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EDITED BY
Gideon Danso-Abbeam,
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REVIEWED BY
Pouria Ataei,
Tarbiat Modares University, Iran

*CORRESPONDENCE
Philipp Aerni
✉ philipp.aerni@botinst.uzh.ch

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COP-27: A great opportunity to address the double crisis of food security and climate change—and for the EU to re-align its farm to fork strategy

Philipp Aerni^{1,2*}

¹Center for Corporate Responsibility and Sustainability (CCRS) at the School of Management Fribourg (HES-SO), Fribourg, Switzerland, ²Head of Science and Public Policy Unit, Department of Plant and Microbial Biology, University of Zurich, Zurich, Switzerland

The 27th Conference of the Parties (COP 27) of the UN Framework Convention on Climate Change (FCCC) held in November 2022 in Sharm-el-Sheik, Egypt, ended with joint commitments to compensate for loss and damage and increase funds for climate change adaptation in future. This outcome is likely to be supportive of current efforts to render agricultural systems in low income tropical countries more resilient and productive through locally adapted forms of sustainable intensification. However, the farm-to-fork (f2f) strategy launched in 2020 by the European Union (EU) has set targets that associate sustainable agriculture primarily with extensification rather than intensification. This paper critically reviews the literature that assesses the impact of current agricultural, environmental and development policies on global food security, biodiversity and climate change. It challenges the view that the European Green Deal and the f2f strategy will have its desired effects. It also argues that the intention of the European Commission (EC) to promote the f2f strategy in low income tropical countries may not be compatible with its commitment to the ownership principle in development assistance. The decision of the EC in fall 2022 to propose a regulatory framework on new breeding techniques (NBTs) indicates that methods of sustainable intensification may be reconsidered if they serve the goals of the Green Deal and the f2f strategy. Such a readjustment would also be in line with the outcome of COP27 and indicate that the polarized global debate on sustainable food systems may become more pragmatic and outcome-oriented again.

KEYWORDS

new breeding techniques (NBT), sustainable intensification (SI), farm to fork, ownership principle in development assistance, COP 27

1. Introduction

The impact of food systems on food security and climate change was a core topic at the UN Food Systems Summit (UN FSS) in fall 2021.¹ Prior to the Summit, a review of studies that look at the different components of food systems and how to tackle them effectively has been carried out.² The studies point out that food systems contribute one-third to all greenhouse gas emissions, can be a threat to biodiversity, and are among the largest consumers of freshwater (Crippa et al., 2021). Furthermore, about one-third of the food produced goes to waste. In return,

1 <https://www.un.org/en/food-systems-summit/>

2 The list of publications can be downloaded on the following website: <https://sc-fss2021.org/materials/publications-and-reports-of-relevance-for-food-systems-summit/>

food systems, especially in low income tropical countries, are also most affected by climate change, facing more droughts, storms and floods combined with an increase in biotic stress factors. Farm households in these countries need support to cope with loss and damage as well as to adapt to the reality of climate change. Their farming systems must become more resilient, sustainable and productive, and private sector investments will have to play an important role in ensuring inclusive and sustainable growth.³ As such, the UN FSS was not just about coping with risk, but also about seizing the opportunity to foster the adoption of improved practices, ensure better access to finance, effective capacity development and markets to promote inclusiveness, empower communities against hunger and poverty and make them more resilient in the face of climate change.

The shift in focus from climate change mitigation to climate change adaptation and compensation for loss and damage at the 27th Conference of the Parties of the UNFCCC (COP 27) in Sharm-el-Sheik Egypt (November 6-20, 2022) chimes well with the outcome of the UN FSS and its focus to promote more resilient and productive food systems. It must also be understood in the context of the combined global food and energy crisis in 2022 as a result of the War of Russia on the Ukraine, which affected people in low income countries to a much greater extent.

Yet, the aim to promote inclusive forms of sustainable intensification through public-private partnerships may eventually clash with the popular view in many affluent societies, expressed also in the aftermath of last year's UN Food Systems Summit that economic and technological change associated with industrial agriculture is the main driver of health-related and environmental problems in agriculture, a major cause of global greenhouse gas emissions as well as a driver of global food insecurity and social inequality (Canfield et al., 2021). This view was also embraced in an influential report called International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD)⁴ published during the Global Food Crisis in 2008. Back then, it reassured many policy makers in Europe that the concept of multifunctional agriculture,⁵ which underpins the EU's Common Agricultural Policy (CAP), would help mitigate the negative impact of industrial agriculture on human health and the environment (Stoian and Caprita, 2019; Gargano et al., 2021).

Yet, the impact of multifunctional agriculture on greenhouse gas mitigation, biodiversity as well as the reduction of agricultural input was marginal (Tscharnatke et al., 2021; García-Navas et al.,

2022; Rosenheim et al., 2022).⁶ Moreover, the conditional direct farm income support schemes that underpin the concept of multifunctional agriculture did not encourage investment in innovation and made farming less attractive for the younger generations, compared to countries that liberalized their agricultural economy, such as New Zealand (Aerni, 2009).

A recent paper by Paarlberg (2022) even suggests that Europe lags behind the United States in terms of agri-environmental and social performance in view of the fact that European farmers continue to use roughly one third more in chemical input and fertilizer per hectare than US farmers while seeing farm household earnings continuously decreasing.

The EU seems to have recognized some of the shortcomings of the multifunctionality approach (Gravey et al., 2021) and its new "farm to fork" (f2f) strategy aims to improve the performance of the CAP through prescriptive policies that are meant to render the food systems more fair, healthy and environmentally-friendly.⁷ Yet, some scholars warn that the strategy may also result in many unintended side effects that are likely to undermine the laudable goals (Cortignani et al., 2022; Paarlberg, 2022; Wynn and Webb, 2022).

This paper critically reviews the baseline assumptions underpinning the EU's f2f strategy and explores to what extent there is a gap between the stated goals and the outcome to be expected. In this context, the paper challenges the EU's stated intent to pursue the development of Green Alliances on sustainable food systems with all its partners in bilateral and multilateral relations designed to export the f2f strategy to low income tropical countries. This would be in conflict with the ownership principle in development assistance to which the EU signed up to as well since the priorities in making food systems more inclusive and resilient are different in low income countries where poverty rather than affluence is the main enemy of sustainability. Finally, the paper points at the possibility of change from within the EU due changing public attitudes and the intention of the European Commission to propose a new regulatory framework that would make it possible for gene-editing to contribute to the Green Deal through sustainable intensification in agriculture. This development would be very much in line with the shift of attention from climate change mitigation to adaptation at the COP27.

2. The EU's farm-to-fork (f2f) strategy: A plan to promote agricultural extensification?

The f2f strategy was first presented by the European Commission (EC) in May 2020 as part of the European Green Deal designed to ensure carbon neutrality in agriculture and to render the EU food system more sustainable across the whole value chain. While recalling food security and safety as priorities, the strategy's main goal is to render European agriculture more sustainable by reducing the use of pesticides, fertilizers and microbials by 50% and increasing the share of organic agriculture to up to 25% by 2030.⁸ Yet, complying with such policies without increasing labor costs and decreasing agricultural productivity

3 <https://climatechampions.unfccc.int/to-reverse-runaway-climate-change-and-build-resilient-societies-we-need-to-transform-food-systems/>

4 <https://www.globalagriculture.org/report-topics/about-the-iaastd-report.html>

5 The concept of multifunctionality argues that agriculture produces more than just food if farmers embrace sustainable agricultural practices that generate positive externalities for society and the environment (e.g., protection of the environment, preservation of landscapes and agrobiodiversity, safe food, socioeconomic and cultural well-being of farm families, recreation value for urban residents). It is assumed that all these public goods are not valued in the global market for agricultural commodities. For that purpose, the state needs to act as an indirect buyer of such environmental and social services through direct but conditional farm income support schemes (see Renting et al., 2009; Aerni et al., 2015).

6 <https://www.oecd.org/agriculture/topics/agricultural-policy-monitoring-and-evaluation/most-support-does-little-to-address-climate-change.htm>

7 https://food.ec.europa.eu/horizontal-topics/farm-fork-strategy_en

8 <https://www.consilium.europa.eu/en/policies/from-farm-to-fork/>

would require farmers to adopt technologies, such as precision agriculture (Raj et al., 2021), regenerative agricultural practices and agricultural biotechnology (Ashok et al., 2019) that are able to meet the new standards while ensuring that farm households remain economically viable. There is however no real innovation strategy that would ensure that the implementation of f2f strategy does not lead to a growing dependence on food imports from outside Europe.⁹

The f2f strategy may point out that agricultural sustainability has to take into account the economic viability of farms as well as the affordability of healthy and nutritious food, but it does not present a convincing plan in view of the problem with the capitalization of direct payments that may improve short-term rents but undermines farm competitiveness on the long run (Góral and Kulawik, 2015).

Overall Total Factor Productivity (TFP)¹⁰ in EU agriculture has been largely stagnating for the past two decades—and this despite the catch-up growth in agriculture of new member states from Eastern Europe¹¹ (EU, 2016). The challenge of reconciling agricultural sustainability with the need to enhance TFP is therefore of high relevance in European agriculture.

In this context, the European Commission appointed a High-Level Expert Group (HLEG) with the task to explore the needs, feasibility and options for enhancing science-policy interfaces (SPIs) that could kick start and substantially support the ambitious goal of food systems transformation in the coming decades. The report was meant to support the Green Deal and the f2f strategy, but it also suggested that the EU's agricultural and development policies should be more informed by the best science, by evidence of likely benefits and costs and by knowledge of what can work (and how) in different contexts. The HLEG points out in this report [European Commission (EC), 2021] that the UN Food Systems Summit (UN FSS) held in fall 2021 represents a great opportunity to enable a sustainable

transformation of the global food system in a pragmatic and practical rather than an ideology-based way. One of the priorities of the UN FSS is the promotion of sustainable intensification (von Braun et al., 2021). As a signatory of the Sustainable Productivity Growth (SPG) Coalition,¹² the EU also signaled its commitment to this priority.¹³ However, it is not yet reflected its current agro-environmental and development policies.

3. Opportunities and obstacles in the promotion of sustainable intensification in Europe

Agricultural policies that embrace technological change through the use of digital technologies in precision farming are likely to improve TFP to a significant extent while enabling a substantially more efficient use of agricultural input (Finger et al., 2019). Yet it may have to be combined with other promising technologies that enhance sustainable intensification such as regenerative agriculture, which is focused on the enhancement of soil health and the improvement of soil conservation (LaCanne and Lundgren, 2018; Gish, 2022). Regenerative agriculture involves the mixing of crops and livestock, to further boost soil quality and on-farm fertility (Oberč and Arroyo Schnell, 2020). One of its main approaches to maintain soil health is through cover crops that are planted in the off-season to protect the soil from erosion, revitalize soil biota, add nutrients for the coming crops, sequester carbon, improve biodiversity and prevent water runoff. In this context, variations of cover seeds help to literally grow the soil. They may add important nutrients to the soil for an upcoming crop in place of fertilizer. Furthermore, New Breeding Techniques (NBT) may enable the design of cover seeds that deter potential pests and thus reduce the need for pesticide treatment (Jordan et al., 2022).

However, within the EU, NBTs are currently subject to the process-oriented regulatory framework entrenched in the so-called GMO Directive (2001/18/EC) on the deliberate release into the environment of genetically modified organisms. This makes it very costly and uncertain to make use of gene-editing in agriculture, even though its potential to address climate risks in agriculture is widely considered to be significant (Karavolias et al., 2021).

Regenerative agriculture is most effective in reducing the carbon footprint of agriculture when combined with no-tilling practices which, in most cases, require the pre-treatment with herbicides (Claassen et al., 2018). Yet, due to the use of herbicides, no-tilling practices are not compatible with the principles of organic agriculture, which is to be promoted by the EU's f2f strategy. Moreover, the EU continues to have a de-facto ban on the use of genetically modified herbicide tolerant crops even though their impact on climate change mitigation proved to be significant over

9 Horizon Europe intends to spend EUR 10 billion on research and innovation on food, bioeconomy, natural resources, agriculture, fisheries, aquaculture and the environment as well as the use of digital technologies and nature-based solutions for agri-food. The European Commission will also work with Member States to strengthen the role of the European Innovation Partnership "Agricultural Productivity and Sustainability" (EIP-AGRI) in the Strategic Plans. Furthermore, InvestEU Fund aims to foster investment in the agro-food sector by de-risking investments by European corporations and facilitating access to finance for SMEs and mid-cap42 companies [European Commission (EC), 2020]. However, the normative character of all these initiatives implies that the private sector is mainly there to implement innovation, whereas insights in evolutionary economics and economic complexity research strongly indicate that innovation is endogenous in character, meaning that it comes from within entrepreneurial economic systems (Hidalgo, 2015; Antonelli, 2017).

10 Growth in TFP reflects the overall rate of technical and efficiency change in the sector (see <https://www.ers.usda.gov/data-products/international-agricultural-productivity/>).

11 While annual TFP growth exceeded 1% between 1995 and 2005, it only reached 0.8% between 2005 and 2015. This productivity growth is mainly the result of developments within the EU-13 countries, which experienced an annual TFP growth of 1.6% over the last decade. These "old" Member States have experienced a sharp drop in annual TFP growth, from 1.3% in the period 1995-2005 to 0.6% between 2005 and 2015 (see <https://www.farm-europe.eu/news/productivity-in-agriculture-barely-growing-and-for-the-wrong-reasons/>).

12 <https://www.usda.gov/oce/sustainability/spgc-membership>

13 Sustainable intensification (SI) is defined as a process or system where agricultural yields are increased without adverse environmental impact and without the conversion of additional non-agricultural land. The concept does not articulate or privilege any particular vision or method of agricultural production. Rather, it emphasizes ends rather than means, and does not pre-determine technologies, species mix or particular design components (Royal Society, 2009).

the past 20 years thanks to its combination with no-tilling practices (Brookes, 2022; Wynn and Webb, 2022). One important exception within the EU is Spain, which has embraced the use of GM crops to some extent. It had very positive results with genetically modified corn as well as regenerative agriculture in efforts to make agriculture more climate-smart.¹⁴

The EU's f2f strategy has plans to promote "carbon" farming, yet, once again through extensification rather than intensification of agriculture: the Commission presented its sustainable carbon cycles communication in December 2021.¹⁵ It aims to encourage agricultural practices that help to capture carbon from the atmosphere and store it in soil or biomass in a sustainable way. Economic value to such measures shall be attached through a certification framework for carbon removals. This approach does however not address the problem of land use change, which is the biggest driver of greenhouse gas emissions in agriculture according to the International Panel on Climate Change (IPCC, 2019).

4. The f2f strategy and its potential effect on global land use change

The f2f strategy is the outcome of a long consultation process. It builds upon the recommendations of a report that was prepared by the Scientific Advice Mechanism (SAM), the Group of Chief Scientific Advisors of the European Commission. The report called "Toward a sustainable food system"¹⁶, largely reflects the "food systems" perspective advocated by food regime theorists who see market forces and new technologies as the main obstacle to sustainable agriculture (McMichael, 2009; Canfield et al., 2021).

When it was presented to the public in conjunction with the Green Deal and the New Biodiversity Strategy,¹⁷ the goals of the f2f strategy to reduce chemical input and promote organic farming were also endorsed by many environmental advocacy groups as a step in the right direction.¹⁸

In return, European scientists concerned with sustainable agriculture warned that such measures are unlikely to enhance TFP in agriculture, especially in regard to the fact that yields in organic farming reach on average only 60–70 per cent of the level in

conventional farming (Smith et al., 2019; Purnhagen and Wesseler, 2020; Connor, 2021). Moreover, they point at the ongoing regulatory uncertainty surrounding the regulation of gene-editing. The f2f strategy does not mention the use of modern biotechnology as a way to reduce the use of pesticides, fertilizer and greenhouse gas emissions in agriculture, despite the evidence on the ground over the past three decades that the potential contribution of this platform technology to achieving the ambitious environmental goals through the substitution of chemical input is substantial (Munawar et al., 2020; Purnhagen et al., 2021; Wesseler, 2022).

The unintended side effect of EU's embrace of a one-sided focus on extensification in its f2f strategy, so it was argued in a publication in *Nature* (Fuchs et al., 2020), will be "offshoring environmental pollution." This problem occurs because the surface required to produce the same amount of food for European consumers will have to increase significantly elsewhere as domestic agricultural productivity declines due to the expected lower TFP. The ensuing land use change outside Europe (through more food imports) is likely to have a significant negative impact on climate change mitigation, food security and biodiversity (Purnhagen and Wesseler, 2020). Yet, these potential negative side effects do not find any mention in most of the official sustainability assessments of the f2f strategy, even though the risks of such extensification strategies are well-documented.¹⁹

5. The impact of the food and energy crises in 2022 on the implementation of the f2f strategy

After the invasion of Russia in Ukraine in February 2022 the cost of energy, fertilizer, animal feed and food increased to levels not seen since the global food crisis in 2008. The prices of many essential food products subsequently decreased once the Ukraine was able to export its surpluses again. Yet, world prices for cereals continue to be far above the long-term average.²⁰

The rise of food, feed and energy prices also contributed to an increasing inflation rate in Europe, which is currently around 10%²¹; significantly higher than in the United States, which is more independent from food and energy imports. As for food and non-alcoholic beverages, inflation rate increased in October 2022 by 17%.²² This trend clearly conflicts with the goal of the f2f strategy to ensure access to healthy and sustainable foods for all Europeans.²³ In response to the growing concerns about food security, the European Commission presented a package of measures

14 Spain is the big exception in Europe. It adopted pest-resistant Bt corn for the first time in 1998 combined with a set of agricultural practices designed to prevent the development of resistance of pests. Its experience with genetically modified corn over the past twenty years have been evaluated recently and the effects on the environment and society were largely positive (Areal and Riesgo, 2022). Spain has also been an early adopter of herbicide-tolerant crops and regenerative agriculture associated with no-tilling (Loureiro et al., 2019).

15 See <https://www.consilium.europa.eu/en/press/press-releases/2022/04/07/council-adopts-conclusions-on-carbon-farming/>.

16 SAM Report (Group of Chief Scientific Advisors), 2020. Toward a Sustainable Food System: Moving from food as a commodity toward food as more of a common good. European Union, Brussels. Available online: https://ec.europa.eu/info/research-and-innovation/strategy/support-policy-making/scientific-support-eu-policies/group-chief-scientific-advisors/towards-sustainable-food-system_en.

17 https://ec.europa.eu/commission/presscorner/detail/en/IP_20_884

18 <https://www.safefoodadvocacy.eu/farm-to-fork-strategy/>

19 In spring 2021, the government of Sri Lanka decided to make its domestic agricultural system more competitive and sustainable by banning the use of fertilizer and synthetic pesticides and becoming 100% organic. The experiment had to be stopped in late 2021 due to its fatal consequences on crop yield. Lower yields created a domestic food security problem that significantly contributed to the growing political instability in the country. Even though one has to admit that the conversion to 100% organic in such a short period of time was foolish, there are nevertheless lessons to be learned for Europe who welcomed the bold decision of the government of Sri Lanka.

20 <https://www.fao.org/worldfoodsituation/foodpricesindex/en/>

21 <https://ec.europa.eu/eurostat/documents/2995521/15131946/2-19102022-AP-EN.pdf/92861d37-0275-8970-a0c1-89526c25f392>

22 See <https://www.statista.com/statistics/1286407/eu-food-inflation-rate>.

on 'Safeguarding food security and reinforcing the resilience of food systems'. However, apart from announcing more support for the promotion of precision farming, the package included mostly proposals to enhance food security through short and medium term measures²⁴ while reaffirming the view that the f2f strategy is part of the solution and not part of the problem in securing future food security. Member states from Eastern Europe who argued for a readjustment of the f2f strategy in response to the changing geopolitical situation tended to be dismissed by members of the European Commission as voices that support the interests of the powerful agribusiness lobby rather than the public interest.²⁵

6. Why the f2f strategy is in conflict with the ownership principle in development assistance

The European Commission made it very clear in its communication on the f2f strategy (chapter 4) that it intends to promote its agricultural extensification strategy "through its external policies, including international cooperation and trade policy" pursuing the development of Green Alliances on sustainable food systems with all its partners in bilateral, regional and multilateral fora.²⁶ The idea of exporting the f2f strategy to low income countries where lack of access to agricultural input rather than its excessive use is the main food security challenge is controversial because it is not in line with the EU's official commitment to the Paris Declaration on Aid Effectiveness, which asks donors to respect the fact that recipient countries may have different priorities.²⁷ The tendency of the EU to make use of its economic power to impose its food safety and environmental agenda on low income countries while diverting from it at home whenever it is convenient has been criticized before (Paarlberg, 2009; Fuchs et al., 2015; Sozzi et al., 2019; Bradford, 2020; Johnston, 2020).

One obvious current example is the way the EU and its member states have responded to the new energy crisis. The ambitious clean energy agenda has been quickly put on hold in order to restart

its coal and gas-fired plants at home and increase its purchase of fossil fuels from countries that offer an alternative to Russia. Simultaneously, most EU member states are part of the virtue-signaling 39 (v-39) consisting of states and organizations in the affluent world that pledged to stop almost all support fossil-fuel projects anywhere by the end of this year. This clearly collides with the goal of the African Union (AU) to provide every African household with access to electricity by 2030 and to increase productivity in agriculture. In more than half of African states, the largest share of energy supply already comes from renewable energy, but such renewable energy systems have to rely on backup power that provides instantaneous, uninterruptible power—as it is also the case in Europe (The Economist, 2022).

A similar trend can be observed in the context of the policies directly or indirectly related to the f2f strategy. The f2f strategy does not limit its ambition to Europe but would like to foster a 'Green Alliances' on sustainable food systems that includes cooperation with Africa, neighbors and other partners' (EU, 2021, p. 17). In this context, the European Commission refers to its generously funded initiative called DeSIRA.²⁸ launched in the follow-up to the first "One Planet Summit" launched by the French Government in 2017. DeSIRA is designed to promote innovation in the transformation of agricultural and food systems in the South in collaboration with European institutions in the field of capacity development—provided that it is in line with the philosophy of the f2f strategy (Aerni and Zou, 2022).

However, in an online debate organized by FAO (FSN Forum) from 25.10. to 25.11.2017 on "Sustaining the impact of capacity development initiatives for African youth in agriculture".²⁹ many young African agripreneurs have expressed their frustration with the DeSIRA's Capacity Development for Agricultural Innovation Systems (CDAIS) approach.³⁰ The main criticism was that such well-intended participatory CDAIS projects fail to address the real challenges of youth in agriculture, such as lack of access to finance, technology, land and business services that would enable the integration of local agribusiness activities into formal agricultural value chains. These may not be serious concerns in the highly subsidized European agricultural system, but they are very real in low income countries.

Prior to the launch of DeSIRA, the mismatch between European donor and recipient priorities has been highlighted in a large needs assessment on capacity development for agricultural innovation in tropical countries carried out on behalf of the FAO-based Tropical

23 In 2020, the proposed set up of a European food security crisis preparedness and response mechanism (EFSCM) in response to the COVID 19 crises was mainly concerned with safeguarding European food supplies through contingency plans in times of crisis.

24 [https://www.europarl.europa.eu/RegData/etudes/BRIE/2022/733667/EPRS_BRI\(2022\)733667_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/BRIE/2022/733667/EPRS_BRI(2022)733667_EN.pdf)

25 <https://www.investigate-europe.eu/en/2022/frans-timmermans-pesticides-reduction/>

26 <https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52020DC0381&from=EN>

27 The EU and its member states are signatories of the Paris Declaration on Aid Effectiveness. One of its principles is to respect ownership in development assistance by enabling and supporting recipient countries to set their own strategies for poverty reduction, improve their institutions and tackle corruption (<https://www.oecd.org/dac/effectiveness/parisdeclarationandaccraagendaforaction.htm>).

28 DeSIRA stands for Development Smart Innovation through Research in Agriculture (See <https://www.oneplanetsummit.fr/en/coalitions-82/desira-development-smart-innovation-through-research-agriculture-206>).

29 A summary report of the discussion is available on the following website: <https://www.fao.org/publications/card/en/c/18410EN/>.

30 CDAIS – Capacity Development for Agricultural Innovation Systems – claims to develop policy approaches that would drive innovation in tropical rural areas and to test these with national and local innovation partnerships. CDAIS is a partnership developed and implemented by Agrinatura and FAO, and is supported by the European Union (<https://cdais.net/home/>). The problem is that innovation that is economically viable does not take place in academia or international organizations but in business. The core competence of business in the development of customer-oriented innovation is however not taken into account in most development initiatives to promote capacity development for agricultural innovation (Juma and Yee-Cheong, 2005).

Agriculture Platform (TAP) (FAO, 2013). It concluded that there is a serious misalignment between the foreign-funded projects that largely focus on public-sector capacity development and the emphasis of the local stakeholders on the importance of private sector capacity development. When the EU became the largest sponsor of TAP in 2015, it ignored the report and launched instead its CDAIS initiative that did not involve any private sector partner (FAO, 2016). It also did not foresee any support for the integration of local innovative African agripreneurs into formal value chains, even though it is one of the priorities presented in the Common Position Paper of the AU to the UN Food Systems Summit in 2021,³¹ as well as several other Africa-owned initiatives.³² Africa-owned initiatives also emphasize the importance of the transfer and local adaptation of new technologies, including biotechnology and the need for a sustainable increase in crop productivity as well as job creation through agribusiness development. In this context, the reluctance of EU-funded development projects to tap the competences in the private sector in capacity development for agricultural innovation is likely to undermine the credibility of Europe's claim that its Green Deal will contribute to the achievement of the UN Sustainable Development Goals (UN SDGs) (Aerni and Zou, 2022).

The same applies to the EU's preventive regulation of agricultural biotechnology and its export to low-income countries over the past two decades (Paarlberg, 2009; Juma, 2013). For more than two decades countless European stakeholders representing development agencies, large retailers, charities and environmental NGOs exerted pressure *via* aid and trade on low income countries in Africa to adopt Europe's process-oriented regulatory framework on genetically modified organisms (GMO) to discourage the adoption of agricultural biotechnology. Such activities stand in strong conflict with Article 19 in the Convention on Biological Diversity (CBD) which commits its signatories to enable the safe transfer of biotechnology to low income countries.³³

Due to a ruling made by the European Court of Justice in July 2018 (Case C-528/16) the preventive regulatory framework of GMOs is currently also applied to new breeding techniques (NBT) associated with gene-editing. The most prominent one is the CRISPR Cas9 technique.³⁴ The argument of the ECJ was that such techniques

must be subject to the GMO Directive, passed in 2001, because they would lack a safe track record. The decision surprised the scientific community as well as the numerous start-up companies in the agbiotech sector that aimed to make use of the new technology to address environmental challenges in agriculture in a more effective way. Yet, public attitudes toward the use of modern agricultural biotechnology within and outside Europe are currently changing due to global food security concerns associated with the impact of climate change as well as the new geopolitical situation (Kahn, 2021; Kagoe, 2022).

7. Gene-editing regulation in Europe: Reconsidering the role of technology in sustainable agriculture?

New Breeding Techniques (NBT) associated with gene-editing may have the potential to address the challenge of access to healthy food while helping to reduce the use of pesticides and fertilizers in European agriculture.³⁵ Since NBTs may also play a central role in enabling a more productive and inclusive post-fossil agricultural economy (Siebert et al., 2022), the European Commission called for a study regarding the status of novel genomic techniques under Union law. It was issued in April 2021 and concluded that several of the plant products obtained from NBTs have the potential to contribute to the objectives of the EU's Green Deal and, in particular, to the EU's *f2f* strategy as well as to its biodiversity strategy. The study therefore suggests that the current process-oriented GMO legislation in Europe is no longer fit for purpose.³⁶ The subsequent EU-wide public consultation carried out from April 31-July 22, 2022 indicates that the European public tends to share this view.³⁷ The big challenge is however that the stakeholders within the European Commission, the European Parliament, the European Organic Agriculture Industry and European civil society groups who strongly advocate the *f2f* are also strongly opposed to the use of NBT to promote sustainable agriculture. This constellation has also been observed in the global debate on biotechnology and climate change (Aerni et al., 2016).

Nevertheless, the EC announced in fall 2022 to propose a new legal framework on targeted mutagenesis and cisgenesis involving gene-editing in agriculture in spring 2023.³⁸ Apart from ensuring the safe use of these NBT, the goal of the proposed legislation is to enable innovation in the agri-food system and contribute

of a wide variety of organisms. The method does not require a transposon insertion site, leaves no marker, and its efficiency and simplicity has made it the preferred method for genome editing.

³⁵ <https://www.euractiv.com/section/agriculture-food/news/centre-right-warns-commission-overstepping-its-mark-on-pesticide-cuts/>

³⁶ https://food.ec.europa.eu/plants/genetically-modified-organisms/new-techniques-biotechnology/ec-study-new-genomic-techniques_en

³⁷ Overall, four out of five (1732; 79%) participants in the consultation found that the existing provisions of the GMO legislation are not adequate for gene-edited plants obtained through targeted mutagenesis or cisgenesis (https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13119-Legislation-for-plants-produced-by-certain-new-genomic-techniques_en).

³⁸ https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13119-Legislation-for-plants-produced-by-certain-new-genomic-techniques_en

³¹ <https://au.int/en/pressreleases/20210715/africa-mobilizes-common-position-upcoming-un-food-systems-summit-unfss>

³² These also include CAADP (<https://www.nepad.org/cop/comprehensive-africa-agriculture-development-programme-caadp>), Agenda 2063 (<https://au.int/en/agenda2063>), the Africa Continental Free Trade Agreement (AfCFTA), the Science, Technology and Innovation Strategy of Africa (<http://www.ist-africa.org/home/default.asp?page=news-doc-by-id&docid=8793>) as well as African national agricultural innovation plans (NAIPs).

³³ Article 19.2 of CBD states that each Contracting Party shall take all practicable measures to promote and advance priority access on a fair and equitable basis...to the results and benefits arising from biotechnologies (<https://www.cbd.int/convention/articles/?a=cbd-19>).

³⁴ CRISPR stands for "clustered regularly interspaced short palindromic repeats." It is a gene editing tool used to create breaks in specific areas of DNA. This technology uses proteins in bacteria called Cas proteins. To control where these proteins cut DNA, scientists add a specific strand of RNA to a Cas protein and insert it into a cell. The contribution to its discovery has earned Jennifer Doudna and Isabelle Charpentier the Nobel Prize in Chemistry in 2020. CRISPR Cas9 allows for the efficient introduction of various mutations into the genome

to the goals of the European Green Deal and the f2f strategy. This could signal that the EC has recognized that farmers need alternatives beyond organic farming in order to cope with the ambitious reduction targets for synthetic pesticides and fertilizers by 2030. It is also an indirect admission that sustainable intensification does not have to stand in conflict with its ambition to become a leader in sustainable agriculture.

8. Addressing climate change while ensuring future food security requires a commitment for sustainable intensification through innovation

FAO made the role of innovation explicit in its Strategy on Climate Change (SCC) 2023–2031 (FAO, 2022) by arguing that the sustainable and inclusive transformation of agrifood systems must take place in a holistic way in order to address the challenges of food security and climate change simultaneously. The SCC takes into consideration all agricultural sectors, related value chains and ecosystems and recognizes that the Paris Agreement on Climate Change has to be compatible with the inclusive development approach expressed in the UN Sustainable Development Goals. The strategy is rooted in the principles of best available science and innovation and recognizes the importance of scaling up finance and private investment for the transformation of agrifood systems in a coherent manner according to, and dependent on, national contexts and capacities that also include public and private investment to promote sustainable intensification through innovation (FAO, 2018, 2022).

In the run-up to the COP 27 in Sharm-el-Sheik, many stakeholders, especially in low income countries where agriculture is most affected by climate change, called for the need to make it a summit that focuses on the nexus between food systems, energy, and climate.^{39 40} This is not surprising in view of the fact that global food demand continues to grow as the world's population is expected to reach 9.6 bn by 2050. At the same time, the share of people suffering from hunger and malnutrition has not budged much over the past decade (currently around 820 million people) while yields are estimated to have decreased in warmer regions between 26 and 34% since 1961 due to changing weather conditions (Ortiz-Bobea et al., 2021).

Moreover, the IPCC report “Climate Change 2022: Impacts, Adaptation and Vulnerability”⁴¹ states that increasing weather and climate extreme events are the main drivers of reduced water and food security. Climate change will thus affect agrifood systems, food production and people in rural areas in low income tropical countries in particular.

39 <https://climatechampions.unfccc.int/we-must-use-cop27-to-transform-energy-and-food-systems/>

40 <https://www.ft.com/content/6f352052-f2bc-401a-beed-b89d9e98a23d>

41 IPCC report on Climate Change 2022: Impacts, Adaptation and Vulnerability.

9. Africa's exposure to food security and climate change risk

African countries face on average the most degraded agricultural soils in the world, even though soil quality varies widely depending largely on the ability of farmers to invest in soil regeneration. Ninety per cent of SubSaharan Africa's (SSA's) rural population depends on rain-fed small-scale agriculture as its primary source of income. Population growth has led to increasing land scarcity leading to shrinking farm sizes that increasingly become the main driver of migration because the offspring can no more live on the tiny plots inherited (Headey and Jayne, 2014; Aerni, 2016). It is not surprising that the low yields in semi-subsistence small-scale agriculture are hardly able to feed the respective farm households, not to speak of the rapidly growing urban population in Africa. The result is an ever growing bill for food imports (currently US \$ 55 million per year) according to “2022 Africa Agriculture Status Report” (AGRA, 2022).

All these negative trends have nothing to do with the “agro-industrial complex” or “the Green Revolution,” the usual culprits in the global narrative on sustainable agriculture because Africa has largely been by-passed in projects to promote agricultural modernization in the 20th century (Juma, 2010). The true causes of the ongoing food security problems in Africa may be lack of investment in off-farm employment, value chain integration of domestic farmers and agriculture intensification (Aerni and Zou, 2022).

10. Concluding remarks

In view of the lack of progress made in enabling low income countries to cope with climate change in agriculture (<1.7% of climate finance goes into enabling small-scale farmers in low income countries to cope with climate change⁴²) there was increasing doubt that the Conference on Climate Change in Sharm-el-Sheik, Egypt (COP27) will address the concerns of the low- and middle income countries. After all, the effectiveness of prior and future pledges of international donors from affluent countries to support highly vulnerable tropical countries in coping with climate change has been disappointing.

Most funding available went into carbon-offset projects that primarily reflected the almost exclusive focus of donor priorities on climate change mitigation (Seddon et al., 2021; Sovacool, 2021; Wang, 2021). It tended to neglect the priorities in recipient countries to address issues related to loss and damage as well as climate change adaptation.

In view of this prior experience it was surprising that the main group of low- and middle-income countries (G77) were sufficiently well-organized at COP27 to shift the focus from mitigation to “loss and damage” funding for vulnerable countries most affected by climate disasters as well as climate change adaptation. The resulting Sharm el-Sheik Adaptation Agenda is focused on enhancing resilience for people living in the most climate-vulnerable communities by 2030 and will have a major focus on agriculture. According to FAO, this represents a great opportunity for agriculture in the Global South to be reconsidered since it is most

42 <https://www.ifad.org/en/web/latest/-/news/climate-finance-neglects-small-scale-farmers-new-report>

affected by the negative impact of climate change. It is ultimately farmers that need to adapt to climate change most urgently (Sadoff and Semedo, 2022).

At the same time there is significant potential to make agriculture part of the solution to address climate change mitigation and food security through the adoption of new technologies that help reduce greenhouse gas emissions in agriculture such as precision farming, regenerative agriculture and gene editing while also ensuring that agricultural productivity is increasing in regions that are most affected by low yields.

As highlighted in this paper, the EU's *f2f* strategy, in its current form, tends to regard business and new technologies in agriculture as part of the problem rather than part of the solution. The reason for this view is related to the fact that prior advances in agricultural productivity in affluent countries tend to be taken for granted while the potential environment and public health risks associated with modern agriculture have become the major focus of attention (Aerni, 2009). Europe's tendency to export its defensive understanding of sustainable agriculture to low-income countries through bilateral and multilateral development cooperation is however highly problematic since the benefits of modern agriculture that are largely taken for granted in Europe have not yet arrived in many low income tropical countries. Moreover, it is not in line with the ownership principle in development assistance (Ojio et al., 2013; Aerni et al., 2015).

However, the review of recent surveys and policy initiatives in this paper indicates that European attitudes as well as European regulation toward sustainable agriculture are in a process of change. This change of mind may be related to the growing pressure to create a productive post-fossil agricultural economy that is less dependent on environmentally problematic agricultural input while still producing increasing yields to ensure affordability of healthy and sustainable food even in times of global crisis. This is only possible by making use of all currently available options to promote sustainable intensification.

A convergence of views on climate change and food security in low and high income countries, based on prior experience and recent scientific insights is likely to enable a shift from confrontation

to effective collaboration in global strategies to fight food insecurity and climate change. This would help create institutional framework conditions that encourage rural empowerment through innovation-oriented public-private partnerships that have proved to be more responsive to local economic as well as environmental challenges in low income tropical countries (Aerni et al., 2015). This would be very much in line with the overarching goal of inclusiveness as emphasized in several targets of the UN Sustainable Development Goals by 2030 [Aerni, 2021; United Nations (UN), 2021].

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

The author confirms being the sole contributor of this work and has approved it for publication.

Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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