RESILIENCE TASKFORCE SUB REPORT

Annex C

Country Level Impacts of Global Grain Production Shocks

Foreign & Commonwealth Office

UK Science & Innovation Network

Global Food Security
Sustainable, healthy food for all

Contents

This report originates from a Taskforce of academics, industry and policy experts to examine the resilience of the global food system to extreme weather events. The Taskforce was brought together by the UK's Global Food Security programme and was jointly commissioned by the UK Foreign and Commonwealth Office and UK Government Science and Innovation Network. This report on Country level impacts of global grain production sits in the context of two other detailed reports on Climate and global production shocks and a Review of the responses to food production shocks. There is also an overall Extreme weather and resilience of the global food system summary report.

The contents of these reports are based upon workshop discussions held at Willis Tower, Chicago in October 2014 and the Foreign and Commonwealth Office, London in February 2015 (see the Synthesis report for a full participant list).

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Electronic versions of the report series may be found at the addresses below:

Extreme weather and resilience of the global food system summary report
www.foodsecurity.ac.uk/assets/pdfs/extreme-weather-resilience-of-global-food-system.pdf

Climate and Global Crop Production Shocks
www.foodsecurity.ac.uk/assets/pdfs/climate-and-global-crop-production-shocks.pdf

Review of the responses to food production shocks
www.foodsecurity.ac.uk/assets/pdfs/review-of-responses-to-food-production-shocks.pdf

Country level impacts of Global Production Shocks
www.foodsecurity.ac.uk/assets/pdfs/country-impacts-of-global-grain-production-shocks.pdf

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Executive summary

Key Findings

- **General food system impacts at the country level are highly dependent on the degree to which that nation is dependent on imports of one or more of the four impacted grains.** Heavy importers of grain suffer the most severe food system impacts. Neither the EU nor the US are likely to suffer any widespread negative impacts at the food system level due to their robust economies and ability to outbid other countries for whatever grain their markets demand. However, very localized impacts could occur.
- **There are significant interactions between the internal political situation of a country, the magnitude and direction of the food system impacts, and the kind of impacts that could take place in civil society.** The back-to-back food price spikes of the past decade have helped give rise to upheavals in several countries – notably the Arab Spring countries. For example, Saudi Arabia and Egypt both remain vulnerable due to their heavy dependence on grain imports and potentially inflammatory political situations.
- **Of the countries we examined in detail China has probably taken the most inter-governmental actions to protect itself against global grain production shocks.** China does not have much more arable land available, and so the country has executed a number of long-term bilateral grain trade agreements with Brazil, Russia, and others. China is also implementing a strategy of securing agricultural production capacity in several other regions around the world, notably in Sub-Saharan Africa – including Ethiopia.
- **Severe economic impacts of a global grain production shock are limited primarily to Sub-Saharan Africa.** The economic impact of a global grain production shock for a particular country is directly related to exposure to the global markets and the food share as a proportion of household expenditure. Impacts will be felt in terms of poverty, food subsidy costs, macroeconomic consequences, balance of payments, and inflation. The shock could also give rise to additional indirect impacts. For example, health impacts from populations seeking food from alternative sources such as bush-meat leading to increased risk of exposure to diseases including Ebola.
- **The increase in food price has limited, generally negative impacts on nutrition security, but sends a strong economic signal for the increased production of all foods.** This means there is likely to be an immediate increase in land use, where available, for crop production although of course actual production increases are not seen for a number of months. In addition to an increase in land use, other environmental impacts of food production are increased through a short term increase in intensification, such as the use of freshwater, increased greenhouse gas emissions, non-renewable energy utilization, and eutrophication (among others). These impacts may be felt over a longer period of time especially where they involve deforestation or loss of biodiversity.
- **Any increased impact of a global grain production shock in 2026 will be driven by changes in the relative balance between, and particular geographies of, net importers and exporters on the international market.** By 2026, China will have then become more reliant on international markets, particularly for maize and soybeans. Overseas land acquirement is occurring but will only ever be a small proportion of grain supply for the country. By 2026, Egypt plans to have embarked on a massive project of improving irrigation systems and expanded agriculture development into unused desert areas (with proven groundwater resources) although this is likely to increase the demand for fertilizer inputs. However, production shocks and price spikes may cause agreements to be broken in particular where they involve shared water resources between countries. A major factor is what happens at the Climate Change negotiations in Paris later in 2015. If there are major global decarbonisation deals then agriculture will likely need to bear its share of reductions – which may mean less nitrogen fertilizer is allowed for use in crop production. This may cause yields to decline and become more volatile – harming resilience. Adding to uncertainty, however, is the possibility that meat consumption could decrease, for instance, possibly ameliorating such concerns and actually adding to resilience.

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Recommendations

- **Countries with high vulnerability to global grain production shocks should take measures to reduce their exposure.** This could be achieved through trade, stock-holding, by using financial tools such as futures contracts, considering diversification by growing alternative crops or by increasing investment in internal production. China has already boosted internal potato production as one way to become less susceptible to global grain production shocks but this is currently insufficient. Egypt is initiating a long-term program to boost wheat production, as one means for improving its resilience to such shocks. Actions by other countries are needed.
- **Greater investment in agricultural research is needed to reverse losses in the rate of yield-gain in many important food crops and improve efficiency of the food system.** The urgency for such investments increases as the intrinsic volatility of the food system continues to increase – due to both accelerating and the challenges caused by climate change – both direct abiotic effects as well as secondary biotic effects (e.g. shifting weeds, pests, and disease). Importantly, supply chain efficiency, waste reduction, improved diets and alternative food supply systems also need to play a part by improving efficiencies and thereby helping to build resilience.
- **Unsustainable withdrawals of ground water and any unnecessary uses of non-renewable energy in the food system must be stopped.** Such practices violate basic principles of sustainability and decrease the long-term resilience of the agri-food system.
- **Public-private partnerships will play an essential role in efforts to lessen the potential impact of future global grain production shocks.** In an era of limited resources, both financial and human, governments must reach out to the private sector in appropriate and constructive ways to help address these existential challenges to one of our most basic needs: nutritious, safe, and affordable food.
- **Robust quantitative methods for evaluating current levels and trends in resilience patterns should be developed.** These will help policy- and other decision-makers make better informed investments and decisions that result in improved outcomes and reduced risk.

Methods

1.1 Information on potential country level impacts was collected through an expert interview process. The Impacts Team developed an "Interview Questionnaire" (see Appendix A) and identified a list of experts from academia / research institutions, government and the private sector to interview for the countries/regions of interest: Brazil, China, Egypt, Ethiopia, Europe, India, Russia, Saudi Arabia, and the United States. Interviews lasted approximately 45 minutes and for most countries two interviews were conducted.

1.2 Experts were interviewed by phone by Dr. Bradley Hiller. Based on input from the Climate and Response Teams, Dr. Hiller asked each expert to consider a hypothetical grain production shock scenario for the year 2016 in which drought in North America results in 10% losses to maize and soybean. Simultaneously, there is a similar production shock due to heat across Eastern Europe into Russia and China causing a 10% loss in wheat and an 8% loss in rice. Export and customs restrictions are put in place with no change to biofuel mandates. Public food stocks are marginally above "normal" prior to the shock but are not released in response to the shocks quickly enough. Prices for the major grains are above historical shock levels (2008 and 2011) by up to double (for example, wheat is at double today's prices and five times the level of pre-2007 lows) leading to the FAO food index being at 200 (40% higher than historical shock levels).

1.3 The experts were then asked a first set of questions about general food market conditions, the speed of food system recovery (if disrupted), and whether the population of that country might seek alternative food sources. The second set of questions regarded internal governmental and civil impacts: potential for food riots, immigrant migration or displacement, and impacts on neighbouring countries. This set of questions was then followed-up with questions about external governmental impacts: export bans or restrictions, supply route constrictions (e.g. maritime choke points), and geopolitical manoeuvers.

1.4 Questions on economic impacts were then asked: especially impacts on poverty, food system subsidies, macroeconomic effects, balance of payments and exchange rates, inflation, and monetary policy. Nutrition-related questions were also posed on dietary quality and micronutrients, and whether any particular sub-populations (e.g. women and children) would be disproportionately impacted. The final set of questions about a hypothetical 2016 shock involved the potential ecosystem and environmental consequences of such an event. The interview then concluded with a final question about how any of the answers might change for a 2026 shock of similar magnitude.

1.5 Dr. Bradley Hiller prepared reports from each expert interview. At least one interview was conducted for each country of interest, but most countries had two interviews. This summary of those reports was used to inform the scenario which is structured as follows: General Food System, Internal Governmental and Civil (Internal), Governmental (External), Economic, Environmental, Future Trends.

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Impacts

General Food System

2.1 General food system impacts at the country level are highly dependent on the degree to which that nation is dependent on imports of one or more of the four impacted grains. Countries that are net exporters (such as Brazil and the US) are unlikely to experience negative domestic food system impacts – in fact, major grain exporting regions unaffected directly by the shock may benefit significantly from higher demand for grain and associated higher international grain prices. Livestock exporting countries (such as Brazil) may also benefit from increased demand due to elevated feedstock grain prices.

2.2 China maintains large grain reserves, but is a major importer of soybeans, which are used mainly in pork production – so soybean shortfalls might shift diets away from pork and toward poultry. China has already boosted internal potato production as one way to become less susceptible to global grain production shocks, but this is currently insufficient.

2.3 Heavy importers of grain, such as Egypt, are likely to suffer the most severe food system impacts. Egypt is initiating a long-term program to boost wheat production, as one means for improving its resilience to such shocks, although this is likely to increase the demand for fertilizer inputs. However, production shocks and price spikes may cause agreements to be broken in particular where they involve shared water resources between countries. There are significant opportunities to rationalize the agri-food supply chain through efficiency improvements and reduced wastage. However, a similar Saudi program was recently curtailed due to ground water depletion and high costs of production.

2.4 Neither the EU nor the US is likely to suffer any widespread negative impacts at the food system level, due to their robust economies, ability to outbid other countries for whatever grain their markets demand and resilience in their food chains (including at the processing and consumer behaviour ends). There may be a consolidation of the food industry (optimizing processing) and value engineering (slightly altering recipes and sizes of items). However, very localized impacts will occur. For instance, the pork industry in Denmark could be negatively impacted.

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Governmental and Civil (Internal)

3.1 There are significant interactions between the internal political situation of a country, the magnitude and direction of the food system impacts, and the kind of impacts that could take place in civil society. The back-to-back food price spikes of the past decade have helped give rise to upheavals in several countries – notably the Arab Spring countries. Saudi Arabia and Egypt both remain vulnerable due to their heavy dependence on grain imports and potentially inflammatory political situations.

3.2 Many other countries have reasonable political stability with respect to a global grain production shock, but there are localized exceptions. For example, so-called "peasant workers" in China's urban areas are rather vulnerable to high food prices, but are not currently well-organized – so might not be able to act even if they might have a motive to protest. Student groups are purportedly better organized and may be more likely to protest if they are affected. Other groups in China that are also potentially vulnerable and slightly more likely to act include Muslim minorities in the west and Tibetan minorities in the south.

3.3 In Brazil, there is an active civil society and in India food provision issues are high on the local political agenda. The likelihood of protest and unrest may be (at least partially) dependent on the macroeconomic situation in each country at the time of the shock, namely employment rate and minimum wage level relative to food prices.

3.4 Many countries have already experienced significant rural to urban internal migration as a result of broader socioeconomic factors. Brazil is supposedly 80% urbanized and China is encouraging peasant workers and farmers into urban areas to consolidate rural land use. While only one-third of India's population is urban, India has a resilience program – the employee guarantee act – to protect against mass migration occurring but some migration persists due to insufficient land availability. The divide between urban and rural in India is not considered as great as in the past, because many urban dwellers still retain connections to family in rural areas. The prospect of a potential temporary reversal of rural-urban migration trends may exist in Egypt if urban citizens return to rural areas (if some family members remain) to revert to subsistence during a shock.

3.5 There may be a significant increase in "food system refugees," away from food-insecure neighbours, such as between northern African nations (e.g. Somalia, Sudan and Eritrea into Ethiopia), from northern Africa into Europe, or from Bangladesh into India.

3.6 The agricultural model adopted by each country also has some influence on vulnerability to shocks and coping strategies. For example, while the United States has adopted large-scale industrial farming of mostly monocultures, India and China have generally retained traditional smallholder farming systems, and Brazil represents a mixture of both. Each of the models seems to have various advantages and disadvantages

depending on the context and objectives. As an example, industrial-scale systems can be efficient and effective at producing calories at scale, while smallholder systems may support rural communities and produce a diversity of products which may offer more local resilience to shocks.

3.7 The most vulnerable members of society to the food shock scenario are often the urban poor and/or landless. While the poor in rural areas may often constitute a higher proportion of the population (for example in China an estimated 90% of the poor reside in rural areas), those that have access to land may be able to revert to more subsistence living off their own plot during such a crisis, while the urban poor and the landless must still purchase food items (often at elevated prices). In some cases, farmers may also potentially benefit from increased commodity prices. Countries have varying degrees of social protection in place. For example, Brazil has a well-regarded cash transfer program for its poor[1] which would help significantly during a shock scenario. The United States has a food stamp program. Egypt has recently implemented a smart card grain purchase system to promote rationalization of grain use and also provides cash remuneration to deprive families. Ethiopia has a national food safety net program (the second largest in Africa, used to give out food or provide cash to buy food).

3.8 In rural areas in China, farmers typically stock sufficient reserves in their own granary to guard against food shortages. The Chinese government provides subsidies for farming inputs (land, fertilizers, machinery, etc.) to help address some disparities between rural and urban dwellers. In some countries with support systems for the poor, some of the impacts may be borne by middle class consumers (such as in India and Egypt) who may be ineligible for such support, do not have land plots and do not have dispensable cash. In Russia, the rural poor can subsist on their own production during a shock, while the urban poor struggle with increased food prices, particularly of nutrient rich foods in winter. In Saudi Arabia, migrant workers may be the most vulnerable to food price increases due to their reliance on purchasing food coupled with lower wages and lack of social security relative to nationals.

3.9 Some national governments heavily subsidise food. This is especially the case in countries such as Egypt, where wheat and bread are highly subsidised, particularly in the wake of the Arab Spring uprisings. Historically, a 'bread riot' occurred in the 1970s when the then President removed the wheat / bread subsidy and today such a proposal would be unthinkable with wheat / bread regarded as a major national security issue. However, blanket subsidies are made available for all citizens (including the non-poor) and hence more targeted systems may be more fiscally feasible. An estimated 2/3 of India's population benefits from food subsidies, as a part of the national food security act. Other countries, such as Brazil, do not subsidise food but instead rely on other social support mechanisms, such as their cash transfer program. Ethiopia has increasingly started to subsidize wheat (partly in response to Arab Spring events) and does subsidize some farming inputs. Further still, countries such as China and India implement minimum price policies for domestic grain prices to protect rural farmers. Domestic grain prices in China can be up to twice those on the international market and hence rises of prices of some grains internationally may have minimal impact on China (this is not the case for soybean, for which China is highly reliant on imports). China also subsidizes food for some urban consumers (typically not for unregistered peasant workers though).

3.10 In Europe, the Common Agricultural Policy may be considered a production subsidy (the United States adopts similar policies) which can be used to encourage domestic production of certain crops. Russia also subsidizes agricultural products in different forms, including state guarantees, state financing, crop purchase guarantees, inputs such as supply of fuel and fertilizer, regional and federal programs. The state also invests in food storage facilities.

3.11 The macroeconomic situation of a country is regarded as an important factor in determining civil and government response, and in turn recovery speed and capacity. In countries such as Brazil, the price of food relative to minimum wage, employment rates and social support programs are more important than food price rises themselves. How the government responds to such combinations of factors may be more important in determining whether or not civil disruptions occur. In cases where governments have limited ability / capacity to intervene in response to acute shocks, civil disruptions may be more likely. Countries such as China have very large foreign reserves to draw on during a crisis and the government may play more of a supporting role than in other countries.

3.12 Many countries have purportedly changed and/or strengthened their food security approaches in response to lessons learned during the 2008 crisis. Responses vary between countries, but have included greater promotion of regional and national public food banks, diversification of agri-food sourcing (both domestic and imported), increased social support programs and subsidization of staple food items.

3.13 Public food stocks act as important buffers in some countries during such a shock scenario. China has strengthened its food security provisions through rice banks at central and local levels. Egypt maintains three to four months of emergency public wheat stocks at any time. India also maintains considerable stocks of staple food crops at any one time for price stabilization and food security purposes.

3.14 Some political and radical groups in certain countries may take advantage of the shock scenario to bolster their profile. For example, in Egypt some factions provide support to vulnerable populations during such crises in the hope of getting political mileage.

1 *The flagship cash transfer program, Bolsa Familia, reaches a quarter of the Brazilian population. Its cost is half of 1 percent of GDP per year – considered a bargain compared with the cost of social exclusion and unrest (Giugale, M.M., 2014, Economic Development , What Everyone Needs to Know, Oxford University Press).*

Page 6 (Tim Hess)

Governmental (External)

4.1 Russia and India have recently been among the first to institute export bans in response to grain production shocks, and this tendency may be likely to continue. These countries implement bans with intentions to limit the exposure of their domestic consumers to market variations and to help ensure food security. China does not have much more arable land available, and so the country has executed a number of long-term bilateral grain trade agreements with Brazil, Russia, and others. China is also implementing a strategy of securing agricultural production capacity in several other regions around the world, notably in Sub-Saharan Africa – including Ethiopia, one of the countries we studied.

4.2 Brazil is not a major grain importer, but it has entered into a special bilateral arrangement with Argentina in order to provide wheat imports and help protect itself against volatility in global grain markets, should the need arise. India is essentially self-sufficient in terms of grain production, so no such special measures have been taken with regard to bilateral agreements. Therefore, India is left more vulnerable as it experiences its own production losses.

4.3 For the larger countries with diversified national economies (e.g. United States, Russia, China, etc.) and large foreign reserves (e.g. China) there are unlikely to be major macroeconomic consequences resulting from the food price shock. Food price rises and inflation may be likely, but considered manageable. Russia, for example has a diversified economy, including mining, industrial, chemical, agricultural, etc. In contrast, some smaller countries (e.g. Egypt) may have to go (further) into deficit as the government seeks to maintain affordable staple food prices (in Egypt's case, wheat / bread) in the face of rising international market prices.

4.4 There is a dichotomy of approaches by national governments – those that have faith in the market mechanisms / liberalized trade (e.g. United States, Europe) and those that are focusing more on self-sufficiency (such as India) and others at various points along the spectrum between the two extremes (such as Ethiopia, where the Government believes in both control and working with the free market). For many of the emerging economies, the pathway they choose to embark on is likely to have significant impacts on the global agri-food production systems.

4.5 Policies related to issues such as genetically modified organisms may be tested under shock conditions for some countries. For example, if there was a severe reduction in global soybean production for export, China may consider using genetically modified soybeans for domestic production (currently, China imports genetically modified soybeans, but doesn't allow domestic production of GM soybeans). Similarly, Europe is currently endeavouring to maintain itself as a non- GMO destination, but there are concerns about keeping pace with yield increases by countries using GMO crops.

4.6 An interesting hypothetical for the shock scenario is whether exporting countries would continue to honour pre-arranged trade agreements with their trading partners or whether they may renege in favour of their own national food security concerns.

4.7 Some importing countries with sufficient reserves (e.g. China) could temporarily become limited exporting nations to take advantage of higher traded prices.

Economic

5.1 The economic impact of a global grain production shock for a particular country is directly related to exposure to the global markets and the food share as a proportion of household expenditure. Those countries with high dependence on imports and where a high proportion of household expenditure is on food could see extreme economic impacts in terms of poverty, food subsidy costs, macroeconomic consequences, balance of payments, and inflation.

5.2 In general, the larger the country and the more diversified the sources of GDP, the lower the national macroeconomic impacts and the greater capacity to finance recovery efforts in response to the shock. For example, large foreign reserves and a diversified economy would mean little impact of the shock for China, while in Egypt the national budget deficit would be significantly impacted and inflation would be severe because food prices make up a sizeable component of the inflation 'basket'.

5.3 Agri-food production has varying degrees of reliance on prices of other globally traded commodities, such as oil. For example, Saudi Arabia's capacity to purchase imported food products is linked to its export of oil. If food prices increase enough, oil exporting countries may try to maximise their income through oil to ensure they are able to continue to purchase food for import. Large countries such as Brazil and Russia must often transport agri-food products great distances (using fossil-fuel based transport systems) from production areas to port facilities. In turn, shipping costs are also influenced by fossil-fuel costs. Countries such as China have greater issues for oil importation than agri-food commodities.

Nutrition

6.1 There is likely to be limited impact on dietary quality and micronutrients, but generally in the negative direction. Furthermore, it is the most vulnerable, such as marginalized communities and women and children that generally seem to suffer food insecurity that could be caused by such a shock. In some countries, micro-nutrient deficiencies are already present, and could be exacerbated by the shock.

6.2 Obesity is paradoxically on the rise in many countries that also suffer from food insecurity, particularly where there is a food system focus on calorie rather than nutrient provision. For example, on one hand Egypt is suffering from high obesity rates and on the other also anaemia and stunted growth. There are efforts elsewhere[2] to develop quantitative metrics for measuring "sustainable nutrition security," an advance that will be helpful for better quantifying such impacts.

6.3 A debate occurring in countries such as Brazil is about the marginalization of household diets and food security vulnerability, particularly as there is a strong focus on only a few crop products. There can be an impoverishment of diets focused too much on the major grains. Countries such as India and Egypt have micronutrient supplement programs in an attempt to address chronic micro-nutrient deficiencies.

6.4 Some substitution of crops may occur. For example, in Brazil wheat could be substituted with maize, yucca or cassava. In Brazil, alternative crops such as black beans could provide three harvests per year to help in response to a shock, versus the four main grains which typically provide only one major harvest annually. China, which is highly reliant on imports of soybeans for livestock production, may seek alternative feedstocks such as wheat, rice, etc. Similarly, there may be a shift in consumption from pork to poultry, or even to fish.

6.5 Changes in imported feedstock for animal production in Europe could lead to reduced poultry production and a shift to grass-fed cattle and pigs, or a shift to aquaculture. Like China, Europe (and Russia) could also see a shift of production towards potatoes. In Egypt there could be a shift from wheat to maize or beans. In India, some marginalized communities could shift to survival foods such as roots, tubers and forest produce while most others would expand their spending on food to procure staples. In Saudi Arabia, domestically produced livestock and forage crops may be substituted through poultry production and/or imported products.

6.6 Famine is not expected to occur in the majority of the countries as a result of the shock scenario. However, if food production remains low due to ongoing weather impacts beyond 6 or 12 months, after which buffer mechanisms such as reserve stocks, market availability, etc. may become exhausted then impacts will become more severe. For countries such as Ethiopia, which has been historically more vulnerable to famine than some other countries, market mechanisms and associated internal distribution effectiveness / efficiency have improved but access to the international food relief system will be vital. In the case of severe disruption to local availability of food, populations may

2 *"Quantifying Sustainable Nutrition Security with Food System Metrics," ILSI Research Foundation, link.*

seek food from alternative sources which could lead to more significant issues over a medium to long term. For example, an increased use of bush-meat could lead to increased risk of exposure to diseases including Ebola.

Environmental

7.1 A shock in food price would send a strong economic signal for the increased production of all foods, meaning there is likely to be an immediate increase in land use, where available, for crop production although of course these do not see production increases for a number of months. In some countries, such as Ethiopia, expansion may occur into marginalized lands previously avoided due to issues such as periodic flooding, poor infrastructure and disease prevalence – hence their longer term sustainability may be questionable. In Russia, much agricultural land has been left fallow in recent years (an estimated 70 million hectares) and could be brought back into production (at a high cost). Deforestation is possible in countries such as Brazil through expansion of soybean and livestock production areas and in Ethiopia if commodity prices remain high. Increased land degradation, habitat and biodiversity loss are all likely with increased land conversion.

7.2 Other environmental impacts of food production would be increased through more intensification of production, such as the increased pressure on freshwater extraction, increased greenhouse gas emissions, increased non-renewable energy utilization, and eutrophication (among others). Some countries already contain highly intensified production systems (e.g. United States, China) while others (e.g. Ethiopia, Russia) have opportunity to increase irrigated areas and modernize technological inputs. In particular, expansion of irrigated agriculture can cause additional stress to both groundwater and surface water resources. Some issues have arisen in Brazil where water is appropriated for private use rather than being treated as a public good.

7.3 An interesting counter-case may be in Saudi Arabia, where increased costs of imported feedstock grains may reduce domestic production of livestock and shift to a greater focus on imports. Also, in Egypt and India a shock could promote more efficient use of natural resources (e.g. water, energy, land) which could be beneficial in the post-shock period.

7.4 Agricultural production is having significant environmental and social impacts in countries such as Brazil, particularly related to large-scale agriculture monocultures, which can have acute localized impacts on water and land resources which affect local communities. Monocultures may also increase the risk of production shocks including those associated with outbreaks of plant diseases.

7.5 In many cases, environmental impacts may worsen where greater political sway is given to food security and to powerful voices from the agribusiness sector. For example, in Brazil the debate during the shock may be whether to increase national income by seizing an opportunity to export more agri-food and livestock products or to focus on addressing environmental concerns. In Europe, payments to farmers to maintain their land in sound environmental condition could potentially be superseded, despite some binding regulations, if farmers decide they can earn more income by planting biodiversity areas with crops under increased market price conditions.

7.6 These environmental impacts could be felt for a much longer time than the initial production shock. In particular if increased intensification or land conversion causes a local environmental tipping point to be passed these impacts could be irreversible. If, for example, a drought impacts the microbiology or nutrient cycling of an area then the production shock could be felt for a much longer period of time resulting in lower production in subsequent years with consequent impact on food prices. Seeking alternative food sources, such as from fisheries, or switching crops away from livestock could also have much longer terms impacts if fish stocks are depleted or a large portion of livestock culled.

Future trends

8.1 The situation in most countries is unlikely to be dramatically different in 2026. However, even a small increase in international trade or a change in the geo-political balance of net importers and exporters could have a dramatic impact on a possible price response to a production shock.

8.2 China is expected to become more reliant on international markets, particularly for maize and soybeans. By 2026, China is also likely to move further towards trade liberalization. Overseas land acquirement is occurring but would likely only ever be a small proportion of grain supply for the country.

8.3 Countries such as Brazil and Egypt, are considered to be at moments of transition, where their capacities to respond to a hypothetical shock in 2026 may be greater or may be lessened depending on national development trajectory. Much of this may be dependent on the macroeconomic situation of the respective national economies.

8.4 By 2026, Egypt may have embarked on a massive project of improving irrigation systems to achieve better value for resources used. Egypt may have also expanded agriculture development into unused desert areas (with proven groundwater resources) to reduce reliance on food imports – seeking up to 50% increase in total national agricultural land. Egypt also needs to invest heavily in supply chain improvements to reduce grain and other resource wastage (spoilage rates are currently significant). These are ambitious goals with associated environmental costs (e.g. increased fertilizer use) and fraught with uncertainties about future irrigation water availability. However, if Egypt can achieve these measures by 2026, the hypothetical shock impacts could be lessened.

8.5 In Ethiopia, the major trend over the next decade is expected to be substantial economic growth, with the economy becoming less dependent on agriculture. Food consumption will constitute a smaller proportion of total household consumption. Most consumers should be better able to deal with a shock because they will be wealthier (perhaps 2x current income levels if growth rates continue). However, there may be some displacement of small-holders that could lead to local tensions.

8.6 In Saudi Arabia, a shift away from water intensive domestic grain (including) forage and cattle production to poultry and imports may occur. Locally influential communities, such as the Bedouins may continue to influence national politics.

8.7 In Russia, there is expected to be greater clarity on national strategy on decreasing dependency on imports.

8.8 In the United States, both calorific production and proportion of household income spent on food may have been optimized, so there may be a shift to focus on nutritional compromises. Biofuel policies are expected to remain. Some crop production will shift northwards as a result of climate changes. The United States will continue to adopt a market trade approach.

8.9 Climate change over this ten-year timeframe is unlikely to have a detectable signal. However, India is highly dependent on monsoon patterns for rainfall (not glacier-fed water sources) and agricultural system productivity is linked to those patterns. How adversely monsoons are effected by climate change could be a significant factor for India, as will the degree to which India successfully integrates its commodities into international grain markets and it reforms land tenure policies.

8.10 Another major variable is what happens at the climate change negotiations in Europe later in 2015. If we end up with global decarbonisation deals, then agriculture will have to start to bear its share of reductions. This could have consequences for the use of inputs such as nitrogen fertilizers, influencing yields and resilience. At a national level, Brazil is currently introducing a National Plan on Climate Change[3], which is expected to provide guidelines for promoting measures for adaptation to climate change in Brazil.

3 *This plan is in the phase of finalization and aims to bring together the guidelines for promoting measures for adaptation to climate change in Brazil, addressing costs, effectiveness and benefits of the measures suggested. It is expected to be published in 2015. Fundaco Grupo Boticario, 22 January 2015*, Brazil will have a National Plan on Climate Change, *http://www.fundacaogrupoboticario.org.br/en/news/pages/brazil-will-have-a-national-plan-on-climate-change.aspx*.

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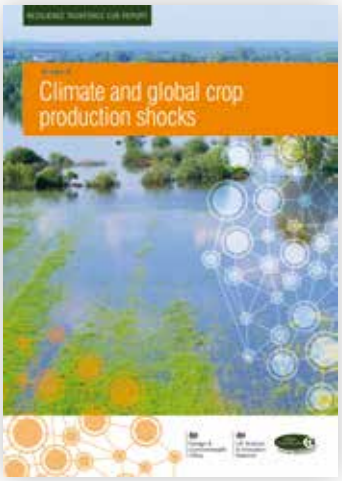

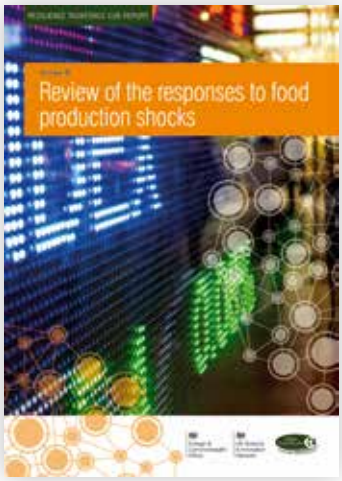

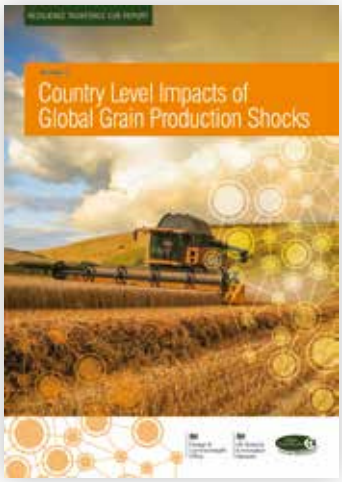

Global Food Security
Sustainable, healthy food for all

Global Food Security (GFS) is a multi-agency programme bringing together the main UK funders of research and training relating to food. GFS publications provide balanced analysis of food security issues on the basis of current evidence, for use by policy-makers and practitioners.

For further information please visit:
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This report has been developed in partnership with the following institutions.

Anglia Ruskin University

The James Hutton Institute

ILSI Research Foundation

University of Reading

Foreign & Commonwealth Office

UK Science & Innovation Network

Appendix A: Interview Questionnaire on Country Level Impacts

Background

The UK-US Taskforce on Resilience of the Agri-Food System to Extreme Weather Events was recently established. The first meeting was held in October 2014 in Chicago and looked at plausible worst case scenarios of disruption to the global agri-food system caused by extreme weather events (such as floods, droughts or wind storm). The Taskforce is supported by the UK Foreign & Commonwealth Office Science and Innovation Network (SIN) and UK Global Food Security Programme (GFS).

The aims of the taskforce are:

- To improve understanding of how changing extreme weather events (severity, type, frequency, geographical impact) may impact on global food security.
- To identify how market and policy responses may exacerbate or ameliorate these effects.
- To improve understanding of how combinations of disruptions to food production and policy and market responses impact on global food security and food system resilience.
- To produce a series of recommendations for policy-makers and industry leaders, outlining what optimal responses to plausible extreme weather worst-case scenarios could be.

Three sets of drivers are being developed around possible disruption pathways:

(i) 'Climate/Weather Events' will explore how large shocks in agricultural production could occur (floods, droughts, wind storms);

(ii) 'Impacts' will explore how society responds to high food prices or limited local availability; and

(iii) 'Responses' will specify the most plausible and likely policy and market response pathways that will result in the global food security impacts based on the crop reductions.

This questionnaire focuses only on the Impacts drivers.

Hypothetical Food Shock Scenario

Consider a 2016 production shock due to drought in North America resulting in 10 % losses to maize and soybean. Simultaneously, there is a similar production shock due to heat across Eastern Europe into Russia and China causing a 10 % loss in wheat and an 8 % loss in rice. Export and customs restrictions are put in place with no change to biofuel mandates. Public food stocks are marginally above 'normal' prior to the shock but are not released in response to the shocks quickly enough. Prices for the major grains are above historical shock levels (2008 and 2011) by up to double (for example, wheat is at double today's prices and five times the level of pre-2007 lows) leading to the FAO food index being at 200 (40 % higher than historical shock levels).

Semi-Structured Interview Questions

General

1. What would be the general impacts of the hypothetical scenario on local food market conditions in your country?
2. Would the food system in your country recover quickly from these events or would there be structural changes, for example loss of processing capacity that would take longer to recover from?
3. If food prices change, would those changes in price and availability lead to people seeking alternative food sources?

a. If yes, then what are these likely to be?

Government & civil response

Internal responses:

1. Recognising that the food price shock of 2008 led to civil unrest in many countries, do you think there could there be such an impact in your country in response to the hypothetical scenario?

Related to that:

a. Are there particularly marginalised or vulnerable groups who would be most likely disproportionately affected (e.g. by high food prices and / or lost livelihoods)?

b. Are there existing political or social schisms that such tensions might exacerbate?

c. Are there domestic radical movements that might capitalise on civil tensions?

d. How would the Government likely respond to heightened levels of civil disturbance?

2. How might internal migration or displacement of populations be impacted?
3. Would there be any impacts in neighbouring countries that could lead to impacts in your country?

External responses:

1. What action if any might your country take in response to key supplier countries (who imposed export bans or restrictions?)
2. Are your country's food supply routes dependent on key transit nations (for over-land) or maritime choke points (for sea-shipment)?
3. What geopolitical manoeuvers might your country make to protect its interests in the midst of such a scenario? e.g. control of key exports (not just food), control of sea lane or transit routes?

Economics & finance (public and private)

1. Is it likely that the changes in food prices will have a significant impact on poverty in your country? Is food normally subsidised and would you expect subsidization policies to change during the hypothetical scenario?

2. Will there be macroeconomic consequences for your country? For example:

a. Where food imports/exports are significant there may be implications for balance of payments and exchange rates?

b. Would you expect inflation to be impacted and as a result would there be changes in national monetary policy?

Nutrition

1. How would the changes in local conditions impact on the quality of the diet?

a. Could the overall level of calories consumed lead to famine?

Could there be any micro-nutrient deficiencies that would arise or worsen?

b. Would there be any groups in society that would be particularly affected?

Ecosystems/environment

1. How might the price shock and responses influence land use changes?

a. Would it lead to an expansion of agricultural area?

i. If yes, into what sort of land? (forest / marginal / grasslands etc.)

b. Would it lead to additional intensification of agriculture?

2. What might the consequences be on water or land use following the price shock and government and civil responses?

3. Would the changes in food price and availability have any consequences on implementation of environmental policies?

Future trends

What would be (up to three) major changes that would make your previous responses completely different if the hypothetical scenario occurred in 2026.