Chapter 5. Focus and perspectives

This focus section complements CropWatch analyses presented in chapters 1 through 4 by presenting a global outlook for 2014 production, as well as other topics of relevance to global agriculture. After a summary of the provisional CropWatch estimates for 2014 production in section 5.1, section 5.2 highlights the extreme atmospheric factors—disaster events—that have interfered with crop production over the monitoring period. Next, sections 5.3 and 5.4 focus on the future of wheat and El Niño.

5.1 Production outlook for 2014

CropWatch estimates

Table 5.1 presents a first 2014 production outlook for maize, rice, wheat, and soybean for the crops already harvested or about to be harvested. The CropWatch findings can be summarized as follows:

- **Maize.** An overall favorable production increase (+1.2%) is achieved for the six countries for which a maize estimate is available. Among them, South Africa tops the list with a production increase of 6.9% compared to 2013, closely followed by Mexico (+6.8%). Slight increases in production are expected in Brazil, Nigeria, and Argentina (+0.9%, +0.9%, +0.3%, respectively). India is the only country that presents a production decrease (-6.8%).

- **Rice.** For South and Southeast Asia, a good 2014 rice production is expected. With the exception of Indonesia, where rice production drops 0.8%, the monitored countries, including Bangladesh, Cambodia, Myanmar, the Philippines, Thailand, and Vietnam, all enjoy increases in production. The total estimated 2014 rice production of the eight monitored countries (see table 5.2) is 404.3 million tons, up 0.7% compared with 2013 estimates.

- **Wheat.** Satisfactory wheat production prevails globally. The total wheat production of the 14 countries in table 5.1 for which wheat production is monitored is 494.4 million tons, up 4% compared with 2013 estimates. Only Iran (-16.3%), Turkey (-7.0%), and Kazakhstan (-5.8%) present a production decrease. The combined increase of wheat production in Australia, France, Russia, and the United Kingdom exceeds 3 million tons.

- **Soybean.** The southern hemisphere enjoys satisfactory soybean production. The two major soybean producers, Argentina and Brazil, both present an increase (2.5%, 0.1% respectively), and the total production of the two is 121.8 million tons, up 1.1% compared with 2013 estimates.

Because the partial production values in the table represent less than 20% of the total annual maize production, about half of the rice production, and less than half of the total soybean production, the percentage increases are only indicative for the countries listed. For wheat, however, for which the bulk of the production is northern hemisphere winter wheat, the current estimate is probably about 70% of the annual production and the indicated increase of 4% could be meaningful.

Table 5.1. 2014 advance production estimates for maize, rice, wheat, and soybean (thousand tons) in selected countries, compared to 2013 CropWatch estimates

	Maize		Rice (paddy)		Wheat		Soybean	
	2013	**Δ%**	**2013**	**Δ%**	**2013**	**Δ%**	**2013**	**Δ%**
ARG Argentina	24816	0.3					51446	2.5
AUS Australia								
BGD Bangladesh			43068	1.5				
BRA Brazil	64068	0.9					70309	0.1
CAN Canada								
CHN CHINA					112228	1.4		
DEU Germany					23407	**3.5**		
EGY Egypt					9143	6.3		
ETH Ethiopia								
FRA France					44001	**12.4**		
GBR United Kingdom					17595	23.4		
IDN Indonesia			66870	-0.8				
IND India	20417	-4.6	155761	0.3	92634	1.9		
IRN Iran					11431	**-16.3**		
KAZ Kazakhstan					16975	-5.8		
KMO Cambodia			9218	2.0				
MEX Mexico	21195	**6.8**						
MMR Myanmar			32172	3.8				
NGA Nigeria	9375	0.9						
PAK Pakistan					24908	2.2		
PHL Philippines			17365	0.0				
POL Poland					9501	**5.9**		
ROU Romania								
RUS Russia					51475	**9.6**		
THA Thailand			36852	1.8				
TUR Turkey					19493	**-7.0**		
UKR Ukraine					19140	0.5		
USA United States					42440	1.6		
UZB Uzbekistan								
VNM Vietnam			43039	0.0				
ZAF South Africa	12218	**6.9**						
Sub total	**152090**	**1.2**	**404346**	**0.7**	**494371**	**4.0**	**121754**	**1.1**

Note: Empty cells indicate "not estimated or insignificant production." Wheat for China only includes winter wheat.

Some noteworthy changes for specific countries are listed below:

- South Africa, maize, 6.9%
- Mexico, maize, 6.8%
- France, wheat, 12.4%
- Iran, wheat, -16.3%
- Poland, wheat, 5.9%
- Russia, wheat, 9.6%
- Turkey, wheat, -7.0%
- Kazakhstan, wheat, -5.8%

The changes are largely compatible with the indicator values presented in Chapter 3, for instance in the case of wheat in France (12.4% increase), Poland (5.9%), and Germany (3.5%). Among the negative changes, Turkey deserves a special mention. Its drop in wheat production is also largely confirmed by the agroclimatic and agronomic indicators listed in other sections of this report.

Comparison with other sources

Early estimates of production are available from other sources, including in particular the USDA/FAS World Agricultural Supply and Demand Estimates (WASDE-529) and the USDA World Markets and Trade report. The values currently stand at 687 million tons for paddy rice[2] and 697 million tons for wheat. For the United States, the WASDE estimate for maize is 334 million tons (no CropWatch estimate available), while for wheat (including summer wheat), the CropWatch and WASDE estimates are 42.4 and 53 million tons, respectively.[3]

National estimates for India for 2014 are available from the India Ministry of Agriculture. A comparison shows the following production estimates: for maize, 20 and 24 million tons for CropWatch and the Indian estimate respectively; for paddy rice: 155/150; for wheat: 92/96; and for soybean 'not-estimated'/12 million tons for the CropWatch/Indian estimates.

Overall, prospects for the future northern hemisphere summer crops and the southern hemisphere winter crops are probably more uncertain this year than in previous seasons due to past large-scale weather anomalies and possible future anomalies linked to El Niño.

5.2 Disaster events

In general, the reporting period included several large scale departures of average weather conditions, including areas with excess precipitation and some relatively warm, dry, and cold areas. Impacts from disasters was relatively low, especially compared to the last reporting period, although two extreme weather events—cyclone Hellen and especially tropical depression Agaton—both had serious effects on agriculture.

Weather conditions and disasters

Weather conditions for the reporting period were characterized by some large scale abnormal but not catastrophic departures from the recent average (as described in more detail in Chapters 2 and 3). Overall, northern America was relatively dry in January and cold in February and March; Western Europe was relatively warm in February and March; and north Argentina (especially its northwest) was relatively warm in January and February. Australia was wet in the west in January and in the southeast in February, while in the United Kingdom the wet conditions that already existed at the end of 2013 (reported in the last bulletin) continued into January and February.

In terms of disasters, fortunately, little was reported by specialized databases and organizations such as CRED and Reliefweb. Drought conditions were reported for the Sindh province in southeast Pakistan in February and for Chile in April. Severe winter conditions are mentioned for Serbia (February) and China. Excess precipitation, sometimes causing floods and often accompanied by flashfloods or landslides, are reported for locations around the world, starting with South America (Colombia and Bolivia in January) and Africa (Zimbabwe in February; Tanzania in January and again in April). In Zimbabwe, 1000 hectares of crops are reported lost. Several central Asian countries suffered from floods at the end of April, including Tajikistan and Kazakhstan and in particular Afghanistan's northeast. In Afghanistan, the floods followed a

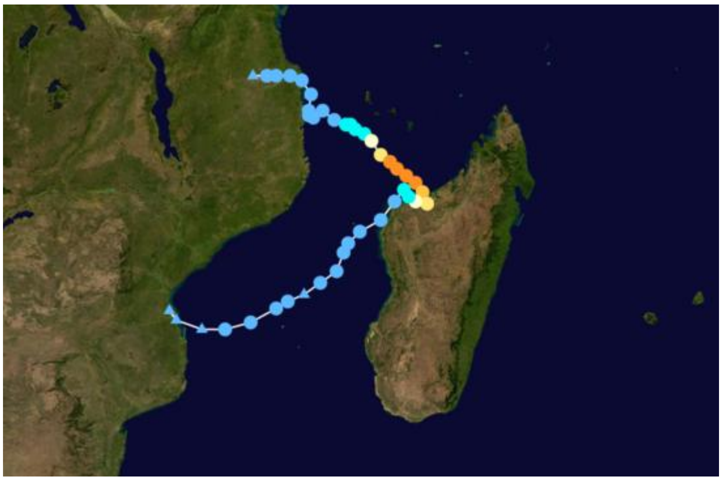
[2] Milled rice converted to paddy using a 0.7 extraction rate.
[3] It can be difficult to ensure data from different sources refer to the same quantity, due to the use of different crop categories (e.g., maize as part of coarse grains together with several other crops, soybean in oilseeds, and rice reported as rice/milled rice/paddy), units, and periods covered (e.g., calendar year vs. different marketing years).

prolonged drought period, which notoriously prevents the infiltration of the first rains because of dry soils and thus exacerbates the effect of the excess precipitation.

Cyclone Hellen and tropical depression Agaton

Two instances of extreme weather had marked impacts on agriculture: cyclone Hellen and the tropical depression Agaton. Cyclone Hellen affected Mozambique, Madagascar, and the Comoro islands, and was one of the most powerful tropical cyclones in the Mozambique Channel on record. The cyclone, also the second most intense of the 2013–14 southwest Indian Ocean season, occurred in the last days of March and moved from northern Mozambique across the Mozambique Channel to northern Madagascar, after which it went back to Mozambique in considerably weakened form (figure 5.1). Some losses are reported from agriculture in Madagascar (4000 ha of rice lost).

Figure 5.1. Path of tropical cyclone Hellen



Source: http://en.wikipedia.org/wiki/Cyclone_Hellen; image modified from Wikimedia.

Tropical depression Agaton affected mostly the southern Philippines (east Mindanao) in the days before January 20 and can be considered responsible for the most serious weather impact on agriculture for the reporting period. According to national sources (Reliefweb 2014), the damage to agriculture amounts to 6.3 million U.S. dollars, resulting from loss of rice and maize (32% of the damage) but particularly from the loss of the more fragile fruits and vegetables (61%). Relatively minor losses are reported form the livestock and fisheries sectors. Agaton occurred at a time when the Philippines are still recovering from cyclone Haiyan, which occurred in November 2013 and affected most of the Visaya group of islands in the central part of the country.

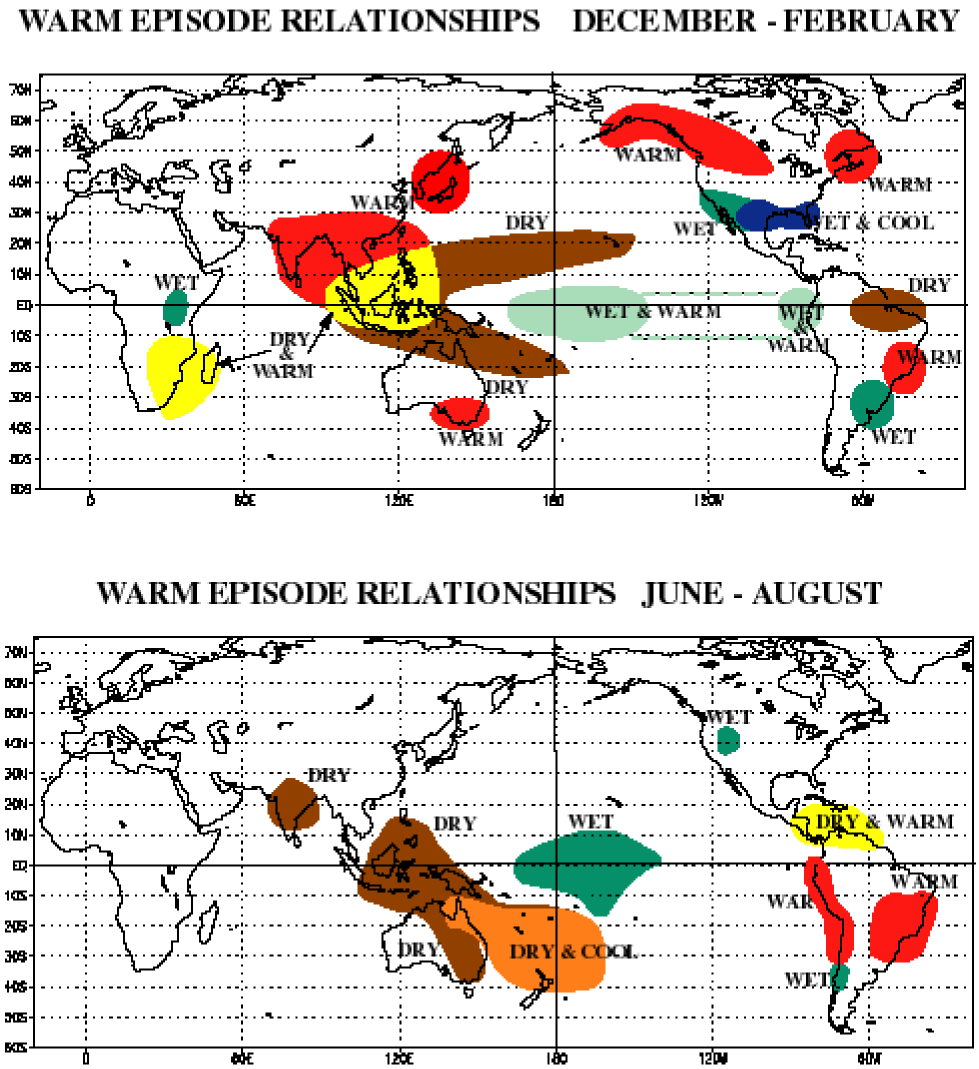
5.3 El Niño

El Niño, which is short for “Warm Episode of the El Niño-Southern Oscillation” (ENSO), describes a periodic warming of surface waters in the central and eastern tropical Pacific Ocean. This event typically occurs every 2-7 years and may last 6-12 months, although sometimes it persists for up to 2 years. The major impacts of El Niño are temperature anomalies, changes in precipitation variability, and floods and droughts throughout the world. Figure 5.2 shows the typical climate anomalies associated with El Niño events.

In comparing figure 5.2 with the CropWatch global map of rainfall and temperature departures (figures 3.1 and 3.2 in Chapter 3), it is interesting to note that several of the typical climate anomalies normally associated with El Niño warm episodes for September-February are already present, as indicated the

CropWatch agroclimatic indicators from January to April. The positive temperature anomalies are prominent, with 5 out of 6 typical impacts being captured, including in the north of Canada; northeast of China, North Korea, South Korean, and Japan; south Asia; southeast of Australia; and Brazil. In addition, expected wet events in South America (figure 5.2) also coincide with abundant rainfall in Colombia and Ecuador and the south of Brazil, Uruguay, and Buenos Aires in Argentina in figure 3.1. The expected wet and cold effects in the southern United States have also been captured with abnormal negative temperature departures in figure 3.2.

Figure 5.2. Typical climate anomalies associated with El Niño events

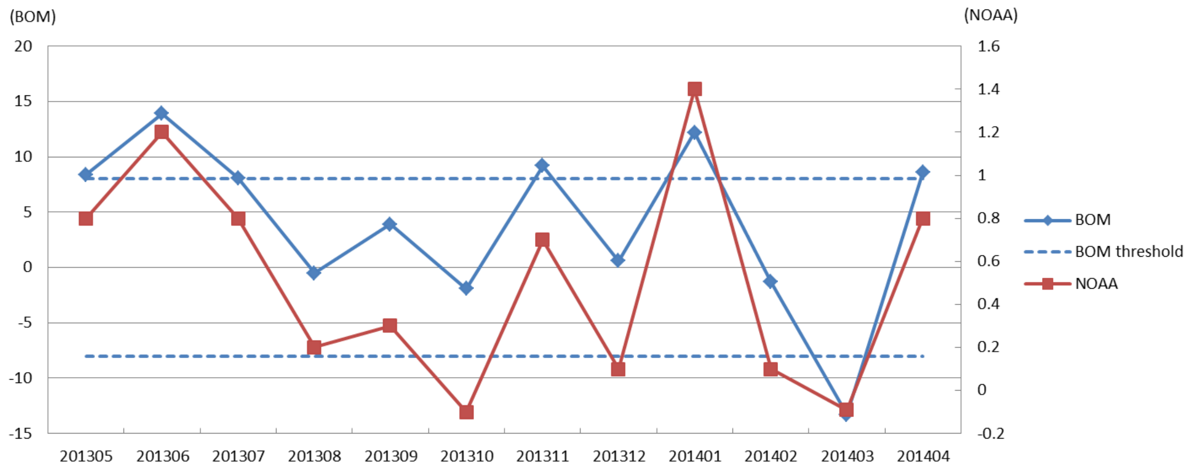


Source: NCDC, http://www.ncdc.noaa.gov/paleo/ctl/images/warm.gif.

Despite the interesting overlap, the coincidence of the climatic anomaly patterns is not sufficient to confirm the development of an El Niño event and other variables need to be considered. The Southern Oscillation Index (SOI) is a simple and commonly used indicator to measure the development and intensity of El Niño events. It is basically calculated using the monthly sea level pressure differences between Tahiti and Darwin, Australia: the negative value of SOI represents higher air pressure at Darwin than Tahiti and sustained periods of negative SOI generally correspond to the El Niño episodes. Figure 5.3 compares two sets of SOI values, based on the two different algorithms for SOI calculation used by the Australian Bureau of Meteorology (BOM) and the U.S. National Oceanic and Atmospheric administration (NOAA). Both datasets present similar SOI variation patterns. According to BOM SOI, the general situation is more likely to be neutral from May 2013 to April 2014.

In spite of the current neutral pattern, many official reports have recently suggested an increased probability for El Niño development during the coming northern hemisphere summer. The International Research Institute for Climate and Society (IRI), for example, announced increasing odds for El Niño in its March climate briefing, while its May update indicates “a continued warming trend, with a transition to sustained El Niño conditions by the early northern summer.” In April, the World Meteorological Organization (WMO) suggested a possible onset of El Niño around the middle of this year, while the BOM issued an alert, indicating a greater than 70% chance of an El Niño developing during the southern hemisphere winter. In May, the Climate Prediction Center/NCEP, NOAA declared the chance of El Niño increasing during the remainder of the year as exceeding 65%.

Figure 5.3. Comparison between monthly BOM and NOAA SOI datasets from May 2013 to April 2014



Note: The dashed blue lines are the El Niño thresholds in the BOM method; sustained negative values of SOI below −8 may indicate an El Niño event, while sustained positive values above +8 are typical of a La Niña event. Values within the range (-8 to +8) indicate neutral conditions. The data and methodology description of the two datasets can be found at http://www.bom.gov.au/climate/glossary/soi.shtml and http://www.bom.gov.au/climate/glossary/soi.shtml.

Because El Niño may result in extreme weather conditions, including drought or abnormal rainfall, around the world, the event may impact crop yields, as they are heavily influenced by temperature and precipitation levels. A recent article by Iizumi et al. (2014) states that “El Nino likely improves the global-mean soybean yield by 2.1-5.4%, but appears to change the yields of maize, rice and wheat by -4.3% to 0.8%.” Judging from the available report and forecast, the northern summer crops may be little impacted by the possible El Niño event. In the next few months, however, CropWatch will keep a close eye on the development of El Niño and the regions that shown sensitivity to this event.

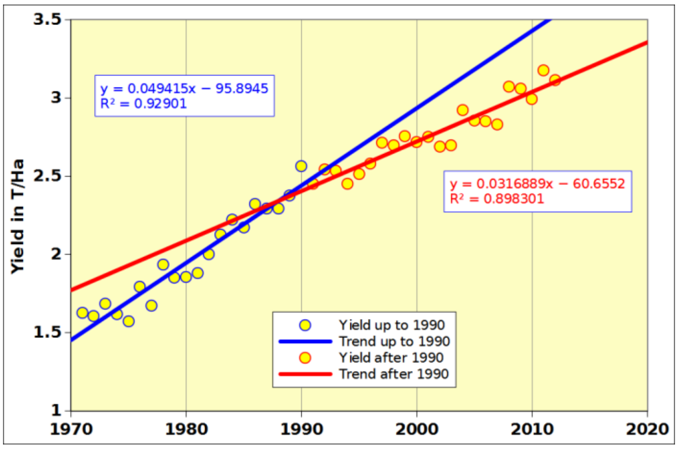
5.4 The future of wheat?

Decreasing yield growth rates and a smaller share of global cereal production

Recent statistics suggest that the relative contribution of wheat to global cereal production is shrinking. As shown in figure 5.4, around 1990 the growth rate of global wheat yields started to decrease, indicated by a well-marked break point in the time series. The slowdown in yield growth mostly affects the main producers and is due to a variety of factors.

While exact causes may vary from country to country, the main reasons are that wheat varieties cannot be improved beyond certain limits, that available sunshine and water eventually dictate the local "potential," and that further yield increases can only be achieved at an unacceptably high economic and environmental cost. Not only wheat, but also rice has been affected by this phenomenon, which in the case of rice was originally known as the "rice gap," to highlight that population growth was outpacing the growth in rice production.

Figure 5.4. Changing trend in global wheat yield around 1990, from 49 kg/ha to 32 kg/ha

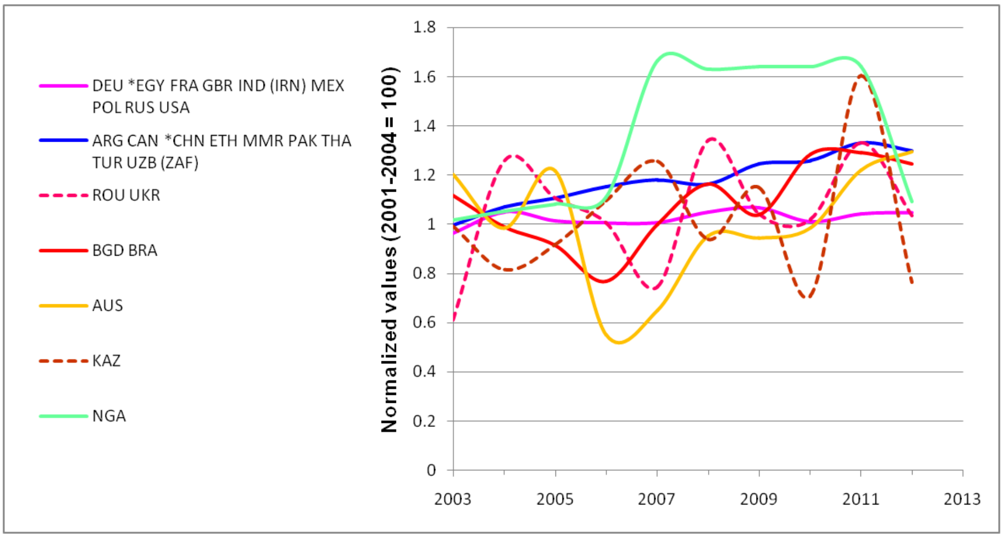


The slowing growth rates for wheat yield, combined with a sustained demand for maize and still growing maize yields, have resulted in wheat losing to maize, and actually slipping to a permanent third place behind rice.

Recent trends

Figure 5.5 illustrates generalized patterns of wheat yields for the 31 countries (including China) monitored by CropWatch.

Figure 5.5. Generalized patterns of wheat yields in CropWatch monitored countries for 2003-12



Note: An asterisk identifies the country that is most typical of the cluster, while the country between brackets is the one most distant from the center of the cluster. Clustering carried out with the Attain software. Values are normalized by using the average yield for 2000-2004 as reference (average yield set to 1).

For wheat yields between 2003 and 2012, several groups of countries (each characterized by a line) can be distinguished. A first group of countries, which includes the major producers (including Germany, France, and the United States) is characterized by very minor increases or, more probably, random fluctuations over the last ten years. The second group, which includes Argentina and Canada, still displays a robust growth in yields averaging about 30% over the recent ten years. The other countries, including Australia, display wide fluctuations in yields.

For the major wheat producing countries, where subsistence farming plays a minor role, size of the cultivated areas is mainly determined by the market and whether a crop appeals to farmers, considering for example expected benefits, labor availability, producer prices, and production costs of both wheat and competing crops. As a result, areas will shrink or grow in response to mostly economic factors. It happens that wheat prices have virtually tripled in the period from 2002 to 2008 (Conforti, 2011) and yet the crop is losing ground in some countries to maize, soybean or potatoes.

Achievable yields

The maximum agroclimatic wheat yields that can be achieved are in the range between 10 and 20 tons/ha (Conforti, 2011). Achievable yields are lowest in the tropics for crops grown during the rainy season because of limited sunshine and high night-time temperatures, which result in night-time respiration losses of photosynthetates accumulated during daytime. Wheat can, however, also be cultivated during the dry season, which usually happens to be cooler and enjoys a much better radiation climate, two factors which contribute to high yields in irrigated wheat, such as for example in Egypt and Nigeria.

Table 5.2 shows current maximum achievable yields for a selection of CropWatch monitored countries (columns d and e), confirming that some countries are indeed very close to their local maximum yield. The table, however, also illustrates good room for improvement in countries listed in both the "stable" group in figure 5.2 (e.g., Russia and the United States), as well as the "growing" group (Argentina, Turkey). Canada is close to reaching its maximum wheat yield and some countries (e.g., Germany (DEU)) even apparently exceed it. The highest country yields, projected for 2050 by Jaggard et al. (2010) (which take into account CO_2 fertilization and increased water use efficiency due to high $CO_{2,}$) are in the range of 8 tons/ha.

Table 5.2 further illustrates which countries still display the largest potential wheat production increases (trend columns), including China, India, and Pakistan, as well as Australia and Kazakhstan (despite large inter-annual variability in the two countries). Wheat production increases can be achieved through various combinations of yield and area increases, although yields usually increase due to better varieties and technology in general. Except in extreme cases, such as a widespread drought, the size of cultivated areas is mostly under the control of farmers. It is, therefore, interesting to note where areas have recently been on a significant downward trend, indicating deliberate action of farmers or governments (through agricultural policies). This is the case most clearly in Turkey and in Argentina where wheat (that is, summer wheat) has suffered from competition with soybean.

For the immediate future, several factors seem to indicate a continuing role for wheat:

- All competitors of wheat are summer crops. It happens that 31% of world wheat production comes from winter wheat (Conforti, 2011), which is largely unaffected by the competition from other field crops.
- Many countries are still far from reaching potential wheat yields, including some large countries such as Kazakhstan.
- There is considerable potential for wheat in many semi-arid countries, which cover large areas, where yield increases can be achieved at a minor cost per unit water in comparison with wetter areas (Padgham 2009).

Table 5.2. Wheat trends and statistics for the fifteen main wheat producers (average 2008-2012 data)

2008-2012 Rank prod.	Country	Yield					Area		Production	
		2008-2012 average T/Ha	Maximum achievable yield T/Ha	%	1993-2012 trend	2003-2012 trend	1993-2012 trend	2003-2012 trend	1993-2012 trend	2003-2012 trend
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h	(i)	(j)	(k)
1	CHN	4.16			20**	21**	-15**	13**	5	34**
2	IND	2.69			11**	20**	8**	16**	19**	36**
3	USA	2.77	6.3	48	10**	9	-16**	-8	-5	1
4	RUS	1.85	3.8	56	20**	12	4	6	24**	18
5	FRA	6.9	7.3	95	1	2	9**	13*	9*	14
6	CAN	2.45	2.8	102	16**	21*	-16**	-12	0	10
7	AUS	1.71	4.4	41	-4	17	22**	9	18	27
8	DEU	7.27	6.7	112	4	1	15**	6	18**	7
9	PAK	2.36			18**	14**	5**	11**	23**	25**
10	UKR	2.8	7.1	44	1	34	8	41	10	60
11	TUR	2.2	5.3	47	16**	24**	-12**	-21**	3	3
12	GBR	7.68	6	128	0	-9	2	5	1	-4
13	KAZ	0.97	3.3	32	22*	14	12**	18**	35**	33
14	IRN	1.87			13**	-16	3	3	17*	-13
15	ARG	2.5	4.6	62	19**	23	-19*	-61**	-2	-37

Note: Attainable yield is under rainfed conditions according to Conforti, 2011; Percentage of attainable yield is the ratio of columns (c) and (d); (f): 2050 yield projections from Jaggard et al., 2010; Columns (g) to (l) are the trends for the respective variables over the indicated period, normalized by dividing them by the corresponding average (unit is year^{-1}) and multiplied by 1000. For productions, the numbers indicate the average annual production increase in kg per ton. * and ** indicate that the linear correlation coefficients are significantly different from 0 at the 0.05 and 0.01 thresholds, respectively.

In the longer term, wheat and other C3 crops (such as rice) will benefit more from increased temperature and high CO_2 than C4 crops such as maize.