

Effects of high global prices of fertilizer and staple foods on the Kenyan economy and household welfare

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Executive summary

Between 2019 and 2022, the world market price of fertilizer almost tripled while the world market price of staple foods increased by almost 50% on average. To analyze the effect of such world market price changes on the Kenyan economy and households, we use a Computable General Equilibrium (CGE) model.

Results show that higher world market prices affect negatively household welfare and the economy as a whole. Higher staple food prices encourage food production to the detriment of non-food activities. At the same time, the higher fertilizer price limits the expansion of food production. As a general result, household welfare and Gross Domestic Production (GDP) decline.

Based on these results, it would be important for Kenya to work on the resilience of the agricultural input supply chain vis-à-vis exogenous shocks. Alternatives to chemical fertilizers and domestic fertilizer production potentials could be explored in the long run. In the short run, a (higher) fertilizer subsidy could mitigate negative effects.

Promoting the domestic consumption of domestic instead of imported food would help to depend less on imports and therefore to be more resilient in case of world market price shocks. Hence, investing in domestic food processing sectors and preference shifts toward domestic products may be important.

Effets de l'augmentation des prix mondiaux des engrais et des produits vivriers sur l'agriculture, le bien-être des ménages et l'ensemble de l'économie au Kenya

Résumé

Entre 2019 et 2022, le prix des engrais sur le marché mondial a presque triplé, tandis que le prix des produits vivriers sur le marché mondial a augmenté de près de 50 % en moyenne. Pour analyser l'effet de ces changements de prix mondiaux sur l'économie et les ménages kenyans, nous avons utilisé un modèle d'équilibre général calculable (EGC).

Les résultats montrent que la hausse des prix du marché mondial a un impact négatif sur le bien-être des ménages et sur l'économie dans son ensemble. La hausse des prix des produits vivriers encourage la production de ces produits au détriment des production non vivrières. Dans le même temps, la hausse du prix des engrais limite l'expansion de la production vivrière. En conséquence, le bien-être des ménages et le Produit Intérieur Brut (PIB) diminuent.

Selon ces résultats, il serait important que le Kenya travaille sur la résilience de la chaîne d'approvisionnement en intrants agricoles face aux chocs exogènes. Les alternatives aux engrais chimiques et les potentiels de production nationale d'engrais pourraient être explorés à long terme. À court terme, une subvention (plus élevée) des engrais pourrait atténuer les effets négatifs.

La promotion de la consommation de produits vivriers nationaux plutôt qu'importés permettrait de moins dépendre des importations et donc d'être plus résistant en cas de chocs des prix sur le marché mondial. Il peut donc être important d'investir dans les secteurs nationaux de transformation agro-alimentaire et de travailler à la mutation des préférences en faveur des produits nationaux.

1. Background

Global prices for food and fertilizers are volatile and have increased strongly in recent decades (FAO, 2023) for different reasons. Climatic troubles (such as long and intense droughts), sanitary crises or conflicts between countries are the most pointed out reasons. In 2008, for example, food prices drastically increased. World market prices peaked again during the COVID 19 pandemic, though to a lesser extent, and currently due to Russia's invasion in Ukraine.

Between 2019 and 2022, world market prices of staple foods increased by 45% on average and the world market price of fertilizers increased by 171% (World Bank, 2022). Kenya has been subject to these global price changes.

To mitigate the effects of high world market prices on its economy, the Kenyan Government has implemented different measures (KIPPPRA, 2022) such as fertilizer subsidies and staple food import tariff abolishment or reduction.

Little research has so far tackled the economy-wide effects of high global food prices in Kenya to guide policymakers in developing coping strategies. In this paper, we aim at analyzing:

- The effects of increasing global fertilizer prices on agricultural production and food consumption as well as the economy as a whole;
- The effects of increasing global prices for staple foods on agricultural production and food consumption as well as the economy as a whole;
- The welfare effects of increasing fertilizer and staple food prices.

In the following sections, we present the method, the results, the conclusion and policy implications to support decision-making.

2. Methods

2.1 Database

A Social Accounting Matrix (SAM) for Kenya for the year 2019 has been designed at the International Agricultural Trade and Development Group at Humboldt-Universität zu Berlin based on Elnour et al. (2022) and extended with support from the staff of the Kenya National Bureau of Statistics.

The SAM identifies 46 activities producing 49 commodities, of which 20 are agricultural commodities. Additionally, the SAM includes eight production factors: two types of capital (agricultural and not), two land types (irrigated and not) and four labour categories. Labour is classified based on skill level (skilled and unskilled) and gender (male and female). Besides, households are categorised into four groups, depending on location (rural and urban) and income level (poor and non-poor).

2.2 Model and closure rules

We use the computable general equilibrium (CGE) model STAGE (McDonald and Thierfelder, 2015). A CGE model combines economic theory and numerical models to establish the impact of shocks in an economy. Real economic data is used to fit a set of equations that replicate the structure of the economy. From this framework, it is possible to simulate the effect of

Effects of high global prices of fertilizer and staple foods on the Kenyan economy

exogenous shocks, such as policy changes, including economy-wide interactions. The following presents a summary of the CGE model used:

- Production is structured by a three-level nest of Constant Elasticity of Substitution (CES) and Leontief production functions. At the top level, aggregate value-added, and intermediate inputs are combined using a CES function. Production factors are aggregated using CES functions at different levels, whereas the intermediate input component is aggregated using a Leontief production function (the second level). Aggregate primary factors (i.e., labour and land) are combined using CES functions (the third level).
- Producers sell their products either in the local or foreign markets, based on relative prices, as determined by a Constant Elasticity of Transformation (CET) function.
- Households supply production factors to productive activities through factor markets in exchange for wages that constitute a significant portion of their incomes. After paying taxes and making savings, households spend their income on purchasing products. Households maximise their utility subject to Stone-Geary utility functions, selecting the optimal mix of commodities and services while considering purchase prices, preferences, and income constraints.

We apply flexible exchange rate regime closure. The model is saving-driven. All production factors are fully employed across all markets and fully mobile across sectors. The model numéraire for the scenarios is the CPI. The government savings are fixed, and the household tax rate is flexible. Therefore, any policy implemented in the model is financed through income tax on households.

2.3 Scenarios

Scenarios are developed based on observed changes in aggregate global prices between 2019 and 2022 (World Bank, 2022). Three scenarios are implemented:

1. A 45% increase in the world market price (of imports and exports) for staple foods (PW_food). Staple foods here include the categories staple food crops and animal products (animal husbandry products and fish);
2. A 171% increase in the world market price of imported fertilizer (PWM_fertilizer);
3. A combination of the first two scenarios (PW_food&fertilizer). This scenario reflects a potential reality on the ground. The first two scenarios support understanding the impact pathways.

3. Results

3.1 Domestic production

With the world market prices of imports and exports of staple foods increasing (PW_food), the domestic production of these products increases (Figure 1) for two reasons. First, the higher import price of staple food induces lower imports and higher domestic prices, incentivizing domestic production. Second, higher world market prices for food exports induce higher staple food production to supply the world market. The production of “other crops” declines because staple food production is demanding more agricultural factors making these factors less available for other crops. Because of its high export share and no limitation by agricultural

Effects of high global prices of fertilizer and staple foods on the Kenyan economy

land, fish production more than triples due to the higher export price. As the fish sector is highly capital intensive, the increasing non-agricultural capital demand from the fish sector makes this capital less available for industrial and service sectors which slightly decline.

With only a fertilizer price increase on the world market (PWM_fertilizer), total crop production decreases. The production of staple food crops declines slightly while other crops decline strongly because of their fertilizer use intensity. Animal product production declines because of a substantial share of their intermediate inputs provided by crops, which are getting scarcer. The food industry and services decline as well. Other industry production increases slightly.

Combining the increasing staple food prices with the increasing fertilizer prices (PW_food&fertilizer) results in total staple food (staple food crops and animal products) production increasing. Some of the single staple food production activities decline and some increase due to their different fertilizer use intensities. Other sectors decline, except forestry which increases slightly. Forestry increases slightly because of its very low labour intensity and high non-agricultural capital intensity. Labour is getting relatively scarce in comparison to other factors because of higher demand by staple food sectors. As most of the staple food sectors are using agricultural capital and draw labour from the non-agricultural sectors, these non-agricultural sectors use less capital which can be used by forestry.

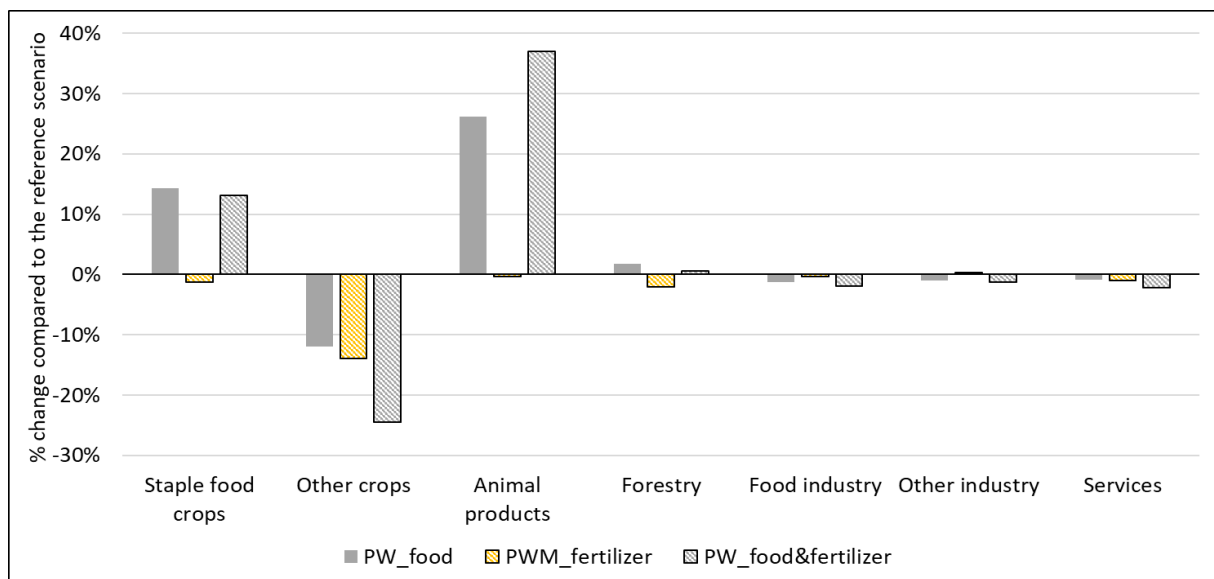


Figure 1: Effects on quantities of domestic production, % change compared to the reference scenario

Source: Author's calculations based on simulation results.

3.2 Household welfare

Welfare and income effects are quite similar, as welfare effects are dominated by income effects. The size of the effect slightly differs because price changes also affect welfare. All household groups are affected negatively (Figure 2). This is because most factor prices drop (Figure 3). Only the price for non-agricultural capital increases under PW_food and PW_food&fertilizer because of higher production of fish and forestry being highly non-agricultural capital intensive.

Effects of high global prices of fertilizer and staple foods on the Kenyan economy

The welfare effects are negative in general because Kenya is a net staple food importer. Staple food (staple food crops and animal products) imports are about 5 times higher than the exports of these commodities in Kenya. This is why consumers suffer more from higher prices than producer benefit. The negative welfare effects are stronger in rural areas because the prices of the factors that rural households hold the most (agricultural capital and land) are declining the most (Figure 3). This drives rural income effects and therefore welfare effects.

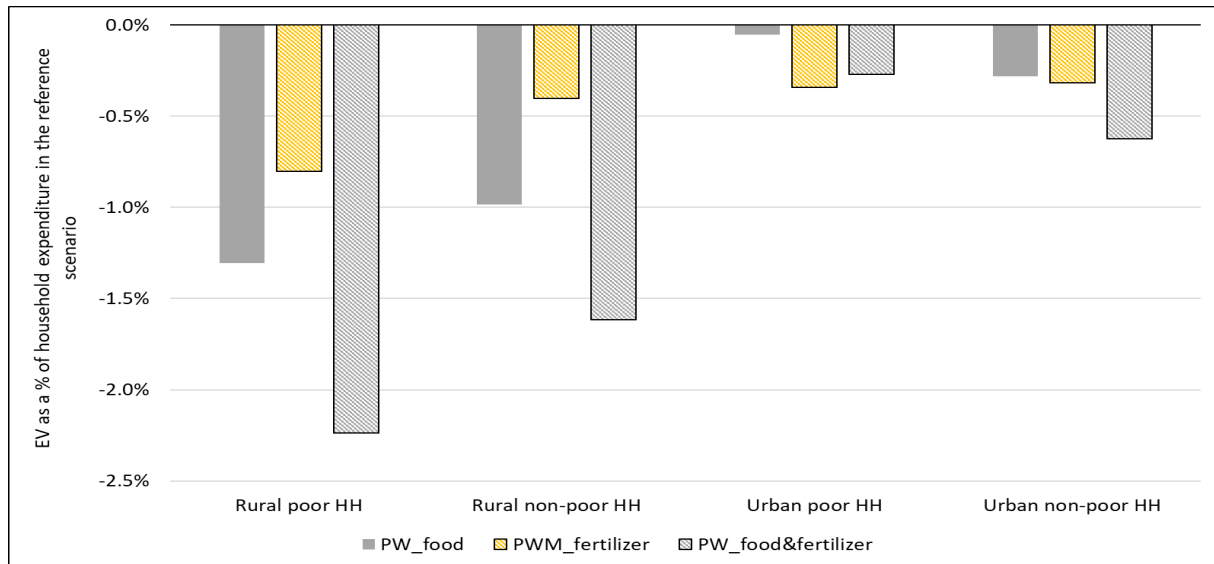


Figure 2: Effects on household welfare, Equivalent variation (EV) as a share of household expenditure in the reference scenario¹

Source: Author's calculations based on simulation results.

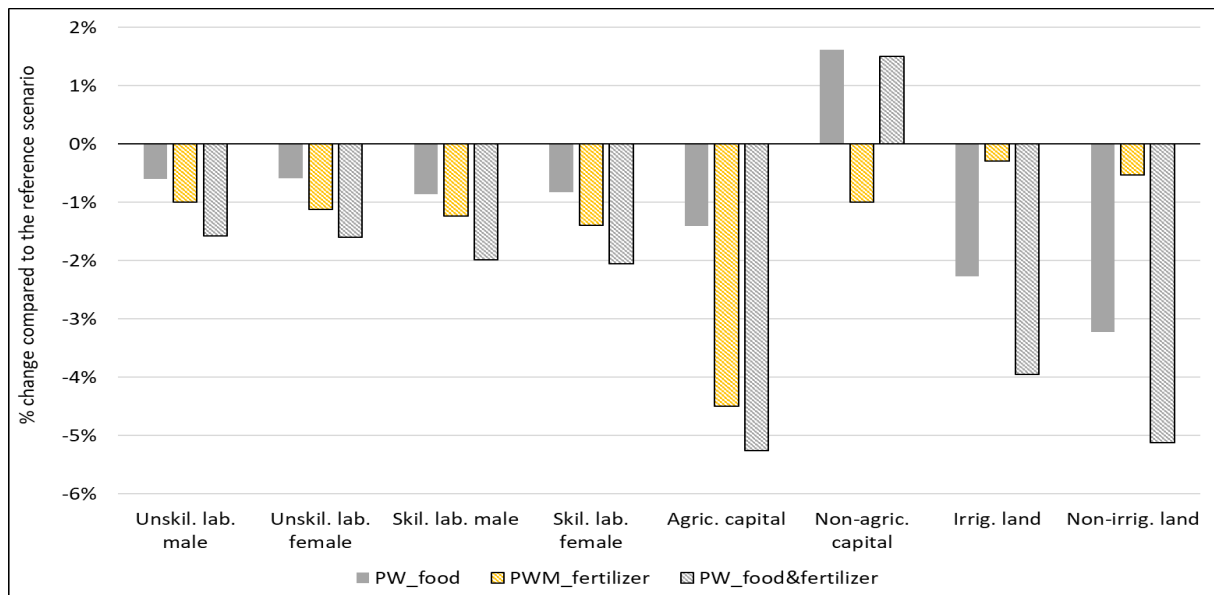


Figure 3: Effects on factor prices, % change compared to the reference scenario

Source: Author's calculations based on simulation results.

¹ Equivalent variation (EV) refers to a change in income that would have an equivalent effect on utility as all price and income changes combined.

3.3 Macroeconomic effects

The simultaneous increase of world market prices of staple foods and fertilizers (PW_food&fertilizer) results in declining household demand, imports, exports and GDP (Figure 4).

Investment increases under PW_food and PW_food&fertilizer because of higher savings. Under these two scenarios, the non-agricultural capital price increases. This provides more income to enterprises, which own 73% of this capital. Therefore, enterprise savings in the economy increases. Enterprises are the most important savers in Kenyan economy. This brings total savings up.

Imports increase under PW_food because of a strong appreciation (3.3%) of the Kenyan currency under this scenario. This makes imports more attractive and exports less attractive.

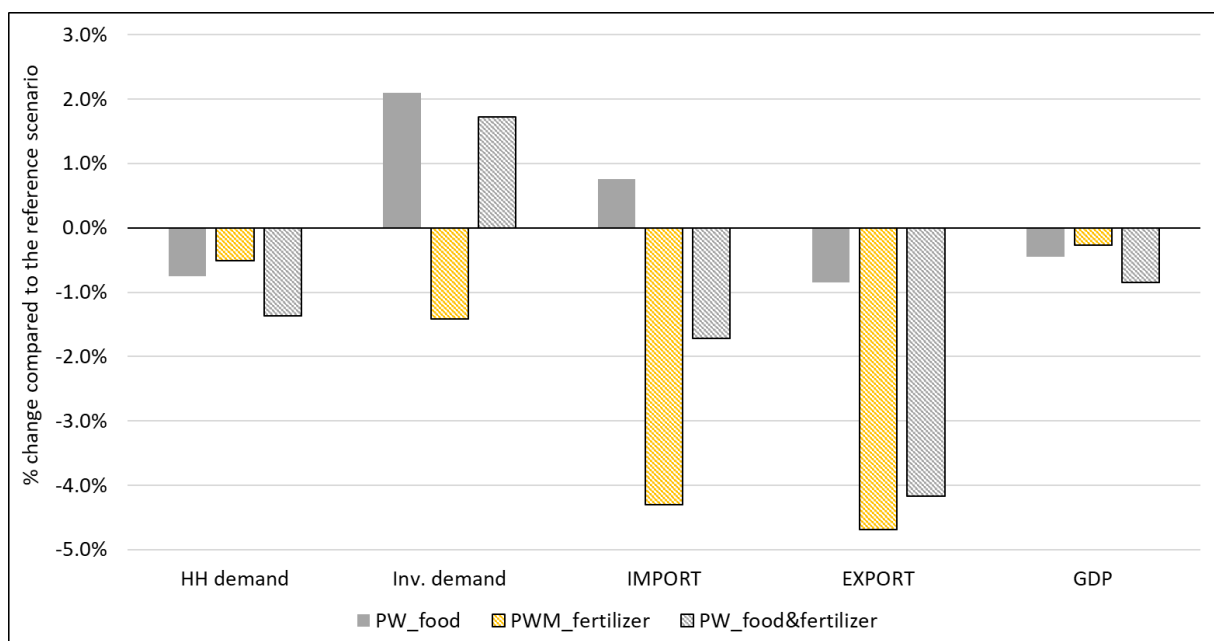


Figure 4: Effects on macroeconomic indicators, % change compared to the reference scenario

Source: Author's calculations based on simulation results.

4. Conclusions

This paper shows that agriculture-based economies such as Kenya can be heavily affected by world market price changes for agricultural inputs and staple foods. A fertilizer price increase affects negatively the economy by decreasing agricultural production.

Food price increases have a net negative effect on consumption and the economy as a whole. Kenyan households are worse-off under high world market prices of staple foods and fertilizers.

5. Policy implications

Results suggest two kinds of policy implications.

- In the short run:
 - The government could subsidize fertilizers to help farmers to face these price increases in order to mitigate the negative effects.
 - Regarding food, it may be important to abolish import tariffs on staple foods and/or restrict exports of these products for a short period to relieve households of these negative effects. Alternatively, the government may use direct transfers to low-income households in order to support them in case of high food prices.
- In the long run:
 - The government could promote the use of domestic alternatives to chemical fertilizers (e.g. manure) and a more efficient fertilizer use and explore the development of domestic fertilizer production capacities.
 - Regarding food, the government could enhance self-sufficiency to decrease the import dependency on important food commodities. For that, domestic food processing development and shifting consumption habits may be important to make the domestic market more resilient to exogenous world market price shocks.

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