Methodological Note

IFPRI's Framework for Vulnerability Analysis of Global Food and Fertilizer Market Shocks, V.1

Country Typology of Food and Fertilizer Market Vulnerability to the Ukraine Crisis

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About this note

The present note explains the framework for the vulnerability analysis undertaken by IFPRI in the first months following the start of the Russian invasion in Ukraine which sent shock waves to global food and fertilizer markets from February 2022. This framework also served to underpin early assessments of the exposure of, especially, developing countries to these shocks and to obtain initial insights into the risks those shock posed to food security. Much of this analysis can be found in the IFPRI blog series here.

The initial framework focused on the direct exposure to supplies of grains (wheat more in particular) and fertilizer from Ukraine and Russia. The dashboard, data and analyses can be found on IFPRI's Food Security Portal (www.foodsecurityportal.org) which is funded by the European Commission.

With support from the Foreign, Commonwealth and Development Office (FCDO) of the United Kingdom and the United States Agency for International Development (USAID), Version 1 (V.1) of the framework was developed by David Laborde who also undertook the initial data analysis applying the framework. A more general framework for assessing country vulnerability to global food market shocks and the risks to food security is under development.

The war in Ukraine and global food security

The escalating tensions in the Black Sea region have heaped fresh risks on global food markets already struggling with soaring prices, supply-chain disruptions, and a bumpy recovery from the COVID-19 pandemic. Even before the crisis, agricultural commodity supplies were tight and market prices were at (nominal) record levels. Prices for most grains and oilseeds (figure 1) have risen sharply since the war began in late February 2022.

The war is directly impacting commodity prices in world markets as both Russia and Ukraine are important exporters of grains, oil seeds and vegetable oils. Before the war, Russia and Ukraine together supplied about 12% of global agricultural exports on a caloric basis, over 30% of global wheat exports and over 70% of global sunflower oil exports. In addition, Russia is a major exporter of oil, natural gas and chemical fertilizer. The war has destroyed transport logistics while blockades and mines near the harbors in the Black Sea area are impeding most exports from going out. Shortages in world markets will increase further as the war continues and likely very little wheat, barley and oil seeds will be harvested in Ukraine.

Availability of grains and fertilizer in international markets is constrained further by sanctions and export restrictions imposed on trade in grains and fertilizers. These restrictions not only affect exports from Ukraine and Russia but also those from other producing countries in efforts to keep prices down in their own domestic markets but causing prices in international markets to rise further. As IFPRI's Food and Fertilizer Export Restrictions Tracker showed, by the end of April 2022, 28 countries had imposed restrictions on grain exports, affecting 16% of total traded food (expressed in Kcal). Seven countries had restricted fertilizer exports affecting one third of global trade in nitrogenous fertilizer and one fifth of trade in potash- and phosphate-based fertilizer.

At the other side of food trade, Ukraine and Russia command even higher shares in the wheat-dependent economies of the Middle East and North Africa, where – by April 2022 – wheat prices had risen over 30% compared to pre-war levels, directly affecting food security in these countries. But food security is also threatened in countries with less direct exposure to imports of grains, vegetable oil, and fertilizer from Ukraine and/or Russia. First, because food and other commodity prices have risen more generally. Second, rising import bills has put further pressure on external balances, especially of low-income countries who were already hard hit by the COVID-19 crisis. Currencies of many of these countries have weakened further enhancing the transmission effect of international onto domestic food, fertilizer, and energy prices. Third, their fiscal capacity, already weakened by the COVID-19 crisis, unlikely suffices to provide buffers for farmers against rising input costs and vulnerable households against starkly rising food prices.

Figure 1

Commodity prices in constant USD per Metric Ton

Prices expressed in 2022 USD.

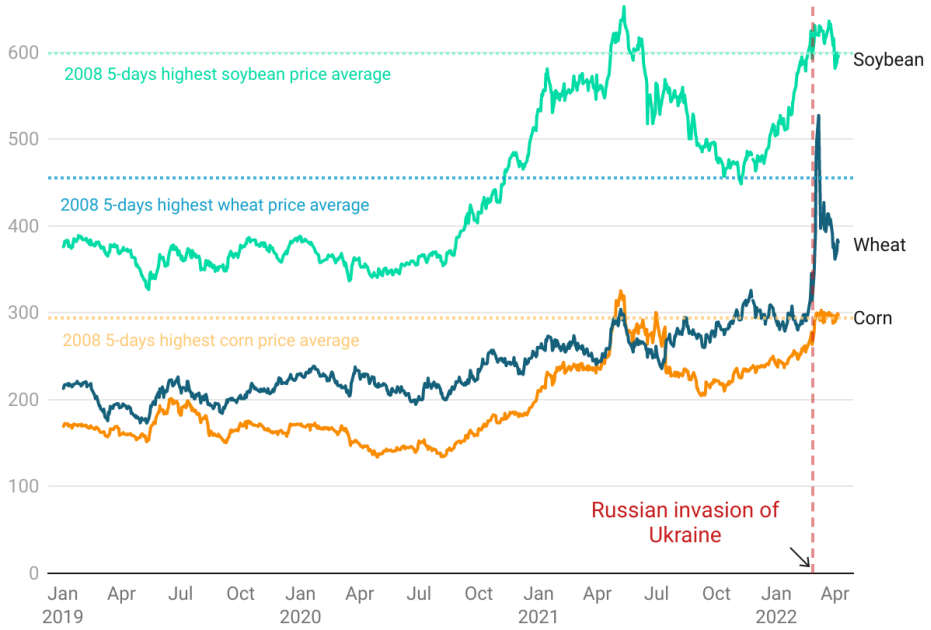


Chart: David Laborde • Source: IFPRI based on CBOT quotation and US Bureau of Labor statistics

The degree of exposure and vulnerability to the shocks to global food and fertilizer markets provoked by the war in Ukraine varies greatly across countries. It is important to identify the nature and degree of vulnerability to understand the potential impact on food security and needs for policy response and international assistance. For this purpose, IFPRI has developed country typology identifying the type and degree of vulnerability to the current crisis. This note lays out the methodology. The dashboard, data and analyses can be found on IFPRI's Food Security Portal (www.foodsecurityportal.org).

Vulnerability framework V.1

The vulnerability analysis focuses on short-term assessments of (expected) global impacts of the Ukraine crisis (and global commodity market shocks in general) through trade and production bottlenecks in wheat, other staple foods, and fertilizer markets, as well as through trade and other policy responses. The analysis should serve the identification of "hot spots" of country-specific vulnerability to the crisis and a starting point for the identification of the potential impacts on food security.

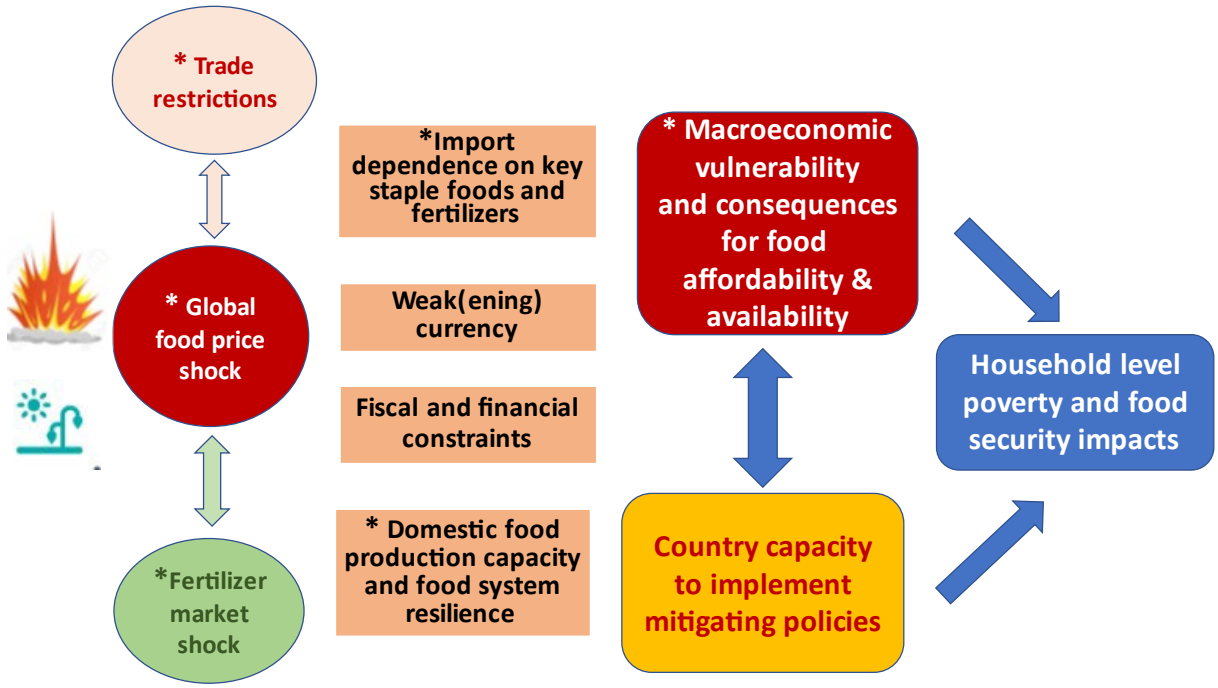
Figure 2 captures the main elements of the framework for the country-level vulnerability analysis. It captures the size of the shock caused by the military conflict in the Baltic Sea area (but could equally be used for other shocks, like weather extremes, with global market impacts).

It considers:

- The impacts on global food and fertilizer availability and prices, as well as policy responses in the form of trade restrictions on staple foods and fertilizers (left-hand side of Figure 2).
- The degrees of country-level exposure to the shock(s) are measured in first instance by the dependence on staple food (shares of Kcal of food consumption at risk) and fertilizer imports (distinguishing between imports from Ukraine/Russia and the rest of the world) (second column).
- The capacity to meet potential shortages in staple foods (proxied for present purposes by the availability of stocks of wheat in number of days of domestic consumption), as a short-term proxy for the domestic food production capacity (second column).
- The short-term macroeconomic vulnerability to reduced food availability and affordability (proxied by the estimated rise in the cost of food relative to GDP).
- Probability of significant impact on food insecurity (proxied by initial levels of the prevalence of undernourishment).

The elements considered in the present version of the Vulnerability Dashboard are marked with an asterisk (*) in Figure 2. In future versions, other elements indicated in the framework will also be included, including, exchange rate effects, fiscal and financial capacity, and more detailed specification of transmission effects of global food price shocks onto domestic food prices and household level food security.

Figure 2 Framework for Country Vulnerability Analysis



The annex table provides the detailed list of variables and indicators used for the analysis.

Table 1 summarizes the country typology derived from the analysis of the vulnerability indicators. In line with the above and as shown in the table, country vulnerabilities are distinguished using three criteria:

(1) the likelihood of food availability and/or food access being seriously compromised by price shocks and export restrictions through direct exposure to the conflict (import dependence on Russia and Ukraine) or indirectly through global commodity market spillover effects);
(2) the capacity to meet potential shortages in staple foods, proxied by availability of stocks of wheat; and
(3) the probability of significant impact on food insecurity, proxied by initial prevalence of undernourishment (PoU) among the population

Along these criteria and using threshold levels for the corresponding indicators[1], **ten types** and degrees of country-level vulnerability for food security that may be compromised by the Ukraine-Russia conflict have been identified:

1 **Extremely High**: food consumption directly exposed to the conflict between Ukraine and Russia and low availability of stocks of wheat
2 **Extremely High**: food consumption directly exposed to export restrictions and low availability of stocks of wheat
3 **Very High**: food consumption directly exposed to conflict between Ukraine and Russia
4 **Very High**: food consumption directly exposed to export restrictions
5 **High**: food consumption exposed to export restrictions or conflicts
6 **High**: major increase in cost of food (relative to GDP) is expected
7 **High:** high risk of domestic food price increases due to last month's changes in world market prices
8 **Moderate:** high risk of domestic food price increases due to changes in world market prices over past 12 months
9 **Moderate**: no immediate major food price risks, but fertilizer supply compromised
10 **Minor risk**

[1] Thresholds were determined based on the distribution of indicator values across countries.

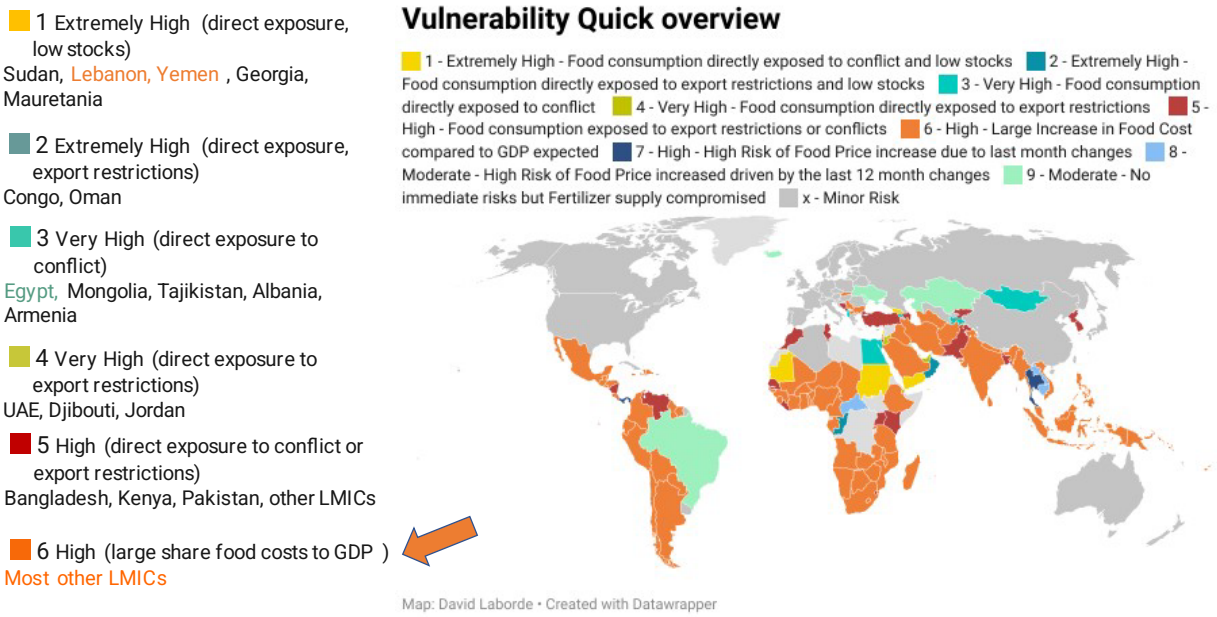
Table 1 Criteria for country-level vulnerability typology

External driver/threat Criterion 1	Criterion 2	Initial food insecurity Criterion 3	Main Type of Vulnerability
Share of calories imported from countries involved in the conflict > **10%** of domestic caloric consumption	Less than **60** days of stock of wheat	PoU above 7.5%	**1** - Extremely High - Food consumption directly exposed to conflict and low stocks
Share of calories imported from countries implementing export restrictions (on the commodities traded) > **10%** of domestic caloric consumption	Less than **60** days of stock of wheat	PoU above 7.5%	**2** - Extremely High - Food consumption directly exposed to export restrictions and low stocks
Share of calories imported from countries involved in the conflict > **10%** of domestic caloric consumption	Less than **90** days of stock of wheat	PoU above 3%	**3** - Very High - Food consumption directly exposed to conflict
Share of calories imported from countries implementing export restrictions (on the commodities traded) > **10%** of domestic caloric consumption		PoU above 3%	**4** - Very High - Food consumption directly exposed to export restrictions
Share of calories imported from countries involved in the conflict OR the share of calories imported from countries implementing export restrictions (on the commodities traded) > **5%** of domestic caloric consumption		PoU above 2.5%	**5** - High - Food consumption exposed to export restrictions or conflicts
Last month's increase of commodity prices, if continued during the year, will represent more than 5% of GDP (Capture price increase and economic resilience)		PoU above 2.5%	**6** - High - Large increase in Food Cost compared to GDP expected
The rate of increase in average diet cost, estimated at world prices, increase by more than 5% in the last month		PoU above 2.5%	**7** - High - High Risk of Food Price increase due to last month changes
The rate of increase in average diet cost, estimated at world prices, increase by more than 30% in the previous 12 month		PoU above 2.5%	**8** - Moderate - High Risk of Food Price increased driven by the last 12 month changes
The dependency to the countries in conflict (import/total ag use) for a**t least one type of fertilizer (N or P or K)** ***is above 25%***			**9** - Moderate - No immediate risks but Fertilizer supply compromised"

Vulnerability 'hot spot' map per April 2022

Based on data available in March-April 2020, country vulnerability to the Ukraine-Russia conflict was identified as presented on the world map in Figure 3. The figure further identifies countries most vulnerable for the first 6 categories of the typology. It shows a significant number of countries directly and very strongly exposed to the conflict and/or subsequent export restrictions, especially countries in the Middle East, North Africa, and Central Asia, as well as a few countries in Africa and Asia. It also shows that the vast majority of low- and middle-income countries (LMICs) are more indirectly affected, as they face significant increases in the cost of food, their populations spend high shares of income on food, and initial food insecurity levels are already high.

Figure 3 Vulnerability "hot spot" map (April 2022)



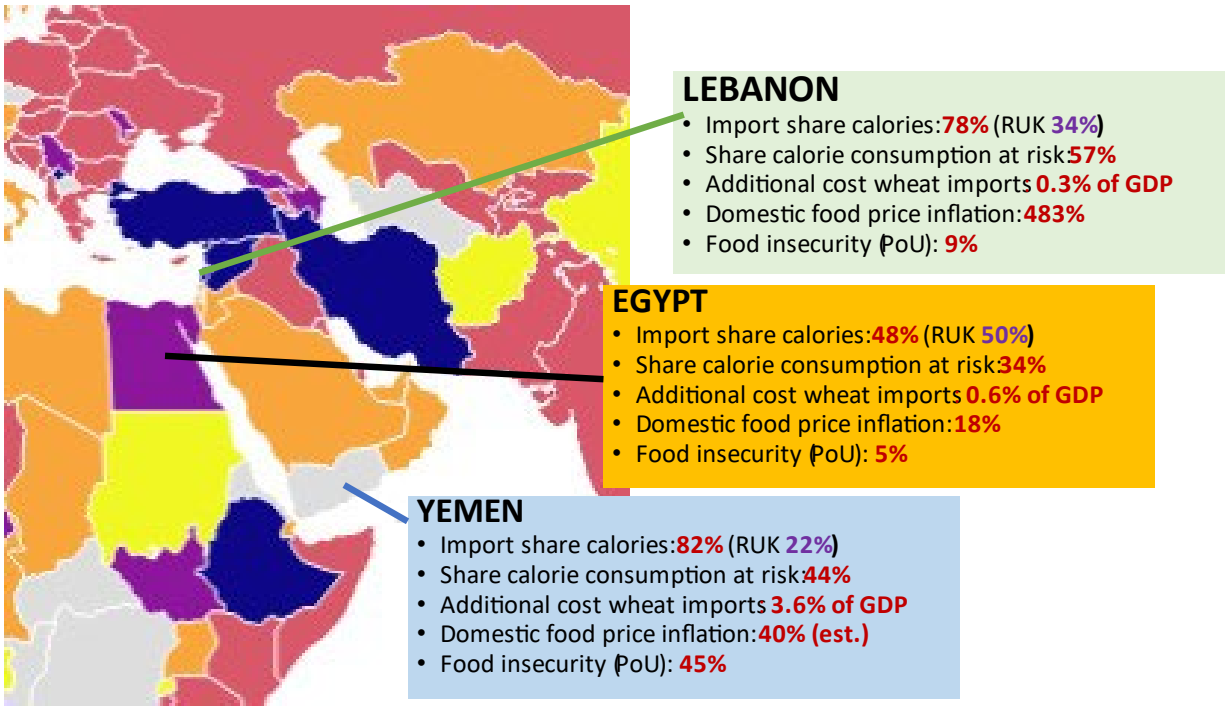
How to use the vulnerability dashboard and data for policy and foreign assistance responses

The vulnerability dashboard identifies the degree and type of exposure of country-level food security to the conflict. This is useful as a diagnosis. While informative, the typology by itself does not provide direct answers to what would be the best response for countries and the international community to take in order to mitigate the adverse impacts on food security and nutrition.

For this a closer look at the dashboard data will be needed, as well as linking those data to additional data and analysis of country-specific contexts. As an example, this could involve the following steps:

- First, from the dashboard data, a more specific country profile can be determined, for instance in the way done in Figure 4, which shows a selection of key vulnerability indicators for three countries: Lebanon and Yemen (both in category 1) and Egypt (category 3).
- Second, a closer look at food price transmission and links to household level food insecurity (work in progress).
- Third, corroborate initial policy response options with other information and country analysis (e.g., fiscal capacity, existing social protection, domestic food production prospects, etc.).

Figure 4



Further reading on related vulnerability analyses

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Joseph Glauber, David Laborde | Feb 24, 2022

The Russia-Ukraine crisis poses a serious food security threat for Egypt

Kibrom Abay, Lina Abdelfattah, Clemens Breisinger, Joseph Glauber, David Laborde | Mar 14, 2022

The Russian invasion of Ukraine threatens to further exacerbate the food insecurity emergency in Yemen

Sikandra Kurdi, Clemens Breisinger, Joseph Glauber, David Laborde | Mar 23, 2022

West Africa faces mixed food security impacts from the Russia-Ukraine conflict

Antoine Bouët, David Laborde, Fousseini Traoré | Apr 1, 2022

The Russia-Ukraine conflict is likely to compound Sudan's existing food security problems

Clemens Breisinger, Oliver Kirui, Paul Dorosh, Joseph Glauber, David Laborde | Apr 6, 2022

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Food price shocks and diets among poor households in Egypt

Kibrom Abay, Naureen Karachiwalla, Sikandra Kurdi, Yousra Salama | Dec 29, 2022

Ukraine one year later: Impacts on global food security

Joseph Glauber | Feb 23, 2023

ANNEX TABLE Vulnerability Analysis - List and definition of variables

Variable and indicator names	Description
Country code	ISO3 Code
Area	Country Name
GDP	GDP, current, USD
Pop	Population, current,
PoU	Prevalence of Undernourishment. (In case of unavailability of official estimates, unofficial sources were used)
FoodCPI	Food consumer price index (CPI) (observed), Feb 2021 to Feb 2022
ShareKCal_RiskConflict	Share of Kcal at risk from conflict (i.e., originating from Ukraine, Russia and Belarus) in total domestic food consumption
ShareKCal_ExpRestr	Share of Kcal threatened by export restrictions in total domestic food consumption
Rate_Increase_12Months	Increase in food consumption at world market prices. 12 months. Rates are additive across products (total food cost = sum of the rates of the 3 products)
Rate_Increase_LastMonth	Increase in food consumption at world market prices. 4 weeks. Rates are additive across products (total food cost = sum of the rates of the 3 products)
Cost12monthGDP	Crude Proxy for potential increase in total food expenditures as share of GDP (relative ranking more important than absolute value). 12-month period (Feb. 2021 to Feb. 2022)
Cost1monthGDP	Crude Proxy for potential increase in total food expenditures as share of GDP (relative ranking more important than absolute value). Most recent 4 weeks
Days_Stock_Wheat	Estimated number of days of consumption of wheat stocks
K_Fertilizer_RiskConflict	Share of K (Potash) fertilizer threatened by conflict in TOTAL domestic use
N_Fertilizer_RiskConflict	Share of N (Nitrogenous) fertilizer threatened by conflict in TOTAL domestic use
P_Fertilizer_RiskConflict	Share of P (Phosphate) fertilizer threatened by conflict in TOTAL domestic use
Vulnerability	Vulnerability Assessment
FOOD_delta_billnet_MioUSD	12-month variation in the net food import bill - (delta of (imports-exports)). Negative value implies reduction in trade deficit. Measured in millions of USD for all FOOD products
FOOD_delta_import_MioUSD	12-month variation in the food import bill. Positive value means an increase in the import bill. Measured in millions USD for all FOOD products
AGRI_delta_billnet_MioUSD	12-month variation in the net agricultural products import bill - (delta of (imports-exports)). Negative value implies reduction in trade deficit. Measured in millions of USD for all AGRICULTURAL products

Variable and indicator names	Description
AGRI_delta_import_MioUSD	12-month variation in the import bill for agricultural products. Positive value means an increase in the import bill. Measured in millions USD for all AGRICULTURAL products
TOTAL_delta_billnet_MioUSD	Variations in the total net import bill - (delta of (imports-exports)). Negative values indicate a reduction in the trade deficit. Measured in millions of USD for all ALL products.
TOTAL_delta_import_MioUSD	12-month variation in the total import bill. Positive value means an increase in the import bill. Measured in millions USD for ALL products
FOOD_delta_billnet_asPctGDP	12-month variation in the net food import bill - (delta of (imports-exports)). Negative value implies reduction in trade deficit. Measured as percentage of GDP for all FOOD products
FOOD_delta_import_asPctGDP	12-month variation in the food import bill. Positive value means an increase in the import bill. Measured percentage of GDP for all FOOD products
AGRI_delta_billnet_asPctGDP	12-month variation in the net agricultural products import bill - (delta of (imports-exports)). Negative value implies reduction in trade deficit. Measured as percentage of GDP for all AGRICULTURAL products
AGRI_delta_import_asPctGDP	12-month variation in the import bill for agricultural products. Positive value means an increase in the import bill. Measured as percentage of GDP for all AGRICULTURAL products
TOTAL_delta_billnet_asPctGDP	Variations in the total net import bill - (delta of (imports-exports)). Negative values indicate a reduction in the trade deficit. Measured as percentage of GDP for all ALL products.
TOTAL_delta_import_asPctGDP	12-month variation in the total import bill. Positive value means an increase in the import bill. Measured as percentage of GDP for ALL products