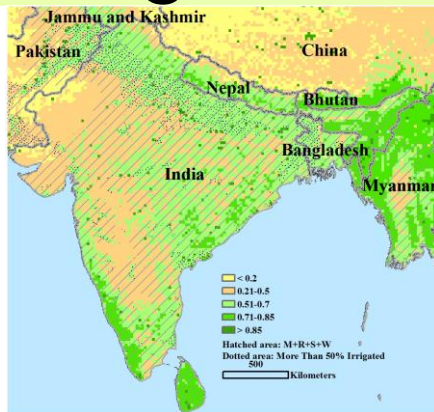
Table 3.3 Kazakhstan, 2013 production, in representative major agricultural states (thousand tons)

	Wheat	
	2013	$\Delta\%$
Akmolinskaya	4231	103.9
Karagandinskaya	185	35.6
Kustanayskaya	2570	106.8
Pavlodarskaya	547	-7.7
Severo-kazachstanskaya	7828	26.7
Vostochno-kazachstanskaya	487	3.3
Zapadno-kazachstanskaya	36	49.3
Sub total	15884	
Other provinces	2135	
Kazakhstan	18019	35.4

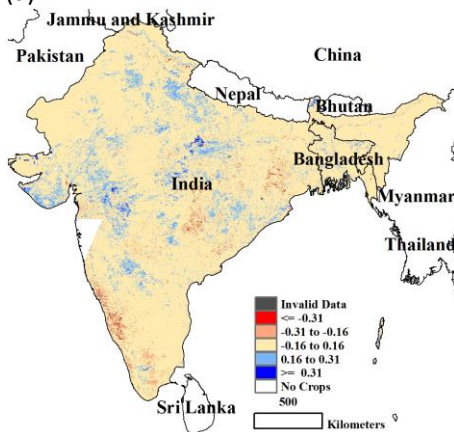
Note: $\Delta\%$ indicates percent difference with 2012

Asia - South

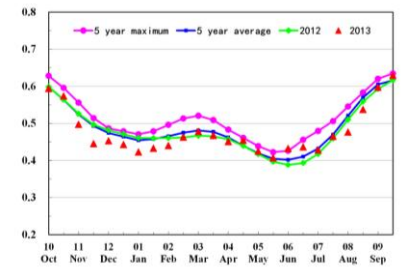
Bangladesh-India



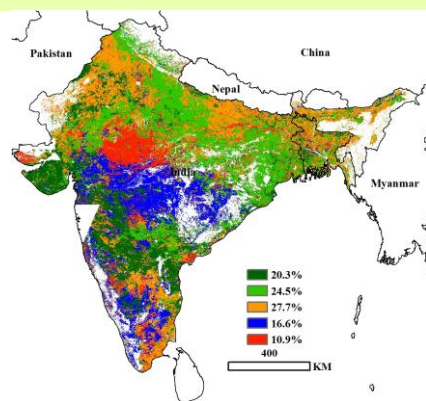
(a)



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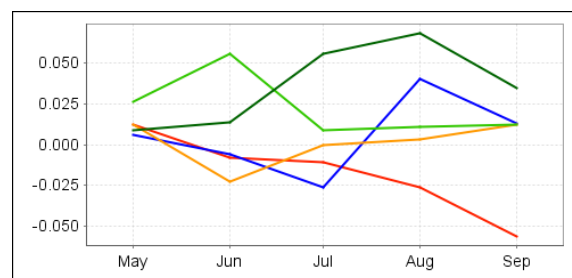


(d)

The Indian agricultural seasons are organized around the rainfall patterns: they are centered around June to September in the north-western lowlands (e.g. Haryana State), but grow longer in the east (e.g., May-October in West Bengal), and occur later in the south (e.g., May to November, with abundant rainfall in September-November in Tamil Nadu).

This bulletin covers the June to January rice and maize kharif crops. Irrigation plays a major part, mainly in the north (from Punjab to Uttar Pradesh) and in the north-west (West Bengal). The period from June to September enjoyed favorable conditions in about half the country, mostly in the western half of Uttar Pradesh, West Bengal, Jharkhand, and most of Orissa. The most favorable conditions occurred in Gujarat and parts of Maharashtra in July and August. Remaining areas have more mixed prospects: In Punjab, Haryana, North Rajasthan, and eastern Uttar Pradesh, conditions were unfavorable in June.

As illustrated in figures 3.1 and 3.2, India suffered from a combination of below average rainfall and temperature, mostly in the north-west and west. The situation was unfavorable in most of Madhya Pradesh in July, but recovered rapidly in August. Finally, an area centered around northern-central Madhya Pradesh underwent constantly deteriorating conditions from May to September. Conditions in Bangladesh were mostly close to average in the south, but less favorable in the northern half, which experienced the June deterioration also observed in parts of India.



(e)

Figure 3.9 Crop condition Bangladesh and India.

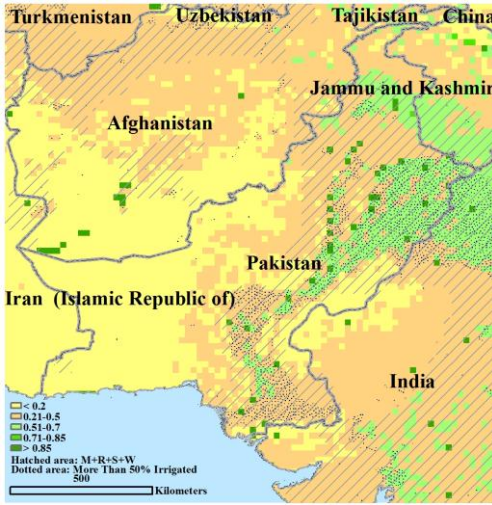
Table 3.4 India, 2013 production by state (thousand tons)

	Maize		Rice (paddy)		Wheat	
	2013	Δ%	2013	Δ%	2013	Δ%
Andhra Pradesh	3807	4.1	13657	5.9	12	9.1
Assam	15	-3.3	4626	2.4	57	-6.2
Delhi	2	166.9	30	-0.3	98	15.5
Goa			118	-2.8		
Gujarat	803	2.2	1643	-8.2	4046	-0.7
Haryana	22	-10.4	3616	-3.8	12158	-4.2
Himachal Pradesh	693	-3.1	130	-1	571	-4.1
Karnataka	4265	4.4	4072	3	236	22.3
Kerala			546	-4.1		
Maharashtra	2518	3.5	2769	-2.6	1807	37.6
Manipur	38	8.7	556	-5.9	5	-1.1
Meghalaya	26	-1.2	212	-2.2	1	7.7
Mizoram	11	31.2	51	-6.5		
Nagaland	134	-0.1	382	-0.1	5	-0.5
Orissa	255	20.4	6317	8.8	3	36.9
Punjab	497	-1.1	10690	1.4	16876	-2.3
Rajasthan	1860	11.6	259	2.4	8267	-11.3
Sikkim	66		21	0.2	3	1.1
Tamil Nadu	1361	-19.7	6626	-11.2		
Tripura	5	-9.5	710	-1.1	1	9.1
West Bengal	358	-1.6	13826	-5.3	874	0.1
Arunachal Pradesh	67	-2.8	244	-4.1	6	-4.6
Bihar	1525	-5.3	5132	-28.4	4411	-6.6
Chhattisgarh	179	4	6094	1.1	130	-2.4
Dadra-Nagar Haveli			19	7.4		
Jharkhand	292	-9.3	2120	-32.3	231	-23.8
Madhya Pradesh	1169	-9.2	2000	-10.2	9583	-17
Puducherry			47	11.7		
Uttar Pradesh	1211	-7.4	13007	-7.2	30147	-0.5
Uttarakhand	42	2	572	-3.7	878	
Sub-total	21221		100092		90405	
Other states total	189		55158		472	
National total	21410	1.7	155250	1.7	90877	-4.2

Note: Δ% indicates percent difference with 2012.

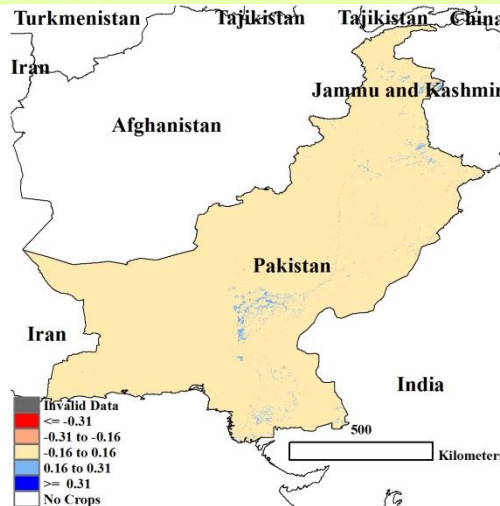
Asia - South

Pakistan

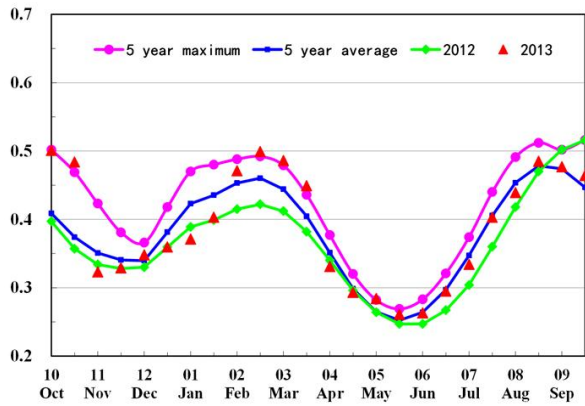


(a)

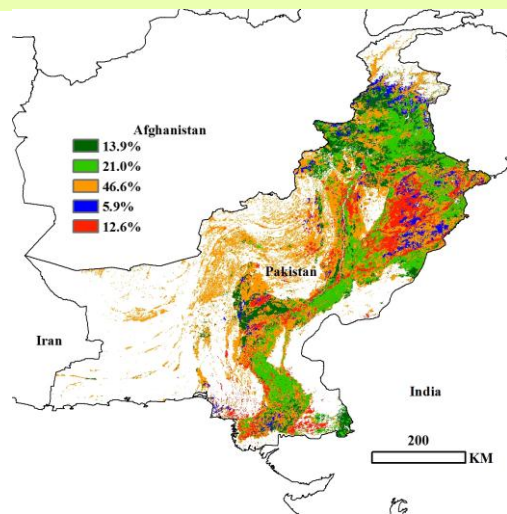
The 2012-13 rabi (winter; wheat) season in India ended with conditions that were generally comparable to or better than those in the recent past (the last five years). The kharif (summer; rice and maize) season underwent contrasting conditions in July, but mostly unfavorable in the northern Northwestern Frontier Province (NWFP) and east of that area. In August and September, much of north Punjab displayed below average crop condition.



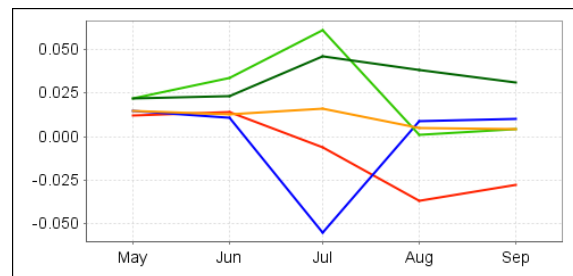
(b)



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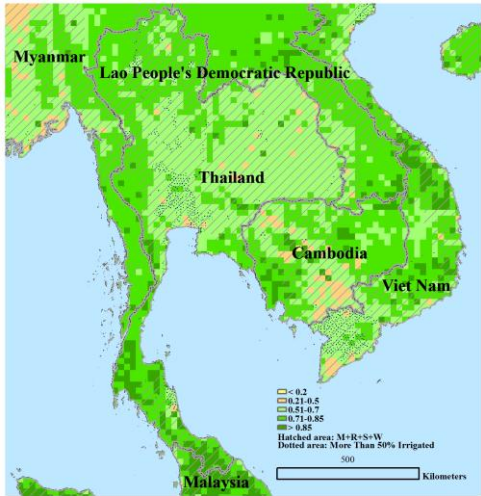
(e)

Figure 3.10 Crop condition Pakistan

For descriptions of figures a-e, see figure 3.2 for Egypt.

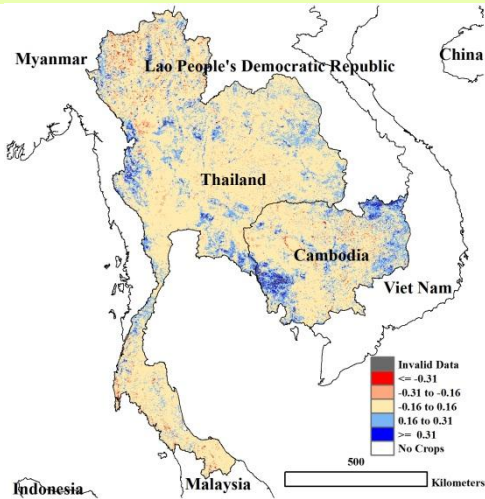
Asia -Southeast

Cambodia-Thailand

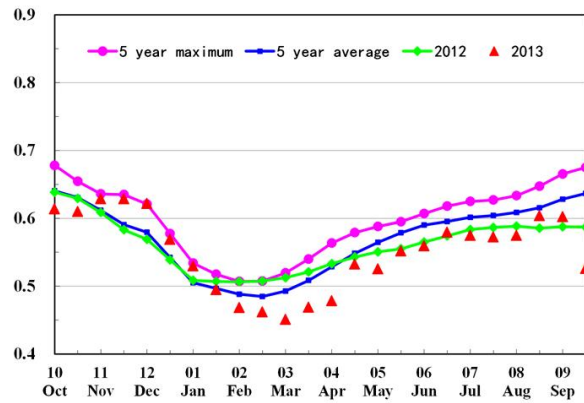


(a)

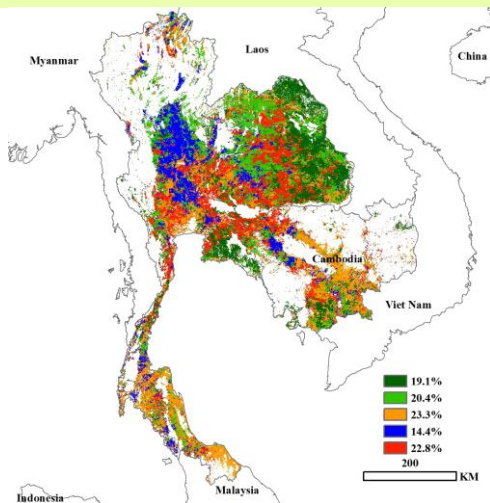
Conditions from May to September were mostly above average, with large spatial differences. In June, conditions were below average in an area approximately stretching from Sukhotai to Lopburi provinces. Similarly, in September a deterioration that affected the maize harvest impacted east (Nonkhai to Suri and the Lao border) as well as southeast Cambodia (Kampong Chang to Takeo) and, in a more diffuse way, the center of the country. The second rice crop (harvested in June) was unaffected, while for the first crop (planted in May and due for harvest early next year), the final condition will largely depend on conditions at the end of 2013 and early 2014.



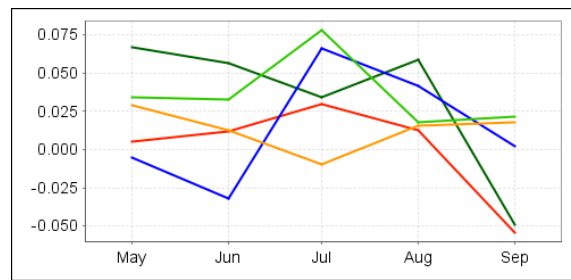
(b)



(c)



(d)



(e)

Figure 3.11 Crop condition Cambodia and Thailand

For descriptions of figures a-e, see figure 3.2 for Egypt.

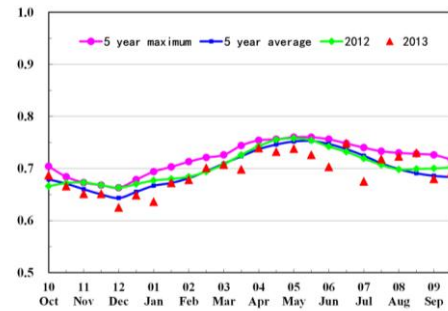
Asia -Southeast

Indonesia



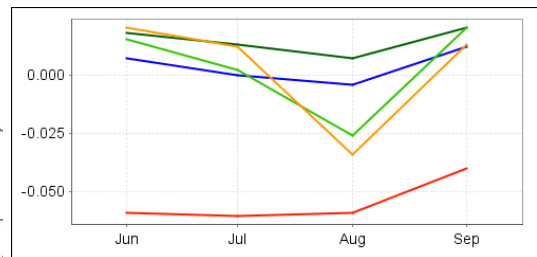
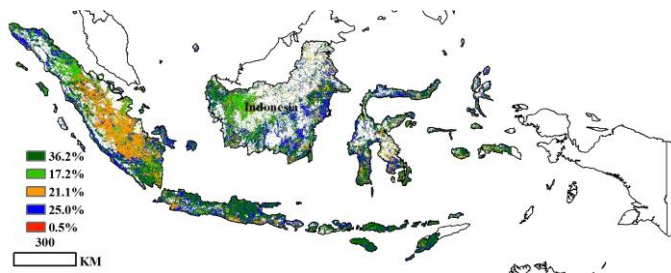
Monsoon season crops are currently in the field, to be harvested in December. Compared with the recent past, conditions are generally average (the last five years), with the exception of a marked drop in crop condition during August, which affected about 40 percent of the crops, mostly in central Sumatra (Utera to Selatan).

(a)



(b)

(c)



(d)

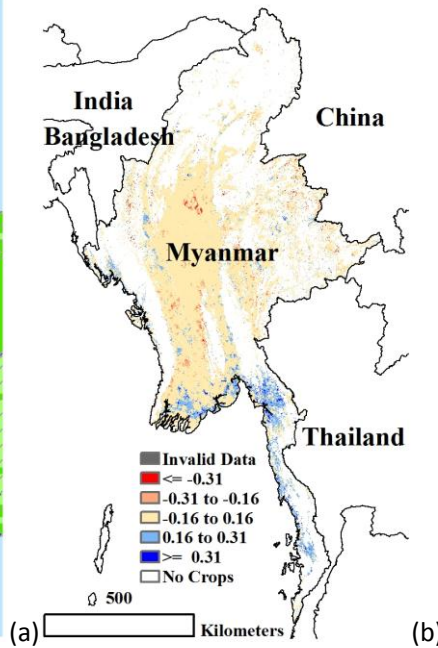
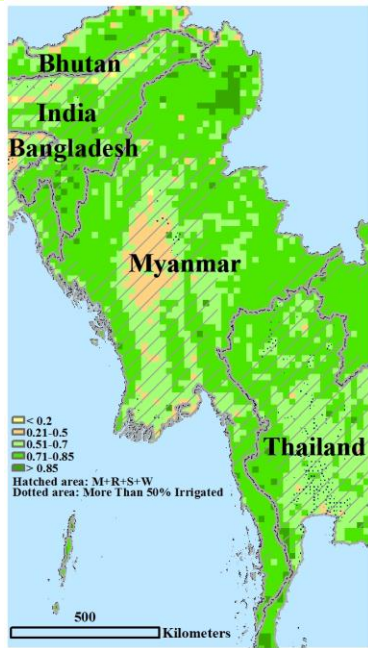
(e)

Figure 3.12 Crop condition Indonesia

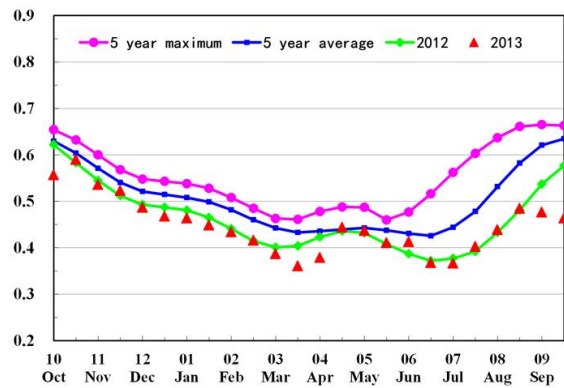
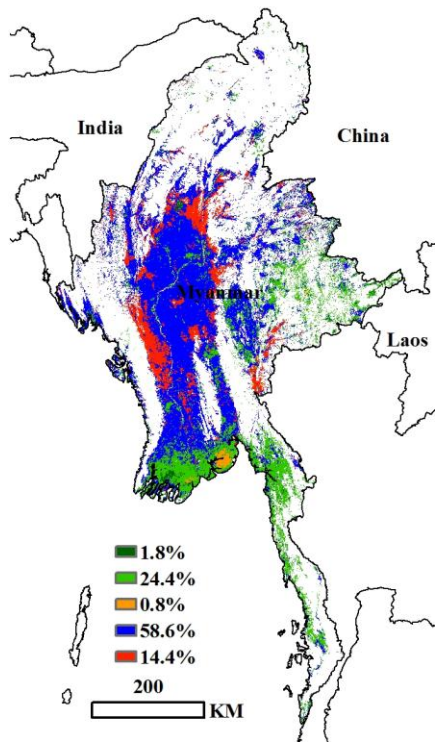
For descriptions of figures a-e, see figure 3.2 for Egypt.

Asia -Southeast

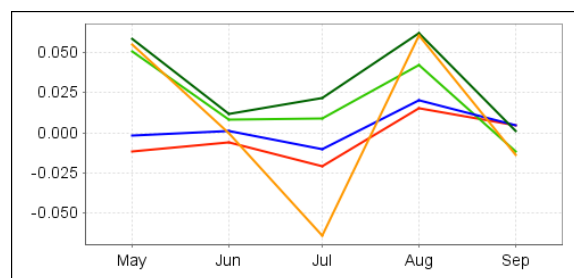
Myanmar



In Myanmar, the period covered by the analysis corresponds to the main rice harvest in the country from May to December (about 80 percent of production). About 85 percent of the cropped areas enjoyed good or better crop prospects. About 14 percent—mainly at the edges of the main producing areas (Magway, west Chan)—display conditions that are consistently below average. Average crop condition, as assessed by NDVI, sharply deteriorated in September.



(c)



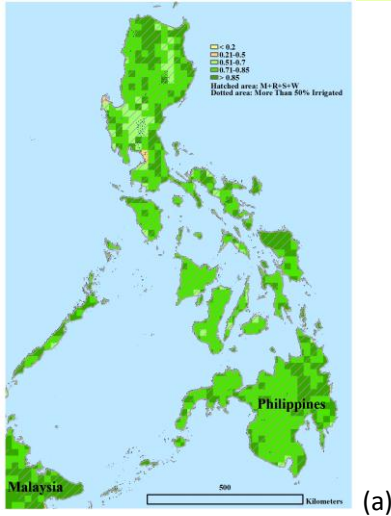
(e)

Figure 3.13 Crop condition Myanmar

For descriptions of figures a-e, see figure 3.2 for Egypt.

Asia -Southeast

Philippines



The Philippines, like Indonesia, mostly enjoy a very long humid season with ample moisture supply, interrupted locally by a short dry season around the beginning of the year. As a result, crops planted in April (for harvesting around October) rarely suffer drought conditions, the main limiting factor for crop production being solar radiation. NDVI profiles indicate that throughout the season the country underwent average conditions comparable with those of previous years. According to the recent crop condition map (3.14b and c) Luzon generally enjoyed favorable conditions, in stark contrast with Mindanao.

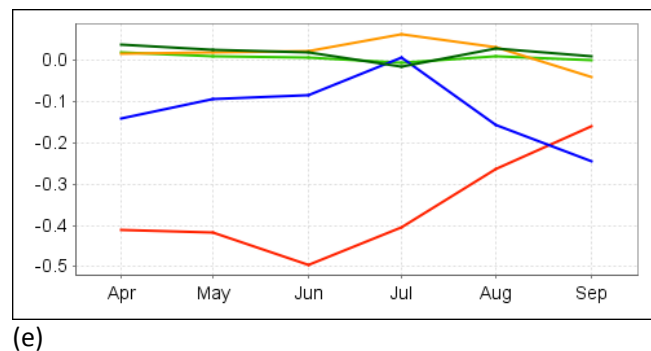
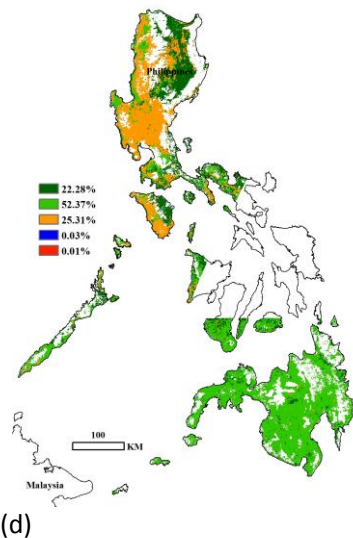
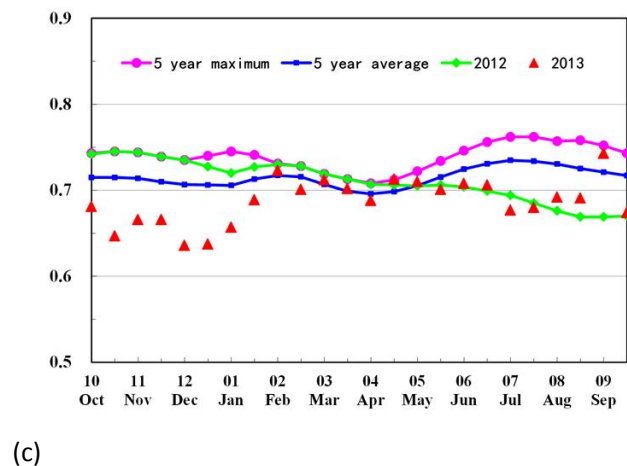
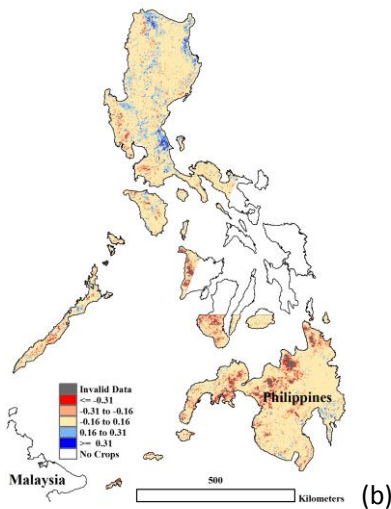
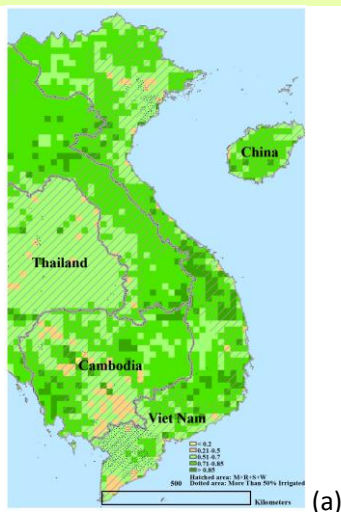


Figure 3.14 Crop condition Philippines

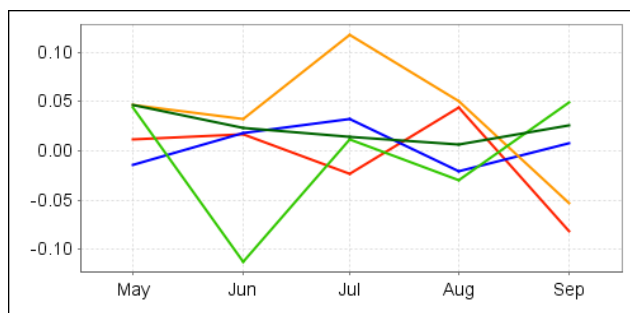
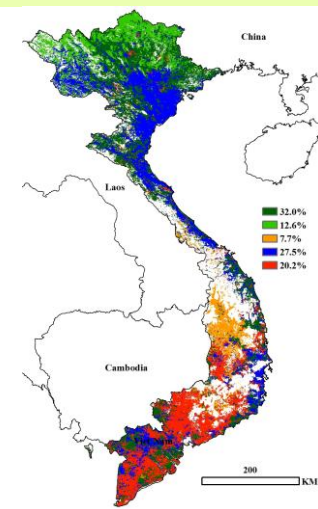
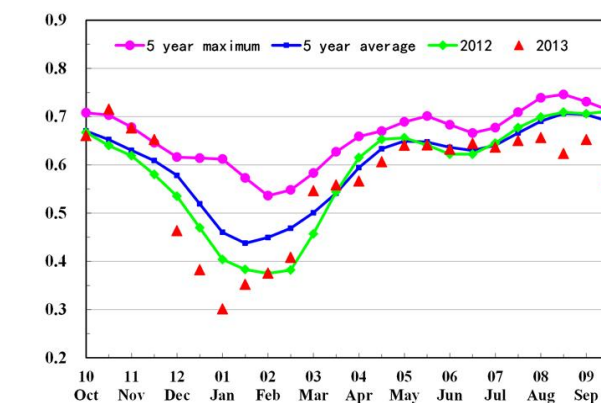
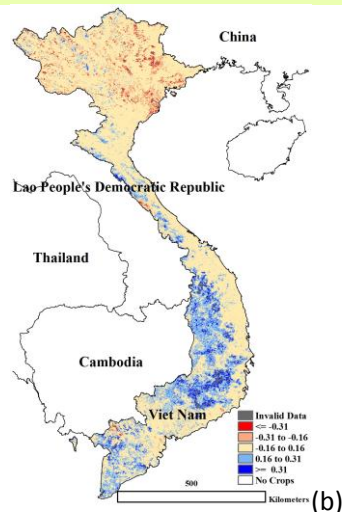
For descriptions of figures a-e, see figure 3.2 for Egypt.

Asia -Southeast

Vietnam



Summer rice season normally extends from May to October, while the first rice crop in the north is planted somewhat later (June) to be harvested at the end of the year. The extreme north of the country, along the Chinese border from Ha Giang to CaoBang, suffered a marked drop in crop condition in June, affecting early summer rice. In September, a drop in crop condition was observed in the south, approximately from Gia Lai to Ca Mau (but avoiding central coastal provinces), for an area including the Mekong delta, the major single rice producing area in the country. Average crop condition (3.15c) shows the deterioration in recent months, particularly affecting the North and limited areas in the Mekong Delta along the Cambodian border.



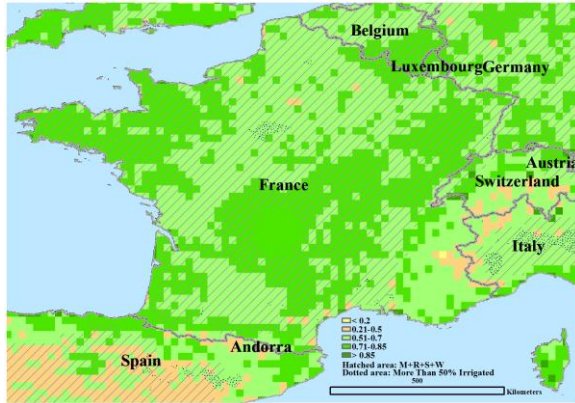
(d) **Figure 3.15 Crop condition Vietnam**

For descriptions of figures a-e, see figure 3.2 for Egypt.

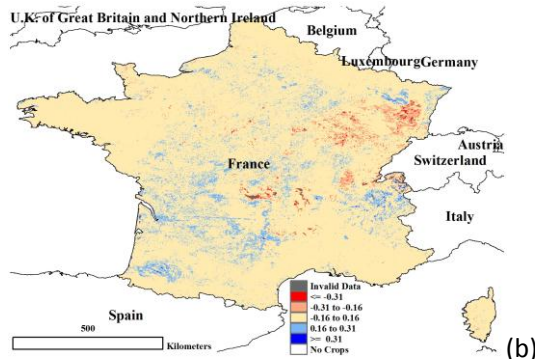
Europe and Russia

France

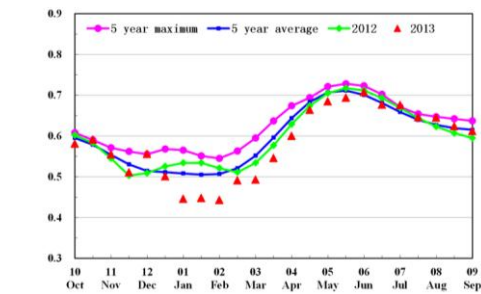
For France, the monitored period from March to August covers the final stages and the harvest of the winter wheat crop (planted from September 2012), the whole cycle of spring wheat (May to August), and the early and mid-season stages of maize, the harvest of which is nearing completion. Consistent crop condition patterns can be observed: only about half the crops enjoyed conditions comparable with the previous seasons, while about 15 percent, mostly in the center-north (Pas de Calais to North Centre region) suffered well-below average conditions in March, which gradually improved until reaching near-normal values in June and above-average ones in July. In the extreme south (Pyrenees) and the southeast (east of Rhone-Alpes and northeast of Provence-Alpes Côte d’Azur) conditions kept deteriorating from March to June, after which they improved, returning to normal in July. Finally, large areas from Bretagne to Franche-Comté and Alsace (but avoiding Poitou Charentes) display poor condition in May, which affects about 27 percent of the country’s crops. Altogether winter conditions were relatively poor (3.16c), while summer crops (maize) are average.



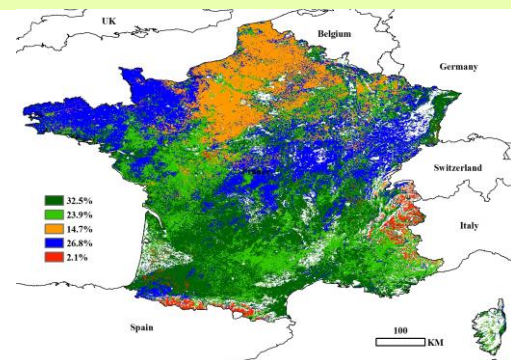
(a)



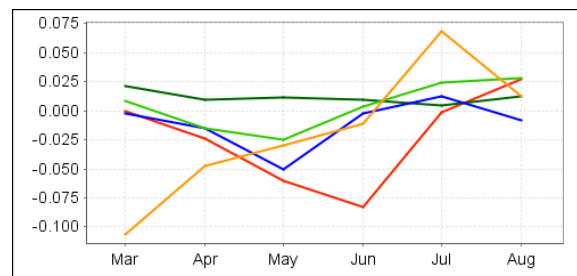
(b)



(c)



(d)



(e)

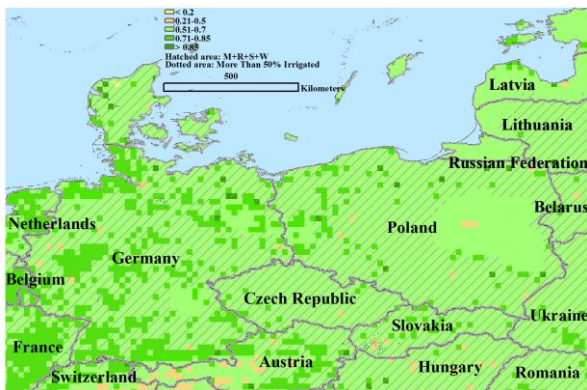
Figure 3.16 Crop condition France

For descriptions of figures a-e, see figure 3.2 for Egypt.

Europe and Russia

Germany-Poland

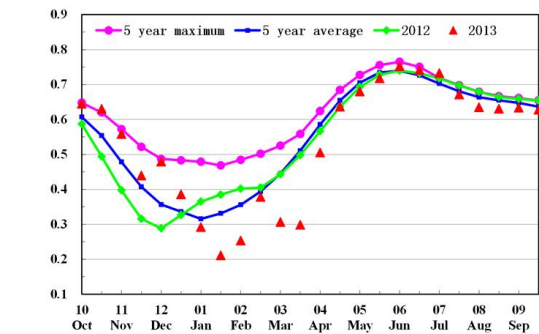
In April and May, Germany and Poland enjoyed conditions very similar to those of the last five years. Before April however, conditions are markedly different in two groups of areas. In the first, covering about 60 percent of the countries, conditions deteriorated after March to approximately average conditions, which lasted until the harvest of the wheat crops, including both winter wheat (planted Sep. 2012) and spring wheat (planted around May). In the second area, conditions are characterized by well-below average conditions in March, which turned about average in April and especially May. The affected areas include (i) Schleswig-Holstein to north Dolnoslaskie; (ii) a narrow strip from south Dolnoslaskie to the Belgian border in Rheinland-Pfalz, opening fan-like and becoming more patchy in the west; and (c) the eastern third of Poland along the borders of Lithuania, Belarus, Ukraine, and Slovakia. Particularly in the east (3.17a) winter wheat suffered from a cold spring.



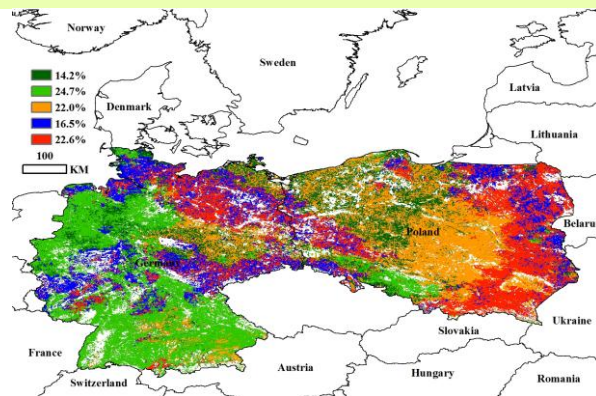
(a)



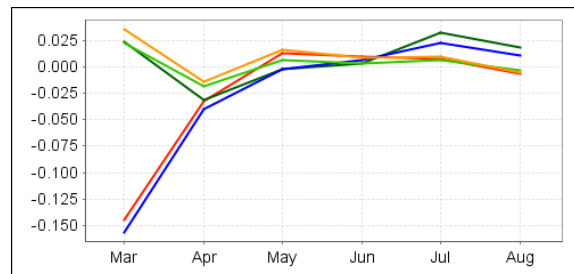
(b)



(c)



(d)



(e)

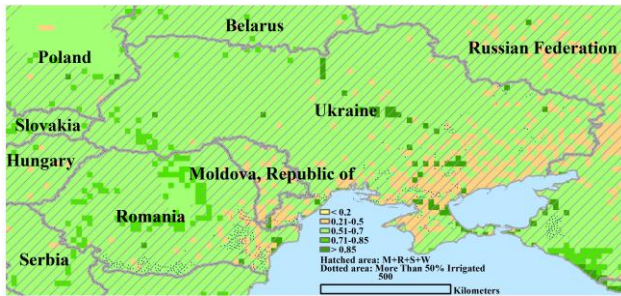
Figure 3.17 Crop conditions Germany and Poland

For descriptions of figures a-e, see figure 3.2 for Egypt.

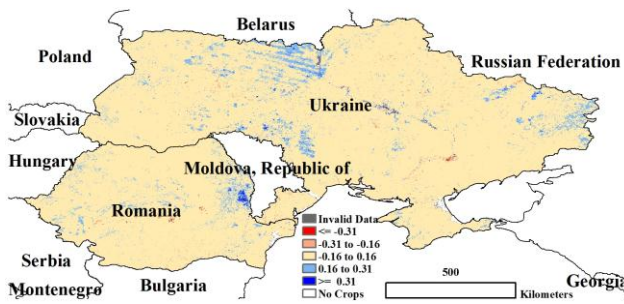
Europe and Russia

Romania-Ukraine

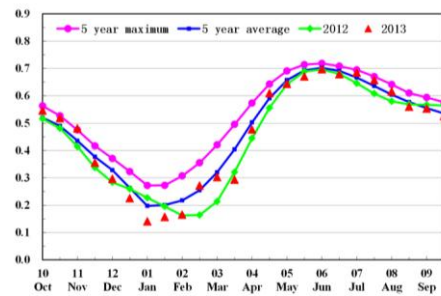
For Romania-Ukraine, the west of the region continues the pattern that was observed in Germany and Poland, i.e., very poor crop conditions in March. The pattern affects about one quarter of the region. Contrary to their western neighbors, however, Romania and the Ukraine again suffered from poor conditions in August and September in the same areas, thus including the harvest time of spring and winter wheat as well as mid-season stages of maize. Other areas in the two countries underwent a multiplicity of conditions (figure e). They range from (i) very favorable in July (poor in May and average in September) in a south-west oriented zone stretching from northeast Ukraine (Chernihiv and Sum regions) to the Moldovan border in Romania, to (ii) very favorable until May, poor in July and August, and recovering thereafter.



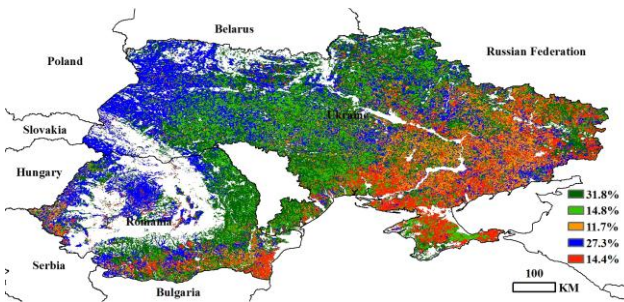
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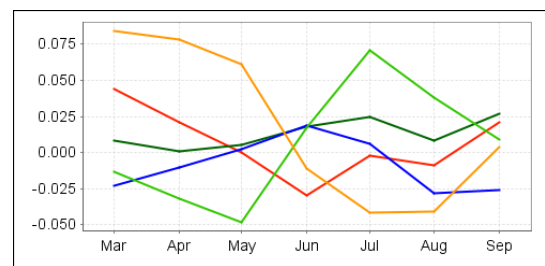
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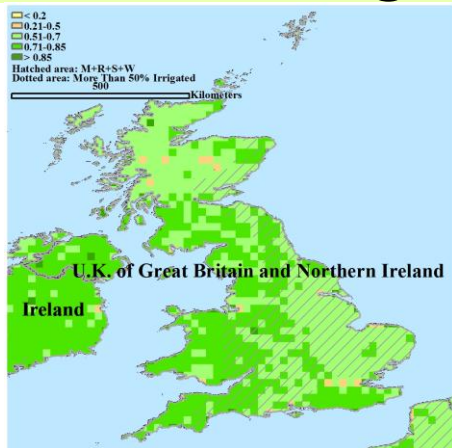
(e)

Figure 3.18 Crop condition Romania and Ukraine

For descriptions of figures a-e, see figure 3.2 for Egypt.

Europe and Russia

United Kingdom



Crops conditions in the United Kingdom are easily described as having undergone constant improvement from poor and very poor conditions in April to average and above average condition in August. Unusually poor conditions were recorded in May in southern-central England.

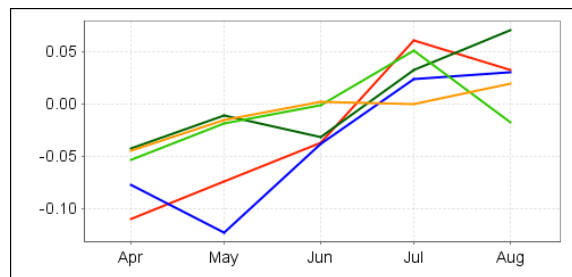
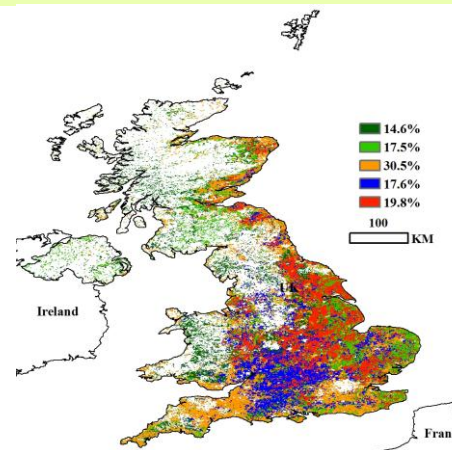
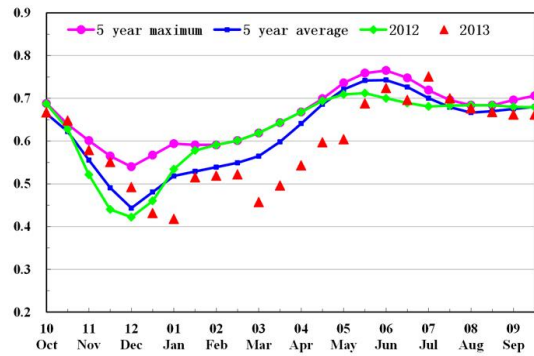
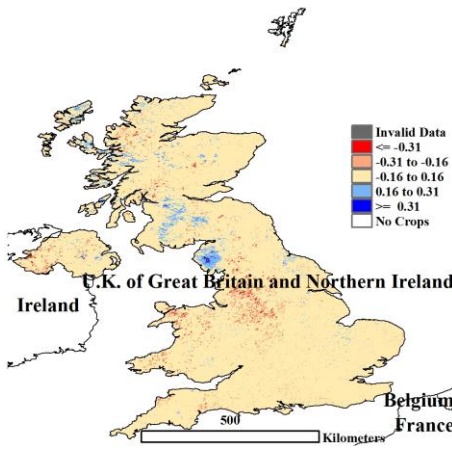


Figure 3.19 Crop condition United Kingdom

For descriptions of figures a-e, see figure 3.2 for Egypt.

Europe and Russia

Russia

Compared with its western and less continental neighbors, crops in Russia follow a different crop calendar: spring wheat and maize are harvested in September (planted in May and April, resp.) and the cycle of winter wheat covers the period from August to July. Poor conditions (a significant deterioration in June and July compared with the recent average) affected mostly the southern oblasts of Rostov, Stavropol and the autonomous Kalmyk Republic. Areas where crop condition is poor at the time of harvest (September) include about 35 percent of the cropped area in Russia and affects the western regions north of the oblasts of Saratov and Belgorod. Large areas in the southeast enjoyed better than average conditions during summer (3.20c).

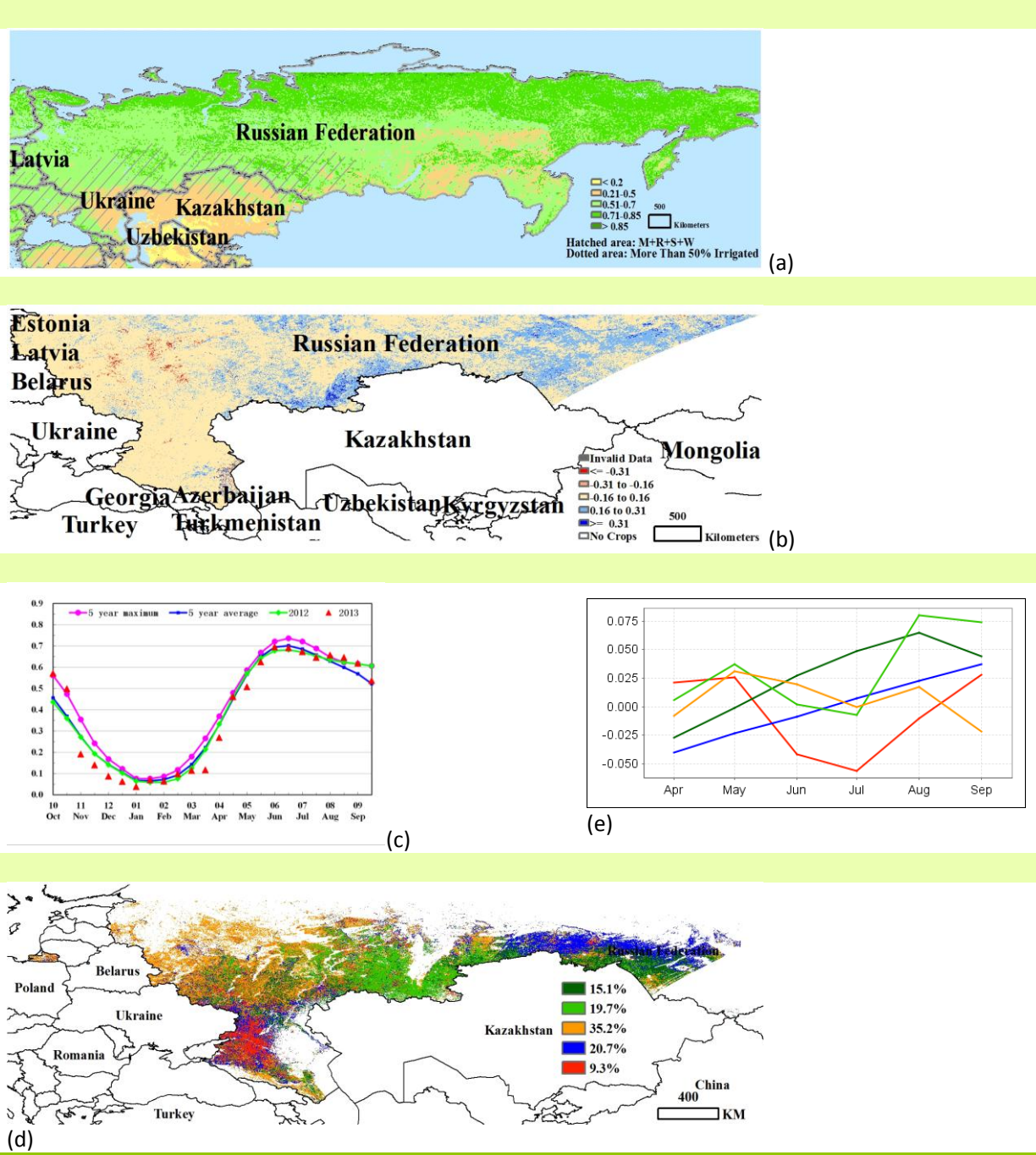
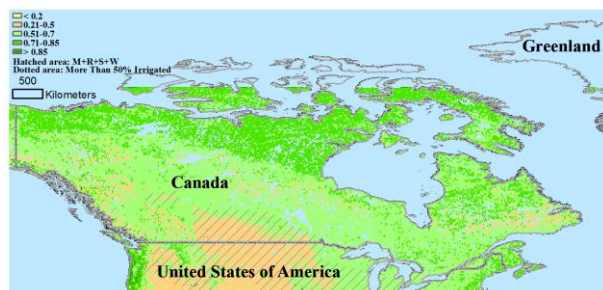


Figure 3.20 Crop condition Russia

For descriptions of figures a-e, see figure 3.2 for Egypt.

North America

Canada

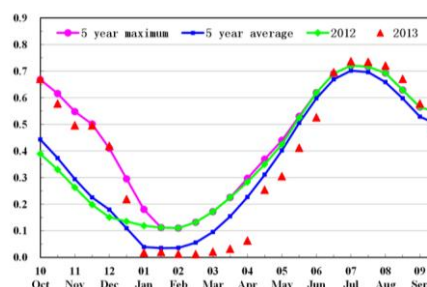


(a)

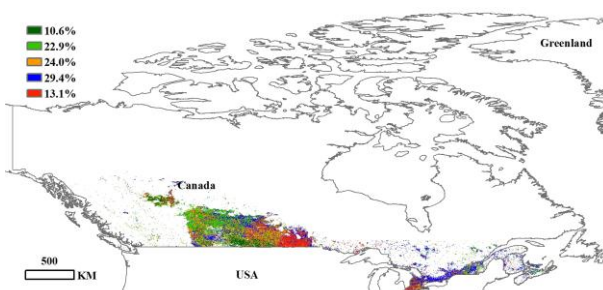
Throughout the country, crop conditions, compared with their recent average, were normal at the end of September, one month before the maize harvest and the planting time for winter wheat. However, spring conditions were consistently poor and they gradually increased to above normal from around July, coinciding with the harvest of winter wheat. On average (3.21a) the country experienced poor conditions, well below the recent five-year average.



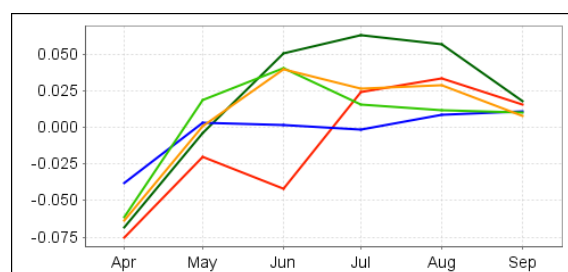
(b)



(c)



(d)



(e)

Figure 3.21 Crop condition Canada

For descriptions of figures a-e, see figure 3.2 for Egypt.

Table 3.5 Canada, 2013 production by province (thousand tons)

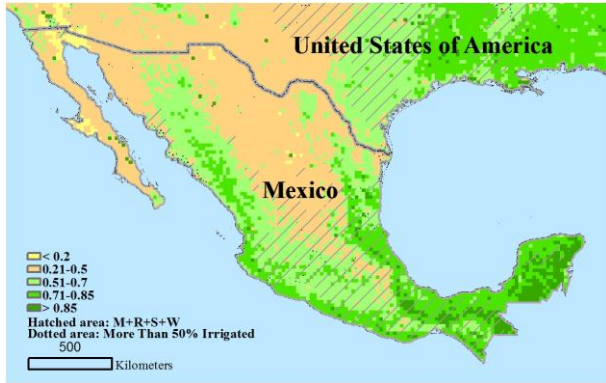
	Maize		Rice		Soybean		Wheat	
	2013	Δ%	2013	Δ%	2013	Δ%	2013	Δ%
Alberta							8604	3.0
Manitoba							3076	-22.0
Saskatchewan							12127	-5.0
Sub total							23807	
Other provinces							2330	
National total							26137	-3.0

Note: Δ% indicates percentage difference with 2012.

North America

Mexico

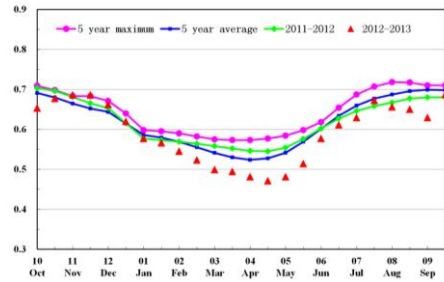
At the end of September, most areas in Mexico were characterized by close to average crop conditions, although the situation developed along rather different trajectories. For instance, the main maize growing areas in the center of the country and the north-west started with unfavorable conditions at the time of planting in April. The bulk of the maize harvest (about three quarters) is due in January, so that the final outcome of the season largely depends on current conditions (reported on by the next CropWatch bulletin). The bulk of the wheat harvest occurred in June, mostly in the north-west, where condition is at least average. Except during mid-July (3.22c), crop condition was usually below the recent five-year average. At the end of September, both NDVI clusters (3.22e) and crop condition (3.22c) had returned to 'normal'.



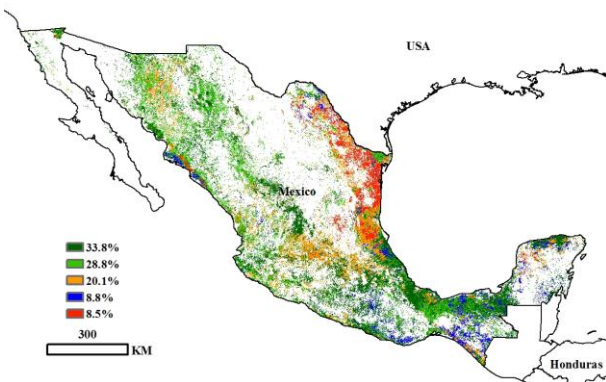
(a)



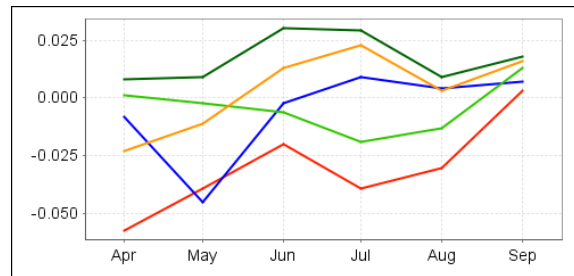
(b)



(c)



(d)



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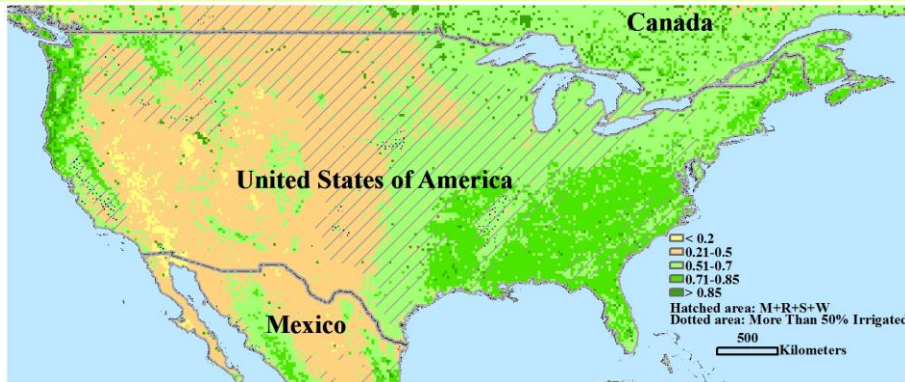
Figure 3.22 Crop condition Mexico

For descriptions of figures a-e, see figure 3.2 for Egypt.

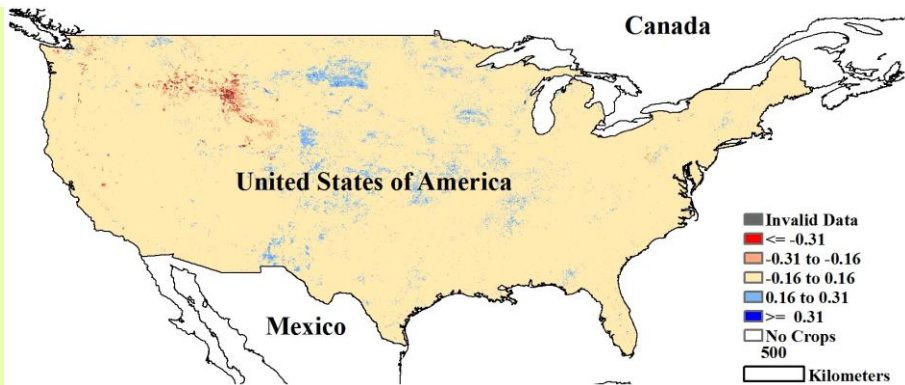
North America

United States

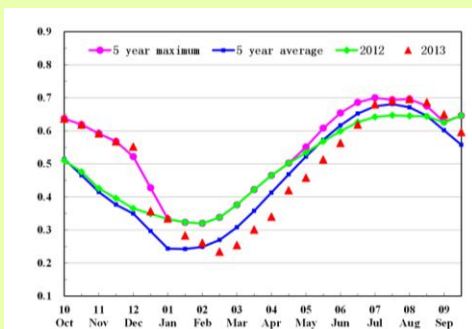
In June almost all crop areas in the United States could be listed as about “average” by the standard of the last five years. A month later, when winter wheat was being harvested, and two months later (spring wheat harvest), crop condition curves had opened fanlike (3.23e), providing a range of different conditions that remained stable until September. Conditions were favorable along the Canadian border, although a number of patches suffered poor conditions, including in South Dakota, parts of Missouri, Iowa, Colorado and Texas. Crop condition (3.23c) stayed below the recent reference curves from February to June, improving thereafter, while maize and soybean matured.



(a)



(b)



(c)

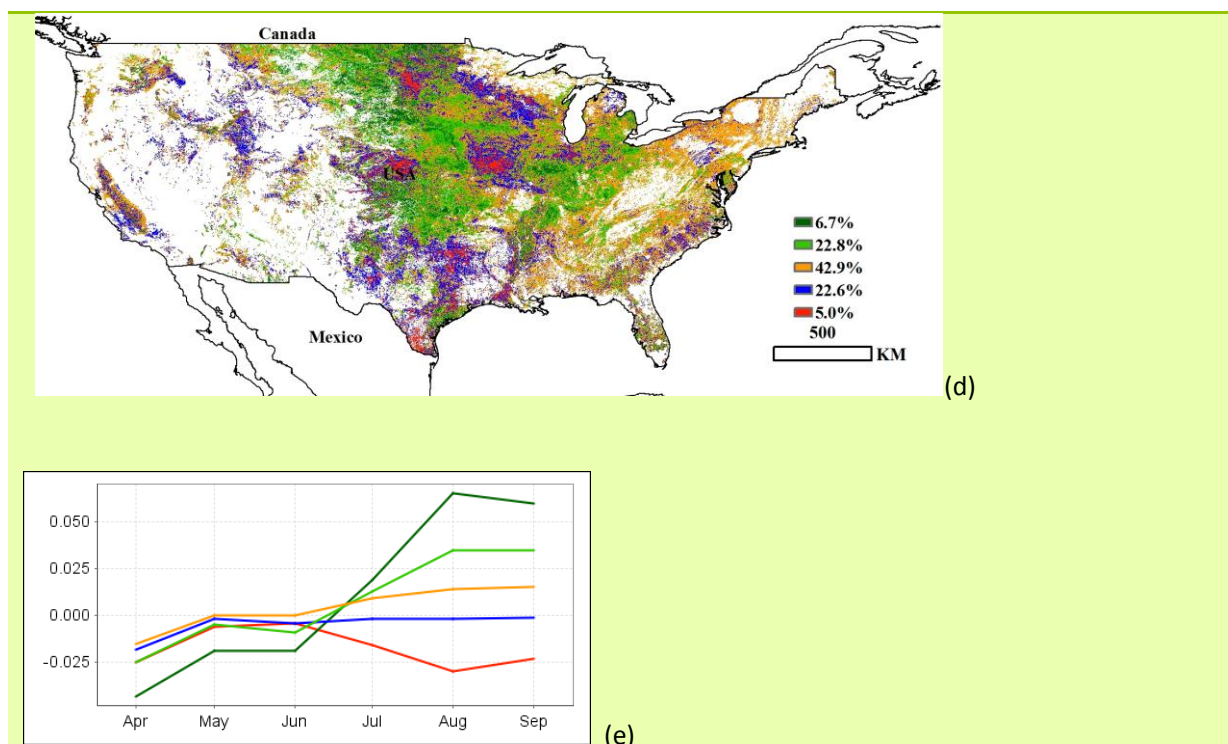


Figure 3.23 Crop condition United States

For descriptions of figures a-e, see figure 3.2 for Egypt.

Table 3.6 United States, 2013 production by state (thousand tons)

	Maize		Rice (paddy)		Soybean		Wheat*	
	2013	Δ%	2013	Δ%	2013	Δ%	2013	Δ%
Arkansas	2509	-20.2	3948	11.5	3540	-4.3	747	10.9
California			2120	-3.4			844	17.7
Idaho							1665	3.3
Illinois	41062	25.7			10886	4.3	1188	7.4
Indiana	18244	20.3			6282	3.2		
Iowa	53765	12.8			11974	6.3		
Kansas	10524	9.3			2518	10.4	8963	-13.8
Michigan	8293	2.7			2326	-0.1	1252	12.1
Minnesota	32712	-6.3			7768	-5		
Missouri	7588	20.7	469	24.5	4694	11.2	998	-6.8
Montana							2373	3.1
Nebraska	35920	9.4			6334	12.4	1613	11.2
North Dakota	8108	-24.4			3720	-15	735	-32.7
Ohio	12163	6.7			5739	2.3	1093	29.4
Oklahoma							3064	-27.3
Oregon							1569	11.3
South Dakota	15097	11			3972	3.3	1732	5.2
Texas	4295	-16.1	548	-6.7		-20.1	1979	-24.3
Washington							3379	4.7
Wisconsin	11649	14.9			1962	2.2		
Sub total	261931		7085		71716		33197	
Other states	31959		1634		11407		24887	
United States	293890	7.3	8719	-3.6	83123	1.3	58084	-5.9

Note: *Wheat production for the individual states is winter wheat, while the last line for the United States includes winter wheat, durum wheat, and spring wheat. The wheat production of other states was calculated by total wheat production minus 'subtotal' winter wheat production. Δ% indicates percentage difference with 2012.

South America

Argentina

May and June are the months in Argentina during which most summer crops are harvested, in particular maize, rice, and the first and second soybean crops. The crop condition profiles, assessed by their departure from the average of the previous five years, was average or above average for those crops in most areas, except in areas including and north of Santiago del Estero, where conditions had been poor since February. In central Buenos Aires and adjacent areas in east La Pampa province, conditions deteriorated rapidly between January and March, but returned to normal starting in April.

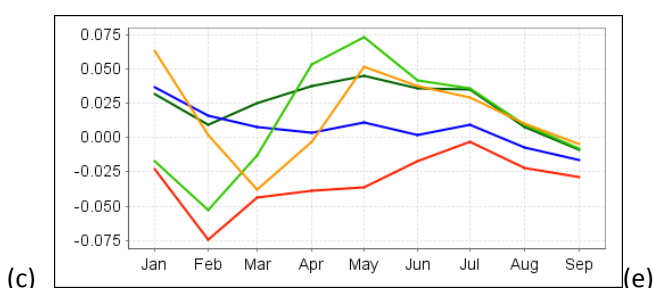
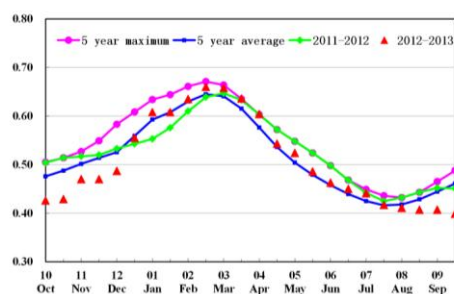
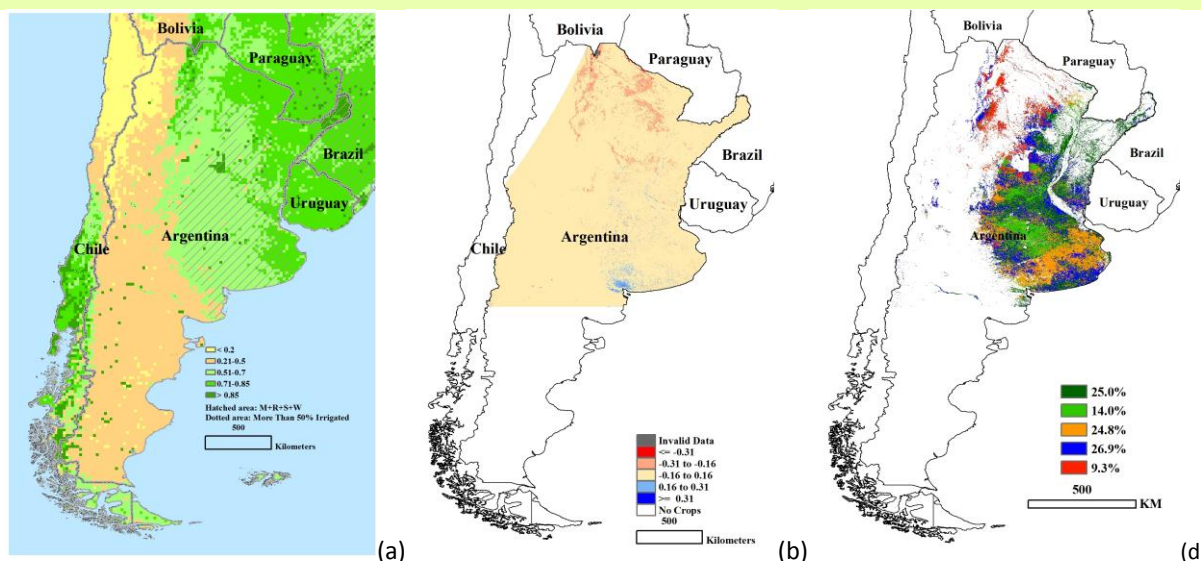


Figure 3.24 Crop condition Argentina

For descriptions of figures a-e, see figure 3.2 for Egypt

Table 3.7 Argentina, 2013 production by province (thousand tons)

	Maize		Soybean		Wheat	
	2013	$\Delta\%$	2013	$\Delta\%$	2013	$\Delta\%$
Buenos Aires	8710	-11.0	16604	-6.8	6188	61.2
Córdoba	7792	-27.8	11432	-12.6	1404	1.8
Santa Fe	4647	-14.9	9343	-11.1	1451	6.0
Sub total	21149		37380		9043	
Other provinces	3601		12809		3504	
Argentina	24750	-3.7	50189	-2.5	12547	14.1

$\Delta\%$ indicates percentage difference with 2012

South America

Brazil

Compared with the last five years, most areas in Brazil benefited from average to above average conditions. Unfavorable conditions have affected the east of Rio Grande do Norte to Espírito Santo, which are not among the major producing areas for maize, soybean, rice and wheat. Wheat, grown mostly in the areas that actually have winter conditions, is mostly produced in the southernmost part of the country, such as Ro Grande do Sul where conditions were favorable from the time of planting (April) to now (harvest is currently underway in November). Soybean growing areas, essentially Mato Grosso and Parana, displayed average or above average conditions at the time of harvest in May. The same applies to rice and maize, harvested between June and August (except for the Nordeste where harvest season is still to start (December)).

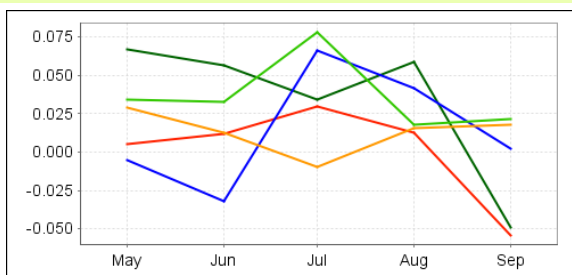
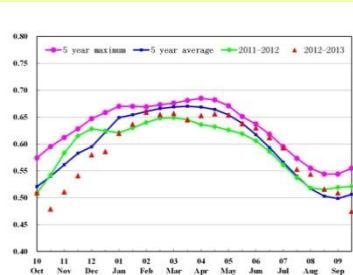
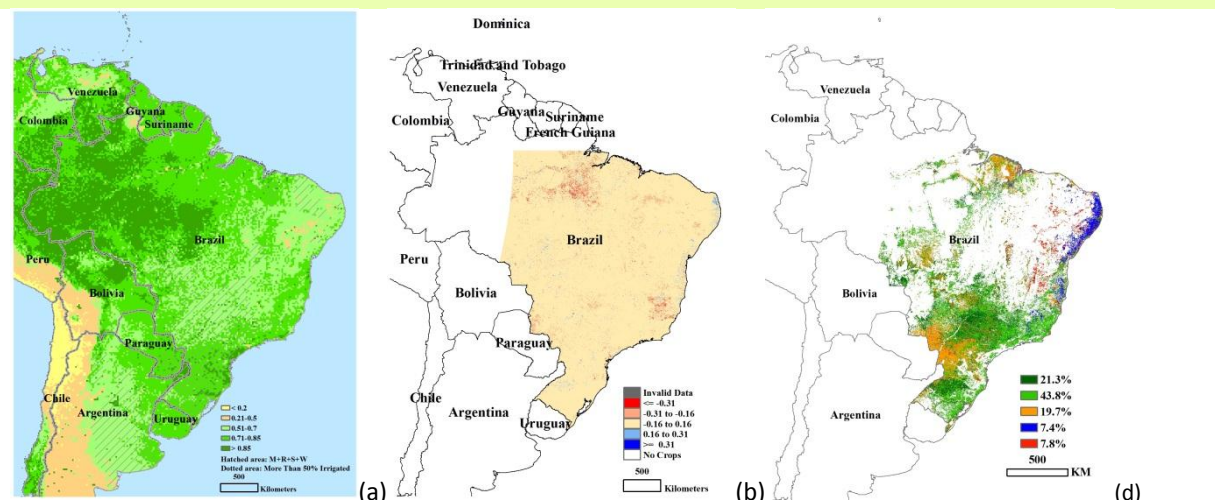


Figure 3.25 Crop condition Brazil

For descriptions of figures a-e, see figure 3.2 for Egypt

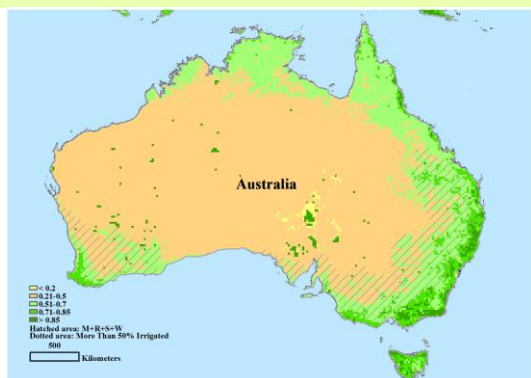
Table 3.8 Brazil, 2013 production by state (thousand tons)

	Maize		Rice		Soybean		Wheat	
	2013	Δ%	2013	Δ%	2013	Δ%	2013	Δ%
Mato Grosso	20186	29.0	497	8.9	23417	7.2		
MG Do Sul	7574	16.9	96	-9.6	5781	25.8	9	-61.7
Minas Gerais	7437	-30.9	43	-30.9	3376	9.8	119	48.7
Parana	17489	-1.4	175	-1.4	15921	45.7	1711	-18.5
Rio Gr. Do Sul	5350	5.3	8098	5.3	12757	114.6	2717	45.6
Santa Catarina	3326	-6.7	1024	-6.7	1587	47	218	56.2
Sao Paulo	4596	13.4	93	13.4	1933	31.4	87	-29.6
Total	65958	3.6	10026	3.6	64771	32.4	4861	12.2

Δ% indicates percentage difference with 2012.

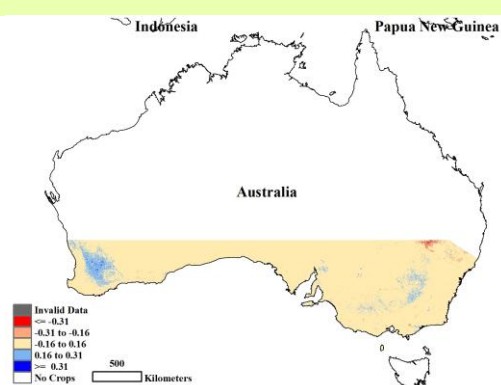
Oceania

Australia

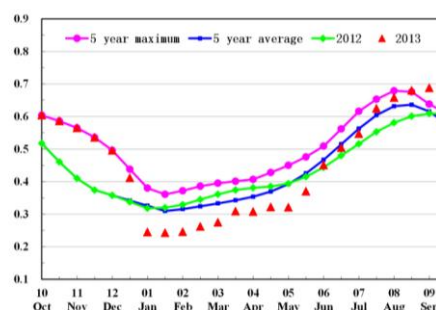


(a)

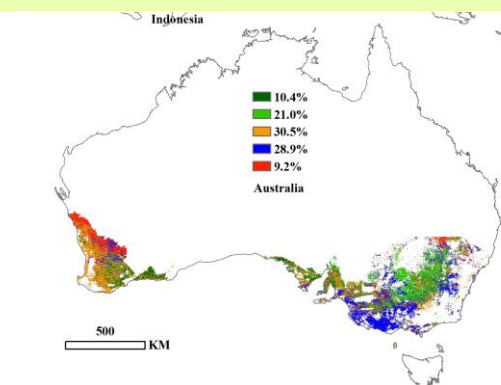
In Australia, overall crop conditions compared with the most recent five years were generally average to above average in September, about two months before the start of the ongoing wheat harvest. Condition is poor in about 10 percent of the areas and confined to the northernmost cropping areas of Western Australia and New South Wales.



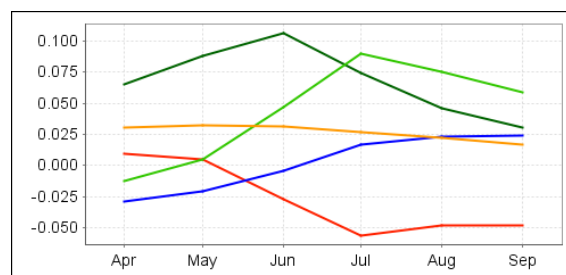
(b)



(c)



(d)



(e)

Figure 3.26 Crop condition Australia

For descriptions of figures a-e, see figure 3.2 for Egypt.

Table 3.9 Australia, 2013 production by state (thousand tons)

	Wheat	
	2013	$\Delta\%$
Western Australia	8020	-27.0
South Australia	5241	16.0
New South Wales	9512	11.0
Victoria	4160	6.0
Sub total	26934	
Other states	2023	
National total	28957	-4.17

$\Delta\%$ indicates percentage difference with 2012;

Chapter 4 Focus

4.1 Rice situation in South and Southeast Asia

The present CropWatch bulletin puts the world rice production of 2012/13 (leading to 2013/14 marketing year) at 739 million tons (480 million tons milled equivalent for an extraction rate of 65 percent), an increase of 1.6 percent over the previous season, largely due to expanded areas that compensated for adverse weather in many locations.

Most of the rice production takes place in the Asia-Pacific region, where rice is the major staple food and where cropping intensities sometimes reach 300 percent. Of the global rice areas, 31 percent is harvested in Southeast Asian countries (6). However, rice production, especially in Southeast Asia, is generally constrained by several factors, including weather fluctuations, natural disasters, insect-pest and weed management, limited resources, and technologies and mechanization, not to mention the shortage of natural resources such as land and water in some countries, especially islands.

Crops and weather conditions

The rice season is well advanced in most countries of the region and early estimates mention an expansion in planted area (7). Rice production estimates in Indonesia decrease from the previous year by 2.4 percent. Similarly, the main season rice crop in Vietnam is expected to reduce to 43 million tons (-1.5 percent) due to inconsistent rains and hot weather from mid-January to March 2013, tropical storms, and an outbreak of pests and diseases in March and April, 2013 (8). In the Philippines, the bureau of agricultural statistics reported that rice production from January to June 2013 surpassed the 2012 production by 1.3 percent, while Western Visayas and Mimaropa reported declines in production due to extremely hot weather and insufficient water supply (9). In September 2013, growing conditions are reported as adequate, as the monsoon maintained good moisture across most of the region. According to (10) rice growing conditions were mostly favorable in India, Bangladesh, Indonesia, and Thailand, while Vietnam as well as the Philippines suffered from excess moisture.

Adverse factors

In the recent past, the increase in the number of floods and periods of drought has adversely affected rice productivity in the region. Among countries severely affected by floods are Sri Lanka, India, western Nepal, Cambodia, and the Philippines. In November and December 2012, the Sri Lankan Ministry of Agriculture forecast a 10 percent decline of rice plantation due to heavy rains and flooding, especially in the districts of Batticalo, Trincomalee, and Vavuniya (11). The Corporate Disaster Resource Network (CDRN, India) reported that excessive rain and consequent floods in June 2013 have led to rice production losses in the flood-prone areas of Uttarakhand and Himachal Pradesh, and western Nepal (12) (13). Typhoon Usagi has caused flooding and severe rice damage in many countries. In Cambodia, 120,000 hectares of rice paddies are reported lost due to heavy monsoon rains; the same occurred in the southern part of Itbayat Island, the Philippines (14). By contrast, the rice plantation areas in Vietnam have suffered from drought. Due to the inadequate water in Nepal from April to June, the farmers reportedly are shifting vast areas from rice to vegetable farming (15).

Production/trade

In 2012/13, the top ten rice producing countries in the world are in Asia (they also include Brazil which ranks the ninth). Next to China, India occupies the world's largest rice plantation area. Recently, India has emerged as one of the world's largest rice exporters, displacing Thailand last year due to the government of India lifting the ban on exports of non-basmati rice after four years. According to data from the Food Corporation of India (FCI), the rice stocks stand at 23 million tons on October 1st, 2013, which is sufficient to cover domestic demand. According to the International Grains Council (IGC), India's 2013 rice exports are expected to reach 9.4 million tons based on stronger global trade and large supplies (16). Vietnam is the world's second largest rice exporter. Rice production in the country mainly occurs in the Mekong River and the Red River delta regions. Vietnam exported about 5.34 million tons of rice in the first nine months of 2013, according to the General Statistics Office of Vietnam (17). It is sharply down because of the strong competition from other major rice exporters (especially Thailand) and lower demand from its major customers, such as China, the Philippines, and Indonesia, due to the improved domestic production. Thailand's rice exports move to a third place due to the government's rice pledging policy, which goals are raising the income of farmers and pushing a higher price of domestic paddy (18) (19). In the first nine months of 2013, Thailand exported only 4.6 million tons of rice because of a drop in Thai jasmine rice and steamed rice export, according to (19). Meanwhile, the Philippines, one of the world's largest rice importers, are seeking to achieve rice self-sufficiency by increased yield and slight expansion in planted area (0.9 percent according to CropWatch estimates). Similarly, Indonesia allocates top priority on increasing self-sufficiency in rice in order to respond to the rise of food prices. The innovative financing programs for smallholder farmers were used to increase rice production in Indonesia. Laos is actually a small net exporter of rice with very low rice imports.

Policy trends

The Government of Malaysia has announced to establish new granaries focused on the East Malaysia region. The planted area is expected to expand by about 2.5 percent to increase rice production. The rice production is slightly above the previous year's record output, mainly reflecting adequate weather and subsidized farm inputs (20). The world's largest exporters in the history such as the Philippines, Malaysia, and Indonesia have also been more or less consistent importers of rice, which illustrates that food self-sufficiency is not an easily achieved goal (21). For instance, the Indonesian Bureau of Logistics has revealed plans to decrease rice imports this year, based on a rice surplus in the country that is expected to reach around 1.87 million tons by the end of 2013 (22). According to CropWatch, Myanmar will very rapidly become a major player in the agricultural landscape of the region. Rice exports in this fiscal year have reached a 46-year record high, supported by cross border trade with China and Thailand and duty-free rice exports to the European Union (23) (24).

4.2 Disasters and extreme events

This section focuses on some extreme geophysical factors that affected the countries monitored by CropWatch in 2013, most prominently cyclones and an exceptional cold spell that impacted crops and eventually the agricultural production in those regions. While many of these extreme factors and disasters have led to intense human suffering and deaths in many areas, the report focuses on factors with direct agricultural impacts. Earthquakes and other extreme factors are not included, as they disrupt human activities, but usually only indirectly affect crop production, for example through the destruction of infrastructure (irrigation channels, dams, and bunds).

Tropical cyclones in Asia

Several cyclones (typhoons, cyclonic storms) have hit Asia this season, including Haiyan in November 2013, one of the strongest storms on record (25), to be reported on in the next CropWatch bulletin.

In early May 2013, the cyclonic storm Mahasen (26) affected Myanmar (27), Sri Lanka, India, Thailand, Indonesia (26), and Bangladesh, where it coincided with Aman rice crop planting. Fortunately, in the other countries, in particular India and Indonesia, the impact occurred before the June crop planting.

August 2013 witnessed the development and growth of Utor (28) (known as Mangkhut in Thailand and Trami in Vietnam) which mostly affected the Philippines (Central Luzon (29)) and China, especially the provinces of Guangdong, Guangxi, Jiangxi, and Hunan. In China, the cyclone caused the largest floods in five decades; over 1.07 million hectares of crops and other plants have been reported damaged (27). While not directly touching land in Thailand and Laos, the cyclone nevertheless “enhanced” rainfall and caused widespread flooding (29).

In September 2013, typhoon Usagi, the second strongest storm in 2013 (30) affected mostly the Philippines and China. In the Philippines (where the storm is known as Odette) significant damage was inflicted on agriculture to the first maize and rice crops (29). In China (29), landfall occurred in Guangdong province. In Cambodia, Usagi led to floods that affected mostly the central provinces (31) (29).

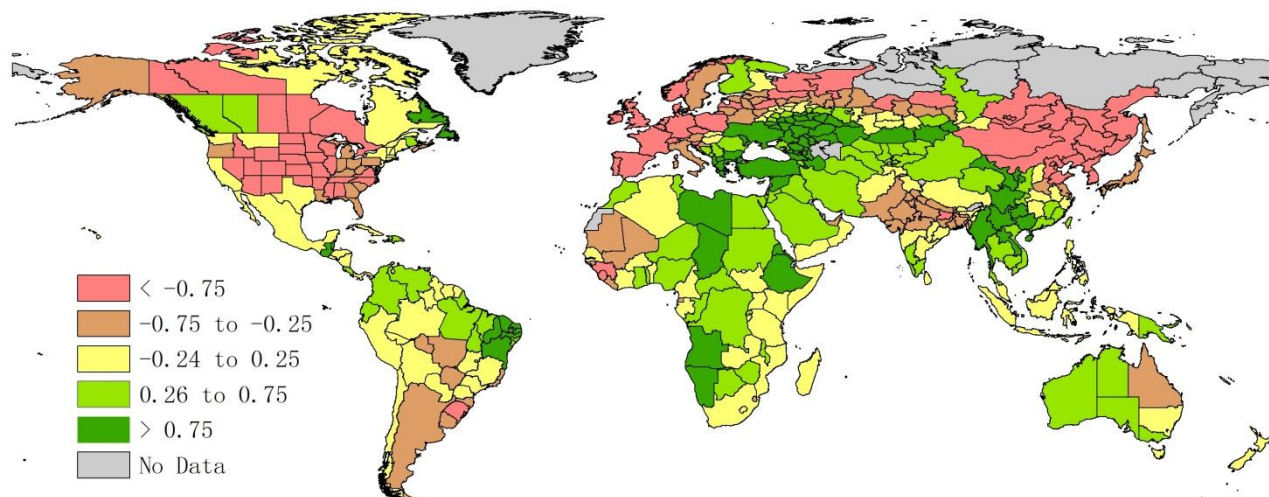
Early 2013 cold spell

A cold wave spell that affected very large areas across the northern hemisphere is one of the major features of 2013. It started actually in December 2012, affecting Bangladesh (northern districts of the sub-Himalayan regions) (29) (32), Kazakhstan (northern, eastern, and central parts (29) (32), and Eastern Europe (32). Cold conditions are also reported for the United States (32), in particular the Midwest (32) and Southwest. In January, extreme cold weather was reported in Tajikistan (29) (32), Belarus (29) (32), north India (which experienced the coldest weather in decades in Uttar Pradesh, Punjab, and Haryana) (29), China (Anhui, Hubei, Jiangsu) (32), and the North American Great Lakes area in the United States (32). In February, again, the northeastern United States reported exceptionally cold weather, while in March the cold affected essentially Poland and the Ukraine (32).

In northeast China, cold weather in March and April—in line with weather in the northern hemisphere, specifically Europe and Russia—led to crop structure changes from soya to corn or spring wheat.

Figure 4.1 shows that the extreme conditions (averaged over the first six months of the year) actually involved some areas in the Southern hemisphere as well.

In August 2013 a more limited cold wave affected western-central South America, with abundant snowfall in five departments in Western Bolivia (29). The unseasonal cold weather and frost also affected Parana State of Brazil, which normally produces close to 50 percent of the wheat output of Brazil (33).

Figure 4.1 Average temperature index anomaly, January to April 2013 (°C)

Floods

Floods were reported for various areas. Although their local impact may be devastating, their spatial extension is usually more limited and often confined to the bottom of valleys. Among floods with explicit agricultural impacts, the Parana and Iguazu Rivers created havoc in the littoral region of Argentina during June and July 2013. The neighboring countries of Paraguay and Uruguay have also been affected by the floods, as has southern Brazil (27) (29).

In Asia, India experienced floods during late June to August, particularly in northwest and northeast parts of the country (34). Landslides occurred over the states of Uttar Pradesh, Uttarkhand, and Himachal Pradesh, also touching Nepal (27) (29) (32). In neighboring Pakistan, floods occurred later, starting in August (Punjab and Sindh) and in September, destroying “hundreds of thousands of acres of crops” (27). In China, floods affected the North-East; in June 2013 they also created damage in the south and the east (Gansu and Sichuan provinces) (32).

In West Africa, floods occurred in late 2012, and again between July and September 2013, destroying farmland in the states of Zamfara, Kogi, and Bauchi in Nigeria (27) (29). Floods also struck large areas in Ethiopia starting in mid-April 2013, causing damage to infrastructure and loss of farmland (29).

In May 2013, floods affected Manitoba, Saskatchewan, Ontario, and Quebec provinces in Canada (32), but the most widely publicized floods are those that touched Colorado in September, exacerbated by a long and exceptional drought that effectively blocked the infiltration of rainfall into the dry soil.

In Eurasia, water excess affected agriculture in eastern Romania (September 2013) (29) and in Russia where August floods, the worst over a century, followed heavy rains which began in July, affecting the Amur Region, Khabarovsk Territory, and the Jewish Autonomous Region (27) (29).

Drought

Droughts, like floods, occur in seemingly random patterns. In reality, they are often linked through the larger atmospheric circulation and seasonal movements of the monsoon, e.g., in Africa where delays of the start of the rainy season are necessarily associated with an unusually long season in the southern hemisphere. For the current reporting period, South America during September suffered extended wildfires in Cordoba province in Argentina, caused by high seasonal temperatures and strong winds.

15,000 hectares of land have been affected by the fires (27) (35). The same area also includes the Paraguayan Chaco (drought from May to September) (29).

In Africa, according to (36), rainfall was generally below average conditions. As a result, production was less than average in the semi-arid regions in the south and north. Central areas were impacted less, compared to the eastern part of the country, especially after improved rainfall (though still below average) from late August to September in the main maize and wheat growing areas reduced the worst effects of the drought. In Nigeria early season rain was irregular in the northeast. Rainfall was generally below last year's and often below average (36)

In India, rain was below average during July to August over much of eastern parts, mainly in the important rice producing states such as in Bihar, Haryana, and Tamil Nadu. (34). In Indonesia, 2013 also brought a drought, although it did not have a serious effect on rice growth.

In Europe, 2013 did not bring anything comparable with the regional 2012 drought that affected large parts of the Black Sea region, the Balkans and Central Europe (29) (32). The only noteworthy 2013 drought seems to be the one that occurred in Moldova, where a combination of low rainfall and a heat wave caused significant crop losses.

In the United States, the drought that affected Colorado was already mentioned in the context of the September 2013 floods, the destructive power of which partly resulted from the preceding drought period. (32) (27) (37)

Chapter 5 China: Production and Crop Conditions

5.1 Summary of production estimates by province

The 2012-13 cropping season in China is best described as “globally average,” with the following productions and differences with the previous season: maize 194,178 thousand tons (+ 3.1 percent), rice (as paddy) 200,145 thousand tons (+0.6 percent), soybean 13,245 thousand tons (-6.8 percent) and wheat 118,178 thousand tons (-1.3 percent) (table 5.1).

The largest single contribution of any province to the national production for a particular crop is 35 percent (soybean in Heilongjiang). For maize, the national production is dominated by Heilongjiang, Jilin, and Shandong (13, 12 and 10 percent, respectively). For rice, the largest contributors are Hunan (13 percent), Heilongjiang (10 percent), Jiangxi (9 percent), Anhui (8 percent) and Jiangsu (8 percent), a much more balanced situation than for other crops. For soybean, in addition to Heilongjiang, the major contributors are Anhui and Inner Mongolia with 8 percent and 6 percent, respectively. Finally, for wheat, more than half the production hails from the three provinces of Henan (22 percent), Shandong (19 percent), and Anhui (9 percent).

Considering the detail of changes over the previous season, the most dramatic difference occurs for wheat in Heilongjiang, with a decrease of 35.6 percent due essentially to very unfavorable temperature conditions during late winter and early spring in northeast China. In addition to yield loss, the phenomenon also accounts for changes in the cropping structure, in particular wheat to maize. Heilongjiang also underwent a dramatic drop in Soybean production (-5.2 percent), which was compensated for by a shift to maize (+5.5 percent). For rice, the extreme variations are those of Ningxia (-2.4 percent) and Anhui (+3.6 percent). The largest increase for any crop was achieved for maize in Shanxi (+11.7 percent).

Interestingly, for all crops, the yield variation compared with last year stays in the range from -2 percent to +3 percent, with few minor exceptions, for instance, approximately -3 to +3 percent for early rice, and -0.5 to + 1 percent for late rice (table E.3 in annex E).

For area, patterns are much less obvious. For maize, the variation ranges from -1.2 percent to +4.9 (in Heilongjiang); for soybean, from -5.1 percent (also Heilongjiang) to +0.6 percent. The most spectacular decrease is for wheat in Heilongjiang (-35.5 percent), followed by -4.5 percent in Ningxia, which stresses the abnormality of the conditions that affected Heilongjiang this year. The largest increase for wheat (+4.5 percent) occurred in Inner Mongolia. As to the three rice typologies in table 5.3, the area increases all are within a range of -3 percent to +2 percent. The difference between the (low) variability of yields and the (larger) variability of areas derives from the fact that a large volume of national Chinese production is irrigated.

Table 5.1 China, 2013 production and percent difference with 2012, by province (thousand tons)

	Maize		Rice (paddy)		Soybean		Wheat	
	2013	Δ%	2013	Δ%	2013	Δ%	2013	Δ%
Anhui	3799	-3.9	16746	3.6	1096	-4.1	11050	-2.3
Chongqing	2037	-1.5	4866	1.4			1137	-2.1
Fujian			2822	0.5				
Gansu	4942	0.7					2744	-0.6
Guangdong			11106	-1.7				
Guangxi			10953	1.2				
Guizhou	4722	-2.6	5126	-1.1				
Hebei	16635	6.2			174	3.7	10245	-1.6
Heilongjiang	25481	2.5	20044	1.7	4625	-10.9	482	-35.6
Henan	16697	-1.2	4102	1.8	776	-9.6	25486	-0.7
Hubei			15871	-1.0			4410	-2.8
Hunan			25547	-1.7				
Inner Mongolia	15172	4.7			845	-4.2	1904	2.5
Jiangsu	2170	0.5	16715	0.1	797	1.2	9052	0.4
Jiangxi			17221	-2.3				
Jilin	23947	4.0	5066	1.4	649	-3.9		
Liaoning	13270	0.3	4695	0.5	520	-3.5		
Ningxia	1687	-14.9	462	-2.4			741	-6.7
Shaanxi	3998	2.3	1052	2.4			3890	-8.3
Shandong	18587	5.5			697	-4.6	22242	0.7
Shanxi	9786	11.7			193	10.9	1970	-4.8
Sichuan	7060	1.4	14581	1.6			4567	1.6
Yunnan	5890	0.1	5074	-1.7				
Zhejiang			2815	3.2				
Sub-total	175879	2.7	184865	0.2	10372	-7.0	99919	-1.2
Remaining 12 provinces	18299	7.1	15280	6.6	2873	-6.3	18259	-2.0
National Total	194178	3.1	200145	0.6	13245	-6.8	118178	-1.3

5.2 Cropland use intensity and cropping structure

Most Chinese provinces practice cropping intensities in excess of 100 percent: the average reaches 168 percent, a slight decrease compared to last year. More than half the provinces have cropping intensity values in excess of 192, with values close to the maximum (235 percent in Guangxi) being observed in Zhejiang (234 percent) and in Jiangxi (226 percent). Interestingly, the next highest values are all about 20 percent below the top three. The largest decrease for cropping intensity this year occurred in Guangdong (-3.5 percent), while the largest increase was recorded in Zhejiang (+3.5 percent). Both cropping index and cropping index change show a marked difference between the average and the median, indicating a negative skew in the distribution of cropping intensities between provinces.

Uncropped arable land is less than 1 percent (0.85 percent), a notable increase over last year, no doubt due to the variety of adverse conditions that have affected the country this year. The highest value is that of Ningxia (3.8 percent). Regarding the potential biomass ratio (PBR), the difference between median (0.897) and average (0.879) is significantly less marked than for the other indicators in this table.

However, some spectacular changes are recorded when comparing this year's value with the previous one: from -5.8 percent (Anhui) to 25 percent in Ningxia.

As was also observed in chapter 3, the indicators are not mutually independent. A strong positive correlation ($r=0.7$) is noted between uncropped arable land and the change in potential biomass ratio, pointing at increasing efficiency, particularly in areas where uncropped arable land is high. Noteworthy and significant negative associations concern cropping intensity and both potential biomass ratio and its change since last year: the lower the cropping intensity, the higher the PBR and its growth. All these correlations could stem from specific development efforts being targeted at the technologically less advanced provinces.

Table 5.2 China, cropping intensity, uncropped arable land, and potential biomass ratio, 2013, by province

	Cropping Intensity		Uncropped arable land		Potential biomass ratio	
	2013	Δ%	2013 (%)	Δ%	2013	Δ%
Anhui	206	0.8	1.39	122	0.855	-5.8
Chongqing	193	0.7	0.08	-65	0.888	-2.8
Fujian	217	0.8	0.60	7	0.897	-0.3
Gansu	107	-1.5	1.60	-62	0.918	11.6
Guangdong	214	-3.5	0.59	-1	0.870	-1.6
Guangxi	235	0.5	0.09	109	0.912	0.2
Guizhou	206	1.4	0.03	216	0.897	-2.2
Hebei	154	-1.9	0.94	-16	0.885	-1
Heilongjiang	100	-0.6	1.39	115	0.935	-0.6
Henan	196	0.7	0.57	266	0.865	-4.4
Hubei	195	-2.8	0.63	122	0.872	-4.1
Hunan	209	-0.5	0.40	152	0.877	-3.3
Jiangsu	201	0.3	1.73	38	0.846	-4.1
Jiangxi	226	0.1	1.31	92	0.878	-2
Jilin	100	-1.6	0.67	41	0.935	1
Liaoning	100	-0.4	0.35	7	0.929	1.6
Inner Mongolia	100	-2	1.66	-77	0.919	8.7
Ningxia	100	0	3.84	-70	0.898	25
Shaanxi	133	1.6	0.39	-9	0.911	2
Shandong	182	1.1	0.65	-21	0.863	-1.6
Shanxi	134	-1.9	0.48	-47	0.923	5.7
Sichuan	186	-1.9	0.37	-70	0.908	0.3
Yunnan	191	0.8	0.25	116	0.912	0.5
Zhejiang	234	3.5	0.64	44	0.876	-2.1
Weighted average	168	-0.3	0.85	65	0.892	-0.8

Note: Δ% indicates percent difference with 2008-2012 average. The averages were obtained by weighting table values by the total provincial area under maize, rice, soybean and wheat.

Cropping structure, that is the distribution of land between different crops, is shown in table 5.3 for four major crops only. The table immediately shows the relative importance of summer crops in terms of cultivated land: maize: 59 percent; rice: 19 percent; soybeans: 6 percent. The provinces where maize occupied more than 70 percent of summer cultivated land include Guizhou, Hebei, Henan, Inner Mongolia, Jilin, Liaoning, Ningxia, Shaanxi, and Shanxi, while Guangxi, Hunan, and Jiangsu cultivates very little. It is a characteristic of the maize data in table 5.3 that the crop either plays a dominant part, or almost no part. There are no "intermediate" provinces.

For rice, the focus (>40 percent of land) is in Guangxi, Hunan, Jiangsu, and Sichuan, and many provinces do not cultivate rice at all. As for soybean, it remains a subordinate crop, except for in Anhui (30 percent) and the three provinces of Guizhou, Heilongjiang and Henan where it occupies between 10 and 15

percent. Henan and Shandong are the provinces which, by far, cultivate the largest proportion of wheat. Spring wheat is insignificant except for Gansu, Heilongjiang, Inner Mongolia and Ningxia. The bulk of the production, however, originates in Henan, Shandong, Hebei, Jiangsu, and Anhui.

Table 5.3 China 2013 cropping structure

	Maize	Rice	Soybean	Wheat**
Anhui	28.86	26.76	24.17	39.21
Chongqing	52.69	26.49	3.46	19.83
Fujian*				
Gansu	50.57	0.09	0.49	25.27
Guangdong*				
Guangxi	6.29	45.88	0.08	
Guizhou	82.12	2.36	15.49	
Hebei	76.58	0.02	0.34	36.79
Heilongjiang	60.68	21.69	15.03	1.32
Henan	74.27	0.01	11.42	68.80
Hubei	21.81	38.31	1.03	16.36
Hunan	9.37	71.61	0.29	
Inner Mongolia	77.49	0.05	0.29	5.10
Jiangsu	3.87	50.70	5.94	40.71
Jiangxi*				
Jilin	79.09	14.03	1.65	
Liaoning	80.85	7.56	0.42	
Ningxia	72.30	13.98	0.00	20.03
Shaanxi	71.54	7.65	0.37	18.57
Shandong	54.58	0.00	0.18	57.80
Shanxi	75.50	0.00	1.08	15.74
Sichuan	28.89	44.68	3.63	28.46
Yunnan	47.22	12.78	1.97	
Zhejiang*				
%weighted average	52	19	6	

Note: The numbers indicate the percentage of the area cultivated under maize, rice, and soybean during early July and early October, and under wheat during mid-May in 2013. The difference between 100 percent and the sum of maize, rice, and soybean per province is "other summer crops."

*Fujian, Guangdong, Jiangxi, and Zhejiang were not sampled because rice is by far the dominant crop among the four major crops.

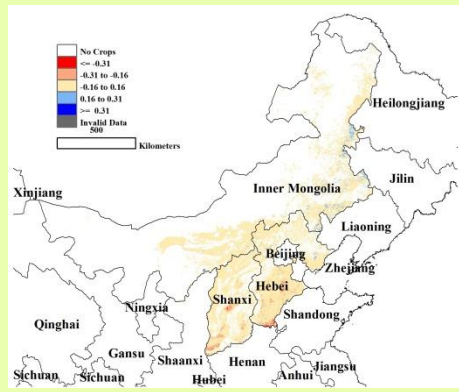
** Both spring wheat and winter wheat were included.

5.3 Province narratives and figures

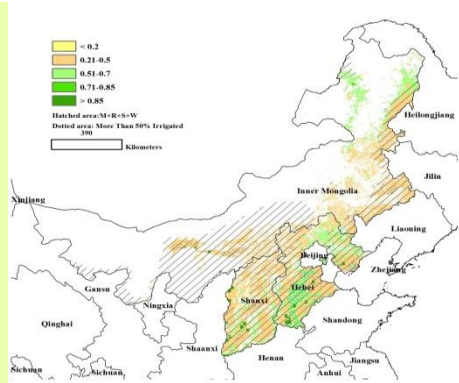
For each of China's six regions, the figures 5.1 through 5.6 present crop condition information. Similar to what was provided for countries in chapter 3, the provided information is as follows: (a) General setting, provided by a NDVI background showing combined maize, rice, soybean, and wheat cultivation area, and areas where more than 50 percent of the land is irrigated; (b) Crop condition map compared with the average of the previous five years; (c) Crop condition development graph: a comparison of NDVI of the current year with the previous year and the average of the previous five years; (d) Spatial NDVI patterns of the latest or ongoing season; and (e) NDVI profiles associated with the spatial patterns. Additional information, including CropWatch estimates for yield and cropped areas by province, is presented in Annex E.

North China | HEBEI, INNER MONGOLIA, SHANXI

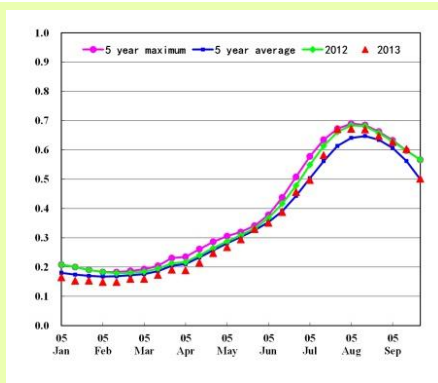
In Hebei province winter wheat growth was delayed due to low temperature, but the crop grew quickly after February due to improved conditions. Unfortunately, cold weather returned in several waves, inhibiting normal crop development. In Shanxi, during late February and April, high temperature and little rain led to the drought. Since then good weather condition promoted the crop growth until July. After the maize sowing in mid-June, Rainfall exceeded last year's negatively affected maize growth. From August, sufficient sunshine and suitable temperatures in the North China have accelerated the growth of the crops. In Inner Mongolia adequate rainfall and temperature from July to September led to crop condition comparable with the previous season. Overall, at the time of the NDVI peak in the region, crop condition (c) was comparable to the 2012 and slightly above the average of the last five years. Poor conditions (e) were observed in two locations: southeast Shanxi in May, which resulted in a decrease in wheat yield and production, and southeast Hebei during late summer, resulting in a drop in maize production.



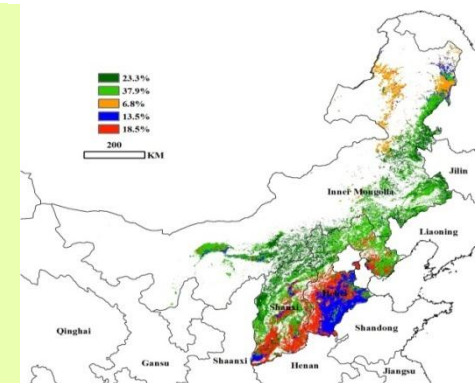
(a)



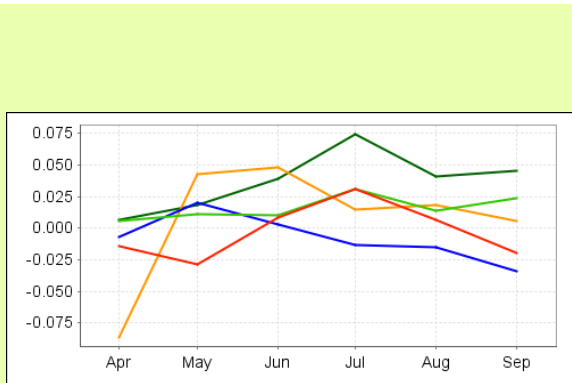
(b)



(c)



(d)

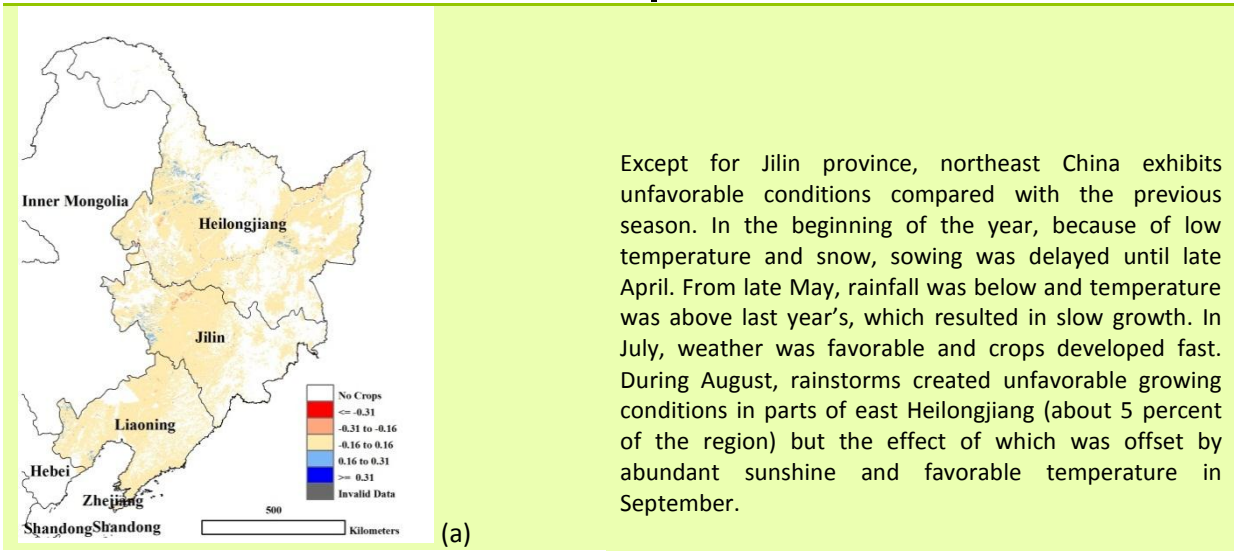


(e)

Figure 5.1 Crop condition for North China. (a) General setting: NDVI background; combined maize, rice, soybean and wheat cultivation area, and areas where more than 50 percent of the land is irrigated. (b) Crop condition map compared with the average of the previous five years. (c) Crop condition development graph: a comparison of NDVI of the current year with the previous year and the average of the previous five years. (d) Spatial NDVI patterns during the latest or ongoing season. (e) NDVI profiles associated with the spatial patterns.

Northeast China

HEILONGJIANG, JILIN, LIAONING



Except for Jilin province, northeast China exhibits unfavorable conditions compared with the previous season. In the beginning of the year, because of low temperature and snow, sowing was delayed until late April. From late May, rainfall was below and temperature was above last year's, which resulted in slow growth. In July, weather was favorable and crops developed fast. During August, rainstorms created unfavorable growing conditions in parts of east Heilongjiang (about 5 percent of the region) but the effect of which was offset by abundant sunshine and favorable temperature in September.

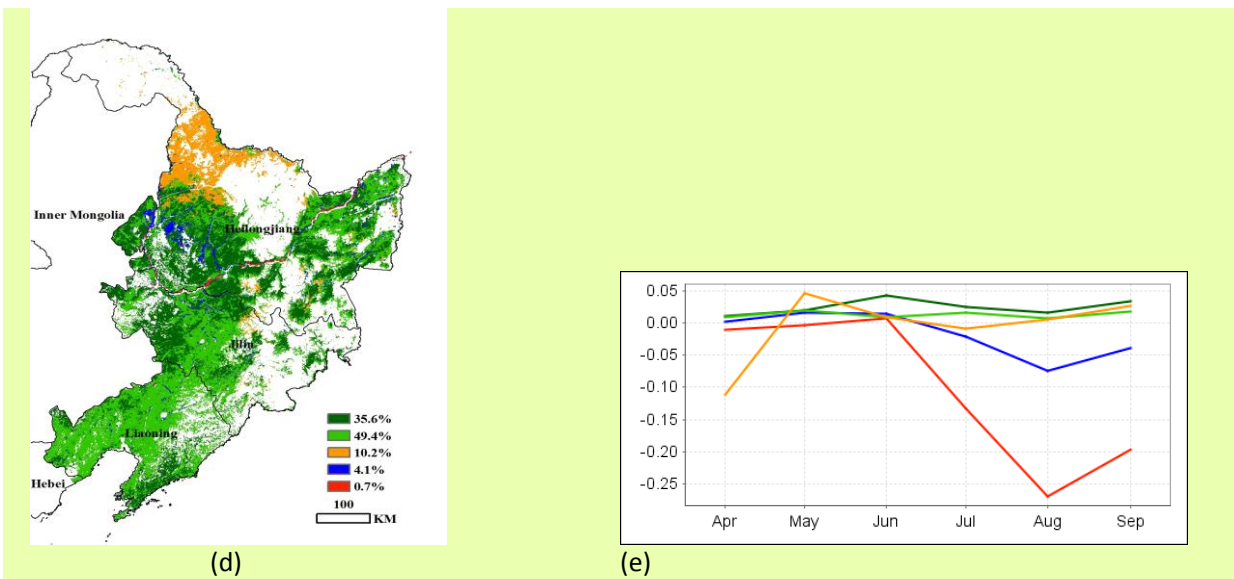
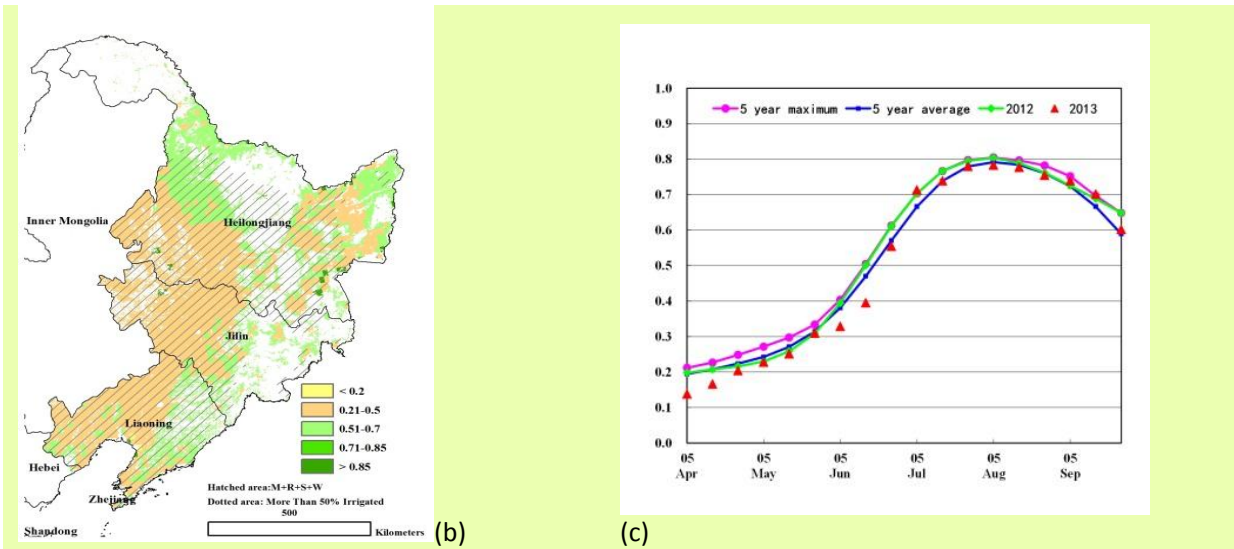
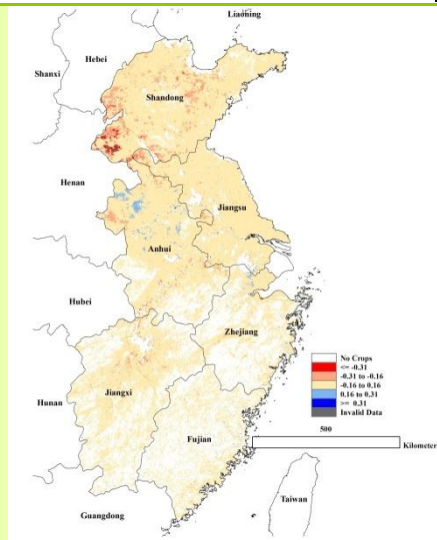


Figure 5.2 Crop condition for Northeast China. For descriptions of figures a-e, see figure 5.1.

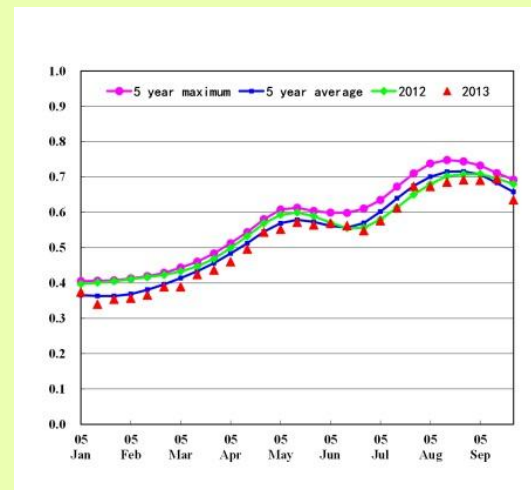
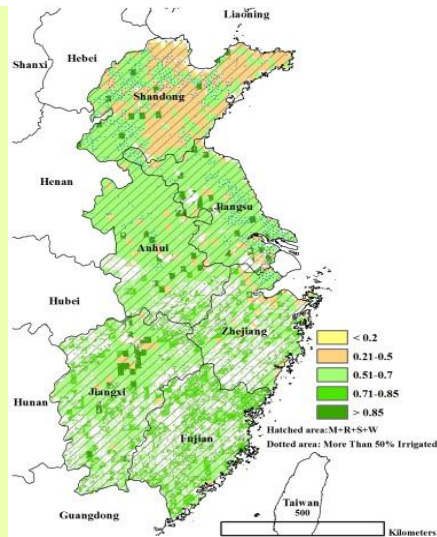
East China

ANHUI, FUJIAN, JIANGSU, JIANGXI, SHANDONG, ZHEJIANG

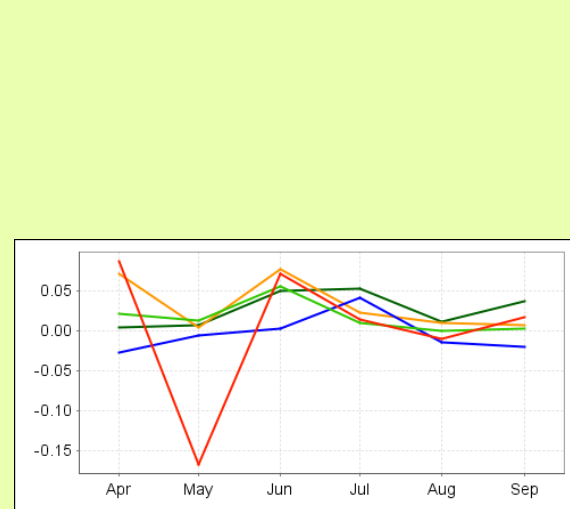
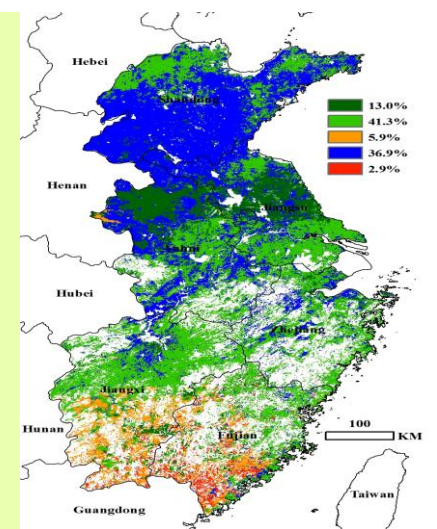


Low temperatures affected East China at the beginning of the year, inducing slow crop growth, except in Fujian where normal weather favored crop growth. From early February, adequate temperature in Jiangsu and Anhui promoted the growth of crops which reached the same stage as in Zhejiang since early March. In May, heavy rainfall in East China (except Jiangsu) limited crop growth followed, around late April by low temperatures that inhibited crop growth in Jiangsu. After sowing in July, Shandong suffered slow crop development due to heavy rain. During August and September, weather and crop conditions improved in Fujian, Jiangxi and Shandong provinces. The high temperature and drought that negatively impacted crops in Jiangsu, Zhejiang and Anhui during August was succeeded by good rains in September. By Mid-September crop condition was comparable to last year's.

(a)



(b) (c)



(d)

(e)

Figure 5.3 Crop condition for East China. For descriptions of figures a-e, see figure 5.1.

Central, South China

GUANGDONG, GUANGXI, HENAN, HUBEI, HUNAN

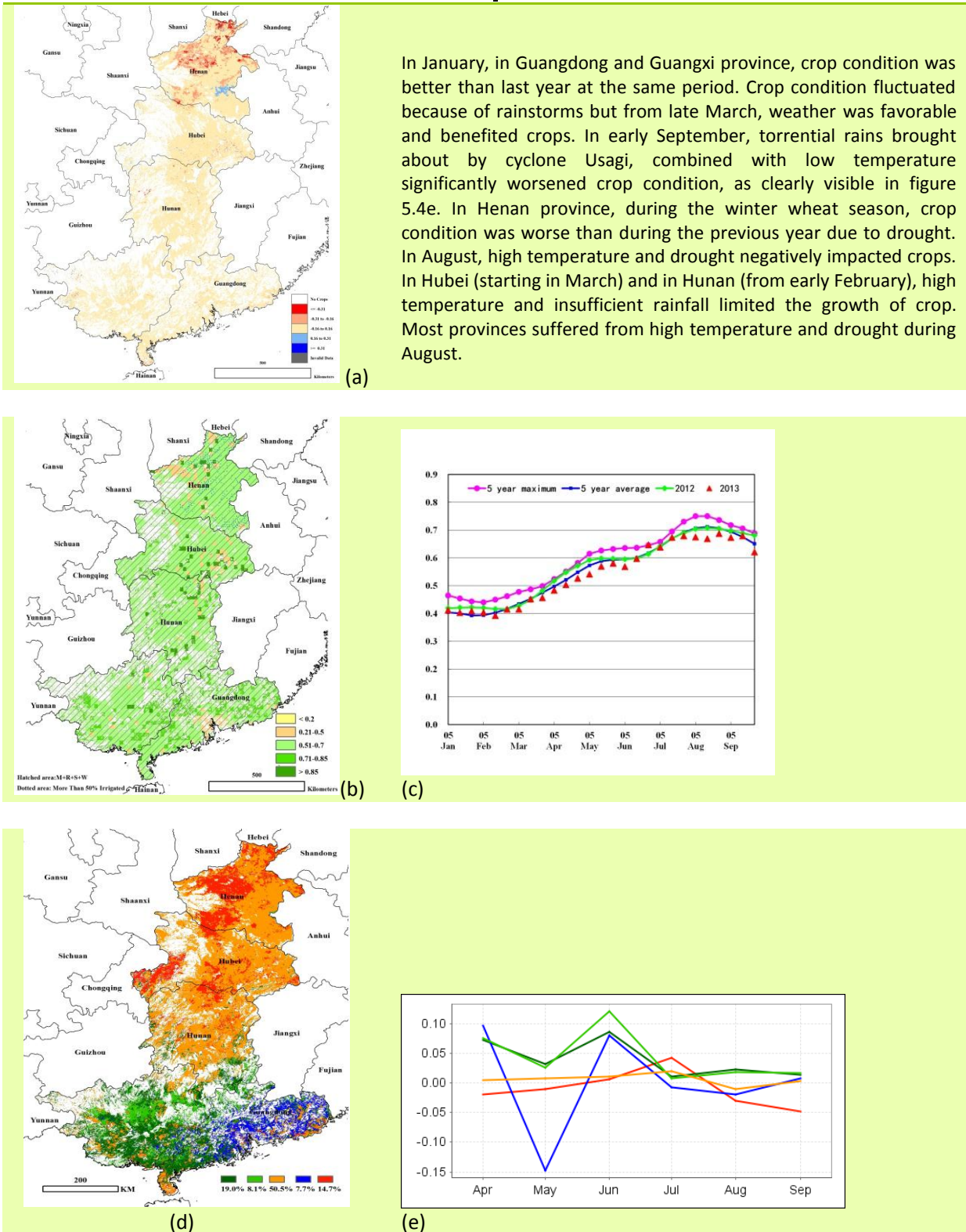


Figure 5.4 Crop condition for Central and South China. For descriptions of figures a-e, see figure 5.1.

Southwest China | CHONGQING, GUIZHOU, SICHUAN, YUNNAN

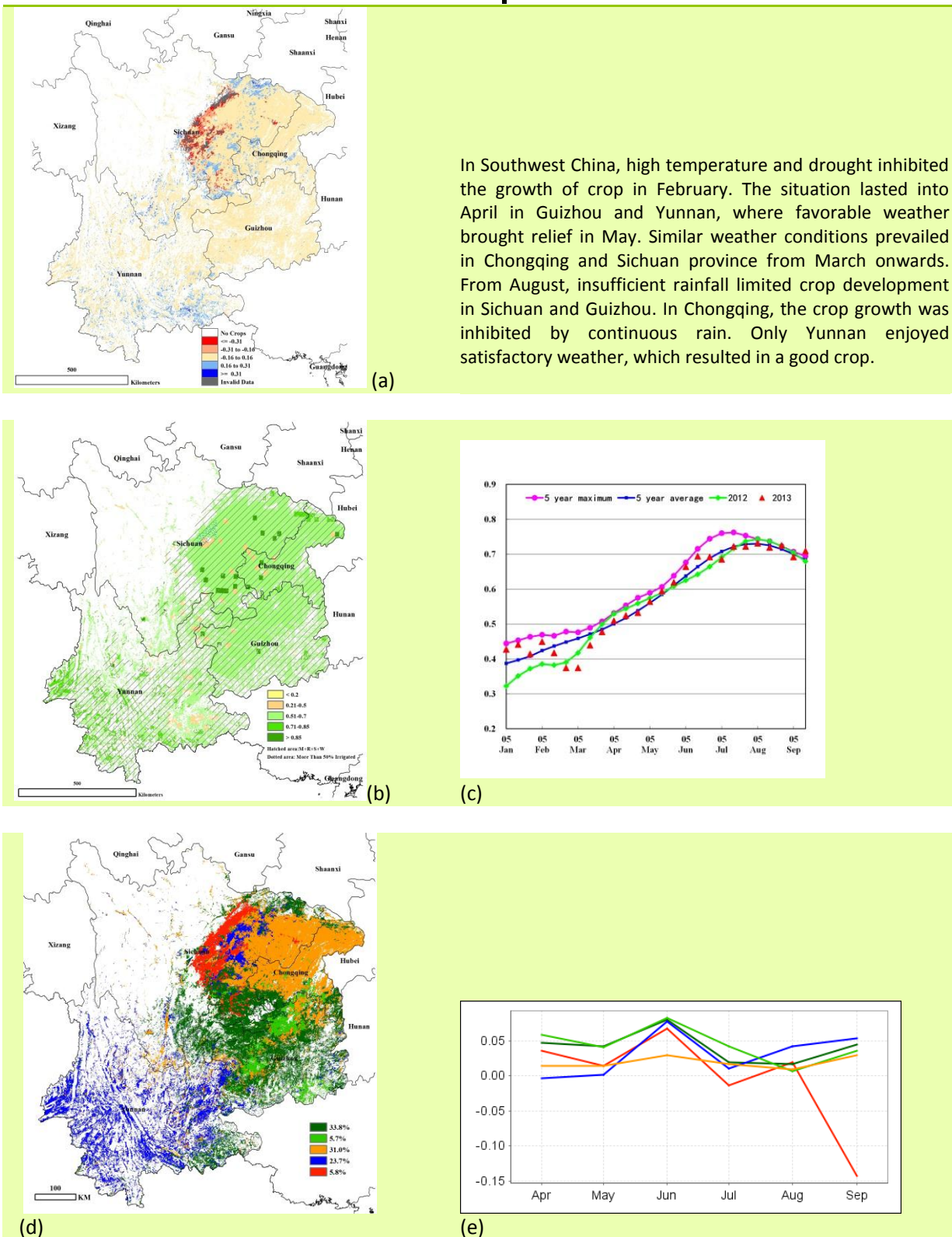


Figure 5.5 Crop condition for Southwest China. For descriptions of figures a-e, see figure 5.1.

Northwest China | GANSU, NINGXIA, SHAANXI

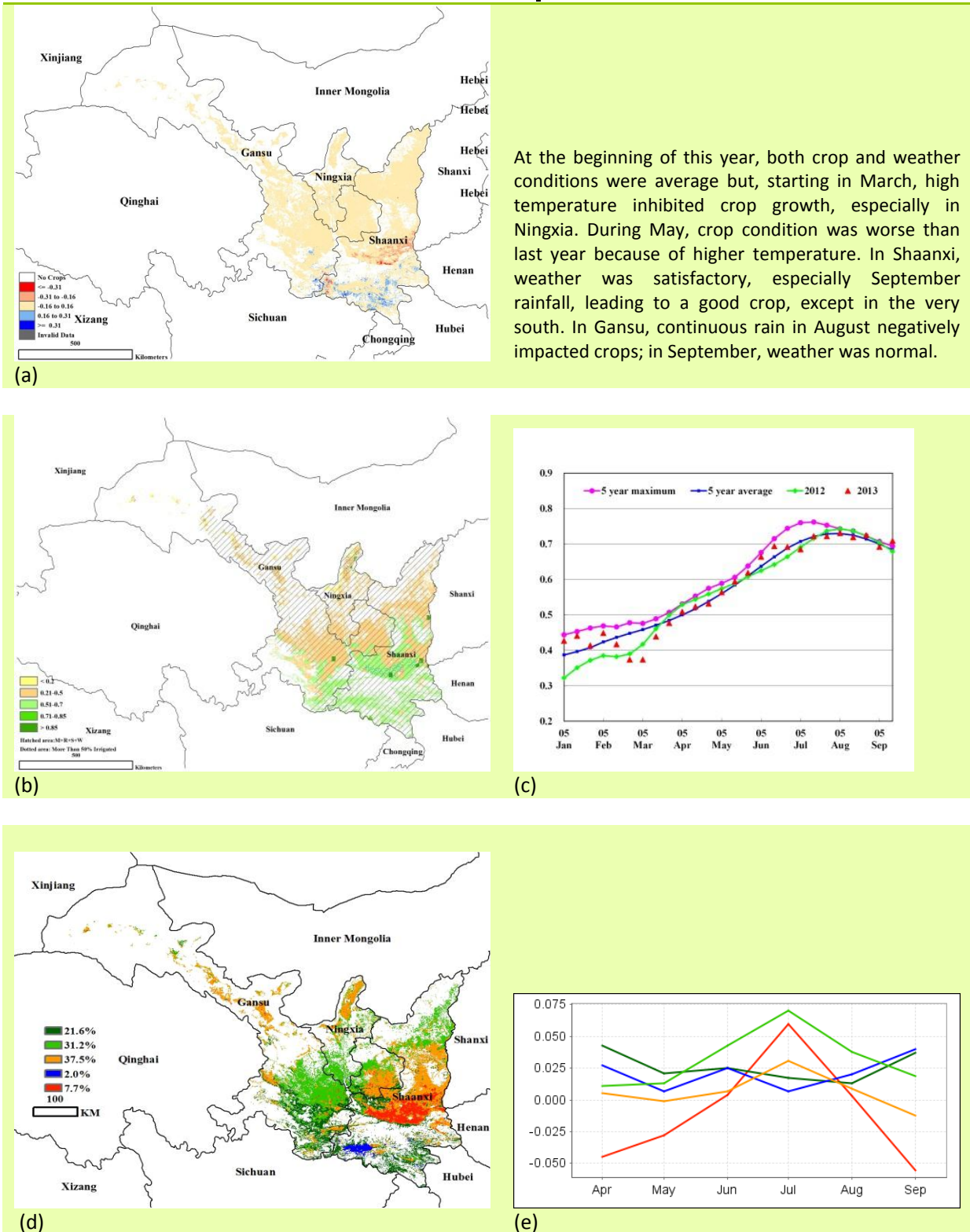


Figure 5.6 Crop condition for Northwest China. For descriptions of figures a-e, see figure 5.1.

Chapter 6 Background

6.1 Geographic units of analysis

This bulletin adopts the Global Administrative Units Layer (GAUL) boundaries for all national and sub-national units, except for China, where official Chinese data have been used. GAUL is available from FAO GeoNetwork (38)

6.1.1 Crop Production System Zones

For a detailed overview of the Crop Production System Zones (CPSZ), see Annex A. The main basis for the delineation of the CPSZs is the global ecological map prepared in the ambit of the FAO Forest Resources Assessment (39), further subdivided when necessary or otherwise modified based mainly on Köppen climate zones (the digital maps from Grieser et al. (40), VASClimO 1976-2000 data), “the most suitable cereal” grids available from the Global Agroecological Zones project (41). Other sources include USDA (42), Ramkuttu’s Global distribution of cultivable lands (43) and Monfreda et al. (44).

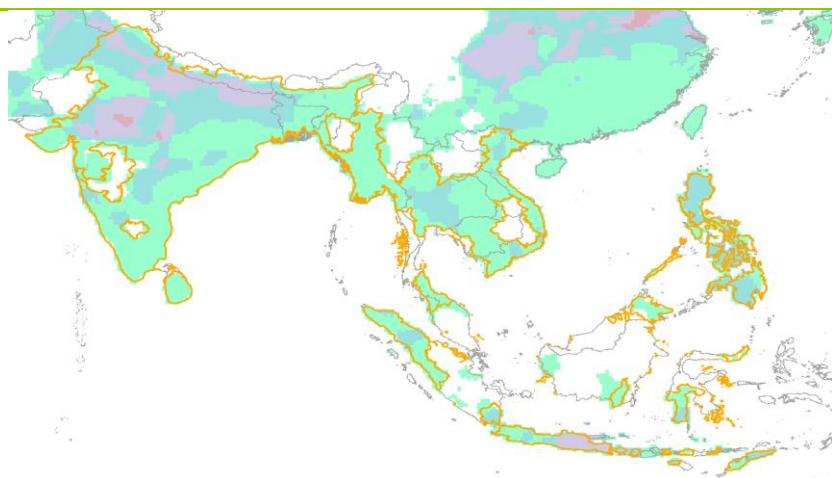
A special mention is needed about China, where the zones were not derived using the same approach, but cover standard Chinese agroecological zones (published in Chinese by Sun He (45); an English language description can be found in Hu Zizhi and Zhang Degang (46).

6.1.2 Major Production Zones

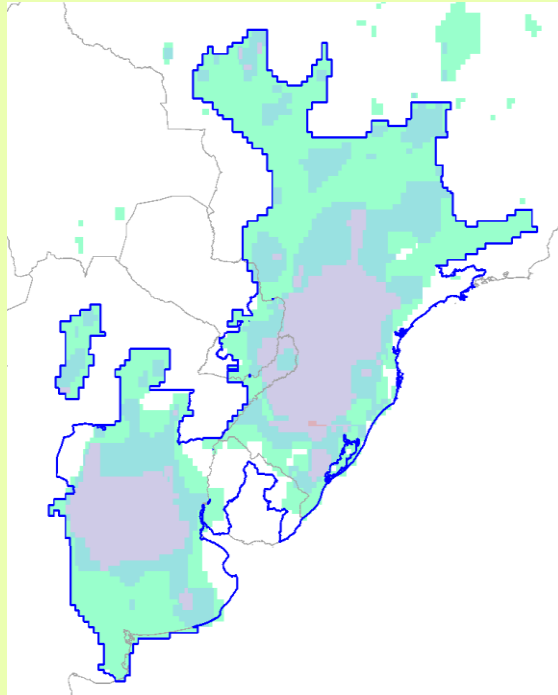
The Major Production Zones (MPZs) were selected based essentially on a combined maize, rice, soybean and wheat distribution raster map based on JRC crop masks (figure 6.1). For the areas of interest, each MPZ includes the area where at least one of the four crops is cultivated, bounded either by the area where none of the four crops is cultivated or by national or sub-national political boundaries. In one instance (central Europe and W. Russia), the northern limit was taken to coincide with CPSZ 59 (“Ukraine to Kazakhstan”) and the eastern limit is given by the Ural Mountains.

The CropWatch Bulletin may cover different “major production zones” in subsequent issues.

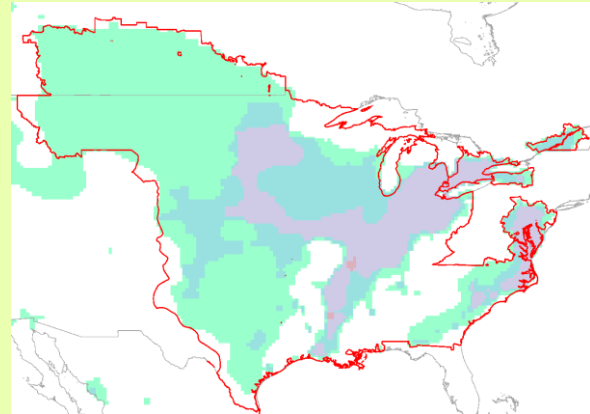
Figure 6.1 Map of the major crop producing zones showing political boundaries and the number of cultivated crops.



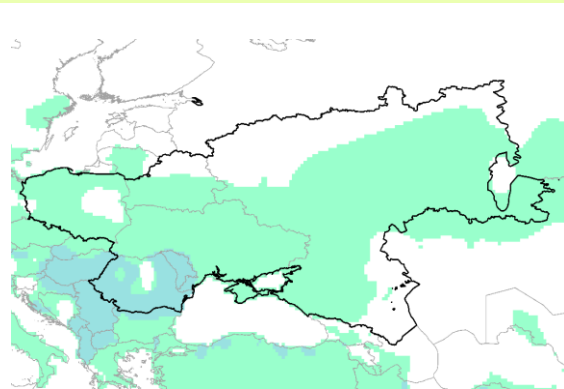
South-East Asia



South America



United States and Canada



Poland and Romania to Ural mountains in Russia.

Note: Figures shows only maize, rice, soybean and wheat. White background: none of the four crops is grown; light green: only one crop is grown; dark blue-green: two crops are grown; purple: three crops; dark purple-red: all four crops. Very few areas cultivate all four crops (mostly in India). 6.1.3 Thirty countries

6.1.3 Country selection

The selection of countries was done based on statistics published by FAO on production and trade, to include 80 percent of both. Several countries near the “end” of the list were included based on other considerations, e.g., their location in Asia (such as Uzbekistan) or in Africa (Ethiopia). Some generic information about the countries and their agriculture is given in Annex F.

6.1.4 CPSZ, MPZ and country boundaries

Environmental indices were computed for several spatial units: CPSZs, MPZs as well as the selection of 173 countries and territories. The polygons constitute a subset of GAUL_0 (the national level) after exclusion of all “small” polygons defined as those which are smaller than a 25 km x 25 km pixel, empirically measured by polygon perimeter length.

6.1.5 Sub-national units

For some of the largest countries (Australia, Brazil, Canada, China, India, Kazakhstan, Russia, and the United States), the first level administrative units were included in the analyses.

6.1.6 Chinese provinces

For China, 24 province-level subdivisions are covered in the report, divided into six official geographic regions, namely North China, Northeast China, East China, South and Central China, Southwest China and Northwest China (47).

6.1.7 Crop masks and arable land masks

Global crop masks were provided by JRC. The original crop masks were created for global water satisfaction indices and cover 11 crops. In our analysis, maize, rice, soybean and wheat masks at 0.25 degree resolution were used. Other sources include major crop areas by USDA (42) and the suitability map for rain-fed plus irrigated crops by FAO/IIASA (48) (41).

The arable land mask was created by joining the arable land from MODIS-derived land use and land cover products for 2010 and 2011 (49), Version 2 International Geosphere Biosphere Programme (IGBP) global land cover dataset (IGBP-DISCover) (50), and GlobCover 2009 (51) (52). The arable land maps for China in 2000, 2005, and 2010 were extracted from ChinaCover 2000, 2005, and 2010 provided by the Institute of Remote Sensing and Digital Earth (RADI) (53).

6.2 Data

6.2.1 NDVI

NDVI data for this bulletin is mostly MODIS NDVI provided by NASA, selected mainly because of its high spatial and temporal consistency. The NDVI data covers January 2002 to the end of September 2013. Only MODIS Terra Land Level 3/Level 4 16-Day Tiled Products (found on the LAADS Website (54)) with one kilometer resolution were used. After downloading the data covering target regions, crop masks were applied to remove the non-arable land from the downloaded data.

In addition, long-term average NDVI over the years from 1999 to 2012 with a resolution of 0.1875 degree based on SPOT-VEGETATION (provided by VITO (55)) was used to produce growing season masks.

6.2.2 Temperature

The air temperature used in this report is a global gridded (0.25x0.25 degree) monthly product from January 2000 to September 2013 generated based on the Global Surface Summary of the Day (GSOD) dataset, available from the Global Change Master Directory (56).

The GSOD dataset is derived from the Integrated Surface Hourly (ISH) dataset, DSI-3505 (C00532), and is produced by the National Climatic Data Center (NCDC). Its online data dates back to 1929 and the latest daily summary data are normally available 1-2 days after the date-time of the observations used in the daily summaries. Over 9000 stations' data (including air temperature, dew point, sea level pressure, wind speed, precipitation, snow depth) are typically available in this dataset.

The mean daily air temperatures from 2000 to 2013 in the GSOD dataset were extracted to calculate the monthly air temperature for each station. Then kriging interpolation was applied combined with STRM_DEM data (57) considering temperature elevation correction to generate the 0.25x0.25 degree global monthly product.

6.2.3 PAR

Photosynthetically active radiation (PAR), which covers radiation in the 400 to 700 nm range, is an important biological variable. It can be derived from shortwave irradiance in the 300 to 2000 nm range (58). For the years between 2001 and 2012, global monthly mean PAR data was calculated from the NASA CERES Energy Balanced and Filled (EBAF)-Surface Ed2.7 data product (59). For the year 2013 global monthly mean PAR data were obtained from original hourly geoland-2 project DSSF products and the FY-2D surface radiation product (60) (61) (62). All three products were converted to the WGS84 with a resolution of 0.25 x 0.25 degree.

6.2.4 Rainfall

CropWatch has assembled composite rainfall grids for the period from 2000.10 to 2013.9 covering the whole land surface at 0.25 degree spatial resolution. Two rainfall products were merged: (i) version-7 TRMM rainfall (63) at 0.25 degree resolution extending from 50 degrees south (50S) to 50 degree northern latitude (50N) and (ii) GPCC rainfall (64) rescaled from 0.5 or 1 degree to 0.25 degree. For the period between 2000.10 and 2010.12, TRMM 3B43 monthly rainfall was used between 50S and 50N and GPCC monthly data in other regions. From 2011.1 to 2013.6, GPCC Monitoring Analysis product (65) replaced GPCC in other regions. From 2013.7 to 2013.9, monthly TRMM rainfall products were combined with 3 hours TRMM 3B42 real time products, and the merged rasters were used between 50S and 50N, GPCC first guess product (66) replacing GPCC monitoring product in other regions. The comparison of satellite-based rainfall with rain gauges shows good consistence, with some “lines” existing at the boundary regions due to the different data sources.

6.2.5 VHI

The Vegetation Health Index (VHI) is an effective indication of the crop growth condition. In this bulletin, the VHI was calculated (67) (68) (69) by weighting the Vegetation Condition Index (VCI) and Temperature Condition Index (TCI), which are downloaded separately from the NOAA Star Center for Satellite Applications and Research GVI-x VH dataset (70). The equation is as follows:

$$VHI = a * TCI + (1 - a) * VCI$$

The weighting factor (a) is an empirical coefficient for which the constant value of 0.5 was used.

6.2.6 Biomass

In this report, the net primary production (NPP) according to the Lieth’s “Miami model” (71) (72) is used to describe the global biomass situation. The Miami model expresses NPP as a function of two environmental factors, temperature and precipitation using following equations:

$$NPP = \min(NPP_T, NPP_p)$$

$$NPP_T = \frac{3000}{1 + e^{1.315 - 0.119T_C}}$$

$$NPP_p = 3000(1 - e^{-0.000664Prec})$$

Where T_C is average annual temperature in ° C and Prec is annual precipitation in mm.

6.3 Methodology

6.3.1 Environmental indices (EI)

To compare the agricultural impact of environmental variables across years and geographic areas (e.g., countries), it is necessary to use an index that gives a high weight to agricultural areas and focuses on the period covered by the cropping cycle. The intention is to derive “one number per year,” so that it becomes comparable with other variables that are available at the same spatial and temporal scale, i.e., agricultural statistics and a number of socio-economic indicators and variables.

Such an index has been defined earlier for rainfall (73) and applied for synthetic studies (e.g., (74) (75)). This bulletin expands the notion of Rainfall Index to Environmental Index by applying basically the same approach to PAR and temperature.

The EIs are defined for one variable V (rainfall, PAR, temperature) and one polygon, which may be a CPSZ or a country or any other spatial unit. They are based on spatial grids at a resolution of 25 km and are computed as the spatial average over an arable land mask of the values of V accumulated over a user defined period, using the net primary production potential (1976-2000 VASclimO based NPPP) (72) as the weighting factor: the most productive pixels receive a higher weight than unproductive ones. For this study, PAR and rainfall are simply accumulated, while temperature is taken above a threshold of 5°C. For most maps, the accumulation period is the entire period from October 2012 to September 2013, with some exceptions that are indicated in the text, e.g., January to May to cover winter crops in the northern hemisphere.

6.3.2 Production, Area and Yield

Production

The crop phenology of each individual country was considered and the average NDVI of the current growing season over a specific crop mask combined with the production of two previous years was used to calculate the production of the current year for the four crops (maize, wheat, soybean and rice) using the following equation:

$$\text{Production}_i = a + b * \text{NDVI}_i + c * \text{Production}_{i-1} + d * \text{Production}_{i-2}$$

where i is the current year; a , b , c and d are four coefficients estimated by stepwise regression with the average NDVI from 2002 to 2012 and the production from 2000 to 2011 from FAOSTAT.

For China, the production is estimated by using the area and yield estimated for each crop with following equation:

$$\text{Production} = \text{Yield} * \text{Area}$$

Area

For China, CropWatch combines remote-sensing based estimate of the crop planting proportion (cropped area to arable land) with a crop type proportion (specific type area to total cropped area) to estimate crop area (76) (77). The planting proportion is estimated based on an unsupervised classification of high resolution satellite images from HJ-1 CCD images. The crop-type proportion for China was estimated by GVG instrument from field transects (see also 6.3.6). The area of a specific crop was 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, we employed two methods. One relies on the profile features derived from time series MODIS NDVI data (78) (79) (80) (81), the other one relies on regression of crop area to that of the two previous years using the following formula:

$$\text{Area}_i = a + b * \text{Area}_{i-1} + c * \text{Area}_{i-2}$$

where a, b, and c are the coefficients generated by stepwise regression with area from FAOSTAT or national sources.

Yield

For 30 countries, yield for each crop is estimated using production and area:

$$\text{Yield} = \text{Production}/\text{Area}$$

For China, two models, namely an agrometeorological model and a remote sensing index model were applied (82) (83). The values pooled from the two models are combined and averaged to predict the crop yield per unit area.

6.3.3 Cropping intensity (CI)

The Cropping Intensity index describes the extent to which arable is used over a growing season. It is the ratio of total crop area of all planting seasons in a year to the total area of arable land (84). It also can be used to describe the food-producing potential of an area (85). This report adopts the method proposed by Fan and Wu (86) based on an NDVI time-series derived from MODIS Terra and reconstructed by the S-G filter method (87). The following descriptors were derived from the data: number of peaks, width of each peak and peak values at pixel level.

The calculation of Cropping Intensity involves counting the number of peaks in the NDVI profile; we use the difference method to extract the maximum value of the discrete points. Assuming a pixel is in a discrete points series, the values of pixels before and after the point constitute a point series S1 which include N-1 pixels,

$$S1 = \text{DIFF} (S)$$

where DIFF is the function used to calculate the difference among these points. Then, determine the sign of each pixel in S1, if the value of a pixel less than zero, assign the element value to minus one, otherwise, the element value is assigned to one; these values constitute a point series S2,

$$S2 = \text{SIGN} (S1)$$

Where SIGN is the function used to determine whether the values are positive or negative. As a next step, calculate the difference of pixels before and after a point in series S2, which yields the points series S3

$$S3 = \text{DIFF} (S2),$$

Finally, count the number of pixels with value minus two, which is the number of peaks in the NDVI profile. Based on the above equations and with other limitation, the model can generate a Cropping Intensity of one, two, and three per pixel, to illustrate areas with a single, two, or three crop seasons respectively.

6.3.4 Uncropped arable land ratio (UAL)

Uncropped arable land ratio was introduced to demonstrate the proportion of uncropped cultivated land to the total cultivated land over a certain geographic area (countries or sub-national units). Previous studies have shown a high correlation between NDVI and the photosynthetic biomass of cropped fields (88) (89). MODIS NDVI time series were used to identify whether an agricultural pixel is cropped or uncropped. For each cultivated pixel, 23 MODIS NDVI values were extracted from time series NDVI images and smoothed using Savitzky-Golay (S-G) smoothing filter (87). Maximum NDVI peak value was acquired from smoothed NDVI profiles from 2002 to 2013. Average and standard deviation of annual NDVI peaks ($NDVI_m$ and $NDVI_{std}$) were calculated based on annual maximum NDVI peak values from 2002 to 2013. A NDVI threshold method (90) (91) together with a decision tree were used to identify whether an agricultural pixel was cropped or uncropped over the last whole year (i.e., from October 2012 to September 2013). The difference between average and standard deviation of annual NDVI peaks were incorporated as a threshold to eliminate the inter-annual variability of biomass, crop phenology, and crop rotation. The decision tree can be described as follows:

$$\text{Status} = \begin{cases} \text{uncropped, if } \text{Peak}_{2013} \leq 0.15 \\ \text{uncropped, if } 0.15 < \text{Peak}_{2013} < 0.45 \text{ and } \text{Peak}_{2013} < (NDVI_m - NDVI_{std}) \\ \text{cropped, if } 0.15 < \text{Peak}_{2013} < 0.45 \text{ and } \text{Peak}_{2013} \geq (NDVI_m - NDVI_{std}) \\ \text{cropped, if } \text{Peak}_{2013} \geq 0.45 \end{cases}$$

6.3.5 Potential biomass ratio

Potential Biomass Ratio (PBR) is a new index proposed in this report to describe the current crop biomass potential compared with the maximum crop biomass potential. Based on the good relationship between NDVI and plant productivity and biomass (92) (93) (94) (95), NDVI is used here as a proxy of crop biomass and the time-series NDVI (2002 to 2013) are applied to calculate crop PBR with following equation:

$$\text{PBR} = \frac{NDVI_{\max_c} - NDVI_{\min_h}}{NDVI_{\max_h} - NDVI_{\min_h}}$$

where $NDVI_{\max_c}$ is the maximum NDVI of current year, $NDVI_{\max_h}$ is the historical maximum NDVI and $NDVI_{\min_h}$ is the historical minimum NDVI. Although $NDVI_{\max_c}$ and $NDVI_{\max_h}$ can be determined by assigning the maximum NDVI values of current year and the whole time range respectively, this cannot apply to $NDVI_{\min_h}$, because the low values of non-vegetation NDVI may contaminate the crop minimum NDVI. In this report, the empirical minimum vegetation NDVI value (0.15) is introduced to calculate $NDVI_{\min_h}$ with following equation:

$$NDVI_{\min_h} = \max(0.15, NDVI_{\min_{h0}})$$

where $NDVI_{\min_{h0}}$ is the original minimum NDVI of the whole time series.

Based on above equations, PBR can be used as a relative measure of current biomass condition with value from 0 to 1. The higher the BVR value is, the larger biomass potential it indicates for that year.

6.3.6 Cropping structure

Cropping structure is an additional variable only applied to China. It precisely illustrates the proportion of area under a given crop type to the total sown area (i.e., crop type proportion) for geographic areas (i.e., provinces). The crop type proportion was estimated by combining GPS, video, and GIS data (collectively referred to as GVG) from field transects (76). The specifically developed GVG instrument collects

thousands of field photos that are used to estimate the proportion of different crop types with accuracy above 98 percent (96) (97) (98) (85).

6.3.7 Time profile clustering

Based on a time series of pixel-based (raster) images, time profile clustering is a method that automatically or semi-automatically compares the time profiles of all pixels and distributes them among a limited number of "typical" behaviors (classes) that can be mapped. The method has the advantage of very synthetically describing the spatial distribution of typical time profiles (99) (100). In the CropWatch bulletin, we have used the SPIRITS software developed for JRC/MARS by VITO (101). NDVI and VHI profiles have been clustered, especially the difference between the current season and the average of the last five years taken as reference.

Annex A Concise Definition of Crop Production System Zones

Figure E.1 and table E.2 locate the sixty CPSZ defined for the CropWatch bulletin and provide a quick overview of some relevant physiographic and agriculturally relevant variables. The numbers on the map correspond with the numbers in the table.

Figure A.1 Global map of the sixty Crop Production System Zones

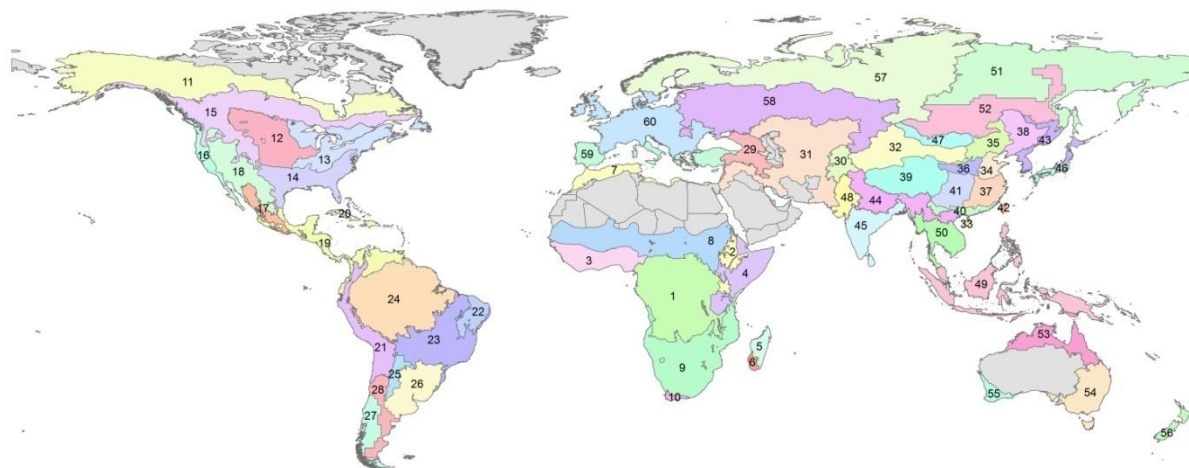


Table A.1 Physiographic and agricultural characteristics of Crop Production System Zones

	Long name	Area (kkm ²)	Altitude above sea level (m) ^a	Total annual rainfall (mm) ^a	Avg. temp ^a	Season ^a	Crop-land % ^b	Irrigation% ^c	NPPP (tons/ha) ^d	Vix ^e
1	Equatorial central Africa	7500	807	1437	23.3	EQ	5.3	1.3	1.63	0.66
2	East African highlands	800	1818	1070	19.1	CoWi	24.5	3.1	1.42	0.57
3	Gulf of Guinea	2300	281	1501	26.4	EQ	23.6	1.7	1.69	0.56
4	Horn of Africa	2400	680	440	25.3	WaSu	4.0	4.2	0.91	0.31
5	Madagascar (main)	600	594	1580	22.6	WaSu	6.9	4.9	1.85	0.67
6	SW Madagascar	200	357	692	23.8	WaSu	2.1	3.1	1.26	0.62
7	North Africa Mediterranean	1100	721	349	16.6	CoWi	30.3	15.4	0.59	0.31
8	Sahel	5800	417	464	27.7	WaSu	14.3	11.3	0.72	0.40
9	Southern Africa	5700	880	595	20.6	WaSu	6.6	3.8	0.91	0.53
10	S. Africa Western Cape	100	527	475	15.9	CoWi	16.7	8.7	0.70	0.52
11	Boreal North America	11000	494	422	-5.9	WaSu	0.3	0.1	0.37	0.69
12	America northern great plains	3400	687	531	7.1	WaSu	47.2	3.7	0.84	0.60
13	America corn belt	3600	292	999	6.7	WaSu	21.6	0.7	1.09	0.83
14	America cotton belt-Mexican coastal plain	2900	290	1069	17.0	WaSu	20.7	4.8	1.41	0.67
15	Sub-boreal North America	6900	874	672	0.5	WaSu	4.7	3.6	0.63	0.70
16	America West Coast	700	744	976	11.1	CoWi	12.9	14.7	1.02	0.59
17	Sierra Madre	800	1738	781	17.6	WaSu	13.6	13.2	1.12	0.65
18	SW Mexico and N. Mexico highlands	2900	1303	293	13.9	WaSu	6.9	7.5	0.52	0.29
19	Northern South and Central America	2500	346	1885	25.2	EQ	12.9	4.6	1.83	0.72

	Long name	Area (kkm ²)	Altitude above sea level (m) ^a	Total annual rainfall (mm) ^a	Avg. temp ^a	Season ^a	Cropland % ^b	Irrigation% ^c	NPPP (tons/ha) ^d	Vix ^e
20	Caribbean	300	200	1391	24.7	WaSu	30.9	10.4	1.61	0.77
21	Central-Northern Andes	2200	2621	805	13.2	WaSu	3.6	3.7	0.96	0.38
22	Brazil Nordeste	1000	417	754	24.5	WaSu	5.8	0.8	1.22	0.61
23	Central-Eastern Brazil	4500	438	1368	23.8	EQ	13.0	0.7	1.75	0.72
24	Amazon	7500	206	2317	25.8	EQ	1.9	0.3	2.18	0.80
25	Central-North Argentina	600	347	668	20.8	WaSu	7.1	5.3	1.19	0.70
26	SE Brazil-Concepcion-Bahia Blanca	2500	218	1148	18.1	WaSu	22.8	1.7	1.58	0.72
27	SW Southern Cone	1400	744	935	8.0	CoWi	2.0	17.5	0.97	0.50
28	Semi-arid Southern Cone	1400	1024	236	11.5	WaSu	1.0	7.5	0.51	0.26
29	Caucasus	1500	1224	583	9.7	CoWi	32.6	16.9	0.86	0.43
30	Central Asia Pamir mountains	900	2618	514	5.5	CoWi	15.0	17.7	0.65	0.42
31	Western Asia	7400	559	207	12.8	CoWi	8.3	21.2	0.39	0.26
32	China Gansu-Xinjiang	3400	1739	113	5.8	WaSu	2.7	18.1	0.20	0.17
33	China Hainan	40	197	1500	24.0	WaSu	19.4	6.2	1.86	0.77
34	China Huang Huaihai	600	91	656	13.3	WaSu	57.2	38.5	1.02	0.73
35	China Inner Mongolia	1300	976	366	3.3	WaSu	13.5	13.4	0.59	0.53
36	China Loess region	600	1355	523	8.8	WaSu	32.0	17.1	0.79	0.58
37	China Lower Yangtze	1300	258	1421	16.9	WaSu	27.1	22.4	1.72	0.73
38	North East China	1600	386	577	1.5	WaSu	24.3	10.5	0.70	0.81
39	China Qinghai-Tibet	3100	4390	384	-1.3	WaSu	0.4	4.2	0.49	0.34
40	Southern China	600	682	1519	20.1	WaSu	16.0	11.8	1.82	0.67
41	South-West China	1300	1234	1090	14.5	WaSu	19.3	11.2	1.41	0.70
42	Taiwan	45	792	2536	19.1	WaSu	12.0	21.6	2.01	0.73
43	East Asia	1100	377	991	4.2	WaSu	10.9	13.0	0.92	0.82
44	Southern Himalayas	2500	993	1426	20.2	WaSu	35.9	26.2	1.61	0.60
45	Southern Asia	1900	349	1262	26.3	EQ	56.3	21.0	1.59	0.52
46	Southern Japan and Korea	300	318	1864	13.4	WaSu	13.2	21.4	1.64	0.75
47	Mongolia region	1100	1491	118	2.7	WaSu	0.0	1.4	0.24	0.17
48	S. Asia Punjab to Gujarat	1000	216	458	25.7	WaSu	54.2	33.8	0.79	0.38
49	SE Asia islands	3400	373	2821	25.0	EQ	17.7	13.0	2.30	0.77
50	SE Asia mainland	1700	276	1844	25.7	EQ	27.6	12.5	1.99	0.65
51	Eastern Siberia	14100	416			WaSu	0.0	0.0	0.00	0.00
52	Eastern Central Asia	5400	1034	408	-5.5	WaSu	2.4	1.9	0.36	0.67
53	North Australia	2100	209	938	25.7	WaSu	2.8	0.7	1.29	0.55
54	Australia Queensland to Victoria	2300	276	640	17.0	WaSu	19.3	2.2	0.90	0.57
55	Australia Nullarbor-Darling	400	248	473	17.2	CoWi	45.6	0.2	0.74	0.64
56	New Zealand	400	495	1668	10.3	CoWi	1.7	2.9	1.32	0.71
57	Boreal Eurasia	18200	264	485	-5.5	WaSu	1.1	0.9	0.42	0.72
58	Ukraine to Kazakhstan	11000	278	498	3.7	WaSu	26.9	2.4	0.75	0.64
59	Mediterranean Europe and Turkey	1800	691	634	13.0	CoWi	32.4	10.2	0.99	0.47
60	W. Europe (non-Mediterranean)	5500	336	775	9.1	WaSu	33.9	7.3	1.09	0.67

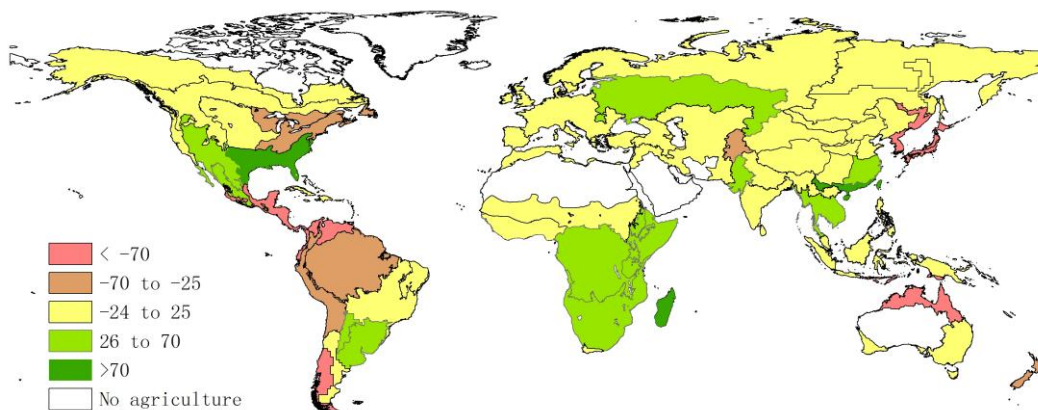
Note: Area is approximate area in thousands of square kilometers, derived from the shapefile. Altitude is the average altitude in meters above sea level. Avg. temp is the average annual temperature (°C). Season is the type of rainy season: EQ, stands for equatorial, characterized by an average annual temperature in excess of 22°C, an annual thermal amplitude below 3°C and rainfall in excess of 1000 mm. Equatorial climates are characterized by an all-year-round wet growing season, potentially high cropping intensities and crops such as rubber, cocoa and oil palm. CoWi indicates that the cold season is also the wet season. Because of altitude, the cold season does not always correspond to the local winter. WaSu indicates that the wettest and the warmest months coincide. The season type was derived based on data from (102). Cropland% is the average percent cropland (103) and Irrigation% is the percentage of the area that is equipped for irrigation (104). NPPP is the plant biomass (=net primary production) potential in tons of dry matter per ha according to the Miami model, based on 1976-2000 VasClimo data (105) (106) (71). Vix is the maximum of the average February and August Spot Vegetation NDVI.

Annex B Environmental Indices for Crop Production System Zones

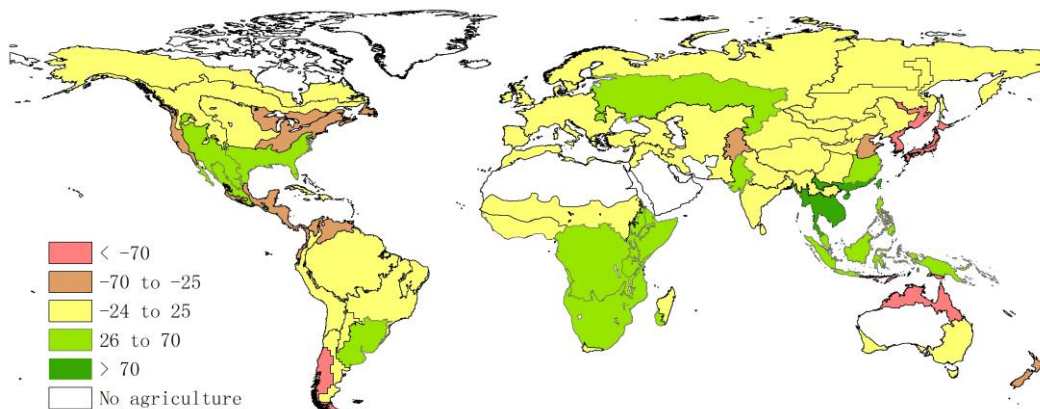
Figures B.1, B.2, and B.3 and tables B.1, B.2, and B.3 illustrate and describe accumulated rainfall, temperature accumulation, and accumulated photosynthetically active radiation (PAR) for the 60 crop production system zones (CPSZ) for the period October 2012 to September 2013. The figures each show the values' departure from the five-year average for 2008-12 (a), departure from the twelve-year average (2001-12) (b), and the trend for 2001-13 normalized by dividing it by the twelve-year average (c). The tables B.1, B.2, and B.3 provide the data itself, adding the correlation and significance of the trend. Data is based on 0.25 degree pixels over agricultural areas using NPPP weighting and Spot Vegetation derived monthly average growing season masks. Figure B.4 shows temperature and rainfall anomaly for shorter time periods.

Figure B.1 CPSZ October 2012-September 2013 rainfall accumulation (mm)

a. 2013 accumulated rainfall departure from the five-year average



b. 2013 accumulated rainfall departure from the twelve-year average



c. Accumulated rainfall trend for 2001-2013, expressed by the coefficient of correlation of rainfall regressed against time. Significance thresholds are 0.476 ($p \leq 0.05$) and 0.635 ($p \leq 0.01$).

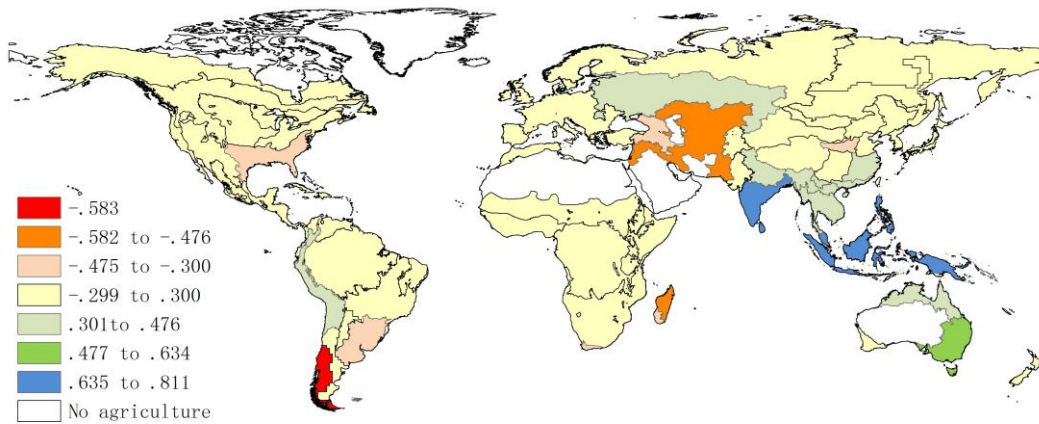
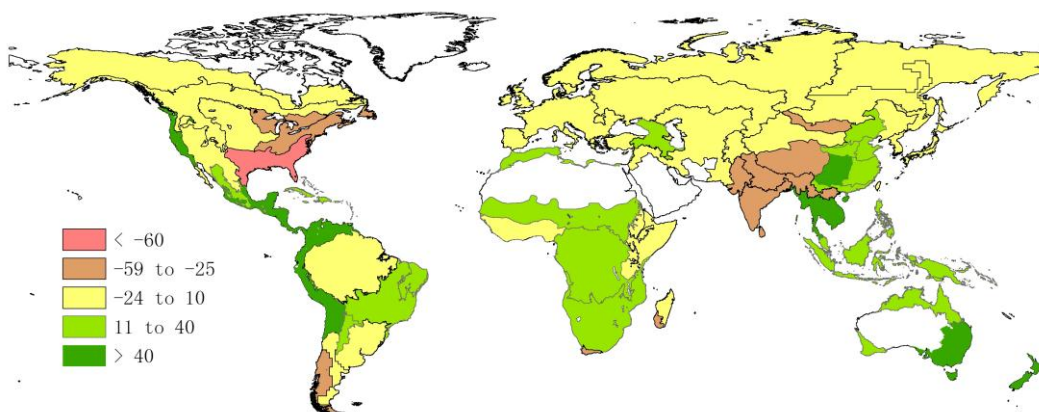
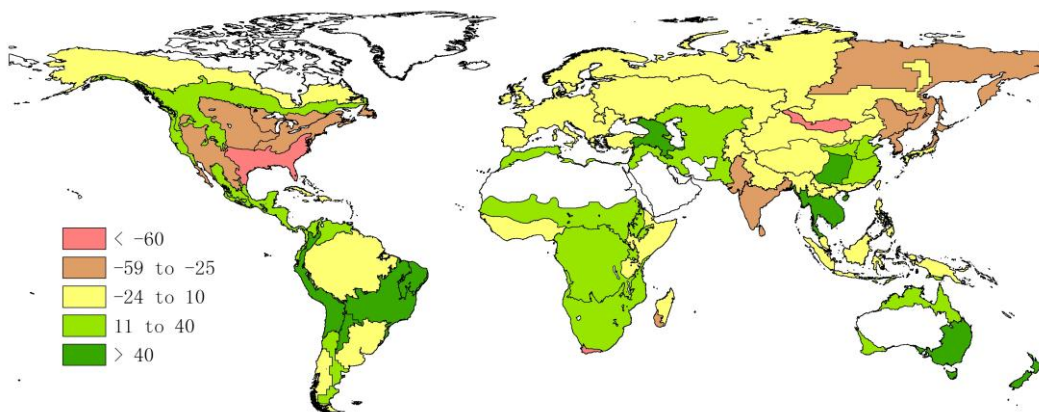


Figure B.2 CPSZ October 2012-September 2013 temperature accumulation ($^{\circ}\text{C}$)

a. 2013 Temperature accumulation above 5°C , departure from the five-year average



b. 2013 Temperature accumulation above 5°C , departure from the twelve-year average



c. Temperature trend, 2001-2013 (refer to B1.c for details)

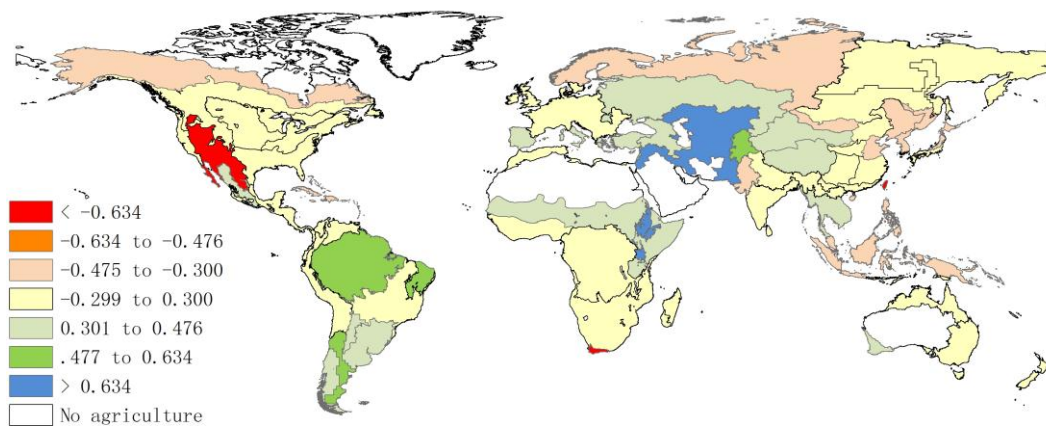
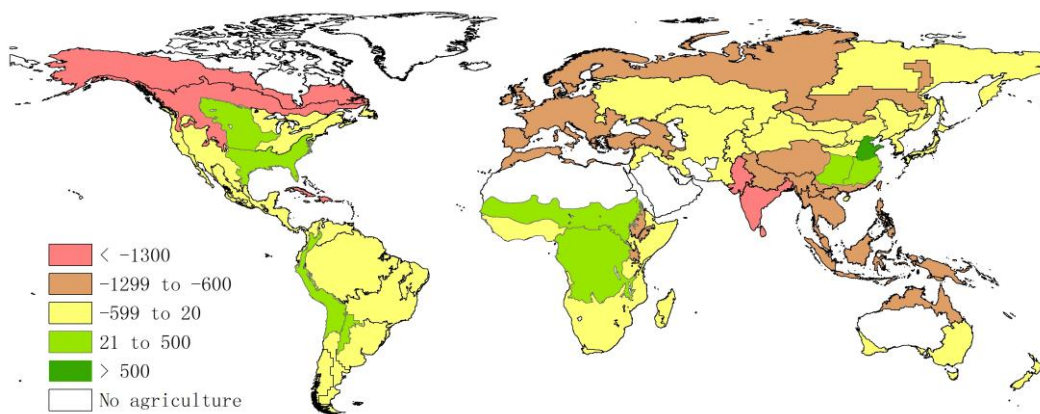
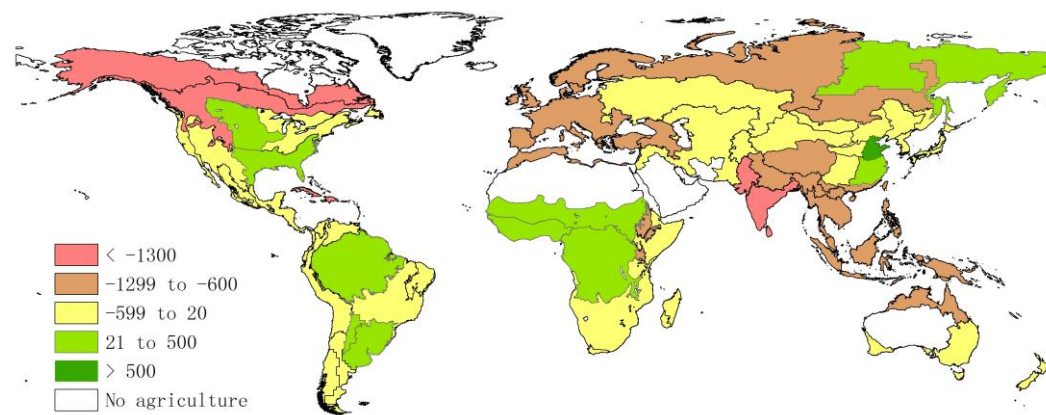


Figure B.3 CPSZ October 2012-September 2013 accumulated PAR (W/m^2)

a. 2013 accumulated PAR departure from the five-year average



b. 2013 accumulated PAR departure from the twelve-year average



c. Accumulated PAR trend for 2001-2013 (Refer to B1.c for details)

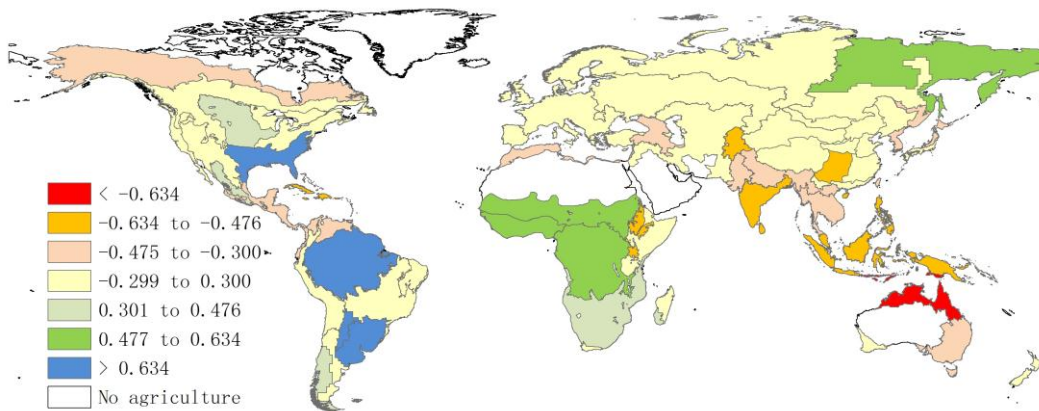
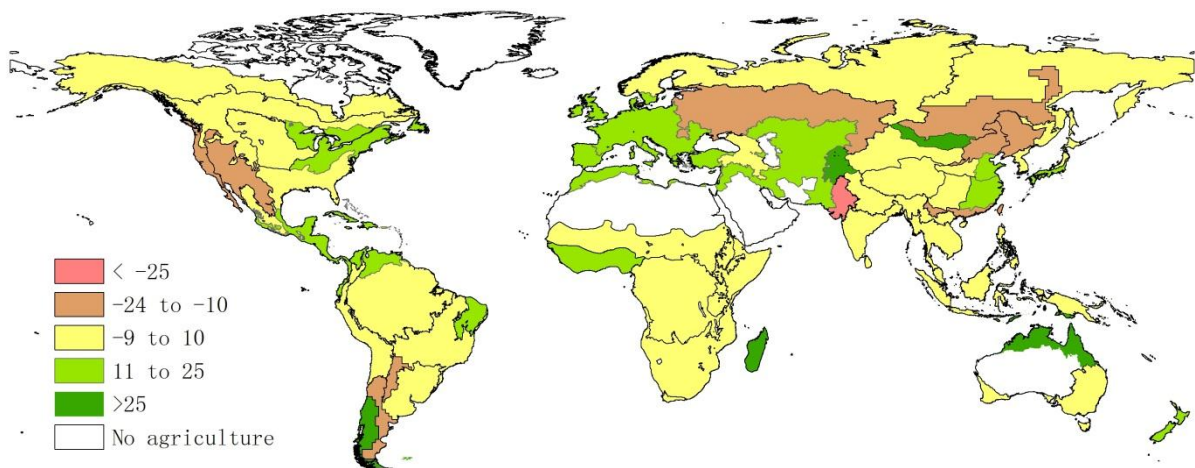


Figure B.4 CPSZ temperature and rainfall anomaly indices

a. Average rainfall index anomaly for crop production system zones, April-September (percent)



b. Average temperature index anomaly for crop production system zones, April-September (°C)

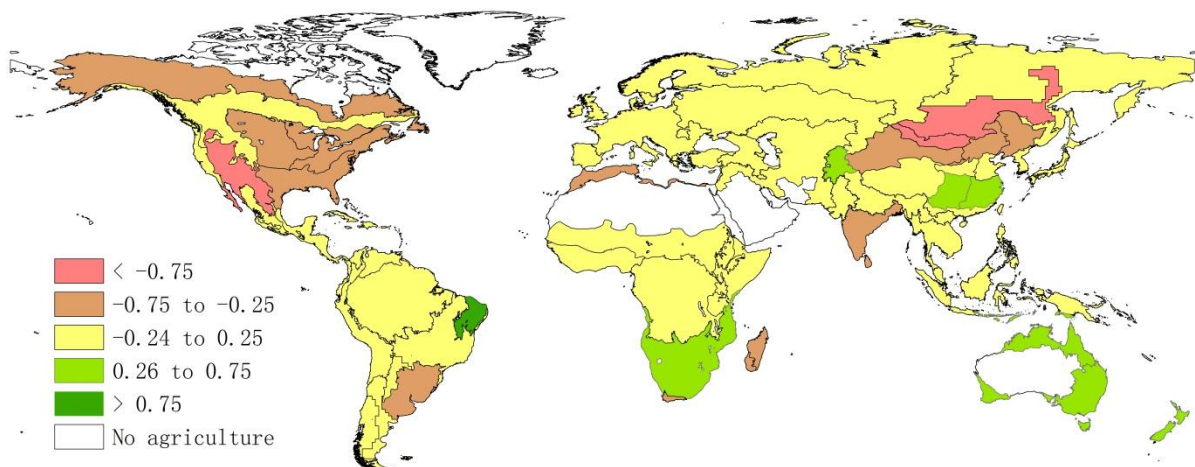


Table B.1 Environmental indices for Crop Production System Zones: Rainfall accumulation (mm)

	2013 rainfall (mm)	Twelve-year average (2001-12)	Five-year average (2008-12)	2001-13 normalized trend	Coefficient of correlation	Significance level of trend	Difference between 2013 and twelve-year average	Difference between 2013 and five-year average	
1	Equatorial central Africa	448	415	409	1.224	0.077	33	39	
2	East African highlands	377	347	333	-0.003	0	30	44	
3	Gulf of Guinea	446	467	469	0.03	0.002	-21	-23	
4	Horn of Africa	240	214	197	-6.743	-0.15	26	43	
5	Madagascar (main)	384	365	303	-21.633	-0.478	*	19	81
6	SW Madagascar	170	130	99	-24.362	-0.327	40	71	
7	North Africa Mediterranean	109	130	132	-7.031	-0.137	-21	-23	
8	Sahel	158	170	171	2.382	0.086	-12	-13	
9	Southern Africa	156	120	125	12.708	0.275	36	31	
10	S. Africa Western Cape	135	125	111	-19.632	-0.359	10	24	
11	Boreal North America	106	106	103	7.368	0.141	0	3	
12	America northern great plains	146	149	157	5.644	0.189	-3	-11	
13	America corn belt	146	205	202	-11.034	-0.288	-59	-56	
14	America cotton belt-Mexican coastal plain	405	345	325	-13.757	-0.39	60	80	
15	Sub-boreal North America	104	100	96	-4.04	-0.186	4	8	
16	America West Coast	194	225	211	-4.12	-0.107	-31	-17	
17	Sierra Madre	281	250	247	6.928	0.24	31	34	
18	SW Mexico and N. Mexico highlands	124	97	92	5.536	0.148	27	32	
19	Northern South and Central America	475	535	552	4.523	0.291	-60	-77	
20	Caribbean	395	390	383	-3.474	-0.198	5	12	
21	Central-Northern Andes	423	440	455	6.784	0.394	-17	-32	
22	Brazil Nordeste	163	162	164	-0.938	-0.018	1	-1	
23	Central-Eastern Brazil	264	278	276	0.835	0.049	-14	-12	
24	Amazon	595	615	622	2.989	0.252	-20	-27	
25	Central-North Argentina	150	125	112	-10.992	-0.246	25	38	
26	SE Brazil-Concepcion-Bahia Blanca	463	434	403	-14.972	-0.373	29	60	
27	SW Southern Cone	-9	293	274	-46.044	-0.583	*	-302	-283
28	Semi-arid Southern Cone	80	78	76	-2.833	-0.042	2	4	
29	Caucasus	162	177	166	-11.729	-0.46	-15	-4	
30	Central Asia Pamir mountains	100	140	142	-3.229	-0.056	-40	-42	
31	Western Asia	81	87	75	-24.529	-0.525	*	-6	6
32	China Gansu-Xinjiang	42	45	47	-5.511	-0.124	-3	-5	
33	China Hainan	694	490	585	32.786	0.372	204	109	
34	China Huang Huaihai	274	299	292	0.348	0.007	-25	-18	
35	China Inner Mongolia	76	83	86	0.614	0.01	-7	-10	
36	China Loess region	158	158	151	-10.487	-0.307	0	7	

		2013 rainfall (mm)	Twelve- year average (2001-12)	Five-year average (2008-12)	2001-13 normalized trend	Coefficient of correlation	Significanc e level of trend	Difference between 2013 and twelve- year average	Difference between 2013 and five-year average
37	China Lower Yangtze	406	357	375	13.092	0.398		49	31
38	North East China	69	86	88	10.36	0.192		-17	-19
39	China Qinghai-Tibet	347	356	361	1.98	0.123		-9	-14
40	Southern China	605	458	467	12.028	0.315		147	138
41	South-West China	256	233	237	4.571	0.201		23	19
42	Taiwan	815	554	587	20.181	0.265		261	228
43	East Asia	169	258	253	-0.771	-0.014		-89	-84
44	Southern Himalayas	527	525	545	7.219	0.404		2	-18
45	Southern Asia	481	475	490	15.413	0.65	**	6	-9
46	Southern Japan and Korea	407	490	484	-2.435	-0.071		-83	-77
47	Mongolia region	19	23	26	16.565	0.151		-4	-7
48	S. Asia Punjab to Gujarat	355	289	288	18.516	0.281		66	67
49	SE Asia islands	945	878	940	15.525	0.811	**	67	5
50	SE Asia mainland	741	670	682	6.546	0.301		71	59
51	Eastern Siberia	97	106	110	0.019	0		-9	-13
52	Eastern Central Asia	65	53	53	-3.623	-0.075		12	12
53	North Australia	238	314	354	20.261	0.393		-76	-116
54	Australia Queensland to Victoria	158	151	170	20.775	0.489	*	7	-12
55	Australia Nullarbor-Darling	93	89	88	1.461	0.022		4	5
56	New Zealand	367	407	399	-5.961	-0.273		-40	-32
57	Boreal Eurasia	116	117	117	-3.248	-0.086		-1	-1
58	Ukraine to Kazakhstan	125	89	90	16.899	0.462		36	35
59	Mediterranean Europe and Turkey	233	229	235	3.188	0.154		4	-2
60	W. Europe (non-Mediterranean)	248	231	229	-3.048	-0.111		17	19

Note: Table data represents rainfall accumulation (mm) between October 2012 and September 2013. The normalized trend is the 2001-13 trend normalized by dividing it by the twelve-year average. The significance level of the trend is * for $p < 0.05$ and ** for $p < 0.01$. See figure B.1 for a graphical representation of some of the variables in this table.

Table B.2 Environmental indices for Crop Production System Zones: Temperature accumulation above 5°C

		2013	Twelve- year average (2001- 12)	Five-year average (2008-12)	2001-13 normalized trend	Coefficient of correlation	Significanc e level of trend	Difference between 2013 and twelve- year average	Difference between 2013 and five-year average
1	Equatorial central Africa	2109	2,097	2,098	0.756	0.204		12	11
2	East African highlands	1446	1,431	1,449	3.154	0.726	**	15	-3
3	Gulf of Guinea	2358	2,379	2,378	0.258	0.105		-21	-20
4	Horn of Africa	1812	1,820	1,826	1.174	0.347		-8	-14
5	Madagascar (main)	1256	1,271	1,275	0.628	0.185		-15	-19
6	SW Madagascar	1316	1,344	1,346	0.356	0.078		-28	-30
7	North Africa Mediterranean	961	947	944	1.308	0.159		14	17

	2013	Twelve-year average (2001-12)	Five-year average (2008-12)	2001-13 normalized trend	Coefficient of correlation	Significance level of trend	Difference between 2013 and twelve-year average	Difference between 2013 and five-year average
8 Sahel	1542	1,526	1,531	1.313	0.447		16	11
9 Southern Africa	1219	1,208	1205	0.351	0.081		11	14
10 S. Africa Western Cape	581	645	621	-10.124	-0.817	**	-64	-40
11 Boreal North America	50	64	59	-17.219	-0.422		-14	-9
12 America northern great plains	604	636	616	-3.145	-0.203		-32	-12
13 America corn belt	359	386	394	3.212	0.152		-27	-35
14 America cotton belt-Mexican coastal plain	1417	1,497	1,508	1.993	0.212		-80	-91
15 Sub-boreal North America	178	166	170	6.301	0.239		12	8
16 America West Coast	664	637	621	-2.812	-0.215		27	43
17 Sierra Madre	1105	1,084	1,091	1.813	0.415		21	14
18 SW Mexico and N. Mexico highlands	1004	1,046	1,019	-6.657	-0.817	**	-42	-15
19 Northern South and Central America	2173	2,137	2,132	0.287	0.105		36	41
20 Caribbean	1905	1,908	1,883	-2.031	-0.434		-3	22
21 Central-Northern Andes	1174	1,117	1,109	0.431	0.054		57	65
22 Brazil Nordeste	1649	1,565	1,620	6.06	0.597	*	84	29
23 Central-Eastern Brazil	1703	1,654	1,665	0.85	0.171		49	38
24 Amazon	2305	2,301	2,318	1.458	0.556	*	4	-13
25 Central-North Argentina	1195	1,144	1,162	3.787	0.458		51	33
26 SE Brazil-Concepcion-Bahia Blanca	1,498	1,497	1,520	1.85	0.334		1	-22
27 SW Southern Cone	564	577	595	4.419	0.325		-13	-31
28 Semi-arid Southern Cone	795	781	814	7.896	0.626	*	14	-19
29 Caucasus	790	749	775	6.661	0.45		41	15
30 Central Asia Pamir mountains	981	971	977	2.659	0.479	*	10	4
31 Western Asia	974	946	972	6.369	0.637	**	28	2
32 China Gansu-Xinjiang	560	554	556	5.458	0.415		6	4
33 China Hainan	1,737	1,685	1,651	-3.191	-0.423		52	86
34 China Huang Huaihai	1,564	1,553	1,532	-1.905	-0.312		11	32
35 China Inner Mongolia	544	544	532	-3.494	-0.208		0	12
36 China Loess region	779	766	759	0.168	0.018		13	20
37 China Lower Yangtze	1,288	1,266	1,260	-0.919	-0.143		22	28
38 North East China	402	432	422	-8.164	-0.353		-30	-20
39 China Qinghai-Tibet	403	420	429	3.117	0.325		-17	-26
40 Southern China	1,623	1,616	1,610	-0.613	-0.191		7	13
41 South-West China	905	845	847	1.782	0.181		60	58
42 Taiwan	1,713	1,724	1,707	-2.983	-0.672	**	-11	6
43 East Asia	465	490	484	-5.99	-0.41		-25	-19
44 Southern Himalayas	1,896	1,913	1,921	0.306	0.09		-17	-25
45 Southern Asia	2,015	2,044	2,048	-0.316	-0.118		-29	-33

		2013	Twelve-year average (2001-12)	Five-year average (2008-12)	2001-13 normalized trend	Coefficient of correlation	Significance level of trend	Difference between 2013 and twelve-year average	Difference between 2013 and five-year average
46	Southern Japan and Korea	1,052	1,052	1,046	-1.572	-0.186		0	6
47	Mongolia region	472	536	530	-7.698	-0.306		-64	-58
48	S. Asia Punjab to Gujarat	2,394	2,445	2,438	-1.437	-0.332		-51	-44
49	SE Asia islands	2,242	2,232	2,222	-0.653	-0.358		10	20
50	SE Asia mainland	2,327	2,257	2,256	1.119	0.313		70	71
51	Eastern Siberia	87	112	106	-3.357	-0.074		-25	-19
52	Eastern Central Asia	85	96	89	-1.635	-0.028		-11	-4
53	North Australia	1,766	1,747	1,737	-0.953	-0.196		19	29
54	Australia Queensland to Victoria	950	908	898	-0.148	-0.018		42	52
55	Australia Nullarbor-Darling	633	597	602	3.714	0.399		36	31
56	New Zealand	753	699	696	0.155	0.012		54	57
57	Boreal Eurasia	52	65	59	-23.277	-0.389		-13	-7
58	Ukraine to Kazakhstan	305	312	321	9.237	0.427		-7	-16
59	Mediterranean Europe and Turkey	972	980	993	2.297	0.31		-8	-21
60	W. Europe (non-Mediterranean)	588	601	588	-2.899	-0.222		-13	0

Note: Table data represents temperature over a threshold of 5.0°C between October 2012 and September 2013. The normalized trend is the 2001-13 trend normalized by dividing it by the twelve-year average. Significance level of the trend is * for $p < 0.05$ and ** for $p < 0.01$. See figure B.2 for a graphical representation of some of the variables in this table.

Table B.3 Environmental indices for Crop Production System Zones: accumulated PAR (W/m^2)

		2013 PAR (W/m^2)	Twelve-year average (2001-12)	Five-year average (2008-12)	2001-13 normalized trend	Coefficient of correlation	Significance level of trend	Difference between 2013 and 12-year average	Difference between 2013 and 5-year average
1	Equatorial central Africa	11355	11232	11301	1.518	0.518	*	123	54
2	East African highlands	10799	11463	11416	-3.418	-0.551	*	-664	-617
3	Gulf of Guinea	11416	11390	11469	1.705	0.536	*	26	-53
4	Horn of Africa	10812	11208	11263	-0.541	-0.122		-396	-451
5	Madagascar (main)	7461	7884	8027	1.119	0.183		-423	-566
6	SW Madagascar	8368	8546	8646	1.196	0.313		-178	-278
7	North Africa Mediterranean	7480	8619	8679	-3.431	-0.333		-1139	-1199
8	Sahel	7856	7674	7721	1.937	0.549	*	182	135
9	Southern Africa	7715	7785	7813	1.278	0.324		-70	-98
10	S. Africa Western Cape	6411	6960	6993	-0.598	-0.082		-549	-582
11	Boreal North America	197	4527	4630	-28.865	-0.42		-4330	-4433
12	America northern great plains	7423	7072	7067	2.317	0.451		351	356
13	America corn belt	4857	5121	5186	0.558	0.087		-264	-329
14	America cotton	10513	10206	10432	6.401	0.768	**	307	81

	2013 PAR (W/m ²)	Twelve- year average (2001-12)	Five-year average (2008-12)	2001-13 normalized trend	Coefficient of correlation	Significanc e level of trend	Difference between 2013 and 12-year average	Difference between 2013 and 5-year average
belt-Mexican coastal plain								
15 Sub-boreal North America	4396	5725	5824	-4.74	-0.272		-1329	-1428
16 America West Coast	8911	9177	9188	-1.14	-0.251		-266	-277
17 Sierra Madre	9133	9244	9321	1.406	0.301		-111	-188
18 SW Mexico and N. Mexico highlands	10036	10097	10126	-0.286	-0.105		-61	-90
19 Northern South and Central America	10399	10544	10542	-0.69	-0.354		-145	-143
20 Caribbean	8437	10373	10375	-6.465	-0.476		-1936	-1938
21 Central-Northern Andes	10066	10066	10031	-0.6	-0.252		0	35
22 Brazil Nordeste	8632	8828	8849	0.122	0.035		-196	-217
23 Central-Eastern Brazil	8973	9005	9024	-0.17	-0.048		-32	-51
24 Amazon	10934	10809	10958	2.583	0.66	**	125	-24
25 Central-North Argentina	7623	7202	7311	6.002	0.762	**	421	312
26 SE Brazil- Concepcion-Bahia Blanca	10948	10924	11185	5.632	0.661	**	24	-237
27 SW Southern Cone	8745	8898	9028	1.782	0.384		-153	-283
28 Semi-arid Southern Cone	9219	9500	9550	0.093	0.024		-281	-331
29 Caucasus	7716	8457	8438	-2.908	-0.371		-741	-722
30 Central Asia Pamir mountains	9835	10396	10345	-3.324	-0.599	*	-561	-510
31 Western Asia	8261	8747	8804	-0.817	-0.15		-486	-543
32 China Gansu- Xinjiang	6691	6750	6740	1.161	0.233		-59	-49
33 China Hainan	7226	7864	7735	-5.934	-0.599	*	-638	-509
34 China Huang Huaihai	10005	9179	9066	0.098	0.009		826	939
35 China Inner Mongolia	6499	6588	6618	1.515	0.183		-89	-119
36 China Loess region	6988	7116	7060	-0.185	-0.026		-128	-72
37 China Lower Yangtze	6920	6736	6656	-1.936	-0.273		184	264
38 North East China	5862	5891	5919	-0.239	-0.03		-29	-57
39 China Qinghai-Tibet	6823	7863	7879	-2.797	-0.263		-1040	-1056
40 Southern China	8051	8715	8750	-1.959	-0.275		-664	-699
41 South-West China	5823	5868	5802	-2.796	-0.545	*	-45	21
42 Taiwan	7909	9042	8984	-5.946	-0.455		-1133	-1075
43 East Asia	5754	6140	6163	-3.25	-0.344		-386	-409
44 Southern Himalayas	9519	10435	10468	-2.541	-0.354		-916	-949
45 Southern Asia	8564	9904	9882	-5.534	-0.535	*	-1340	-1318
46 Southern Japan and Korea	7413	7469	7500	-0.575	-0.064		-56	-87
47 Mongolia region	7298	7278	7348	2.025	0.241		20	-50
48 S. Asia Punjab to Gujarat	10430	11989	12011	-4.74	-0.453		-1559	-1581

		2013 PAR (W/m ²)	Twelve- year average (2001-12)	Five-year average (2008-12)	2001-13 normalized trend	Coefficient of correlation	Significanc e level of trend	Difference between 2013 and 12-year average	Difference between 2013 and 5-year average
49	SE Asia islands	10316	11365	11316	-3.625	-0.527	*	-1049	-1000
50	SE Asia mainland	9954	10753	10716	-2.807	-0.369		-799	-762
51	Eastern Siberia	4844	4799	4862	4.4	0.513	*	45	-18
52	Eastern Central Asia	5115	5717	5791	0.704	0.059		-602	-676
53	North Australia	8747	9881	9712	-6.882	-0.663	**	-1134	-965
54	Australia Queensland to Victoria	8628	8965	8798	-3.179	-0.392		-337	-170
55	Australia Nullarbor- Darling	5671	6098	6169	1.136	0.151		-427	-498
56	New Zealand	9384	9695	9683	-1.012	-0.18		-311	-299
57	Boreal Eurasia	1765	2961	3009	-8.142	-0.27		-1196	-1244
58	Ukraine to Kazakhstan	4574	4770	4821	2	0.218		-196	-247
59	Mediterranean Europe and Turkey	8832	10039	10127	-1.543	-0.16		-1207	-1295
60	W. Europe (non- Mediterranean)	5483	6385	6501	1.349	0.096		-902	-1018

Note: Table data represents accumulated photosynthetically active radiation (PAR) (W/m²) over the growing season(s) between October 2012 and September 2013. The normalized trend is the 2001-13 trend normalized by dividing it by the twelve-year average. Significance level of the trend is * for p<=0.05 and ** for p<=0.01. See figure B.3 for a graphical representation of some of the variables in this table.

Annex C Environmental Indices and Crop Indicators for Major Production Zones

Table C.1 Environmental indices for Major Production Zones

Major production zone	2013 value	Twelve-year average (2001-12)	Five-year average (2008-12)	2001-13 normalized trend	Coefficient of correlation	Significance level of trend	Difference between 2013 and twelve-year average	Difference between 2013 and five-year average
NORTH AMERICA								
Rainfall (mm)	241	234	229	-10.077	-0.42		7	12
Temperature (°C)	854	908	907	0.823	0.083		-54	-53
PAR (W/m ²)	8070	7832	7938	4.438	0.772	**	238	132
SOUTH AMERICA								
Rainfall (mm)	358	352	330	-12.557	-0.424		6	28
Temperature (°C)	1483	1460	1466	0.056	0.013		23	17
PAR (W/m ²)	9760	9699	9842	3.416	0.725	**	61	-82
CENTRAL EUROPE – W.RUSSIA								
Rainfall (mm)	151	112	114	14.393	0.454		39	37
Temperature (°C)	382	387	395	6.261	0.373		-5	-13
PAR (W/m ²)	4505	5004	5066	1.09	0.097		-499	-561
SOUTH AND SOUTHEAST ASIA								
Rainfall (mm)	618	590	616	11.646	0.828	**	28	2
Temperature (°C)	2170	2175	2175	-0.139	-0.059		-5	-5
PAR (W/m ²)	9633	10790	10770	-4.021	-0.492	*	-1157	-1137

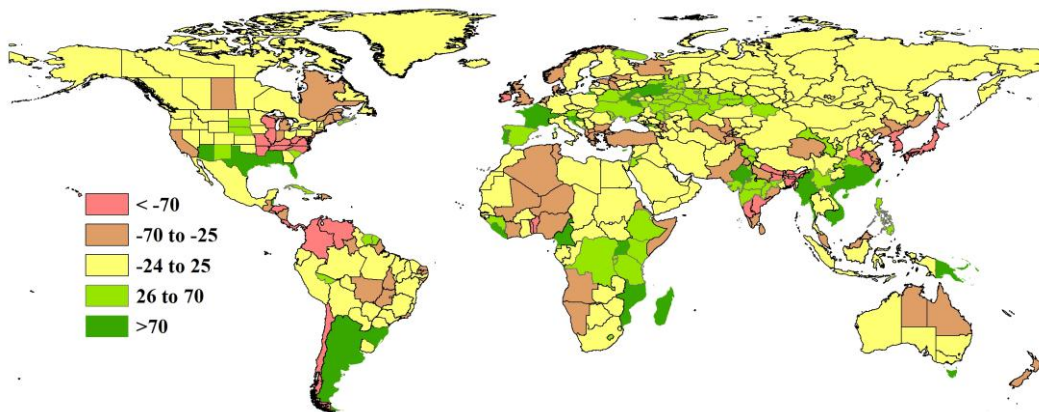
Note: Temperature is temperature accumulation over a threshold of 5.0°C between October 2012 and September 2013; rainfall is TRMM-derived rainfall; PAR is accumulated photosynthetically active radiation (W/m²). The normalized trend is the 2001-2013 trend normalized by dividing it by the twelve-year average. Significance level of the trend is * for p<=0.05 and ** for p<=0.01.

Annex D Environmental Indices and Production Estimates by Country

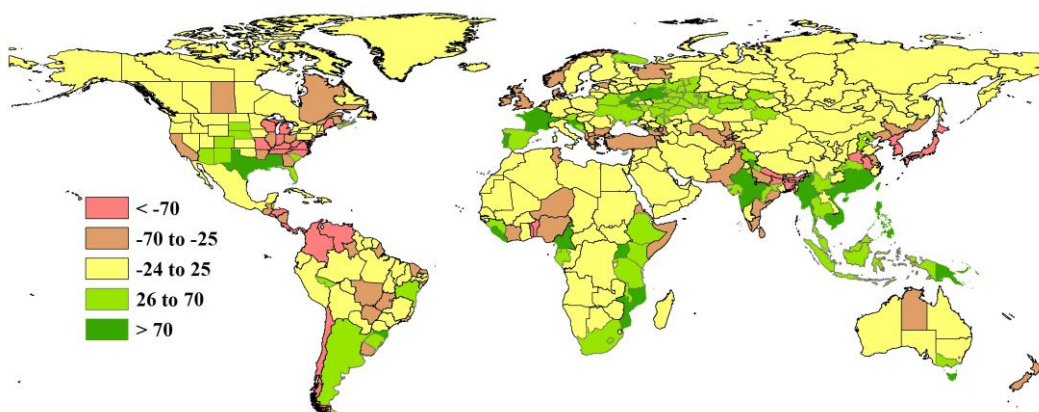
Figures D.1, D.2, and D.3 illustrate accumulated rainfall, temperature accumulation, and accumulated photosynthetically active radiation (PAR) for 173 countries and territories and the first-level administrative units for eight large countries—Australia, Brazil, Canada, China, India, Kazakhstan, Russia, and the United States. The figures each show the values' departure from the five-year average for 2008-12 (a), departure from the twelve-year average (2001-12) (b), and the trend for 2001-13 normalized by dividing it by the twelve-year average (c).

Figure D.1 October 2012-September 2013 rainfall accumulation, for countries and sub-national units (mm)

a. 2013 accumulated rainfall departure from the five-year average



b. 2013 accumulated rainfall departure from the twelve-year average



c. Accumulated rainfall trend for 2001-2013 (refer to figure B.1c for details)

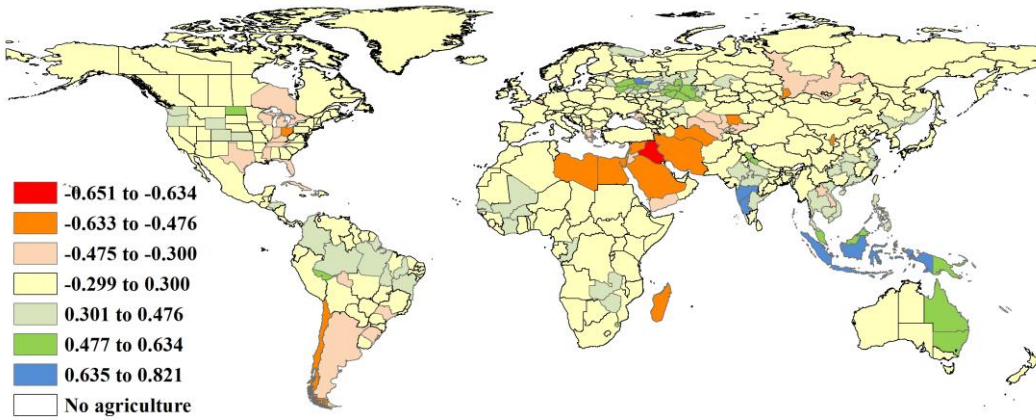
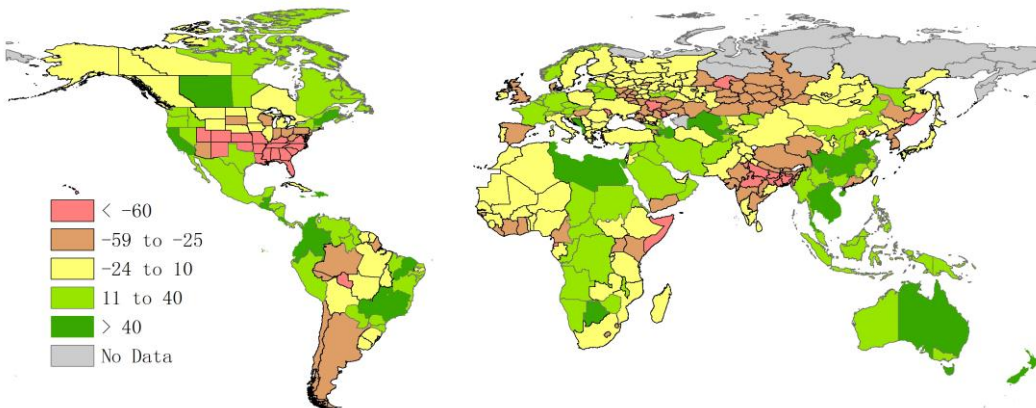
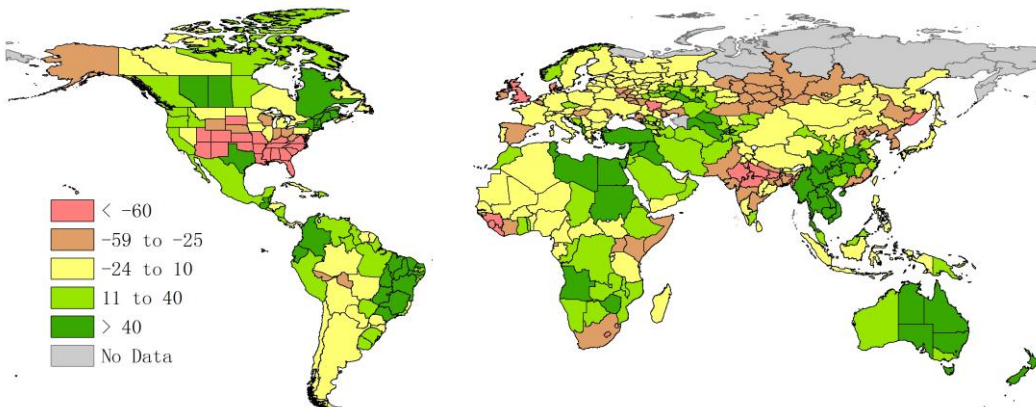


Figure D.2 October 2012-September 2013 temperature accumulation, for countries and sub-national units (°C)

a. 2013 Temperature departure from the five-year average



b. 2013 Temperature departure from the twelve-year average



c. Temperature trend for 2001-2013 (refer to figure B.1c for details)

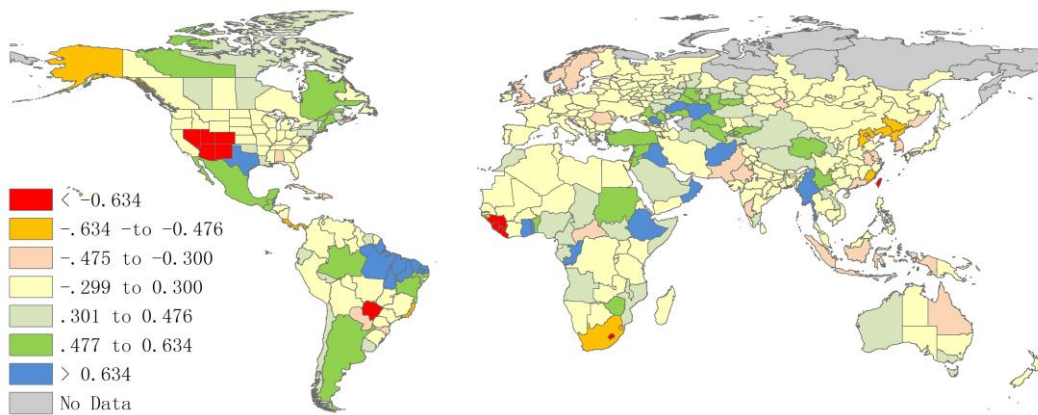
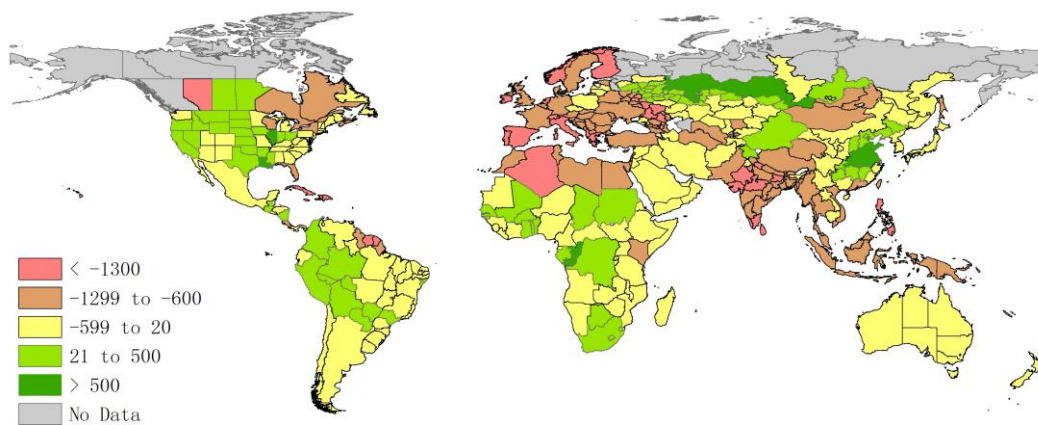
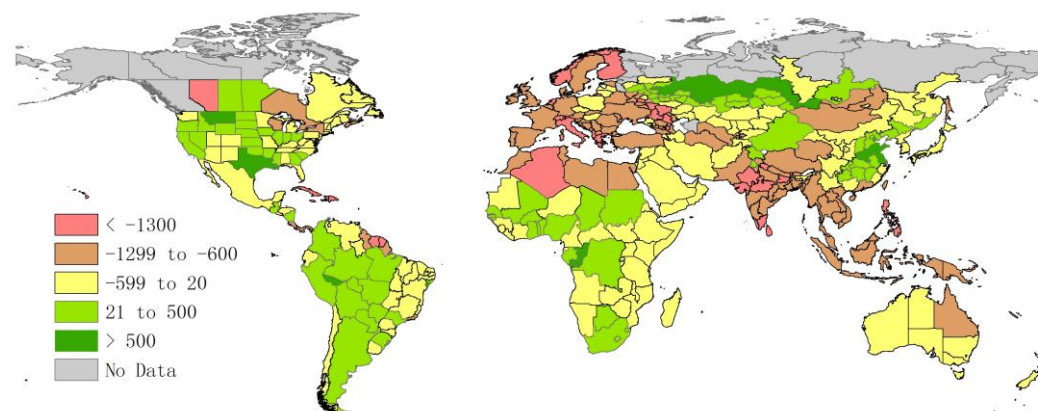


Figure D.3 October 2012-September 2013 accumulated PAR, for countries and sub-national units (W/m^2)

a. 2013 accumulated PAR departure from the five-year average



b. 2013 accumulated PAR departure from the twelve-year average



c. Accumulated PAR trend for 2001-2013 (Refer to figure B.1c for details)

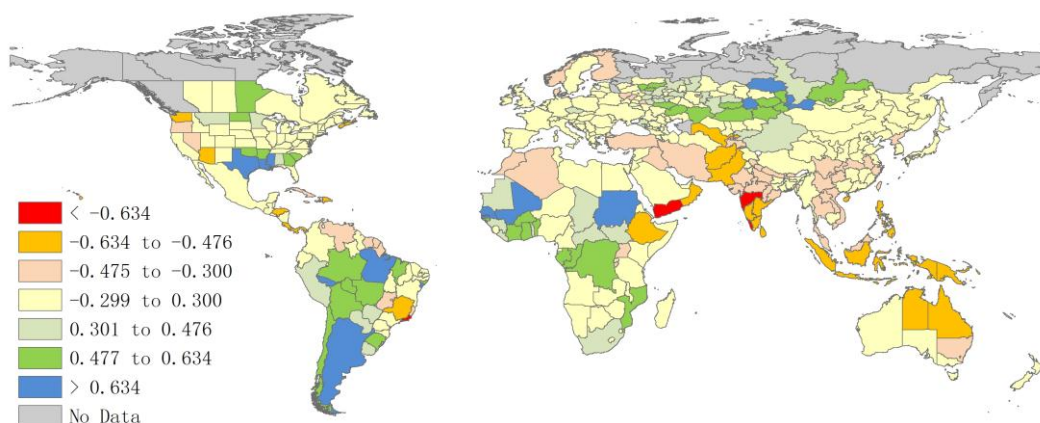
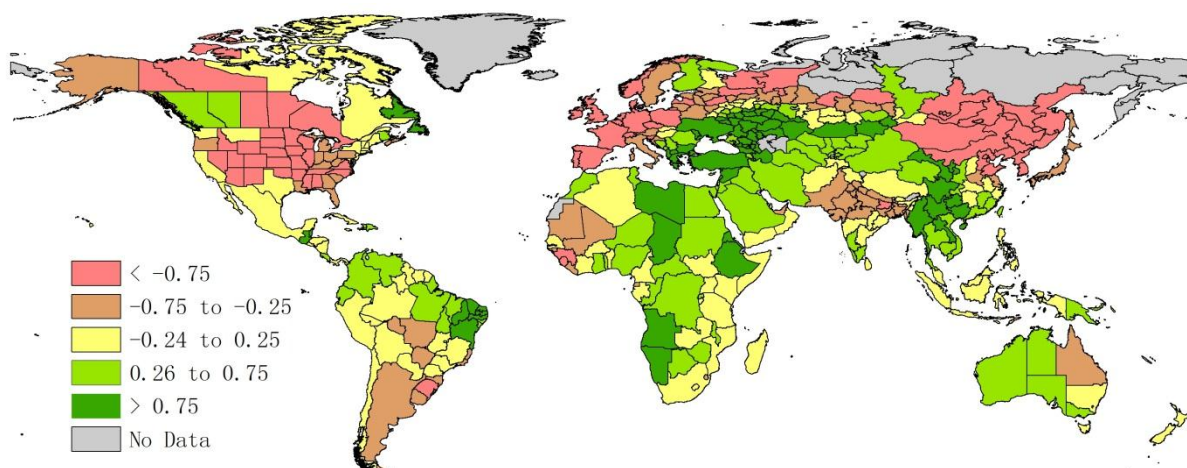
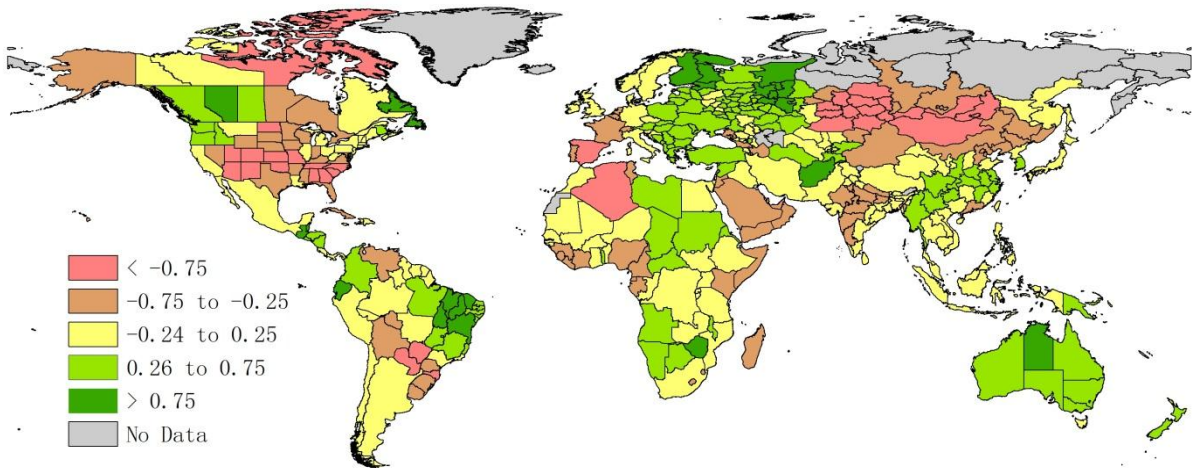


Figure D.4 Temperature and rainfall anomaly indices, for countries and sub-national units

a. Average temperature index anomaly, January-June (°C)



b. Average temperature index anomaly, April-September 2013 (°C)



c. Average rainfall index anomaly, April – September 2013 (percent)

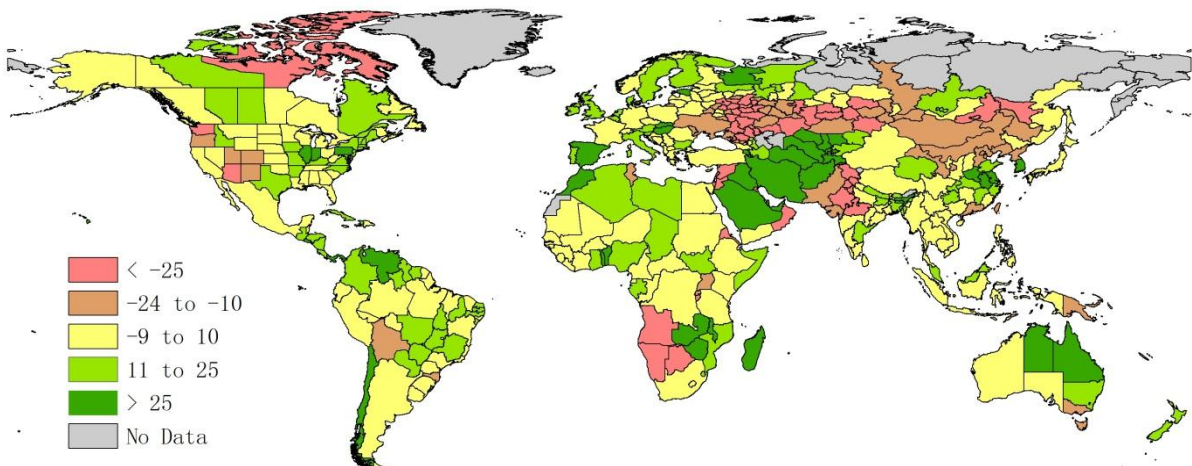


Table D.1 2013 Yield (maize, rice, soybean, wheat), and percent difference with 2012, by country (tons/ha)

	Maize		Rice		Soybean		Wheat	
	2013	Δ%	2013	Δ%	2013	Δ%	2013	Δ%
AFRICA								
Egypt	8.47	-9.3	9.64	-0.7	3.17	-1.2	6.27	-3.8
Ethiopia	2.78	-7.8	2.97	2.3	1.70	-8.8	1.98	-2.6
Nigeria	1.78	-1.9	1.79	-0.8	0.97	-5.5	1.41	26.2
S-Africa	3.64	-5.3			1.70	-0.0	3.17	5.1
WEST ASIA								
Iran	7.03	3.5	5.00	0.0	2.47	-1.3	1.94	-1.7
Turkey	7.26	-1.7	8.12	10.5	3.76	2.9	2.84	6.4
Central Asia								
Kazakhstan	3.05	175.7	2.99	30.6	1.97	-2.8	1.38	40.1
Uzbekistan	6.45	14.5	2.53	41.2				
EAST ASIA								
China	5.94	0.7	6.04	0.4	1.86	0.1	4.13	-0.1
SOUTH ASIA								
Bangladesh	6.05	0.8	3.60	23.0	1.53	3.8	2.59	0.5
India	2.47	3.0	3.61	4.1	1.13	6.2	3.08	-2.9
Pakistan	3.92	0.8	3.55	2.0			2.81	3.7
SE ASIA								
Cambodia	2.32	-3.1	2.81	-6.4	1.61	0.7		
Indonesia	4.64	-5.1	4.96	-3.4	1.43	-4.9		
Myanmar	3.77	-4.5	3.73	-7.9	1.36	10.9	1.80	0.1
Philippines	2.80	-2.0	3.67	-4.6				
Thailand	4.37	-1.9	2.80	-6.8	1.88	4.3		
Vietnam	4.30	0.2	5.60	-0.5	1.46	0.7		
EUROPE- RUSSIA								
France	9.21	1.4	5.93	-0.6	2.86	3.1	7.36	-3.2
Germany	10.20	4.1					7.37	0.6
Poland	6.23	-0.5					4.29	4.0
Romania	3.58	63.6	4.84	7.6	1.64	23.1	3.16	18.7
U. Kingdom							8.10	21.6
Ukraine	4.48	-6.5	5.96	-3.9	1.85	8.6	3.10	10.7
W. Russia	4.29	1.1	5.29	-3.7	1.39	5.8	2.00	12.9
N. AMERICA								
Canada	8.61	3.0			2.84	-2.7	2.58	-9.4
Mexico	2.96	-7.3	5.35	-4.6	1.52	-12.6	5.50	-0.8
United States	8.30	5.4	8.86	5.0	2.77	1.4	3.12	-0.4
S. AMERICA								
Argentina	5.84	-16.0	6.73	1.0	2.59	-11.5	3.78	8.6
Brazil	3.95	-16.5	5.15	7.1	2.51	-4.1	2.56	10.6
OCEANIA								
Australia	6.11	-5.3	9.18	3.0	2.06	-7.6	2.00	-7.9

Note: Δ% indicates percent difference with 2012.

Table D.2 2013 harvested area (maize, rice, soybean, wheat), by country (thousand ha)

	Maize		Rice		Soybean		Wheat	
	2013	Δ%	2013	Δ%	2013	Δ%	2013	Δ%
AFRICA								
Egypt	819	9.2	632	-5.7	10	-2.3	1373	1.7
Ethiopia	1988	-1.2	30	-1.3	15	-21.0	1461	1.6
Nigeria	5235	0.7	2632	-2.0	524	19.2	95	5.0
S-Africa	3139	-3.4			459	-8.2	600	0.8
WEST ASIA								
Iran	179	-0.6	470	-2.1	75	-6.3	7040	0.6
Turkey	606	-2.7	110	-8.5	29	-8.2	7380	-2.0
Central Asia								
Kazakhstan	97	-0.2	95	-2.0	77	-8.3	13014	-3.3
Uzbekistan	36	-2.6	47	-29.1			1399	0.2
EAST ASIA								
China	34616	1.6	34287	0.2	7165	-3.7	25839	-0.1
SOUTH ASIA								
Bangladesh	253	-25.7	11798	0.8	42	-0.7	387	-3.3
India	8668	-1.3	43029	-2.2	10490	-2.9	29463	-1.3
Pakistan	997	9.5	2619	-3.0			8658	-0.1
SE ASIA								
Cambodia	325	-1.5	3218	3.8	73	-2.9		
Indonesia	3984	0.6	13575	1.0	594	4.7		
Myanmar	396	4.1	8312	2.0	162	-2.8	99	-3.7
Philippines	2569	-0.9	4734	0.9				
Thailand	1101	1.9	12940	2.7	95	-5.1		
Vietnam	1120	0.1	7687	-0.9	151	25.1		
EUROPE- RUSSIA								
France	1712	-0.4	21	2.7	40	5.4	5323	0.4
Germany	499	-2.2					3068	0.2
Poland	439	-19.4					2094	0.2
Romania	2468	-9.3	12	6.0	75	-3.9	1969	-1.2
U. Kingdom							1760	-11.6
Ukraine	4883	11.7	28	7.4	1261	-10.7	6144	9.1
Russia	1770	-8.6	199	4.1	1281	-6.8	23466	10.3
N. AMERICA								
Canada	1301	-7.1			1605	-3.8	10147	6.8
Mexico	6714	-3.0	33	3.5	149	4.6	535	31.4
USA.	35419	1.9	984	-8.2	29980	-0.1	18608	-5.5
S. AMERICA								
Argentina	4237	14.6	246	4.7	19363	10.2	3320	5.1
Brazil	16058	6.6	2416	1.9	27939	11.5	1966	4.0
OCEANIA								
Australia	66	-5.4	89	-13.3	28	-27.2	14460	4.0
Sub total	141692	1.6	150244	-0.2	101683	3.9	189667	1.1
other countries	40577	8.1	13192	2.3	7239	-17.3	28530	-1.6
World	182269	3.0	163436	0.0	108922	2.2	218197	0.7

Note: Δ% indicates percent difference with 2012. The world areas for the four crops are extrapolated from FAO statistics.

Table D.3 Environmental indices by country: Accumulated rainfall (mm), October-September

	2013 rainfall (mm)	Twelve-year average (2001-12)	Five-year average (2008-12)	2001-13 normalized trend	Coefficient of correlation	Significance level of trend	Difference between 2013 and twelve-year average	Difference between 2013 and five-year average
Argentina	321	283	249	-19.753	-0.395		38	72
Australia	159	149	167	22.564	0.521	*	10	-8
Bangladesh	655	757	783	2.741	0.117		-102	-128
Brazil	375	383	384	0.953	0.121		-8	-9
Cambodia	800	638	646	11.451	0.302		162	154
Canada	104	123	120	-6.618	-0.217		-19	-16
China	308	273	280	8.883	0.46		35	28
Egypt	14	9	5	-75.444	-0.529	*	5	9
Ethiopia	370	339	331	2.968	0.11		31	39
France	385	292	278	-0.942	-0.02		93	107
Germany	231	251	247	-9.331	-0.275		-20	-16
India	456	453	473	15.435	0.621	*	3	-17
Indonesia	921	866	928	16.151	0.778	**	55	-7
Iran	101	110	90	-27.227	-0.504	*	-9	11
Kazakhstan	97	66	60	-3.773	-0.078		31	37
Mexico	293	281	279	3	0.146		12	14
Myanmar	776	677	666	0.708	0.039		99	110
Nigeria	365	409	415	-2.482	-0.136		-44	-50
Pakistan	153	196	193	-1.429	-0.022		-43	-40
Philippines	988	872	944	14.505	0.456		116	44
Poland	147	145	150	0.041	0.001		2	-3
Romania	113	126	132	2.357	0.058		-13	-19
Russia	120	92	93	14.891	0.431		28	27
South Africa	148	117	124	9.325	0.143		31	24
Thailand	576	539	563	10.581	0.47		37	13
Turkey	138	186	189	-8.134	-0.206		-48	-51
UK	260	290	290	-5.938	-0.225		-30	-30
USA	242	235	228	-8.617	-0.432		7	14
Ukraine	173	119	119	9.353	0.172		54	54
Uzbekistan	50	85	81	-25.6	-0.3		-35	-31
Viet Nam	780	662	701	13.822	0.409		118	79

Note: Table displays rainfall accumulation (mm) between October 2012 and September 2013. The normalized trend is the 2001-2013 trend normalized by dividing it by the twelve-year average. Significance level of the trend is * for $p < 0.05$ and ** for $p < 0.01$. See also figures D.1a –c for a graphical representation of some of the variables in this table.

Table D.4 Environmental indices by country: Temperature (°C), October-September accumulation

	2013 temperature (°C)	Twelve-year average (2001-12)	Five-year average (2008-12)	2001-13 normalized trend	Coefficient of correlation	Significance level of trend	Difference between 2013 and twelve-year average	Difference between 2013 and five-year average
Argentina	1284	1280	1312	4.11	0.55	*	4	-28
Australia	940	899	891	-0.018	-0.003		41	49
Bangladesh	2359	2417	2423	-0.416	-0.167		-58	-64
Brazil	1844	1807	1827	1.714	0.416		37	17
Cambodia	2592	2527	2522	0.519	0.151		65	70
Canada	197	156	161	13.795	0.316		41	36
China	1041	1022	1016	-0.762	-0.128		19	25
Egypt	2222	2166	2174	-0.084	-0.016		56	48
Ethiopia	1435	1406	1427	3.764	0.836	**	29	8
France	836	841	818	-3.578	-0.218		-5	18
Germany	681	682	661	-3.849	-0.227		-1	20
India	2036	2080	2083	-0.638	-0.181		-44	-47
Indonesia	2249	2241	2230	-0.852	-0.441		8	19
Iran	955	921	939	2.826	0.21		34	16
Kazakhstan	470	472	490	11.083	0.562	*	-2	-20
Mexico	1456	1430	1438	1.951	0.578	*	26	18
Myanmar	1970	1913	1933	3.065	0.654	**	57	37
Nigeria	2242	2243	2246	1.192	0.322		-1	-4
Pakistan	1955	1991	1979	-1.785	-0.398		-36	-24
Philippines	2342	2333	2324	-0.219	-0.125		9	18
Poland	429	448	435	-2.658	-0.164		-19	-6
Romania	328	333	325	-8.24	-0.303		-5	3
Russia	304	316	326	9.81	0.446		-12	-22
South Africa	785	811	787	-6.234	-0.592	*	-26	-2
Thailand	2377	2305	2295	0.548	0.139		72	82
Turkey	860	806	854	11.128	0.593	*	54	6
UK	517	578	558	-6.839	-0.369		-61	-41
USA	833	890	887	-0.345	-0.037		-57	-54
Ukraine	361	378	380	2.405	0.149		-17	-19
Uzbekistan	1400	1338	1354	4.681	0.576	*	62	46
Viet Nam	2197	2121	2118	0.841	0.208		76	79

Note: Table displays temperature accumulation (°C) over a threshold of 5.0 °C between October 2012 and September 2013. The normalized trend is the 2001-2013 trend normalized by dividing it by the twelve-year average. Significance level of the trend is * for $p < 0.05$ and ** for $p < 0.01$. See also figures D.2a – c for a graphical representation of some of the variables in this table.

Table D.5 Environmental indices by country: PAR (W/m^2), October-September accumulation

	2013 PAR (W/m^2)	Twelve-year average (2001-12)	Five-year average (2008-12)	2001-13 normalized trend	Coefficient of correlation	Significance level of trend	Difference between 2013 and twelve-year average	Difference between 2013 and five-year average
Argentina	10125	9984	10273	6.897	0.786	**	141	-148
Australia	8079	8482	8352	-3.085	-0.408		-403	-273
Bangladesh	9911	11134	11198	-2.685	-0.299		-1223	-1287
Brazil	9745	9780	9855	1.116	0.386		-35	-110
Cambodia	11126	11742	11713	-1.888	-0.272		-616	-587
Canada	3889	4935	5034	-3.322	-0.19		-1046	-1145
China	6907	6953	6913	-1.463	-0.46		-46	-6
Egypt	14185	14914	15035	-0.373	-0.087		-729	-850
Ethiopia	10075	10606	10546	-3.402	-0.562	*	-531	-471
France	7255	8300	8501	1.506	0.111		-1045	-1246
Germany	5989	6624	6726	2.904	0.196		-635	-737
India	9079	10305	10317	-4.287	-0.466		-1226	-1238
Indonesia	10310	11313	11262	-3.572	-0.551	*	-1003	-952
Iran	8800	9307	9274	-3.108	-0.391		-507	-474
Kazakhstan	6448	6449	6600	5.601	0.574	*	-1	-152
Mexico	9177	9387	9478	1.296	0.273		-210	-301
Myanmar	8853	9681	9726	-2.019	-0.259		-828	-873
Nigeria	10765	10714	10746	0.73	0.247		51	19
Pakistan	11160	12096	12071	-3.864	-0.547	*	-936	-911
Philippines	10445	11926	11777	-5.669	-0.486	*	-1481	-1332
Poland	4493	5003	5025	2.401	0.141		-510	-532
Romania	3870	4785	4906	2.065	0.099		-915	-1036
Russia	4991	5084	5145	2.273	0.323		-93	-154
South Africa	7202	7085	7086	2.509	0.302		117	116
Thailand	10502	11231	11182	-2.968	-0.406		-729	-680
Turkey	9031	9713	9681	-2.656	-0.368		-682	-650
UK	4856	6085	6135	-2.795	-0.165		-1229	-1279
USA	8064	8067	8161	2.723	0.645	**	-3	-97
Ukraine	3902	4925	4984	-0.391	-0.018		-1023	-1082
Uzbekistan	10724	11447	11377	-3.258	-0.517	*	-723	-653
Viet Nam	9423	10390	10254	-4.652	-0.471		-967	-831

Note: Table displays accumulated photosynthetically active radiation (PAR) (W/m^2) over the growing season(s) between October 2012 and September 2013. The normalized trend is the 2001-2013 trend normalized by dividing it by the twelve-year average. Significance level of the trend is * for $p \leq 0.05$ and ** for $p \leq 0.01$. See also figures D.3a –c for a graphical representation of some of the variables in this table.

Table D.6 Kazakhstan, 2013 yield (maize, rice, soybean, wheat), by province (tons/ha)

	Maize		Rice		Soybean		Wheat	
	2013	Δ%	2013	Δ%	2013	Δ%	2013	Δ%
Akmolinskaya							1.12	61.3
Karagandinskaya							0.87	32.8
Kustanayskaya							1.22	99.2
Pavlodarskaya							0.57	50.8
Severo-kazachstanskaya							1.62	40.9
Vostochno-kazachstanskaya							1.08	-0.9
Zapadno-kazachstanskaya							0.77	31.4

Note: Δ% is percent difference with 2012.

Table D.7 Kazakhstan, 2013 area under production (maize, rice, soybean, wheat), by province (thousand ha)

	Maize		Rice		Soybean		Wheat	
	2013	Δ%	2013	Δ%	2013	Δ%	2013	Δ%
Akmolinskaya							3767	26.4
Karagandinskaya							214	2.1
Kustanayskaya							2104	3.8
Pavlodarskaya							963	-38.8
Severo-kazachstanskaya							4832	-10.1
Vostochno-kazachstanskaya							451	4.2
Zapadno-kazachstanskaya							47	13.6
Sub total							12378	
Other provinces							636	
Kazakhstan							13014	-3.34

Note: Δ% is percent difference with 2012.

Table D.8 India, 2013 yield, by state (tons/ha)

	Maize		Rice (paddy)		Soybean		Wheat	
	2013	Δ%	2013	Δ%	2013	Δ%	2013	Δ%
Andhra Pradesh	4.74	11.8	3.09	-1.9				
Assam	0.71	-1.9	1.81	1.8			1.15	0.6
Delhi							4.26	-2.1
Goa			2.52	-2.3				
Gujarat	1.58	3.6	2.00	-6.6			3.08	2.2
Haryana	2.15	-19.4	2.92	-4.2			4.83	-4.1
Himachal Pradesh	2.35	-3.4	1.69	-0.7			1.60	-4.3
Karnataka	3.23	6.8	2.75	-1.4			0.98	14.6
Kerala			2.59	-5.3				
Maharashtra	2.84	2.9	1.81	-1.8			1.68	7.9
Manipur	1.83	3.5	2.55	-3.4				
Meghalaya	1.54	0.9	1.94	-2.3				
Mizoram			1.27	-10.1				
Nagaland	1.97	0.7	2.11	0.2				
Orissa	2.32	12.6	1.54	5.9				
Punjab	3.82	-4.2	3.78	1.1			4.80	-2.1
Rajasthan	1.70	6.6	1.95	3.4			3.05	-3.8

	Maize		Rice (paddy)		Soybean		Wheat	
	2013	Δ%	2013	Δ%	2013	Δ%	2013	Δ%
Sikkim	1.66	-0.1	1.74	0.8				
Tamil Nadu	5.32	-12.0	3.48	-11.2				
Tripura			2.68	-0.7				
West Bengal	3.85	3.5	2.66	-0.9			2.76	-0.02
Arunachal Pradesh	1.45	-1.7	1.99	-3.7				
Bihar	2.31	-3.2	1.67	-22.6			2.08	-5.8
Chhattisgarh	1.74	5.0	1.63	2.1			1.18	-3.7
Dadra and Nagar Haveli			1.77	0.7				
Jharkhand	1.36	-9.1	1.94	-9.1			1.80	-5.6
Madhya Pradesh	1.38	-7.5	1.23	-8.6			2.08	-12.0
Puducherry			2.61	2.9				
Uttar Pradesh	1.57	-5.5	2.24	-4.9			3.11	0.0
Uttarakhand	1.49	1.9	2.01	-5.4			2.35	-1.3

Note: Δ% is percent difference with 2012.

Table D.9 India, 2013 area under production, by state (thousand ha)

	Maize		Rice		Soybean		Wheat	
	2013	Δ%	2013	Δ%	2013	Δ%	2013	Δ%
Andhra Pradesh	804	-6.9	4424	8.0				
Assam	21	-3.5	2554	0.7			49	-7.4
Delhi							23	15.6
Gujarat	509	-1.5	822	-1.7			1313	-2.9
Haryana	10	5.6	1240	0.4			2519	-0.1
Himachal Pradesh	295	0.4					357	0.09
Karnataka	1319	-2.3	1478	4.4			240	6.7
Maharashtra	886	0.6	1531	-0.8			1075	27.5
Manipur	21	5.9	218	-2.5				
Meghalaya	17	-0.2	109	-0.3				
Nagaland	68	-0.07						
Orissa	110	7.0	4115	2.8				
Punjab	130	2.8	2825	0.2			3519	-0.3
Rajasthan	1094	4.7					2707	-7.8
Sikkim	40	0.3						
Tamil Nadu	256	-8.9	1905	0.05				
Tripura			265	-0.3				
West Bengal	93	-4.7	5189	-4.5			316	0.2
Arunachal Pradesh	46	-1.5						
Bihar	660	-2.2	3078	-7.4			2123	-0.9
Chhattisgarh	103	-0.6	3738	-0.9			110	1.1
Jharkhand	215	-0.03	1095	-25.5			128	-19.6
Madhya Pradesh	847	-1.9	1632	-1.8			4615	-5.6
Uttar Pradesh	771	-2.1	5802	-2.4			9684	-0.5
Uttarakhand	28	0.7	285	1.7			374	1.4
Sub total	8343		42305				29152	
Other states	325		724				311	
India	8668	-1.3	43029	-2.2			29463	-1.3

Note: Δ% is percent difference with 2012.

Table D.10 Canada, 2013 yield by province (tons/ha)

	Maize		Rice		Soybean		Wheat	
	2013	Δ%	2013	Δ%	2013	Δ%	2013	Δ%
Alberta							2.41	-14.3
Manitoba							2.29	-19.8
Saskatchewan							2.68	-4.9

Note: Δ% is percent difference with 2012.

Table D.11 Canada, 2013 area under production, by province (thousand ha)

	Maize		Rice		Soybean		Wheat	
	2013	Δ%	2013	Δ%	2013	Δ%	2013	Δ%
Alberta							3566	19.9
Manitoba							1344	-2.3
Saskatchewan							4526	0.1
Sub total							9436	
Other provinces							711	
Canada							10147	6.8

Note: Δ% is percent difference with 2012.

Table D.12 United States, 2013 yield and percent difference with 2012, by state (tons/ha)

	Maize		Rice		Soybean		Wheat	
	2013	Δ%	2013	Δ%	2013	Δ%	2013	Δ%
Arkansas	6.50	-41.8	8.42	24.0	2.42	-16.2		
California			9.06	-6.1				
Idaho								
Illinois	8.51	29.2			2.98	2.9		
Indiana	7.61	22.5			3.04	3.9		
Iowa	10.05	16.9			3.29	9.8		
Kansas	5.57	-7.5			1.72	16.4		
Michigan	7.12	-14.6			3.09	6.9		
Minnesota	9.41	-9.1			2.96	2.2		
Missouri	5.95	26.3	7.44	44.8	2.11	6.3		
Montana								
Nebraska	8.20	-8.1			3.42	22.5		
North Dakota	5.59	-26.9			2.17	-4.9		
Ohio	7.64	-1.1			3.24	6.9		
Oklahoma								
Oregon								
South Dakota	5.93	-6.5			2.12	5.0		
Texas	4.52	-44.6	8.43	-22.0		-20.1		
Washington								
Wisconsin	10.12	33.3			3.31	18.8		

Note: Δ% is percent difference with 2012.

Table D.13 United States, 2013 area under production, by state (thousand ha)

	Maize		Rice		Soybean		Wheat*	
	2013	Δ%	2013	Δ%	2013	Δ%	2013	Δ%
Arkansas	386	37.3	469	-10.1	1460	14.2	280	54.0
California			234	2.9			276	53.3
Idaho							535	6.7
Illinois	4823	-2.7			3659	1.3	254	-2.7
Indiana	2396	-1.8			2067	-0.6		
Iowa	5351	-3.5			3645	-3.1		
Kansas	1889	18.2			1463	-5.1	3315	-10.0
Michigan	1164	20.3			752	-6.6	272	24.4
Minnesota	3477	3.1			2628	-7.1	457	-13.7
Missouri	1276	-4.5	63	-14.0	2226	4.6	355	27.1
Montana							2152	-4.8
Nebraska	4383	19.0			1853	-8.2	474	-10.0
North Dakota	1450	3.5			1712	-10.6	2712	-13.6
Ohio	1593	7.8			1774	-4.3	245	34.4
Oklahoma							1920	10.3
Oregon							376	6.0
South Dakota	2546	18.7			1875	-1.7	805	-10.8
Texas	950	51.5	65	19.7			776	-36.1
Washington							895	1.7
Wisconsin	1151	-13.8			592	-14.0		
Sub total	32835		831		25706		16099	
Other states	2584		153		4274		2509	
United States	35419	1.9	984	-8.2	29980	-0.1	18608	-5.5

Note: Δ% is percent difference with 2012.

* Wheat area in the table includes areas of winter wheat, durum wheat, and spring wheat.

Table D.14 Argentina 2013 yield, by province (tons/ha)

	Maize		Rice (paddy)		Soybean		Wheat	
	2013	Δ%	2013	Δ%	2013	Δ%	2013	Δ%
Buenos Aires	6.71	-17.5			2.54	-19.6	2.89	-17.5
Córdoba	5.69	-54.3			2.22	-18.8	9.17	65.3
Santa Fe	7.42	-24.8			2.92	-17.6	7.72	63.5

Note: Δ% is percent difference with 2012.

Table D.15 Argentina, 2013 area under production, by province (thousand ha)

	Maize		Rice		Soybean		Wheat	
	2013	Δ%	2013	Δ%	2013	Δ%	2013	Δ%
Buenos Aires	1298	7.9			6537	12.8	2142	80.9
Córdoba	1369	58.1			5161	6.2	153	-67.5
Santa Fe	626	13.1			3201	6.4	188	-61.6
Sub total	3293				14899		2483	
Other provinces	944				4464		837	
Argentina	4237	14.6			19363	10.2	3320	5.1

Note: Δ% is percent difference with 2012.

Table D.16 Brazil, 2013 yield, by state (tons/ha)

	Maize		Rice (paddy)		Soybean		Wheat	
	2013	Δ%	2013	Δ%	2013	Δ%	2013	Δ%
Mato Grosso	5.91	3.5	3.15	-2.3	2.95	-5.6		
Mato Grosso Do Sul	4.91	-5.7	6.18	-2.7	2.91	14.9	0.92	-41.6
Minas Gerais	5.82	-2.8	1.94	0.08	2.93	-2.1	3.30	-10.8
Parana	5.77	5.2	5.29	4.2	3.35	36.5	1.75	-35.3
Rio Grande Do Sul	5.28	87.3	7.46	1.1	2.70	93.8	2.59	37.1
Santa Catarina	6.87	25.6	6.82	-7.3	3.04	27.5	3.00	43.3
Sao Paulo	5.25	-5.0	5.30	21.8	3.15	13.8	2.52	-18.8

Note: Δ% is percent difference with 2012.

Table D.17 Brazil, 2013 area, by state (thousand ha)

	Maize		Rice		Soybean		Wheat	
	2013	Δ%	2013	Δ%	2013	Δ%	2013	Δ%
Goiás*	1229	0.7	44	-25.1	2937	10.2	4	-58.5
Mato Grosso*	3417	24.7	158	11.4	7932	13.6		
Mato Grosso Do Sul*	1538	23.6	16	-6.8	1987	9.6	10	-32.8
Minas Gerais*	1214	-1.4	20	-34.6	1151	11.9	36	66.7
Parana*	3033	1.1	33	-5.4	4755	6.8	977	25.8
Rio Grande Do Sul*	984	-2.3	1084	4.3	4728	13.8	1040	5.1
Santa Catarina*	484	-6.5	150	0.8	521	15.5	73	9.0
Sao Paulo*	876	1.7	18	-7.0	615	15.4	35	-13.3
Sub total	12775		1523		24626		2175	
Other states	3283		893		3313		-209	
Brazil	16058	6.6	2416	1.9	27939	11.5	1966	3.9

Source: Database aggregates, the Brazilian Institute of Geographic and Statistics (IBGE) (107).

Note: Δ% is percent difference with 2012.

Table D.18 Australia, 2013 yield, by state (tons/ha).

	Maize		Rice		Soybean		Wheat	
	2013	Δ%	2013	Δ%	2013	Δ%	2013	Δ%
Western Australia							1.95	-30.0
South Australia							1.97	7.4
New South Wales							2.38	17.5
Victoria							2.11	-13.4

Note: Δ% is percent difference with 2012.

Table D.19 Australia, 2013 area, by state (thousand ha)

	Maize		Rice		Soybean		Wheat	
	2013	Δ%	2013	Δ%	2013	Δ%	2013	Δ%
Western Australia							4116	3.9
South Australia							2667	7.7
New South Wales							3997	-5.1
Victoria							1973	22.9
Sub total							12754	
Other states							1706	
Australia							14460	4.0

Note: Δ% is percent difference with 2012.

Annex E China Production Estimates and Environmental Indices

Table E.1 China, 2013 area under maize, soybean, and wheat production and percentage difference with 2012 (thousand hectares)

	Maize		Soybean		Wheat	
	2013	Δ%	2013	Δ%	2013	Δ%
Anhui	872	-2.2	822	-2.4	2593	-1.5
Chongqing	424	-2.4			363	-1.5
Fujian						
Gansu	1015	-1.1			737	-0.5
Guangdong						
Guangxi						
Guizhou	1037	-2.1				
Hebei	2967	2.9	112	3.2	1958	-1.9
Heilongjiang	4740	0.9	2714	-10.8	157	-34.0
Henan	3124	-1.9	445	-9.8	4925	-0.3
Hubei					1043	-1.9
Hunan						
Inner Mongolia	2682	2.0	640	-4.9	588	-0.2
Jiangsu	427	0.2	287	0.8	1930	1.7
Jiangxi						
Jilin	3501	3.8	310	-4.7		
Liaoning	2205	-0.3	224	-2.5		
Ningxia	254	-16.6			221	-4.5
Shaanxi	829	-0.6			1027	-6.8
Shandong	3118	0.6	294	-3.8	4146	0.5
Shanxi	1772	9.9	155	10.8	497	-3.2
Sichuan	1410	-0.9			1273	1.2
Yunnan	1516	-1.0				
Zhejiang						
Sub total	31894	0.9	6002	-6.9	21458	-1.1
Other provinces	3318	5.2	1662	-6.2	4135	-0.4
China	35213	1.3	7664	-6.7	25593	-1.0

Note: Δ% is percent difference with 2012.

Table E.2 China, rice areas in China for single season, early, and late rice, 2013 and percentage difference with 2012 (thousand hectares)

	Single rice		Early rice		Late rice	
	2013	Δ%	2013	Δ%	2013	Δ%
Anhui	1946	4.0	318	0.7	338	-1.3
Chongqing	784	-0.9				
Fujian			268	-3.6	210	13.8
Gansu						
Guangdong			975	0.3	1140	-3.3
Guangxi			1002	0.2	1089	-0.2
Guizhou	809	-0.6				
Hebei						
Heilongjiang	2991	1.3				

	Single rice		Early rice		Late rice	
	2013	Δ%	2013	Δ%	2013	Δ%
Henan	619	0.3				
Hubei	1325	-0.2	413	-1.3	521	-0.2
Hunan	1270	0.4	1514	-0.9	1514	-0.9
Inner Mongolia						
Jiangsu	2335	0.8				
Jiangxi	463	-0.7	1415	0.2	1358	-1.6
Jilin	720	1.0				
Liaoning	658	0.0				
Ningxia	59	-2.8				
Shaanxi	164	0.0				
Shandong						
Shanxi						
Sichuan	2207	-1.1				
Yunnan	919	-0.3				
Zhejiang			271	0.2	215	6.6
Sub total	17270		6176		6385	
Other provinces	1853		308		204	
China	19124	1.3	6484	-0.3	6589	-0.7

Note: Δ% is percent difference with 2012.

Table E.3 China, 2013 yield of maize, soybean, and wheat, by province (tons/ha)

	Maize		Soybean		Wheat	
	2013	Δ%	2013	Δ%	2013	Δ%
Anhui	4.357	-1.8	1.334	-1.7	4.262	-0.8
Chongqing	4.809	0.9			3.114	-0.8
Fujian						
Gansu	4.867	1.8			3.725	0.0
Guangdong						
Guangxi						
Guizhou	4.553	-0.6				
Hebei	5.607	3.3	1.553	0.5	5.232	0.2
Heilongjiang	5.376	1.5	1.704	-0.1	3.072	-2.3
Henan	5.345	0.7	1.745	0.1	5.175	-0.4
Hubei					4.226	-0.9
Hunan						
Inner Mongolia	5.657	2.6	1.320	0.8	3.247	2.8
Jiangsu	5.076	0.3	2.780	0.4	4.729	-1.0
Jiangxi						
Jilin	6.839	0.2	2.094	0.7		
Liaoning	6.017	0.6	2.326	-1.1		
Ningxia	6.639	2.1			3.337	-2.4
Shaanxi	4.824	2.9			3.786	-1.6
Shandong	5.961	4.9	2.371	-0.8	5.365	0.2
Shanxi	5.521	1.6	1.243	0.1	3.967	-1.6
Sichuan	5.006	2.3			3.587	0.5
Yunnan	3.886	1.2				
Zhejiang						

Note: Δ% is percent difference with 2012.

Table E.4 China, yield of single cropped rice, early rice and late rice by province (thousand tons)

	Single crop		Early rice		Late rice	
	2013	Δ%	2013	Δ%	2013	Δ%
Anhui	6.704	0.6	6.074	0.4	5.231	0.2
Chongqing	6.206	2.2				
Fujian			6.254	-3.6	5.471	0.3
Gansu						
Guangdong			5.418	2.0	5.111	-1.7
Guangxi			5.477	1.7	5.019	0.7
Guizhou	6.333	-0.6				
Hebei						
Heilongjiang	6.701	0.3				
Henan	6.631	1.4				
Hubei	7.973	-1.6	5.934	2.9	5.477	-0.1
Hunan	6.367	-2.1	5.646	0.4	5.884	-2.1
Inner Mongolia						
Jiangsu	7.159	-0.6				
Jiangxi	6.012	0.1	5.064	-1.8	5.354	-2.0
Jilin	7.035	0.4				
Liaoning	7.135	0.5				
Ningxia	7.827	0.4				
Shaanxi	6.400	2.4				
Shandong						
Shanxi						
Sichuan	6.606	2.8				
Yunnan	5.524	-1.4				
Zhejiang			5.646	-0.1	5.977	0.5

Note: Δ% is percent difference with 2012.

Table E.5 Environmental indices in China: Rainfall (mm), October-September accumulation

	2013 rainfall (mm)	Twelve-year average (2001-12)	Five-year average (2008-12)	2001-13 normalized trend	Coefficient of correlation	Significance level of trend	Difference between 2013 and 12-year average	Difference between 2013 and 5-year average
Anhui	310	384	414	14.039	0.276		-74	-104
Chongqing	209	164	159	2.768	0.06		45	50
Fujian	471	356	367	19.115	0.293		115	104
Gansu	150	125	118	-7.472	-0.216		25	32
Guangdong	754	549	560	15.224	0.301		205	194
Guangxi	507	389	403	9.679	0.253		118	104
Guizhou	230	228	240	12.399	0.338		2	-10
Hebei	185	158	167	13.608	0.259		27	18
Heilongjiang	67	78	79	7.436	0.113		-11	-12
Henan	224	314	312	0.761	0.013		-90	-88
Hubei	305	269	279	10.565	0.323		36	26
Hunan	343	253	265	19.858	0.462		90	78
Inner Mongolia	70	68	68	-2.147	-0.04		2	2
Jiangsu	384	416	431	11.159	0.403		-32	-47
Jiangxi	455	375	371	1.715	0.033		80	84
Jilin	61	94	104	24.191	0.375		-33	-43
Liaoning	80	105	106	4.438	0.056		-25	-26

Ningxia Huizu	84	74	64	-27.635	-0.491	*	10	20
Shaanxi	167	165	160	-8.467	-0.236		2	7
Shandong	297	301	281	-8.598	-0.13		-4	16
Shanxi	125	134	136	-4.396	-0.095		-9	-11
Sichuan	243	241	247	2.751	0.132		2	-4
Yunnan	411	364	363	2.659	0.091		47	48
Zhejiang	313	311	368	22.855	0.372		2	-55

Note: Rainfall accumulation (mm) between October 2012 and September 2013. Significance level of the trend: * for $p \leq 0.05$ and ** for $p \leq 0.01$. See also figure D.4a-c for a graphical representation of some of the variables in this table.

Table E.6 Environmental indices in China: Temperature (°C), October-September accumulation

	2013 temp (°C)	Twelve-year average (2001-12)	Five-year average (2008-12)	2001-13 normalized trend	Coefficient of correlation	Significance level of trend	Difference between 2013 and 12-year average	Difference between 2013 and 5- year average
Anhui	1496	1455	1433	-2.09	-0.304		41	63
Chongqing	604	558	556	-1.957	-0.102		46	48
Fujian	1065	1093	1076	-4.384	-0.549	*	-28	-11
Gansu	536	524	527	3.742	0.35		12	9
Guangdong	1911	1954	1941	-1.865	-0.381		-43	-30
Guangxi	1695	1674	1667	-0.131	-0.025		21	28
Guizhou	962	895	896	0.956	0.077		67	66
Hebei	985	1021	1000	-5.278	-0.483	*	-36	-15
Heilongjiang	328	360	355	-6.414	-0.211		-32	-27
Henan	1596	1513	1498	0.309	0.043		83	98
Hubei	1079	1026	1020	-0.721	-0.073		53	59
Hunan	991	942	948	1.064	0.075		49	43
Inner Mongolia	471	467	458	-1.867	-0.101		4	13
Jiangsu	1686	1686	1663	-2.44	-0.369		0	23
Jiangxi	1235	1214	1221	1.037	0.146		21	14
Jilin	507	529	514	-8.471	-0.488	*	-22	-7
Liaoning	590	629	608	-10.488	-0.565	*	-39	-18
Ningxia Huizu	575	572	571	3.17	0.212		3	4
Shaanxi	752	719	716	1.337	0.149		33	36
Shandong	1556	1533	1513	-1.688	-0.25		23	43
Shanxi	665	660	649	-1.662	-0.131		5	16
Sichuan	870	814	812	0.842	0.08		56	58
Yunnan	1133	1082	1093	3.244	0.556	*	51	40
Zhejiang	1007	990	982	-1.623	-0.155		17	25

Note: Temperature is temperature accumulation over a threshold of 5.0 °C between October 2012 and September 2013. Significance level of the trend: * for $p \leq 0.05$ and ** for $p \leq 0.01$. See also figure D.4a-c for a graphical representation of some of the variables in this table.

Table E.7 Environmental indices in China: PAR (W/m^2), October-September accumulation

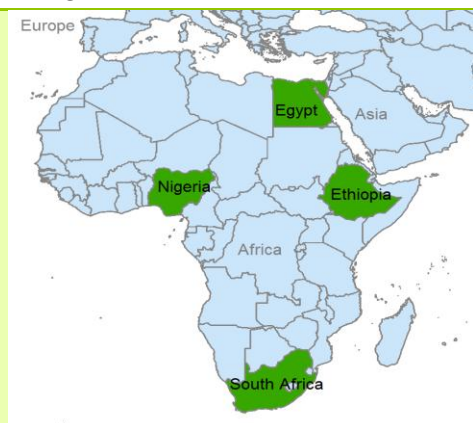
	2013 PAR (W/m^2)	Twelve-year average (2001-12)	Five-year average (2008-12)	2001-13 normalized trend	Coefficient of correlation	Significance level of trend	Difference between 2013 and 12-year average	Difference between 2013 and 5- year average
Anhui	8354	7874	7672	-3.477	-0.348		480	682
Chongqing	3578	3530	3461	-5.369	-0.455		48	117
Fujian	6102	6416	6395	-2.408	-0.13		-314	-293
Gansu	6030	6551	6502	-1.684	-0.189		-521	-472
Guangdong	8276	9172	9283	-1.285	-0.106		-896	-1007
Guangxi	7934	8088	8118	-0.055	-0.012		-154	-184
Guizhou	5596	5479	5393	-4.257	-0.454		117	203
Hebei	7976	7724	7695	1.309	0.145		252	281
Heilongjiang	5634	5754	5827	0.062	0.005		-120	-193
Henan	9759	8912	8728	-1.493	-0.114		847	1031
Hubei	6424	6002	5859	-3.449	-0.34		422	565
Hunan	5116	4819	4747	-3.032	-0.266		297	369
Inner Mongolia	6318	6470	6528	1.868	0.233		-152	-210
Jiangsu	10505	9701	9553	-0.849	-0.097		804	952
Jiangxi	6229	6128	6117	0.214	0.017		101	112
Jilin	6095	6063	6056	-1.704	-0.187		32	39
Liaoning	6403	6135	6062	-0.104	-0.008		268	341
Ningxia Huizu	5838	6412	6314	-2.005	-0.147		-574	-476
Shaanxi	6066	6254	6184	-0.803	-0.119		-188	-118
Shandong	9900	8967	8868	0.167	0.013		933	1032
Shanxi	6810	6755	6747	2	0.22		55	63
Sichuan	5780	5972	5905	-3.253	-0.455		-192	-125
Yunnan	8366	8794	8788	-1.808	-0.316		-428	-422
Zhejiang	5696	5985	5846	-4.768	-0.387		-289	-150

Note: PAR-1: Accumulated Photosynthetically active radiation (W/m^2) over the growing season(s) between October 2012 and September 2013. Significance level of the trend: * for $p < 0.05$ and ** for $p < 0.01$. See also figure D.4a-c for a graphical representation of some of the variables in this table

Annex F Country Profiles

The following are brief country profiles of the 31 countries that together constitute over 80 percent of the world's production and export of crops and also are the focus of this report. Statistics are based on FAOSTAT data for 2011 (land area) and 2013 (population) (6).

AFRICA



Overview The four focus countries in this region are among the five most populated in the continent. While maize is the major cereal for most of them, the crop comes only second after wheat in Egypt. Wheat is also planted in significant amounts in South Africa and in Ethiopia, where the preferred cereal after maize is teff, a local crop. None of the countries is a major soybean producer and rice maintains a subordinate role in Egypt.

Egypt Land area: 995 kkm² (3% arable land) Population: 85 million (26% agricultural population)

Wheat, maize, and rice are the major cereals in Egypt, although they rank only second after sugarcane in terms of value and production. Soybean cultivation is very limited. Virtually all crops are irrigated, which also explains why—with the exception of wheat (grown as a winter crop)—areas have been stagnating over the last 12 years. Pressured by the other countries in the Nile basin, the government has been trying to discourage the cultivation of rice and substitute it with less water demanding crops such as maize (another summer crop). Some farmers strongly resist the move and no equilibrium has been reached about the share of the main cereals. With a population of about 85 million, Egypt is the main wheat importer in the world, importing about 10 million tons, which is more than the national production. The country also imports significant amounts of maize (6000 kT) and Soybean (2000 kT).

Ethiopia Land area: 1,000 kkm² (15% arable land) Population: 88 million (76% agricultural population)

The preferred cereal in most parts of Ethiopia is teff, a crop hardly grown outside of the country. Among the “mainstream” cereals, maize comes first, followed by teff and wheat, while rice cultivation is very limited; Because of elevation, the climate is mostly temperate, particularly in the areas where water is normally available and the requirements of rice could be met. Altogether, Ethiopian agriculture and particularly the production of maize are developing fast. The country is characterized by complex terrain with uni-modal or bimodal rainfall. The main crops are harvested towards the end of the year (in October and November, sometimes in December) while planting takes place from March, sometimes with very long cycles (maize).

Nigeria Land area: 911 kkm² (40% arable land) Population: 171 million (23% agricultural population)

Nigeria is, by far, the most populated country in Africa (about 180 million people), while Egypt and Ethiopia come next with a population less than half the Nigerian population. The climate of the country is mostly “zonal” and spans very contrasting climate zones: from equatorial in the south (growing season of cereals from March to November) to semi-arid (Sahelian) in the north (growing season from May or June to October). The main maize producing areas are in the central latitudes, which combine favorable sunshine (insufficient in the south) and rainfall (low and unreliable in the north). Agriculture, especially rice and maize are developing fast, while soybean and wheat (a dry season irrigated crop in the north during winter) play a very minor part. Nigeria imports large

amounts of wheat (about 4000 kT) and rice (2000 kT, about half the national production).

South Africa Land area: 1,213 kkm² (10% arable land) Population: 51 million (9% agricultural population)

In the African context, South Africa has been a major producer of maize. In spite of constantly decreasing areas, production has kept increasing due to significant improvements of average yields (approximate doubling since 2000, but with large fluctuations that also affect production). Maize is grown as a summer crop during the south-African monsoon (November to May), while most wheat (a winter crop grown May to November) originates from the Mediterranean areas in Western Cape province, in the southernmost part of the country. Wheat is no longer perceived as an attractive crop by South African farmers and imports have constantly increased from the 1980s in parallel with decreasing wheat hectares, to the extent that wheat and soybean, which is picking up, currently both stay at about 700 kHa. Decreasing wheat production and a needed but repeatedly delayed land reform are two of the major issues facing South-African agriculture.

ASIA – EAST ASIA



Overview China spans 35 degrees of latitude and 60 degrees of longitude, thereby bridging a range of climatic, ecological and agricultural conditions ranging from continental central Asia to the maritime Pacific coast, and from cold to temperate and tropical. As such, China occupies a category of its own in East Asia, next to Japan and the two Koreas. The two countries are not included among the top 80 percent producers or exporters of maize, rice, soybean or wheat.

China Land area: 9,327 kkm² (12% arable land) Population: 1,391 million (59% agricultural population)

Due to its population of 1.4 billion people, China comes first among the producers of wheat and rice and ranks among the major producers of soybeans and maize. In terms of exports, however, the country plays a negligible role. The country feeds 22 percent of the world population with only 7 percent of arable land (108). In fact, large expanses of land are too cold or too dry for farming; agriculture is concentrated in the east. Crops are exposed to variable environmental conditions, which often result in production variability. For instance, in 2007 maize and soybean suffered from drought, while wheat yield decreased due to cold weather. Agriculture also competes with industry for land, which is the main factor behind the decrease in harvested area in 2003. The production increase of maize in China is mainly due to the expansion of areas. Soybean follows a decreasing trend observed in many countries, mainly as a result of the competition for land with maize, which is much more attractive to farmers.

ASIA – SOUTH ASIA



Overview South Asia, the southern region of the Asian continent, is located between 0° and -37° degrees northern latitude and 60° to 100° degrees eastern longitude. The area includes seven countries of which Nepal and Bhutan are landlocked; India, Pakistan and Bangladesh are coastal countries; and Sri Lanka and Maldives are island countries. Topographically, this area is dominated by the Indian Plate, which rises above sea level as the Indian subcontinent south of the Himalayas and the Hindu Kush. The region is home to about one fourth of the world's population. South Asia is also the world's second poorest region after Sub-Saharan Africa. According to the World Bank, 70 percent of the South Asian population and about 75 percent of South

Asia's poor live in rural areas and most rely on agriculture for their livelihood. (109) (6)

Bangladesh Land area: 130 kkm² (59% arable land) Population: 154 million (43% agricultural population)

Bangladesh, located on the fertile Bengal delta, is the world's eighth most populous country, as well as one of the world's most densely populated countries. It is bordered by India to its north, west and east, by Myanmar to its southeast, and by the Bay of Bengal to its south (110). The main food crops planted in Bangladesh are potato, rice, sorghum and wheat. Rice is the most important crop in Bangladesh and the production of rice accounts for 7 percent of global rice production (6).

India Land area: 2,973 kkm² (53% arable land) Population: 1,275 million (47% agricultural population)

India is the seventh-largest country by area and the second-most populous country in the world; 64 percent of cultivated land in India is dependent on monsoons (111). The main food crops are rice, maize, sorghum, millet, groundnut, soybean, wheat and rapeseed. (112) India is the second largest producer of wheat and rice, the world's major food staples after maize. India accounts for 22 percent of the global rice production, 12 percent of wheat, 2 percent or maize, and 5 percent of soybean. (6)

Nepal Land area: 143 kkm² (34% arable land) Population: 31 million (93% agricultural population)

Nepal is located in the northern part of South Asia, is the world's 93rd largest country by area, and the 41st most populous country. (111) The main food crops planted in Nepal are maize, rice and wheat. Though rice is the dominant crop, the production contributes little to the global rice production.

Sri Lanka Land area: 63 kkm² (19% arable land) Population: 21 million (42% agricultural population)

The main cereal cultivated in Sri Lanka is rice, like in most other countries in the region. The second cereal is maize, the production of which represents only a fraction of that of rice (the maize/rice production ratio is approx. 20). While wheat is not cultivated, it comes second in terms of consumption (a rice/wheat consumption ratio of 3), resulting in heavy dependence on imports (net wheat imports about 1 million tons [2]). Although yields did usually increase over the last ten years, agriculture mostly stagnates, as exemplified by the number of tractors or the area equipped for irrigation [2]. According to the World Bank the main factors negatively affecting the agricultural sector include weak planning, heavy public sector interventions, and weak delivery of services in rural areas [1].

ASIA – SOUTHEAST ASIA



Overview The Southeast Asian countries can be divided into the “mainland” or “continental” and “maritime” or “island” areas although, strictly speaking, none of the areas comes close to continental climatic conditions. All are characterized by the proximity of the ocean, i.e., relative low annual and daily thermal amplitudes and mostly abundant monsoon rainfall, especially in the equatorial areas. Elevation is the major factor modifying the above-mentioned patterns.

Cambodia Land area: 177 kkm² (23% arable land) Population: 15 million (65% agricultural population)

The climate of Cambodia is dominated by the monsoon winds. It consists of two major seasons: mid-May to early October and early November to mid-March. Rice cultivation dominates the agricultural landscape and makes up around 85 per cent of the total cultivated area. The Mekong River and the Tonle Sap (Great Lake) are the major rice cultivation regions. Traditionally two or three rice crops are grown during the year. Around 80 percent of rice production occurs in the monsoon season, while 20 percent is produced under irrigation during the dry season.

Indonesia Land area: 1,812 kkm² (13% arable land) Population: 247 million (35% agricultural population)

Indonesia is the world's largest archipelago nation, consisting of approximately 17,508 islands. Indonesia has a tropical climate with a dry season and a rainy season with mostly heavy precipitation, and high temperature and humidity throughout the year (equatorial climate). Palm oil is one of the most important agricultural export products. Additionally, Indonesia is the world's third largest rice producer and consumer. The rice cultivation regions are around 30 percent of total cropland.

Laos Land area: 231 kkm² (6% arable land) Population: 6 million (75% agricultural population)

The only landlocked country in Southeast Asia is Laos and only about six percent of the land is suitable for subsistence agriculture. There are two main seasons: the rainy season (May to November) and the dry season (December to April). Laos is characterized by a very large biodiversity of rice, one of the largest in the world. The second cereal is maize, which is about four times less abundant than rice. Roughly 80 percent of the arable land area is used for rice cultivation. The glutinous rice is the most popular type of rice. Most of the rice cultivation area in Laos is rain-fed (lowland rice). The only crop produced for export is coffee.

Malaysia Land area: 329 kkm² (5% arable land) Population: 29 million (12% agricultural population)

Malaysia is located near the equator. It is separated by the South China Sea into two regions: Peninsular Malaysia and Malaysian Borneo. The weather stays hot and humid all year round, and the country is a major producer of the main equatorial plantation crops (rubber, oil palm, and cocoa) which dominate agricultural exports. Malaysia is the world's second largest producer of palm oil next to Indonesia. Rice, the main food crop, is cultivated on small farm. Of the total rice plantation area, 85 percent is under wetland.

Myanmar Land area: 653 kkm² (17% arable land) Population: 49 million (66% agricultural population)

Myanmar functions as a land bridge between East Asia, Southeast Asia, and South Asia. It is a country rich in oil, natural gas, and other mineral resources. Rice is the principal agricultural product that covers around 60 percent of the total cropland. The main rice producing regions are in the delta zone (Ayeyarwady, Pegu, Yangon, and Mon states). Myanmar's principal rice ecosystems include rain-fed lowland rice, submerged deep-water rice, irrigated lowland rice, and rain-fed upland rice.

Philippines Land area: 298 kkm² (18% arable land) Population: 98 million (32% agricultural population)

The Philippines is one of the largest island groups in the world. The islands are divided into three groups: Luzon, Visayas, and Mindanao. The country benefits from a tropical and usually hot and humid climate. The major four crops cultivated are coconut, rice, maize, and sugarcane. Sugar is the most important agricultural export of the Philippines. Around one-fourth of the total cropland is used for rice cultivation, which is grown especially in central and north-central Luzon, south-central Mindanao, western Negros, and eastern and central Panay.

Thailand Land area: 511 kkm² (31% arable land) Population: 70 million (39% agricultural population)

Thailand has a tropical monsoon climate with high temperatures and humidity. The Mekong River and the Chao Phraya River are the main sources of water for agriculture. Rice is the most important crop and the central plains are known as the rice bowl of the country. Thailand has long been the world's major rice exporter.

Vietnam Land area: 310 kkm² (21% arable land) Population: 91 million (62% agricultural population)

Vietnam is an elongated S-shaped country with tropical lowlands, hills, and densely forested highlands. It has a humid subtropical climate in the north with humidity averaging around 84 percent throughout the year, and a tropical savanna climate in the south region. Vietnam is divided into two extensive alluvial deltas by the Red River in the north and the Mekong River in the south. Main products of Vietnam agriculture are rice, coffee, tea, and rubber. Rice is the most important

crop and cultivated on about 82 percent of the arable land.

ASIA – WESTERN AND CENTRAL ASIA



Overview Western and Central Asia consists of 25 countries. About 75 percent of the region is arid. It is the least forested region in the world with only four percent forest cover. (113)

Turkey Land area: 770 kkm² (27% arable land) Population: 75 million (18% agricultural population)

Turkey is a transcontinental country located in South-Eastern Europe and South-Western Asia bordering the Black Sea (114). The country's arable land (of which about one quarter is irrigated) accounts for 27 percent of the total land area. The main crops include tobacco, cotton, grain, dried fruits and fresh fruits; the major grain crops are wheat, barley, and maize. Turkey is one of the world's biggest wheat and barley producers. According to FAO statistical data, wheat area and yield have been steadily and significantly increasing over the last twelve years.

Iran Land area: 1,629 kkm² (11% arable land) Population: 76 million (20% agricultural population)

Iran is a country located in the Middle East bordering the Gulf of Oman, the Persian Gulf, and the Caspian Sea. (115) Most land area is arid and semi-arid. The arable land accounts for 11 percent of the total land area. The main crops include grain, potatoes, cotton, sugarcane, tea, and tobacco. Wheat, rice, and barley are the major grain crops. Over the last twelve years, rice area has significantly decreased, according to FAO statistical data.

Pakistan Land area: 771 kkm² (27% arable land) Population: 183 million (41% agricultural population)

Pakistan is a populous country with an ethnically and linguistically diverse population; about 41 percent of the population engages in agriculture. Important crops include wheat, cotton, rice, and sugarcane, and the country exports significant amounts of wheat and especially rice. For both wheat and rice area, yield, and production, increasing trends have been observed for the last twelve years (FAO statistical data).

Kazakhstan Land area: 2700 kkm² (9% arable land) Population: 17 million (15% agricultural population)

Kazakhstan is one of the largest countries in the world. It has a strong economy supported by vast natural resources. The main grain crop is wheat, which accounts for about 56 percent of the arable land area. Over the last twelve years, wheat yield, production, and in particular area have been increasing, according to FAO statistical data.

Uzbekistan Land area: 425 kkm² (10% arable land) Population: 28 million (20% agricultural population)

Due to rich natural resources, including oil, gas and gold, economic prospects of Uzbekistan look promising. The important crops are wheat and cotton, of which the country is one of the world's largest producers; its agricultural success story, however, is coupled with serious ecological problems affecting the Aral Sea. (116) Wheat is cultivated in the east and accounts for about one third of the cultivated land. According to FAO statistical data, wheat yield and production have increased significantly over the last twelve years.

EUROPE



Overview This report covers the United Kingdom, France, Germany, Poland, Romania, Ukraine, Belarus, and Russia. Of those eight countries, five (Germany, France, UK, Poland, and Romania) have joined the European Union (EU) and share the same rules and regulations for agriculture. Wheat is the dominant crop grown in Europe, followed by maize, and rice. Soybean plays only a minor role.

Belarus Land area: 203 kkm² (27% arable land) Population: 9 million (8% agricultural population)

In Belarus, sugar beet, potatoes, wheat, barley, and maize are the five most produced commodities. According to FAOSTAT statistics from 2001 to 2012, the acreage, yield, and production of both wheat and maize present a significant increasing trend. However, less than one percent of total cereal production is available for export due to the expansion of the country's livestock and the high demand for feed. (117) In 2013 Belarus plans to increase the share of feed crop cultivation aiming for self-sufficiency in feed production. (118)

France Land area: 548 kkm² (34% arable land) Population: 64 million (2% agricultural population)

France is the third largest economy in the EU. It is the world's fifth wheat producer and ranks second and fourth respectively in global wheat and maize export. Wheat, sugar beet, maize, barley, and grapes are the five most produced commodities. According to FAOSTAT statistics, soybean acreage and production have been decreasing significantly between 2001 and 2012, while the planting area and production for wheat have significantly increased.

Germany Land area: 349 kkm² (34% arable land) Population: 82 million (1% agricultural population)

Germany is the largest economy and second most populous nation (after Russia) in Europe. In the second half of the 20th century, the number of farms in Germany decreased dramatically, but the production actually increased due to the employed technologies and more efficient production methods. Sugar beet, wheat, barley, potatoes, and rapeseed are the most produced agricultural products. According to FAOSTAT statistics, the planting areas of both wheat and maize have significantly increased from 2001 to 2012.

Poland Land area: 304 kkm² (36% arable land) Population: 38 million (14% agricultural population)

Poland generally has a temperate climate with warm summers and cold winters and is one of the driest (continental) countries in Europe. A mixed type of farming prevails in most parts due to soil and climatic conditions. Potatoes, sugar beet, wheat, rye, and mixed grains are the five most produced commodities, of which wheat is mainly grown in the south of the country where the soil is richer. No significant trend has been observed for either wheat or maize production from 2001 to 2012. Drought occasionally affects summer crops, as happened in 2006, resulting in decreased wheat and maize production.

Romania Land area: 230 kkm² (39% arable land) Population: 21 million (7% agricultural population)

In Romania, maize, wheat, potatoes, sugar beet, and barley are the five most produced commodities. A large problem faced by the country's agricultural sector is the lack of major investments, which has led to its current relatively poor mechanization compared with other European countries. Besides, Romanian products often fail to meet EU quality standards and 64 percent of Romanian farms produce mainly for national consumption. (119). According to the FAOSTAT statistics from 2001 to 2012, significant decreasing trends are observed for the Romanian maize acreage, while rice acreage, yield, and production have significantly increased.

United Kingdom Land area: 242 kkm² (25% arable land) Population: 63million (1% agricultural population)

The temperate climate of the United Kingdom is too cool for some crops (e.g., maize) to reach

maturity, but the summer warmth is sufficient for wheat production. As a result, wheat is the dominant crop in UK, followed by sugar beet, potatoes, barley, and rapeseed. Due to the climate, autumn sown crops outyield spring sowings. Aging of the farmer population is often listed as an issue for the country's agriculture. According to FAOSTAT data (table G.1), no significant trend has been observed in the area, yield, and production of wheat in the UK between 2001 and 2012.

Ukraine Land area: 579 kkm² (56% arable land) Population: 45 million (10% agricultural population)

Ukraine ranks fifth in global maize production and sixth in global maize export. Sugar beet, potatoes, wheat, barley, and maize are the five most produced commodities in this country. According to FAOSTAT statistics from 2001 to 2012, a significant increasing trend can be seen in the acreage, yield, and production of maize, rice, and soybean, but not of wheat. This may be attributed to the drop in wheat production in 2003, caused by severe winter weather with persistent snow crusts that smothered the crop. (120) (121).

Russia Land area: 16,377kkm² (7% arable land) Population: 143 million (7% agricultural population)

Russia is the largest country on earth in terms of surface area and it globally ranks third in wheat production. Agriculture in Russia suffered a severe decline in the early 1990s as it struggled to transform from a centralized economy to a market-oriented system. (122) The five most produced commodities are wheat, potatoes, sugar beet, barley, and oats. Between 2001 and 2012, acreage, yield, and production of maize, soybean, and rice, but not wheat, have shown a significant increasing trend (FAO statistical data).

NORTH AMERICA



Overview The center of the continent is occupied by a large plain with abundant water resources, fertilized soil, and favorable climate. At the same time, agriculture largely benefits from scientific and technological innovations. North America has become the most important cereal producer and exporter in the world.

United States of America Land area: 9,147 kkm² (18% arable land) Population: 318 million (2% agricultural population)

For the last 12 years, the United States has been the largest cereal producer and exporter in the world, a position achieved mostly as a result of a rapid increase in yields. Although the harvested areas of soybean have shown significant decreasing trends over the same time period, the country remains the major producer of the crop. The U.S. is also the third wheat producer in the world. Grain exports are the main source of the country's trade surplus.

Canada Land area: 9,094 kkm² (5% arable land) Population: 35 million (2% agricultural population)

Due to the country's cold climate, only about 5 percent of Canada's land area consists of arable land. Thanks to a sparse population and advanced technology, Canada has become another cereal producer and exporter in North America. In the last 12 years, the production of maize, wheat, and soybean all increased greatly as a result of yield increases. Canada has become the third major wheat exporter in the world. Similar to the situation in the United States, Canada's large trade surplus is derived from cereal exports.

Mexico Land area: 1,944 kkm² (13% arable land) Population: 117 million (16% agricultural population)

Mexico is a mountainous country and arable land only occupies 13 percent of the land area. Local wheat demand deriving from the large population is the main driver of cereal production. Although Mexico is a main maize producer, despite greatly increasing yields, production hasn't grown due the decrease in cultivated area over the last 12 years. A similar trend is observed for rice Mexico complements its insufficient domestic food production by importing maize and wheat from the

United States and Canada; the country has become the third largest maize importer in the world.

OCEANIA



Overview Oceania is situated in the southern Pacific Ocean sub-tropics. It consists of 14 countries, among which Australia is the largest. Oceania has vast areas of semi-arid land and a limited population. Hence, stockbreeding in Australia and New Zealand is well developed. Australia is the world's leading wool producer and exporter and New Zealand ranks as the first exporter of mutton in the world.

Australia Land area: 7,682 kkm² (6% arable land) Population: 23 million (4% agricultural population)

Australia is one of the key wheat producers and exporters in the world. Wheat and barley are the two major crops in Australia, while maize, soybean, and rice are very limited. Water scarcity is the main limiting factor for agriculture, although more than 70 percent of available water is used for agriculture. As a result, irrigation plays an important role. Over the last two decades, Australia has seen expanded wheat cultivation while maize, soybean, and rice planting areas either decreased or kept stable. Australia also produces considerable amounts of cotton based on irrigation.

SOUTH AMERICA



Overview The expansion of planting areas for soybean and other crops in four major agriculture countries in South American has resulted in the conversion of pasture to arable land as well as deforestation. The situation varies among countries.

Argentina Land area: 2,737 kkm² (14% arable land) Population: 41 million (7% agricultural population)

Argentina now ranks as the second largest maize exporter and the third largest soybean exporter and producer in the world. Maize produced in Argentina is exported around the world to more than two thirds of all countries. To the contrary, rice cultivation is very limited. Since the mid-1970s, cultivation areas for soybean have grown strongly compared with those of other field crops. Large expanses of pasture and forest have been replaced by cultivated lands as a result of agricultural development. In 1991, the government implemented structural reforms, which reduced both export taxes on agricultural commodities and tariffs on imported inputs. As a result, imports of agricultural inputs (e.g., pesticide, fertilizer, and machinery) have accelerated (123). This has led to a sudden boom in soybean cultivation, a stable cultivation area in maize, and a decrease in wheat plantation because of higher incomes for soybean cultivation.

Brazil Land area: 8,459 kkm² (9% arable land) Population: 200 million (10% agricultural population)

Agriculture plays an important role in Brazil's economy as this country has vast agricultural lands.

Brazil is one of the most significant producers and exporters of maize and soybean, not to mention sugarcane and coffee. Brazil's farming systems display great latitudinal diversity. The central states produce most of the country's grain and oilseeds crops. The production of maize, rice, soybean, as well as wheat increased during the past 12 years. While areas for rice decreased, increases in planting area as well as yield were observed for maize, soybean, and wheat. Since the early 1970s, planting areas for soybean have grown strongly with soybean production increasing more than thirty-fold in the past 35 years. (123). In parallel, the volume of soybean exports shot up after the 1990s to make a substantial contribution to Brazil's GDP.

Paraguay Land area: 397 kkm² (10% arable land) Population: 7 million (29 % agricultural population)

Agriculture in Paraguay has been the mainstay of the economy. The gross value of agricultural products accounts for about 20 percent of GDP according to FAO data (6). Soybean areas and exports have increased since the 1980s and soybean has replaced cotton as the country's most important crop. Planting areas have also increased, even if yields of different crops are very variable due to predominantly rain-fed farming systems. According to FAOSTAT data (6), the production of both grain crops and oilseeds crops has increased. In contrast, the prevalence of undernourishment has also increased in the country. Paraguay is the only country in South America whose food security problem is getting worse. One of the reasons seems to be that public policy is biased toward the large-scale farmers who buy large areas of lands to expand soy monoculture. (124)

Uruguay Land area: 175 kkm² (10% arable land) Population: 3 million (10% agricultural population)

Unlike other countries in the region, Uruguay has no mountains. Potentially, most of the land can be used for agriculture. However, only 10 percent of the land is used for crop cultivation. Large areas of grasslands are used for livestock activity. From the 1950s to the 1990s, cultivation areas of both maize and wheat decreased, while the planting area of rice increased. Until 2000, rice was even the most important export grain crop. Uruguay's soybean sector did not emerge until 2000, lagging other South American agricultural countries by more than two decades. Since 2003, Uruguay's has been economy recovering and the planted area, production and soybean exports exploded.

Annex G Country Long Term Trends

Table G.1 presents average crop area, yield, and production values for maize, rice, soybean, and wheat for the years 2010-2012 based on FAOSTAT (6). Colors indicate significant trends based on statistics for 2001-2012, showing increasing trends at 0.05 and 0.01 levels of significance. Positive (increasing) trends are in blue ($p \leq 0.01$) and green ($p \leq 0.05$), while negative (decreasing) trends are shown in orange ($p \leq 0.05$) and red ($P \leq 0.01$). No color indicates trends are not significant. No values indicate cultivated areas are nil or insignificant.

Table G.1 Crop area, yield, production values and their 2001-2012 trends by country

2010-2012 average	Maize			Rice			Soybean			Wheat		
	Area kHa	Yield T/Ha	Prod. kT	Area kHa	Yield T/Ha	Prod. kT	Area kHa	Yield T/Ha	Prod. kT	Area kHa	Yield T/Ha	Prod. kT
AFRICA												
Egypt	652	8.11	6,972	431	9.56	5,502	9	3.06	35	981	6.21	8,127
Ethiopia	1,916	2.58	4,984	36	2.69	94	12	1.55	20	1,558	1.90	2,949
Nigeria	5,119	1.73	8,756	2,556	1.80	4,624	444	0.99	433	85	1.48	125
S-Africa	2,788	4.30	11,892	1	2.60	3	410	1.74	709	586	2.96	1,743
ASIA												
Bangladesh	219	6.00	1,315	11,742	3.83	44,963	41	1.60	66	383	2.52	968
Cambodia	327	2.33	760	2,934	2.99	8,775	83	1.58	130			
China	33,664	5.72	192,779	30,076	6.66	200,349	7,718	1.83	14,123	24,222	4.86	117,724
India	8,554	2.52	21,515	43,110	3.51	151,000	10,178	1.20	12,150	29,142	3.00	87,519
Indonesia	3,984	4.63	18,845	13,299	5.04	67,085	617	1.41	868			
Iran	199	7.67	1,554	501	5.12	2,571	75	2.36	178	7,040	1.93	13,600
Kazakhstan	96	3.64	350	95	3.33	314	72	1.92	139	13,432	1.13	15,226
Laos*	207	5.23	1,081	869	3.69	3,209	7	1.58	11			
Malaysia*	9	5.42	50	689	3.84	2,650						
Myanmar	394	3.70	1,454	7,909	3.98	31,530	163	1.43	233	100	1.81	181
Nepal*	884	2.30	2,034	1,503	3.00	4,519	28	0.95	26	755	2.27	1,716
Pakistan	989	3.88	3,838	2,546	3.37	8,610				8,899	2.70	24,014
Philippines	2,546	2.72	6,918	4,527	3.71	16,830	1	1.34	1			
Sri Lanka*												
Thailand	1,122	4.31	4,830	12,117	2.97	35,991	99	1.81	178	1	0.99	1
Turkey	602	7.26	4,370	106	8.36	880	27	3.73	101	7,910	2.60	20,525
Uzbekistan	35	6.66	232	44	4.47	149				1,399	4.71	6,590
Vietnam	1,122	4.23	4,749	7,633	5.50	42,022	167	1.48	247			
EUROPE- RUSSIA												
Belarus*	162	5.52	906							653	3.26	2,142
France	1,632	9.30	15,167	21	5.73	122	43	2.83	121	5,687	7.00	39,694
Germany	487	9.74	4,749							3,202	7.23	23,113
Poland	392	6.06	2,393							2,252	4.07	9,146
Romania	2,468	3.68	8,904	12	4.87	59	71	1.90	132	2,030	3.00	6,080
United Kingdom										1,967	7.36	14,465
Ukraine	3,521	5.25	18,584	28	5.66	159	1,186	1.79	2,118	6,190	2.95	18,313
Russia	1,522	3.86	6,087	200	5.29	1,056	1,200	1.32	1,595	22,584	1.99	45,156
NORTH AMERICA												
Canada	1,563	8.30	10,003	-	-	-	1,563	2.87	4,487	9,373	2.55	2,3867
Mexico	6,714	3.12	21,002	53	4.75	249	150	1.38	207	650	5.03	3,263
United States.	31,222	8.86	301,315	762	7.94	9,488	14,777	2.80	85,617	19,847	3.06	58,744
OCEANIA												
Australia	68	5.53	373	73	8.74	643	28	1.99	55	12,798	1.65	21,282

2010-2012 average	Maize			Rice			Soybean			Wheat		
	Area kHa	Yield T/Ha	Prod. kT	Area kHa	Yield T/Ha	Prod. kT	Area kHa	Yield T/Ha	Prod. kT	Area kHa	Yield T/Ha	Prod. kT
SOUTH AMERICA												
Argentina	2,844	6.48	18,527	180	6.19	1,126	14,747	2.60	38,462	5,234	2.64	13,630
Brazil	12,863	3.68	47,826	3,093	3.84	11,688	20,372	2.65	54,153	2,080	2.13	4,514
Paraguay*	624	2.72	1,787	43	4.06	182	2,107	2.39	5,050	388	2.13	858
Uruguay*	68	4.11	282	171	7.13	1,218	402	1.99	834	263	2.73	769

Source: All data and trends were computed based on FAOSTAT (6).

Note: Countries identified with an asterisks (*) are outside the main focus area for this report (i.e., not among the 80 percent major producers or exporters) but have been included to improve the coverage of major producing zones (MPZ).

Data Notes and Bibliography

A note on the data: Careful attention has been paid to the appropriate acknowledgement of the many sources for the current CropWatch bulletin. Sources are listed throughout the text, in the acknowledgements, and chapter 6. In the event that a source is not properly acknowledged, this is unintentional; when brought to our attention this error will be rectified in the next edition of the bulletin.

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The current CropWatch bulletin introduces several new but 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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This CropWatch bulletin provides a comprehensive overview of the 2012-13 global production of wheat, rice, maize, and soybean. It is based on a thorough analysis of environmental conditions and a quantitative assessment of their impact on crops, focusing on key producing areas and countries, including China. The CropWatch analysis takes advantage of newly available data, including the high quality data from the Chinese FY-3 and HJ-1 satellites, and introduces new spatial units of analysis, new methods, and several innovative remote sensing-based indicators. This bulletin, the first CropWatch bulletin simultaneously released in both English and Chinese, adds a Chinese voice on global food security perception. It contributes to the global effort to provide more reliable, transparent, and up-to-date information on agricultural production to fight against hunger and ensure sustainable agricultural development across the world.