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CAP measures towards environmental sustainability

Trade opportunities for Africa?

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Abstract

The future EU Common Agricultural Policy (CAP) requires coherence with the Sustainable Development Goals (SDGs) and the international commitments in the fight against climate change. Next to ensuring stable food supply by supporting farmers and enhancing agricultural productivity, environmental sustainability is a core aspect of the proposed future CAP. At the same time, new policies must not compromise socio-economic development in low-income countries, especially in Africa, as stated in the European consensus on development. On the contrary, the extensification of agriculture in the EU may create trade opportunities for African countries. We apply a global agri-economic model to assess trade-related impacts of potential, environmentally motivated changes of CAP policies in the EU and Africa. Our findings suggest that EU production levels of meat would change with a stronger environmental focus of the CAP. These changes reduce the EU's share in agri-trade flows to Africa. However, food supply in Africa is not projected to deteriorate, as imports from other world regions and, to a limited extent, increasing domestic production can fill the gap. In how far potentials for domestic production growth can be used in African regions depends at least partly on their competitiveness vis-á-vis substituting importers. A sensitivity analysis on reduced transport costs shows that infrastructure investments could contribute to a stronger integration of Africa in international markets. On a global level, our analysis reveals the need to balance sustainability trade-offs in terms of avoiding leakage effects from EU agricultural production changes versus facilitating economic growth potentials in low- and middle-income countries.

Keywords: CAP reform, EU-Africa-trade, transport costs, coupled payments

JEL codes: Q17, Q18, Q56

1. Introduction

The Multiannual Financial Framework and the main orientation of the Common Agricultural Policy (CAP) of the EU member states for 2021-2027 are currently under discussion in the light of internal and global challenges. The proposal[1] of the European Commission (2018) aims at a simpler and fairer distribution of payments. Increased flexibility regarding the allocation of funds by EU member states is suggested to reduce bureaucracy and strengthen subsidiarity, but also raises concerns to prepare the ground for a comeback of the intensified use of voluntary coupled payments which have been criticized for inhibiting agricultural production efficiency in the past (Matthews, 2018; Kornher and von Braun, 2020; Zhu et al., 2012). At the same time, the future CAP shall meet higher ambitions on environmental and climate targets laid down in the United Nation's Sustainable Development Goals (SDGs)[2] and the Paris Agreement[3]. The political relevance of these goals is pointed out with the proposal of a "European Green Deal"[4] for climate neutrality by 2050. While the future CAP shall increasingly serve environmental targets, implications on sustainable development in trading partner countries have not been at the core of the CAP in the past or in the current reform discussion. Achieving food security and rural development especially in low-income countries (LICs) are declared aims of the SDGs, and therefore, also principles for European policy making. In "The Future of Food and Farming" the European Commission (2017) urges to take into account the global implications of the CAP as well as the objectives of development cooperation in the EU's agricultural policy design. Several policies in the focus of the ongoing discussion on the CAP reform might substantially affect environmental and other sustainable development targets primarily through changes in the production and trade of agricultural goods. In order to ensure coherence between EU policies and international commitments, the assessment of potential trade-offs and synergies of policy targets is necessary.

Sustainable growth and development progress in Africa are key components for meeting the global SDGs by 2030 (Kedir et al., 2017; Schwerhoff and Sy, 2017). Also, new EU policies must not compromise socio-economic development in low-income countries, especially in Africa, as stated in the "New European consensus on development" (European Council et al., 2017). While challenges to increase agricultural productivity and efficiency in local value chains to reduce food insecurity and poverty persist in Africa, its involvement in global agri-food value chains has expanded rapidly (Feyaerts et al., 2020). Exploiting comparative advantages in trade relations offers great welfare and development potentials according to mainstream economic theory (Kanji and Barrientos, 2002). However, Desai and Rudra (2019) find that agricultural trade impacts on poverty in developing countries are ambiguous and depending

[1] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52018PC0392&from=EN
[2] https://sustainabledevelopment.un.org/post2015/transformingourworld
[3] https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement
[4] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

on the net trade status of a country. Also, global economic crises can weaken the reliability of trade flows and thus increase the necessity of ensuring (at least) partial self-sufficiency and a diversified food supply in staples (Puma et al., 2015; Chen and Villoria, 2019). The EU continues to be Africa's most important trading partner, roughly covering one-third of African imports and exports in 2018 (Eurostat, 2019). Food commodities represent about one-tenth of African imports from and exports to the EU (Eurostat, 2019). Agricultural raw materials, such as cocoa, coffee, and sugar are the most important exports from Africa to the EU, while the EU mainly exports processed foods, dairy products and wheat to Africa.

There has been an increasing trend in traded agricultural quantities for several products between the EU and Africa since the beginning of the 21st century (Figure A1). With respect to African imports from the EU, cereals stand out in level and growth. Moreover, imported quantities of vegetables and fruits, and meat increased between 2000 and 2013. The meat imports are demanded almost entirely from Sub-Saharan Africa. The traded quantities from Africa to the EU do not reach up to the high level of cereal inflows. Still, a strong growth trend is visible for fruit and vegetable exports from Africa, specifically from North Africa to the EU. The second largest export flow in terms of quantity is constituted by the high value group of coffee, cocoa and teas sourced in Sub-Saharan Africa. Despite its comparably high level, no clear increasing trend is visible. A sudden increase in cereal exports from Sub-Saharan Africa to Europe is evident around the year 2010.

Agricultural trade between EU and Africa has been criticized for negatively impacting African agricultural producers (Dupraz and Postolle, 2013; Weible and Pelikan, 2016). In this context, the CAP is suspected to aggravate barriers to development through implicitly subsidizing exports (Reichert and Thomsen, 2018). A recent publication by Flaig and Boysen-Urban (2019) assesses the flow of EU agricultural subsidies along the respective value chains and concludes that about 2% of those payments are forwarded to African trading partner countries indirectly via price effects. Consequently, opposite welfare implications arise for African net-producers and -consumers of the respective commodities (Rudloff and Brüntrup, 2018).

A reduction of the direct payments and their redistribution in particular to sustainability measures is discussed in the reform proposal (European Commission, 2018). The "New Green Architecture" of the CAP allows for the possibility to set the necessary incentives through agri-environment-climate measures or eco-schemes (Matthews, 2018; European Commission, 2019). Only minor impacts on EU production and trade are related to the currently existing direct payments schemes according to the literature (Boysen et al., 2016; Philippidis et al., 2016). However, marginal areas are more likely to be kept in production, which increases EU agri-food net trade surpluses (Brady et al., 2017). According to Matthews (2018), a redistribution of direct payments to small and medium-sized farms could reduce EU exports while increasing agricultural imports to the EU, also from low-income countries. Bureau and Swinnen (2018) argue that despite limited incentives from direct payments for agricultural production and trade, the world market is impacted via policy effects on welfare and farmers' risk.

Animal production is the main contributor to environmental pollution from agriculture in the EU and bears the greatest potential for reducing greenhouse gas emissions from the sector (Leip et al., 2015; Herrero et al., 2016). Applying both mineral and organic fertilizer beyond the cultivars' nutrient needs contributes to nitrogen pollution of soil, adjacent water bodies and the groundwater (Sutton et al., 2011; van Grinsven et al., 2012). Therefore, nitrogen surpluses are especially present in regions of high animal density (Svanbäck et al., 2019). In the European Commission's proposal on the CAP reform it is stated that the policy framework shall better consider "the need to improve farms sustainability, and in particular the nutrients management" (European Commission, 2018, paragraph 22) as well as "the response of EU agriculture to societal demands on […] animal welfare" (European Commission, 2018, specific objectives (i)). Restricting animal density and nitrogen application has the potential to become part of the future EU agricultural policy under animal welfare and environmental considerations.

EU market access for African producers is aggravated by relatively high trade costs, amongst bureaucratic procedures in the country of origin, large transport costs, and non-tariff trade measures (NTM) in form of sanitary and phytosanitary standards. Trade costs depend, among other factors, on geographical distance, available logistics, and transport costs including associated lead times (Arvis et al., 2013). Low-income countries are found to have a higher level of trade costs, which have also been falling more slowly over time in the recent past compared to the cost development in other countries (Arvis et al., 2013). Sub-Saharan Africa has about twice the lead time to import and three times the lead time to export compared to North African countries. Sub-Saharan Africa's lead time to export was the highest worldwide between 2010 and 2018 (World Bank, 2019a, b). Despite a strong expansion of the road network in Sub-Saharan Africa, the infrastructure remains of poor quality and insufficient in density and extent (Berg, 2018). Hatzenbuehler (2019) identifies deficiencies in infrastructure and comparatively high transport costs as the main trade barriers for Sub-Saharan Africa. Similarly, Gashu et al. (2019) state that the market participation of farmers remains constrained by poor infrastructure and high transaction costs. The EU Task Force Rural Africa has pointed out the need for substantial investments in infrastructure to achieve sustainable agricultural growth and to promote Africa's agricultural export capacity (Task Force Rural Africa, 2019).

In the study at hand, we apply an agri-economic model to analyze the impacts of potential CAP policy reforms on EU production and trade with Africa. The considered CAP scenarios are designed with a focus on environmental sustainability, i.e. a change in direct payments in favor of more extensive production, and a shift towards stronger regulations on animal density and nitrogen application. The impacts arising from EU agricultural policies are contrasted with a reduction in transport costs as part of a sensitivity analysis which aims to reveal how trade-relevant investments in infrastructure could potentially contribute to agricultural production and trade in Africa. The model description and the scenario design are provided in Chapter 2. Our results focus on adjustments in prices, production, consumption, trade, and environmental impacts in the EU, its African trading partners, and partly globally (Chapter 3). Limitations inherent to the modelling approach, underlying assumptions and data availability are discussed in Chapter 4. Our assessment builds upon existing simulation studies while considering the ongoing reform debate. Furthermore, we add to the literature by putting the analysis into the context of coherence with respect to different policy domains, namely agriculture, development and trade.

2. Methods

In order to assess potential impacts of future policies, applying ex-ante simulation tools is an established method. Alternative policies can be tested as scenarios within the model setup. In this case the results of the reference scenario are compared to those of the alternative policy shocks for a future point in time. The Common Agricultural Policy Regionalized Impact (CAPRI) modelling system is a state-of-the-art and widely applied economic model (e.g., Himics et al., 2020; Frank et al., 2019). Its features and the scenario specifications for the present study are explained in the following.

2.1 Model description

CAPRI[5] (Britz and Witzke, 2014) is a global, agri-economic partial equilibrium model with a detailed representation of the EU agricultural sector. The latter is simulated by regional programming models maximizing farm income subject to given market prices, subsidies and other payments. The availability of land, compliance with regulations and the interplay of soil nutrient needs, feed, and livestock serve as boundary conditions for agricultural production. Supply-side reactions reflect medium-term adjustments under the current model specifications. Thus, variable inputs like feed and fertilizers adjust to changed incentives, whereas capital and labor are less responsive. The EU supply model is linked to a second module, the global market model, via the exchange of production quantities and market price changes. In this global model, consumers, producers and traders interact as economic agents based on microeconomic theory. Trade flows are modelled in a two-stage demand system based on the 'Armington (1969) assumption' which allows for a differentiation between domestic sales and imports as well as between imports of different origin. The underlying reasoning in the CAPRI implementation is that consumers substitute less easily between domestic and imported goods than they do between imported goods of different origin. In addition to effects on quantities and prices, a number of environmental indicators (e.g. nutrient surpluses and greenhouse gas emissions from the agricultural sector) are also calculated in the modelling system.

2.2 Scenario Design

The chosen reference scenario is based on the "Agricultural Outlook" of the European Commission (2016). In this scenario, the current CAP is extended until 2030. Technological progress, population and economic growth are projected based on trend assumptions. As this

[5] https://www.capri-model.org/

scenario is based on the currently implemented EU agricultural policy, it can be interpreted as "business-as-usual" (BAU) scenario.

In the first alternative policy scenario, we analyze a reduction of direct payments by 50% (DP50) based on the respective amount paid in the BAU scenario. While direct payments to farmers are organized within the first pillar of the CAP, the second pillar is designed to support rural areas within the EU. In our scenario, the capped direct payments drop completely out of the CAP budget. The reduction is implemented as a cut on all measures in the first pillar of the CAP including decoupled direct payments and voluntary coupled support. Based on this, our second scenario is designed as a transfer of the budget freed-up by halving the payments previously related to the first CAP pillar to measures with a focus on extensive crop production in the second pillar (DPTRANS). The scenario is inspired by the proposal of allocating 30% of the pillar 1 payments to schemes for organic farming, permanent grasslands or marginal areas (European Commission, 2018). In the discussion on the future CAP, Matthews (2018) describes a planned transfer of 15% of the pillar 1 national ceilings to environmental and climate measures in the second pillar. Our scenario exceeds these suggestions and the probable CAP changes to stress the potential of such a transfer. Areas of high animal density are hotspots for nitrogen surpluses and related pollution of soils and water (Jørgensen et al., 2018). To account for regional heterogeneity regarding nutrient balances, we restrict animal density in our scenario LSMAX to the respective local soil nitrogen needs in the BAU scenario. Like this, we prevent a nutrient undersupply of the soil and related strong negative consequences for yields and plant productivity (Csathó and Radimszky, 2009). The shock is attenuated in areas with low soil nitrogen needs by implementing a minimum boundary of 0.6 livestock units/ha. This limit lies within the boundaries which Buckwell and Nadeau (2018) describe as sustainable animal density for ruminants. While EU nitrogen surpluses generally decline, in hotspot areas strong surpluses persist and the overall surplus level in the EU remains high by international comparison (van Grinsven et al., 2012; Potter et al., 2010). In the CAPRI modelling system, we simulate an enforced Nitrates Directive by reducing the nitrogen surplus limits to 50kg/ha (NITR). This is an enforcement by up to factor 6 depending on the regions and their nitrate vulnerability status. In the NCOMBI scenario, we assess the restriction of animal density and nitrogen application in a combined approach.

In order to assess how strongly the CAP impact on Africa is influenced by the limited integration of this region into the international trading system, we perform a sensitivity analysis varying the level of transport costs. For the calibration of CAPRI, a matrix of transport cost (TC) is estimated based on the detailed trade matrix from FAOSTAT (2015) giving trade values at free on board (FOB) prices for exporters and cost, insurance and freight (CIF) prices for importers by bilateral trade flows. This information is combined with a matrix of geographical distance between trading countries, whether a country is landlocked and to which continent it belongs in order to consolidate the price information in such a way that for each trade flow we finally have CIF equal to the sum of FOB and TC. The more detailed regional information on bilateral trade flows from FAOSTAT (2015) is mapped and added up to our CAPRI regions. Trade flows within these model regions are excluded from the trade values and quantities reported in the results section. In the model simulation, transport costs are endogenized being one component of import prices expressed in Euros per metric ton. We analyze how a fifty percent reduction in transport costs for imports to and exports from African regions coincides with the CAP policy scenario showing the strongest implications for Africa. Such a reduction in transport costs could for example be achieved by investments in deficient transport infrastructure elements or by improving border handling of goods.

2.3 Indicators

In the scenario assessment, we focus on relevant impacts on EU-Africa trade flows. For the reference scenario, trade flows of agricultural products are analyzed for the EU and the African model regions in 2030. Policy scenario impacts are assessed on the basis of changes in consumer and producer prices, production, consumption, import and export quantities. Substituting trade flows to Africa from other countries are considered in this analysis as well. We also investigate land use changes, nitrogen surpluses and agricultural greenhouse gas emissions in terms of how they are affected by the implemented policy changes given that the policy design aims at contributing to increased environmental sustainability. Playing a distinct role in the ongoing CAP reform debate, we dedicate a specific consideration of remaining voluntary coupled payments within the first CAP pillar, which differ in their application by EU member states. While these payments are shocked as all other measures in the first CAP pillar in our direct payment scenarios, the CAP breakdown by country and production activity implemented in CAPRI on the basis of member state notifications on voluntary coupled support until 2015 allows a differentiated analysis (for further CAPRI implementation details refer to M'Barek et al. (2017)).

3. Results

For a number of agricultural products, Africa is projected to be a net importer in the BAU scenario in 2030. Especially regarding wheat, rice and most oil products, African production cannot satisfy domestic demand for human consumption, processing and animal feeding. Furthermore, the demand for meat and certain dairy products (especially milk powders) is mainly met by imports. Africa's self-sufficiency shares for human consumption of cereals, vegetables and fruits, oilseeds and dairy products according to the BAU projection for 2030 are provided in Table A1. Agricultural trade flows between the EU and Africa in the BAU scenario demonstrate the projected current trend for the year 2030.

For Africa, the EU is projected to be an important trading partner with a share of 19% of the total agricultural import value. Most African cereal imports originate from the EU. With respect to dairy products, the EU's share is 30% and regarding meat products 20% of the total import value to Africa for these product groups. Vice versa, Africa is also the dominant cereal exporter to the EU making up 42% of the total EU cereal import value in 2030. Grain maize accounts for 82% of the African cereal exports to the EU. Figure 1 shows the EU-African trade flows as aggregated million Euros. Africa imports more agricultural products from the EU than the other way around. The group of coffee, tea and cocoa holds the highest share in EU imports from Africa in monetary terms predominantly driven by cocoa trade. While among the African countries South Africa is the largest exporter to the EU, North Africa imports most in value from the EU comparing the African CAPRI regions.

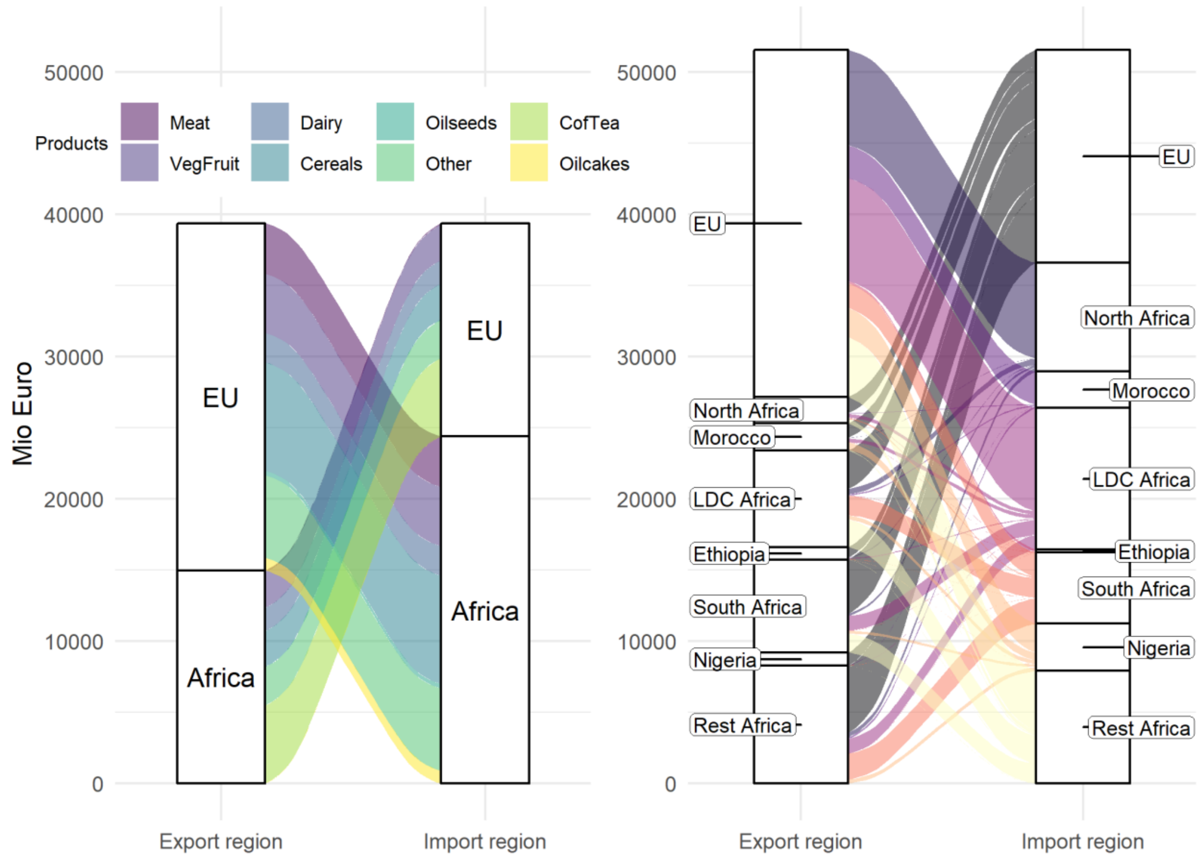

Figure 1: EU-African trade flows of agricultural products in BAU 2030

Notes: Agri-trade flows of the EU with Africa by product groups (left) and by African CAPRI regions and their bilateral trade flows (right) as aggregated monetary value in million Euros. LDC Africa = “Least Developed Countries“ region group in CAPRI. Rest Africa = region group in CAPRI including the remaining African countries, not captured in one of the other explicitly shown regions. CofTea = Coffee, tea, cocoa aggregate. VegFruit = Vegetable and fruits. Dairy = Dairy products. Other = all agricultural products not captured under the explicit groups. All products in primary equivalents and thus including processed foods.

Source: CAPRI model results.

3.1 Adjustment of Direct Payments

Halving the direct payments (DP50) only has a minimal impact on overall EU agricultural production in the modelling system (Figure 2). This is implied by the decoupling of the payments. On EU average, voluntary coupled payments make up only 10% of the value paid under CAP pillar 1 in the 2030 BAU simulation. As coupled support is voluntary, application rates differ between member states. This implies that the implications of halving the payments under pillar one differ by farming activity, member state, and the share of coupled payments received in the reference situation. However, on EU average, the effects are mainly restricted to marginal land dropping out of production. The decline of about 1-2% in cereal and oilseed production is the most noticeable reduction. Nevertheless, the drop in direct payments does not only reduce the income that EU farmers receive from grazing and pasture activities but also the income related to all crop and most other livestock activities. Especially income from beef production and dairy farming activities are affected in member states such as Sweden, Spain, Greece or Italy, where these are comparatively more supported by voluntary coupled payments than in other EU countries. Revenues for the remaining farming activities increase mostly based on slightly rising producer prices (Table 1). EU human consumption remains nearly unaffected as EU consumer price changes remain below 1%. In contrast, the EU production change mainly affects trade flows. The resulting decline in EU exports of cereals and, less strongly, of oilseeds and meat does not leave export flows to Africa unaffected. Declining imports from the EU are largely compensated by increasing imports from other world regions. A smaller part of the supply gap is filled by increased domestic production. Overall, African production and consumption hardly change. Rising producer prices in Africa have the potential to reduce poverty and improve food security among net-agricultural producers. However, for net-food consumers, increasing consumer prices could rather worsen their food security status. Nevertheless, relative price changes in Africa following from a reduction in EU direct payments remain very close to zero so that the described potential impacts are likely marginal. Moreover, the average African calorie intake and consumption pattern is unaffected by this EU policy change.

Transferring half of the pillar 1 budget to extensive measures in pillar 2 (DPTRANS) has slightly different effects compared to the previously analyzed scenario. The EU production decline is smaller as producers are supported through additional agri-environmental-climate measures. Furthermore, the decline in coupled payments is partly compensated by these additional payments under pillar 2. The payment transfer shifts production slightly towards more extensive, but also less profitable production. Consequently, price and trade reactions are less substantial than in the DP50 scenario.

Table 1: Percentage price changes in EU and Africa relative to BAU 2030

	Producer price change (%)				**Consumer price change (%)**			
	DP50		**DPTRANS**		**DP50**		**DPTRANS**	
	EU	Africa	EU	Africa	EU	Africa	EU	Africa
Cereals	1.33	0.28	0.67	0.14	0.17	0.17	0.09	0.10
Dairy	0.16	0.05	-0.07	-0.01	0.12	0.05	-0.05	0.00
Meat	0.72	0.13	0.01	-0.02	0.30	0.12	-0.00	-0.01
Beef	1.70	0.14	0.86	0.05	0.87	0.13	0.44	0.05
Pork	0.45	0.17	-0.40	-0.09	0.14	0.16	-0.12	-0.10
Poultry	0.38	0.13	0.17	0.05	0.16	0.11	0.07	0.04

Source: CAPRI model results.

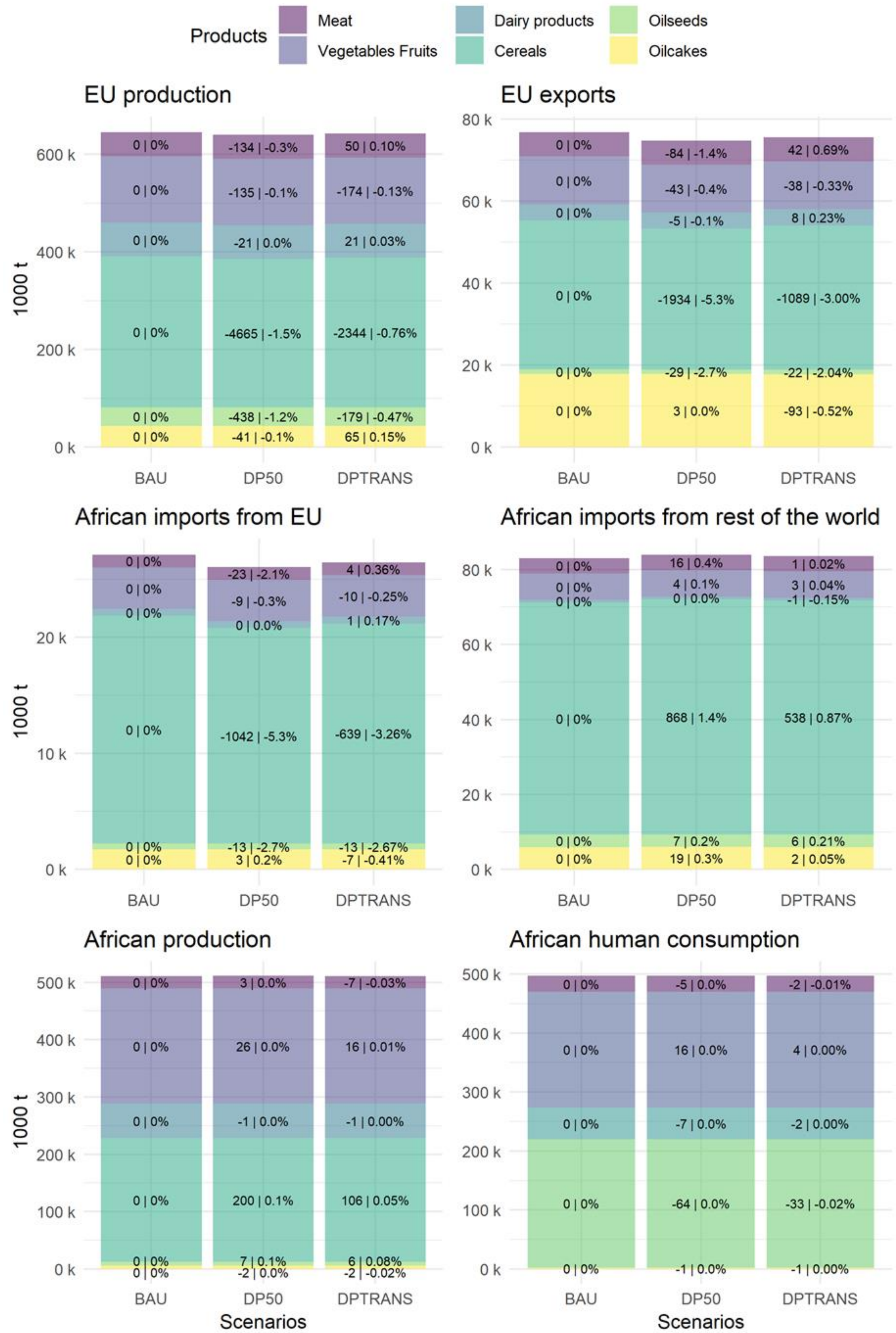

Figure 2: Impacts of a reduction or transfer of direct payments relative to BAU 2030

Notes: Volume, absolute and percentage changes for production, consumption and trade between EU and Africa. All products in primary equivalents and thus including processed foods.
Source: CAPRI model results.

When comparing results by African CAPRI regions, percentage changes in cereal imports from the EU hardly differ by region and lie between -4 and -6% for the DP50 scenario. In absolute terms, North Africa records the strongest decline in cereal imports from the EU. The smaller import changes in DPTRANS follows a similar pattern. Reducing the total CAP budget in the DP50 scenario implies a small decline in crop production areas within the EU which are largely converted to forestry or other non-agricultural land use. For the total agricultural area in the EU this means a reduction of 2%. In case the budget is instead transferred to pillar 2 payments, we do not observe nearly any change in land use shares compared to the BAU scenario. The area used for grassland (meadows and pastures) increases slightly as consequence of the additional support of extensive production and less favored area payments. However, relative to the total area, this change is negligible. Nitrogen surpluses at soil level decrease by less than 1% in the DP50 scenario and by about 2% with the payment transfer to extensive production. EU agricultural greenhouse gas emissions decrease by about 1% in both scenarios involving an adjustment of direct payments. Globally, emissions related to the agricultural sector show almost no change in relative terms.

3.2 Restrictions of animal density and nitrogen application

Enforcing stronger regulations for nitrogen application and animal density restrictions implies small changes in crop and dairy production in the modelling system, whereas meat production decreases more strongly by up to 11% (Figure 3). EU producer prices for meat in general and pork in particular increase by up to nearly 50% (Table 2). Also, EU consumer prices for meat increase, which reduces calorie intake from meat products by 3% on EU average. Overall, the effect on EU domestic human consumption is rather small. These EU agricultural policy interventions mainly affect trade. Domestically, the EU fills part of the gap in domestic supply by increased imports and reduced exports to other countries. African imports of meat and dairy products from the EU show a substantial decline. African imports of cereals and oilcakes from the EU increase following the restriction of animal density as a consequence of a drop in EU feed demand. The drop in African meat and dairy imports from the EU is mainly compensated by increasing imports from other world regions. A smaller share is offset by additional African production driven by increasing producer prices. Relative to quantitative production and consumption in Africa in the BAU scenario, the respective scenario effects are marginal. While African agricultural profits from livestock production increase, they drop if coming from cereal production. Comparing impacts for the different African regions in CAPRI, cereal imports from the EU are projected to rise for all.

Table 2: Percentage price changes in EU and Africa (Afr) relative to BAU 2030

	Producer price change (%)						Consumer price change (%)					
	LSMAX		**NITR**		**NCOMBI**		**LSMAX**		**NITR**		**NCOMBI**	
	EU	Afr	EU	Afr	EU	Afr	EU	Afr	EU	Afr	EU	Afr
Cereals	-1.7	-0.3	-0.2	0.1	-1.0	-0.1	-0.2	-0.1	-0.0	0.0	-0.1	-0.1
Dairy	4.0	1.0	3.8	0.9	5.5	1.3	3.0	0.6	2.9	0.6	4.1	0.8
Meat	28.2	1.4	11.9	1.0	31.4	1.7	10.6	1.5	4.6	1.1	11.8	1.8
Beef	33.6	1.1	15.4	0.9	37.5	1.4	17.6	1.0	7.9	0.9	19.6	1.3
Pork	46.2	8.7	12.9	3.8	47.5	9.0	14.8	9.1	4.4	4.0	15.1	9.4
Poultry	1.3	0.7	6.6	1.2	5.8	1.3	0.7	0.6	2.8	1.0	2.5	1.1

Source: CAPRI model results.

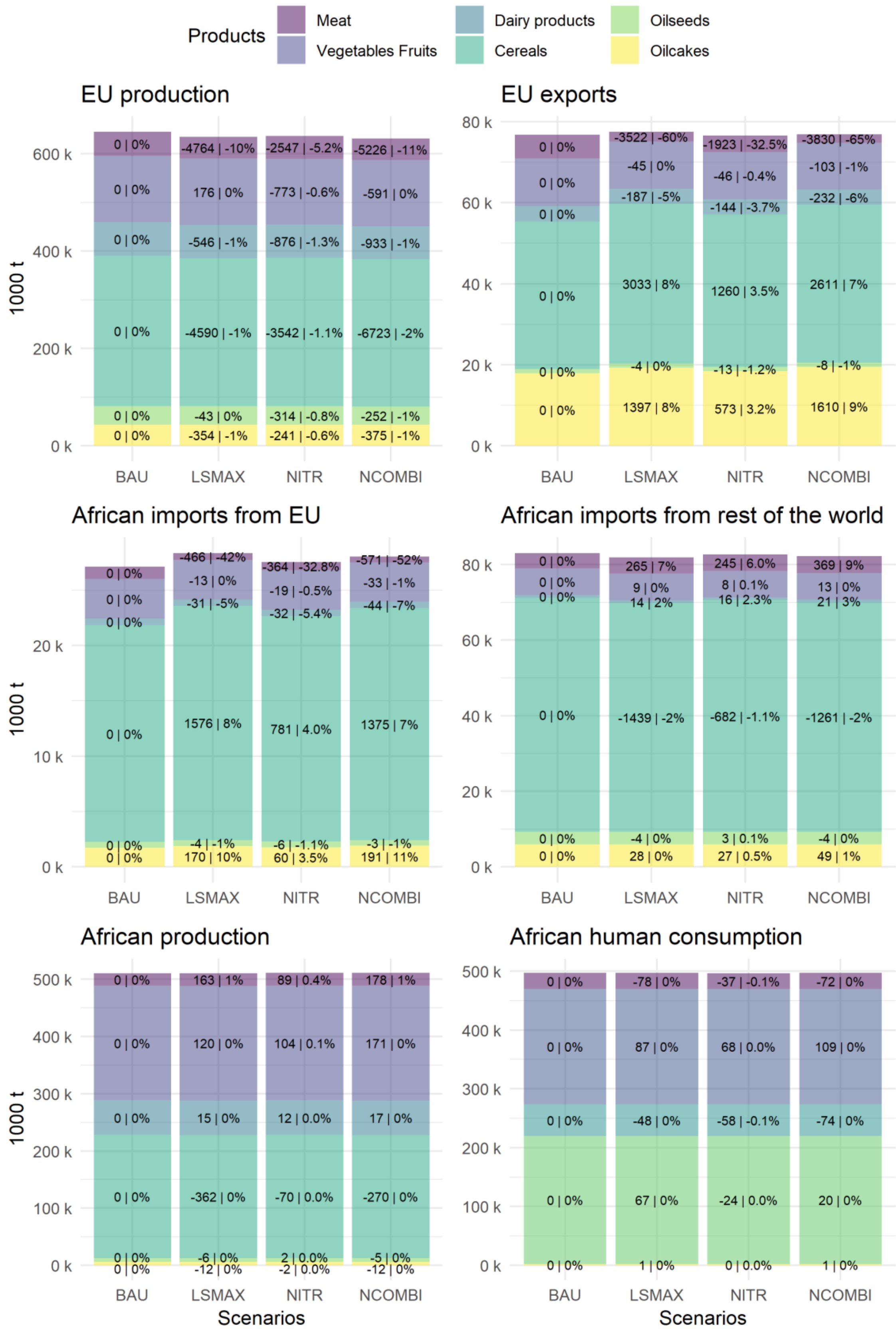

Figure 3: Impacts of animal density and nitrogen application restrictions relative to BAU 2030

Notes: Volume, absolute and percentage changes for production, consumption and trade between EU and Africa. All products in primary equivalents and thus including processed foods.
Source: CAPRI model results.

The strongest increase (7-9%) is implied by the LSMAX scenario. Even though cereal imports also increase if nitrogen application is restricted (NITR), the effect does not appear to be additive if measures are combined (NCOMBI). Meat imports from the EU decline strongly in all African regions in al scenarios. Regional effects differ substantially, and the impacts of the combination of nitrogen and livestock density restriction are slightly additive. The strongest percentage decline is seen for North Africa of up to 94%, however, based on a low import level in BAU. In absolute terms meat imports from the EU decrease strongest in the group of African LDCs. The import drop consists largely of reduced pork imports driven by the strongest price change for this product group (Table 3).

Table 3: Meat imports to African LDCs from the EU (changes relative to BAU 2030)

	Total	Change					
	BAU	**LSMAX**		**NITR**		**NCOMBI**	
	1 000 t	1 000 t	%	1 000 t	%	1 000 t	%
Meat	468	-227	-49	-168	-36	-266	-57
Pork	220	-195	-89	-98	-45	-196	-89
Poultry	215	-5	-2	-52	-24	-43	-20
Beef	21	-20	-93	-15	-71	-20	-94
Goat/ Sheep	11	-7	-60	-3	-29	-7	-62

Source: CAPRI model results.

Table 4 shows the main substituting flows by trading partner or by own domestic production. The regional disaggregation reveals that for most African regions, domestic production is among the most relevant substitution options. The differentiated view reveals that- despite trade relations being diverse among African regions – Brazil and India would play a major role in filling the meat import gap across the continent. The simulated enforcement of stronger regulations of animal density and nitrogen application only slightly changes EU land use patterns. A small increase in cropland leads to a drop in the share previously covered by forestry and other non-agricultural areas. This way a lower fertilizer application rate is substituted with an increased input of land. Soil nutrient surpluses at the EU level are reduced by about 18% in the NCOMBI scenario relative to the BAU scenario. In those regions with the highest nutrient surpluses in the reference situation, a decrease of even up to 88% is found. Greenhouse gas emissions related to the EU agricultural sector decrease by up to 8% in these scenarios, while global agricultural greenhouse gas emissions vary by not even 1%. As most of the production decrease in the EU is compensated by increased production in other countries, this goes along with emission leakage rather than achieving an actual reduction of the global emission burden.

Compared to adjusting direct payments, implementing restrictions on nitrogen application and animal density shows stronger impacts on EU agricultural trade with Africa. The EU share in African meat imports is reduced by about 50%. Moreover, the relevance of wheat imports from the EU in total African wheat imports increases a bit following the drop in feed demand in the EU. Relative changes in the relevance of imports from the EU are comparable for African

LDCs as well as for the non-LDC African countries. However, the share of meat and dairy imports from the EU in the 2030 BAU situation is considerably higher for African LDCs than for the rest of Africa. The observed changes in EU-Africa-trade following from these adjustments in CAP regulations are predominantly compensated by African trade with other countries. Domestic African production replaces lower imports from the EU only to a limited extent. Comparably low competitiveness of African production systems for the analyzed goods could be a reason for this result. Boulanger et al. (2018) similarly show the limited influence of the CAP on agricultural production in Sub-Saharan Africa and suggest increased support aiming at productivity gains in and trade involvement of the African agricultural sector.

Table 4: Substitution of declining African meat imports from the EU (absolute changes relative to BAU 2030)

	Change in 1 000 t								
	LSMAX			NITR			NCOMBI		
	EU	Substitution		EU	Substitution		EU	Substitution	
LDC Africa	-277	126	Brazil	-168	79	Brazil	-226	143	Brazil
		39	**LDC Africa**		25	USA		**38**	**LDC Africa**
		8	India		**22**	**LDC Africa**		19	USA
North Africa	-23	**15**	**North Africa**	-17	**10**	**North Africa**	-23	**16**	**North Africa**
		2	India		3	India		3	India
		0,2	Argentina		0,4	Argentina		0,3	Argentina
Morocco	-4	**4**	**Morocco**	-7	**5**	**Morocco**	-8	**6**	**Morocco**
		0,2	Argentina		0,2	Argentina		0,3	Argentina
Ethiopia	0	**1**	**Ethiopia**	0	**0,7**	**Ethiopia**	-1	**1**	**Ethiopia**
Nigeria	-8	**4**	**Nigeria**	-4	**2**	**Nigeria**	-8	**4**	**Nigeria**
		0,1	Turkey		0,1	Turkey		0,1	Turkey
South Africa	-75	**40**	**South Africa**	-63	30	Brazil	-100	**47**	**South Africa**
		18	Canada		**25**	**South Africa**		24	Brazil
		8	Thailand		10	Argentina		19	Canada
Rest Africa	-128	27	Brazil	-104	26	Brazil	-165	40	Brazil
		26	India		15	USA		29	India
		17	**Rest Africa**		15	India		16	Canada

Notes: Import substitution of the decline in meat imports from the EU by imports from other regions and African production for serving domestic demand (in bold).
Source: CAPRI model results.

3.3 Sensitivity analysis on transport costs

Transport costs restrict Africa's trade involvement. We conduct a sensitivity analysis to assess in how far a reduction in transport costs related to African trade flows influences the results of the analyzed CAP model scenarios. The combined scenario on imposing restrictions on livestock density and nitrogen application, NCOMBI, shows the strongest impact on trade between EU and Africa among our tested CAP scenarios. Therefore, we choose this scenario to analyze how a fifty percent reduction in transport costs for imports to and exports from African regions coincides with a CAP policy change (NCOMBI_TC50). We find that the reduction of transport costs outperforms all analyzed potential CAP changes with respect to the size of African import and export changes. In contrast to the effects in the NCOMBI scenario, not only the trading partners shift under the transport cost reduction, but also total import and export quantities increase substantially for several product groups traded by African countries. In relative terms, the strongest increases are found for exports from African countries (Figure 4). The outstanding percentage changes are however driven by the comparably small total export quantities in the BAU scenario. In absolute terms though, changes in imports exceed changes in exports for almost all product categories (with dairy products being the only exception) in the combined NCOMBI_TC50 scenario. In the case of meat trade, the NCOMBI induced change for African meat imports is reversed from a small decrease to a small increase, while the meat export effect amplifies. Despite improving Africa's trade integration, the model results do not suggest a push for agricultural production in Africa. Based on the used model settings, the regional reduction in transport costs rather creates an African marketplace favorable for exports and imports. This also bears the risk of increased competition between domestic and export demand for food products as exports unilaterally benefit from the transport cost reduction in our implementation. The aggregated impacts in Figure 4 do not explicitly show varying and partly counteracting effects that become visible by differentiating African regions, trading partners, and product groups. The example of meat shows, that the aggregated 3% increase in African meat imports captures a 40% reduction of imports from the EU relative to the BAU scenario. While this encompasses a reduction of only 24% of meat imports from the EU for South Africa, the North African countries import even 95% less meat from the EU. Overall, African meat exports increase by 129% excluding intra-African trade, while the export from Africa to the EU increases by 420%. Across the African CAPRI regions this is composed of an increase by 44% for meat exports from Morocco to the EU up to an increase of 2860% for Ethiopian meat exports to the EU. In absolute terms though these two countries contribute little to overall African meat exports. Also, intra-African trade flows are sensitive to the reduction in transport costs in the NCOMBI_TC50 scenario. For example, meat exports from each African CAPRI region to Africa increase relative to the BAU scenario. The comparison to the NCOMBI scenario shows that this export increase is strongly driven by the additional transport cost reduction (e.g. +39% from LDC Africa, +38% from South Africa, +15% from Rest Africa). Only meat exports from Ethiopia to the other African regions decrease in sum with the additional transport cost reduction. Despite this trade boost as a consequence of halving transport costs, Africa remains a small contributor to global meat exports.

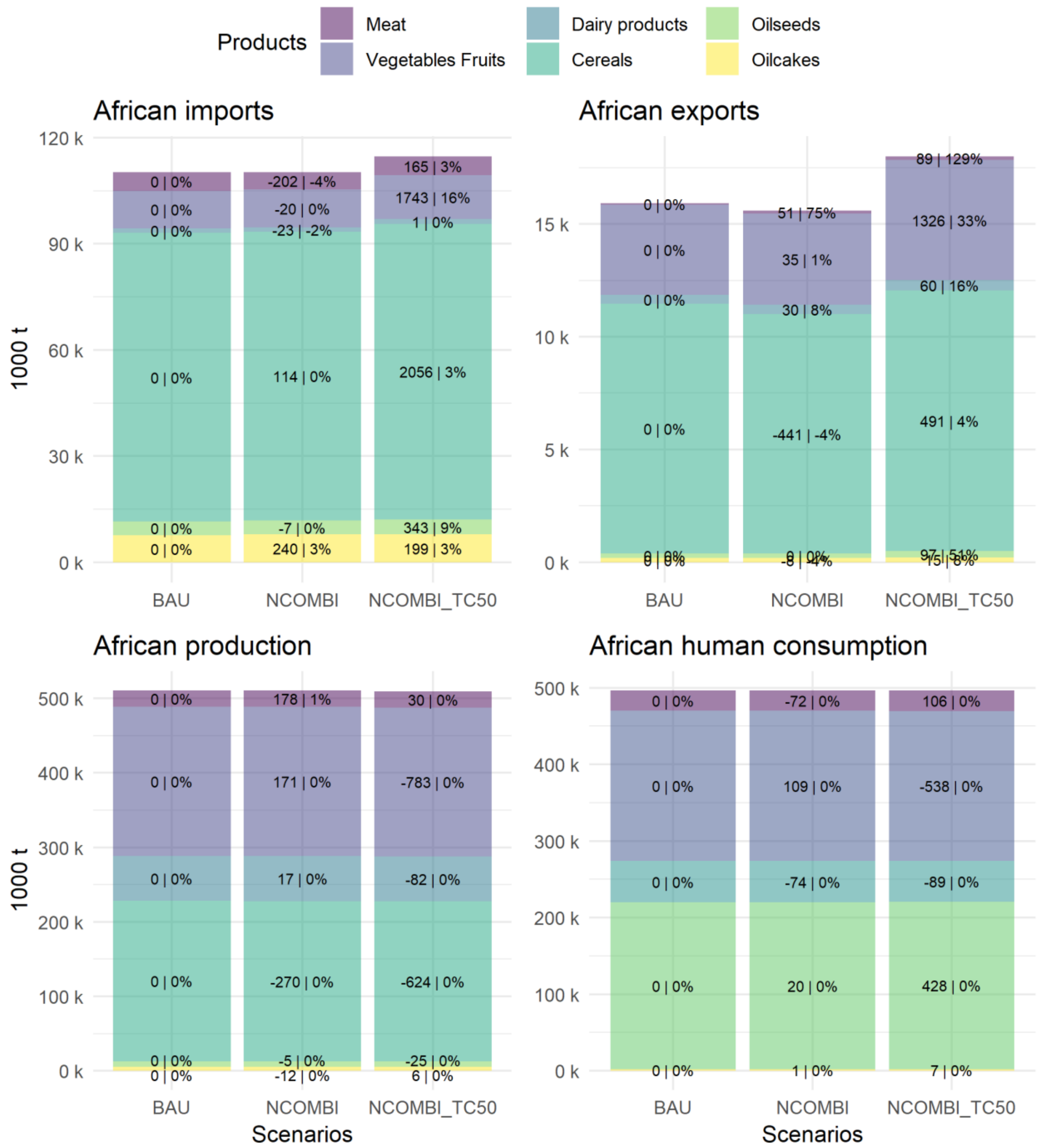

Figure 4: Impacts of combined animal density and nitrogen application restrictions with and without transport cost reduction relative to BAU 2030

Notes: Volume, absolute and percentage changes for African production, consumption and trade (excluding intra-African imports and export). All products in primary equivalents and thus including processed foods.
Source: CAPRI model results.

4. Discussion and Conclusion

The future of the Common Agricultural Policy of the EU is subject to international commitments on climate, environmental and sustainable development goals. Our analysis indicates that the implementation of stronger regulations on extensification, animal density and nitrogen application imply only limited consequences for production and consumption in African trading partner countries. Nevertheless, in contrast to changes in direct payments, restricting animal density and nitrogen application in the EU has substantial consequences for the trade flows between the EU and African countries with respect to certain agricultural products. EU meat production declines by up to 11% in the combined scenario imposing a reduction of more than 50% of African meat imports from the EU.

Impacts from reducing direct payments on EU agricultural production are found to be minimal and largely restricted to marginal land due to the wide decoupling of payments in the past. Existing voluntary coupled support in some member states implies differentiated income effects for farmers as consequence of the cut. The more detailed analysis of regionally and sectorally differentiated impacts following from a decoupling of direct payments by Offermann et al. (2016) supports this observation. A potential return to the increased use of coupled payments following from attempts to extend member state flexibility could bring back trade distortions eliminated by previous CAP reforms (e.g., Rude, 2008). These could furthermore inhibit innovation and efficiency gains in the agricultural sector (Zhu et al., 2012). A scenario like this could be taken up by future research if such a development substantiates.

In the applied model setup, the effect of long-term adjustments of primary inputs on supply and trade is reflected only to a limited extent. This could imply an underestimation of trade reactions in the long-term, following changes in direct payments. In contrast, the policy-induced scarcity of nitrogen and livestock could be compensated by a more efficient use in the long-term which might weaken the projected production and trade impacts.

Reducing transport costs has shown to push African trade of agricultural goods stronger than the assessed changes in EU agricultural policies. An investment in important transport infrastructure could induce such a change. Our approach has the limitation, that intra-regional transport is not captured and thus, does not benefit from this cost reduction. This might actually be the case for export-relevant infrastructure such as harbors, while improved road networks would in reality also facilitate trade within a region. Furthermore, potential productivity increases could follow from reduced transport costs in the long-term and the only minor production incentives seen in the sensitivity analysis could be an underestimation due to the scenario assumptions. Moreover, potential negative side effects of building transport infrastructure have not been incorporated in our analysis. Additional land requirements for the infrastructural projects may conflict with policy targets on biodiversity conservation, climate action, reducing inequality and ensuring equitable access to land (Enns, 2019). At the same time, improved transport infrastructure might help to reduce post-harvest food losses, another SDG target by itself. This could increase sales of agricultural producers beyond what is reflected in our results (Wunderlich and Martinez, 2018). Since our simulations are limited to the agricultural sector, we do not reflect shifts in the sectoral composition of economic activities that could occur as consequence of an infrastructure development (Adam, 2016; Berg, 2018).

Even though our modelling results are influenced by the assumptions underlying the model implementation, our general results are supported by the scientific literature which similarly concludes that the impact of the CAP on trade is limited (Matthews et al., 2017) and that investments in improved transport infrastructure bear development potential for Africa (Hatzenbuehler, 2019). Changes in world market prices as consequences of new CAP measures probably affect net-food-consumers and -producers in the opposite direction (Matthews, 2018). Assessing the implications for each African country individually or even at subnational level is, however, beyond the scope of this study.

Trade bears a welfare increasing potential through reduced prices for imported consumption goods or production inputs and additional opportunities for sales to export markets. However, the 2020 global economic crisis as consequence of the Corona virus pandemic reveals several risks incorporated in the interconnectedness of global value chains. Consequently, scarcity following production stops and border closing endanger the functionality of food supply chains and the access of import-dependent countries (IFPRI, 2020; FAO, 2020; UNCTAD, 2020). These observations stress the necessity for the development of crises prevention strategies that may also involve measures supporting domestic production of some critical products. Additionally, the consequences of climate change may make the occurrence of similar economic events more likely in the future (Dellink et al., 2017).

Directing the future CAP more strongly towards environmental sustainability holds the potential for production increases in non-EU regions including low-income countries. Our assessment has shown that substituting production and trade flows are likely to fill the gap caused by EU production decreases due to EU policy reforms. To what extent these potentials can be used in African regions depends at least partly on their competitiveness as compared to substituting importers and the access of their products to export markets (Matthews, 2018). Therefore, investments in Africa's agricultural sector, specifically to improve agricultural productivity and the functioning of agricultural value chains, are inevitable to promote agricultural growth in Africa and international trade between Africa and the EU (Task Force Rural Africa, 2019; Kornher and von Braun, 2020).

Trade-offs regarding global SDGs are inherent in the analyzed, regionally implemented agricultural policy changes. In order to reach global environmental improvements, additional measures are required to minimize leakage effects and to improve environmental sustainability beyond the European context. Complementing measures could be implemented to steer a demand reduction in high-income economies like the EU to support reaching the environmental targets on a global scale (Latka et al., 2020). Reducing demand and supply of emission-intensive products jointly could contribute to environmental sustainability, while it might limit additional trade potentials for other countries including opportunities to improve the social and economic sustainability status in low- and middle-income countries, also in Africa.

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Appendix

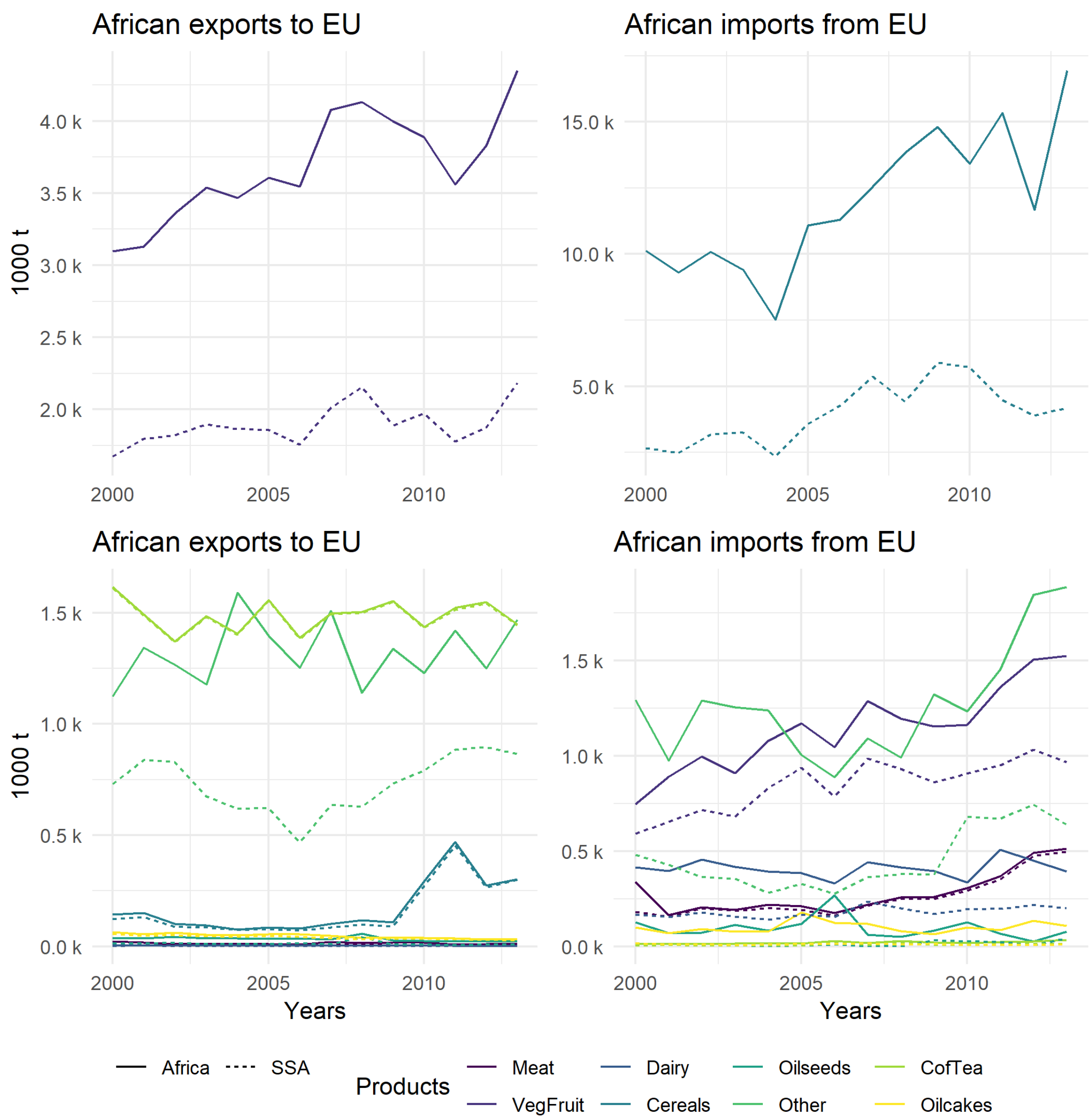

Figure A2: Agricultural trade flows (in quantities) between EU and Africa with explicit differentiation of Sub-Saharan Africa (SSA) between 2000 and 2013

Notes: CofTea = Coffee, tea, cocoa aggregate. VegFruit = Vegetable and fruits. Dairy = Dairy products. Other = all agricultural products not captured under the explicit groups. All products in primary equivalents and thus including processed foods.

Source: Bilateral trade quantities are taken from FAOSTAT (2015) and processed to CAPRI aggregates under consideration of data quality applying a trust indicator for trade notifications from different reporters.

Table A2: African domestic supply, domestic demand, and self-sufficiency shares in BAU 2030

Product group	Domestic supply (Mio t)	Domestic demand (Mio t)	Self-sufficiency share
Meat	22	27	0.81
Vegetables/ Fruits	20	21	0.97
Dairy	60	61	0.99
Cereals	215	286	0.75
Oilseeds	7	11	0.66
Coffee/ Tea/ Cocoa	5	2	2.09
Oilcakes	6	13	0.43

Source: CAPRI model results.