

Resilience of African food security – a CGE analysis of the Russia-Ukraine war

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Abstract

The effects of the Russian invasion to Ukraine are studied. The effects on the food security in Africa are largely negative although not evenly distributed. The countries that are able to export energy resources can increase their incomes on the short-run. The countries that are the most dependent on importing food and energy face the most negative effects. The short-term effects are partly mitigated on the medium term. The structures of the African economies shift increasingly to producing food and other low value added commodities.

Introduction

Russia's attack on Ukraine in February 2022 has launched a series of events that has many difficult-to-predict repercussions to outside parties. In economic terms, the war has increased inflationary pressures of many internationally traded commodities. Both Russia and Ukraine are significant players in international markets of several key food (e.g. wheat, sunflower seeds and oil), fertilizer and energy commodities (natural gas and crude oil). An increase of these commodities' prices can have especially detrimental effects on many developing countries that are net importers. The situation was already severe due to Covid-19 pandemic disruptions on supply chains, and some local weather events such as droughts. On top of that, the on-going climate crisis poses a long-term challenge for food systems globally. The resiliency for all of these detrimental factors is a key to secure adequate food intake for vast amounts people in low-income countries.

In this paper, we estimate the effects that the invasion could have for the African countries. In order to control considerable amount of uncertainty in the events, we construct a few likely scenarios. We focus on the effects on food security, which could be severely affected by the movements in international food prices. We use the CGE model MAGNET (Woltjer et al. 2014) in our analysis. The model is based on the GTAP model version 7 (Corong et al. 2017) and database version 10 (Aguiar et al. 2019). We build a short-term baseline based on the IMF's World Economic Outlook data and projections. The policy scenarios take into account the effects of the war itself (reduced production and exporting potential in Ukraine) and actions taken by various third parties for influencing the war (e.g. sanctions on Russia and its ally Belarus).

The preliminary results indicate a moderate deterioration of the food security situation for several African countries. On average, the consumers' purchasing power for food decreases due to increased food prices. The initial negative effects are partly mitigated when African countries are able ramp up their own production in following years. Nevertheless, the benefits accrue only for regions with capacity for food exporting. Similarly, countries that export energy commodities benefit from higher energy prices. However, these countries also experience the highest overall inflation rates that undermine especially the low-income households' welfare.

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In addition to the aforementioned specific results of the war, we can point out some more general insights about the resilience of African food systems. Evidently, the countries dependent on food and energy imports are the most vulnerable for such disruptions. In addition, the countries that can benefit from increasing energy prices could still face problems when food prices increase and the welfare of the low-income groups deteriorates.

Previous studies

Berndt and others (2022) used an ensemble of three economic models (GTAP, DART-BIO and CAPRI) to estimate the effects of the war on the global food and nutrition security, the bioeconomy and the EU's Common Agricultural Policy (CAP). The study considers the effects of the disruptions on Ukraine's and Russia's grain supply and exports. The study finds 0.5-3.6% increase in wheat prices in the long-term, depending on model. The increases are 2.3-2.6% points higher in Africa. Short-term effects are drastically higher, especially for low-income net food-importers. The study also showed that the disruptions in the fertilizer markets should be taken into account as they significantly alter the outcome.

Balma and others (2022) studied the long-term impacts of the war on the African Development Fund (ADF) countries using the static CGE model KITE. They studied three scenarios: 1) 50% productivity reduction in Ukrainian agriculture, 2) 50% productivity reduction in Ukrainian agriculture and rising trade costs (50% increase in Ukraine and 25% in Russia), and 3) 50% productivity reduction in Ukrainian agriculture, rising trade costs (50% increase in Ukraine and 25% in Russia) and export ban on Russian wheat. All the scenarios increase global food prices. The first scenario yields lower overall effects, which nevertheless affects some countries severely. The remaining two scenarios have more overarching effects, and the Russian export ban has an especially severe effects on global wheat prices.

Lin and others (2023) estimate the effects on global food security. They estimate the losses in Ukrainian harvests by analysing the satellite data, and use these estimates as shocks in SGETM, a global CGE model. They find that global average wheat price increases by 3-12% depending on the duration of the conflict. The same increase in the countries that are the most dependent on wheat imports is 46%. However, the authors also conclude that the negative effects can be curbed by 2-3% increase in production and avoidance of unnecessary trade restrictions.

The baseline and the scenarios

To analyse the impact of the Ukraine invasion by Russia on African agri-food sectors and food security we employ the global multi-sector Computable General Equilibrium model MAGNET.

The purpose of the analysis is to identify the short and medium term (2023 and 2025, respectively) impacts of the invasion. For this reason, we produce a baseline that runs until 2025. We calibrate the baseline on the 2021 World Economic Outlook by the IMF, because it includes the most up-to-date country level macro-economic projections. The historical part of the baseline, 2014-2021, is calibrated with the same data for GDP and population projections.

The analysis looks at two scenarios (a mild and an extreme one) based on three effects of the invasion:

1. **Trade disruptions.** Reduction of imports and exports of goods from and to Russia by EU27, UK, Switzerland, Norway, USA, Canada, Australia, New Zealand, Korea and Japan due to sanctions. Reductions by commodity groups are 20% and 50% for primary resources (other than agriculture and food), 30% and 50% for manufactured commodities, and 30% and 60% for energy commodities. The same restrictions also apply to **Belarus** although only with

EU27, UK, Switzerland, Norway, USA and Canada participating. In addition, fertilizer imports from Belarus are cut by 30% and 50%. In addition, Russia will place export bans on primary agricultural and food commodities by 50 and 85%. Trade between Russia-Belarus and Ukraine stops almost completely.

2. Reduction of **Ukrainian production factors** availability of labour (-25% and -30%) and land (-9% and -15%). Capital is exogenous, developing along the GDP growth.
3. **Additional export costs** for Ukraine due to destroyed infrastructure (30% and 60% reductions for bulky commodity trade volumes, and 20% and 40% reductions for the other commodities).

Results

Preliminary results indicate that the response is heterogeneous within Africa. Majority of countries and the population face negative economic consequences of the crisis. The natural gas and crude oil producing countries will benefit from increased world prices that will mitigate the negative effects to various extents.

The wheat market is of particular interest because both Ukraine and Russia have large export shares in world markets. In our simulations, Ukrainian wheat production falls by 71 – 87% in 2023 under the two scenarios compared to the baseline. The global price of wheat increases by 4.1 – 6.1% in 2023. The price changes vary considerably within Africa, from 0.7% - 9.7% in the Mild scenario and 1.0% - 13% in the Extreme scenario. The highest increases happen in Tunisia, Kenya and Uganda where the increases are more than 10% in the Extreme scenario (Figure 1). The global wheat output decreases marginally (-0.1%), although reduction in Ukraine is large (2.3 – 2.9 billion USD between scenarios). The regions that fill the gap the most in absolute terms are the EU (0.41 – 0.5 billion USD), Asia (0.29 – 0.41 billion USD), Canada (0.27 – 0.38 billion USD) and the Middle East (0.3 – 0.31 billion USD).

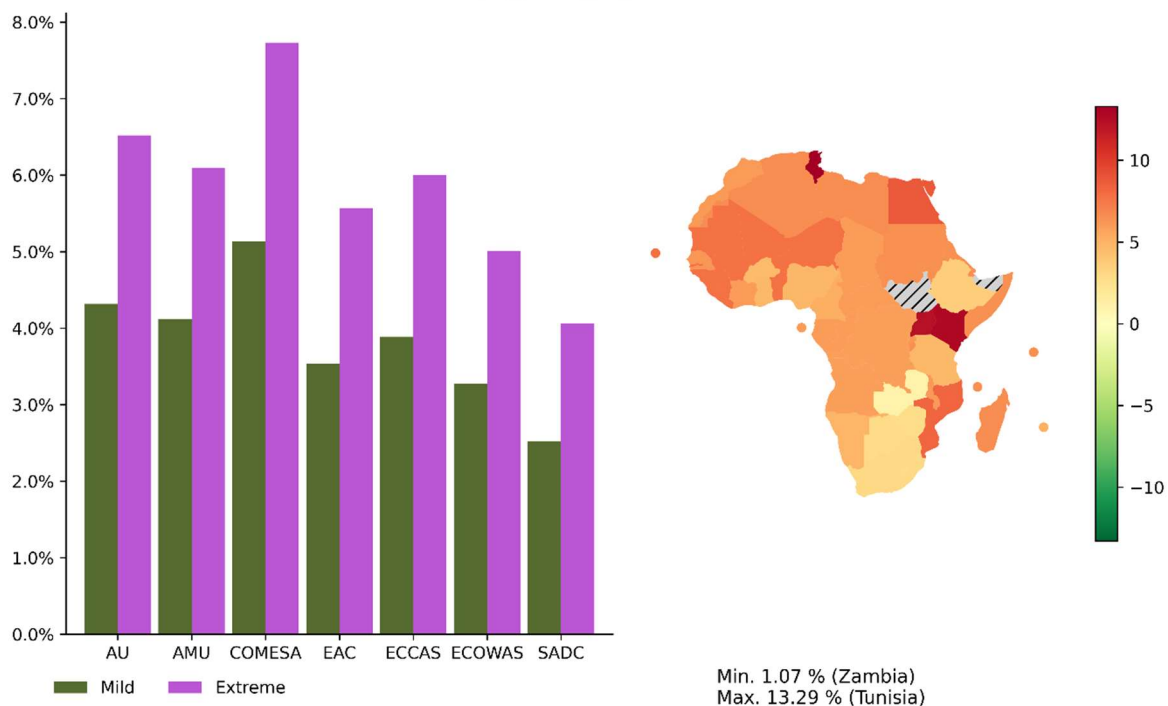


Figure 1. Consumer price of wheat (%-change with respect to baseline in 2023)

The AU prices of agri-food commodities generally increase immediately (primary agricultural commodities between 5.5% and 8.0%, processed foods between 2.9% and 4.3%) and in 2025 the

increase is only slightly mitigated (5.3% and 7.7% for primary agricultural commodities, and 2.6% and 3.9% for processed foods). Figure 2 depicts the ratio of unskilled agricultural workers with respect to cereal prices, which indicates the changes in food affordability for the low-income households. The measure is slightly negatively affected on average, but there are regions that have significant negative effects. For instance, the AMU region gains large income export increases, but also experiences a deterioration in food affordability because of increasing cereal prices. On the other hand, the situation improves in Southern Africa.

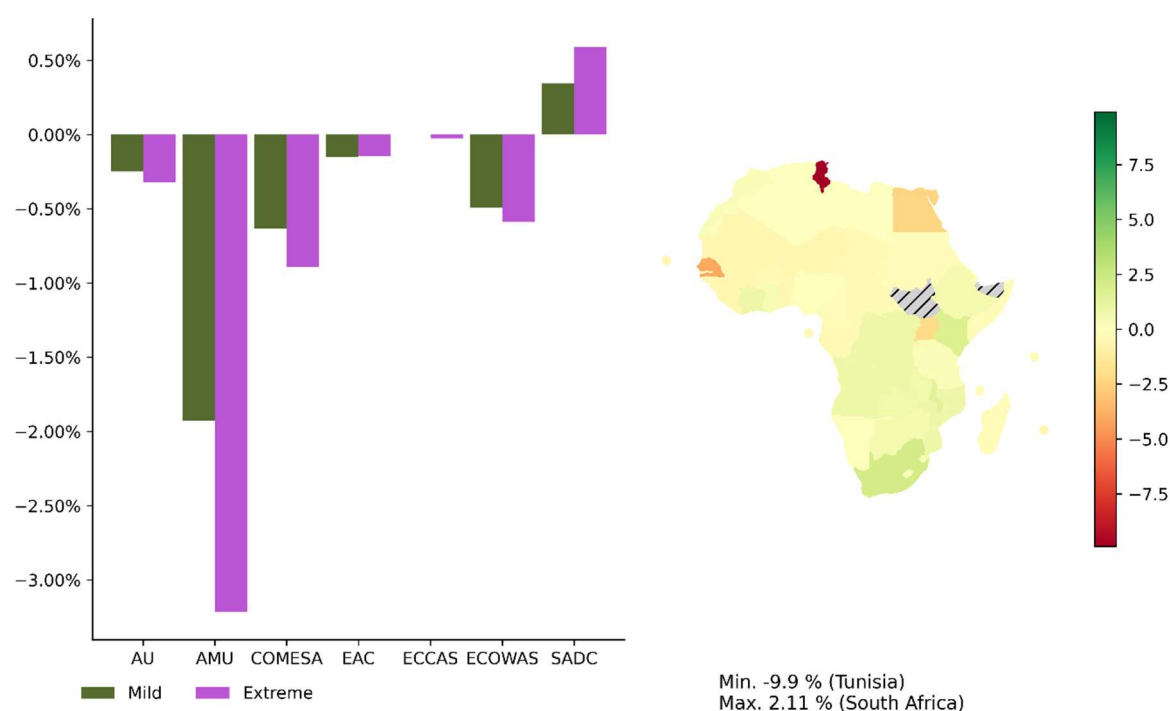


Figure 2. Ratio of unskilled agricultural wages to cereal prices (%-change with respect to baseline in 2023)

The output of primary agricultural products increases in most of the African regions due to necessity to replace lost imports. The immediate country level baseline deviations are modest (-0.55 – 0.31% in 2023) due to investment constraints, but they change by -1.6 – 9.8% by 2025. The total increase in the AU production is 4.8 – 7.0%. The processed food output decreases initially in the AU level, but increases by 2.5 – 3.7% in 2025. The country level variation is -1.7 – 14%.

The imports quantity of primary agricultural commodities will increase by 1.0 – 2.0% in the AU in 2023 (Figure 3). The imports increase slightly more from non-African sources therefore increasing the import dependence in Africa. The country deviations are between -4.6 – 7.6%. The countries that increase their energy resource exports are able to increase their imports of other commodities. The processed food imports quantity increases by 3.0 – 4.3% in the AU, while the country deviations are between -4.1 – 24.9% (Figure 4). The AMU region increases their processed food imports the most, by 12.1 – 17.2% (by 2023). The region has a high share of its income coming from oil and gas exports, and they are geographically conveniently located to respond to the demand gap caused by the decreasing Russian exports to Europe.

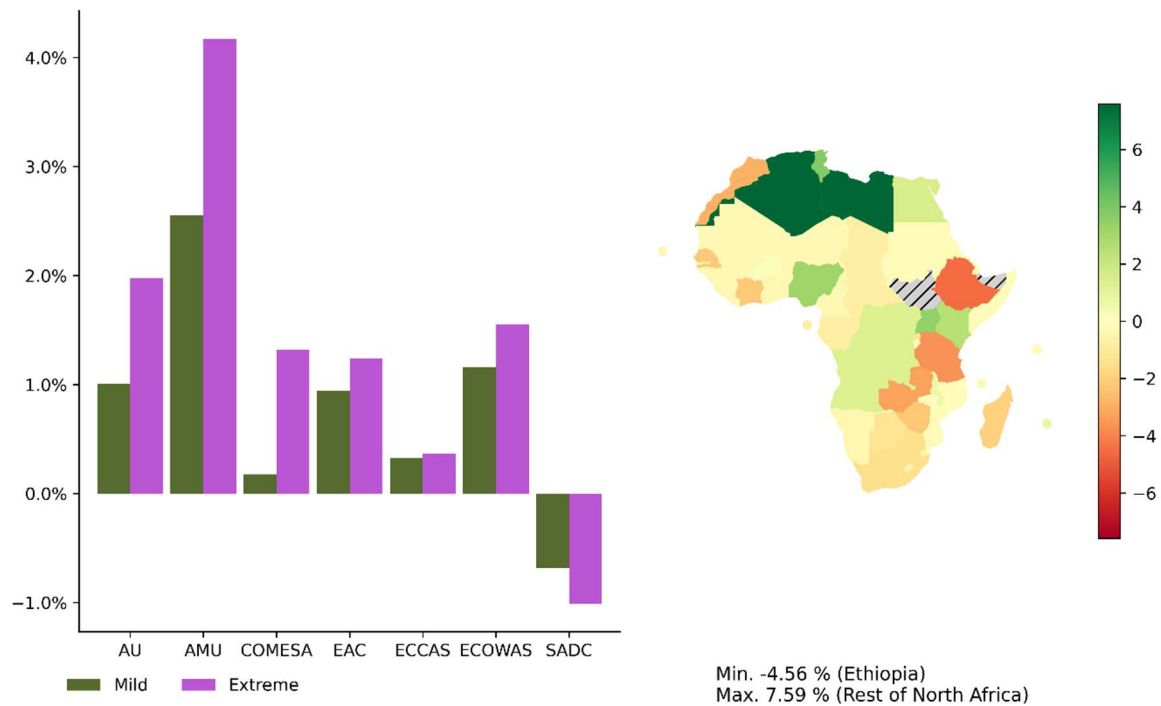


Figure 3. Primary agricultural imports (%-change with respect to baseline in 2023)

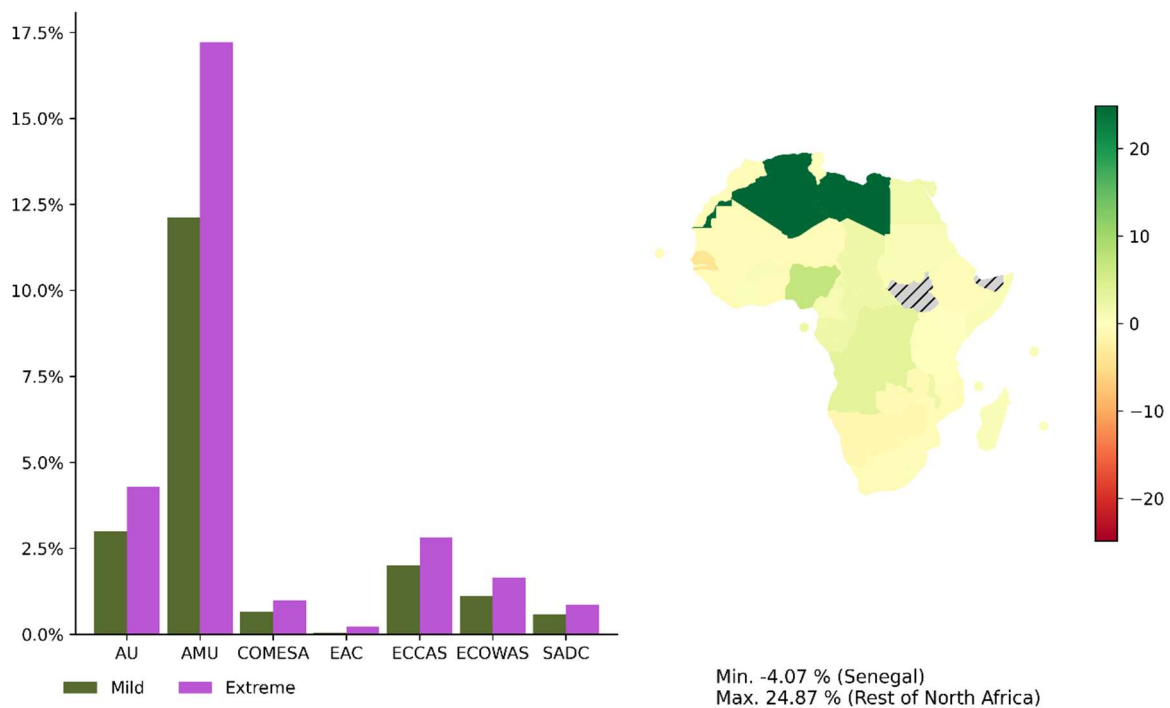


Figure 4. Processed food imports (%-change with respect to baseline in 2023)

The exports of primary agricultural products increase by 1.1 – 1.9% in the AU, but with significant regional variation ranging between -10.6 – 7.8%. Only Nigeria and Rest of North Africa decrease their agricultural exports significantly.

The domestic consumption of food can either increase or decrease depending on the countries' natural resource incomes. In the AU, food consumption does not change significantly (less than 0.1% change in 2023; Figure 5). The effect is nevertheless negative in some regions, and food

consumption decreases the most in Tunisia (-2.9 – -4.2%), Senegal (-2.1 – 2.9%), and Namibia (-1.0 – -1.5%). Resource rich countries are able to increase their food consumption, e.g. Rest of North Africa (8.7 - 11.6%), Rest of Central Africa (0.9 – 1.3%), and South Central Africa (0.8 – 1.1%) increase their food consumption the most. Due to overall increase in food consumption, the number of undernourished in Africa remains unaffected in average in 2023 (Figure 6). The AMU and ECCAS have food security improvements due to increased resource export incomes as the number of undernourished decreases by 0.7 – 0.9% and 0.4 - 0.6%, respectively. Regions with highest increases in the number of undernourished are Tunisia (4.8 – 6.8%), Senegal (3.4 – 4.7%), and Namibia (0.8 – 1.2%).

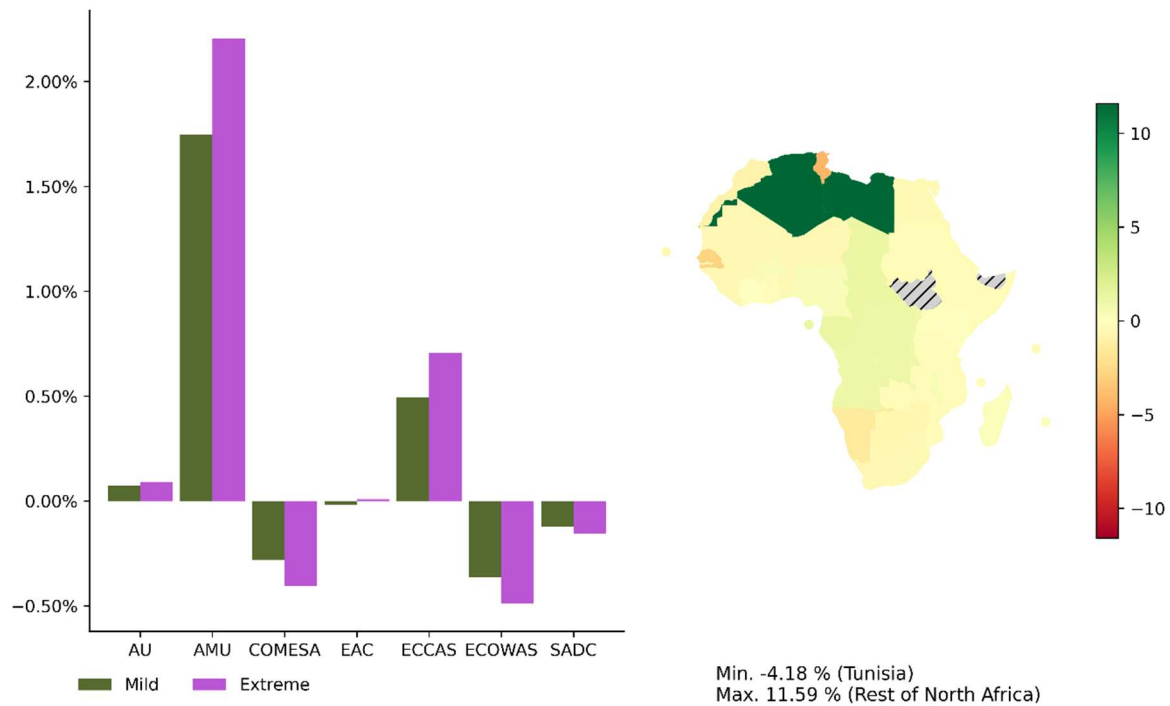


Figure 5. Food consumption (%-change with respect to baseline in 2023)

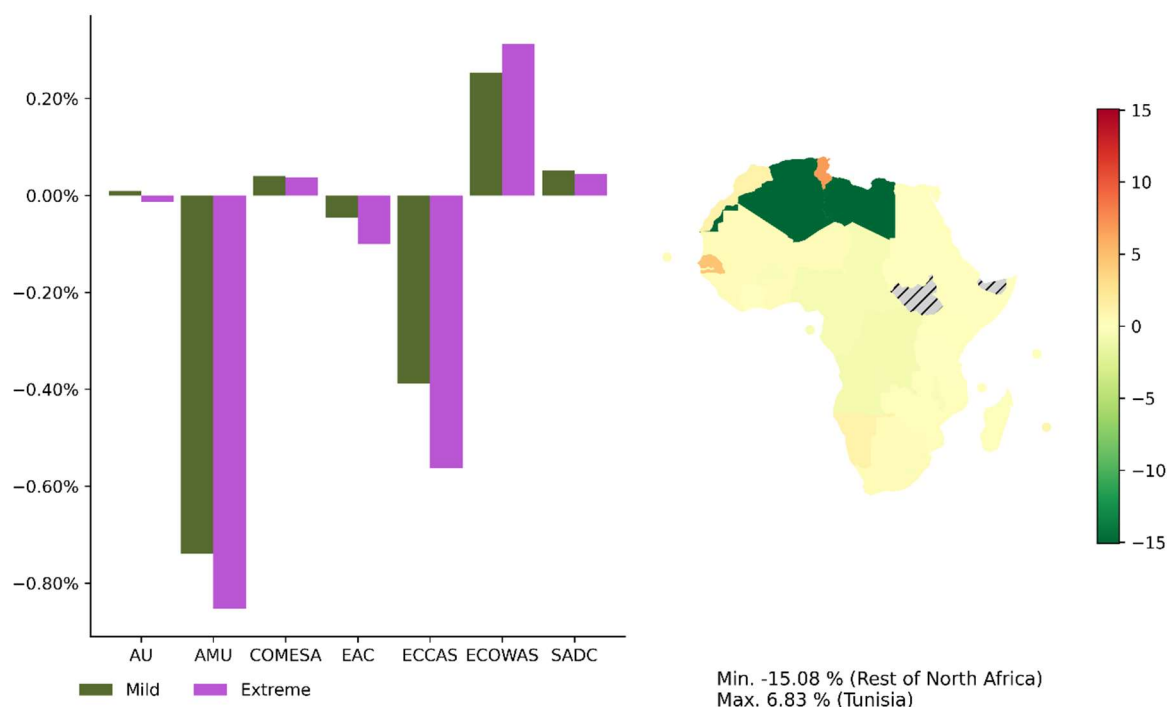


Figure 6. Number of undernourished people (%-change with respect to baseline in 2023)

Overall, the AU GDP is marginally affected (between -0.01 and 0.02% in 2023; Figure 7). The highest decreases happen in Tunisia and Senegal, -1.7 – -2.7% and -1.7 – -2.5% in 2023, respectively. The trade deficits grow in Africa in total by 31 – 45 billion USD by 2023 (Figure 8). The highest increases happen for resource rich regions: the total increase in Rest of North Africa is 22 – 30 billion USD. The change in the trade deficit is due to increased import bills that are affected by the general increase in prices (Figure 9). The import bill for food commodities increase too, with very similar pattern as the total imports (Figure 10).

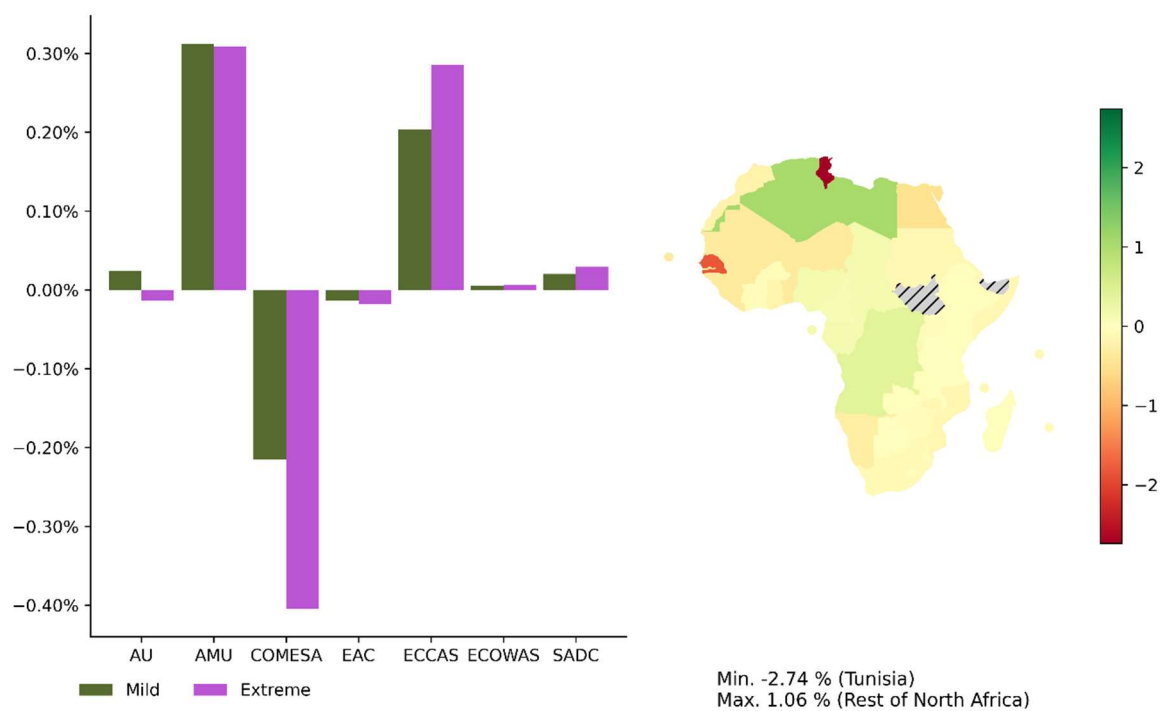


Figure 7. GDP (%-change with respect to baseline in 2023)

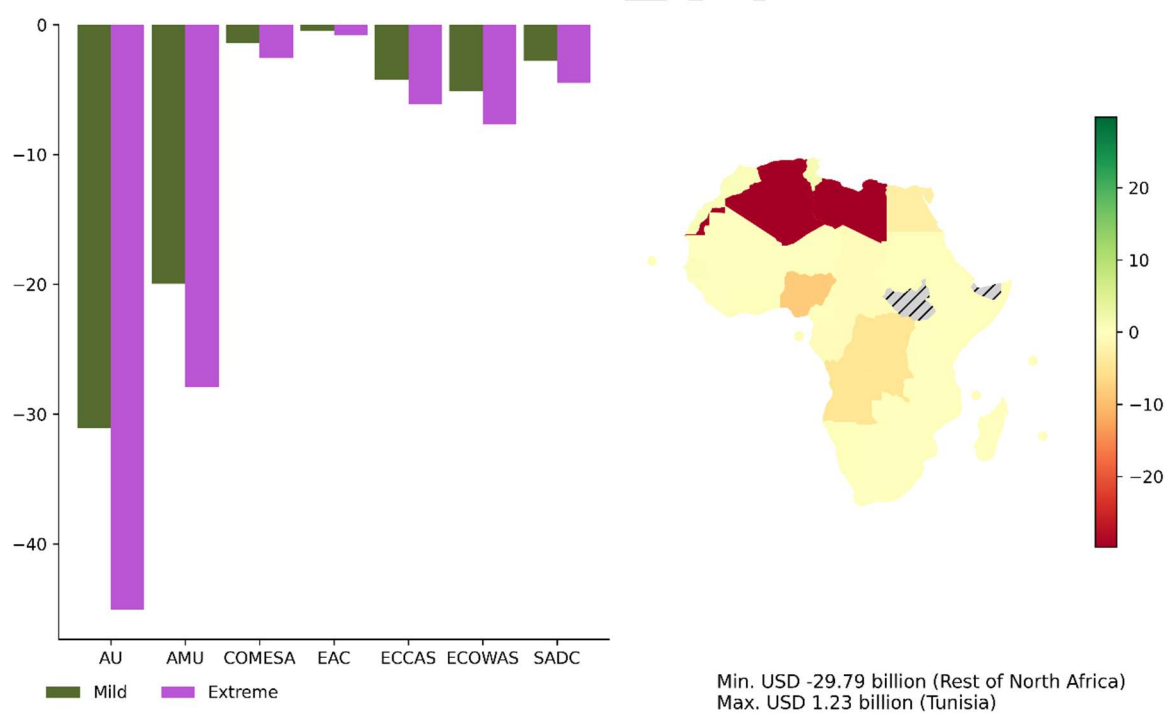


Figure 8. Trade balance (absolute change with respect to baseline in 2023, billions of 2014 USD)

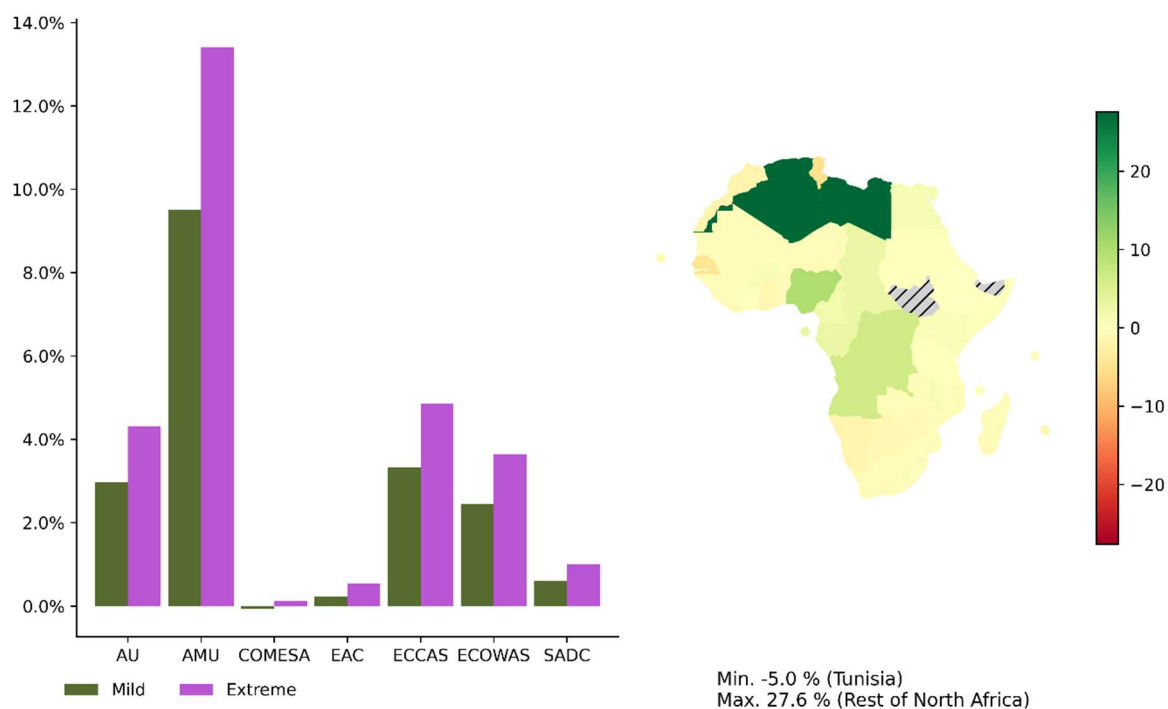


Figure 9. Imports bill (total) (%-change with respect to baseline in 2023)

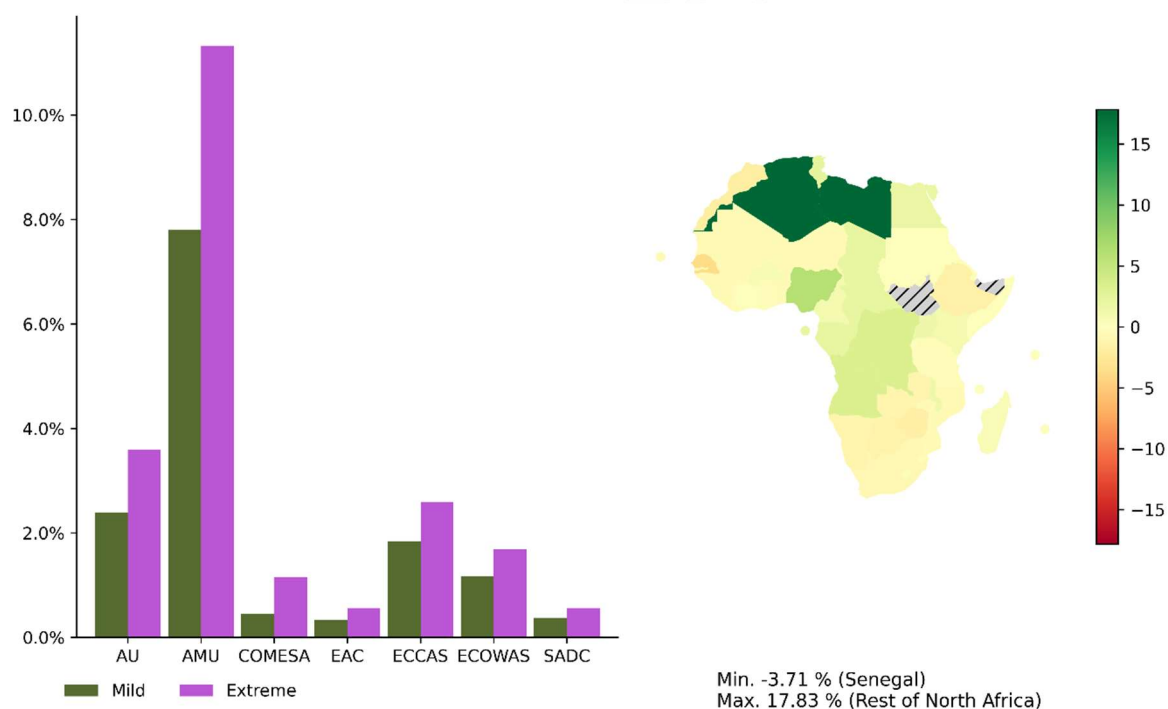


Figure 10. Imports bill (food) (%-change with respect to baseline in 2023)

Discussion and conclusions

Our simulations indicate that the effects of the Ukrainian war on African agri-food sectors and food security are mixed. Defining issue is whether the countries are exporting or importing resources and food. Many African countries export crude oil and gas to world markets. On the other hand, Africa is dependent on food imports. Many countries are able to benefit from higher prices of their main export products. This in general means better food security situation. On the other hand, we can

also see that the price effects are likely to mitigate the positive effects and the situation for the poorest consumer groups can be negative despite the overall income improvements. Finally, some countries like Senegal and Tunisia are left out of the economic benefits accruing to the region.

The increased incomes of the resource exporting countries and lower availability of food in world markets help to create demand for increased agri-food output in Africa. This process is not immediate, but will get stronger when the investments are increasingly allocated to agri-food industries. In the new equilibrium the African economic structures tend to develop towards decreased value added production, e.g. more primary agricultural and natural resources output, which runs counter to the long term objectives of African development.

Our study does not take into account possible retaliatory trade policies that could hamper the trade channel adjustment. The outcomes presented here would be too optimistic in case of such increased protectionism.

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