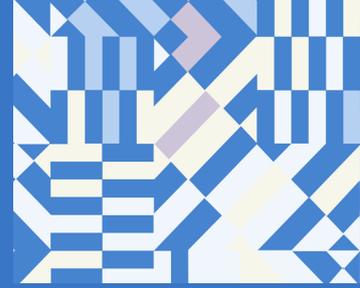




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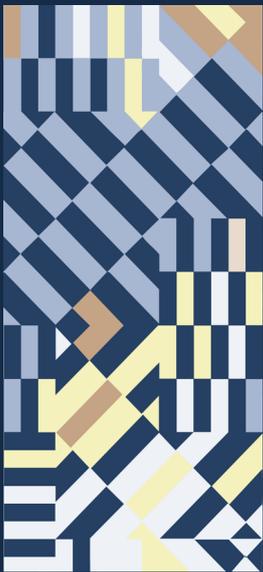


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Agricultural Productivity and Growth Effects of Fertilizer Sector Disruptions

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Introduction

African countries are going to be significantly affected by the sharp increases in global fertilizer prices. While the use of fertilizers on the continent is on average lower than in other regions, use tends to be concentrated in a few sectors which are very sensitive to supply disruption. The exposure of African countries largely arises from the reality that they rely heavily on fertilizer imports, including from Ukraine and Russia. According to Badiane et al. 2022, a total of 36 African countries import fertilizer from Russia and Ukraine. These countries are directly exposed to the reduction of exports from the conflicting countries. More significantly, the same report shows that many African countries import more fertilizer than they use in domestic consumption. A total of 20 African countries had a fertilizer import penetration rate that was higher than 100% for the 2015-2019 period, meaning that they imported more fertilizer than the quantities they consumed over the same period. These surplus quantities are re-exported to neighboring countries. Fertilizer re-export within Africa reached 581 million USD in 2020. This means that considerably more countries are exposed to the disruption of fertilizer markets beyond those dealing directly with Ukraine and Russia or those engaged in foreign export markets in general.

THE UKRAINE CRISIS
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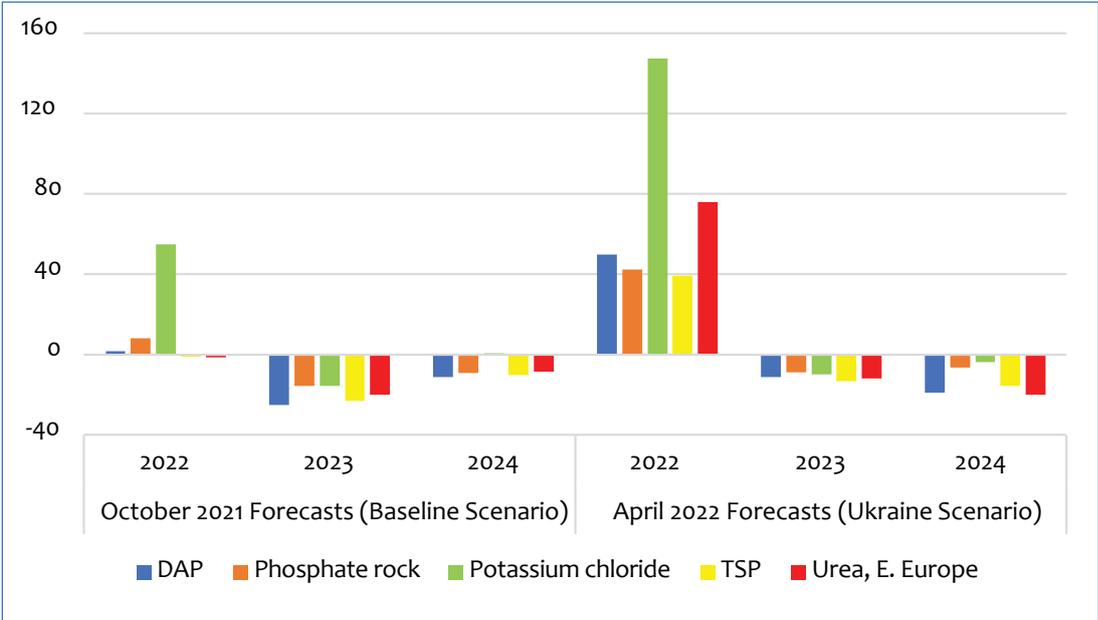
The disruption of global fertilizer supply chains and the ensuing sharp price increases are therefore certain to affect African economies. Higher prices and supply shortages reduce application rates which lower productivity per hectare (ha), leading to decreased crop output. Declines in individual crop output lower the contribution of the agricultural sector to the overall economy and depresses growth of gross domestic product (GDP). The current report presents results from simulations of this chain of events in eight of the most exposed African countries, namely: Ghana, Kenya, Malawi, Mozambique, Nigeria, Senegal, Tanzania, and Uganda. The remaining two countries of the ten covered by this study – Benin and South Africa – are not included because the data set used for the study does not disaggregate their agricultural data sufficiently to allow for the modeling of individual crop sectors.

2. Supply Chain Disruptions and Changes in Global Market Prices for Fertilizers

Figure 1 presents projected fertilizer prices in October 2021, a few months before the Ukraine war broke out in February 2022. This represents the baseline scenario and is plotted against projections made in April 2022 which represent the Ukraine war scenario. As Figure 1 reveals, the effects of the Ukraine war on global fertilizer markets are illustrated by the sharp differences between the baseline and the Ukraine war scenarios. Except for potassium, global fertilizer prices in the baseline scenario (which shows the post-COVID-19 situation) would stabilize in 2022 before trending downwards in 2023 and 2024. However, following the start of the war, the downward trend in prices of all fertilizer types reversed course, rising by at least 40%. Essentially, prices for urea almost doubled, while potassium prices increased threefold compared to their already very high levels in 2022.

The modest declines projected for 2023 and 2024 under the Ukraine scenario suggest that prices will barely recover from the surge in 2022 and will therefore remain at high levels into 2024. This finding suggests that African countries are expected to face significant increases in prices for all fertilizer types in 2022, with only modest downward corrections in 2023 and 2024. It also indicates that high fertilizer prices are expected to prevail across African countries for the near future.

Figure 1: Fertilizer Price, Percentage Annual Changes

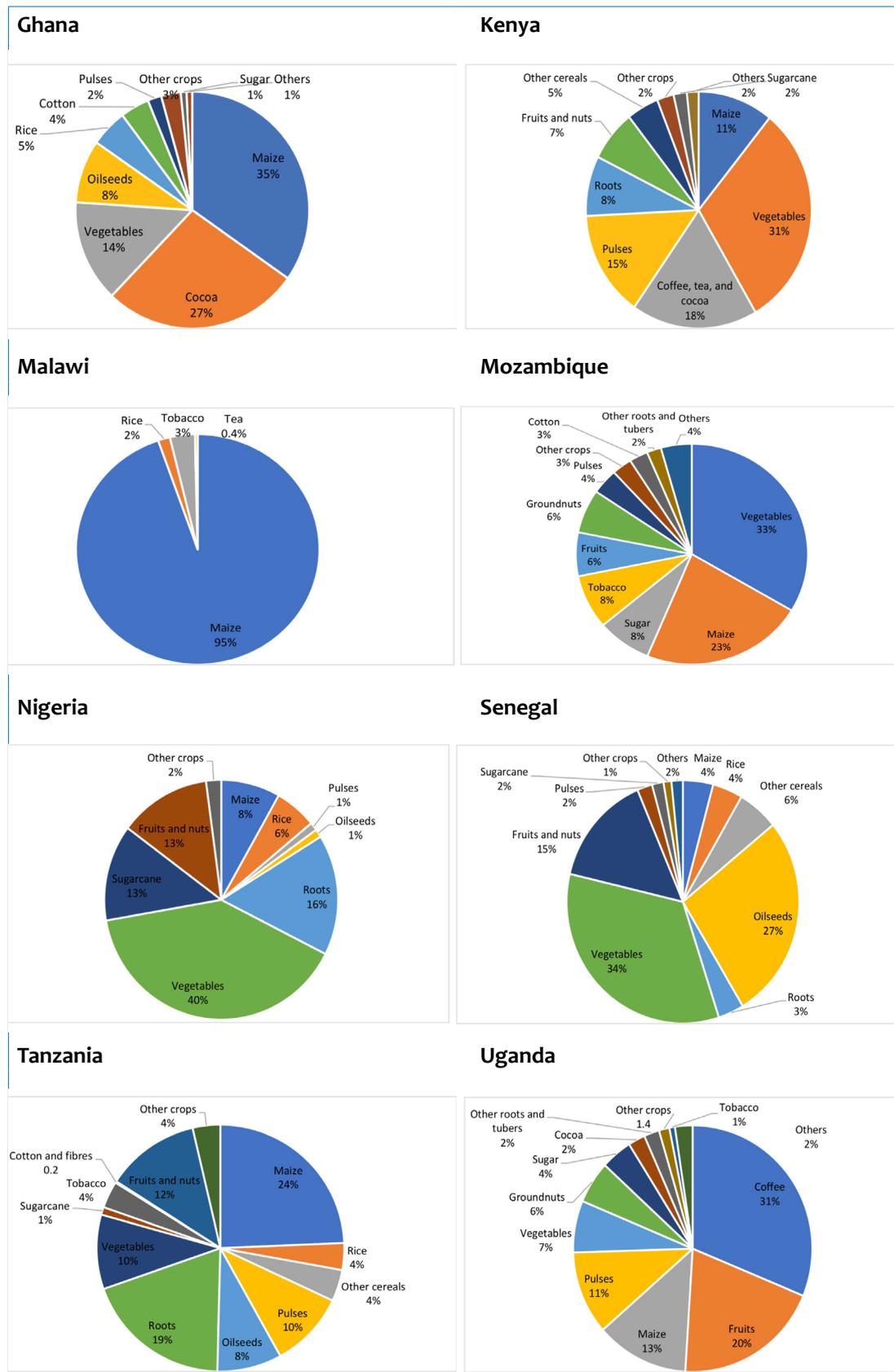


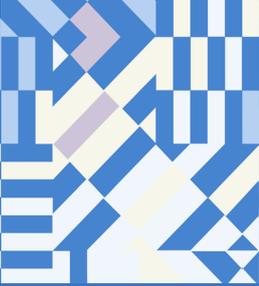
3. Fertilizer Use Patterns and Trade Disruption Effects in African Countries

The share of fertilizer used for different crop types shows that fertilizer use in African countries tends to be concentrated among just a few crops. As Figure 2 and Annex Table 1 reveal,

no more than two crop types account for at least half of the total fertilizer used in practically all countries covered in this study.

Figure 2: Fertilizer Use Share by Crop Type





However, significant variations are evident in the proportions of crop fertilizer used among the study countries. That is, the consumption shares of the top two fertilizer-using crop types are highest in Malawi, Ghana, and Senegal, where they reach 98%, 62% and 61% respectively. These three countries are followed by Mozambique, and Nigeria with a 56% share each, Uganda at 51% and Kenya at 49%. Tanzania is the only exception among the study countries with the top two fertilizer-using crop types claiming slightly more than 40% of total fertilizer consumption. The top consuming crop types in most cases are industrial crops such as oilseeds in Senegal, as well as coffee and/or cocoa in Uganda, Ghana, and Kenya. The vegetable sector is another large user of fertilizers, particularly in Nigeria, Senegal, Mozambique and Kenya, with shares ranging between 30% and 40%.

Cereals, namely maize, rank among the top consuming crop types only in Malawi, Ghana, Tanzania, and Mozambique. In Malawi, maize is virtually the only fertilizer-using crop type accounting for 95% of fertilizer consumption. The share of fertilizer use in cereals is the least in Nigeria, Senegal, Kenya, and Uganda. In Nigeria, the shares of cereals – maize and rice – in total fertilizer consumption are in the single digits. Similarly, in Kenya and Uganda, the share of maize, which is the only cereal with notable fertilizer use, is barely higher than 10%. In Senegal, the shares of fertilizer use in maize and rice production are less than 5% each.

4. Fertilizer Price Shocks and Consumption Changes

Compared to the baseline scenario, all eight countries are projected to show declines in fertilizer use for all crops under the Ukraine scenario. However, there are variations in the results in terms of magnitude and the type of crops affected across countries (Figure 3; Annex Table 2). On average, fertilizer use is expected to decline by between 20% and 45% across the study countries. The highest average change in fertilizer use (approximately -30%) is observed in Uganda and Kenya. In Ghana, Kenya and Uganda, the coffee and cocoa sectors which are among the top fertilizer users, will see the largest declines in use. Other important fertilizer consuming crop types that will see significant reductions in fertilizer use are tea in Malawi, cotton and rice in Senegal, oilseeds in Ghana, tobacco and fruits in Mozambique, and pulses in Tanzania.

As Figure 3 shows, an average decline in consumption is expected among leading cereals i.e., maize and rice. While maize is a top fertilizer user only in Malawi, Ghana, and Tanzania, rice has a minor share of demand in most countries. The tobacco sector will also record an important decline in consumption, but it only plays a noticeable role in Mozambique, Malawi, and Tanzania.

Figure 3: Fertilizer Use by Type of Crop, Percentage Changes Ukraine Compared to Baseline Scenarios



For most crops and countries, fertilizer use is expected to decline further in 2023 with only a partial recovery in 2024. None of the study countries or crops is projected to recover from the

sharp decline in fertilizer use in 2022, in line with global fertilizer prices remaining solidly above pre-war levels even into 2024.

5. Output and Growth Effects

The analysis shows that the significantly higher fertilizer prices and lower application rates across all crop types will translate into lower output and the decline of the agricultural sector as a whole in all countries. This is evidenced by the drop in crop and agricultural output as well as GDP under the Ukraine scenario in comparison to the baseline scenario (Figure 4; Annex Table 3).

Agricultural value-added as a measure of output, declines by 5% to 10% in Kenya, Malawi, Senegal, Tanzania, and Uganda. For Ghana, Mozambique and Nigeria, the corresponding decline is much lower and lies significantly below 5%. As shown in Figure 4, the drop in crop output persists for all countries, and sharpens, particularly in Ghana, Senegal, and Uganda, through 2024.

The analysis further shows that lower output for the different crop types reduces agricultural sector value-added in all countries. This effect is particularly significant in Ghana, Kenya, and Nigeria where the induced change in overall agricultural sector output is almost equivalent to the change in crop sector output. Moreover, the decline in agricultural sector output continues through 2024 in all countries. However, Senegal and to a lesser extent Tanzania, are the only countries where agricultural sector output starts to recover by 2024, with a noticeable decrease in the rate of decline. Similarly, Malawi, Mozambique and Kenya also face modestly lower rates of decline in 2024 compared to 2023. In contrast, the rate of decline of agricultural sector output remains high in Ghana and Uganda relative to 2022 and rises noticeably in Nigeria in 2024.

Figure 4 and Annex Table 3 also show that the decline in crop and agricultural sector output results in lower GDP growth across all countries studied. More specifically, GDP growth effects are highest in Kenya, Tanzania, and Uganda, where GDP declines by 3% to 5% in 2024. For the remaining countries, the rate of GDP decline is less than 1.5%. It is important to note that for all countries, the rate of GDP decline in 2023 and 2024 exceeds the initial drop in 2022, reflecting the lingering economywide effects of the disruption to global fertilizer supply chains. Consequently, it will take several years to fully recover from the initial shock in 2022 for all study countries. This indicates that the Ukraine war will pose a noticeable threat to Africa's economy and food security in the coming years.



Figure 4: Output Effects, Percentage Changes Ukraine Compared to Baseline Scenarios



Conclusion

The war in Ukraine has driven fertilizer prices substantially higher in 2022, with modest declines projected for 2023 and 2024. This trend suggests that countries in Africa will continue to face high fertilizer prices for the coming years. The disruption of global fertilizer markets is expected to reduce fertilizer use for all crops, in all the countries covered by the study. This reduction in fertilizer use is projected to translate into lower output in the agricultural sector, with negative effects on GDP growth. Unless effective responses are found urgently this year or by the next cycle of growing seasons at the latest, the fertilizer crisis is likely to trigger wider macroeconomic and balance of payment problems for many African countries.

ANNEX TABLES

Tables 1: Crop Fertilizer Use and Value-Added Share

GHANA

	Share Total Fertilizer	Share Agricultural Value Added
Maize	34.7	12.3
Rice	5.1	5.2
Other cereals	0.4	3.6
Pulses	1.9	1.2
Groundnuts	0.2	2.0
Oilseeds	8.6	3.3
Vegetables	13.9	14.5
Sugar	0.8	0.2
Tobacco	0.1	0.0
Cotton	4.0	0.5
Cocoa	27.3	7.7
Coffee	0.1	0.0
Other crops	2.7	0.3

KENYA

	Share Total Fertilizer	Share Agricultural Value Added
Maize	10.8	21.8
Other cereals	4.6	5.3
Pulses	14.5	14.8
Oilseeds	0.9	1.5
Roots	8.2	6.7
Vegetables	30.8	11.9
Sugarcane	1.9	2.5
Tobacco	0.4	0.2
Cotton and fibres	0.4	0.5
Fruits and nuts	7.0	12.7
Coffee, tea, and cocoa	18.1	5.8
Other crops	2.4	2.3

MALAWI

	Share Total Fertilizer	Share Agricultural Value Added
Maize	94.72	40.3
Rice	1.59	3.5
Tobacco	3.33	3.3
Tea	0.36	0.5

MOZAMBIQUE

	Share Total Fertilizer	Share Agricultural Value Added
Maize	22.7	29.1
Rice	1.1	3.3
Wheat	0.0	0.0
Other cereals	0.8	1.5
Pulses	3.7	7.0
Groundnuts	6.4	5.2
Oilseeds	1.4	2.1
Other roots and tubers	2.0	1.1
Vegetables	33.5	17.0
Sugar	7.6	7.4
Tobacco	7.9	7.5
Cotton	2.6	3.9
Fruits	6.4	3.7
Coffee	1.0	1.0
Other crops	2.8	2.9

Source: All data in Tables 1 are from
AKADEMIYA2063 Social Accounting
Matrices Database

Tables 1: Crop Fertilizer Use and Value-Added Share (Continued)

NIGERIA

	Share Total Fertilizer	Share Agricultural Value Added
Maize	8.2	4.4
Rice	5.8	5.2
Pulses	1.1	0.7
Oilseeds	1.1	2.4
Roots	16.3	38.0
Vegetables	39.8	20.5
Sugarcane	13.0	0.6
Fruits and nuts	12.7	12.9
Other crops	2.1	0.1

SENEGAL

	Share Total Fertilizer	Share Agricultural Value Added
Maize	4.2	3.1
Rice	4.2	7.6
Other cereals	5.7	9.4
Pulses	2.1	1.2
Oilseeds	27.3	13.2
Roots	3.6	3.3
Vegetables	33.7	13.0
Sugarcane	1.6	1.2
Tobacco	1.1	0.5
Cotton and fibres	0.5	0.4
Fruits and nuts	14.9	8.8
Other crops	1.1	0.7

TANZANIA

	Share Total Fertilizer	Share Agricultural Value Added
Maize	24.2	6.0
Rice	3.5	5.2
Other cereals	4.1	2.0
Pulses	9.9	5.0
Oilseeds	8.4	6.2
Roots	19.1	12.4
Vegetables	9.7	2.5
Sugarcane	1.0	0.6
Tobacco	3.5	1.2
Cotton and fibres	0.2	0.2
Fruits and nuts	12.2	14.3
Other crops	3.6	1.0

UGANDA

	Share Total Fertilizer	Share Agricultural Value Added
Maize	12.56	8.5
Sorghum	0.43	2.4
Rice	0.09	0.6
Other cereals	0.26	0.1
Pulses	10.95	5.2
Groundnuts	5.53	2.7
Oilseeds	0.41	1.6
Cassava	1.10	4.8
Other roots and tubers	2.07	4.7
Vegetables	6.80	3.1
Sugar	4.22	1.4
Tobacco	0.75	0.3
Cotton	0.11	0.2
Fruits	19.76	15.6
Cocoa	2.30	0.5
Coffee	31.24	5.8
Other crops	1.42	1.0

Tables 2: Changes in Crop Fertilizer Use Compared to Baseline (%)

GHANA

	2022	2023	2024
Maize	-18.7	-23.1	-21.4
Rice	-21.9	-26.8	-24.6
Other cereals	-22.1	-27.0	-24.8
Pulses	-17.2	-21.4	-19.7
Groundnuts	-19.6	-24.2	-22.1
Oilseeds	-22.2	-27.7	-25.6
Vegetables	-18.8	-23.4	-21.3
Sugar	-18.5	-23.7	-22.2
Tobacco	-18.0	-22.5	-20.9
Cotton	-16.6	-21.1	-19.6
Cocoa	-25.2	-32.3	-30.5
Coffee	-28.7	-36.8	-36.8
Other crops	-18.6	-23.4	-21.5

KENYA

	2022	2023	2024
Maize	-22.5	-28.3	-25.9
Other cereals	-22.9	-29.1	-26.4
Pulses	-21.4	-26.7	-24.6
Oilseeds	-21.6	-27.4	-25.4
Roots	-20.5	-25.6	-23.7
Vegetables	-18.9	-23.7	-22.1
Sugarcane	-20.4	-25.9	-23.9
Tobacco	-25.9	-33.5	-29.9
Cotton and fibres	-19.7	-26.3	-25.4
Fruits and nuts	-21.5	-26.8	-24.7
Coffee, tea, and cocoa	-34.2	-41.4	-37.8
Other crops	-24.3	-31.5	-28.1

MALAWI

	2022	2023	2024
Maize	-19.9	-24.6	-22.6
Rice	-21.6	-26.2	-23.9
Tobacco	-20.5	-25.2	-23.1
Leaf tea	-28.0	-33.6	-30.5

MOZAMBIQUE

	2022	2023	2024
Maize	-21.4	-26.1	-23.9
Rice	-21.0	-25.6	-23.4
Wheat	-25.2	-31.2	-27.7
Other cereals	-20.7	-25.4	-23.1
Pulses	-23.2	-28.4	-25.7
Groundnuts	-22.4	-27.2	-24.9
Oilseeds	-24.8	-31.1	-27.2
Other roots and tubers	-23.0	-28.1	-25.5
Vegetables	-21.3	-26.0	-23.8
Sugar	-22.6	-28.3	-25.1
Tobacco	-23.0	-30.6	-27.0
Cotton	-23.6	-29.5	-26.2
Fruits	-24.4	-30.5	-26.7
Coffee	-23.7	-29.4	-26.3
Other crops	-22.2	-27.0	-24.8
Maize	-21.4	-26.1	-23.9
Rice	-21.0	-25.6	-23.4

Source: All data in Tables 2 are based on results from the authors' simulations

Tables 2: Changes in crop fertilizer use compared to baseline (% , Continued)

NIGERIA

	2022	2023	2024
Maize	-20.5	-24.8	-22.9
Rice	-20.8	-24.9	-23.3
Pulses	-20.6	-24.9	-23.1
Oilseeds	-22.2	-26.6	-24.5
Roots	-19.9	-24.1	-22.2
Vegetables	-19.9	-24.2	-22.2
Sugarcane	-19.5	-24.0	-22.1
Fruits and nuts	-20.7	-25.1	-23.1
Other crops	-25.3	-32.0	-28.6

SENEGAL

	2022	2023	2024
Maize	-23.1	-28.8	-25.9
Rice	-21.9	-28.6	-26.4
Other cereals	-22.2	-27.7	-25.3
Pulses	-19.0	-23.7	-21.7
Oilseeds	-19.7	-25.4	-23.1
Roots	-20.9	-25.9	-23.6
Vegetables	-20.7	-26.2	-23.5
Sugarcane	-16.6	-21.6	-20.2
Tobacco	-21.5	-37.0	-35.4
Cotton and fibres	-20.2	-30.2	-30.5
Fruits and nuts	-21.0	-26.6	-23.8
Other crops	-23.9	-30.8	-27.1

TANZANIA

	2022	2023	2024
Maize	-19.7	-24.9	-22.7
Rice	-22.0	-29.2	-25.2
Other cereals	-21.4	-29.7	-23.5
Pulses	-22.3	-30.5	-23.5
Oilseeds	-20.5	-27.3	-24.1
Roots	-21.2	-26.7	-24.4
Vegetables	-17.5	-22.7	-20.2
Sugarcane	-18.0	-24.4	-20.9
Tobacco	-23.3	-43.5	-41.5
Cotton and fibres	-19.1	-27.9	-25.0
Fruits and nuts	-22.1	-28.0	-25.1
Other crops	-26.2	-45.3	-33.5

UGANDA

	2022	2023	2024
Maize	-21.2	-26.5	-24.2
Sorghum	-22.5	-27.5	-25.3
Rice	-23.5	-29.3	-26.6
Other cereals	-27.1	-35.7	-31.8
Pulses	-20.9	-26.0	-23.9
Groundnuts	-19.3	-24.1	-22.5
Oilseeds	-22.6	-28.1	-25.8
Cassava	-22.0	-26.9	-25.0
Other roots and tubers	-21.5	-26.4	-24.5
Vegetables	-19.7	-24.4	-22.7
Sugar	-24.8	-32.9	-29.7
Tobacco	-29.8	-39.5	-36.6
Cotton	-22.0	-27.6	-26.1
Fruits	-20.5	-25.2	-23.4
Cocoa	-29.2	-38.0	-35.2
Coffee	-32.9	-42.0	-40.8
Other crops	-23.8	-30.5	-27.3

Tables 3: Changes in Crop Output, Agricultural Value-Added and GDP

GHANA			
	2022	2023	2024
Value Added, Crops	-2.4	-3.1	-3
Value Added, Agriculture	-2	-2.5	-2.5
GDP	-0.6	-1	-1.3

KENYA			
	2022	2023	2024
Value Added, Crops	-7.2	-9.4	-8.5
Value Added, Agriculture	-6.3	-8.6	-7.7
GDP	-2.1	-3.5	-4.1

MALAWI			
	2022	2023	2024
Value Added, Crops	-5.6	-7.1	-6.6
Value Added, Agriculture	-3.4	-4.5	-4.3
GDP	-1	-1.5	-1.7

MOZAMBIQUE			
	2022	2023	2024
Value Added, Crops	-2.4	-3.1	-3
Value Added, Agriculture	-1.8	-2.4	-2.3
GDP	-0.7	-1.2	-1.4

NIGERIA			
	2022	2023	2024
Value Added, Crops	-1.9	-1.8	-2.2
Value Added, Agriculture	-1.7	-1.6	-2.1
GDP	-0.6	-1	-1.3

SENEGAL			
	2022	2023	2024
Value Added, Crops	-5.9	-8.5	-7.2
Value Added, Agriculture	-3.7	-5.6	-5
GDP	-0.9	-1.5	-1.7

TANZANIA			
	2022	2023	2024
Value Added, Crops	-6.3	-9.7	-7.4
Value Added, Agriculture	-3.7	-6.1	-5.4
GDP	-1.4	-2.6	-3.2

UGANDA			
	2022	2023	2024
Value Added, Crops	-6.7	-8.8	-8.5
Value Added, Agriculture	-3.9	-5.5	-5.7
GDP	-1.2	-2.2	-3

Source: All data in Tables 3 are based on results from the authors' simulations.

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