Chokepoints and Vulnerabilities in Global Food Trade

chathamhouse.org/ 27 June 2017

https://www.chathamhouse.org/publication/chokepoints-vulnerabilities-global-food-trade

Policymakers must take action immediately to mitigate the risk of severe disruption at certain ports, maritime straits, and inland transport routes, which could have devastating knock-on effects for global food security.

Key findings

- Trade chokepoints – maritime, coastal and inland – pose an underexplored and growing risk to global food security.
- Maritime chokepoints will become increasingly integral to meeting global food supply as population growth, shifting dietary preferences, bioenergy expansion and slowing improvements in crop yields drive up demand for imported grain.
- Rising trade volumes, increasing dependence on imports among food-deficit countries, underinvestment, weak governance, climate change and emerging disruptive hazards together make chokepoint disruptions – both small-scale and large-scale – increasingly likely.
- Climate change will have a compounding effect on chokepoint risk, increasing the probability of both isolated and multiple concurrent weather-induced disturbances.
- Investment in infrastructure lags demand growth: critical networks in major crop-producing regions are weak and ageing, and extra capacity is urgently needed.

Recommendations

- Integrate chokepoint analysis into mainstream risk management and security planning - for example, government agencies should assess exposure and vulnerability to chokepoint risk at the national and subnational levels.
- Invest in infrastructure to ensure future food security - for example by agreeing on guidelines for climate-compatible infrastructure through an international taskforce established under the G20.
- Enhance confidence and predictability in global trade - for example, through a process under the World Trade Organization (WTO) to continually reduce the scope for export restrictions.
- Develop emergency supply-sharing arrangements and smarter strategic storage, e.g. an emerging response mechanism among major players in the global food trade, modelled in part on that of
the International Energy Agency in oil markets and led by the UN Food and Agriculture Organization (FAO), the UN World Food Programme (WFP) or the Agricultural Market Information System (AMIS).

- Build the evidence base around chokepoint risk - including through the collection of data on real-time food trade and infrastructural capacity to aid in assessing risks to food supply chains.

Further Reading

- Read more about chokepoints in global food trade at www.resourcetrade.earth
- Take a closer look at chokepoints and food security threats in an interview with a report author and experts in related fields
- Discover the 5 things you need to know about chokepoints
- Explore what the Qatar crisis tells us about food supply risk (in The New Arab)
Key maritime chokepoints in global food trade

55% of global trade in grain is shipped through at least one of these

There are 8 key maritime chokepoints*

11% of global trade in grain relies on a maritime chokepoint with no viable alternative

Trucks loaded with grain are parked on the shoulder of the highway leading to the port city of Paranagua, Brazil. Unions and grain exporters shut down the port in a dispute that has blocked soybean shipments from the world’s №2 bean producer for a fifth day.
Which countries do you think are most at risk and why? Does this vary between low-income and high-income countries?

**Conor Walsh:** Climate change is a global process which means it will manifest everywhere but what this means will be different depending on the regional context. I think regions which are likely to exhibit both population increases and more severe climate change impacts are at the greatest risk, such as in northern and sub-Saharan Africa and in the Middle East.

Examining the trends in population, consumption and potential climate change impacts suggests that countries such as Egypt and Nigeria, for example, could actually become almost wholly import-dependent by 2050.

In contrast, regions such as Russia and Canada may potentially benefit from increases in cultivable land. In 2016, we saw how increased production in regions such as Russia allowed for Russian wheat to levy a competitive advantage and erode the market penetration of US wheat in African markets such as Nigeria. However the costs and damaging impact on its domestic sector resulted in Nigeria capping/begrenzen wheat imports at a certain level. Nonetheless, Russian wheat exports continue to expand, with significant movement through the Bosphorus straits. But the net gain under climate change is highly uncertain.

**Laura Wellesley:** Yes, the level of risk varies between high- and low-income countries. There are import-dependent, high-income countries such as South Korea and Japan, who really need to consider the
dependency of their food imports on a small number of chokepoints. But being high-income countries, they have the capacity to cope with a potential supply shortage: they have the financial capacity to source imports from elsewhere and they’re able to support their populations at risk.

In the case of low-income, food deficit countries, that’s not the same. The vulnerabilities are much higher because at both the national and household level the spending on food from total available financial resources is extremely high and the options for accessing higher priced food – when we see a food shortage, we tend to see food prices rise – is limited. There is an existing level of high food insecurity that could be easily worsened or tip a food insecure population into crisis.

**Does the changing climate and political or social instability affect the threat of disruptions to chokepoints? How?**

**Conor Walsh:** Certainly. Ports or centres of production play a vital role in most modern economies and therefore serve a strategically important function during periods of unrest. We have seen how political tensions in Libya, intensified by water stress, resulted in oil terminal ports being seized by rebels in 2011 and 2016 and exports being disrupted. Similarly the increasing cost of grain prices as a result of the Russian export embargo in Egypt prompted protests, as the subsidizing of wheat was unable to compete with the resultant price increase due to supply chain difficulties.

The stresses associated with the availability of basic commodities such as wheat and water can exacerbate the socioeconomic conditions which imperil supply chain functioning such as piracy.

**Laura Wellesley:** For me, climate change will particularly threaten chokepoints. The risk of climate-related disruptions to chokepoints will rise as climate change worsens but climate change is also expected to have a risk multiplying effect on political and security hazards. We’re looking likely to see more conflicts over land and water and scarce resources, but also a greater risk of countries imposing protectionist measures when their own food supplies are threatened.

At a global level, protectionism will put pressure on prices and limit supply if lots of countries follow the same path. We saw that in the 2010 food crisis where there was a really rapid contagion of export controls that was really the issue rather than a supply shortage.

**Andrew E. Tucci:** Sea level rise and severe weather events will have a significant impact on ports and waterways, for example, rising sea level
can flood port terminals and make passage of large vessels under bridges impossible. Social and political instability therefore weakens the governance structures and institutions that must plan, fund and execute the infrastructure and other measures that can reduce the impact of these changes.

**Are there particular recommendations in the report that you think should be the priority for national governments, the international community or industries?**

**Conor Walsh:** I would argue that the recommendation to invest in infrastructure to ensure future food security is a critical policy priority especially in a changing climate. Conventionally, trends of increasing import dependency might not be seen as terminally dangerous in the face of historic growth in yields and crop production; however, under a future in which climate change impacts are manifested and yields cannot keep pace with consumptive demand, additional infrastructure will be necessary to minimize the impact of supply chain disruptions.

**Laura Wellesley:** I think in the first instance there’s a really urgent need for governments and the international community to better assess and understand the risks. Until now the importance of chokepoints and the physical infrastructure to global food security has been largely overlooked and until we understand the risks, it will be difficult to manage these risks. So I think the immediate priority is to establish mechanisms, working groups, task forces at the national and international level to figure out just how dependent we are on chokepoints. How much of a risk do they pose and where do the major vulnerabilities of different populations lie?

Beyond that, the other priority is investment: ramping up investment in infrastructure that is fit for the future so it can withstand climate change and cope with the rising volume of trade. This report looks particularly at North America, South America and the Black Sea, and each of these regions has proved unfit so far.

**Andrew E. Tucci:** For me, national and international governance is key. The global supply chain is remarkably resilient, but that resilience has its limits. Chokepoints are testing that resilience on a routine basis and can contribute to acute shortages in food supply when all is not well with the world. Those shortages can lead to human suffering and instability. Sound governance can minimize the likelihood of trouble at a chokepoint occurring and will help facilitate a quick, orderly response when chokepoint-related disruptions do occur.
In your field, how have chokepoints been considered until now? How have the risks of chokepoint disruption been managed and does this now need to change?

Conor Walsh: Within climate change research, chokepoints have rarely been analysed as an issue itself, other than as an indicator of unsustainable consumption. I believe it behoves us to examine the implications of significant and regular disruptions to supply across several vital trade routes for essential commodities, and not merely look at these individually. The role of chokepoints serves as a timely and fiercely relevant consideration when discussing climate change. Additionally I believe there needs to be additional global efforts to circumvent market failures that might become commonplace when climate change impacts become more severe. What happens when transit through very difficult but increasingly vital chokepoints becomes inviable? This is a matter of humanitarian urgency and failure to prepare for worst case scenarios risks regional stability.

Laura Wellesley: In the sphere of food security, the chokepoint risks that we’re looking at in our report really haven’t featured in research or government strategies up until this point.

In the context of developing countries, the need for infrastructure investment and greater market connectivity, both within national borders and across international markets, has long been recognized and has been a priority for multilateral banks and donor agencies and civil society – but there has been very little attention paid to the importance of infrastructure in middle and advanced economies that are the breadbasket regions of the world.

Andrew E. Tucci: In slight contrast, in my coast guard work, there have been many activities related to strengthening our chokepoint resilience, including protection of critical infrastructure, building governance at the multilateral, bilateral and local level, and in contingency planning and emergency operations related to restoring maritime commerce after a disruption to a chokepoint, and we are continuing to work on this area.
How do you see the insights in this report being used by those in your field? What opportunities do you see for learning across sectors, disciplines and geographies to boost the resilience of the global food trade?

**Conor Walsh:** This report gives practical examples of the broad and potentially unexpected ways in which climate change vulnerability will be manifested. Dependable supply of materials in the future cannot be relied upon, and I believe the points raised in this report advocate for viewing climate change adaptation in a wider context to include the full gamut of measures which will reduce the risk of our over-reliance on chokepoints – including seeking to keep passages free and supply sustained.

I see the main opportunity for learning – with regards to resilience – is a greater awareness across sectors of the indirect implications of climate mitigation. For example it may not be apparent to horticulturists or agricultural scientists that seeking domestically grown, more climate tolerant alternatives to cereals, for example, may have a tacit benefit in alleviating reliance on the transit of imports through a chokepoint for grain trade.

**Laura Wellesley:** I hope that the insights of our report will be taken forwards by a range of actors in the field of food security in assessing national dependence on food imports and infrastructural chokepoints, and also on the strategic global importance of bottlenecks among governments in breadbasket regions in advanced economies.

Equally important is for the research community to build on this initial assessment and draw on a range of expertise from network analysts to transportation networks, to insurers and investors to figure out the next steps in building resilience and managing the risk of chokepoint disruptions. The international community has a major role to play both in encouraging investment in resilient infrastructure and in better governing the political and security risks that threaten chokepoint operations. So, for example, designating critical food security corridors where they exist and setting up shipping lanes that really need to be kept open to avoid a major food emergency as well as the supervision of those corridors by the UN World Food Programme, could then form the basis of more normative agreements between states to work together in the case of a disruption and protect the passage of critical food supplies.

In terms of learning across sectors, we argue that the energy sector has long recognized the market risks posed by maritime chokepoints like the Strait of Hormuz – and one of the ways that major oil exporting and importing countries have sought to manage the risks of chokepoint disruption has been through the International Energy Agency’s emergency
sharing mechanism, by which countries are required to maintain a certain level of oil reserves that are then released in an agreed way in the case of a supply shortage. Whether that will work for food is a difficult question, and there have been major concerns in oil sector over whether countries will share their resources if their own supply was threatened. So any kind of agency that seeks to set normative and non-binding rules to administer chokepoint risks will need to take into account the potential for protectionist trade measures by countries.

**Andrew E. Tucci:** Chokepoints are not simply vulnerabilities to the abstract concept known as food security – they are vulnerabilities to human beings around the world too. This report highlights that we have a moral obligation to work towards common solutions. The good news is that as we work towards improvements in food security we can use the focus on chokepoints to draw in other stakeholders and leverage our efforts in other areas of local, regional and global cooperation.
Recent events highlight concerns about the risks to global food security posed by changing patterns of extreme weather affecting the world’s ‘breadbasket’ regions such as the American midwest, South America’s southern cone, the Black Sea and the Yangtze River valley. In 2012, the worst drought to hit the US midwest in half a century sent international maize and soybean prices to record levels. In 2011, wheat prices nearly doubled after an unprecedented heat wave devastated the Russian harvest. The global food price crisis of 2007-08 had its roots in a run of poor harvests in previous years.

Global food security largely depends on the production of a few ‘mega-crops’ in the breadbasket regions: maize, wheat, rice and soybeans. On the whole, the system works well. International trade provides a global market for these specialized production centres, reducing the cost of food for billions of people by allowing agriculture to flourish where it can be most efficient. Trade also allows countries to meet unforeseen production shortfalls through imports, as Britain did in the summer of 2013 after floods spoiled the winter wheat harvest. But when extreme weather ruins the harvest in a breadbasket region, that’s not just a problem in the country affected, it’s a problem for all importing countries.

Of course the risk to the world’s food security doesn’t arise simply from bouts of bad weather. Weather’s impact can be compounded by the actions of governments and markets. Governments can make things much worse when, for example, they try to shore up domestic food supplies by banning or limiting agricultural exports, further pushing up international prices. The 2007-08 crisis saw over 30 governments impose export restrictions in a spiral of rising prices and collapsing market confidence; the 2011 wheat spike was amplified when Russia turned off exports.

Likewise it is becoming clear that severe weather shocks rippling through the food system can ignite wider instability. During the 2007-08 crisis, protests erupted in 61 countries and turned violent in 23. In the wake of the Russian heat wave, the price of bread was one of several grievances behind the Arab Spring. Once shocks to the food system spill over into other areas, they can cascade through economic and political systems with sometimes devastating consequences.

**Global food instability**

Amid these pressures, the global food system is coming under increasing strain, as highlighted in a recent report that we wrote in conjunction with other British and American experts for the UK-led Global Food Security programme. Rising incomes and changing dietary preferences mean demand for food is growing faster than cereal yields.
Water scarcity and soil depletion present challenges for agriculture, which faces sharper competition for resources from urbanization and energy production. A precarious supply-and-demand balance means the system is easily unbalanced.

The stability of the global food system faces risks from the increasingly frequent extreme weather that is being driven by climate change.

ψ For example, in the United States there were more than four times more weather events causing damage in excess of $1 billion (in 2011 prices) in 2007-11 than in 1980-1985.
ψ Drought is a particularly powerful driver of global food shocks. Two episodes stand out: in 1988-89, when maize and soybean were seriously affected in the US Midwest, and in 2002-2003, when rice and wheat were hit in Eastern Europe and western Asia.

Were these two events to happen in the same year — a multiple breadbasket failure — it would result in the loss of between 5 and 10 per cent of the production of these major crops, more than enough to supply the basic calorie needs of the United States for a year.

Ω Until recently, such a calamity would have been expected every 100 to 200 years, but this number is shrinking rapidly due to climate change.
Ω An initial analysis of recent data suggests that the risk of a 1-in-100-year event during the second half of the last century is likely to increase to 1-in-30 years by 2040 — and perhaps even 1-in-15 years in the decades after 2050.

A multiple failure in the world’s breadbaskets in the same year is, in our view, a plausible worst-case scenario for today. In fact, by the end of the century such an event may occur every few years unless emissions are reduced overall, and what is grown and how it is grown is adapted to the changing climate.

Such a crisis would almost certainly be compounded by export restrictions, panic buying and hoarding, driving food prices to new heights.

Ω This would be particularly serious for the food-importing countries of the developing world, especially in sub-Saharan Africa.
Ω The shock would come at the economic level, in the form of inflation, balance-of-payment difficulties and budgetary pressures, and it would strike at the human level in increasing poverty; in the developed economies, consumers would feel the pinch as grocery prices climbed.
Of even more concern, however, would be the spread of the crisis from food markets to political systems in the world’s geopolitical hotspots; fragile countries could be destabilized, especially the major grain importers of the Middle East and North Africa.

Given these predictions and warnings, what needs to be done?

- Agriculture must of course be adapted to a dramatically changing climate: declines in yield growth need to be reversed.
- This requires significantly more research and development investment to increase maximum attainable yields and to expand agricultural extension services.
- Additional investment is needed to reduce the environmental impact of farming and to bolster its ability to withstand climate change.
- In addition, vulnerable countries can shore up their food security through policy measures to insulate their populations from market shocks.
- Such efforts include holding strategic stocks, raising national production to reduce import dependency and improve self-sufficiency, and 'buying forward' to lock in future import prices.
- The greatest challenge will be to make the global food system far more resilient.
- Rules limiting the use of export barriers will become vital if a functional trading system is to be maintained.
- Biofuel policies will also need to be reformed by making mandates flexible, so that biofuel use falls when food prices rise, or by limiting the use of staple food crops in biofuel production when food demand outstrips supply.

I hate biofuel!

Recent multilateral efforts to improve the quality and availability of key market data, such as food stock levels, can help governments anticipate crises and avoid panic.

But improved climate and economic modeling is needed to understand the risks and assess how best to manage them. Armed with this knowledge, governments, international organizations and businesses could engage in contingency planning, set up early-warning systems and coordinate the management of strategic stocks.

International food shocks exacerbated by extreme weather events can affect millions of people in countries around the world. Taking smart and practical steps to ease the impact of the changing climate on food supplies is vital to ride out the droughts and storms that will impact food prices.
• Sustainable food self-sufficiency is unattainable for the countries of the Gulf Cooperation Council (GCC).

• Domestic production meets only a small proportion of needs, yet consumes significant economic resources and almost monopolizes water use.

• GCC food security rests on international trade, leaving countries exposed to price risk (relating to volatility of import prices) and supply risk (relating to import disruption).

• Recent events such as the 2011 Arab uprisings, continued instability in Egypt and Syria, threats by Iran to close the Strait of Hormuz and repeated spikes in international food prices have sharpened these risks.

• The worst-case scenario is conflict in the wider Middle East and North Africa region that disrupts multiple import routes for a sustained period. GCC governments can hedge supply risks through strategic storage and investments in port and rail infrastructure to create a regional import and transport network.

• Land-based investments in food-insecure countries with weak governance and poor rural infrastructure do little to manage price or supply risk. Overseas investments are better targeted at existing farm operations in key trade partners.

• GCC resource wealth mitigates price risk.
• In the long run, the ability of governments to manage price risk will depend upon successful economic diversification.
Agricultural Commodity Supply Chains: Trade, Consumption and Deforestation

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Private-sector commitments and government policies, a loss of support for biofuels, and health concerns over the consumption of palm oil and beef, are factors that may help to restrict the further expansion of agricultural land into forest areas.

Clearance of forests for agriculture is a major cause of deforestation worldwide; The three most significant commodities in this regard are **palm oil, soy and beef**, which between them accounted for an estimated 76 per cent of the deforestation associated with agriculture in 1990–2008.

International markets are an important driver of demand, particularly for palm oil and soy.
- **palm oil**
  - Global production of palm oil has grown strongly for several decades, more than doubling over the period 2000–2013. Indonesia and Malaysia between them account for more than 80 per cent of palm oil production, and are likely to continue to dominate world exports.
  - The European Union (EU), India and China are the main consumers, importing almost 60 per cent of the market;
  - EU demand is driven significantly by biofuel policy, while India and China use palm oil mainly as a cooking oil and in processed foods.

- **soybean**
  - Global production of soybeans has roughly doubled since 2000, and the expansion of output has been particularly rapid in South America; Brazil and Argentina accounted for almost 50 per cent of global production in 2013.
  - Overwhelmingly the main importer is China (which took 43 per cent of all soy imports in 2014), mainly for animal feed for its growing meat industry.
  - The EU is the second largest importer, using soy for animal feed and biofuel.
  - In contrast, consumption and production of beef has grown only slowly. Major producers are the US, Brazil, the EU and China; principal exporters are Brazil, India, Australia and the US.
  - The US and the EU are still major consumers, although – as in most developed countries – consumption is falling slightly; other significant consumers include Brazil, India, Pakistan and China. Russia and Japan are also significant importers.

- **Three main factors underlie the growth in both consumption and production of palm oil and soy:**
  - Population growth;
  - Changing dietary preferences; and
  - Policy support for biofuels.

- The first two are just as relevant to beef.
- Continued growth in world population and the expansion of the global middle class, with accompanying higher consumption levels of processed food and meat, will continue to drive demand upwards – strongly for palm oil and soy, more weakly for beef.
- Given the difficulty of increasing yields, particularly in developing countries, the further expansion of agricultural land into forest areas is inevitable.
- None the less, three other factors may restrict this growth:
  - The private-sector commitments and government policies that are being developed with the aim of
    - Decoupling agricultural production from deforestation;
    - A loss of support for biofuels, most notably in the EU; and
    - Health concerns, particularly over the consumption of palm oil and beef.