Food Prices

October 2015 update

Special: El Niño

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Key messages

- **Projections for 2015/16** maize, rice, and wheat see harvests of some 2.18 billion tonnes — down 34M tonnes from the 2014/15 record, and 2M tonnes below projected consumption
- Lower production probably results from the **continuing decline in prices** reducing incentives to farmers
- **Spot prices of maize, rice, and wheat have fallen further** to **US$171** a tonne for US maize, **US$350** a tonne for Thai rice, and **US$222** a tonne for US wheat, with future prices indicating that further slight falls are expected.
- A strong **El Niño** is predicted for late 2015 and early 2016. This will change rainfall across much of the tropics. Globally it could lead to the loss of 30M tonnes of maize, pushing up maize prices — at least until next year's northern hemisphere harvests. Regionally this could mean drought in southern Africa, floods in Kenya, and possibly drier conditions in 2016 in Ethiopia, south and south-east Asia.

Contents

Recap from earlier updates

- Good harvests of maize and wheat since early 2013 have allowed maize and wheat prices to fall substantially the highs of September 2012.

- Rice prices which were high but stable over much of 2011 and 2012 fell in 2013. The substantial gap between Thai prices and those of other leading exporters which opened in the last year disappeared by the end of 2013, thanks in large part to the end of the Thai paddy pledging scheme.

- With no major harvest failures, global maize, rice, and wheat produced in 2014/15 set a new record, reaching some 2.2 billion tonnes combined (USDA estimate).

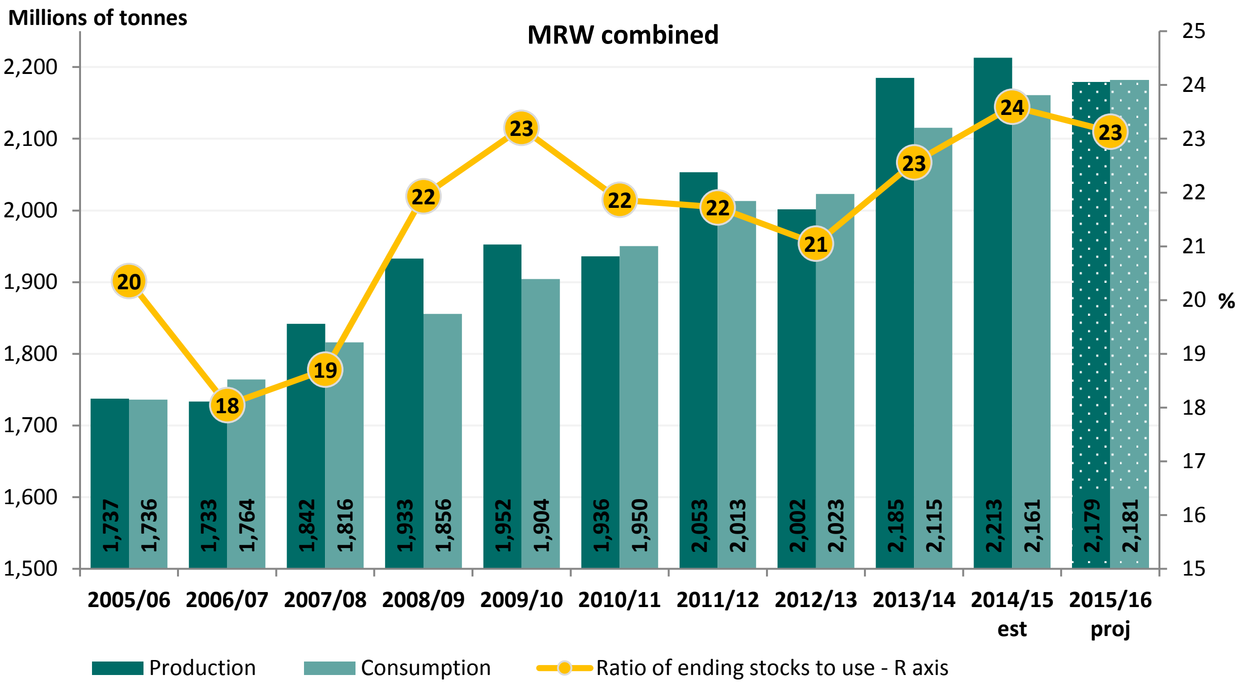
Key developments since May 2015

1.1 Supply

2015/16 projections down slightly on last two years

Maize, rice, and wheat production in 2015/16 is projected to fall short of last year's record harvest by some 34M tonnes. (Figure A) This is also about 2M tonnes short of expected consumption, hence stock to use ratios are projected to fall — though by less than one percentage point. At 23% the ratio remains, however, relatively high. (USDA FAS, October 2015).

Figure A: World maize, rice, and wheat production and consumption, 2005/06 to 2015/16 forecast



Source: *Data from USDA FAS (Oct 2015 forecast).*
Note: *Rice is milled equivalent.*

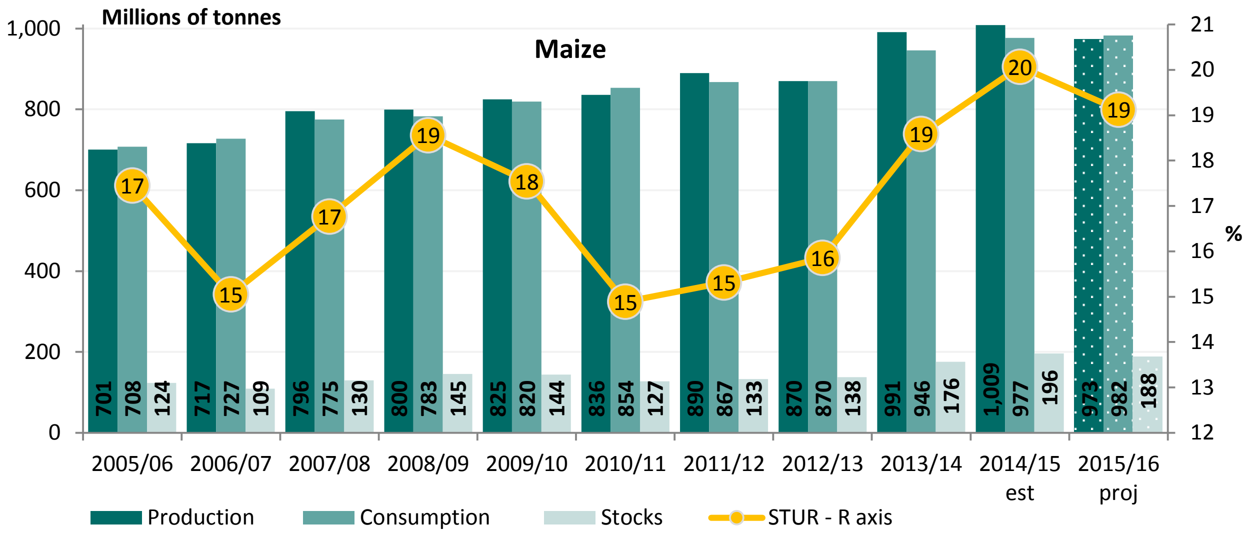
Maize

World ***maize*** projections for 2015/16 still 3rd highest

World maize harvests for 2015/16 of **973M** tonnes are predicted, 36M tonnes below the 2014/15 record of 1,009M tonnes (Figure B). For the first time in 5 years, production is expected to fall short of consumption, with stocks — which rose by 20M tonnes the previous year — expected to fall by some 8M tonnes. The stock-to-use ratio is thus projected to fall, but only by about one percentage point, to 19%.

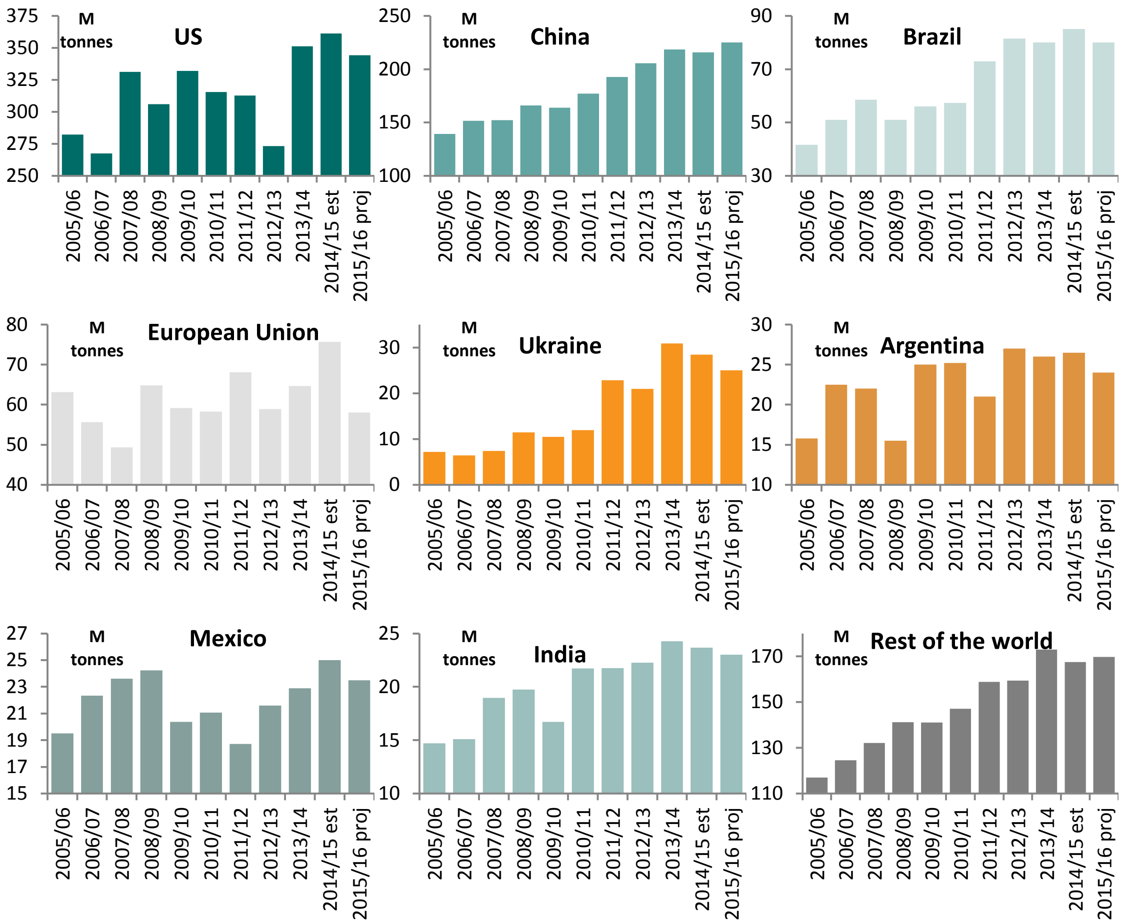
The largest production declines from 2014/15 to 2015/16 come from drops in the US (down 17M tonnes) and EU (down 18M tonnes); although some other producers expect to see increases, most notably China, by about 9M tonnes (Figure C).

Figure B: World maize production, consumption, ending stocks and stock ratios, 2005/06 to 2015/16 projection [at October 2015]



Source: *Data from USDA.* ***Note***: *STUR (stock-to-use ratio) expresses ending stocks as a percent of total consumption.*

Figure C: Top maize-producing areas' maize crops – 2005/06 to 2015/16 projection [at October, 2015]



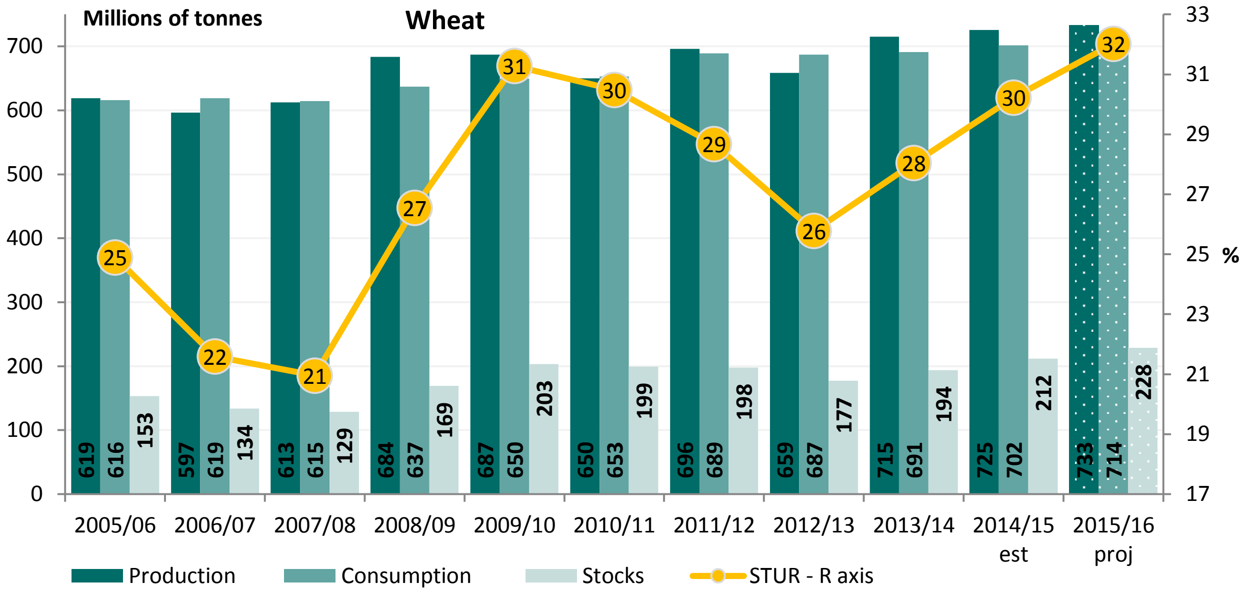
Source: Data from USDA, October 2015

Wheat

Another record world ***wheat*** harvest still projected

Worldwide, wheat harvests for 2015/16 are projected to be **733M** tonnes, up 8M tonnes from the 2014/15 record, and exceeding projected consumption by 19M tonnes (Figure D). Stocks and stock-to-use ratios will rise a little, for the third year running, to reach 32%.

Figure D: World wheat production, consumption, ending stocks and stock ratios, 2005/06 to 2015/16 projection [at October 2015]



Source: *Data from USDA*

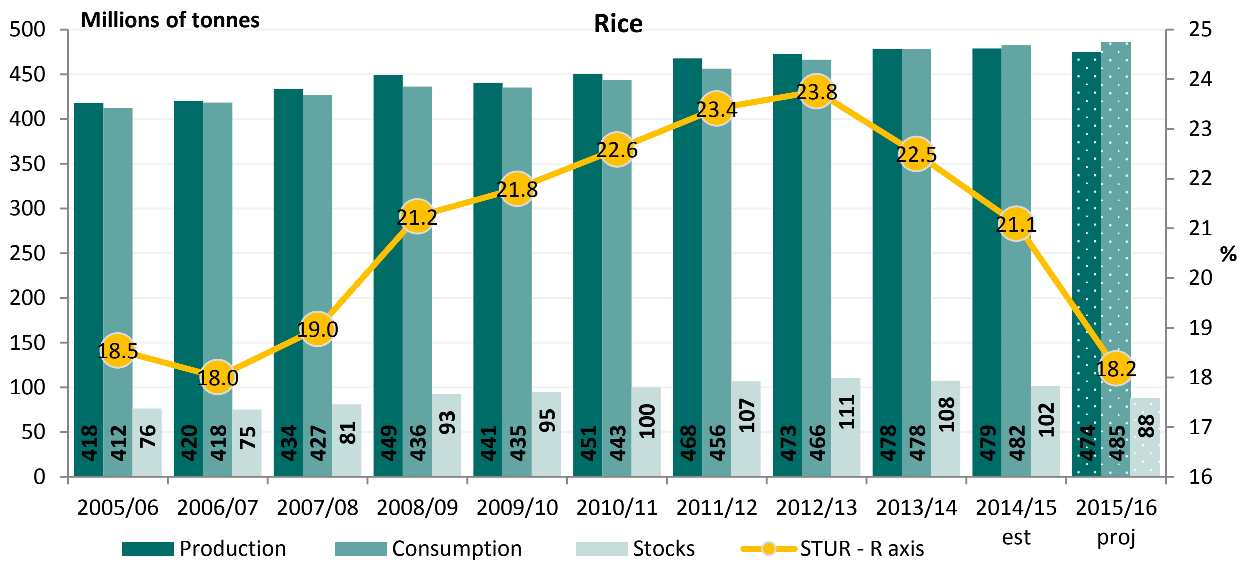
Rice

Rice harvest slightly down on last year

Rice production forecast for 2015/16 is down 5M tonnes on last year's record (Figure E), owing to lower production in Thailand, India, and the US (down 2.4M, 1.3M and 1.1M tonnes respectively), as well as from smaller downturns in other countries including around half a million tonnes less from both Egypt and Brazil. Increased production from China (1M tonnes) and Bangladesh (around 0.5M tonnes) will not offset these declines (Figure F). Box A explores what is driving this decline in rice production and stock-to-use ratios.

Consumption is expected to exceed production for the second year in a row, with stocks falling to a ratio of 18.2% – the third consecutive year of falling stocks will see the stock-to-user ratio reach a level close to what it was going into the food price spike of 2007/08.

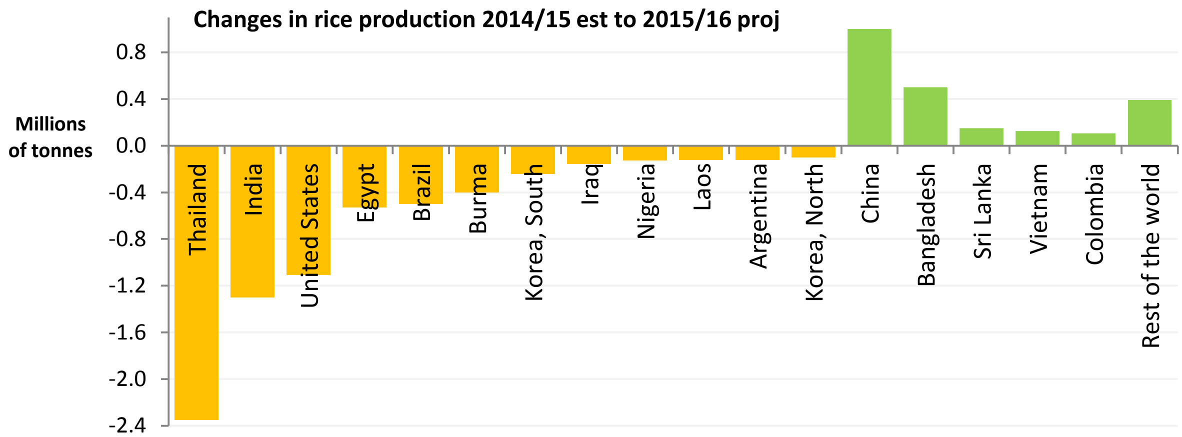
Figure E: World rice production, consumption, ending stocks and stock ratios, 2005/06 to 2015/16 projection [at October 2015]



Source: *Data from USDA.* ***Note***: *Rice is expressed on a milled basis.*

Stocks: The difference between production and consumption does not equate to changes in ending stocks, as ending stocks are calculated using production, consumption, imports, and exports: but USDA's estimates for imports and exports globally are not the same (for instance, in 2012/13, USDA estimated some 36.1 million tonnes of rice would be imported, and some 39 million tonnes exported). Hence the small differences between the implicit stock change of production minus consumption, as opposed to the fuller estimate.

Figure F: Change in rice production from last year – 2014/15 to 2015/16



Source: Data from USDA FAS

Box A: What's driving falling rice production and stocks?

Rice production is expected to fall short of consumption for the second year in a row, with rice stock-to-use ratios declining for a third consecutive year. Changes in production and stocking among some of the top producers explain this.

In recent years the largest absolute declines in stocks have been in ***India*** and ***Thailand***, both countries where production has also dropped from 2013/14. India's stocks look set to be almost 11M tonnes smaller in 2015/16 than in 2013/14, while Thai stocks will be more than 6M tonnes smaller (Figure A1). Stock levels have dropped in a few of the other large producers, though not by very significant amounts.

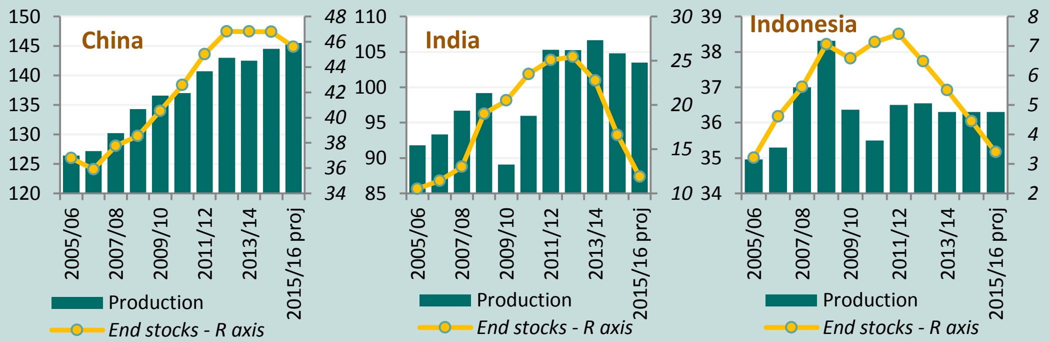
Could production be slowing down owing to lower prices reducing farmer incentive to invest? Certainly in ***Thailand*** this may well be a contributing factor, given removal of the government's rice price support scheme in 2014. Under this scheme, Thailand built up large and expensive stocks, at a cost of around US$25 billion (Suwannakij, Oct 2015), much of which it is still looking to sell off before the stock spoils. Already some 2M tonnes of Thai rice stock unfit for human or animal consumption have been sold off for ethanol feedstock (Hariraksapitak, Oct 2015).

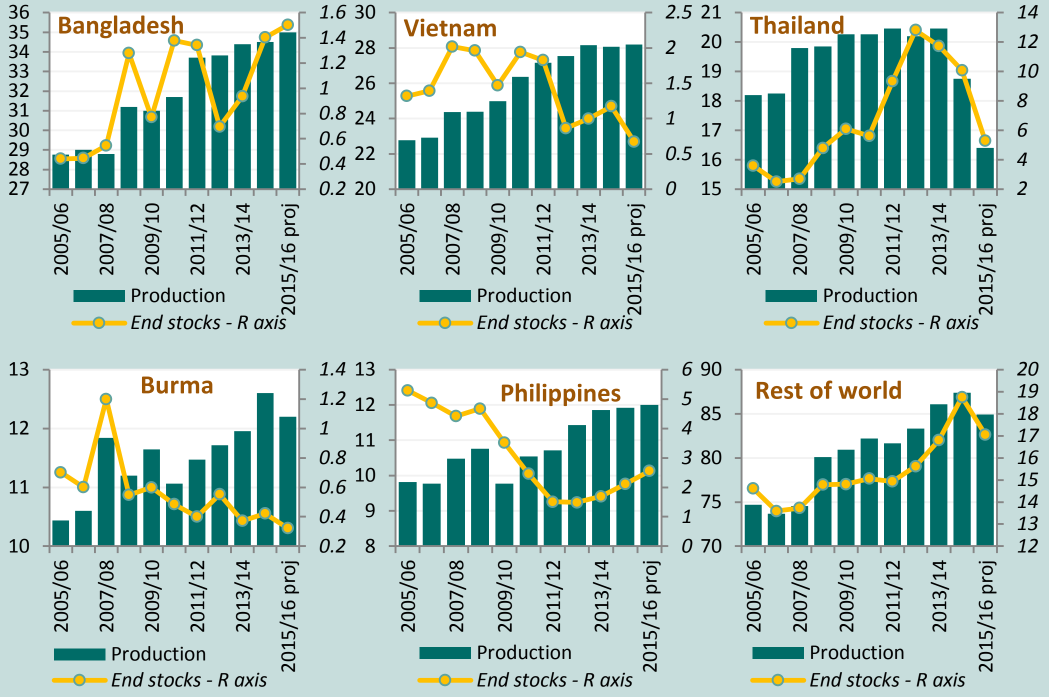
Thai production for 2015/16 is projected to be lower than in recent years, partly owing to changes in policy— the new government is against interfering in product prices and actively encouraging substitution of higher value products in lieu of rice — but also because of fears of drought hitting the dry season rice in Thailand's central provinces:

> *'Water levels in the four main reservoirs in Thailand's central provinces dropped to the lowest since 1993 amid an El Nino-induced drought. The central region normally accounts for nearly half the nation's rice output during the dry season that runs from November to April.*
>
> *…"We're worried about this intensifying situation," Chatchai [Sarikulya, Minister of Agriculture and Cooperatives] said. "There's risk that drought could damage rice crops. The government hopes farmers will not plant rice during the dry season as we have warned them in advance about inadequate water supply."' (Suwannakij, Oct 2015)*

In ***India***, stocks were rebuilt after the global food price crisis in part owing to higher price incentives, and in part to India's (partial) ban on exports in the wake of the 2007/08 crisis which lasted three years to September 2011. India sold off some stocks in 2014 in a bid to curb price inflation following a weak monsoon (Mishra and Gokhale, June 2014). 2015 also saw a weaker monsoon than expected. El Niño conditions are not expected to persist into the 2016 monsoon season (Madaan, Oct 2015, citing the Indian Meteorological Department), though it is early to be sure about this.

Figure A1: Rice production and ending stocks (M tonnes), leading producers, 2005/06 to 2015/16 projection





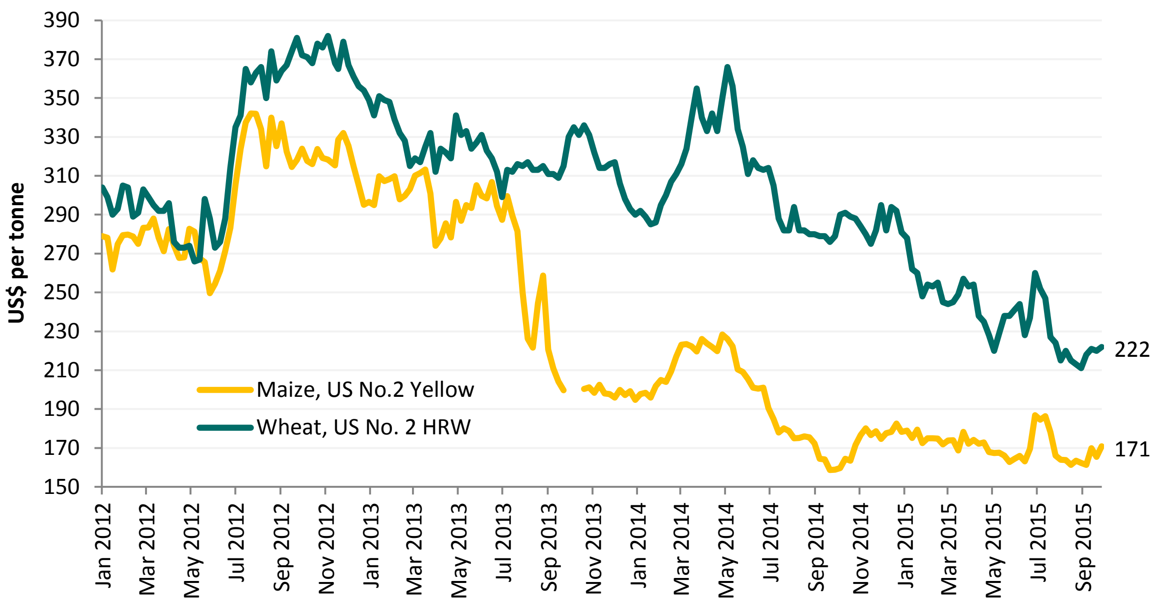
Source: Data from USDA FAS PSD

1.2 Cereals prices on world markets

Spot prices for maize and wheat edging up

A few years of relatively good harvests helped drive down ***spot prices for maize and wheat*** until late January 2014, when prices rose as events in Ukraine spooked importers, while a poor US winter wheat crop was expected. Since early May 2014 prices have continued to fall – though falls in maize prices have slowed since late 2014. By the first week of October 2015, maize and wheat prices stood at **US$171** and **US$222** a tonne, respectively, down by 4% and 27% respectively on their levels in early January 2015 (Figure G).

Figure G: Maize and wheat weekly spot prices from Jan 2012 to October 2015

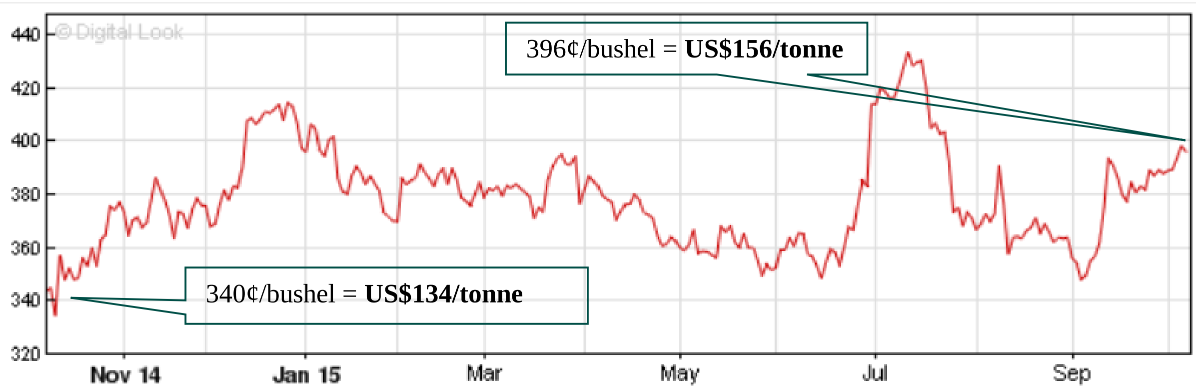


Source: *FAO GIEWS*
Note: *Prices are weekly, to the week ending Oct 02, 2015*

Maize futures seeing a small upturn

On October 08 2015, maize futures at US$156 a tonne were still some US$15 lower than spot prices (Figure H), even if US$22 higher than a year ago. Traders continue to expect a small decline in spot prices. Though harvests are coming in in the Northern hemisphere for 2015, futures prices have seen a small hike since the beginning of September, likely responding to fears of lower than expected harvests.

Figure H: Chicago (CBOT) Corn Futures: US cents/bushel, 12 months to October 8, 2015

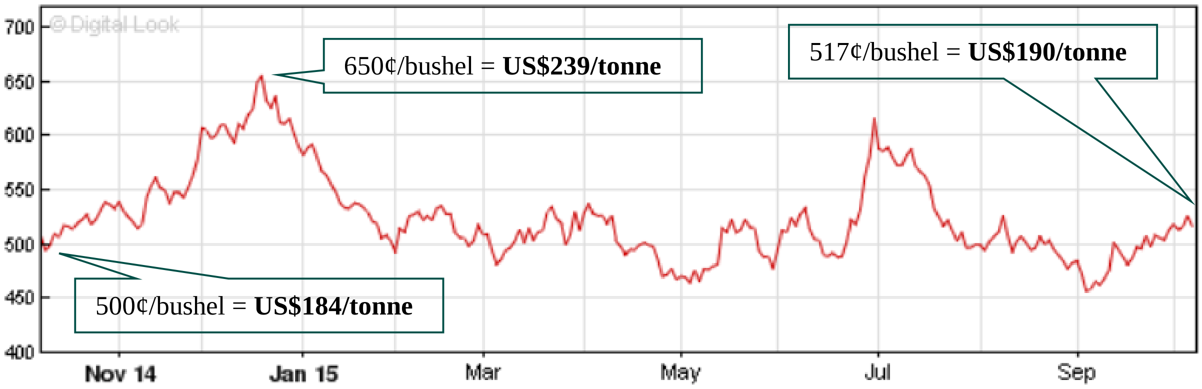


Source: *BBC Market data. US$/tonne added.*

Wheat futures also hovering below spots

Wheat futures, around US$190 a tonne by 08 October 2015, were still more than US$30 a tonne below the current spot prices, indicating traders continue to expect prices to fall. These futures prices fell for much of the last calendar year but have risen since September.

Figure J: Chicago (CBOT) Wheat Futures: US cents/bushel, 12 months to October 8, 2015

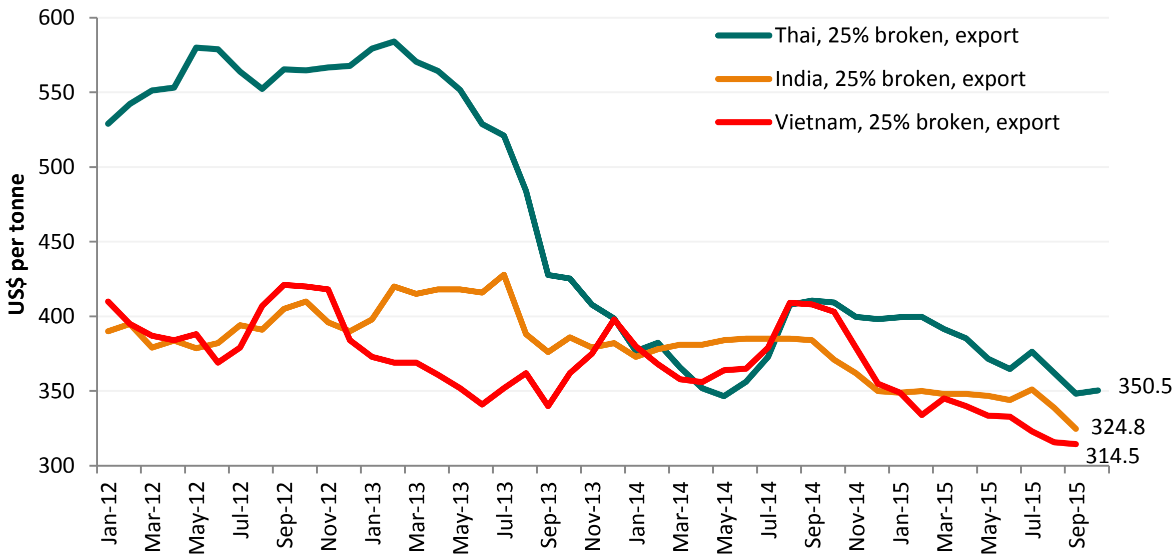


***Source**: BBC Market data. US$/tonne added.*

Rice prices continue slow decline since late 2014

Rice prices have fallen since July 2015 (Figure K). Prices offered by different exporters remain close together, with exports of 25% broken grade from Thailand, India, and Vietnam selling for US$351, US$325, and US$315 a tonne respectively by September/October 2015.

Figure K: Rice prices, monthly averages, Jan 2012 to Sep/Oct 2015



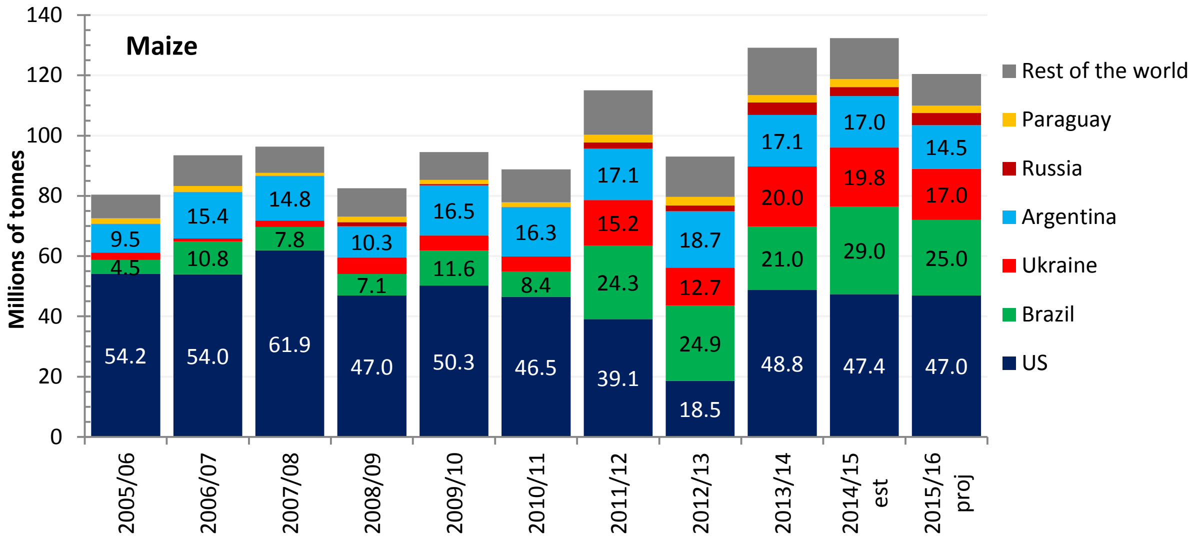
***Source:** Data from FAO GIEWS.*
Note: Prices for Thai 25% broken are for the first week of October, while India and Vietnam prices go to September

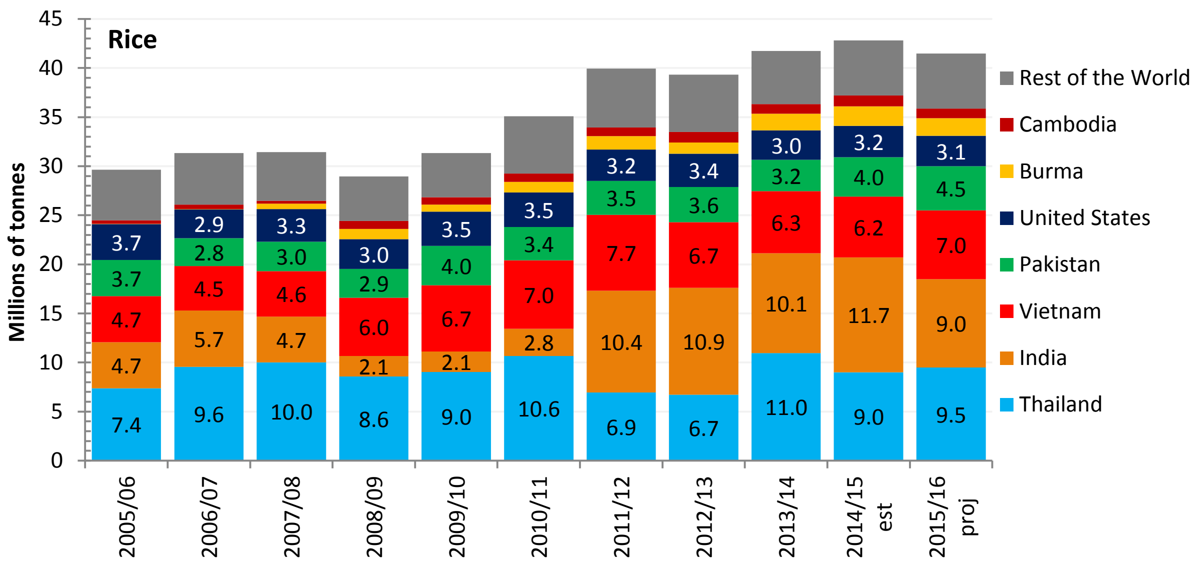
1.3 Export projections

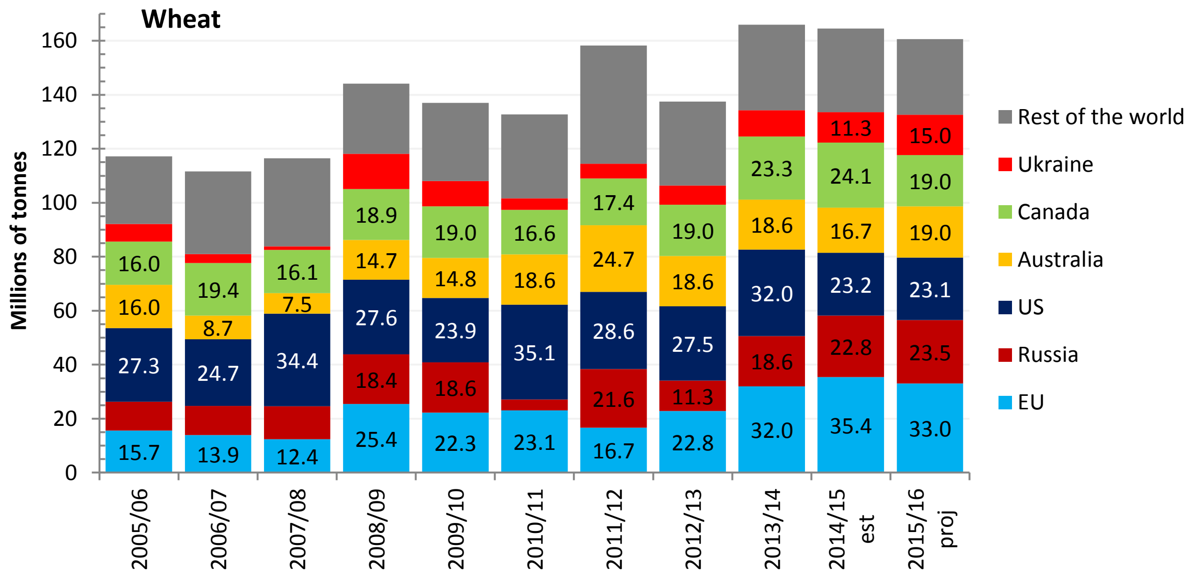
Key cereal exports expected slightly down on 2014/15

Exports of maize, rice, and wheat are predicted to shrink in 2015/16 compared to 2014/15, but not dramatically (Figure L). Overall, maize exports are expected to be some 12M tonnes lower in 2015/16 than in 2014/15 9% less; rice down by 1.3M tonnes, 3%; and wheat down by 3.9M tonnes, 2%.

Figure L: Global maize, rice, and wheat exports, by origin, 2005/06 to 2014/15 projection







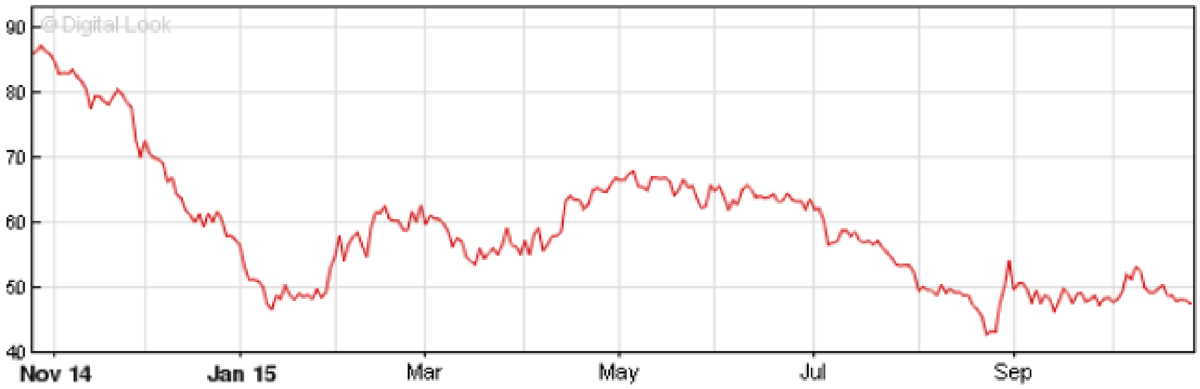
Source: *Data from USDA FAS PSD. Rice is expressed on a milled basis*

1.4 Reflections

Should the downturn in overall grain production for 2015/16 and falling stocks cause concern? Perhaps not: these downturns correspond with weak prices; especially clearly in the case for rice, where prices are considerably lower than their levels of a few years ago. Producers thus have fewer incentives to expand production than has applied in most years since 2007/08.

Falling oil prices will also have reduced some costs of production — urea, fuel for machinery — and of transport (Figure M).[1] A relative glut in supply means oil prices look set to remain around US$50 a barrel, at least in the short term.

Figure M: ICE Futures Europe Brent Crude Oil: US dollars/barrel, 12 months to October 27, 2015



Source: *BBC Market data.*

Lower production and stocks may thus be the result of considerable success in boosting supply and building stocks since the 2007/08 price spikes. Since much of increased supply came as much, if not more, from public action to stimulate production rather than from price response, especially in Africa and Asia; then the question for the future is whether lower and relatively stable grain prices may lead to complacency among policy-makers with less enthusiasm for spending on agricultural research, extension and investments in rural roads, irrigation and drainage.

[1] For more detail see our March 2015 bulletin http://www.odi.org/publications/8890-surprising-fall-oil-prices-since-mid-2014-does-mean-food-agriculture

Special focus: El Niño Southern Oscillation (ENSO)

2.1 What is an El Niño and why should we worry?

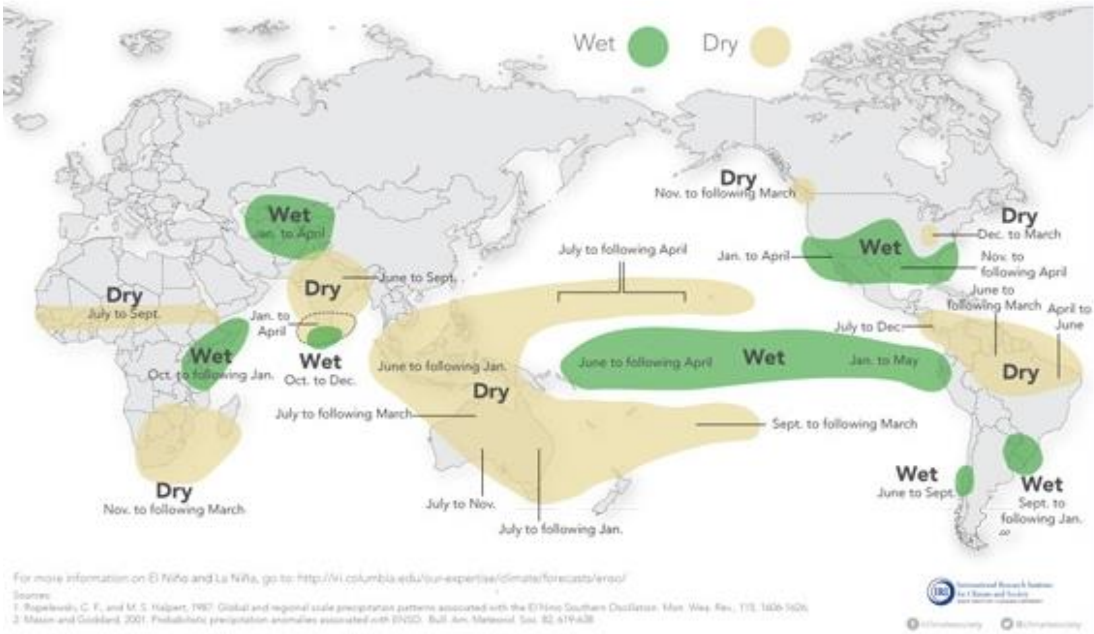
The El Niño-Southern Oscillation (ENSO) is a major system of ocean currents in equatorial latitudes of the Pacific Ocean: see Annex A for a primer. It is marked by anomalies that arise every three to five years when either the waters of the eastern Pacific become unusually warm, an event known as El Niño (because it arises at Christmas time), or become unusually cold, dubbed La Niña. These anomalies to the ENSO matter. They govern much of the seasonal changes to weather in the tropical Pacific. Moreover, through teleconnections as winds in the upper atmosphere change, ENSO events affect other parts of the globe, mainly in tropical latitudes, extending to the Indian Ocean, Africa and even into the Atlantic.

Though many other factors affect seasonal weather around the globe, ENSO events matter because, unlike some of the other factors, they have fairly predictable effects.

The impact of an El Niño on rains across the Pacific and Indian Ocean and on the countries adjacent to these is sufficiently well established for a map to be sketched, see Figure N.

An El Niño is likely to lead to drier conditions in the Sahel and Ethiopian highlands, southern Africa, much of South Asia, Southeast Asia and Australia; while leading to more rain in equatorial East Africa, and in the western Pacific region.

Figure N: Typical rainfall changes arising from El Niño



Source: IRI.

Note: El Niño conditions in the tropical Pacific are known to shift rainfall patterns in many different parts of the world. Although they vary somewhat from one El Niño to the next, the strongest shifts remain fairly consistent in the regions and seasons shown on this map.

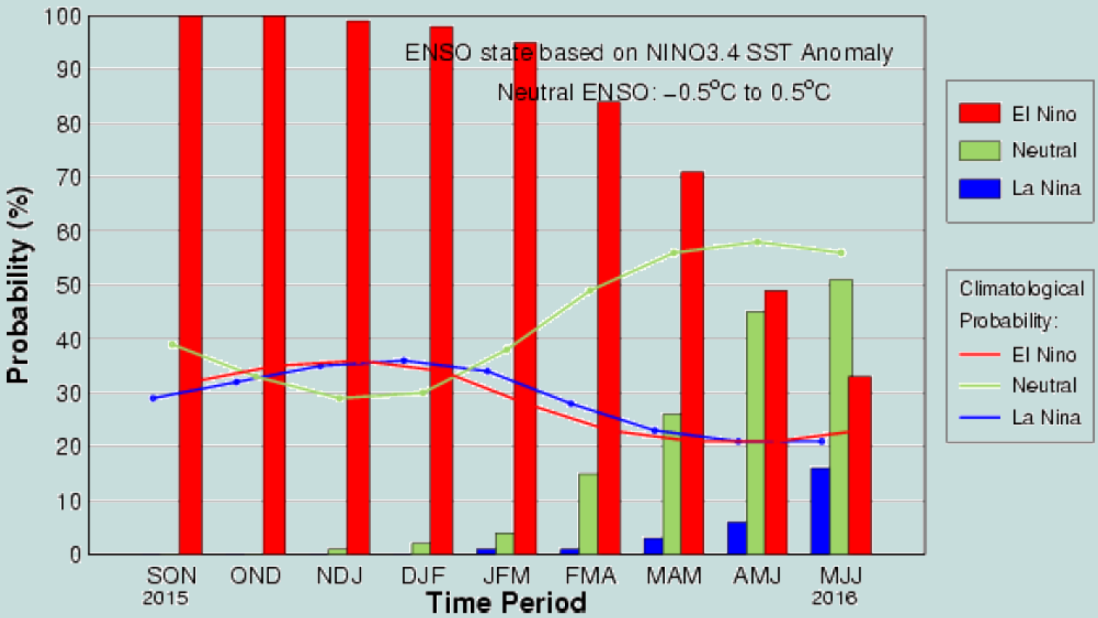
2.2 What do meteorologists predict will happen this El Niño season?

The latest October updates on ENSO conditions suggest a mature and strong El Niño is already present in the tropical Pacific Ocean, and likely to continue into the next few months – see Box 2.

Box 2: Meteorological outlook for El Niño from late 2015

- Since August 2015, the ocean and atmosphere over the tropical Pacific exhibit behaviour indicative of a ***strong El Niño***
- Expert opinion and most models agree the rest of 2015 will see ***further strengthening*** of the 2015-16 El Niño.
- The peak strength of this El Niño, expected between ***October 2015*** and ***January 2016***, could place it among the ***four strongest El Niño events since 1950***.
- Impacts from this El Niño may be felt into ***May*** 2016, gradually weakening – see Figure 2.A. There is a 95% chance El Niño will continue through N. Hemisphere winter 2015/16, gradually weakening into the N. Hemisphere spring 2016
- El Niño events ***typically decline and then dissipate during the first and second quarters of the year following their formation***, though impacts in some regions are still expected during the dissipation phase.

Figure 2A: Probabilistic ENSO Forecast from Oct 2015



Source: Early-Oct CPC/IRI Consensus Probabilistic ENSO Forecast from NOAA, Oct 2016

Sources: National Oceanic & Atmospheric Administration, 26 Oct, 2015; World Meteorological Organisation, Sep 2015

2.3 What might it mean for agricultural production?

Regional effects

The typical changes to weather patterns associated with a strong El Niño are expected to influence agricultural production significantly in late 2015 to early 2016 across the world, especially in the tropics and sub-tropics (Figure O). In most cases, the effect of El Niño is to reduce rainfall and thereby ***decrease agricultural production***, with a few exceptions of heavier rains in Eastern Africa, parts of North America and southern South America.

The effects of a strong El Niño are of most concern for regions where:

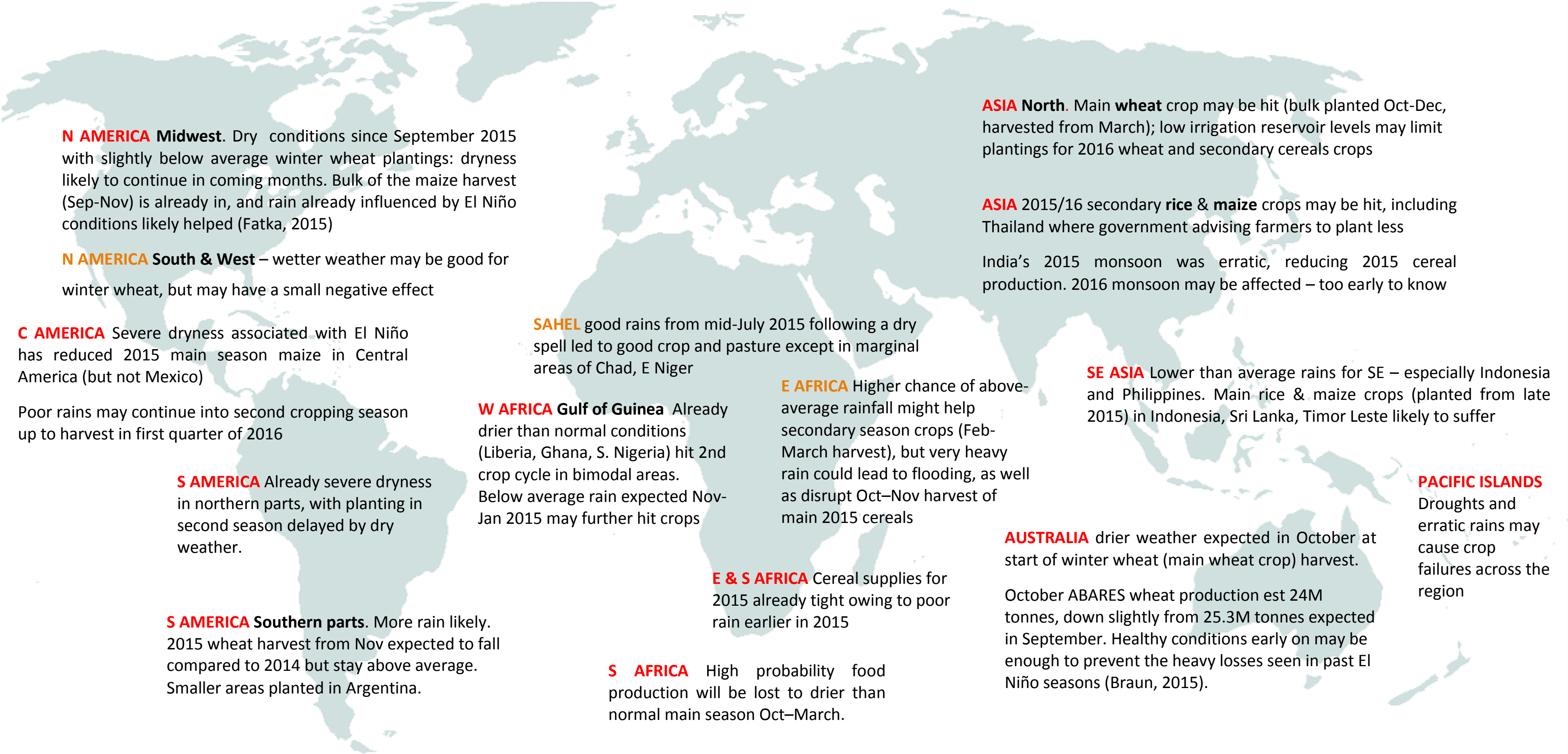
- much of the population depends on farming;
- many are on low incomes;
- local food production is particularly important for food supplies and prices; and where
- the effect of the ENSO anomaly is strong.

Southern Africa is an exemplar. The expected El Niño will lead to low rains during the single rainy season that runs from November to April, almost certainly leading to major harvest losses if past experience is any guide.[2] Moreover, for inland southern Africa the cost of shipping in replacement maize imports is high, so that local deficits typically lead to large price increases, as much as doubling local prices. Heavy rain in late 2015 and early 2016 may affect crops and lead to flooding in ***East Africa***.

Other parts of the developing world may be affected, but for these cases it would be through weather in mid-2016. Since at this time it is much less possible to predict the strength of the El Niño, possible consequences are more speculative. If the event persisted, however, it could lead to drier weather during main growing seasons in ***Ethiopia***, ***India*** and ***Burma/Myanmar*** with significant harvest losses.

[2] For example, major harvest failures were seen in 1983 and 1984, and in 1992: both sets correspond with a strong El Niño.

Figure O: Expected impacts of ENSO on crops in late 2015 to early 2016



Source: FAO, Oct 2015 Crop Prospects, supplemented by: Suwannakij, Oct 2015; Landcommodities.com, accessed Oct 2015; Braun, 2015; Fatka, 2015; Oxfam, 2015; WFP VAM, Oct 2015

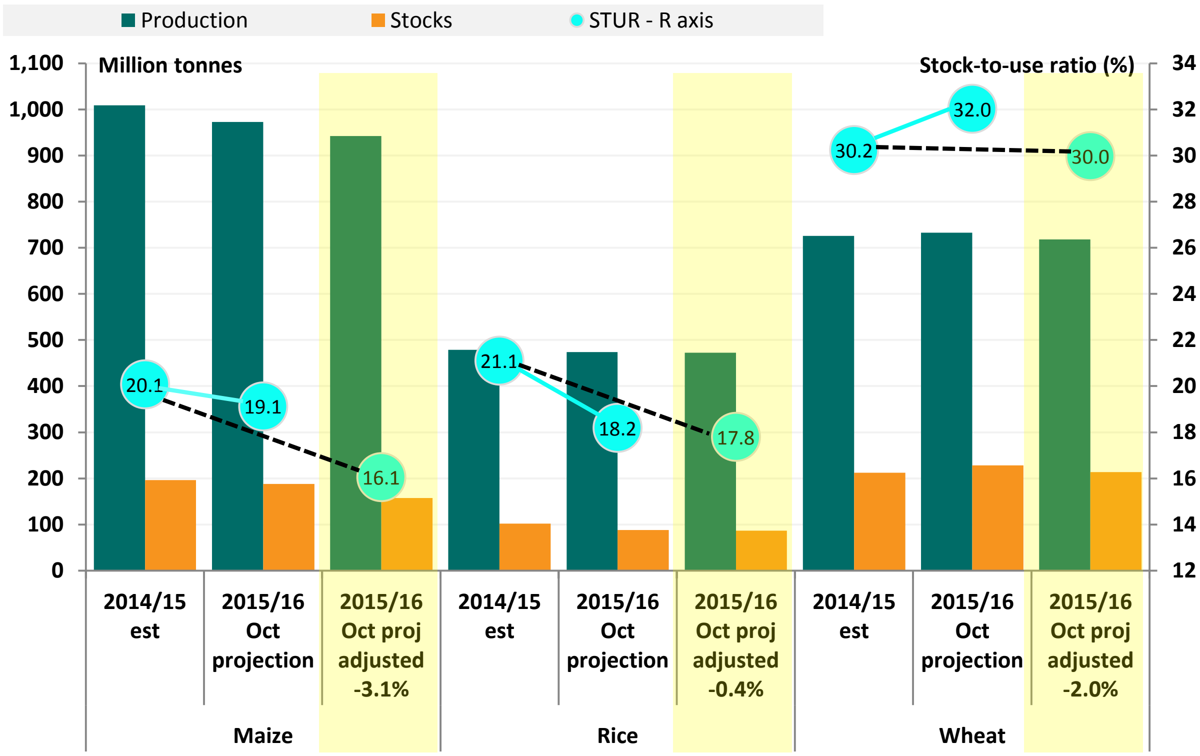
Global effects

Decreased production could influence world prices if large producers and exporters see significant impacts. How, then, might a strong El Niño impact maize, rice, and wheat production?

A rough and ready calculation can be made from the estimated impacts of ENSO anomalies on global yields of maize, rice, and wheat. From analysis of all ENSO events between 1984 and 2004 and associated crop production, Iizumi et al. (2014) have estimated impacts on crop yields. The bounds of their estimates are relatively tight[3] and appear normally distributed; suggesting impacts predicted are not likely to vary widely from the mean. The estimated reductions in world production are -3.1% for maize, -0.4% for rice and -2% for wheat.

Reducing USDA's production projections for 2015/16 of maize, rice, and wheat by these factors[4], ***maize production falls by around 30M tonnes, milled rice by about 1.9M tonnes, and wheat by around 15M tonnes***[5]. Given relatively highly stocks, such losses could be countered by releases of stocks. Were that to happen, then maize stock-to-use ratios would fall between 2014/15 and 2015/16 from 20% to 16% for maize, from 21% to 18% for rice, and from 30.2% to 30% for wheat (Figure P).

Figure P: Cereal production and stocks, adjusted for an El Niño in 2015/16



Source: Data for estimates and projections from USDA FAS, October 2015.

Maize is thus the main cause for concern: rice and wheat production will be little affected. Moreover for rice, Thailand is looking for opportunities to offload some of the large public stocks the country holds.[6] If maize harvests are reduced by 30M tonnes as a result of El Niño, not all of this will be

[3] Impacts on maize vary between about -4% and -2%, with most of the impact clustered around the -3.1% mean. Those on wheat vary between around -3.5% and -0.9%, with again most concentrated in the central part of the distribution. Impacts on rice have the widest bounds, going from about -1.6% to +0.8%, but again most of the impact is concentrated near the centre.

[4] This is a strong estimate since USDA forecasters may have already tried to factor in likely impacts from ENSO to the projections they revise monthly.

[5] At the extremes of the bounds discussed, these figures would resemble: for maize, a decline of between 19M and 39M tonnes; for wheat, a decline of between 26M and 6.6M tonnes; and for rice, either a decline of up to 7.6M tonnes or an increase up to 3.8M tonnes.

[6] Other studies confirm that El Niño affects maize more than other cereals. Ray et al. (2014) for example found maize to be generally more sensitive to climate change and climate shocks compared to rice and wheat. With climate change set to usher in more frequent extreme weather in the future, including stronger ENSO events (Cai et al., 2014) stronger impacts on all three crops are likely to be felt.

compensated by stock releases: it is certain to push up prices — which of course will trigger some stock release — to some degree. Indeed, 30M tonnes represents a quarter of the maize likely to be traded in 2015/16, so significant price increases may be seen on the maize market. A rough and ready estimate is that maize prices might increase by around 17%, assuming that higher prices would reduce demand and that some stocks would be released were prices to rise.[7]

Since the most vulnerable maize harvests will be those from the southern hemisphere, it is likely that this effect will apply in the first half of 2016; after that they would be countered by increased planting of maize in response to higher prices in the northern hemisphere, so that prices might be expected to decline as the northern crops are harvested in late 2016.

[7] This assumes that the price elasticity of demand for maize traded on the main world markets is 0.18 [based on median of FAPRI model elasticities]; that 75% of the change in world prices is passed through to domestic markets; that the price elasticity of maize that is domestically produced and consumed is 0.15; and that the elasticity of release of maize stocks in response to prices is unity.

Annex A: El Niño-Southern Oscillation, a primer

A.1 Influence of El Niño-Southern Oscillation (ENSO) anomalies on climate in Pacific and Indian Ocean regions

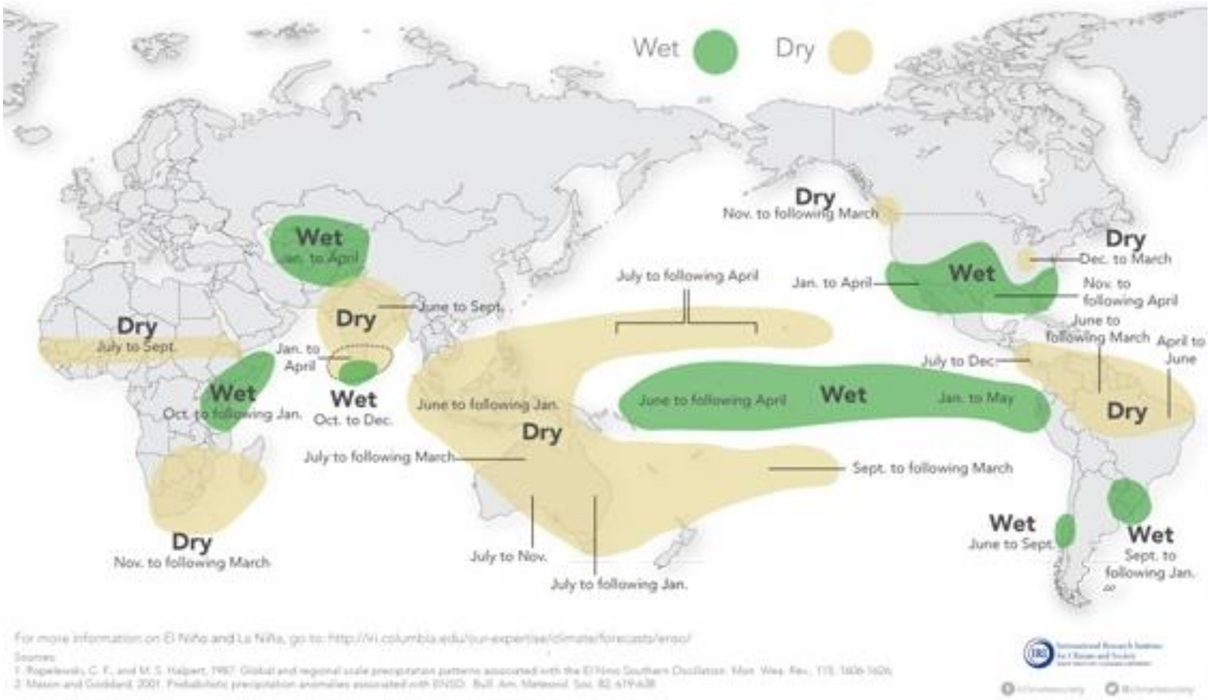
The ENSO is a major system of ocean currents in equatorial latitudes of the Pacific Ocean. It is marked by anomalies that arise every three to five years when either the waters of the eastern Pacific become unusually warm, an event known as El Niño (because it arises at Christmas time), or become unusually cold, dubbed La Niña[8]. These anomalies to the ENSO matter. They govern much of the seasonal changes to weather in the tropical Pacific. Moreover, through teleconnections as winds in the upper atmosphere change, ENSO events affect other parts of the globe, mainly in tropical latitudes, extending to the Indian Ocean, Africa and even into the Atlantic. [see http://iri.columbia.edu/our-expertise/climate/enso/enso-essentials/ for a guide to the physical science.]

ENSO events, however, are only one thing that affect seasonal weather in these regions, especially where the impacts are teleconnected. Other forces are equally if not more important. Thus no correlation exists between the annual number of climatic extremes of storms and drought seen worldwide and El Niño or La Niña events.

Yet ENSO events do matter because they have reasonably predictable effects, unlike some of the other factors. For example, the impact of an El Niño on rains across the Pacific and Indian Ocean and on the countries adjacent to these, is sufficiently well established for a guidance map to be sketched, see Figure M. An El Niño is likely to lead to drier conditions in the Sahel and Ethiopian highlands, southern Africa, much of South Asia, Southeast Asia and Australia; while leading to more rain in equatorial East Africa, and in the western Pacific region.

[8] In ENSO neutral years, winds and ocean currents flow from east to west in the equatorial latitudes of the Pacific Ocean; because typically the east has low atmospheric pressure and the west has high pressure. Consequently the western Pacific sees convection rains; while the eastern Pacific has a dry climate — the deserts of Peru and Chile are some of the driest in the world, with coastal upwelling that produces rich fishing grounds.
An El Niño arises when temperatures of the sea rise in the east, leading to an interruption to trade winds, with heavy convection rain on the Pacific coast of the Americas; while in the western Pacific there is less rain, often to the point of drought.
La Niña is the opposite, with even cooler seas in the eastern Pacific and an intensification of the circulations of wind and water seen in ENSO neutral conditions.

Figure A.1 Typical rainfall changes arising from El Niño



Source: IRI.

Note: El Niño conditions in the tropical Pacific are known to shift rainfall patterns in many different parts of the world. Although they vary somewhat from one El Niño to the next, the strongest shifts remain fairly consistent in the regions and seasons shown on this map.

A.2 Predicting ENSO anomalies and their impacts

Effects are reasonably predictable, but far from exact since ENSO events vary by their timing, pattern and force:

> *Because each El Niño and La Niña event has unique characteristics of timing, intensity and specific pattern changes, such shifts are never exactly the same during every El Niño and La Niña event.* [IRI web]

Hence predictions are expressed as probabilities rather than certainties.

Prediction proceeds by using either dynamic simulations based on the data collected from the Pacific on sea temperatures, or regression models of the effect of previous changes to Pacific conditions. Predictive power is weak at seven months, but becomes quite high with one month to go, see Table A.

Table A.1 Accuracy of forecasts of ENSO events

Model Type	Correlation Coefficient			Mean Absolute Error		
Lead in months:	Lead 1	Lead 4	Lead 7	Lead 1	Lead 4	Lead 7
Dynamical	0.89	0.60	0.14	0.17	0.32	0.44
Statistical	0.79	0.46	0.12	0.22	0.29	0.31

Source: Barnston 2014

So we can be reasonably sure about ENSO events one month ahead, but only have at most 60% confidence with four months to go.

The next step in prediction links ENSO events to changes to weather over, say, parts of Africa. Jury (2015), for example, has created a regression model that correctly predicts, two-thirds of the time, low rains in highland Ethiopia when an El Niño occurs.

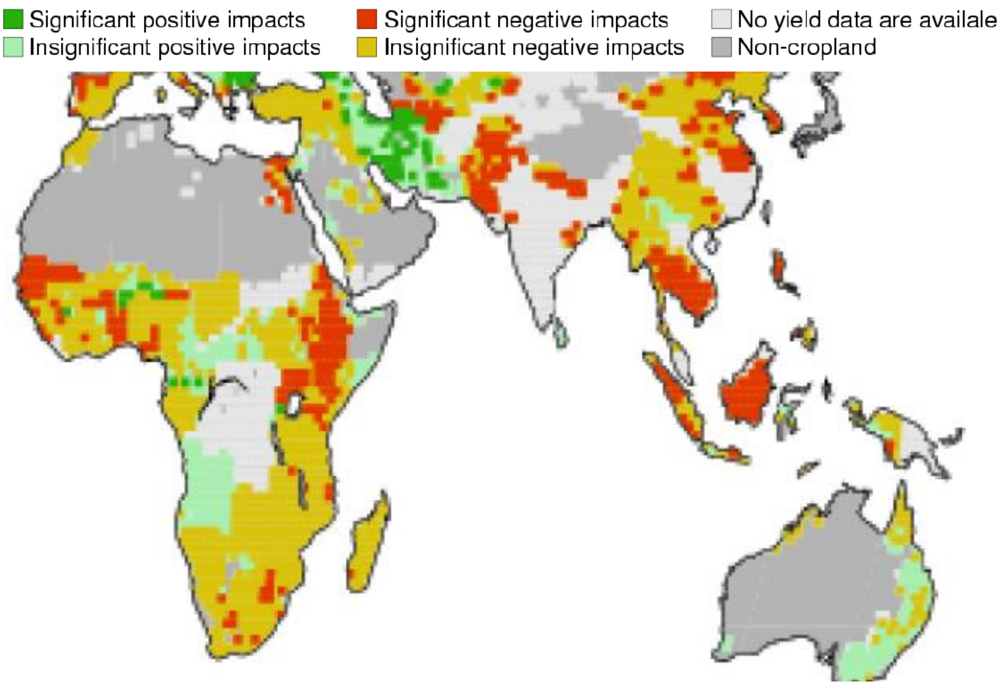
Finally there's the link from rains to vegetation. When Philippon et al. (2014) looked at ENSO events and changes to vegetation in Africa, they saw clear patterns. From July, marking the beginning of ENSO's peak phase, to September, an El Niño is associated with less vegetation north of the equator, including the Sahel, Gulf of Guinea coast, and regions from the north of DR Congo to Ethiopia, although effects are uneven and correlate only moderately at around 0.30. At the same time, positive correlations are seen over the winter rain region of South Africa.

From October to November, negative correlations over Ethiopia, Sudan, and Uganda disappear, while positive correlations appear for the Horn of Africa, and South Africa's southeast coast. December marks the end of ENSO's peak phase, with positive correlations appearing over the Horn of Africa, spreading south and west, while negative correlations appear over Mozambique, Zimbabwe, and South Africa. This pattern strengthens to become well established over February-March (when ENSO is decaying), with less vegetation seen in ENSO years south of 18˚S, and more seen in areas north of 18˚S; though at the same time, north of around 2˚N, negative correlations move northward. Finally, at the end of the ENSO decay period (April-June), negative correlations spread north (to 10˚S) and east into southern Tanzania, as well as south of 18˚S (Philippon et al, 2014).

These complex interactions between vegetation and ENSO events, varying through time and space, have only recently been identified with this level of detail and accuracy.

Others have also recently modelled links between agricultural output and ENSO events. Iizumi et al. (2014) examined outcomes by major crop — maize, rice, wheat, and soybeans, generating global maps of areas positively and negatively affected by El Niño events. See Figure B for an example of maize. While globally they found maize yields might fall by around 3.1%, wide variations exist by region.

Figure A.2 Influence of El Niño on maize crops in Africa and Asia



Source: From Figure 4 in Supplementary Materials to Iizumi et al., 2014

A.3 Existing monitoring

The importance of the ENSO for Africa is well appreciated: sufficient to establish climate networks and forums that monitor developments and particularly ENSO conditions, predict probable changes to weather, and discuss impacts. These include:

> *In sub-Saharan Africa seasonal climate forecasting is being provided through the regional climate outlook forums (RCOFs) which include: SARCOF (southern Africa), GHACOF (Greater Horn of Africa) and PRESAO (West Africa). The main purpose of these forums is to generate consensus forecasts by bringing together climate forecasters and facilitate cooperation and dissemination of climate information.*
>
> *RCOFs have been organized jointly by the regional meteorological institutions, world meteorological organization (WMO) and the international research institute for climate prediction (IRI) with funding support from donor agencies.*
>
> *…. Currently there are discussions on the formation of Food Security Outlook Forum linked to the COFs which would focus mainly on the forecast implications on food security. (Haile 2005)*

GHACOF, for example (see http://www.icpac.net/products/products.html), produces regular bulletins on weather for the region, including warnings of ENSO events expected to affect East Africa and the Horn.

Moreover, the impacts of previous ENSO events are documented, both direct effects on rains and storms, and consequent effects on crops, flooding, disease, locust outbreaks, etc. Policy options to anticipate and respond to such threats are also documented (see, for example, Hellmuth et al. 2007, Hellmuth et al. 2011).

A.4 From forecasts to action

Between weather forecasting and effective action, however, lie at least two challenges. One is ***communication***. Can forecasts be expressed in ways that potential users can understand? For example, in southern Africa it has been found that farmers are much better informed about forecasts when they get the information in discussion groups where they can check understandings and develop their own interpretation of what it means for their farms; compared to just hearing a bulletin on the radio (Patt et al., 2007).

The other challenge lies in the ***psychology*** of acting on probabilities. Forecasts based on probable conditions can be interpreted as certainties leading to frustration and loss of trust when conditions turn out to be different, even if these outcomes were less probable than the forecast. Farmers may plant low-yielding but drought resilient crops, losing potential yield when normal rains arrive; relief agencies may build stores of food in anticipation of a harvest failure that never occurs; governments may warn people to relocate to higher ground in expectation of a flood that never materialises — all these are hazards in themselves, even if less severe than the predicted disaster. Studies may show that over the medium term, reacting to probabilities pays off; but that does not avoid the problem of the improbably good outcome. Small wonder, then, that the climate risk literature stresses the importance of building partnerships between climatologists, public agencies, and the general public so that all understand what is at stake, what the forecasts mean, and all share the responsibility for consequences — comfortable that in the medium term that reacting to forecasts will be worthwhile.

Existing ***early warnings systems*** (EWS) such as Fewsnet (Famine Early Warnings network) or GIEWS (Global Information and Early Warnings System) factor information beyond weather into analyses and projections – such as existing humanitarian responses, conflict, prevailing livelihood conditions and so forth, which adds another layer of complexity. The mixed experience of existing

early warning systems[9] highlights the importance of politics as opposed to skill of technical forecasts in this area.

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[9] See Levine et al. 2011 for a description of some limitations of EWS, or Hillbruner and Moloney, 2012, for a specific discussion of limitations of early warning in the context of the 2011 Somalia famine

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