#### <u>Ukraine & Global Food Crisis of 2022:</u> <u>Mitigating Food Insecurity</u> By Marcus S. Snow Peacekeeping and Stability Operations Institute Carlisle Barracks, PA

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#### Abstract

Russia's invasion of Ukraine set the wheels in motion for the Global Food Crisis of 2022. As epicenters of world food, fertilizer, cooking oil, and gas production, the removal of Russian and Ukrainian exports created an enormous supply shock sending food prices soaring. The least resilient and food insecure nations were hit the hardest.

The rise in prices prompted an increase in alternative sources of supply, but only after several difficult months. The gap was partially filled by exhausting existing food and cash reserves as well as extending credit. On the diplomatic front, the signing of the BSGI also proved instrumental by allowing at least a portion of blockaded food supplies to be exported. For its part, the US government response was dramatic: extending aid, resources, and credit. That said, with many resources exhausted, the risk of a future food crisis remains concerning. Food supply shocks are best understood through a pricing perspective and resiliency efforts best assessed by their ability to place downward pressure on food prices. The Food Supply Shock model provides a useful tool for planners to understand, shape and assess their actions. Rather than being proscriptive, planners can assess actions and activities based on how they can address the pricing issue, and thus open an array of creative and non-standard solutions. Traditionally, USG efforts have relied on the Diplomatic and Development aspects of foreign policy to address food insecurity. This is understandable given the nature of the task to build resiliency in fragile states. That said, Defense has an important and underappreciated role in preparing for the next food supply shock. It's unique suite of defense stability tasks can provide significant downward pressure on food prices.

#### **Keywords**

Food insecurity, resiliency, Ukraine, Russia, invasion, sea lanes, wheat, grain, sunflower oil, cooking oil, fertilizer, supply shock, supply chain, Food Crisis, Black Sea, ports, security assistance, security cooperation, stability, stabilization, famine, instability, piracy, shipping, sanctions, world food program, FEWSNET, USAID, import dependency, Gulf of Guinea, Global Fragility Act, food prices, fragile states, International Monetary Fund (IMF), USAID, President's Emergency Plan for Adaptation and Resilience (PREPARE), U.S. International Development Finance Corporation (DFC), Feed the Future, Roadmap for Global Food Security, Food Import Financing Facility (FIFF), debt, commodity prices, Horn of Africa, Chicago Board of Trade, Natural Gas, Interagency Conflict Assessment Framework (ICAF), Maritime, anti-piracy, risk, Benin, Tanzania, USS Hershel "Woody" Williams, embassy.

## **Introduction**

Russia's invasion of Ukraine in Feb of 2022 was a disaster on multiple fronts. The trauma and damage inflicted on the Ukrainian people are well-known and documented. The disruption to oil and gas flows imperiling the safety and productivity of European economies is also well understood. Less well known, and perhaps the most fatal, was the global food supply shock which resulted in the severe food crisis in the summer of 2022 and whose ill effects endanger the lives of millions even now.

Before the war, Ukraine and Russia were among the world's most significant producers of food staples and fertilizer exporters. Many of the poorest and most food-insecure nations heavily depended on Russian and Ukrainian wheat, cooking oils, and fertilizers. Indeed, Russia and Ukraine were the discount food suppliers to many of the globe's neediest people. The war initially turned off that supply and then reduced it to a fraction of its former volume. Prices soared to levels that made food virtually unaffordable to many. The food prices settled down by the end of summer as trade agreements and alternate sources fought to fill the supply gap- albeit at a higher price. The pre-war discounts were off the table, replaced by higher cost sources and lower volumes. All of this became a gut punch to struggling nations.

Food availability is always an important issue, compounded when nations are less resilient. Russia's invasion of Ukraine blocked or prevented food exports which in turn made this issue more serious. To offset market shortfalls, many countries were forced to exhaust what food, cash, and credit reserves they had to see through the worst of the supply shock. The United States and the international community have stepped up admirably to address the worst effects of the supply shortage. Still, the situation is precarious, and many existing mitigation resources have been depleted.

The threat of broad famine in the summer of 2022 has largely receded, but it must be acknowledged that we dodged a bullet. Weak financial and food reserves as well as insecure supply chains leave many nations one more supply shock away from starvation or instability. Perversely, the most numerous victims of the war in Ukraine may very well be in Africa as malnutrition works its evils. The stability of critical nations in Africa and our Global Fragility Act (GFA) partner nations is at risk. The US response ought to be as robust as the problem is profound.

To soften the blow of supply shocks like the one triggered by the invasion of Ukraine, the United State maintains a solid set of institutions and programs to encourage resiliency building in developing or at-risk nations. US efforts are primarily implemented through just two of the three "D's" of foreign policy (Diplomacy, Development, and Defense).

Diplomacy, through the Department of State, strengthens international institutions which provide financing and broker the international cooperation needed to solve problems. Development, through USAID, provides not only immediate aid relief but promotes the conditions for enduring resiliency at the local level. USAID and the Department of State lead the US response, however, Defense has a significant and overlooked contribution to building resiliency and alleviating food insecurity.

The US military can play a crucial role as well. An array of stability tasks are available to military planners that can make a significant impact on reducing food insecurity. The military is uniquely positioned to reduce the cost of food by assessing and removing the risks and obstacles which drive up its price. The US military can ensure freedom of navigation, secure lines of supply, train security forces, remove bad actors, and share intelligence. Indeed, there are a variety of creative military stabilizations solutions available to military planners across the Joint force. In short, the military can help get a sack of wheat from point A to point B safer and more cheaply than it could otherwise- whether we do it or enable our partners to do it.

The invasion of Ukraine and subsequent supply shock should serve as a wakeup call for planners across the US government. While the worst of the crisis has subsided, it is no time for complacency. It is a call to better understand the background of the crisis, to learn the dynamics of food supply shocks, and to understand how to apply scarce resources towards building resiliency and stability.

To this end, the paper is broken into two broad parts. Part I provides the background needed to understand why the food crisis of 2022 happened. It reviews the pre-war role of Ukraine and Russia in food supply and the dependency many nations had on this supply. It then looks at the supply shock following the Ukraine invasion, its impact on global food prices, and the toll it has taken on vulnerable populations. Lastly, it looks at where we are now and the international response to the date of this publication.

Part II explores ways to address the problem, describes the dynamics of food insecurity, and provides a conceptual framework. It looks a food supply shock model and indicates the effect of external assistance on nations in a state of crisis. This section also identifies some sticky wickets for planners to keep in mind- that is- economic conundrums where the unintended consequences of otherwise reasonable actions that may contribute to adverse effects. Finally, we will examine ways the military can respond and complement USAID and Department of State efforts.

The invasion of Ukraine shone on a spotlight on the precarious state of global food insecurity and revealed key vulnerabilities that led to a supply shock. This destabilizing challenge must be understood, resiliencies developed, and the full range diplomatic, development, and defense tools applied to the task.

# Part I: Understanding The Food Crisis of 2022

- Situation Pre-War
- Invasion of Ukraine: Supply Shock and Food Crisis
- Where things stand now

#### **The Situation Pre-War**

Russia and Ukraine are global heavyweights in the supply of export cereals and fertilizer. Prior to the war, over 20% of the world's export cereals departed from Ukrainian and Russian ports on the Black Sea and passed through the Dardanelles straights<sup>1</sup>.

Understanding the scale of the world's food supply traversing the Black Sea shipping lanes is imperative. To appreciate this scope, the following charts from the Food and Agriculture Organization of the UN (FAO) are revelatory.

#### Production

The first chart below details the Russian (yellow) and Ukrainian (green) shares in selected crop production over the last five years. In short, Ukraine and Russia produced over half of the world's sunflower seed oil (an essential cooking oil), over 20% of the world's barley, and nearly 20% of the world's wheat<sup>2</sup>.



#### Share in global production of selected crops (2016/17-2020/21 Avg.)

From FAO's "The importance of Ukraine and the Russian Federation for global agricultural markets and the risks associated with the current conflict," 10 June 2022 Update.

#### **Food Exports**

More importantly, Russia and Ukraine produce far more than they consume and comprise an even larger share of exports than their already significant share of production. Below you can see that Russia and Ukraine export over 25% of the global wheat supply, nearly that much in barley, and about 15% of the world's maize<sup>3</sup>. The figure below illustrates the 2021 share of global exports in wheat, barley, and maize held by Russia (yellow) and Ukraine (green):



From FAO's "The importance of Ukraine and the Russian Federation for global agricultural markets and the risks associated with the current conflict," 10 June 2022 Update.

#### **Cooking Oil Exports**

The story of cooking oil production is even more dramatic. Russia and Ukraine account for nearly 70% of the world's sunflower seed oil and a significant share of rape seed and rape seed oil. These oils are widely used for cooking, and food manufacturing and many nations are highly dependent on Russian and Ukrainian sunflower oil. Unsurprisingly, shortages of sunflower oil led to surging prices in alternative vegetable oil prices<sup>4</sup>. The chart below indicates Russia's (yellow) and Ukraine's (green) share of global exports in seed oils:



From FAO's "The importance of Ukraine and the Russian Federation for global agricultural markets and the risks associated with the current conflict," 10 June 2022 Update.

#### **Fertilizer Exports**

Aside from serving as a primary source of food staples, Russia is a critical contributor to the global fertilizer supply, the same commodities which allow other nations to maximize their food production. As seen below, Russia (yellow) is among the top exporters of the three primary export fertilizer commodities<sup>5</sup>.





#### **Black Sea Shipping Lanes**

The enormous volume of food, fertilizer, and seed oil (not to mention oil and gas) exported by Russia and Ukraine must go somewhere, and it essentially must travel through the Black Sea. The graphic shows ship traffic lanes prior to the war<sup>6</sup>. As you can see, shipping is heavily



NAVSEA III Black Sea shipping traffic lanes

concentrated along two main lanes, with a large concentration in the west coming from Odesa and along the western coast and an eastern concentration coming from Novorossiysk and the Kerch straights. The Russian Naval base at Sevastopol in Crimea is well positioned between the two and can protect Russian and/or interdict Ukrainian shipping.

#### **Import Dependency- Fertilizer**

To appreciate the importance of the Black Sea exporters' importance in fending off food insecurity in at-risk nations, consider the oversized role that Russia and Ukraine play in supplying some of the most fragile states. The charts below illustrate the dependency that existed before the Russian invasion. Seven nations fill over 50% of their fertilizer needs from Russia, and five GFA nations (Ghana, Cote d'Ivoire, Guinea, Mozambique, and Benin- in yellow) are highly dependent on Russia<sup>7</sup>. This does not mean that alternative sources are not available, but it does mean that Russia provides the most affordable price for these nations, and finding new sources will add time delays and increase costs.



Fertilizer Import Dependency, net importers, 2021 (%)

From FAO's "The importance of Ukraine and the Russian Federation for global agricultural markets and the risks associated with the current conflict," 10 June 2022 Update.

#### **Import Dependency- Wheat**

Even more alarming is the number of food-insecure nations dependent on Russia and Ukraine for their wheat. Twenty-Six nations get more than 50% of their wheat from the two Black Sea combatants, including three GFA countries. East Africa, particularly, was extraordinarily dependent on wheat from the Black Sea, with Eritrea and Somalia importing an enormous share of their wheat from Russia and Ukraine<sup>8</sup>.



From FAO's "The importance of Ukraine and the Russian Federation for global agricultural markets and the risks associated with the current conflict," 10 June 2022 Update.

#### **Food Insecurity Pre-War**

As of Jan 2022, food-insecure nations heavily dependent on Russian fertilizer and Ukrainian wheat and vegetable oil were already experiencing instability. With low cash reserves, a poor current account balance, higher than average food prices, drought, and a population already using a large part of their income for food staples, many of the poorest nations were already teetering on the edge of calamity and, therefore especially vulnerable to higher food prices. Sadly, the number of those facing acute food insecurity has soared from 135 million to 345 million since 2019. A total of 50 million people in 45 countries are teetering on the edge of famine.<sup>9</sup> The illustration below from the Famine Early Warning System Network (FEWSNET) gives a sense of the food insecurity situation at the end of 2021 and the estimated need for 2022. Prior to the invasion of Ukraine, FEWSNET estimated that 105 million people would require humanitarian food assistance in 2022<sup>10</sup>.



#### Invasion of Ukraine: Supply Shock and Food Crisis

The Russian invasion of Ukraine sent shock waves around the world. None were quite as harmful as the impact of the war on global food prices. Indeed, the bulk of the human suffering resulting from Putin's ignoble invasion may have fallen on the heads of destitute groups in Africa, where soaring food prices sent millions into famine. While it is hard to say at the moment with any clarity, it is not speculative to predict that more children will die in Africa from the invasion of Ukraine than will be the case in Ukraine. Bullets and bombs kill retail. Famine is a wholesale murderer.

To appreciate which countries the global food crisis hurt the most, the chart below illustrates the number of people in acute food insecurity in hotspot countries. It highlights the early warning from the United Nations (FAO-WFP) on acute food insecurity during the worst period.



Number of people in acute food insecurity in hotspot countries

Hunger Hotspots FAO-WFP early warnings on acute food insecurity June to September 2022 Outlook

#### **Food Insecurity Worsened**

Food insecurity is a complex problem stemming from several factors: climate effects, high energy costs, internal conflicts, mismanagement, lack of diverse food sources, and even rapid growth and development. Many nations, particularly in the conflict zone and the drought-stricken Horn of Africa, were especially vulnerable to acute food insecurity before the war. Supply shocks created by the war in Ukraine lower near-term global food availability and dramatically raise prices. More stable countries can pay more for food and are inconvenienced by the higher prices. Price fluctuations have a more significant impact on fragile and at-risk countries.

Many of the poorest nations in Africa were highly dependent on food staples (cereals) and fertilizer from ships that passed through the Black Sea, whether their cargos were Ukrainian, Belarusian, or Russian in origin. The chart below shows which countries were affected the most by the closure of the Black Sea<sup>11</sup>.





Famine Early Warning Systems Network

#### **Sanctions Cut Exports**

The chart below shows how Western sanctions reduced various Russian export commodities during three different periods during the crisis. Note that Russian exports are down as well. While sanctions exempt foodstuffs and agricultural inputs, the international community does not want to be seen dealing with Russia. For their part, Russia uses export restrictions as a weapon particularly with fertilizers and wheat<sup>12</sup>.

# Imports from Russia by reporting importers, 2022 versus 2021

Percent change



88 reporting importers. Items (iii) include the nutrient contents of Chart: Joe Glauber & David Laborde • Source: TDM

#### **Pricing as an Indicator**

Problems with supply chain management can cause prices to soar. For instance, the removal of 20% of the world's wheat export supply sent prices to new heights, doubling in weeks. LNG based fertilizer prices nearly tripled, and sunflower oil doubled.

Let's turn to how pricing is a key indicator highlighting how much progress (or lack of progress) is being made in the global food crisis. The war impacted prices in two distinct ways. First, it sidelined or destroyed agricultural production in Ukraine; less food was produced. Next, it severely disrupted the food supply chain; less food was exported. Of the two, the supply chain disruption was the most severe—quite a feat considering the large areas of prime Ukrainian farmland that was rendered unusable. Despite the production limitations, Ukrainian grain is still backlogged at ports and storage sites.

# **Production Damaged**

A June 2022 damage assessment of Ukraine by the World Bank (chart below) found that over 20% of the funds needed for recovery would be for land decontamination<sup>13</sup>. That is the removal of mines, unexploded munitions, and battle damage cleanup required to make land usable. Farmlands constitute the largest areas to be decontaminated. A further 5% of the recovery funds needed were assessed due to direct damage to agricultural capital and infrastructure<sup>14</sup>.



Total needs as of June 1, 2022: US\$349 billion; World Bank assessment team.

Of note, this damage assessment was published on 1 Jun 2022- after the extensive damage from the initial invasion, but before the September counteroffensive and subsequent fierce fighting n Kharkiv, Kherson, and Bakhmut. Nor does this assessment consider Russia's missile campaign against Ukrainian infrastructure. Still, it gives an idea of the scope of the damage done to Ukraine's agricultural productive capacity.

Most interesting is that while production was hindered, it was not the critical factor in limited grain exports. Instead, damage to the transportation network and blockading key ports was the primary source of export reduction. The Ukrainian transportation network was assessed as slightly more damaged than the land contamination and remained the leading sector damaged in the assessment period. Grain was still grown, but it had difficulty getting to ports, and when it got there, it found overfilled storage facilities and no ships able to leave the port. More than any other factor, the Russian blockade of Ukrainian ports prevented food from getting to where it was most desperately needed. With the Black Sea turned into a mined warzone, grain, cooking oil, and fertilizer exports ground to a halt. It cut both ways, as Russian cargo ships found it too risky. Lloyd's of London would not insure the vessel in a war zone. This reduced the number of ships to those few willing to ship food without insurance.

# **Sea Lanes Threatened**

The threat of sea mines and possible direct attack by belligerent forces threatened the major global artery, the Black Sea. Even now, the war has imposed a significant risk premium on the price of shipped goods, leaving few viable alternatives for moving available grain.



# Mine danger areas in the Black Sea

#### Overland routes weren't enough.

The sharp reduction in the maritime shipment of food meant that the developing world needed to find alternative routes. In terms of supply chain management, alternative routes were far less attractive. Rail and road networks support only 10% of pre-war export levels at a higher cost. Differing rail gauges and inadequate storage and transfer facilities make overland routes unfeasible in the near future. Costly, time-consuming infrastructure buildout is needed.



# Alternative routes for Ukrainian grain

## Warnings of Disaster

At its height, the food crisis elicited dire warnings of famine. Prior to the BSGI, Russia's blockade of Ukrainian ports left an estimated 25 million tons of grain backed up in silos, and there were grave concerns that it would spoil if not exported<sup>15</sup>. Indeed, the Department of State released a statement that Russia was weaponizing food and endangering the world's access to critical food resources. <sup>16</sup>

WFP projected that, due to the disruptions and price spikes from Russia's invasion, the number of acute food insecure people could increase by 47 million in 2022<sup>17</sup>. Moreover, FAO simulations projected an increase in the number of undernourished people globally could increase by between 7.6 and 13.1 million people in 2022/23 because of the ripple effects of the conflict<sup>18</sup>.

#### **Global Response**

As noted, the Food Crisis peaked in the summer of 2022 but has since improved. Several factors went into mitigating the worst of the crisis. The Black Sea Grain Initiative (BSGI) was one of the more important actions which brought the crisis down from its peaks. Brokered by the United Nations, the BSGI allowed Ukrainian and Russian ships to export food again. US aid efforts led by USAID helped alleviate some of the worst suffering, as have other international aid and relief efforts. Finally, the price spike spurred increased production elsewhere and, with some delay, gave hope that additional supplies of food from alternate sources would be able to refill quickly, emptying grain reserves.

#### **Black Sea Grain Initiative**

Shortly after the war started, the Black Sea became a war zone. Shipping effectively halted. Under pressure from its export markets, Russia proved amenable to talks to end its blockade of Ukrainian ports and allow grain and fertilizer to flow. With help from the United Nations and with Turkey serving as an inspector, a deal was brokered in July of 2022, allowing Ukraine to resume food exports. Millions of tons of grain were able to be exported through the Black Sea. Part of the BSGI included direct shipments to the most food-insecure nations. The BSGI initially ran for 120 days but was renewed this November again. The FAO credits the BSGI with reducing food prices every month that it has been in effect. Due to the success of the BSGI, there is concern that Russia may withdraw or refuse to renew it, which would create a new supply shock all over again.

#### **US Response led by USAID**

The US Government's response to the Food Crisis has been robust. In addition, the US Government maintains a long-term development focus. USAID has committed over \$10.5 billion in aid in response to the global food security crisis. Much of this has been immediate humanitarian assistance and direct food aid. With the acute drought in the Horn of Africa on top of the Ukrainian war, USAID has more than doubled its funding commitments in FY22.

After the BSGI was signed, USAID supported shipping 210k tons of Ukrainian grain directly to those in urgent need. This complements the Agriculture Resilience Initiative (AGRI) in Ukraine to bolster agricultural production and exports. The initiative focuses on delivering critical farm inputs, improving the supply chain, and increasing access to financing for the agriculture sector.

Considering the extraordinary circumstances, USAID and USDA drew out the entire balance of \$282 million from the Bill Emerson Humanitarian Trust to purchase and ship US food to countries suffering from severe food insecurity.<sup>19</sup>

With an eye towards long term, sustainable results, the US Feed the Future Initiative harnesses several agencies of the US Government and works to solve food insecurity in several areas. It has targeted getting fertilizer into the hands of communities that need it most and supporting farmers with alternative fertilizer strategies. Beyond emergency assistance, the program emphasizes increasing agricultural capacity and resilience by working with small farm holders to protect their food security and improve their resiliency to supply shocks.<sup>20</sup>

Within the Feed the Future framework, the U.S. International Development Finance Corporation (DFC) provides loans, equity financing, and other services that help expand businesses and build credit in emerging markets. This enables small farmers to access affordable insurance, crop inputs, and training to maximize yields. Through financing, farmers can increase their earnings and expand production even in the face of shocks.<sup>21</sup>

The President's Emergency Plan for Adaptation and Resilience (PREPARE), a climate resiliency initiative, provides long term development assistance to at-risk farmers to better respond to droughts and manage resilient farms. This summer's food supply shock added tremendous impetus to longer term programs like PREPARE.

Feed the Future works with vulnerable communities to access import tax waivers on vitamin and mineral premix and equipment. This reduces the cost of fortified foods in the country and helps to safeguard nutrition for communities.

At the height of the Food Crisis this summer, Secretary of State Antony Blinken led efforts to galvanize global efforts to combat food insecurity. He convened a UN ministerial meeting to prompt action on the global food crisis and called for countries and stakeholders to join a new Roadmap for Global Food Security. It is still to early too know what concrete actions will come of this, but the attention on the subject is encouraging.

#### **Financing the Gap**

In late September of this year, the International Monetary Fund (IMF) approved a new temporary Food Shock Window under its emergency financing instruments. This allows additional access to emergency financing for countries that might not otherwise be able to obtain it. To further assist with obtaining financing during acute food price shocks, the FAO proposed a Food Import Financing Facility (FIFF) to help ease immediate food import financing costs.

The importance of this type of financing cannot be understated. Nations with poor current account balances, low foreign currency reserves, and poor credit are not able to obtain credit through normal market processes. They are "bad bets" from a credit and lending perspective. Their poor financial condition (self-induced or otherwise), make them exceptionally vulnerable to food shocks as they cannot compete for food imports in a rapidly escalating food price environment. It should be no surprise, but nations with healthier financial profiles can endure a food bidding war. Alternatively, those with unhealthy financial profiles find themselves without a chair when the music stops.

This is where financing support comes in; whether through the IMF, through USAID, or any of a variety of financing regimes created by international organizations. External financing regimes allow fiscally unsound nations to obtain credit for food when they would not otherwise be able to. Not only are at risk nations afforded the extension of needed credit, but they are given these at below market rates (for their credit profile).

The upside to this is that it allows precious food to reach distressed populations who would otherwise be in grave jeopardy without it. The downside is that it can build dependency, fiscal irresponsibility, and layer additional debt burdens on already strapped economies. On balance, the negatives of below-market financing regimes are outweighed by the humanitarian positives of famine reduction and a resultant less malnourished population.

# Where things stand now

Fortunately, the global food crisis is now less severe. A good indicator of improving food security is the decline in the spot price for wheat and other agricultural commodities. That said, current food price levels remain elevated above norms over the last decade. It is not too bold to say that we dodged a bullet in the summer of 2022. Food insecurity remains precarious. The time to prepare is now. It will also take some time for resiliency programs to fully take effect. Moreover, the ongoing drought in the Horn of Africa, internecine conflicts, persistently high fertilizer costs, the exhaustion of food and cash reserves, and the unresolved war in Ukraine place many areas at risk. They remain one supply shock away from famine and gross instability.

# **Food Prices**

To appreciate the rise and fall of food insecurity, the chart below illustrates the spot price of wheat futures over the last two years as quoted on the Chicago Board of Trade (CBOT). It is an excellent way to understand the recent history of the global food crisis and helps us understand where we are with food prices. Of course, wheat is not the only staple food commodity in play,



but its pricing is largely indicative of overall food pricing and thus is a useful measuring stick. Note that prices edged up in the months prior to the Russian invasion and were already higher than prior year pricing. The war in Ukraine caused an immediate spike in prices as buyers reacted to the real and perceived loss of grain shipments and fertilizers that originate in that vital agricultural corner of the world. Prices soared both because of the feared loss in production in Ukraine's farmlands, but also ports and shipping lanes were shut down due to naval action and sea mines as well as the inability of shippers to purchase insurance.

You can see the equally dramatic drop in prices as buyers considered: a) Ukrainian battlefield victories preserved significant parts of their agricultural heartland, b) international assessment teams were able to accurately survey the war damage in those productive areas, and c) Russia was pushed to the negotiating table to first, cease hostile actions against food shipments and then, enter into the Black Sea Grain Initiative to allow the grain to flow. Interestingly, Russia was pressured not only by the West but also by their African and Middle Eastern grain customers, who were alarmed and threatened by the loss of grain imports.

Perhaps most instrumental was Turkey, a regional economic and military powerhouse, which saw its food prices soar by nearly 400%. While the US was unwilling to take direct action, and western NATO members were unable to, Turkey possessed the will and capability to take stern action against Russian interests. As a result, wheat prices have returned to those found at the beginning of the year- much lower than the summer peak, but still elevated over historic norms.



The Economist

#### Key Input Pricing: Natural Gas

It is also important to understand how prices in the global food supply are interconnected with prices in the oil and gas industry. To highlight this interconnection, we've included a chart which illustrates the spot price of natural gas over the last two years as quoted on the Ney York Mercantile Exchange (NYMEX). Natural gas is a key fertilizer feedstock and directly impacts future food production volumes and pricing. Fertilizer accounts for 44% of food commodity cost<sup>22</sup>, and natural gas accounts for "90% of the variable costs in fertilizer production<sup>23</sup>. Shocks to NG and, thus fertilizer have a wide impact on future food prices. This chart has some differences from what we saw with wheat prices. First, we see that while natural gas prices skyrocketed with the invasion and decreased following the Black Sea Grain Initiative, they were further affected by the Nord Stream pipeline explosion. They have since returned to more normal but elevated levels as alternative (but more expensive) sources come online. Aside from the possible cold winter for many Europeans, the higher natural gas prices bode ill for fertilizer costs and, thus, higher future food costs.



#### Production and Exports are still down

The various causes of the global food crisis we cited earlier sharply reduced Ukraine's grain exports. The chart below shows a sharp fall in the volume of Ukrainian grain exports between pre-war and wartime environments. Also, despite the Black Sea Grain Initiative, production and exports are severely down in 2022.



Black Sea = exports reported through the Black Sea Grain Initiative. Grain exports include barley, maize and wheat. Other exports available only through August 2022.

Chart: Joseph Glauber • Source: COMTRADE; UN Black Sea Grain Initiative as of 28 October 202

# PART II The Food Shock Model and the Role of the Military

- **Creating a Pricing Framework:** 
  - Understanding Pricing
  - Food Shock Model
  - Sticky Wickets (Catch-22's)
- Increasing Resiliency: The Role of the Military

# Food Insecurity- a Pricing Perspective

As we move from the global food crisis towards strengthening global food security, it is important to understand the underlying economic dynamics at play. In this regard, the production of food staples is demand-driven, like all commodities. Production can and will meet demand, but severe supply shocks introduce two critical caveats for low-income countries.

First, price is the key demand signal. Producers are highly responsive to price signals and will grow more (or less) food staples as prices fluctuate. High prices are a sublimely elegant mechanism to achieve more food production. With higher production, prices tend to settle back down to previous levels. This occurs daily, with food production slowly expanding as the population rises and food costs slowly winding downwards over long periods.

The next caveat in the face of a severe supply shock is the time lag between the new demand signal (higher prices) and increased supply (via increased production). Unlike the supply of the proverbial widget, food staples have a multi-month time delay from sowing to reaping...and then add shipping. It is the period between the increased demand signal (price goes up) and the eventual increase in supply wherein lies the rub. Nations interested in feeding their population (that is to say, most but not all of them) have three choices: one, maintain adequate storage infrastructure and supply (to include alternative food staples) to see them through the high prices, two, maintain adequate foreign reserves or lines of credit to purchase food staples at the inflated prices, or three maintain a robust domestic production capacity sufficient to cover minimal needs.

Regarding the first choice, nations lacking robust food storage infrastructure are disadvantaged to be price takers. With empty or insufficient silos, they lack the capacity to navigate supply shocks. They are forced to exhaust scarce foreign currency reserves or stretched credit lines to buy essential food staples at inflated global spot prices. Adequate food reserves allow countries to purchase futures contracts at a time, quantity, and cost of their choosing. Ideally, more than three months of supply are needed to weather the worst supply shocks.

For some high-income countries, maintaining the sufficient financial capacity to outbid their neighbors remains a compelling and reasonable option. After all, severe supply shocks are few and far between, and the costs of maintaining market inefficient local production or extensive and expensive food storage facilities may exceed the premium paid during the relatively short periods of high food prices. Indeed, three to six months of exceptionally high prices for food staples may very well be the value option compared to decades of domestic agricultural subsidies.

Lastly, maintaining an adequate domestic production capacity for food staples remains viable, though it is no panacea. Clearly, many nations (even the US) favor subsidizing their agricultural sectors. Aside from producing enough to fend off starvation, food staples can be valuable exports increasing national revenues. What's not to like? For one, planting food crops may mean forgoing higher revenues derived from cash crops or diverting resources from more productive economic activities; revenues which can buy cheaper, higher quality food staples from more agriculturally efficient neighbors or global suppliers. Of note, when food prices are at their highest, there is a devilish temptation for states to export food staples amid a crisis to maximize state revenues. A Machiavellian leader might think, why give away something so valuable to the destitute in my country when I can sell it at a premium to outsiders with the financial where withal to do so?

#### **Prices follow markets**

Because food staples are commodities, prices tend to be essentially fungible such that even nations that can produce their supply of food are affected by increased food prices. Local production is a traditional and effective tool for staving off the worst aspect of food insecurity, but that does not mean that they are immune from the pricing function. The food produced becomes more marketable and valuable as an export. Given the fractured markets and geographies of much of Africa, increased pricing means that more food is exported from those areas adjacent to ports to other countries willing to pay higher prices. Thus, it is reasonable to expect that parts of a nation may be experiencing a food crisis while other parts actively export food to neighboring countries. This isn't necessarily the result of bad actors within a state. Rather, it is the natural consequence of the pricing function- moving commodities towards easy to access markets with the ability to pay the going market rate. Poor regions far from ports and good roads are unable to pay the market price plus the transport and risk premium without external subsidies.

The pricing mechanism does not address the consumers who simply cannot afford higher prices. Unlike virtually everything else on the market, food staples are extraordinarily inelastic in price; consumers will give their last dollar not to starve. Unfortunately, the last dollar of household income comes shockingly fast for millions of families in the lowest income states. The result is that the poorest are simply outbid on food staples. High prices are inconvenient to most but potentially lethal to the poorest.

## Food Supply Shock Model

To better understand the dynamics at work in the global food crisis, it helps to review a model of the mechanics at play. The Food Supply Shock Model provides a simplified illustration of some major factors.

This simple model looks at the price of staple foods over time. To the bottom left is the presupply shock food price (generally). A blue line along the chart indicates the pre-shock price levels for comparison. Above that is a notional "National Resiliency Line." This red line represents the capacity of a nation to replace, buy, or finance food imports during a supply shock. This line varies for each nation and over time as finances, grain storage levels, credit rating, and development progress change.

Once food prices exceed the National Resiliency Line, internal resources are presumed to be exhausted, and the nation is in a food crisis. It simply cannot pay for more food and needs external assistance from food aid, subsidies, or loan guarantees.

The supply shock will keep sending prices up rapidly. The higher prices send a powerful demand signal to producers to increase production, and they will start to do so. Growers will plant more for future harvests, and suppliers with grain reserves will release them, given the premium price they fetch. The process of increasing supply isn't quick, however. A food supply shock can send a nation into a food crisis for months or longer. As new supply becomes available, prices are driven down.



Time

Source: "Food Supply Shock Model: Snow, Marcus, PKSOI, Dec 2022

A new post-shock price is settled but often higher than the pre-shock price. In the Ukrainian supply shock, for example, there is still risk associated with the future of the BSGI and concerns

about the recovery of Ukrainian agricultural production. There are also concerns about the future pricing of fertilizer.

What that means is that all things being equal, the post-Shock price is closer to the National Resiliency Line than the Pre-Shock Price. That is, the next supply shock will send at-risk nations into crisis sooner and more deeply than before. The period following a supply shock is especially vulnerable for at-risk nations.

The solution, of course, is to take action to raise the National Resiliency Line and reduce pricing both before and after a food crisis.

#### **Determining National Resiliency Line**

Determining a National Resiliency Line is a complex task beyond the scope of this paper. Given the myriad variables, questionable data, and difficult to quantify effects of efforts to increase resiliency, it won't ever completely be known. It is better to view it as a fuzzy conceptual line.



This is even more so when you consider it is not the actual national line but rather a regional line. In truth, many nations in food crises have regions that are doing quite well, while others may be in severe distress. This is, in part, why Pricing was chosen. It is easily quantifiable, and the ability of a nation to buy or finance purchases is a matter of considerable transparency.

That said, several areas can help tell the story of where a nation stands in its resiliency. For example, the ability to fund or finance food in an emergency is critical to resiliency. The robustness of grain reserves and the internal distribution network are also fundamental.

# Sticky Wickets (Catch-22s)

Inevitably, any complex problem entails responses that undermine or counteract other solutions. Initiatives meant to solve one aspect of a problem can exacerbate another aspect. Some refer to this as a double-edge-sword, and economists refer to it as the law of unintended consequences. Sadly, there are no easy answers, just effects that must be carefully considered.

#### **Sanctions Boomerang**

An unfortunate side effect of the sanctions imposed on Russia is their adverse effects on heavy food- and energy-dependent nations struggling with food insecurity. The Russian sanctions deliver a double gut punch to struggling countries. Western sanctions limit the supply of oil and gas on the global market. This drives prices up. Oil plays a critical role in the transportation of agricultural products through the global supply chain. Thus, any increase in fuel cost necessarily raises the price of foodstuffs for the poorest households.

Transportation is not the only connection between the oil and gas industry and food. Fertilizer is essential to maximize yield and, thus, the volume of food production. The oil and gas industry produces fertilizer. When the price of fertilizer rises, food production falls, and food prices rise.

In this regard, natural gas is the key input into the creation of much of the world's fertilizers. Indeed, absent natural gas based fertilizers, global food production would plummet catastrophically. It is not a stretch to say that absent natural gas based fertilizers, the current world population would be unsupportable. Fertilizers are the unsung heroes of the green revolution. The sustained price hike in LNG, driven in large part by the sanction regime against Russia, is keeping the cost of growing food unsustainably high.

As mentioned previously, oil and gas exports are down, raising food shipping costs and precluding other nations from producing more LNG based fertilizers. Cereals and fertilizer exports are also down considerably as private firms are skittish about dealing with the sanctioned and pariah state of Russia. Russian ships are uninsurable, and Lloyd's of London is unlikely to pick up Russian commodities. To be sure, goods still flow at a reduced pace and are more expensive to boot.

Western sanctions had a limited impact on Russia early in the war. The West thought sanctions on Russian energy would also be a double-edged sword and hurt consumers. More recently,

newer Western sanctions on Russian energy exports started to have a more severe impact on the Russian economy, weakening the Russian war machine.

If the law of unintended consequences is shown anywhere, it is with sanctions. It is still unclear how badly oil and gas sanctions harmed Russia's balance sheet, but the supply shock of the cuts made life more miserable in the poorest countries. The negative stigma associated with sanctions on Russia carried over to non-sanctioned items, dropping net exports of wheat and fertilizer. Leaving aside their dubious efficacy as a tool of coercion, the collateral damage of sanctions on Russia has been malnourishment and starvation in Africa.

The moral implications of warfare- purposefully killing other humans- are rightly well considered and fretted upon. The moral implications of sanctions- which have much the same effect- are an afterthought.

#### **Green Initiatives**

Another area perversely contributing to the global food crisis is the numerous Green initiatives meant to mitigate climate change. Reducing poverty and starvation must, at least temporarily, outweigh reducing oil and gas production. In a grim reminder of the law of unintended consequences, green policies *designed to reduce the damage wrought by climate change*, raise the price of food, and exacerbate famines.

Production limitations on LNG, for example, raised fertilizer costs and had the same effect as the sanctions on Russia. Decommissioning vast swathes of Dutch and German farms removes some of our planet's best and most agriculturally productive land from contributing to the global food supply. Green initiatives meant to help have not always factored in the other side of the balance sheet. That is: lost productive capacity coupled with increased production and transport costs yield soaring food prices and exacerbate food insecurity.

Make no mistake- this isn't a call to end green initiatives, but rather a call to examine the unintended consequences of driving up prices on the key feedstock for the current global fertilizer supply. There are several promising carbon capture initiatives which bypass natural gas and create fertilizer such as biochar. Optimistically, this is a "sticky wicket" which may very well have a technical solution in the near future.

#### Insulating vs. Supply Shock weakens Ukraine

As markets find ways around the dramatic loss of Ukrainian and Russian exports, those two nations become less relevant to the global food supply. Indeed, given the instability of the Black Sea region, buyers, being risk adverse, will seek to secure more reliable sources of supply. As nations insulate themselves against future supply shocks from the Black Sea, this will make Ukraine decreasingly important to the global food supply. That will mean lost revenues, production, and a prolonged and incomplete recovery. The fantastic Ukrainian farmland will not have changed one iota, but the risk associated with being in a bad neighborhood will reduce the value of Ukrainian imports. That is, so long as Russian remains a malign actor.

#### Local Production Trades One Risk for Another

A natural response to massive supply shocks such as that experienced this summer is seeking national self-sufficiency. That is to say, if a country cannot rely on imports, then it must provide for itself. This is compelling on the surface, but some sharp rocks are beneath these waters. Firstly, by localizing production, a nation transfers supply risk from a global market to a regional one. A nation that is over reliant on domestic production is at risk that a single regional drought, for example, could wipe out its food supply. It is a case of putting all your eggs in one basket. Multiple suppliers spread the risk of calamities out. Thus, as one diversifies an investment portfolio, diversification of food suppliers matters even more.

Next, a program stimulating local production necessarily shifts assets from more productive to less productive sectors. Subsidies, by their nature, move resources to activities a free market would not usually support at the intended levels. This means less net wealth production. Now, subsidies are often used to soften the blows to areas that market neglect or require collective underwriting to unstick, but their overuse can lead to gross inefficiencies.

Many nations cannot feed themselves but possess significant economic reserves to weather virtually any storm. Were they to divert resources from, say, productive manufacturing or tech sector to smallholder farming, the country would suffer grievously. Imagine Singapore or China following such a path. While agricultural subsidies in search of diversification are cogent risk reducing strategies, subsidies to achieve food independence are not.

Another will-o-wisp is the displacement of cash crops for food crops. In marginal cases, this can make sense, but given the purchasing power of cash, higher revenue generating crops are almost always preferable. Wealthy nations can always buy their way out of a food crisis; developing nations cannot. As always, an allowance should be made for diversification, including an overreliance on a single export commodity like some cash crops. That shifts the supply shock risk to another sector.

#### **Over Globalization**

In contrast to everything written above, more than overly market efficient solutions ALSO create weakness to supply shocks (economics is dismal). A hyper efficient trading system has little slack, little in the way of reserves (think "just in time" philosophy), and it is better suited to highly developed and highly redundant economies trading in highly replaceable product sets. When it comes to essential food staples: secure, redundant, reliable, and diversified are the King, Queen, and Royal Court of the match.

The key is to ensure just enough domestic production to preclude the worst effects of a food shock. This is the case even when domestic production is the more expensive option. If, for example, domestic production costs are 110% of the delivered global market price, the 10% subsidy becomes, in effect, an insurance premium. This "insurance premium" protects a nation against external supply shocks. It should be noted that this applies only to that portion of the food supply that are essential staples.

# **Resiliency: Ready to Soften the Blow in Future Crises**

The world community cannot be flatfooted for the next crisis. World leaders need to anticipate future crises and have resiliency plans to be implemented to soften the blows when another food and or gas crisis occurs.

Fortunately, the United States has significant capabilities in this area. State, and USAID in particular, are addressing ways to increase local food production in afflicted areas, build crop resiliency and diversification in the face of climate change, provide emergency food shipments, and are working with international financial institutions to provide below-market financing options to keep grain supplies coming. Still, it is not enough. Defense has a compelling and essential role in amplifying the efforts of Diplomacy and Development. The Defense mission for this is Stabilization.

# The military role in Reducing Food Prices

In this regard, the ability of the US DoD to positively affect the pricing variable in food security is both significant and perhaps underutilized. The key is in decomposing the market price paid by the end purchaser and attempting to identify those variables related to risks, perils, and inefficiencies which the DoD is adept at reducing. It must be understood that the military's role does not need to be overwhelming. The World Bank estimates that every percentage point increases in global food prices push 10 million people into extreme poverty<sup>24</sup>. Even small price reductions can have an outsized positive impact.

This should occur through the engagement continuum- before, during, and after an acute crisis. For example:

- What portion of the final market price of a bag of wheat is attributable to the additional insurance paid by the shipping company to traverse areas with a known or perceived threat of piracy or state threats of physical violence and interdiction?
- What portion goes to pay additional fuel, crew, and maintenance costs for ships making circuitous routes around areas of known o perceived risks?
- What portion of the cost is to offset losses due to graft and theft at port or inland storage sites?
- What portion of the cost is due to wastage or spoilage due to poor transfer or storage facilities?
- What portion is due to inefficient offloading, transferring, and onward movement costs?
- What portion is due to the opacity of risk intelligence (compelling shipping firms to make suboptimal routing and shipping choices)?

Thus, if the spot price of a food commodity as it is loaded on a ship in a port were subtracted from the market price of that same commodity as paid by a consumer in food crisis area, we'd be left with the cost of moving the product from point A to point B. Suppose we further break down the cost of shipping into its components. In that case, we'll find that many of the variables identified in the preceding paragraph can be reasonably estimated or even known and then addressed in detail.

This should be news to no one. Certainly, the shipping insurance industry has been working on identifying these costs for several centuries. Indeed, it has long been known that much of the virtue of Pax Britannica and Pax Americana was in reducing these costs. That said, because it's so well known, it should be an all the more compelling reason for the US and its NATO partners to use defense assets and its array of stabilization tasks to greatly reduce food prices in the poorest and least resilient nations.

It should be noted that while the military is not the primary instrument of the US government to address food insecurity, its role can be instrumental. Given that food insecurity is often driven by small changes in pricing, even actions that shave a few percentage points of price increases can have a significant positive effect. Consider that in some of the most food insecure areas, food spending can account for more than half of household spending. Further consider that in such a stricken area, the household income may only be \$1,000, yr.- with half of that going to food staples. Even a slight reduction in food costs has an outsized impact on household well-being compared to what families in wealthier countries would feel.

A wide variety of joint stability activities are open to the US military throughout the competition continuum to help alleviate the global food crisis. Military planners seeking to make the most significant impact on the global goods crisis will conduct country and even sub-national price decomposition analyses in food insecure areas in close cooperation with their USAID and State partners, identify the variables the joint force can most affect, and then synchronize joint component and interagency efforts.

The Global Fragility Act (GFA) framework provides the geographic focus, the Interagency Conflict Assessment Framework (ICAF) provides a US government common operating picture, and the SAR provides an operational framework. Military planners can then assign joint force components tasks to address each of the variables driving food costs up.

As explored in the basic price decomposition earlier, some stabilization tasks become apparent. Maritime tasks such as freedom of navigation and anti-piracy leap out as activities that readily reduce the risk premium attributable to the final market price of imported goods. Indeed, a wide variety of maritime component tasks positively impact reducing the cost of shipping. Maritime ISR and threat intelligence sharing with shipping firms, insurance companies, and local security forces can be highly effective in helping reduce risk premiums.

According to one estimate by Stable Seas, the cost of piracy in the Gulf of Guinea alone was close to \$ 2 billion in 2021<sup>25</sup>. That is almost 20% of the US commitment to international aid and development. A penny saved is a penny earned and preventing losses like this can go a long way toward mitigating food insecurity. The following illustration highlights in red the areas where piracy is most active.

GLOBAL PIRACY HEAT MAP, 2019



2020 Maritime Security Index, Piracy and Armed Robbery, Stable Seas<sup>26</sup>.

Security Assistance and Security Cooperation tasks supporting port security, facilities improvements, and security force capability development also reduce risk premiums and prevent loss. Given the volume of intra-regional shipping, littoral shipping security and freedom of navigation can be as important as securing the trans-oceanic lanes.

Similar tasks align with air and land force component activities, especially in the Security and Security Cooperation spheres. Assessing, securing, and improving inland supply routes and airports to critically impacted areas are vital and can be whickered into country campaign plans. Demining, route clearance, area assessments, and security force assistance all come into play. Scarce funding sources can best be applied to creating a more secure and robust food supply chain.

If we revisit the Food Supply Shock Model, we can visualize the role played by military stabilization activities. The various price-reducing activities raise the National Resiliency Line and reduce the area of the crisis zone. Given that supply shocks such as that experienced with the invasion of Ukraine carry a residual level of risk, military stabilization actions can mitigate those risks and lower the post-shock price point. To what degree they do this is hard to say, but stabilization activities place downward pressure on prices.



#### Time

Positioning a critical assets such as the expeditionary sea base USS Hershel "Woody" Williams, in the Gulf of Guinea is an excellent example of maritime stabilization actions which increases area security, reduce the cost of shipping, and ultimately place downward pressure on import pricing. Indeed, the Williams is a floating, mobile, food price-reducing asset when it applies itself to anti-piracy, law enforcement support and training, ISR sharing, and otherwise making the maritime and littoral environment safe and secure for local and international commerce.

Security cooperation and security assistance programs which provide littoral patrol craft, training, and support facilities such as was done recently in Benin<sup>27</sup> and Tanzania<sup>28</sup> are other excellent examples where the US military can exert downward pressure on food prices. These are anecdotes of effective actions. A comprehensive approach is needed with an eye towards tracking the pricing results of military activities.

Much of the pricing data is available through the US embassies, and much of the effect can be determined through price surveys at various ports, by USAID or various contracted assessment sources as needed. Did the visit of the USS Williams reduce prices? Probably, but a survey would need to be done. If shippers see the effects of the USS Williams as ephemeral, then, pricing may not have changed. It is reasonable to assume that military security cooperation and stabilization activities as they are now do exert downward pressure on pricing. To ensure these activities are not desultory, however, interagency planning and assessments are required.

To illustrate the effect of military stability, security cooperation, and security assistance tasks have on reducing prices, imagine a supply chain model for food distribution to vulnerable populations. Now imagine the inefficiencies in each node and each link such as security threats, poor transportation infrastructure, corruption etc. Finally, think on how security forces play a role in reducing those risks and how the US and partner militaries can make a positive impact in reducing the risks and inefficiencies which drive up costs.

Supply chains generally follow the most efficient and least risky path from a pricing perspective. Secure, efficient supply chains with few nodes and high volume afford the lowest cost to move an item from Point A to point B. Unstable, inefficient, arduous, risky, low volume, or numerous links in the supply chain add costs or preclude shipment altogether. The additional cost of shipment is a premium added to the price of the good at the final destination. As noted, in the case of food staples, this premium can make food unaffordable to consumers. Poor transport infrastructure, storage facilities, and material handling add to costs. Bribes, wastage, theft, security costs, and insurance add to the price premium paid by consumers.

The chart below provides a picture of the thought model outlined above. A notional five node supply chain is shown: port of export to the port of delivery to a bulk storage site to a distributions point and final to the consumer. The costs are incurred both at and in the link between each of these nodes. The large red arrows show some common factors found in food insecure environments which increase supply chain costs. Military activities can counter or at least mitigate many of the factors driving up costs. The large green arrows illustrate some military activities which lower supply chain costs.



Regardless of the Joint Force Component Stabilization task, various creative, non-standard solutions can be imagined through a food price reduction lens. Risk reduction through security improvements, partner security capability improvements, and threat neutralization come to mind. Activities that improve the efficiency of the supply chain (port assessments, port improvements, road, rail, storage, and transfer) also top the list. Finally, supporting interagency partners with deep wells of functional experience and leveraging partner nation militaries can have a tremendous multiplier effect when tackling the compound problem of food insecurity.

# **Conclusion**

Russia's invasion of Ukraine set the wheels in motion for the Global Food Crisis of 2022. As epicenters of world food, fertilizer, cooking oil, and gas production, the removal of Russian and Ukrainian exports created an enormous supply shock sending food prices soaring. The least resilient and food insecure nations were hit the hardest.

Ultimately, the rise in prices prompted an increase in alternative sources of supply, but only after several difficult months. The gap was partially filled by exhausting existing food and cash reserves as well as extending credit. On the diplomatic front, the signing of the BSGI also proved instrumental by allowing at least a portion of blockaded food supplies to be exported. For its part, the US government response was dramatic: extending aid, resources, and credit. That said, with many resources exhausted, the risk of a future food crisis remains concerning.

Traditionally, USG efforts have relied on the Diplomatic and Development aspects of foreign policy to address food insecurity. This is understandable given the nature of the task to build resiliency in fragile states. That said, Defense has an important and under appreciated role in preparing for the next food supply shock. It's unique suite of defense stability tasks can provide significant downward pressure on food prices.

Food supply shocks are best understood through a pricing perspective and resiliency efforts best assessed by their ability to place downward pressure on food prices. The Food Supply Shock model provides a useful tool for planners to understand, shape and assess their actions. Rather than being proscriptive, planners can assess actions and activities based on how they can address the pricing issue, and thus open an array of creative and non-standard solutions.

Lastly, the military contribution to build and maintain resiliency to and during the next food supply shock is significant. This is even more the case when military stabilization and security cooperation and security assistance efforts support the existing efforts of USAID and the Department of State. Though it is not the lead agency, Defense cannot sit idle- it brings too many invaluable capabilities to the table.

<sup>2</sup>ibid, p.6

<sup>3</sup> ibid, p.10

<sup>4</sup> ibid

<sup>5</sup> ibid

<sup>6</sup> NAVSEA III maritime shipping warning, <u>https://sealagom.com/navarea/3/</u>. Accessed 6 Jan 2023.

<sup>7</sup> Food and Agriculture Organization of the United Nations. "The importance of Ukraine and the Russian Federation for global agricultural markets and the risks associated with the current conflict." Information Note, 10 June 2022 Update, p.12.

<sup>8</sup> ibid, p.11

<sup>9</sup> USAID, <u>https://www.usaid.gov/food-security</u>. Accessed 15 Dec 2022.

<sup>10</sup> Famine Early Warning Systems Network. "Assessment of 2022 food assistance needs as of 31 Oct 2021." <u>https://fews.net/</u>. Accessed 14 Jan 2023.

<sup>12</sup> Glauber, Joseph and Laborde, David. "How sanctions on Russia and Belarus are impacting exports of agricultural products and fertilizer." IFPRI, 9 November 2022, <u>https://www.ifpri.org/blog/how-sanctions-russia-and-belarus-are-impacting-exports-agricultural-products-and-fertilizer</u>. Accessed 10 December 2022.

<sup>13</sup> The World Bank, "Ukraine Rapid Damage and Needs Assessment", August 2022,

https://documents.worldbank.org/en/publication/documents-

reports/documentdetail/099445209072239810/p17884304837910630b9c6040ac12428d5c.

<sup>14</sup> ibid

<sup>16</sup> US Department of State, Press Statement, 23 June 2022.

<sup>17</sup> World Food Program and Food and Agriculture Organization. "2022 Hunger Hotspots. FAO-WFP early warnings on acute food insecurity: June to September 2022 Outlook". Rome, p. 28.

<sup>18</sup> ibid, p.29

<sup>19</sup> Feed the Future. <u>https://www.feedthefuture.gov/</u>.Accessed 17 Dec 2023.

<sup>20</sup> Feed the Future. <u>https://www.feedthefuture.gov/article/4-ways-the-u-s-government-is-responding-to-the-global-food-security-crisis/</u>. Accessed 17 Dec 2023.

<sup>21</sup> Feed the Future. <u>https://www.feedthefuture.gov/article/qa-with-dfc-chief-development-officer-andrew-herscowitz-</u>how-the-u-s-governments-development-finance-arm-helps-communities-respond-to-crises-and-conflict/. Accessed

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<sup>22</sup> Gnutzmann, Hinnerk and Spiewanowski, Piotr. "Fertilizer Fuels Food Prices: Identification Through the Oil-Gas Spread" 29 September 2016.

<sup>23</sup> Wild, Royston, "Fertilizer Prices Spike Again As Russia Cuts Natural Gas Supply", Forbes, 5 Sep 2022.

<sup>24</sup> World Food Program and Food and Agriculture Organization. "2022 Hunger Hotspots. FAO-WFP early warnings on acute food insecurity: June to September 2022 Outlook". Rome, p.27

<sup>25</sup> Stable Seas. "Pirates of the Gulf of Guinea: A Cost Analysis for Coastal States", 7 Dec 2021, p.65

<sup>26</sup> Stable Seas. "2020 Maritime Security Index, Piracy and Armed Robbery",

https://www.stableseas.org/\_files/ugd/1e2140\_03f3aba5241f4a4ba1d5f08d47a755c4.pdf. Accessed 10 Jan 2023.

<sup>27</sup> Gardner, Christopher, "US Partnering with Benin to combat piracy in the Gulf of Guinea", Dec 14, 2022.

<sup>28</sup> US Embassy Tanzania press release, "US donates high-speed patrol boats in Tanzania", US Embassy in Tanzania, 16 Dec 2022.

<sup>&</sup>lt;sup>1</sup> Food and Agriculture Organization of the United Nations. "The importance of Ukraine and the Russian Federation for global agricultural markets and the risks associated with the current conflict." Information Note, 10 June 2022 Update,

<sup>&</sup>lt;sup>11</sup> Famine Early Warning Systems Network. "Acute Food Insecurity, estimates through Jan 2023." <u>https://fews.net/</u>. Accessed 15 Jan 2023.

<sup>&</sup>lt;sup>15</sup> Secretary of State Blinken Statement, 23 June 2022.