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 deceased 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.

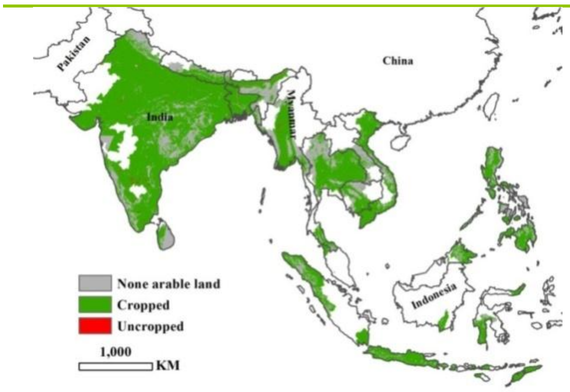
Temperature was significantly above average in continental Southeast Asia during most of last year, while winter was cold north of northern Rajasthan and an area centered on Bihar and West Bengal. Madhya Pradesh and Uttar Pradesh suffered unseasonably high temperatures in May.

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.

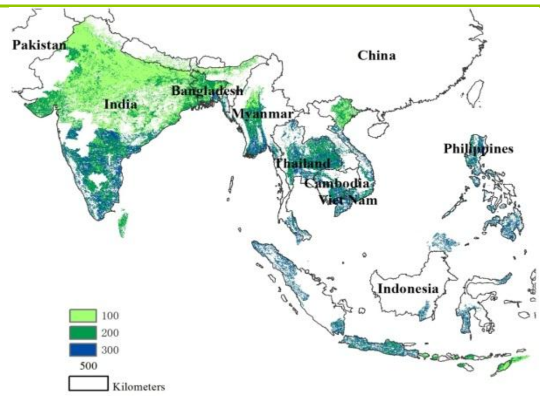
The VHI and biomass indicators describe similar situations for areas in both central and northwest India and areas in central continental South-East Asia for the current season. For the first region, both indicators point to favorable conditions, while for the second region both indicate conditions are 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).

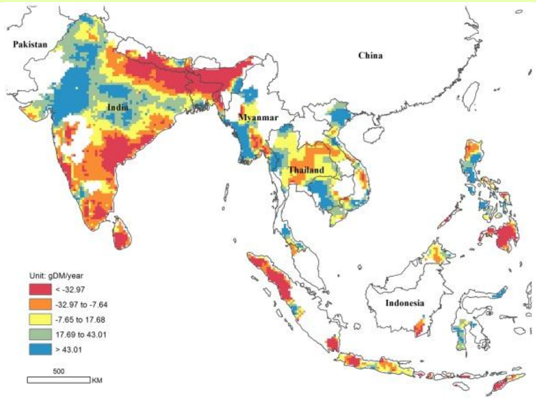
Figure 2.1 Environmental and crop production indices for South and South-East Asia MPZ



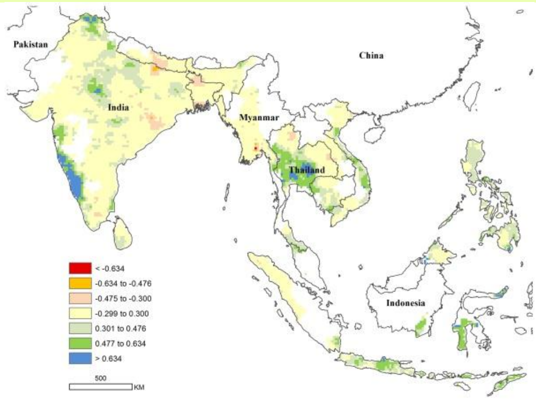
a. Cropped and uncropped arable land



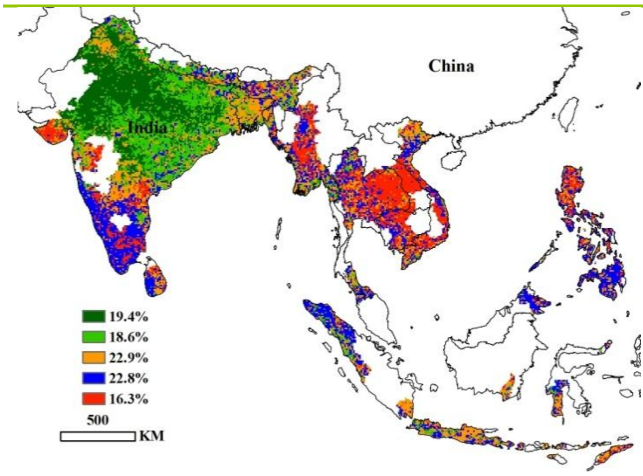
b. Cropping index



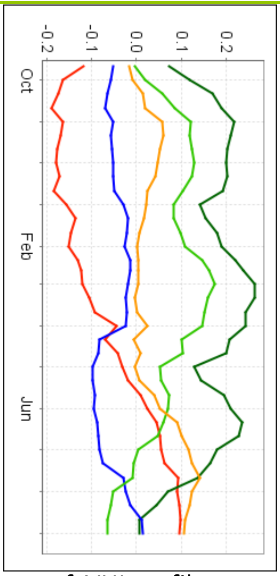
c. 2013 biomass departure from five-year average



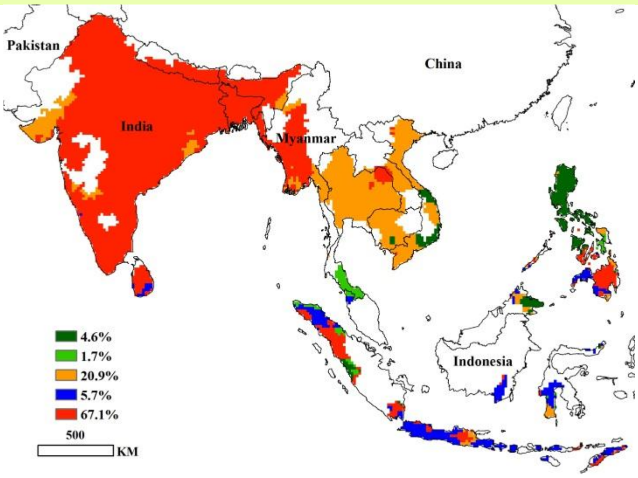
d. Biomass trend



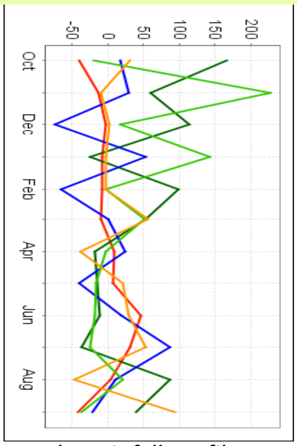
e. VHI departure from the previous five years for period indicated in f.



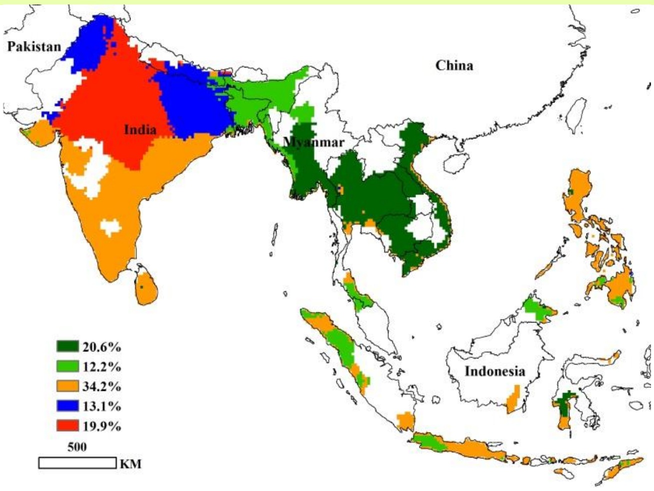
f. VHI profile



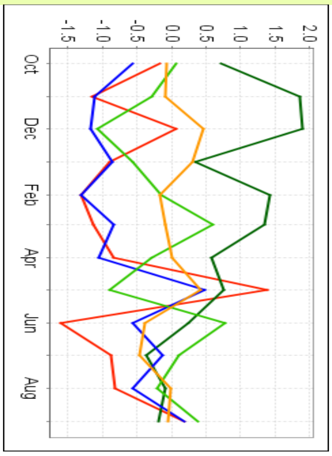
g. Rainfall departure from the previous five years for period indicated in h.



h. Rainfall profile



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



j. Temperature profile

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).

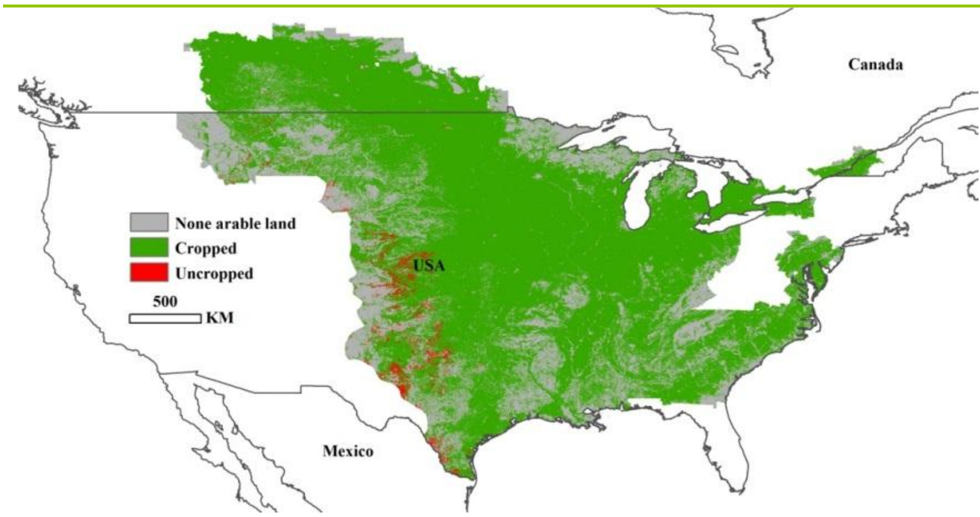
For the two recent seasons (winter and summer crops) the most notable features for this MPZ include a wet early winter (November 2012) in the south-west of the zone (Louisiana and Texas) followed by very variable rainfall in Louisiana. Temperature was significantly below average in (i) parts of the mid-west 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.

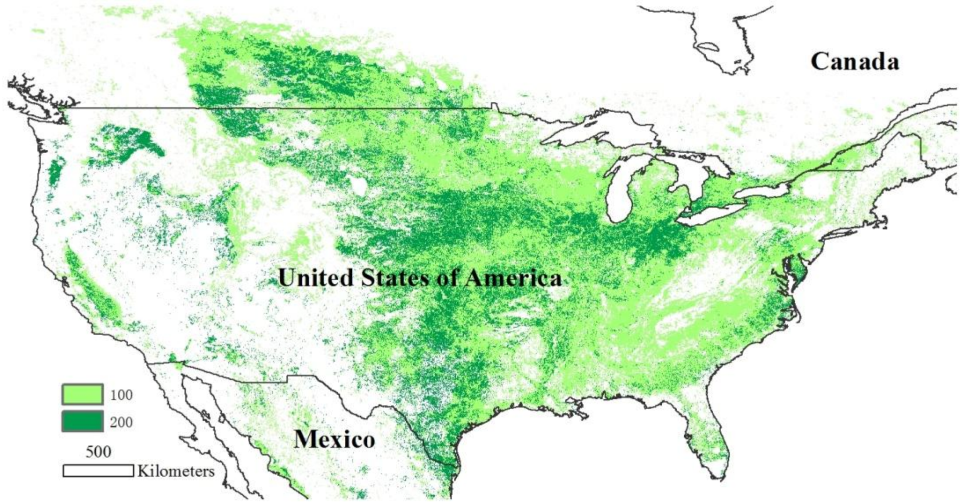
VHI-based drought profiles show average to better than average conditions over most of the MPZ from October 2012 to September 2013, with the exception of drought conditions from February to June in part of the western MPZ, covering about 20 percent of its area. Favorable conditions were recorded in most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

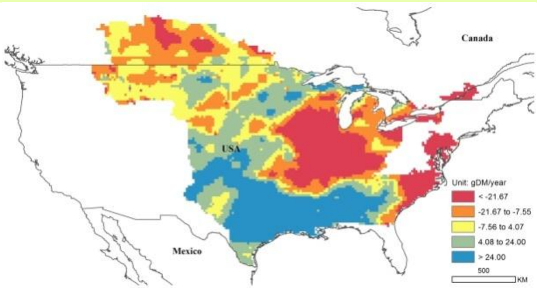
Figure 2.2 Environmental and crop production indices for the North America MPZ



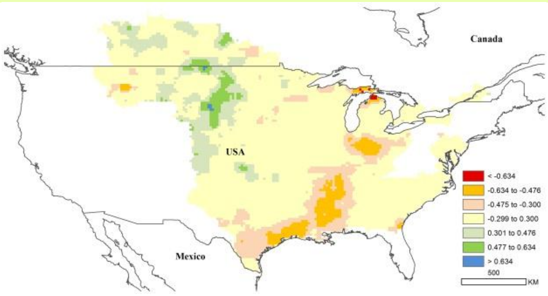
a. Cropped and uncropped arable land



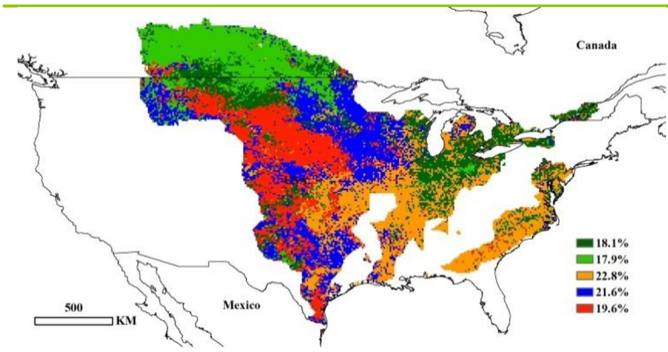
b. Cropping index



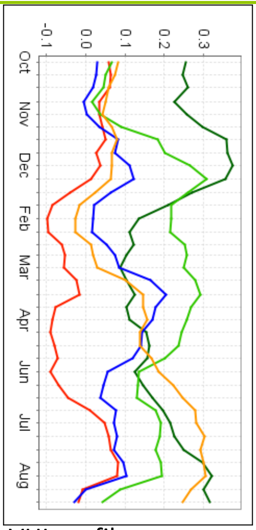
c. Biomass 2013 departure from five-year average



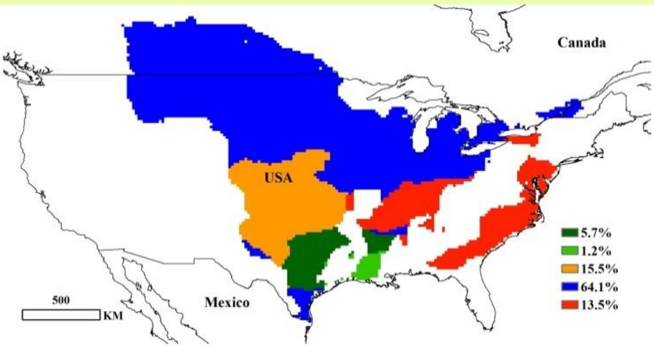
d. Biomass trend



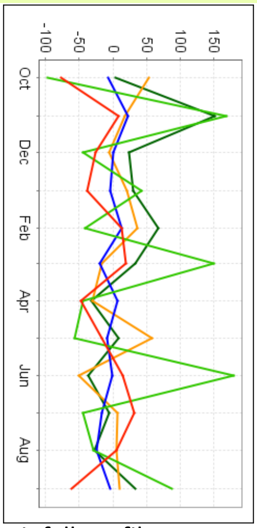
e. VHI departure from the previous five years for period indicated in f.



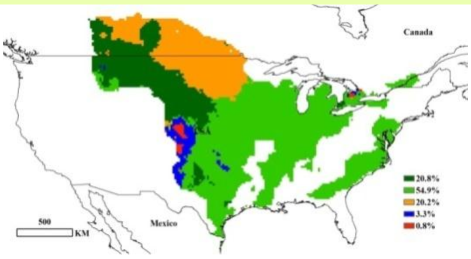
f. VHI profile



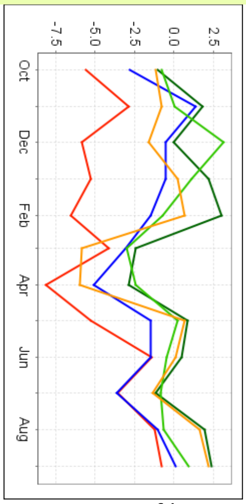
g. Rainfall departure from the previous five years for period indicated in h.



h. Rainfall profile



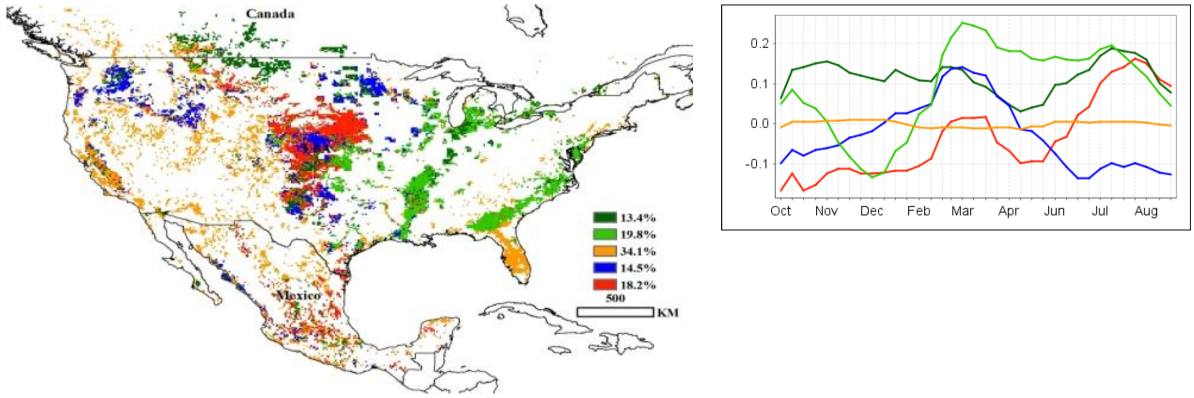
i. Temperature departure from the previous five years for period indicated in j.



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.

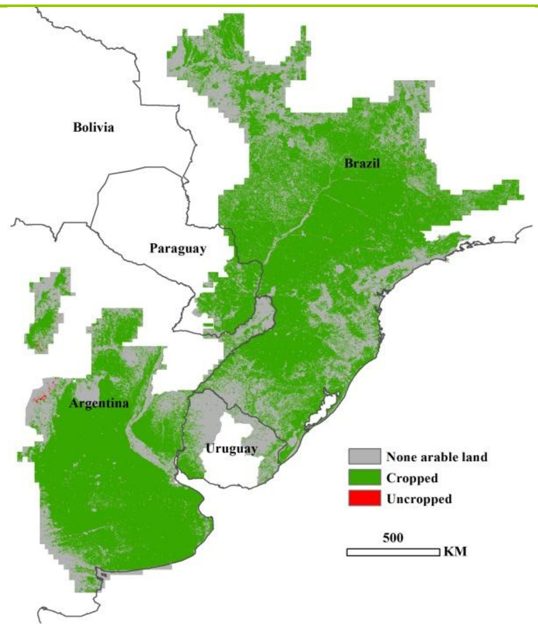
Table 2.3 South America MPZ: Cropping intensity, uncultivated arable land, and potential biomass ratio

	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

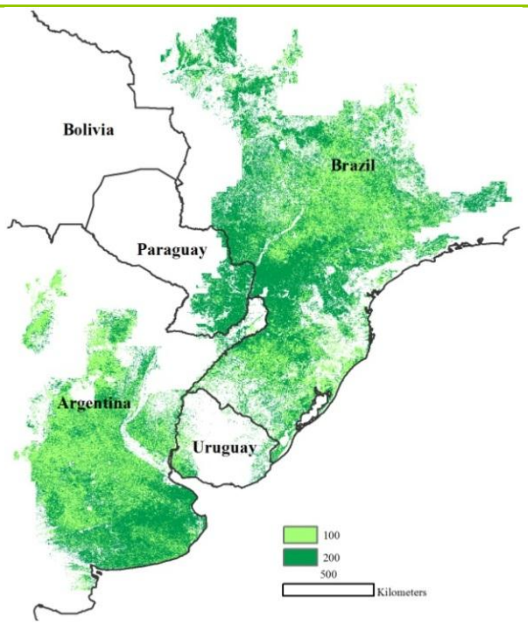
Note: The normalized trend is the 2002-2013 trend normalized by dividing it by the eleven-year average. Significance level of the trend is * for p<=0.05 and ** for p<=0.01.

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.

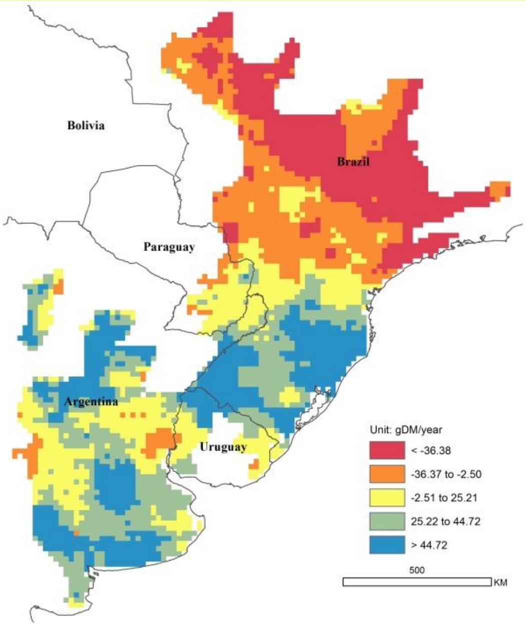
Figure 2.4 Environmental and crop production indices for the South America MPZ



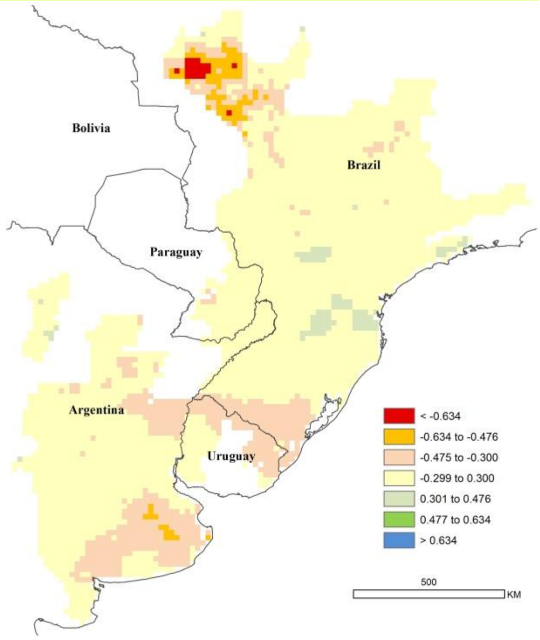
a. Cropped and uncropped arable land



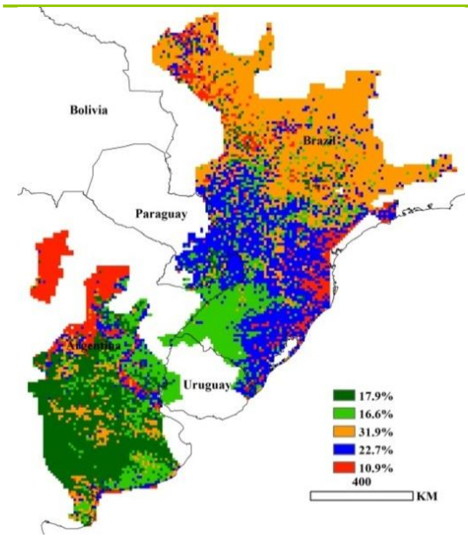
b. Cropping index



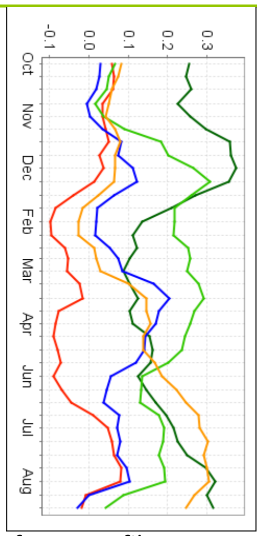
c. 2013 biomass departure from five-year average



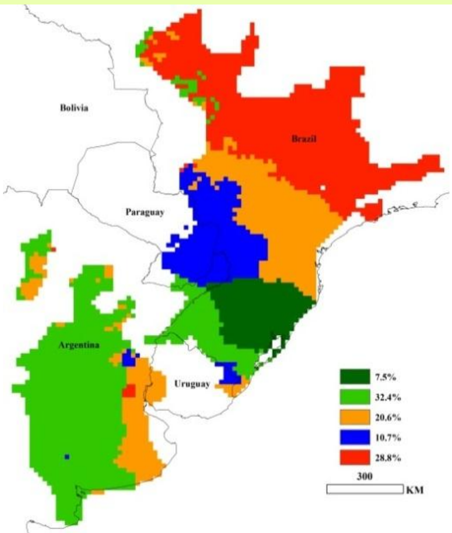
d. Biomass trend



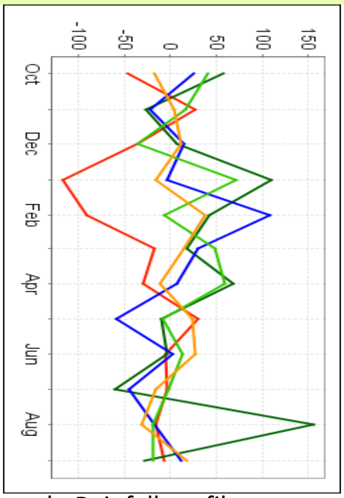
e. VHI departure from the previous five years for period indicated in f.



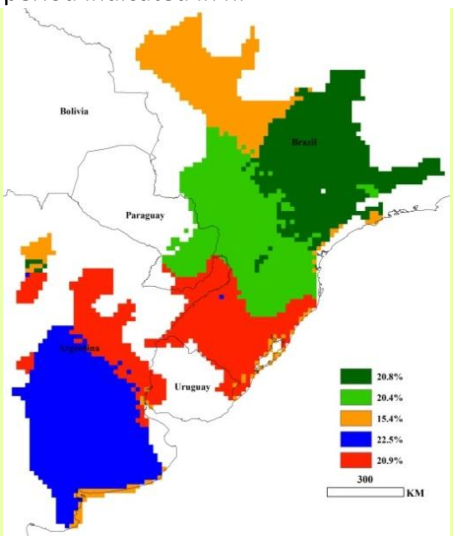
f. VHI profile



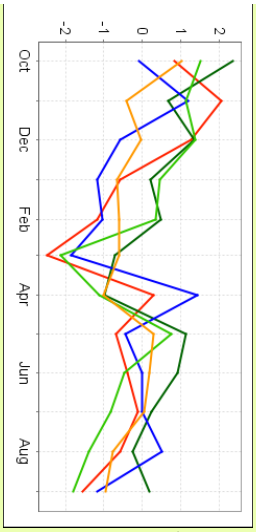
g. Rainfall departure from the previous five years for period indicated in h.



h. Rainfall profile



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



j. Temperature profile

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 Paolo state and northern Mato Grosso do Sul), affecting the soybean crop, and above average rainfall in August in Rio Grande do Sul and Santa Caterina 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 Mordovyian 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.

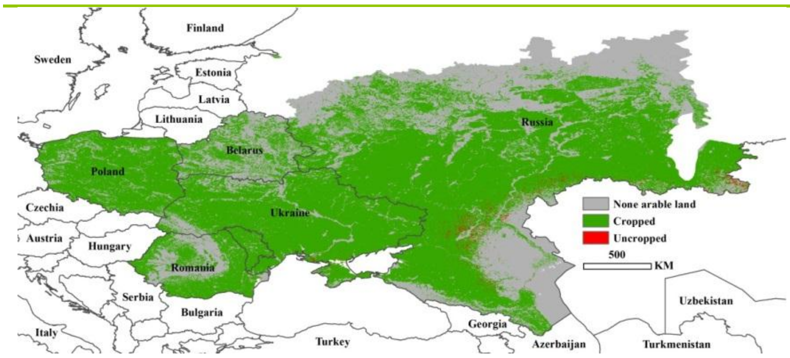
Slightly above average temperatures were recorded during early summer, which according to the VHI index can be associated with drought conditions in the northeastern Black Sea area, an area covering about one fifth of the MPZ and including an area delimited by Kherson (Ukraine) to the Volgograd oblast, 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 Yaroslav 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 south-eastern crescent of the MPZ also includes the areas of the MPZ where uncropped arable land is located.

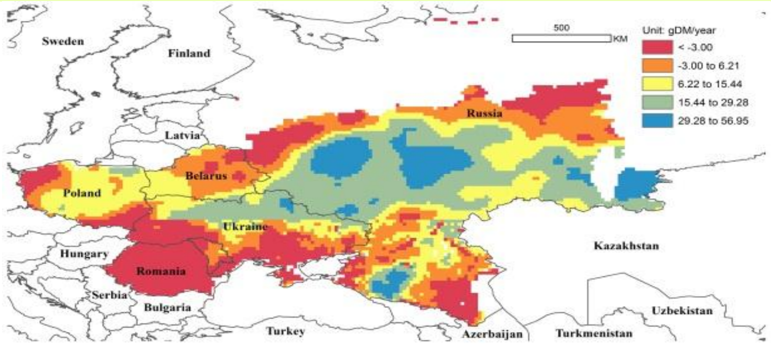
There is little doubt that low values in the north are associated with winter wheat, while low values in the southeast (Black Sea area) are linked with summer drought and affect most summer crops, especially maize.

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

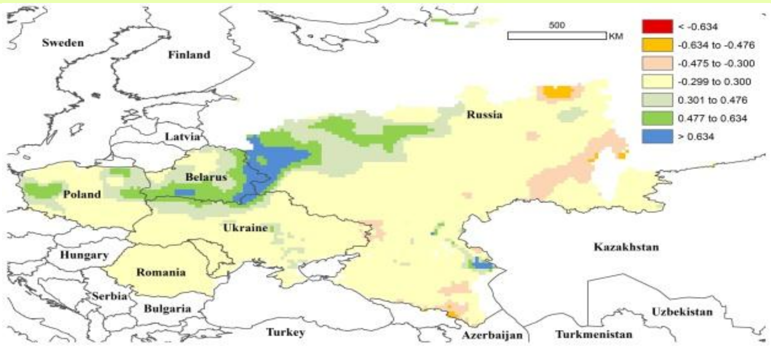


a. Cropped and uncropped arable land

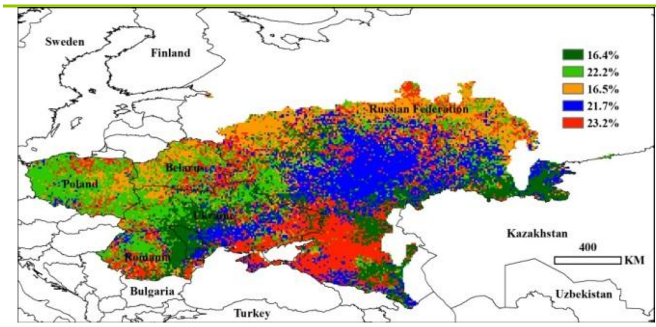
b. Cropping index



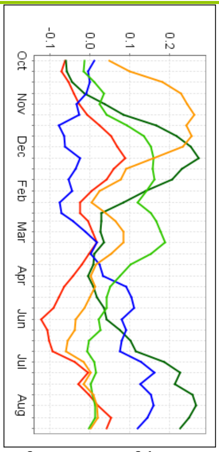
c. 2013 biomass departure from five-year average



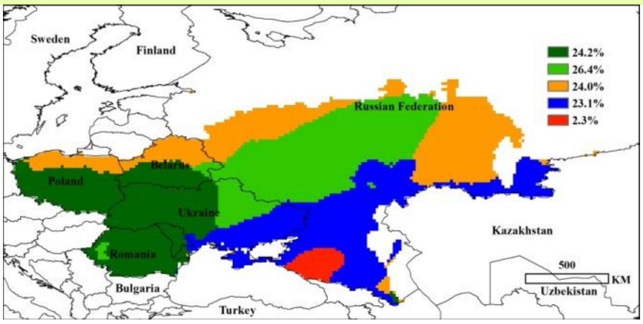
d. Biomass trend



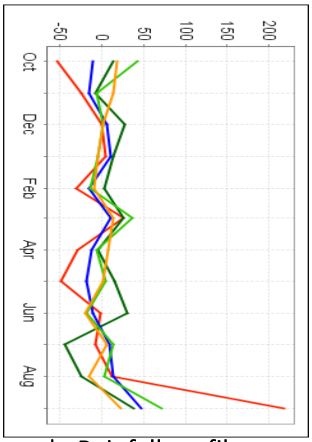
e. VHI departure from the previous five years for period indicated in f.



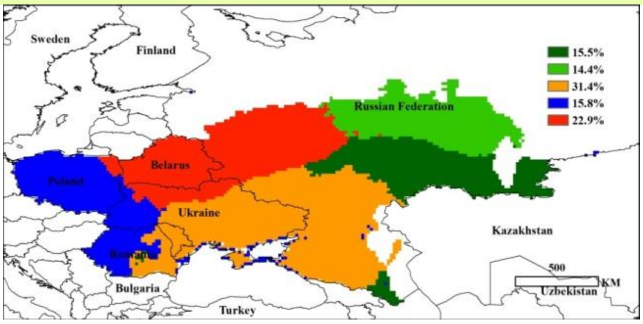
f. VHI profile



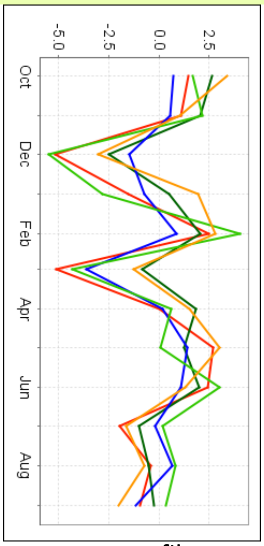
g. Rainfall departure from the previous five years for period indicated in h.



h. Rainfall profile



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



j. Temperature profile