Global Policy Dialogue for Sustainable Agriculture:

2023 Compendium

AGRICULTURE POLICY DIALOGUE

Foreign, Commonwealth & Development Office

WORLD BANK GROUP

Just Rural Transition

Contents

Policy Foreword

The world faces unprecedented challenges to our global food system, as climate and nature crises undermine food security, nutrition and prosperity. We must confront these challenges with bold resolve. COP28 provides a milestone moment to catalyze a food systems transformation that delivers for healthy diets and economies and a liveable planet.

This task is ever more urgent. In 2022, more than 3 billion people could not afford a healthy diet. Food producers are increasingly vulnerable to the impacts of climate change and environmental degradation, which undermine productivity and wipe out production when disaster strikes. At the same time, food systems themselves are the second largest source of climate emissions after energy (causing 1/3rd of Greenhouse Gas (GHG) emissions) and are the main driver of biodiversity loss and freshwater contamination. The challenge grows as demand for food and other agricultural commodities continues to rise and the impacts of climate change intensify.

Government policies play a key role to shape investment in agriculture. Yet current policies and public support are often inefficient and can inadvertently drive harmful practices such as deforestation, land and water degradation and high rates of greenhouse gas emissions, driving nature loss and climate change and undermining food and economic security.

These are complex issues, but there are alternatives. Growing evidence suggests the right mix of policies and interventions can strengthen food security, nutrition and economies, address climate change and protect nature. A transition to clean, green, sustainable agriculture globally could contribute to healthy diets and protect the planet; with a potential $4.3 trillion economic gain by 2040[1].

[1] FOLU 2019

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Launched by the UK and the World Bank in January 2021, the global **Policy Dialogue for Sustainable Agriculture** is building momentum on policy reforms for sustainable agriculture and food systems. The Dialogue provides a forum to share experience and learning, facilitate partnerships and build global ambition on reforms. Over 45 countries from Global North and South have participated in the Dialogue to date.

We are now delighted to share updates from the Policy Dialogue 2023 series including: a Chairs Summary of Policy Dialogue Workshops; a set of 3 briefing notes on 'Policy Pathways to Sustainable Agriculture' based on experiences shared; and a set of 14 country case studies of 'Policy in Action' endorsed by participating countries.

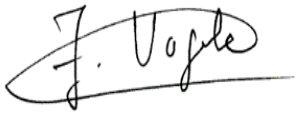
These findings are intended as a contribution to support and further mobilise the urgent action we need on Food Systems Transformation, including to deliver commitments under the Emirates Declaration on Sustainable Agriculture, Resilient Food Systems and Climate Action.

We trust you will find this a useful resource and urge you to join us in continuing collaboration to deliver the Just Transition we need.

Rt Hon. Andrew Mitchell MP

Minister for Development and Africa

United Kingdom



Juergen Voegele

Vice President for Sustainable Development

World Bank

Chairs' Summary of Discussions

Introduction

Agriculture is vital for global food security and national incomes, yet in 2022, over 1 billion people regularly did not have enough food to eat and more than 3 billion people could not afford a healthy diet. Climate change and nature loss are key factors driving food and nutrition insecurity, threatening agricultural production and increasing the vulnerability of farmers and food systems to environmental shocks and stresses like floods, drought and disease.

Agriculture and food systems in turn are the second largest source of greenhouse gas emissions after energy and the biggest driver of biodiversity loss and freshwater pollution. These trends intensify climate shocks and stresses and threaten food security, nutrition and livelihoods.

Governments have a critical role to play to transform food systems, both through public support to agriculture and food sectors, and through setting the incentives, regulations and standards that influence private investment.

Launched by the United Kingdom and World Bank in 2021, the global Agriculture Policy Dialogue is designed to share experience, facilitate partnerships and catalyse action to meet the Paris Agreement and the Sustainable Development Goals. To date, over 45 countries have shared experiences and approaches to policy action and reform for sustainable agriculture through this platform.

Getting effective policies and approaches in place to deliver resilient, sustainable food systems is complex and challenging. Solutions will be context specific and there is no "one size fits all" prescription. Yet no country is isolated from climate and nature crises and collaboration will be key to address the crises we face.

We are thankful to the many colleagues across governments who have shared their experiences through the Agriculture Policy Dialogue. This Chairs' Summary outlines key points from three senior official workshops in 2023. A set of briefing notes on "Policy Pathways for Sustainable Agriculture" and a set of country case studies on "Policy in Action" highlight emerging opportunities and the efforts lead countries are making.

Objectives of Agriculture Policy Dialogue

The Agriculture Policy Dialogue is designed to act as a catalyst for change, providing governments with a global platform for peer support, sharing experience and lessons, evidence on emerging innovative approaches, and building partnerships and mobilizing policy action on sustainable agriculture and food systems.

In 2023, discussions focused on the detail of policy approaches and how to shift incentives for investment in more sustainable practices. The workshops aimed to:

- Maintain momentum on agriculture policy action, aligning with the UAE COP28 Food Systems Transformation campaign.
- Identify priority policy approaches and reforms for sustainable agriculture.
- Identify opportunities to promote sustainable agriculture and food systems through Nationally Determined Contributions and National Adaptation Plans development processes and, where relevant, identify opportunities to attract greater climate finance resources to support reforms.
- Showcase country action on policy reform and share lessons learned.

Key messages

Participants noted:

- The impacts of extreme weather events on agriculture production and rural livelihoods are increasing, driven by climate and nature crises.
- The cost of inaction is higher than the cost of action. This means business as usual is no longer an option and countries must identify "triple win" solutions for agriculture to deliver for people, climate and nature.
- Effective policy design and implementation for sustainable agriculture is complex, challenging and must be adapted to context.
- Successful policy reform needs engagement with all actors in the agricultural value chain and is more effective when done in collaboration with farmers.
- Increasing the uptake of innovative technologies and approaches requires supporting farmers to manage transition risks and recognizing these transitions take time. Farmers can be supported by increasing access to knowledge, extension services and technologies, and mitigating the financial risk, for example through compensation and insurance.

Participants identified four priority policy pathways to accelerate a transition to sustainable agriculture, summarized below:

Policy reform to incentivize efficient and sustainable use of fertilizers

Context and experiences vary greatly, from countries faced with overuse of fertilizers to those with inadequate access. Yet participants agreed that direct input subsidies for fertilizer are a blunt instrument with many pitfalls. Focusing solely on fertilizer subsidies may be insufficient and counterproductive. By contrast, participants described the importance of policies to incentivize integrated soil management alongside fertilizer use, and the need to monitor soil health. Weak knowledge systems, missing advisory services and the challenge of joining up research with farmers on the ground are common constraints that needed to be resolved.

Participants shared a range of policy approaches and experiences including: (i) a holistic approach to offering a mix of technologies along with the necessary advisory services (e.g., on precision agriculture) to prevent overuse of fertilizer; (ii) introducing blends of chemical and/or biological fertilizers to address issues of soil fertility and reduce fiscal burden of subsidizing chemical fertilizers; (iii) moving away from subsidies tied to specific crops to incentivize diversification and optimal allocation of resources; and (iv) introducing regulations and voluntary or mandatory legislation to incentivize shifts to more sustainable practices, e.g., on cover cropping, fertilizer use, emissions or land expansion into protected areas.

Policy action to incentivize soil health for sustainable production

Declining productivity and land degradation are interlinked. Participants highlighted quality soil data as a key element needed to improve the stewardship of agricultural soils.

Participants shared a range of policy approaches to improve soil health, including: (i) improving the capacity of extension systems to conduct soil analysis, monitor soils over time and develop tools to digitize information for analysis and dissemination; (ii) piloting nature-based solutions and setting up farmer schools to encourage adoption; (iii) introducing regulations to prevent exploitation of carbon sinks such as peatlands, and providing incentives for practices that improve carbon sequestration, such as no tillage and cover crops; and (iv) linking production support to specific agroecological zones to discourage land conversion for agriculture.

Payment for ecosystems services through targeted policy measures and instruments

Payments for ecosystems services was highlighted as a potentially effective tool to incentivize changes in farming practices and behaviours to build resilience and sustainability. However, implementation challenges and high costs can be a barrier to adoption. The complexity of monitoring, reporting and verification systems was highlighted as a major challenge due to capacity needs and cost, along with the need for public policy coherence and sufficient benefit to farmers for these schemes to be viable.

Participants shared experience from a variety of approaches, including: (i) introducing tradeable biodiversity certificates that businesses can buy; (ii) offering state-subsidized discounts on interest rates to farmers adopting practices that provide environmental services; (iii) cash transfers to communities and producers for environmental preservation (input and aggregated indicators can reduce monitoring burden); (iv) upfront grants to incentivize landscape restoration; and (v) participatory design within policy framework where farmers are involved in co-design and given choices on support measures to increase feasibility and uptake.

Public policy reforms to incentivize water conservation

Water is a critical input for agricultural production, and climate change-induced weather-related shocks, including droughts and floods, present a significant risk to agricultural production. This is particularly important in water-stressed countries and requires mechanisms that result in efficient water use.

Approaches participants discussed include: (i) establishing functioning water markets to incentivize efficient water use, such as issuing water entitlements which can be traded in a market; (ii) developing crop varieties that are water conserving; (iii) subsidizing investments in irrigation technologies through interest rates on loans; and (iv) incentivizing producers to maintain soil cover, either through non tillage, or other farming techniques that improve both soil health and water conservation.

Experiences shared through the Policy Dialogue has led to the development of three "Policy Pathways to Sustainable Agriculture" briefing notes (with a fourth brief on sustainable water to follow). These offer an overview of emerging experiences and lessons to support peer learning and knowledge exchange.

Policy in action

The Agriculture Policy Dialogue is building a growing knowledge bank of experiences that countries have shared on the policy action they are taking, the challenges and how they seek to address these.

A number of lead countries have contributed a case study to demonstrate policy in action, as an ongoing learning process. This includes experience of scaling sustainable rice management, increased investment in research and development for emissions-reducing technologies and approaches, and reshaping subsidies to encourage soil health management and monitoring. These experiences add to a growing Compendium of Country Case Studies that provides a living platform for further sharing. We are thankful to contributing countries in 2023: Bangladesh, Brazil, Germany, Ghana, Ireland, Malawi, Morocco, Mozambique, Netherlands, New Zealand, Sierra Leone, United Kingdom, Uzbekistan and Viet Nam.

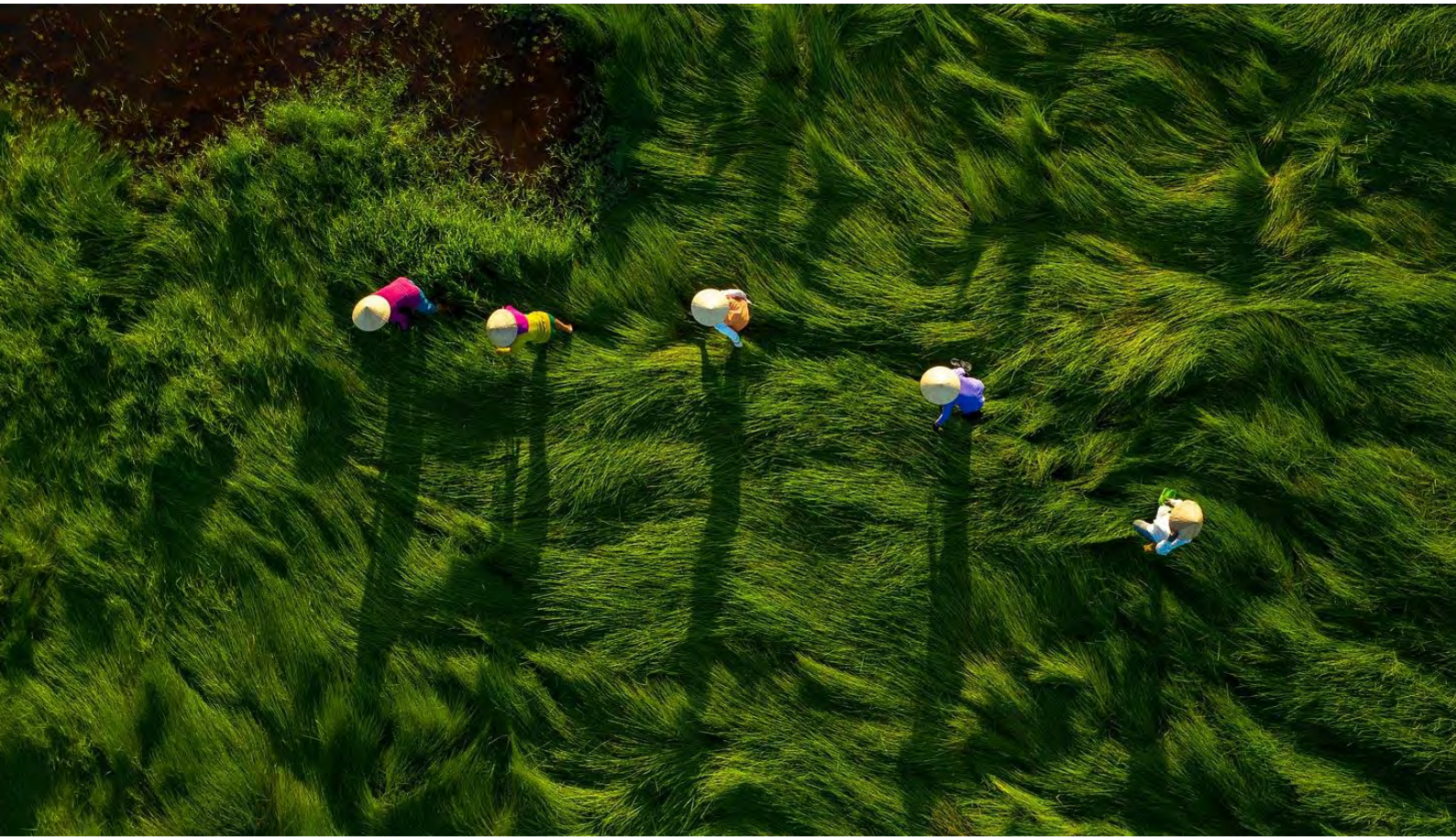
Next steps

The Policy Dialogue – both as an independent channel and through other, existing forums – will continue to provide a platform to share knowledge and experience, to build partnerships and to scale public and private investment into resilient, sustainable approaches.

In partnership with the World Bank Trust Fund FoodSystems 2030 and with the UAE COP28 Technical Cooperation Collaboration initiative, we look forward to continuing dialogue and collaboration in our shared efforts to progress towards sustainable agriculture and food systems.

Policy In Action – Country Case Studies

The following section presents a set of country owned case studies of policy action that individual countries are taking with the aim to redirect investment and practices toward more sustainable agriculture that delivers results for people, prosperity and planet. These case studies are country owned – either directly authored by or approved by Agriculture Ministries in the relevant country. They are intended as a tool to share country experiences. They are not prescriptive and do not represent policy positions of the wider group of participants in the Policy Dialogue. We extend our warm thanks to all contributing countries for sharing this rich experience.



Bangladesh

Experience in policy action for sustainable food system transformation

Context

Bangladesh has exhibited remarkable agricultural growth since the mid-1990s, with the sector consistently expanding at an annual rate exceeding 4% from 1996 to 2019. Along with expanding production, the per capita availability of food items increased substantially.[2] Bangladesh has achieved self-sufficiency in rice production and overall food security, two paramount objectives of past agriculture strategies. Notably, this agricultural progress significantly contributed to the reduction of rural poverty. Between 2005 and 2010, the agriculture sector played a pivotal role, accounting for 69% of rural poverty reduction. Although its contribution decreased from 2010 to 2016, it remained substantial at 27%.

Much of the success in agriculture can be attributed to deliberate policy reforms initiated since the 1980s, coupled with strategic investments in research and infrastructure. These reforms began by liberalizing the agricultural input market in the 1980s, especially concerning fertilizer and irrigation. In the 1990s, additional reforms targeted the seed sector. Furthermore, Bangladesh has maintained a substantial agriculture support programme since the Green Revolution era, with the primary aim of ensuring basic food security. Bangladesh has, therefore, made remarkable progress in domestic food production, which almost doubled during the past two decades, avoided hunger, and ensured food security for 170 million people.

However, this success is accompanied by a set of challenges, including the excessive use of inputs, notably fertilizer and water, leading to environmental, health and even productivity risks. Furthermore, the sector is confronted with other significant issues. Agricultural growth, once robust, has been decelerating since 2010, with the trend growth rate declining to 3.2% in 2017 from over 5% in 2010. Inadequate diversification of agricultural products has also emerged as a concern. Additionally, the changing dietary preferences resulting from rising incomes and rapid urbanization have created a growing demand for diverse and nutrient-rich agricultural products.

[2] Eighth Five Year Plan of Bangladesh, Ministry of Planning, 2021.

These challenges are compounded by climate change, as Bangladesh's agriculture remains highly susceptible to climatic fluctuations. Notably, projections indicate that the increased soil and water salinity due to rising sea levels may lead to a 15.6% reduction in yields of high-yielding rice varieties by 2050.

Rationale

Although Bangladesh's agriculture has achieved notable successes in the past, existing agricultural incentives do not align with the current strategic objectives of climate resilience, diversification and improved nutrition. The policies and incentives that have predominantly focused on expanding cereal production in the past are inadequate to deliver transformation to a sustainable agrifood system. Increased support for the sector is needed. However, it is equally critical to repurpose and realign current agrifood policies and public expenditures to better support productivity, diversification, improved nutrition and sustainability.

Approach

The new Program on Agricultural and Rural Transformation for Nutrition, Entrepreneurship, and Resilience (PARTNER) is built on strong analytical foundations and supports the implementation of the Plan of Action of the National Agriculture Policy 2020. It reorients the strategic priorities of the sector towards diversification, value-addition and climate resilience.

In contrast to the historical focus on rice and fertilizer subsidies within the Ministry of Agriculture's expenditure programme, PARTNER focuses on policies and investments that promote climate resilience, diversification, food safety, nutrition, value chain development and entrepreneurship. Additionally, PARTNER acknowledges the importance of rice and directs its attention primarily to research for stress-tolerant and high-yielding rice varieties, addressing yield gaps and reducing the sector's carbon footprint.

A pivotal component of this new programme is the introduction of an e-voucher pilot, offering an alternative approach to agricultural subsidies. This pilot initiative aims to inform the gradual repurposing of the fertilizer subsidy programme. By offering multiple direct support options for farmers, it intends to generate valuable insights into which of these are best placed to deliver resilience, diversification, productivity, efficiency and profitability for farmers.

Concurrently, a comprehensive review of agricultural public support programmes, including the fertilizer subsidy programme, is underway in a collaboration between the Ministry of Agriculture and the World Bank. The objective is to identify the best policy options to incentivize farmers to optimize their use of inputs as well as how best to redirect public expenditure towards greater investment in research, innovations, extension services, markets and infrastructure. This realignment is expected to build climate resilience, enhance incomes and improve competitiveness in the agricultural sector.

Experience and expected results

- Direct beneficiaries will be the 500,000 farmers, 200,000 of whom are female, who will participate in PARTNER's e-voucher pilot for improved delivery of input subsidies and who will receive additional support for crop diversification and for the adoption of good agricultural practices and improved and efficient irrigation technologies.
- The e-voucher pilot evaluation will assess the effectiveness of different pilot interventions in delivering increased resilience, input use efficiency, diversification, productivity and farmers' profitability. Results will guide repurposing of the country's input subsidy programme towards a more efficient and effective approach to increase resilience and sustainability of the agrifood system.
- The pilot will increase the adoption of climate-smart practices such as precision agriculture, good agricultural practices and improved and efficient irrigation technologies.
- The Ministry of Agriculture will benefit from strengthened policy-making capacity by having access to information and digital tools to track and monitor agricultural public expenditure and to reorient public support, based on evidence, towards more strategic priorities of the sector.

Lessons learned

- To effectively drive the repurposing agenda for agricultural support programmes, it is essential to adopt a gradual reform approach, considering the strong political economy factors.
- Policymakers in Bangladesh tend to be more receptive to reform advice when it originates from local technical experts. Therefore, it is critical to establish consensus at the technical level regarding outcomes like diversification, productivity, efficiency, resilience and farmers' profitability under various policy scenarios. This consensus-building process involves ongoing dialogue and the execution of pilot programmes that explore proposed policy reforms, engaging local technical experts in the process.
- Furthermore, aligning the policy reform agenda with donor supported investment operations can enhance public awareness of the benefits that policy reforms can yield. Also, strong technical assistance support is imperative for designing, implementing and evaluating these policy changes effectively.

This is one in a set of country case studies demonstrating policy action that individual countries are taking with the aim of transition to sustainable agriculture. They are country owned and do not represent wider views of the Policy Dialogue participants.

Brazil

Repurposing of agricultural support policies and programmes under Plano Safra 2023/24

Context

In recent years, Brazil has positioned itself as a highly competitive country for agricultural exports in the world. The level of support to the sector is relatively low, reflecting the competitiveness of its exports. Meanwhile, **Brazil has been increasingly greening the direct support provided to its farmers.**

Although direct farmer support announced in Brazil's new farm credit package (Plano Safra 2023/24) has increased recently, the total support estimate (TSE) declined from 0.7% of GDP in 2000–02 to 0.5% in 2020–22.[3] Already low levels of direct farmer support (producer support estimate – PSE) show a downward trend over the past 20 years, falling from 9.1% in 2000 to 1.5% in 2019. However, over the past three years, PSE has been increasing due to an increase in market price support (MPS). Brazil's total support to producers is composed of: (i) input payments, in particular agricultural credit at preferential rates;[4] (ii) risk management instruments (crop insurance premium subsidies),[5] and (iii) support via MPS.

Plano Safra 2023/24 is the highest level of support in Brazil's history, with an increase of 27% over last year's figures.[6] Support to family farmers has increased in this package and is 34% more than in 2022/23.

Since 2008, the obtention of subsidized rural credit is conditional on environmental criteria, such as registration in the Environmental Rural Registry (CAR) and compliance with zoning rules that promote environmental improvements, such as the preservation of forest and native vegetation. In 2010, only 21% of direct farmer support was considered green. This was also the year when the Brazilian Plan for Adaptation and Low Carbon Emission in Agriculture

[3] OECD. 2023. *Agricultural Policy Monitoring and Evaluation.* OECD Publishing, Paris, France.

[4] Most of the rural credit is earmarked under the National Rural Credit System and provided at preferential interest rates with differentiated conditions for small and medium-size farmers. Additional sources of preferential rural credit are a coffee fund and agribusiness credit notes.

[5] Three main agricultural insurance programmes provide support in the form of insurance premium subsidies or by compensating farmers for production losses due to climatic adversities: the Agricultural Activity Guarantee Programme, the Price Premium Subsidy Programme and Garantia-Safra.

[6] Approximately 45% of farm credit to commercial farmers is not subsidized.

(ABC+) was introduced – the largest credit subsidy scheme globally supporting the adoption of climate-smart agriculture (CSA) technologies/practices. Since then, credit lines supporting the adoption of CSA practices have seen an increase either in their number or their uptake by farmers. The Ministry of Agriculture and Livestock (MAPA) did an ex-post assessment of credit lines subsidized during the agricultural years 2019/20, 2020/21 and 2021/22, and assessed that 61% of the amount of credit under Plano Safra directed at investment in 2021/22 supported investment in sustainable and low-carbon agriculture. For 2021/22, MAPA estimated that 47% of Plano Safra's resources for rural credit (investment and working capital) supported sustainable agricultural production systems (BRL118.66 million).

Rationale

The agrifood sector in Brazil is both highly vulnerable and a significant contributor to climate change. The World Bank found that the agricultural sector already loses, on average, the equivalent of 1% of agricultural GDP annually as the consequence of extreme climate events.[7] On the other hand, land use change (primarily deforestation) and agriculture represent the bulk of Brazil's greenhouse gas emissions (at 52% and 24% respectively). However, Brazil is leading the way in shifting farmer subsidies towards CSA solutions. Brazil has a well-developed legal framework and guidelines for adapting its agricultural sector to climate change, in its national sectoral strategy ABC+.

Agricultural credit – Brazil's main form of support – is conditional on implementation of environmental conditions, and credit lines supporting mitigation and adaptation practices are increasing.[8] With the 2023/24 Plano Safra, Brazil has increased the focus of its rural credit towards supporting climate-smart agriculture. From approximately BRL92 billion in the 2023/24 Plano Safra, about 7.52% is directly linked to the adoption of CSA technologies/practices (ABC+/RenovAgro), while 29.89% relates to other credit lines supporting investment in agricultural innovations and machinery for farmers who choose low-carbon technologies. Brazil aims to further increase its support to CSA, through a national programme for restoration of degraded pastures. This would support farmers' investments in restoring the productivity of degraded areas in the country to increase production while limiting pressure on forested areas. Brazil is also gradually shifting its direct support to farmers towards risk management instruments (such as agriculture insurance and partial credit guarantees) combined with other risk mitigators such as technical assistance to lower farmers' credit risk.

In recent years, public support to public goods in the sector (e.g. research and development (R&D), infrastructure) has been decreasing as a share of the total support estimate (from 30% of TSE in 2014 to 16% in 2021) and as a share of agricultural production (from 3.4% of agricultural value of production in 2000–02 to 1% in 2019–21), indicating that it has not kept pace with the sector's growth. Thus, an important recommendation for Brazil would be to refocus and increase support towards agricultural public goods and services (strengthening the support and greening of R&D, animal plant/health, One Health, rural infrastructure, etc.)

[7] World Bank. 2017. *Policy Note for Strengthening the Agricultural Insurance Market in Brazil.* Washington, DC, USA.

[8] With the 2023/24 Plano Safra and its increased focus on CSA, this share of green subsidies could become higher (reaching 50% in the coming years).

to increase the generation and diffusion of innovations for sustainable and low-carbon agriculture.

Approach

To further support the transition toward climate-smart agriculture, Brazil is expanding access to credit for farmers willing to implement mitigation and adaptation practices, lowering the cost of such investment through subsidized credit. The 2023/204 dedicated credit line to support investment in sustainable practices[9] (RenovAgro, ABC[10]), though only representing 1.9% of the total Plano Safra (1.8% in 2022/23), has seen its share of long-term loans increase (from 6.6% in 2022/23 to 7.5% in 2023/24). It carries the lowest interest rates for large farmers (7%).[11] Other lines of credit, such as the Programme to Encourage Technological Innovation, the Programme for Modernization of Agriculture and Conservation of Natural Resources, the Programme for Modernization of Mechanization, and the Programme for Irrigation also cover investments in the adoption of sustainable technologies, and the recovery of degraded areas.[12] For the first time, the 2023/2024 Plano Safra is also encouraging the adoption of sustainable practices through an increased interest rate reduction equivalent to 0.5 percentage points on the total financing cost of short-term loans to: (i) producers who already have their entry on the Environmental Rural Registry analysed[13], and (ii) producers who adopt agricultural practices that are considered more sustainable, such as organic or agroecological production, and the use of bio-inputs and organic fertilizers. With its programme on the restoration of degraded pastures, Brazil hopes to further expand this support to CSA.

This financial support is also linked to the provision of technical assistance and extension services to farmers to foster the adoption of CSA practices, including through the World Bank-supported project, Sustainable Multiple Use Landscape Consortia in Brazil. This project aims to increase the area of land under sustainable management and promote the integration of food systems and sustainable landscapes, the conservation of biodiversity, and the recovery of degraded areas in selected beef cattle and soybean landscapes.

Furthermore, Brazil is working with the World Bank to identify and develop further repurposing options towards a greener and more resilient sector, in particular relating to rural credit and risk management instruments.

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[9] Amongst the supported practices are recovery of degraded areas and pastures, integrated crop–livestock–forestry systems, conservation practices for the protection of natural resources, organic agriculture, the restoration of permanent preservation areas or legal reserves, the production of bio-inputs and biofertilizers, and systems for generating renewable energy.

[10] The World Bank supported the implementation of the *Programa Agricultura de Baixo Carbono* (ABC) from 2014 to 2019, through technical assistance and the training of farmers.

[11] The other lines of credit benefit from subsidized interest rates varying from 8% to 12.5%.

[12] A study done by the Ministry of Agriculture with the Climate Bond Initiative (CBI) in 2022 estimated that in 2020/21 13.5% of Plano Safra was fully aligned with CBI's criteria for sustainable agricultural practices. https://www.gov.br/agricultura/pt-br/assuntos/noticias/analise-da-cbi-aponta-que-linhas-de-credito-oferecidas-pelo-plano-auxiliam-no-fomento-da-sustentabilidade-agricola-brasileira

[13] As of April 2023, only 26% of producers registered on the CAR had any type of analysis and recommendations. States are the administrative entities responsible for analysis of the CAR.

Experience and emerging results achieved

Land use change and agriculture accounted for 52% and 24%, respectively, of Brazil's total greenhouse gas emissions between 2000 and 2020. Scaling up the ABC+ plan for low-carbon agriculture presents a substantial potential to lower greenhouse gas emissions in the agriculture, forestry and other land-use sector. Projections indicate that full implementation of the ABC+ plan to achieve the sector's goals relating to nationally determined contributions provides the opportunity to reduce greenhouse gas emissions by 48% by 2030, when compared to a business-as-usual scenario. Furthermore, the extra incentive given on the interest rates to farmers who have validated entries in the Environmental Rural Registry, could help foster the implementation of the Forest Code, curb illegal deforestation and foster restoration of degraded protected areas. As an example, when Brazil reduced deforestation in the Amazon rainforest by 80% between 2004 and 2012, it reduced emissions from land-use change by 65%.

This is one in a set of country case studies demonstrating policy action that individual countries are taking with the aim of transition to sustainable agriculture. They are country owned and do not represent wider views of the Policy Dialogue participants.

England

Experience of the Agricultural Transition Plan (2021–2028): Moving from area-based agricultural subsidies to paying farmers to deliver environmental benefits

Context

Following the UK's exit from the European Union and its Common Agriculture Policy (CAP), England is reforming agricultural support to reward farmers for delivering environmental benefits rather than continuing with area-based payments, as was the case under CAP.

Environmental Land Management (ELM) is the foundation of this new approach. England's agricultural reforms[14] will contribute to the goals of:

1. Achieving net zero by 2050 through increasing farmers' adoption of low carbon practices. The decarbonization of agricultural emissions will result in a reduction of 4.2 $MtCO_2e$ per annum in Carbon Budget 6 (2033-37) in England (excluding 3 of the Agri LULUCF measures).
2. Restoring 30% of nature and biodiversity by 2030, in line with the goals of the Kunming-Montreal Global Biodiversity Framework.
3. Improving water quality and soil health in line with legally binding targets in the Environmental Improvement Plan.
4. Improving animal health and welfare – supporting more sustainable farm productivity through higher welfare farming, improved biosecurity, tackling antimicrobial resistance and reducing greenhouse gas emissions from livestock.

These goals will be delivered in tandem with supporting sustainable food production. Under the Agriculture Act 2020, the UK Department for the Environment, Food and Rural Affairs (Defra) has committed to present a UK Food Security Report to Parliament every two years, which will assess the impact of the ELM schemes and report on the commitment to maintain food production at its current levels.

[14] Agriculture in the UK is devolved. Thus, other UK nations (Northern Ireland, Scotland and Wales) are responsible for their own agricultural policies, and are each making their own reforms to agricultural support to prioritize sustainability and environmental benefits.

Rationale

Studies find that, globally, current financial support for agriculture delivers low value for money as a way of helping farmers and is often unequally distributed; for every US dollar of public support, the return to farmers is 35 cents. Redirecting just 10% of public support to agriculture could deliver net gains of USD 2.4 trillion by 2040.[15]

Leaving the CAP has enabled the nations of the UK to rethink agricultural support. In England, the approach is to move away from area-based subsidies that are not directly linked to delivering environmental benefits, where support is inefficient or ineffective, offering poor value for money and undermining productivity improvements. Such direct area-based support can also inadvertently drive climate change, environmental damage and harms to health.

England's new **ELM schemes** are designed to work for farm businesses so that they can combine these schemes with food production to reduce their costs, reduce waste and improve farm productivity and resilience while also improving air and water quality, enhancing biodiversity and reducing emissions. Schemes are voluntary and incentive based, and can be combined as long as they do not pay for the same action twice.

Approach

Under the Agricultural Transition Plan (2021–2028) England is implementing a programme of ongoing payments through ELM schemes and one-off productivity and innovation grants to help farmers invest in new technologies.

[15] Gautam, M., Laborde, D., Mamun, A., Martin, W., Valeria, P. et al. 2022. *Repurposing Agricultural Policies and Support: Options to Transform Agriculture and Food Systems to Better Serve the Health of People, Economies, and the Planet*. Washington, DC, USA: World Bank.

Three schemes are available to pay for environmental and climate goods and services:

- **The Sustainable Farming Incentive** pays for sustainable farming actions that protect and enhance the natural environment alongside food production.
- **Countryside Stewardship** pays for targeted actions to create habitats and to promote cooperation across local areas to deliver bigger and better results.
- **Landscape Recovery** pays for bespoke, long-term, landscape-scale projects that enhance the natural environment.

Additionally, there is funding (in the form of one-off grants) for equipment, technology, and infrastructure to improve farm productivity and environmental benefits through the Farming Investment Fund and Farming Innovation Programme. The UK Government has supported new entrants to join the farming sector via the New Entrants Scheme, and those who wish to leave the sector to do so in a planned way via the Lump Sum Exit Scheme.

Key to the success of the transition is not just what policies are being changed but *how* government is managing it.

- Policy co-design: Working directly with farmers has been fundamental to designing new schemes.
- Simplifying things. Defra has simplified the application process – e.g., making it easier and quicker to apply online, and introducing rolling applications so farmers can apply at any time of year.
- Defra have worked hard to make the offer work for all farmers: all farm types, regardless of size, location, ownership or the systems used, can access funding and support that works for them. This includes making the offer attractive to smaller farms, and adjusting options to ensure they work for upland farmers and tenant farmers.
- Finally, Defra have improved the way rules around farming and the countryside are set and controlled to make regulation fairer, more proportionate and effective, e.g., issuing warnings rather than minor penalties.

Experience and results achieved

- In the first few years of the seven-year transition, a universal offer of schemes has been rolled out to farmers and land managers. This has increased uptake of schemes, and is on track to hit a target of 70% of farms and farmland being in schemes by 2028.
- There are now over 100 paid-for actions available under the Sustainable Farming Incentive and Countryside Stewardship.
- There has been significant uptake of ELM schemes, with 32,000 Countryside Stewardship agreements already in place across England for 2023, representing a 94% increase in uptake since 2020.
- In November 2023, 34 projects were awarded a share of GBP 25 million in project development funding through the second round of the Landscape Recovery scheme to deliver long-term, largescale changes to support environmental and net zero outcomes. These projects will combine both government and private finance to restore peatland, create woodland including some temperate rainforest, and benefit more than 160 protected sites.

- For productivity and innovation, more than GBP 168 million was offered in grant funding across 2023. This includes funding for equipment, technology and infrastructure to improve farm productivity and benefits the environment through the Farming Investment Fund.
- Through the Farming Innovation Programme there are 173 projects under way, involving over 400 organizations driving forward innovations in robotics and automation, more environmentally sustainable pesticides and fertilizers, and making use of artificial intelligence to support animal health and welfare.

Lessons learned

1. **Importance of a gradual transition**. This is the biggest change to farming policy in the UK in 40 years. Therefore, the reforms are being rolled out over a seven-year transition period – while gradually phasing out direct payments, before delinking them from the land – to enable farmers to plan and adjust to the new schemes.
2. **Co-design/farmer engagement.** In order to incentivize farmers to join schemes and deliver our target outcomes for the environment, the schemes must be attractive and workable for all types of farm. Farmers have been brought directly into the policy design process from the beginning and throughout. Co-design pilots, tests and trials have been run with more than 5,000 farmers and other people, as well as several stakeholder organizations, since 2019.
3. **An iterative approach.** Farming is a long-term endeavour but must also be responsive when there is change – for example, climate change. The UK Government will continue to work directly with farmers to adapt and improve the offer. Listening to feedback and adjusting has been crucial so far. For example, farmers who signed up for our Sustainable Farming Incentive in 2022 outlined that they wanted more freedom to select the combination of actions they would undertake, rather than being presented with a menu of fixed packages. In 2023, the Sustainable Farming Incentive was redesigned in response to that feedback. Schemes will continue to adapt and more detail will be set out in an upcoming Agricultural Transition Plan Update in 2024.

Germany

Innovative approaches to incentivize soil health for sustainable production and climate change mitigation and adaptation

Context

Healthy soils offer a wide range of ecosystem services. They sustain agricultural production by providing water and nutrients to crops, regulate the water circle, constitute an uncaptured reserve of biodiversity, and play an essential role in climate change adaptation and mitigation. In this regard, the build-up and conservation of organic matter through sustainable management practices is essential. Protecting and increasing carbon storage in soils is a central element of Germany's path to carbon neutrality. However, there is no one-size-fits-all solution and sustainable soil management decisions need to be context specific, considering the agroecological conditions and farming systems. There is a significant interest among both conventional and organic farmers to engage in healthy soils. However, knowledge exchange between science and practitioners is so far insufficient to support decisions on farm-specific, economically viable and site-appropriate humus (soil organic and mineral content) management. In addition, further proof of concept regarding the effectiveness of different management approaches as well as the economic viability of adapted land management is still needed.

Rationale

Preserving and, where necessary, improving the generally high fertility of soils in Germany is a primary concern for the German government. Hence, various approaches regarding regulation, incentives and research are being followed, e.g., through the national implementation of the EU common agricultural policy, fertilizer regulations, or investments in modern technology which support less invasive and more resource-efficient cultivation. To expand the adoption of agricultural practices targeting the build-up and conservation of organic matter, Germany launched the "Federal Humus Programme" in 2022. Furthermore, Germany is invested in long-term soil monitoring, e.g., through its survey of the state of Germany's agricultural soils.

Approach

The Federal Humus Programme entails research projects, as well as several model and demonstration initiatives, which focus on testing on-farm practices. Participating farmers are in close exchange with the federal research institute to optimize management approaches for the agroecological as well as socioeconomic conditions of each farm. At the same time, data is generated to check the effectiveness of management practices as well as the added value for farm enterprises. The project further aims to expand promising approaches by disseminating knowledge and experiences created in the course of the project. One approach is to foster peer-to-peer learning in “humus clubs”, where participating land managers meet on a regular basis to discuss experiences and develop solutions. Another approach is the Humus Climate Network. This major initiative, launched in 2022, engages 150 farm enterprises and is jointly implemented by the German Farmers’ Association and the German Organic Food Industry Association.

Sound data is required for informed decision-making and reliable reporting on the effects of changing management practices on the organic carbon stocks of agricultural soils. Therefore, Germany is investing in long-term monitoring of the state of its soils. From 2011–2018, the Thünen Institute conducted the first uniform inventory of agriculturally used soils, analysing physical and chemical soil properties which influence organic carbon stocks in the soil as well as information on management practices. The survey will be repeated in the years 2023–2027 to identify potential changes to the carbon stocks over time. The results will feed in to national climate reporting to the United Nations Framework Convention on Climate Change.

Experience and results achieved

The Humus Climate Network has been well received by both organic and conventional farm enterprises. A first broad evaluation of carbon stock changes on participating farms will take place after five years.

The survey of the state of Germany’s agricultural soils provided reliable information on the condition and potential developments of humus stocks in agricultural soils in Germany. The results of the upcoming survey will play an important role for the validation of area-wide modelling of carbon stocks, which further increases the reliability of national emission reporting.

Ghana

Experience in policy action for transitioning from direct input subsidies to a smart input-credit system

Context

The agricultural sector is a key driver of Ghana's economy, contributing an average of 21% to gross domestic product and employing 38.3% of the workforce from 2012 to 2021. It also plays a significant role in generating export earnings, primarily through cocoa, which represents about 75% of agricultural exports. Agricultural exports averaged USD 3.23 billion per year between 2012 and 2021, constituting 24% of total export earnings.

Ghana's agricultural sector achieved robust growth with an annual average growth rate of 4.5% from 2012 to 2021, contributing to the country's overall economic growth, which averaged 5.2% annually during the same period. This growth resulted from increased productivity and land area expansion, with an average annual growth of 3.4% in real value added per harvested hectare. The period from 2017 to 2021 saw remarkable growth, as a result of Planting for Food and Jobs (PFJ) flagship programme, which has been linked to increased yields of major agricultural products.

Despite these successes, climate related factors like erratic rainfall and rising temperatures pose an increasingly significant challenge, added to other obstacles in post-production processing and marketing. The Ghanaian agricultural sector also faces challenges in use of modern inputs and services, as well as infrastructure for irrigation, transportation and storage. Limited research and development capacity has led, among other issues, to limited availability of quality seed that is resilient to pests, diseases and climate change.

Rationale

The Planting for Food and Jobs flagship programme (PFJ, 2017–2022) provided subsidized inputs for farmers cultivating targeted crops (maize, rice, sorghum, soya, groundnuts, cowpeas, vegetables, and root crops) and less than 2 hectares (5 acres). Despite its notable impact, several challenges limited PFJ's effectiveness.

First, the subsidies put the government under a heavy fiscal burden. The cost of the subsidies averaged USD 75 million between 2019 and 2022. This amount represented half (51%) of the

Ministry of Food and Agriculture (MoFA)'s expenditures allocated through the central government. Moreover, subsidies cost three times capital expenditures, suggesting limited resources for value chain upgrading.

Second, although PFJ was originally organized around five pillars, only the first two – promoting fertilizer and seeds availability and access – received sufficient attention. Underfunding of the last three pillars (extension services, marketing and e-agriculture) has hindered PFJ's effectiveness. The present extension agent-to-farmer ratio of 1:745 is a concrete outcome of this matter. Other inefficiencies that limited PFJ's effectiveness are related to beneficiary targeting, crowding out commercial input sales, low input use efficiency, lack of marketing support, and weak monitoring and evaluation system. Repurposing the considerable input subsidies' resources to finance a more holistic, data-driven and value chain-oriented approach will promote sustainable and viable production systems.

Approach

In a second phase, MOFA decided to repurpose government support to farmers away from the provision of direct input subsidies, introducing the PFJ 2.0 in 2023. This is a bold transition from direct input subsidies to a smart input-credit model. PFJ 2.0 prioritizes 11 commodities. The input-credit model involves the provision of a package consisting of high-quality climate-resistant seeds, fertilizers and mechanization and extension services. These services will be accompanied by climate-smart information and adaptation practices, through digitization, aggregators and extension agents. In addition, PFJ 2.0 intends to provide storage and distribution infrastructures and promote off-taker arrangements.

The PFJ 2.0 also integrates the Ghana Agriculture and Agribusiness Platform (GAAP). The GAAP will centralize data and information essential for the development of stakeholder-specific applications. The e-extension system illustrates such applications. It will rely on the centralization of real-time climate and weather information, soil and fertility mapping, and a digital database recording farmers' cropping decisions, supporting farmers in adapting to climate change impacts – particularly floods, droughts and rising temperatures. This electronic system will not only allow the timely delivery of customized agricultural advice to farmers, but also allow a greater number of farmers to be reached through innovation. Considerable efficiency and productivity gains are expected.

Experience and expected results

Key Results achieved from PFJ:

- Average agricultural sector growth rate of 6.3% (2017–2021), up from 2.7% (2016).
- Increases in crop yields for key staples: 135% for maize, 67% for rice and 18% for soybeans.
- Marked increases in crop yields for key staples: maize, rice, and soybeans by 135%, 67%, and 18%, respectively, within the specified period.

The PFJ 2.0's Expected Results and Impacts:

- Ensure food security and climate resilience by promoting sustainable agricultural practices and ensuring that the food supply is sufficient and resilient to shocks such as natural disasters or pandemics.
- Ensure food availability by supporting the production of 11 prioritized commodities.
- Reduce food price inflation through increased production and improved storage.
- Promote import substitution by increasing production and processing of selected crops.
- Promote exports by supporting selected crop production and ensuring they meet required standards.
- Create jobs along the entire commodity value chains, providing employment and growth opportunities for small and medium-sized enterprises.

Lessons learned

- Effective communication and awareness are crucial to informing stakeholders of changes and benefits, particularly related to the smart input-credit system under the PFJ 2.0.
- Transitioning from input subsidies to credit-based approaches requires well-defined regulatory and policy frameworks, along with effective risk management strategies. This requires a thoughtful policy reform approach and adequate preparation time.
- The transition to the digital input-credit platform should be gradual and phased to manage complexity and effort. Ensuring access to financial and digital services for farmers and other stakeholders, both in the government and private sectors, poses challenges, particularly in areas with limited technology access. Extension services and technical support remain essential for optimizing inputs and technologies.
- Inadequate rural infrastructure, such as roads and telecommunications, hinders the delivery of modern extension services, affecting the adoption of digital solutions. The programme's success depends on having sufficient infrastructure, especially for storage.

Ireland

Food Vision 2030: A world leader in sustainable food systems

Context

The agrifood sector is Ireland's largest indigenous exporting industry, playing a vital role in Ireland's economy. The sector accounts for almost 7% of Gross National Income and over 9% of exports in value terms. The sector employs almost 165,000 people, representing close to 7% of total employment in the country, but a far greater proportion in rural and coastal areas. Ireland's greenhouse gas emissions for 2022 show that agriculture is responsible for 38% of total emissions. These figures reflect the relative importance of agriculture to Ireland's economy, and the lack of heavy industry in comparison to many other countries.

Rationale

The Irish agrifood sector has benefited from strategic planning in the development of stakeholder-led strategies. Since their inception 20 years ago, these strategies have ensured that the sector has a coherent, stakeholder-led vision and strategy to underpin its continued development. **Food Vision 2030** aims for Ireland to become a "world leader in sustainable food systems" by 2030. This will deliver significant benefits for the Irish agrifood sector, for Irish society and the environment. In demonstrating that the Irish agrifood sector meets the highest standards of sustainability – economic, environmental and social – this will provide the basis for the future competitive advantage of the sector. By adopting an integrated food-systems approach, Ireland will seek to become a global leader of innovation for sustainable food and agriculture systems, producing safe, nutritious and high-value food, while protecting and enhancing its natural and cultural resources and contributing to vibrant rural and coastal communities and the national economy.

Approach

Food Vision 2030 consists of 22 goals and 218 actions, grouped into four high-level missions for the sector to work towards.

Mission 1 is to achieve "a climate-smart, environmentally sustainable agrifood sector" with an overall target of a climate neutrality by 2050, with verifiable progress to be achieved by 2030. There are seven goals in this mission, encompassing emissions reductions, carbon

sequestration, improvements in air quality, restoration and enhancement of biodiversity, improvements in water quality, development of diverse forests, enhanced seafood sustainability, exploring the bioeconomy and strengthening Origin Green, Ireland's national food and drink sustainability programme.

Mission 2 is for "viable and resilient primary producers, with enhanced well-being." This mission places primary producers, farmers, fishers and foresters at the centre of the strategy. It involves improving the competitiveness and productivity of primary producers; increasing the creation of value and distributing it fairly; introducing greater diversification in production systems and incomes; and improving the social sustainability of primary producers across areas such as generational renewal, gender balance, health and safety, mental health and well-being, and wider rural development.

Mission 3 is for "food that is safe, nutritious and appealing, trusted and valued at home and abroad", with a particular focus on the importance of trade. Food Vision 2030 looks to protect and build on Ireland's global reputation as a trusted supplier of high quality, safe, sustainable food to consumers at home and abroad. This mission aims to prioritize coherent food and health policies for better health outcomes, to enhance consumer trust in our food system, to add value through insight, innovation and product differentiation, and to further develop market and trade opportunities both at home and abroad. Diversifying and developing markets will continue to be a priority.

Mission 4 is for an "innovative, competitive and resilient agrifood sector, driven by technology and talent." There are seven goals in this mission, which are relevant to all other missions and will act as key enablers. They include moving to a challenge-focused innovation system, having a strategic approach to funding research and development, developing dynamic knowledge exchange practices, enhancing the use of technology and data, improving competitiveness and resilience, attracting and nurturing diverse and inclusive talent, and improving policy coherence in sustainable food systems between Ireland's domestic and foreign policy. The strategy envisages a more output-focused collaborative innovation system by 2030, with private research and development to reach 1% of turnover.

Experience and results achieved

Each of these missions has ambitious goals rooted in a strongly practical approach to what needs to be achieved for future environmental, economic and social sustainability. The success of Food Vision 2030 depends on effective implementation and oversight. For this reason, a Monitoring and Implementation Framework is included. A High-Level Implementation Committee chaired by the Minister for Agriculture, Food and the Marine and comprising senior officials from relevant government departments and agencies involved in the agrifood sector oversees the delivery of Food Vision 2030. In addition, a formal implementation plan for Food Vision 2030 was published, identifying stakeholders, deliverables and a time frame for each of the actions. Implementation of Food Vision 2030 is under way, with many of its actions commenced, including important work on environmental sustainability in the dairy and beef sectors, and progressing to specific stakeholder groups. The first Food Vision Annual Report was published in May 2023. In terms of overall progress to date, 14 actions are complete, 108 actions have substantial action undertaken, 92 actions have commenced and are progressing, and 4 actions have not yet commenced.

Lessons learned

A food-systems approach to sustainability involves considering the interconnectivity of the food system. A sustainable food system is one that delivers food security and nutrition for all in such a way that the economic, environmental and social bases to generate food and nutrition for future generations are not compromised. Adopting and advocating this approach highlights that a holistic approach is necessary.

Crucial to success is all actors in the sector working together in a constructive fashion, in a spirit of collaboration and partnership and, if necessary, compromise, to address the challenges and grasp the opportunities.

This is one in a set of country case studies demonstrating policy action that individual countries are taking with the aim of transition to sustainable agriculture. They are country owned and do not represent wider views of the Policy Dialogue participants.

Malawi

Policy action for sustainable food system transformation

Context

Agriculture plays a crucial role in Malawi's economy, contributing significantly to growth, employment, food security and nutrition. It accounts for 22.7% of the country's GDP, generates over 80% of export earnings, and employs 64% of the workforce. However, the sector faces various challenges, including low agricultural productivity, monocropping of maize production, land degradation, vulnerability to climate change, and low levels of commercialization. To address these challenges, Malawi needs to invest in the sector, provide correct incentives and improve provision of public goods and services – to improve productivity, diversify crops and promote sustainable land management practices.

In keeping with the African Union (AU) Comprehensive African Agriculture Development Programme (CAADP) recommendations, Malawi has made progress towards meeting the CAADP target of allocating 10% of national budgets to the agriculture sector over the past decade. However, increased public expenditure for the sector has seen mixed outcomes. For example, Malawi's agricultural GDP growth rates have averaged 2.7% between 2010 and 2021, well below the potential 6% annual average sector growth rate envisioned by the CAADP. The declining macroeconomic situation has further compounded the issue, as increasing debt levels and shrinking fiscal space are putting increasing pressure on budgetary allocations for agriculture. The Malawian kwacha has also faced significant devaluation, which has exerted inflationary pressure leading to forex shortages and affecting the imports of critical inputs such as fertilizers. Consequently, prices of food commodities have been rising, compounded by elevated global prices for grains and cooking oil. Food inflation had reached 37.9% in April 2023, its highest point since 2013.

Rationale

Achieving sustained agricultural growth and rural transformation in Malawi requires a systemic shift in the way the agriculture and food system are supported. For example, about 70% of government agricultural expenditure has been allocated to an agricultural inputs programme (AIP), which has had limited impact on productivity growth, as evidenced by stagnant and low maize yields. This policy bias on subsidizing inputs specifically for maize has crowded out expenditure on essential public goods and services such as research and extension, and skills and infrastructure development. Moreover, it has also incentivized farmers to remain engaged

in subsistence maize farming, which negatively impacts agricultural diversification and the commercialization, resilience and productivity of the sector.

Approach

Reforming the current agricultural support programmes and repurposing expenditure is critical to address the misalignment between policy priorities and public expenditures in Malawi. The Government of Malawi intends to reform its current AIP to provide an enabling environment and incentives to farmers that encourage diversification, productivity growth, resilience and sustainability. However, it is equally important to identify technically viable and politically feasible alternative mechanisms of support to achieve transformative change in the agrifoods system. Hence, the government is planning to pilot several options and generate the necessary evidence on the effectiveness and efficiency of these alternative mechanism of support.

Repurposing options being pursued include: (i) flexible e-vouchers to allow farmers to choose their own input bundles, (ii) incentivizing the adoption of proven practices that improve soil health in the local context by coupling some level of AIP support with the adoption of pre-identified practices and payments for ecosystem services, and (iii) bundling AIP with extension and advisory services to increase the impact of the subsidies provided to farmers. This will include strengthening extension services – through training, content development, and the effective use of the digital information system developed under an ongoing World Bank programme.

Expected results

The objective is to pilot and generate necessary evidence for the government on the efficiency and efficacy of these alternative mechanisms of support which will lead to a reform of the AIP. An expected result is the removing bias of the current AIP on maize production, which encourages farmers to remain in subsistence maize farming. Another expected result is the expanding the mandate of the AIP from solely providing input subsidies, particularly for fertilizer, to also include sustainability of the food system. The final main expected result is higher investments in the provision of public goods and services which improve the efficiency and efficacy of support provided by enhancing the skillset of farmers and improving transparency.

Lessons learned

- Repurposing options need to be designed given the local country context, development challenges and national priorities. The design of the repurposing options should be done in a participatory manner to identify mechanism that are technically feasible and politically and socioeconomically viable given the local country context.
- Policy reform should be evidence based and gradual, given the political economy.

These alternative mechanisms will be developed in collaboration with the government and local and international experts. The pilots will be carried out in selected districts for at least two seasons and scaled up under the World Bank Malawi Food Systems Resilience Program and the government AIP based on findings of the evaluation.

Morocco

Policy action for productive and sustainable agriculture

Context

Agriculture plays an important socioeconomic role in Morocco, representing 15% of the country's gross national product in 2022 (11% for agriculture in the primary sector and 4% for the agrifood sector) and 14% of the value of total exports in 2022, and employing approximately 38% of the population. The Green Morocco Plan 2008–2020 has worked towards strengthening agricultural sectors, increasing productivity and exports. Climate change, characterized by insufficient rainfall and high temperatures, has impacted the productivity of major crops. In addition, the increase in population generates a growing demand for agricultural products, which, combined with geopolitical factors such as the war in Ukraine, has impacted the availability and price of cereals and oilseeds. Consequently, Morocco is compelled to develop a more resilient agriculture to ensure it can meet essential needs in cereals, legumes, meats, fruits and vegetables.

Key agricultural research under the **Generation Green strategy (2020–2030)** involves several programmes for innovative, productive and resilient agriculture. This note focuses on approaches to incentivize soil health for sustainable production. It is well established that the practice of conservation agriculture (no-till system) improves soil health by maintaining water in the soil, preserving soil organic matter and biodiversity, reducing erosion, sequestering carbon and using less energy than conventional tilling. As a result, adopting a conservation agriculture approach can lead to higher crop yield (on average by 30%) compared to conventional tilling, increased carbon sequestration, from less than 1.5% to over 2% of organic matter and 13% after 10 years (-67 t/ha eq CO_2), 60% savings in production costs and 50% reduction in soil erosion (-15 t/ha/yr).

For these reasons, the Moroccan Ministry of Agriculture plans to transition 1 M ha, of the 4 M ha rain-fed area dedicated to cereals, from conventional tilling to conservation agriculture.

Rationale

The behaviour shift entails farmers transitioning from conventional to conservation agriculture. This shift requires investments from the government and other stakeholders in seeders as an

incentive for farmers not yet adopting conservation agriculture. It also needs a large programme of public extension services, capacity building and research.

Approach

The government is subsidizing the purchase of no-till system seeders. Seventy seeders were acquired in 2022, and an additional 130 seeders will be acquired in 2023. These seeders will be made available to small farmers through cooperatives. On average, each seeder will cover 400 ha per year.

In addition to implementing conservation agriculture approach, measures are being taken to address the challenge of drought. There are programmes in place to develop resilient varieties of cereals and legumes as well as to improve water use efficiency through irrigation techniques such as drip irrigation and supplementary irrigation.

Results achieved

The implementation of direct seeding to address drought and soil health issues has been successfully launched since 2020/21 aiming to cover 1 M ha by 2030. The plan is ongoing, the table below presents the realizations in 2020/21, 2021/22, 2022/23 and the plan in the following years.

CA	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29	29/30
Ha	15,000	38,000	53,000	85,000	200,000	300,000	400,000	540,000	730,000	895,000	1,000,000

Lessons learned

The plan to implement conservation agriculture will require a continued commitment from the government to support small farmers with seeders and potentially assist in the purchase of feed for animals, as conservation agriculture requires farmers to leave staple crops in the field and not let animals feed on them.

All stakeholders, including extension services, farmers' associations, research and development institutions and funders, are contributing to the success of this initiative.

Finally, the adoption of conservation agriculture will enhance yields. When combining this practice with other actions, such as utilizing drought-tolerant varieties, it will contribute to the development of resilient agriculture, leading Morocco towards food security.

This is one in a set of country case studies demonstrating policy action that individual countries are taking with the aim of transition to sustainable agriculture. They are country owned and do not represent wider views of the Policy Dialogue participants.

Mozambique

Policy action for sustainable food system transformation

Context

Agriculture plays a key role in Mozambique's economy, as it contributes 28% to the national gross domestic product and employs 70% of the population (FAOSTAT). Most farmers are smallholders and engage in subsistence and semi-subsistence farming. One of the main challenges it is facing is low and stagnating levels of productivity. This is measured as total factor productivity. Between 2010 and 2020, total factor productivity growth contributed negatively to output growth and stagnated at an average of -0.5% per year. Adoption of new technologies is dismally low and as of 2020, around 8% of farmers used agrochemicals, 2% irrigated and only 1% used improved seeds. Yields of staple crops such as maize and rice are well below not just their theoretical potential, but also the levels realized by Mozambique's regional peers.

The agricultural sector can play an important role in poverty reduction and economic resilience. However, the sector is facing several key challenges such as underdeveloped input and output markets, reliance on outdated technologies and farming practices, poor market linkages and unsustainable natural resource management.

Climate change is exacerbating the issue as according to the World Risk Index, Mozambique was the third most vulnerable country on the African continent in 2021[16]. It is also among the most exposed to weather extremes, facing more frequent cyclones, droughts and major flood events than many of its neighbours. As a result, yields of crops are expected to decline.

Rationale

Analysis suggests significant scope for improving the effectiveness and efficiency of limited public budgets to help farmers achieve growth in sustainable agriculture. First, budgetary allocation for the sector is low and much more support is required to accelerate the transformation of the agriculture sector. Moreover, given the extremely limited fiscal space it is very important to maximize public expenditure efficiency and impact (value for money). The

[16] World Risk Report 2022. Bündnis Entwicklung Hilft, Ruhr University Bochum – Institute for International Law of Peace and Conflict 2022. https://weltrisikobericht.de/weltrisikobericht-2022-e.

quality of spending also needs improving, as witnessed by low productivity growth rates. In addition, public support programmes have not fully addressed growing challenges linked to climate change, environmental degradation of soil and water, biodiversity loss, increasing food and nutrition insecurity and pandemic risks. Therefore, aligning public support to better address growing challenges is needed to increase the production and commercialization of key staple food crops, crop diversification and nutritious food products.

Approach

Improving access to technologies such as fertilizers and equipment is necessary, but not sufficient. This suggests more investment should be directed to building the necessary knowledge and services to ensure efficient and effective use of appropriate modern technologies. Important opportunities exist to modernize agricultural extension services and build capacity for the supply of public and private services to smallholder farmers. This includes the use of digital tools to increase and accelerate access to knowledge in remote areas, the provision of basic equipment to extension workers, and combining improved access to inputs with necessary extension services.

As part of repurposing public support, and building on previous pilot experiences, Mozambique will roll out an electronic voucher system to increase the effectiveness of its agriculture input support programme. Changes to the existing input distribution model are being considered, including: making this more flexible by allowing farmers to choose which inputs they want based on their specific needs; bundling subsidies with complementary services such as extension to improve efficacy and efficiency of inputs; rewarding adoption of more sustainable practices and; revising input procurement and distribution mechanisms, which currently hinder a more dynamic and decentralized participation of the private sector.

Secondly, Mozambique will also strengthen extension services including content development for extension training, and building strategic linkages with agricultural research services in areas such as soil health systems and fertilizer recommendations, among others.

Expected Results

Bundling input support with quality extension services is expected to significantly improve the impact of public expenditures and deliver on better productivity and incomes. Evidence from initial work will be used to inform climate adaptation approaches such as soil health considerations in fertilizer practices. The expected result is that this will lead to increased investment in the agriculture sector, especially on the provision of public goods and services that improve productivity in a sustainable manner.

Lessons Learned

- Repurposing options need to be designed given the local country context, development challenges and national priorities. The design of the repurposing options should be done in a participatory manner to identify mechanisms that are technically feasible and politically and socioeconomically viable given the local country context.
- Policy reform should be evidence based and gradual, given the institutional capacities as well as the political economy involved in reforms.
- Proper evidence and information should be collected systemically to inform policy makers and stakeholders on practices that adapt to a changing climate and mitigate carbon emissions.
- These alternate mechanisms will be developed in collaboration with the line ministry and local and international experts. The pilots will be carried out in selected districts for at least two seasons and scaled up under the fourth phase of the World Bank Food Systems Resilience Program in Mozambique.

Netherlands

Policy action towards a sustainable agrifood system

Context

Over the years, the Netherlands has become a global leader in the areas of agriculture and horticulture thanks to continuous innovation and process optimization. The Netherlands is proud of the achievements of its agricultural sector, supply and processing industries and knowledge institutions. These organizations have put the Netherlands on the map as a model for other countries when it comes to agricultural knowledge, production and innovation, and thus in a position to make an important contribution to global food supply and security.

At the same time, the current intensive agricultural systems in the Netherlands have reached – and in many cases exceeded – the limits of what a healthy living environment can handle. Climate change and the loss of biodiversity are a direct threat to food production. The Netherlands faces the challenge of balancing agricultural production with the environment in which food production takes place. In a crowded landscape with many demands, the Dutch agricultural and food system is currently facing a difficult transition towards a sustainable future. This transition is not a luxury, but an absolute necessity that requires government intervention.

Rationale

The Government of the Netherlands is committed to working on this transition by taking an integrated approach when it comes to nitrogen, water, climate and nature. The Netherlands is a small country, but still the situation is different in every region. The quality of nature, water, and soil varies everywhere. Also, the most efficient interventions towards a healthy environment, clean water and fresh air differ per region. Therefore, the Netherlands is developing regional programmes to work towards a sustainable and healthy rural area in the future. Measures are being implemented in various sectors, including agriculture, industry and transportation. All sectors contribute to the country's goals, in terms of reducing nitrogen and greenhouse gas emissions and improving air quality. And perhaps most importantly, in line with the tried and tested 'Dutch polder model' of consensus decision-making, the Netherlands aims to shape its transition through cooperation among all stakeholders. This 'Dutch Diamond Approach', as it is referred to, is essential in successfully transforming our national food system.

Approach

The exact outcome of the transition towards a sustainable future is not set in stone. What is certain, however, is that the national food system will look different in the future. Agricultural production will occur within planetary boundaries, while the agricultural sector will remain economically sound and internationally competitive. Dutch farmers will largely transition to nature-inclusive, organic and circular farming. Production will be future proof and sustainable.

This requires a solid income model for agricultural entrepreneurs. A solid income model can only be created when farmers receive a fair price for their sustainable products from customers such as food producers, supermarkets, and ultimately consumers. A fair, higher price for more sustainable products requires clear standards so that consumers know what they are buying. Since a significant portion of agricultural income is generated abroad, this is a European and international issue. It is important that there is mutual recognition of sustainability labels, so that producers are rewarded for their sustainability efforts and the associated costs when selling on the international market.

Next to a solid income model for agricultural entrepreneurs, it is crucial to stimulate research and innovation. The government – together with the private sector, knowledge institutions and civil society organizations – has developed a knowledge and innovation agenda focused specifically on agriculture, water and food. This agenda will guide innovation and research efforts in the years leading up to 2030. Also, the Dutch government financially stimulates public–private projects with a focus on sustainable economic growth; for example, by investing in a project on cellular agriculture, a project on plant breeding for resilient crops, big data methods and artificial intelligence.

The Netherlands is also investing globally in research and innovation and sharing its knowledge and expertise. Last year, the government announced a substantial increase in the development cooperation budget for food and nutrition security, with an additional EUR450 million over the next five years. The Netherlands also has a six-year USD177 million commitment to the CGIAR partnership, and has further investments in scientific collaboration, knowledge sharing and capacity building for food systems with a primary focus on Africa. The country also organizes innovation missions for its private sector and research institutes to share experiences with other countries. For example, last year there was an innovation mission to Singapore focusing on cellular agriculture.

Conclusion and lessons

In conclusion, the food system transition is taking place at a time of a concerning deterioration in food security for millions of people around the world. The war in Ukraine, climate change and the COVID-19 pandemic have had a major impact on global food markets. This makes clear the significance and value of a stable, sustainable agricultural sector – in balance with nature and the environment – when it comes to food security. It makes us especially focused on how urgent the transition to a more resilient food system is. We have to do this together.

This is one in a set of country case studies demonstrating policy action that individual countries are taking with the aim of transition to sustainable agriculture. They are country owned and do not represent wider views of the Policy Dialogue participants.

New Zealand

Experience in accelerating innovation to reduce agricultural emissions via the Centre for Climate Action on Agricultural Emissions and the Global Research Alliance on Agricultural Greenhouse Gases

Context

New Zealand has a unique emissions profile; 49% of our total emissions come from the agricultural sector, over half of which is methane. Accordingly, agricultural emissions reductions are critical to our transition to a low-emission, climate-resilient economy. To meet climate targets and ensure New Zealand farmers and growers remain competitive with our credible sustainably produced products, the government has taken the following actions:

- Allocated more than NZD 300 million over four years to strengthen the role of research and development in getting new technology and practices that reduce on-farm emissions to farmers faster. This includes funding for the new **Centre for Climate Action on Agricultural Emissions**.
- Continued to promote global collaboration through the **Global Research Alliance on Agricultural Greenhouse Gases (GRA)**.

Rationale

To provide farmers with options to reduce emissions on farm, the New Zealand government is accelerating the research, development and commercialization of tools and technology to reduce emissions through the Centre for Climate Action on Agricultural Emissions.

The Centre for Climate Action on Agricultural Emissions has two key components: AgriZeroNZ, a public–private joint venture with key industry agribusinesses, and the New Zealand Agricultural Greenhouse Gas Research Centre.

The Centre for Climate Action on Agricultural Emissions will:

- Unite efforts to accelerate research and development.
- Get new tools, technology and practices that lower on-farm emissions to farmers faster.
- Support Māori owners with climate change mitigation.

The global collaboration programme via the GRA:

- Accelerates research, expanding the scale and scope of agricultural research.
- Builds global capability and capacity.
- Connects like-minded countries and communities, including through the GRA Indigenous Research Network, to share expertise.
- Helps to establish consistency of measurement.

Approach

Launched in November 2022, the Centre for Climate Action on Agricultural Emissions has already made more than NZD 54 million in investments, alongside industry. Projects includes developing a methane-inhibiting bolus, increasing the pool of researchers with skills in agricultural greenhouse gas (GHG) mitigation, and building a new GHG testing facility for large cattle.

The international collaboration programme supports multi-country research and capability initiatives through the GRA, including best practice for on-farm systems, inhibitor and vaccine research, low-emitting animals, soil carbon and peatlands management. Global collaboration allows participating countries access to expertise, infrastructure and scale with large datasets from multiple sites, accelerating research outcomes.

The capability programme includes the highly successful Climate, Food and Farming, Global Research Alliance Development Scholarships Programme (CLIFF-GRADS). Since 2017, 177 students from 32 developing countries have received CLIFF-GRADS awards, with awards for another 40 students announced at COP28.

In support of New Zealand's development assistance programme, the Climate Smart Agriculture Initiative is being delivered in Southeast Africa, Association of Southeast Asian Nations (ASEAN) and Latin America and the Caribbean through the GRA. New Zealand is working with partner countries, other GRA members and partner organisations to build global climate resilience through in-country capability on farm, locally relevant research, and establishing and maintaining Tier 2 inventories.

Experience and results achieved

The Centre for Climate Action on Agricultural Emissions was launched in November 2022. Since that time, projects funded include:

Sheep genetics partnership. This project aims to increase the supply of low methane rams through genetic selection, introducing more low-methane traits into the national sheep flock for a greater supply of low-methane rams across breeds available for use by sheep farmers.

Ruminant BioTech CALM (Cut Agricultural Livestock Methane) programme. Support for the development of a methane-inhibiting capsule, or bolus, which aims to deliver at least a 70% reduction in methane while active, to assist New Zealand to reach its emissions reductions targets.

Infrastructure and testing equipment. Investments in GHG measuring equipment and infrastructure to accelerate testing capabilities and increase the speed for the development of new tools and technologies for use by farmers. The new equipment will help testing in the short and long term – for cattle and sheep, indoors and in the field, and at multi-locations all over the country.

Plantain research. Further research on the effect plantain has on nitrous oxide emissions to increase the understanding of the key controller of biological nitrification inhibition metabolites in plantain.

PhD and fellowship programme. Government funding for PhD and post-doctoral students over six years, and the development of a national agricultural GHG capability plan to ensure New Zealand can meet the increased demand for researchers.

GHG testing facility. Joint public–private partnership towards the construction of a new GHG testing facility to provide permanent measuring and testing equipment to enable researchers to measure and monitor changes to methane emissions in individual cows.

Lessons learned

Funding research is critical to reduce agricultural emissions and getting new technologies and tools to farmers sooner. Products and practices must be commercialized quickly so that farmers can access them and are trained to implement them. This is particularly important for New Zealand given our emissions profile.

Globally, however, not enough public money is being directed towards research and development activities. For example, the 2023 OECD Agriculture Policies Monitoring and Evaluation Report shows that the 54 countries monitored provided on average USD 851 billion of support to agriculture annually over the 2020–22 period; a record level. Support has remained substantial among countries covered by the OECD analysis, with more than half of the support to producers (USD 333 billion annually) delivered through higher market prices paid by consumers, while the remainder (USD 297 billion annually) was paid by taxpayers through subsidies. Although support has increased overall, the share of money spent on innovation, biosecurity or infrastructure services has declined to 12.5% of support directed to the sector in 2020–22, down from 16% two decades earlier. These services are critical for increasing sustainable productivity growth and reducing GHG emissions from agriculture.

Emission reductions require the development of agricultural production systems of much lower emission intensity. Budgetary support must be oriented towards investments in innovation to foster emission-saving and sustainable productivity growth and to ensure the emergence of new mitigation technologies. Such investments benefit from stronger partnerships between the public and private sectors to maximize synergies. The private sector has a key role to play in climate change mitigation and its responses to climate change are accelerating.

To underpin the transition to sustainable agriculture, New Zealand and Australia have developed the high-level Principles for Cooperation Aimed to Underpin the Transition to Sustainable Agriculture. Recognizing the diversity of agricultural production systems globally, these principles do not define sustainable agriculture but acknowledge that countries will require context-specific, evidence-based management practices to achieve shared their sustainability objectives. The principles are structured around two complementary objectives:

- To demonstrate a shared commitment to progressive improvement of the sustainability of our agricultural production systems, including recognizing the role of agriculture in global efforts to reduce GHG emissions, and ensuring public support and funding to agriculture does not harm the environment.
- To set out how states can cooperate internationally, in a way that supports each country's domestic commitment to sustainable agriculture and sustainable productivity growth in a manner consistent with trade obligations, as opposed to creating barriers.

Research work undertaken by the Centre for Climate Action on Agricultural Emissions and the global collaboration programme of the GRA are consistent with the objectives articulated in the principles, including promoting public investment in sustainable agriculture and strengthening internationally recognized best practice for making transparent, evidence-based claims about the sustainability of agricultural production.

This is one in a set of country case studies demonstrating policy action that individual countries are taking with the aim of transition to sustainable agriculture. They are country owned and do not represent wider views of the Policy Dialogue participants.

Sierra Leone

Accelerating the transition to sustainable agriculture: which approach?[17]

Context

Sierra Leone has faced significant challenges in ensuring food security for its population during the past two decades. The country has depended on imports to meet the growing gap between food production and consumption. In 2021, Sierra Leone imported over USD 130 million worth of rice. This situation got worse in 2023 with the continued war in Ukraine. The price of rice on the local market has continued to increase, a situation that has been exacerbated by India's decision to ban the export of most rice varieties, except for basmati rice.

The high dependence on agriculture and natural resources, coupled with high levels of poverty, unemployment and environmental degradation, makes Sierra Leone vulnerable to climate change impacts. Over the years, the country has been experiencing significant negative impacts from climate change. Heavy rainfall in coastal areas lead to soil erosion, frequent flooding and mudslides along the coastal mountain areas.

Sierra Leone has one of the lowest electricity access rates in the world, with only 36%[18] of the population having access to electricity – mostly in urban and peri-urban areas. The country's poor access to energy has limited inclusive growth, thus deepening poverty and food insecurity. Improved access to electricity in rural areas will help stimulate socioeconomic development, improve learning outcomes for children, and increase food security by reducing post-harvest losses. Rural communities remain particularly vulnerable, with electricity access rates in remote rural areas being as low as 1.3% compared to 45% for urban areas. Deforestation for farming and cooking is on the increase with no commensurate reafforestation.

[17] Senior Officials Policy Dialogue on Accelerating Transition to Sustainable Agriculture through redirecting public policies and support and scaling innovation. Held at Villa Wolkonsky Via Ludovico di Savoia, 00185 Roma RM, Italy. 27 July 2023.

[18] World Bank MTF Report 2023

Promoting privatization for food security

In 2019, the Ministry of Agriculture and Food Security (MAF) introduced a Cabinet Paper detailing the Enhancing Private Sector Participation in Agriculture Strategy, which is commonly known as the "MAF Policy Shift". The main components of the strategy are: (i) an agricultural mechanization service scheme managed by the private sector; (ii) an e-voucher scheme to improve targeting and enhance efficiency in the delivery of public subsidy programmes for agricultural inputs; (iii) training of agro-input dealers and farmers; (iv) an e-extension service; (v) setting up an agricultural credit facility; and (vi) an agricultural investment bank.

A central pillar of the "MAF Policy Shift" was to expand the provision of mechanized land preparation and planting services. To start this effort, the Government of Sierra Leone made 410 machines and implements worth SLL168 billion (USD 13 million) available to the private sector in 2019 through a competitive bidding process for a lease-to-own public-private partnership arrangement. This action was to address previously failed agricultural mechanization approaches that relied heavily on the government directly providing tractors and equipment to farmer groups, or private individuals. The scheme is complemented by the Sierra Leone Seed Certification Act (which established the Sierra Leone Seed Certification Agency) and the National Fertilizer Regulatory Agency Act, which regulates the fertilizer trade, distribution and use in Sierra Leone.

Despite some challenges during the first year relating to the machines and equipment, the scheme has contributed to an increase in the land area under cultivation – in the first year to 15,600 ha – the highest in the past 20 years. It has also served as a proof of concept and has established a public-private partnership pathway for providing agricultural mechanization services, fertilizers and seeds in a more efficient and transparent manner.

Soil health management

As part of the national effort to improve soil health and contribute to food security improvement, poverty reduction and minimization of environmental degradation, the Government of Sierra Leone, through the Ministry of Agriculture, has concluded a National Comprehensive Soil Survey. The survey provides updated data and information on the soils in different agroclimatic and agroecological zones, land use patterns, soil fertility and determination of land sustainability for cropping in Sierra Leone. It is expected that the data and information provided by the survey will help guide sustainable soil management, including the management of soil acidity and soil fertility by small-scale farmers. It will also help to promote the judicious use and management of fertilizers and for sustainable crop production in the country.

Political commitment to address climate change, rural energy and food security nexus

In an economy where agriculture is mainly rain-fed, rising temperatures, changing rainfall patterns and extreme weather events are reducing the viability of agriculture-based livelihoods and putting a significant share of the population at risk of increased hunger, malnutrition and poverty. With less than 45% of the population having access to electricity, accelerating

electrification rates across the country is critical for economic growth, rural development and the delivery of critical social services across the country.

The Government of Sierra Leone has increasingly realized climate change, access to energy and food security are inter-connected. The climate change- renewable energy-food nexus impacts on development, peace and security and economic growth. Thus, addressing one without the others in a holistic approach could be counterproductive. In July 2023, the government elevated the importance of addressing the nexus to a Presidential Initiative. As part of the process, integrated and comprehensive technical assessments, complemented by detailed economic and policy analysis are integrated in designing programmes that are mutually reinforcing for impact.

Lessons

- Sierra Leone's agriculture is mainly rain-fed, thus rising temperatures, changing rainfall patterns and extreme weather events are reducing the viability of agriculture-based livelihoods and putting a significant share of the population at risk of increased hunger, malnutrition and poverty. In this respect, addressing climate change impacts must integrated with improving access to energy and food security.
- Integrated and comprehensive technical assessments, complemented by detailed economic and policy analysis and processes are required to design programmes that are mutually reinforcing to contribute to the 'triple win' criteria: for people, climate and nature.
- The global food and fuel supply chain disruption has deepened food insecurity and poverty in small-developing countries (like Sierra Leone). Thus, repurposing policies to accelerate the transition to sustainable agriculture should not be decoupled from food security, poverty reduction and overall socioeconomic development objectives of countries.
- Although Sierra Leone has private sector friendly agricultural and trade policies in place and has demonstrated the highest level of commitment for transitioning to sustainable agriculture, the country has not been able to attract the intended private sector investments and foreign direct investment, especially for investments in climate-smart and other climate change mitigation technologies.

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Uzbekistan

Experience in policy action for agricultural price liberalization and soil health enhancement

Context

Uzbekistan began its significant economic reforms in 2017, catching up with a long-overdue transition from a planned to a market economy. The country's record of agricultural reforms carried out since then has been impressive. This includes the liberalization and promotion of foreign trade through exchange rate unification and trade facilitation; support to the horticulture sector, which exhibits strong comparative advantages; adoption of the ambitious long-term agricultural modernization strategy; and most important, reforms of the state system for cotton and wheat production and marketing.[19]

Prior to 2017, Uzbek farmers were losing 1.6% of GDP annually from the artificially low state procurement prices for cotton and wheat, while the government spent 2% of GDP on various agricultural programmes. Due to depressed farm gate prices and the focus of public services on the production of cotton and wheat at any cost, the rate of return of agricultural public expenditures was very low.[20] Cotton and wheat yields stagnated, resulting in increased imports of wheat, the main food staple, and decreased exports of cotton. Soils were degrading due to: weak incentives for farmers to invest in soil fertility improvement; low crop diversification; little public support for soil health; and subsidies that encouraged cotton's production on degraded soils and overuse of water for irrigation. Climate change was making things worse, reducing water availability for Uzbekistan's irrigation-dependent farmers.

In 2019, the Government of Uzbekistan adopted an ambitious Strategy for Agriculture Development 2020–2030, which outlined market-friendly reforms and set deadlines and targets. In 2020, the cotton state order system was phased out and cotton prices were liberalized. Wheat prices were liberalized in 2022. In 2019, the government abolished the subsidy for cotton production on plots with low-quality soil, and in 2021 it started an investment programme with matching grants to promote water-efficient irrigation in cotton and horticulture production. In 2021, the government launched its Agricultural Knowledge and Innovations

[19] World Bank. 2021. *Assessing Uzbekistan's Transition*. Country Economic Memorandum. Washington, DC USA.

[20] World Bank. 2020. *Uzbekistan Public Expenditure Review*. Washington, DC, USA.

System (AKIS) to strengthen collaboration between agricultural education, research and advisory services, and increased its funding. Special attention has been given to improving soil health through digital soil mapping, modernized soil testing, and an update of fertilizer recommendations.[21] As a result, the growth of agricultural GDP accelerated from 0.8% in 2017–2018 to 3.3% in 2020–2022.[22]

Rationale

The policy actions intended to: (i) remove agricultural price distortions to enable farmers to invest more, and (ii) repurpose agricultural public expenditures to support a more sustainable sector growth model. Policy actions have so far sought to shift the behaviour of both farmers and policy makers regarding the role of the markets vis-à-vis the state in supporting agriculture.

Approach

Agricultural reforms have been underpinned by estimates of the cost of inaction, and consequent analytical support for the preparation of Uzbekistan's Strategy for Agriculture Development 2020–2030, including the design of reform options. Short just-in-time policy notes were especially useful for the latter to provide quick and impactful advice for senior policy makers.

Agricultural price liberalization reforms were supported by improvements in coverage and support provided through the social safety net to shield the poor and vulnerable population more effectively from food price spikes. The removal of agricultural price distortions was followed by the increased investment and budget funding for agriculture and food and nutrition security from the World Bank and other development partners.

The design and implementation of agricultural price liberalization reforms were supported by several of the World Bank's development policy loans, while investments in public services were supported through the World Bank's Agriculture Modernization Project, the Korean Green Growth Trust Fund, agricultural budget support and technical assistance from the European Union, and investment projects and technical assistance financed by other development partners.

Experience and emerging results achieved

Results so far have seen increased and more sustainable agricultural growth supported by a more diverse set of subsectors, i.e. horticulture and livestock, not only cotton and wheat. More specific results have been the following:

- Cotton and wheat producers received market-level farm gate prices, with an additional income gain of about 1.6% of GDP and an enabling policy for higher rates of return from public expenditures.

[21] World Bank. 2021. *Second Agriculture Public Expenditure Review*. Washington, DC, USA.

[22] World Bank. 2022. *Review of Implementation of Uzbekistan's Agricultural Strategy 2020-2030*. Washington, DC, USA.

- Cotton and wheat yields started increasing again.
- Public investments for AKIS, including soil health and water-efficient irrigation, increased.
- Subsidy that encouraged farmers to produce cotton on degraded soils, which accounted for 5% of total agricultural expenditures, was removed. The government subsidy on interest rates for working capital inputs to cotton and wheat production was reduced. This allows for redirecting resources to support diversification and other investments such as irrigation.
- The Digital Soil Information and Land Management Geoportal was established, and more soil testing has been undertaken. Investments in soil testing infrastructure (i.e. laboratories) and staffing have increased.

These results represent the emerging shifts in policy and public expenditures from 2018 to 2022. Further reforms are needed to avoid reversals of the first-generation reforms; continue repurposing public expenditure; improve the quality of AKIS programmes, including for soil health; and deepen reforms in other areas such as land tenure security, input markets, and the irrigation–agriculture nexus, many of which are critical for promoting climate-smart agriculture.

Lessons learned

The following lessons emerged from the first-phase agricultural reforms in Uzbekistan:

- Reforms require the right political momentum and champions among senior policy makers. Analytical evidence on the costs of inaction and specific policy options should be available on time to underpin reforms.
- Agricultural public expenditure reviews with cross-country comparisons are critical to receive buy-in for reforms, and underpin reform proposals.
- Short just-in-time policy notes combined with more detailed analytical work are very useful for providing quick and impactful advice for senior policy makers.
- Reforms take time, and a gradual sequence of actions is often more feasible than big bang wholesale reforms.
- The successful design and implementation of soil health programmes requires a shift in behaviour and public funding, as well as technical assistance from development partners on best global practices. Improvements relating to soil testing and soil information systems should be complemented by AKIS and other programmes that increase soil fertility to make a difference on the ground.

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Viet Nam

Experience in policy action on climate resilience and a low-carbon rice value chain

Context

Viet Nam had transitioned from a substantially agrarian society to a more diversified "modern industrial economy" and attained middle-income-country status over two decades ago. While in this transition process the agricultural sector had also made enormous progress, there are concerns related to quality and sustainability of the sector's growth and its patterns of development. In particular, the government is concerned about the modest incomes of many smallholder farm families, low or inconsistent performance on product quality and food safety, significant post-harvest losses and a slowing pace of productivity improvements. It was also becoming increasingly evident that parts of the country's agricultural growth were coming at the expense of the environment in the forms of deforestation, biodiversity loss, land degradation, water pollution and increased greenhouse gas (GHG) emissions. Despite all its successes, agriculture is the third-highest emitting sector, accounting for about 19% of total national emissions (in 2020). About half (48%) of the agricultural sector emissions and over 75% of methane emissions come from one single commodity, rice.[23]

Recognizing the urgent need for a new agricultural development model, the government has implemented a series of policy and regulatory reforms since the early 2010s. In June 2013, the Prime Minister approved the Agricultural Restructuring Plan of the Ministry of Agriculture and Rural Development (MARD). The plan was updated in 2017, incorporating lessons learned from the initial years of implementation. In January 2022, MARD adopted a new Strategy for Sustainable Agriculture and Rural Development for 2021–2030, with a Vision to 2050. An action plan to implement this strategy was launched in September 2022. The government approved the first-ever Mekong Delta (MKD) Regional Master Plan in June 2022. In early 2023, another action plan, the "National Action Plan on Food Systems Transformation in Viet Nam towards Transparency, Responsibility, and Sustainability by 2030", was approved by the government. Most recently, the Prime Minister endorsed the "1 Million Hectares High Quality and Low-Carbon Rice Program" and announced it at COP28. These reforms established core principles for the sector's development: (a) promoting environmentally

[23] World Bank. 2022. *Spearheading Vietnam's Green Agricultural Transformation: Moving to Low-Carbon Rice*. Washington, DC, USA: World Bank.

friendly, climate-resilient, adaptive and low-carbon emission agriculture; (b) shifting towards market-led and consumer-driven practices over state-directed and production-led methods; and (c) transitioning the government's role from primary investor/service provider to facilitator of investments and services from the private sector, community organizations, research institutions and others.

Unsustainable growth trajectories and the need for a reorientation in the role of the state moving forward became apparent in two of the largest subsectors, rice and coffee. Much of the growth and dynamism in these subsectors had occurred in the MKD and the Central Highlands regions. The MKD region had grown to account for 55% of national rice production and 90% of its rice exports[24]. However, productivity and export gains were no longer translating into improved living standards for most of the MKD's 1.4 million rice-growing households due to their very small farm sizes, excessive input use and a fragmented value chain that yielded unnecessary logistical and handling costs and did not reward farmers for product quality. Exporting low-quality rice was not generating wealth, least of all for the smallholder suppliers. Production practices were resulting in substantial environmental costs, including localized land and water pollution and GHG emissions.

Rationale

The fundamental premise of the government's Agricultural Restructuring Plan strategic pillar has been to "generate more from less" by achieving more economic value – and farmer and consumer welfare – using less natural and human capital and less harmful intermediate inputs. The government focused on supporting farmers through various programmes to improve their farming practices and value chains for rice and coffee and reduce the environmental footprint of agriculture.

Approach

The support to rice farmers included public investments in upgrading irrigation and road infrastructure and research and extension services to enable them to adopt climate-resilient practices, as well as support for value chain development. With the support of the International Rice Research Institute and the World Bank, agricultural extension services have promoted new approaches to rice cultivation. They started by promoting "Three Reductions, Three Gains" (3R3G), which evolved from the promotion of integrated pest management practices and aimed to reduce input requirements without sacrificing yield. The three reductions encompass a reduction of seed rate, fertilizer use and insecticide spraying. The three gains are an increase in yield, quality of farm produce and net farm profit. In 2021, when more farmers gained experience in 3R3G, the government launched the "One Must Do, Five Reductions" (1M5R) campaign. 1M5R is an integrated technology package that aims to promote best management practices in lowland rice cultivation. It was developed using the requirements specified in the 3R3G practice, whereby the package promotes the use of certified seeds, which is the "One Must Do", combined with five reductions: the reduction of seed rate, fertilizer use, pesticide use, water use and post-harvest losses. Also in 2021, MARD

[24] World Bank, 2023. *Vietnam Sustainable Agriculture Transformation Project. Implementation and Completion Results Report*. Available at: https://documents1.worldbank.org/curated/en/099051123091518844/pdf/BOSIB02c6d17970450bc81069953a0323ea.pdf

approved a technical procedure for an effective and sustainable rice cultivation protocol that combined the goals of the 3R3G and 1M5R campaigns.

The support of farmers through extension services has been complemented by public investments in: (a) irrigation upgrades to enable alternative wetting and drying irrigation techniques; (b) rural roads and storage infrastructure to improve rural connectivity and connect farmer organizations with rice processors; and (c) credit line for crowding-in private investments to help modernize rice mills and value chains. Significant technical assistance was also provided to strengthen farmer cooperatives.

Experience and results achieved

The initial results are encouraging. As a result of the support to low-carbon rice production during 2015–22, about 209,000 ha of rice farming were put under sustainable farming practices as measured by reductions in pesticide and fertilizer use, including 185,000 ha under 3R3G practices. About half of the sustainable farming practices area was under contract farming arrangements with agribusinesses, promoting the reduction in food losses and waste. The reduction in GHG emissions from improved rice farming practices across 184,643 ha of rice land in the MKD was estimated at 1,582,299 tons per year.[25] Support for low-carbon rice production also improved the capacity of farmer groups, value chain development and the quality and reputation of Vietnamese rice. The 1M5R package promotes the application of proper seed densities (by reducing the current seeding rates by 30–40%), which helps reduce the amount of inorganic nitrogen application accordingly. Applying alternative wetting and drying and irrigating at the right time of the growth of rice plants helps save considerable freshwater irrigation and flooded time for paddy. Reducing post-harvest losses and better recycling of rice straws helps reduce the amount of straw burning. These techniques together reduce overall GHG emissions.

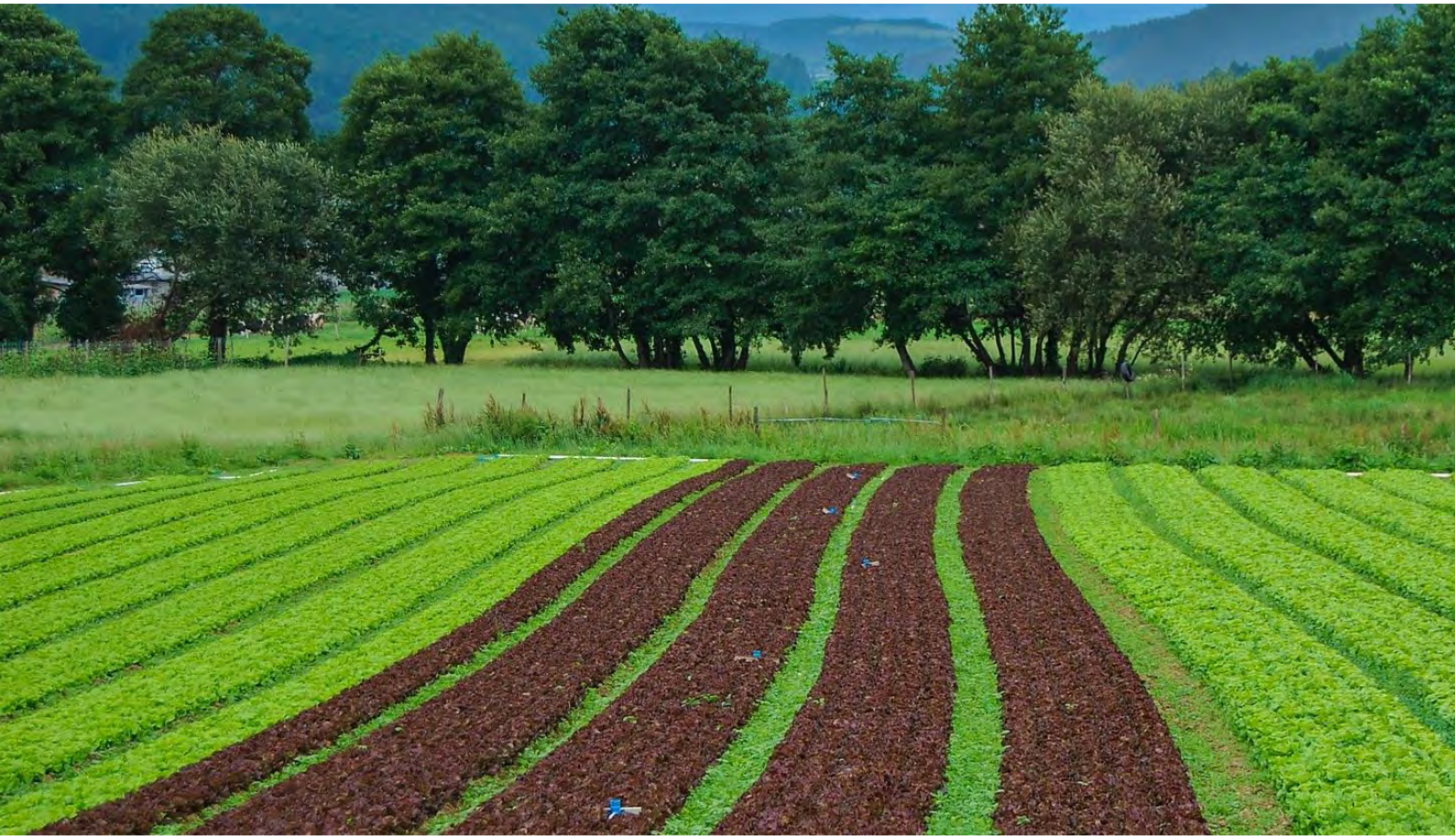
Lessons learned

Providing a comprehensive package that is both “climate and business smart” can provide the experiences, knowledge and good practices needed to encourage the high adoption of low-carbon cultivation technologies among farmers. On the one hand, the approach should be holistic by focusing on training, technical assistance, public investments in infrastructure, credit policy and other public regulation support, including the carbon market. On the other hand, to roll out this climate-resilient, low-carbon rice cultivation model, farmers should also benefit from increased profitability. In Viet Nam's case, these included reduced production costs through the efficient use of inputs while maintaining (and even increasing) production yield and quality.

[25] World Bank, 2023. *Vietnam Sustainable Agriculture Transformation Project. Implementation and Completion Results Report*. Available at: https://documents1.worldbank.org/curated/en/099051123091518844/pdf/BOSIB02c6d17970450bc81069953a0323ea.pdf

Policy Pathways to Sustainable Agriculture – Briefing Notes

Experiences shared through the Agriculture Policy Dialogue has led to the development of three “Policy Pathways to Sustainable Agriculture” briefing notes on topics requested through the Dialogue. The Policy Pathway briefing notes provide an overview of emerging experiences and lessons on policy approaches that can contribute to a transition to climate resilient, sustainable agriculture to support peer learning and knowledge exchange. The briefing notes are in no way exhaustive. The options facing governments will be context specific and look different across and within countries. The briefing notes aim to act as a discussion starter and to facilitate future exchanges between countries engaged in the Agriculture Policy Dialogue and with other global initiatives, drawing on the experiences shared through the Dialogues and examples identified through further research.



Policy Pathway Brief

Promoting Efficient Use and Greener Production of Fertilizers

AGRICULTURE POLICY DIALOGUE

Foreign, Commonwealth & Development Office

WORLD BANK GROUP

Just Rural Transition

In brief

Agriculture and food systems are both drivers and victims of escalating climate and nature crises, in turn increasing the risks to healthy diets, livelihoods and economies. Public policies can set incentives for farming and market practices that further exacerbate these trends, but they can also play a role in reversing them. The global Agriculture Policy Dialogue on Transition to Sustainable Agriculture is a peer-to-peer platform to share experience, facilitate partnerships and catalyse policy leadership to accelerate the transition to sustainable agriculture and food systems that benefit people, prosperity and the planet.

Policy Pathway Briefs provide an overview of emerging experiences and lessons on policy approaches that contribute to this transition, covering a series of topics requested by Policy Dialogue members, to support peer leaning and knowledge exchange. The briefing notes are in no way exhaustive. The options facing governments will be context specific and look different across and within countries. The notes aim to act as a discussion starter and to facilitate exchanges between countries engaged in the Agriculture Policy Dialogue and with other global initiatives, drawing on the experiences presented by members and examples identified through further research.

This brief focuses on fertilizers and provides guidance on policy actions that can incentivize efficient and more sustainable use and production of synthetic fertilizers.

Key messages

- Synthetic fertilizers have played an important role in improving global food security: increased use of fertilizers has enabled crop yields to grow by 30–50%, supported by government policies to increase the availability and use of fertilizers, often through input subsidies.
- However, fertilizer use varies considerably across – and within – countries, with both underuse and overuse of synthetic nutrients. In some countries, inefficient fertilizer use has created negative climate and environmental impacts for farmers and other users of affected ecosystems, threatening further improvements in food security.
- This has been facilitated by government policy that tends to focus on fertilizer subsidies without policies that simultaneously encourage the other complementary interventions required to boost yields and reduce emissions and negative environmental effects.
- There are a range of technological and agroecological solutions that can be pursued to improve fertilizer use efficiency and decarbonize fertilizer supply, some of which are supported by long-standing practices, others which are more recent.
- These can be supported by repurposing public expenditure on agriculture away from blanket subsidies on fertilizer use and towards more targeted support that: rewards a shift towards more efficient fertilizer use and complementary agricultural practices; increases investment in research and extension services to support farmers; helps to decarbonize fertilizer production; and strengthens global cooperation on fertilizer use efficiency and environmental standards to reduce emissions and pollution without reducing yields.

Background

Increased use of synthetic fertilizers[i] has played a key role in improving food security over the past 100 years by rapidly increasing crop yields. By improving nutrient availability in soils, fertilizers have contributed to a 30–50% increase in crop yields, improving food security for billions (Stewart et al., 2005; Smil, 1999). Estimates show that almost half of the global population is sustained through increased production enabled using inorganic nitrogen fertilizers (Erisman et al., 2008). By 2050, worldwide use of synthetic nitrogen fertilizers is expected to increase by 50% from 2012 levels (FAO, 2017).

Government support for increasing fertilizer availability and use – including nutrient-specific subsidies – has enabled the use of such fertilizers. Input subsidy programmes have been a popular mechanism used by many governments to intensify fertilizer application to improve food security.

However, continuing current patterns of fertilizer use faces several challenges:

- The **uneven distribution of fertilizer use and need across the world:** some countries are applying fertilizers beyond the optimal amount and can therefore reduce fertilizer use without compromising on farmer incomes and food production.
    - Without more tailored use of appropriate nutrient blends or other measures to support soil health, using increasingly large amounts of fertilizers do not necessarily translate into a proportionate increase in yield over a sustained period (Damania et al., 2023). Long-term evidence from Malawi, for example, shows a substantial decline in maize yield response to fertilizers over time, as blanket subsidies did not incentivize efficient and tailored use of appropriate nutrients or provide complementary measures (Burke et al., 2022).
    - On the other hand, many poor countries are underusing fertilizers, which does not compensate for the loss of nutrients due to agricultural production and soil degradation. This keeps productivity low, undermines soil health and encourages expansion of the area under cultivation to produce more food (Ritchie et al. 2022).
- **Negative environmental impacts:** a combination of poorly targeted government subsidies, a lack of technical knowledge on proper use and insufficient access to technical advisory services encourages overuse or unbalanced application of fertilizers. Less than half of the 109 million tons of synthetic nitrogen applied to fields each year is absorbed by crops (Peoples et al., 2019). This leads to a series of negative environmental impacts:
    - **Soil degradation** and reduced soil health more broadly,[ii] which further diminishes the response rate of fertilizers and the ability of farmers to use them profitably.
    - **Deterioration of water quality** as excess fertilizer runs into rivers or leaches into water tables; and
    - **Greenhouse gas (GHG) emissions** from fertilizer production and low nutrient use efficiency in the field: fertilizer production and use account for around 5% of total global GHG emissions, around half of which are caused by direct and indirect nitrogen dioxide emissions from fields (IPCC, 2022), and one-third from production (Menegat et al., 2022; Gao and Serrenho, 2023; Naess-Schmidt, 2015).
- Recent shocks over the past few years, particularly the rises in oil prices and the war in Ukraine, have highlighted that **fertilizer production is highly concentrated**, making users vulnerable to short-term price and supply shocks.

Options to improve efficient and sustainable production and use of fertilizers

Across-the-board cuts in fertilizer application are neither feasible nor efficient and fertilizers have a role to play in bolstering food security. Without more access to and use of tailored blends of fertilizers, certain countries and regions, particularly in sub-Saharan Africa, will opt to increase agricultural production by expanding cropland, often leading to deforestation, or mining the soil beyond its regenerative capacity, causing degradation (Ritchie et al., 2022).

However, there are significant opportunities to incentivize fertilizer use efficiency, incorporate alternative sources of soil nutrition and decarbonize the fertilizer supply chain. This could help move farmers to a more sustainable trajectory of agricultural production, contributing to climate, nature and social goals.

Technical solutions

Improving nutrient use efficiency

There are a variety of readily available measures to enhance nutrient use efficiency, both long-standing and emerging, all of which need to be underpinned by information and technical support to farmers to change fertilizer application practices:

- Improve the precision of fertilizer application through the application of the 4 Rs (Johnstone and Bruulsema, 2014) – the right source of nutrients, at the right rate, at the right time and in the right place – or a site-specific nutrient management approach (Chivenge et al., 2022).
- Apply an integrated soil fertility management approach, including through digital tools (i.e., precision farming, soil maps and soil testing) such as integrated soil fertility management.[iii]
- Use of enhanced efficiency fertilizer technologies, such as nitrification inhibitors to reduce the risk of nitrogen loss through leaching and slow- and controlled-release fertilizer (Janke and Bell, 2023).
- A more circular approach focused on biological nitrogen fixation in the soil through intercropping or single planting with leguminous crops, and upscaling the use of organic fertilizers and biochar (Mukherji et al., 2023).

Decarbonizing fertilizer supply

Several approaches to decarbonizing fertilizer production are being considered (Batool and Wetzels, 2019; Ouikhalfan et al., 2022) focused on technological improvements or increasing the use of organic fertilizers and a circular economy approach between livestock and crop production:

- **Technological improvements**: substituting natural gas for hydrogen; improving energy efficiency in production plants; using carbon capture and storage for carbon dioxide emissions; and reducing nitrous oxide emissions during the production process by installing catalyst technology in existing and new nitric acid facilities (EPA, 2010). Several green ammonia production facilities are being planned or under construction, e.g., in Peru, South Africa, Egypt, Brazil and Australia. However, to be commercially viable, large quantities of cheap renewable energy supply must be available and the production of greener fertilizers is still very costly compared to conventional production using hydrocarbons.
- **Agroecological and circular approaches**, using locally produced, composted or fermented animal manure to complement synthetic fertilizer (Wellspring, 2023) or by increasing the use of by-products of fertilizer production, such as waste heat and

carbon dioxide for agricultural greenhouses, or biogas from fermented manure as a feedstock. A full-chain nitrogen use efficiency approach (Kanter et al., 2020) can impact nitrogen losses beyond the farm by including fertilizer producers and wastewater treatment companies. Biological products[iv] can supplement synthetic and organic fertilizers, and in some cases, can partially or fully replace them (Wellspring, 2023).

Policy solutions

While technical solutions are available to improve fertilizer use efficiency, government policies need to be aligned with this goal rather than incentivizing overuse and inequitable distribution. National governments can work domestically and internationally in five main areas to do this and improve both social and environmental outcomes:

- **Repurpose government support that encourages inefficient use of fertilizers:** government subsidies on fertilizers often result in overusing fertilizers or applying fertilizers that are not suited to specific soil conditions and are fiscally unsustainable in the long run, particularly if they are not combined with other interventions to underpin improved crop yields and boost crop responsiveness to fertilizer. To rectify this, governments can implement two complimentary interventions:
    - **Replace blanket subsidies on fertilizers with targeted support** via direct transfers that reward results, such as more sustainable agricultural practices and fertilizer use, soil health, etc.[v] In **Malawi,** the government is reforming the Agricultural Inputs Program to reduce funding on inorganic fertilizer subsidies and discussions are ongoing as how to redirect finance to rewarding farmers for soil health outcomes (Campbell et al., forthcoming).
    - **Increase investment in complementary public goods and services** to generate the necessary research and technology and then disseminate it to farmers through extension services. Starting with identifying areas with overuse and underuse of fertilizer, and soil types and conditions in specific areas, fertilizer support can be bundled with the necessary advisory services for tailored blends are appropriate to the soils and their effective use, improving soil testing systems to allow precision farming, improving the digital infrastructure to improve the extension system, and investing in infrastructure to improve access and reduce costs of fertilizers. Governments can also increase investment in research and development and field-testing of potential alternatives to current synthetic fertilizers, including slow-release and “smart” fertilizers, biologicals and microbials, and green ammonia production. This would address the significant gap in research and development that currently exists.
- **Scale up initiatives to increase access to and use of organic fertilizers, and a circular economy approach between livestock and crop production**, using locally produced, composted or fermented animal manure to complement synthetic fertilizer. The government of **Ghana** has intensified efforts to increase domestic production and uptake of organic fertilizer, using a combination of information (organic fertilizer guidelines, extension material and a repository of information for investors), financial support (negotiating with the EXIM Bank of India for funds to establish organic fertilizer plants) and communications to encourage farmers to use more organic fertilizer (online and radio programmes) (UN Sustainable Development Group, 2023; Nangara, 2022). The **European Union (EU)** promotes a circular economy and organic fertilizer through regulatory tools by incorporating organic fertilizers into existing guidelines on fertilizers, establishing product safety and quality requirements (European Parliament and Council, 2019); and funding via Horizon Europe (Horizon Europe, 2023), the EU’s key funding programme for research and innovation, which includes a focus on increasing

the availability and use of “non-contentious inputs” in organic farming, including manure and recycled nutrients.

- **Strengthen policy and regulatory frameworks to establish baseline expectations** to accelerate transformation of agricultural practices and ensure that quality parameters of fertilizer are defined and met. In **India**, the government made coating of urea with neem oil mandatory to slow nutrient release and improve its efficiency; although the technology had been available for many decades, the introduction of government regulation catalysed its uptake at farm level (Srinivasarao, 2021).
- **Boost efforts to decarbonize fertilizer production**, particularly through supporting energy efficiency in industrial production and promoting the use of more carbon-neutral sources of energy in the production process. Governments could also investigate the feasibility of supporting investment in smaller-scale, modular and localized green ammonia production presents various opportunities, particularly in areas that face challenges accessing traditional mineral fertilizer supply chains, provided that there is access to ample and reliable renewable energy and water (Wellspring, 2023).
- **Strengthen global cooperation on fertilizer-use efficiency and environmental standards** to reduce emissions and pollution without impacting on crop yields. If polluting countries increased their nitrogen use efficiency, nitrogen pollution could be reduced by around 35%, while increasing yield gaps[vi] by only 1% (Wuepper, 2020; Ritchie et al., 2022). As emissions from synthetic nitrogen fertilizers and pollution are highly concentrated in certain geographic areas (Menegat et al., 2022),[vii] attention could be focused on these countries, backed by financial support from the global community, as well as using existing international guidelines on effective fertilizer use, such as the International Code of Conduct for the Sustainable Use and Management of Fertilizers (FAO, 2019).

China's experience of promoting efficient fertilizer use

China’s experience (Ritchie et al., 2022; Cui et al., 2018) demonstrates that providing general services support tailored to specific site conditions can reduce inefficient fertilizer use without compromising yields. Between 2005 and 2015, researchers developed enhanced management practices for rice, wheat and maize, tailored to different agroecological zones in China, using an integrated soil–crop system programme. Researchers trained extension staff and agribusiness personnel to work participatively with farmers through field trials and created a national programme to transmit and monitor recommended practices. This provided high quality inputs and strengthened the technical and organizational capacity of farmers. As a result, nearly 21 million farmers adopted enhanced management practices, reducing nitrogen application by up to 18% and nitrogen losses by almost 35% while average yields rose by up to 11.5%, and grain output expanded by 33 million tons, generating additional farmer income of $12.2 billion, compared to direct programme costs of $454 million. GHG emissions from nitrogen use, manufacture and transport, and diesel use in farming operations fell by up to 13.2%.

Process considerations

Policymakers would need to assess conditions for accelerating and scaling up initiatives to increase fertilizer use efficiency or reduce synthetic fertilizer use by using alternatives in each context, and the time needed to set up systems, establish infrastructure, understand incentives and manage the transition. The experience of Sri Lanka's decision to rapidly ban imports of synthetic fertilizers stands as a cautionary tale.

Policy Dialogue discussions acknowledge that a transition to low-emission, climate-resilient agriculture practices needs to centre on people and engage stakeholders at all stages. This recognizes that stakeholders have vested interests, may have a significant stake in existing agriculture production systems or stand to lose from changes in the short term. It is important to engage stakeholders in policy design – rather than imposing policy on them – to ensure that proposals are feasible, take account of risk appetite and support equitable change through the transition to more sustainable practices that benefit everyone.

In fertilizer production and use, the key stakeholders that need to be engaged by governments are farmers, fertilizer companies and civil society. There are strong and entrenched positions both for and against synthetic fertilizer use across these groups which need to be navigated.

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Endnotes

[i] Also called inorganic or mineral fertilizers. In the rest of the brief, we refer simply to “fertilizers” for synthetic fertilizers.

[ii] See Soil Health Policy Brief for more information.

[iii] See Integrated Soil Fertility Management (IFDC).

[iv] Naturally derived substances and living organisms that can help optimize nutrient uptake and use (Wellspring, 2023).

[v] See Policy Brief on Payment for Ecosystem Services for more information on how this can work.

[vi] The amount that yields could be increased with better management of nutrients.

[vii] In terms of total volumes, the biggest emitters are China, India, North America and Europe. On a per capita basis, the biggest emitters are the major agricultural export countries of North America, South America, Europe and Australia and New Zealand (Menegat et al., 2022).

Policy Pathway Brief

Payments for Ecosystems Services to Support Transitions to Sustainable Agriculture and Land Use

AGRICULTURE POLICY DIALOGUE
Foreign, Commonwealth & Development Office
WORLD BANK GROUP
Just Rural Transition

In brief

Agriculture and food systems are both drivers and victims of escalating climate and nature crises, in turn increasing the risks to healthy diets, livelihoods and economies. Public policies can set incentives for farming and market practices that further exacerbate these trends, but they can also play a role in reversing them. The global Agriculture Policy Dialogue on Transition to Sustainable Agriculture is a peer-to-peer platform to share experience, facilitate partnerships and catalyse policy leadership to accelerate the transition to sustainable agriculture and food systems that benefit people, prosperity and the planet.

Policy Pathway Briefs provide an overview of emerging experiences and lessons on policy approaches that contribute to this transition, covering a series of topics requested by Policy Dialogue members, to support peer leaning and knowledge exchange. The briefing notes are in no way exhaustive. The options facing governments will be context specific and look different across and within countries. The notes aim to act as a discussion starter and to facilitate exchanges between countries engaged in the Agriculture Policy Dialogue and with other global initiatives, drawing on the experiences presented by members and examples identified through further research.

This brief focuses on Payments for Ecosystems or Environmental Services (PES) as a mechanism for providing incentives to land users to transition to more sustainable land management.

Key messages

- Payments for Ecosystems or Environmental Services (PES) are payments made to ecosystem service providers – landholders and other resource stewards – on a conditional and voluntary basis for additional environmental benefits that they generate for others beyond their own land, funded by government, direct users or NGOs and philanthropies.
- PES have been used increasingly since their evolution in the late 1990s, are now worth up to USD 42 billion in annual transactions and have broadened from forestry conservation and watershed protection schemes to include programmes to promote more sustainable agricultural practices, such as soil health.
- There are a series of challenges to confront to ensure that PES schemes can fulfil their potential as an instrument to encourage current or potential land users to steward their land more effectively; these include how to attribute values to nature, wider political economy issues and trade-offs between social and environmental aims and impacts.
- These challenges need to be addressed through thinking about the design, implementation and monitoring and verification of PES schemes, namely: what services to pay for (conditionality); who to pay (targeting); how much to pay and for how long (cost-effectiveness and financial sustainability); what else is needed to change behaviour beyond financial incentives (enabling conditions); and how to know whether service providers have delivered (monitoring, reporting and verification).
- Across all of these activities, experience has shown that it is key to involve farmers and other affected parties at each stage, both to get their buy-in but also to ensure that proposed schemes address the main issues and concerns of producers.

Defining PES

PES are **payments (one-off, continuous or time-bound) made to ecosystem service providers – landholders and other resource stewards – on a conditional and voluntary basis for additional environmental benefits that they generate for others beyond their own land,** such as watershed management, biodiversity conservation, and forest and land-use carbon sequestration (Kuhfuss et al., 2018; Wunder et al., 2020).

PES tend to operate within compliance standards established in legal and regulatory frameworks, encouraging landholders to comply with those frameworks and go beyond them (ibid).

PES schemes are funded by three main sources:

- **Governments**: who purchase improved ecosystem service provision on behalf of the wider public, either domestically or internationally, e.g., with REDD+. Funding can be from a general budget or earmarked taxes (e.g. water or fuel taxes).
- **Direct users**: private organizations and individuals who benefit directly from, and pay directly for, improved ecosystem service provision, such as reduced flood risk, clean water or recreational access. These can include water utilities, park authorities and voluntary carbon offsetting schemes,[i] among others. Mechanisms to capture payments may include carbon offsets, biodiversity credits, entry fees or price premiums passed on to final consumers.
- **NGOs or philanthropies**: buying improved ecosystem service provision on behalf of sections of the general public. For example, the World Wildlife Fund set up PES in the **Danube Basin** to reward the maintenance, improvement or adoption of conservation-friendly land uses (WWF, undated).

Evolution of PES schemes

PES schemes have grown since the classic examples of the late 1990s (Daily and Ruckelshaus, 2022). They emerged in New York City (protecting watersheds to improve municipal water quality), China (restoring forest and grassland on steep slopes to combat floods) and Costa Rica (conserving and restoring forest to sequester carbon, and contribute to water security, landscape beauty and biodiversity protection). A review of PES in 2018 (Salzman et al., 2018) showed that, globally, there were more than 550 active programmes in over 60 countries worth up to USD 42 billion in annual transactions. These were funded mainly through public sector financing and private investments from the Global North and China (United Nations Environment Programme, 2021).

While most PES schemes are directed at forestry conservation, there is increasing interest in using PES to promote more sustainable agricultural practices and target farmers (see Table 1). Such schemes show no sign of abatement, particularly with the growth of carbon and biodiversity credit programmes.

Challenges for PES

Broader discussions – both philosophical and practical – about conditional PES transfers have accompanied the growth in projects and programmes, indicating that PES schemes need to consider wider political economy issues and trade-offs between social and environmental effects (Wunder et al., 2020). Concerns include: the commoditization of nature; the use of a human-centric concept of nature value that does not translate across cultures; the uneven distribution of payments across intermediaries and ecosystem services providers; long-term

financial sustainability; and additionality – whether PES are leading to additional environmental outcomes.

Given the potential for using PES schemes – and growing interest in them – such concerns need to be factored into design and implementation measures to ensure that they achieve their potential.

Designing and implementing PES for sustainable land use

To successfully encourage current or potential land users to steward their land more effectively, PES schemes need to respond to a series of questions in design, implementation and monitoring and verification, namely: what services to pay for (conditionality), who to pay (targeting), how much to pay and for how long (cost-effectiveness), what else is needed (enabling conditions) and how to know whether service providers have delivered (verification).

Conditionality: what to pay for

The agricultural sector provides a set of environmental services beyond food, fuel and fibre production and income for farmers – in themselves are vital for economies. Managing existing cropland and pastures more sustainably can enhance soil health,[ii] boost water availability and quality for downstream users, reduce air pollution and greenhouse gas emissions, and protect and restore biodiversity. Policies also need to reduce the expansion of cropland and ranching into ecosystems that are carbon sinks and biodiversity hotspots, e.g., forests, grasslands and wetlands, and which protect water sources in order to conserve the services that they provide.

Farmers – focused on output and income – may not factor broader environmental services provision into the equation when choosing cultivation practices or land use due to financial constraints. Even where changing practices can boost yields over the longer term, farmers need support to transition the period of additional costs and fall in yields that can occur in the short term.[iii]

Funders and programme managers of PES need to decide what the most important services are in each particular context, depending on the urgency of the issue, the drivers of the problem, who will benefit and the relative costs of a solution.

Targeting: who to pay

In thinking about who to target for PES, funders need to consider both the principles and mechanisms of targeting and selection. In the principles of selection, programme managers normally take into consideration two main principles:

- **Whose behaviour needs to change**. Underlying this is the principle of additionality whereby land users are rewarded for doing things they would not have done in the absence of receiving payments. While this is key to most PES schemes, there is increasing debate about whether existing stewards should be rewarded for continuing good practice, such as protecting forests or soil health: this could avoid introducing adverse incentives whereby such stewards begin unsustainable practices to gain access to payments. However, where resources are limited, funders may need to prioritize changing existing harmful behaviour.
- The **balance between efficiency and equity**: efficiency requirements prioritize selecting those who can yield the best returns for the lowest marginal cost. This means that payments would mostly go to large landowners and cover more land with the lowest transaction costs (Lansing, 2017). However, funders may wish to prioritize more vulnerable land users, such as poorer smallholders (ibid). This has proved hard in practice in some cases, due partly to high transaction costs. For example, **Costa Rica's** PES reaches mainly large landholders and richer smallholders rather than poor

and marginalized smallholder farmers despite government efforts to enrol smallholders across the board (Porras, 2010). However, **Mexico's** experience of targeting smallholders and communal lands in its PES schemes for watershed and biodiversity conservation provides lessons in how this can be done (Izquierdo-Tort et al., 2022).

Programme managers have used different approaches to select recipients, depending on which principles they prioritize:

- The government of **Canada** has used **auctions** to help overcome information asymmetries and select recipients who can provide ecosystem services for the lowest prices, to provide value for money (Balmford et al., 2023). This allows recipients to self-select and explore contract allocation strategies like bonuses for ecosystem services providers to set aside adjacent land (Liu et al., 2019).
- Existing **social protection or public works programmes** offer a mechanism to provide additional cash transfers to socially vulnerable recipients for environmental services (Norton et al., 2020) emphasizing the equity principle. Some social protection schemes already have wide coverage and a roster of eligible households – or a participatory process to identify eligible households – which could be used to identify recipients to provide additional ecosystems services.[iv] FAO has proposed using this approach in **Colombia** to merge social protection and climate and environmental protection.

Cost-effectiveness: how much to pay and for how long

How individuals, institutions or policies might value nature depends on how people–nature relationships are framed (Pascual et al., 2023) – in a more extractive way looking at the value of the ecosystems services nature provides to people, or with a broader vision of living with, and in, nature.

In practice, the main approaches being used or developed to decide on payment levels include (Kuhfuss et al., 2018):

- **Fixed price** schemes, determined by budget availability, whereby ecosystem service providers must decide whether the available payment on offer is sufficient to cover the costs of providing those services. While such fixed price payments are at risk of over- or under-paying farmers for work, they also have much lower transaction costs. **Costa Rica** uses fixed prices for specific interventions, calibrated by criteria such as whether the property is in a critical water conservation area, or if the forest has high biodiversity value.
- **Auctions**, where ecosystem service providers offer the price(s) of provision. This can reveal more transparent information about the opportunity costs that providers expect to incur in adapting land management practices to supply non-market ecosystem services.[v] **Australia's** Emissions Reduction Fund has used auctions of carbon credits to establish contracts with farmers (Keenor et al., 2021). Experimental results in lower income countries are more limited and suggest a cautious approach is needed (Bingham et al., 2021; Van Soest et al., 2018).
- **Negotiations between buyers and sellers of ecosystem services**, e.g., between a water company (buyer) and upstream farmer (service suppliers) for watershed protection to improve water quality and availability. While this approach may lead to a better price discovery, it has high transaction costs and is more difficult to use in scaling up (Fripp, 2014).

The duration of payments is also crucial: payments need to be reliably available for a sufficient length of time to change behaviour and avoid reversal of results. During that time, the

opportunity cost of changing practices may vary as commodity prices fluctuate and funders may need to build in a flexible payment to respond and avoid losing recipients.

Enabling conditions: what else is needed to change behaviour beyond financial incentives

Beyond the "carrot" of financial incentives, other interventions may be needed, especially to prevent environmentally destructive practices simply moving to other areas,[vi] including:

- Providing a **"stick"** through enforcing compliance conditions for receiving payments and regulatory frameworks that set minimum standards.
- Offering **support for behavioural change**, via:
  - **Technical support** to farmers on how to change practices, complemented by information on the associated benefits. For example, **New Zealand** has created a Centre for Climate Action on Agricultural Emissions to get new tools, technology and practices to lower on-farm emissions to farmers faster.
  - **Building trust and relationships** with landholders: experience in the **US** (White et al., 2022) highlighted that farmers may not participate in PES because of perceived unfairness and distrust of the government based on previous experiences. This was mitigated by trusted individuals delivering tailored information about how changes could impact ecosystem service performance in a way that aligned with farmers' own perceptions about how their agricultural systems function and their own relationship with nature.
- Ensuring **clear land rights** as a basis for payments to establish who has rights to receive benefits and ensure conditionality. However, the clarity and precision of the rights required by ecosystem service finance mechanisms may not align with the fluid and overlapping nature of customary tenure systems in some countries (Knox et al., 2011). Additional resources can strengthen rights in different forms, e.g., current efforts under the Tenure Facility to register land rights of Indigenous people and local communities in tropical forests (Tenure Facility, 2022).
- **Aligning existing subsidies** to reinforce PES aims. Agricultural subsidies – often established to boost productivity and farmer incomes – can also drive expansion of production into marginal lands, and promote distorted and inefficient use of inputs that can have negative environmental effects (World Bank, Forthcoming).

Monitoring: how to ensure desired outcomes

Monitoring, reporting on and verification (MRV) of the results of PES need to balance the costs of MRV with its accuracy, as there is usually a trade-off. Assessing compliance of recipients with the conditions of a PES can be input-based or outcome-based.

At the Policy Dialogue in September 2023, country representatives noted that it is difficult for governments to measure the **outcomes** of PES practices at the household level. They suggested that it might be cheaper for governments to measure **practices** at the household level, while focusing on productivity gains, emissions reductions and the protection of natural resources at a more aggregate level (regional, national or landscape).

- A similar approach is being proposed in the current efforts to develop government payments to farmers in **Malawi** for improving soil health. The Malawi scheme may also use a combination of extension field agents to check recipients' practices and third-party sampling of fields through soil testing and remote sensing data to provide information on soil health outcomes. This would reduce the costs of MRV while allowing for a higher degree of accuracy.

- In the **UK**, farmers and the government agreed that the UK Government would reduce farmer reporting requirements to lower the administrative burden on farmers while reserving the right of the government to undertake random audits to ensure that standards being met. Farmers need only report when they receive an inspection, either random or risk-based, providing information on practices applied and the amount of land under improved practices (communication with DEFRA, 21 November 2023).

As part of maintaining incentives for farmers to remain in PES schemes and reinforcing good practice, an MRV approach can measure plural values that balance more extractive approaches to ecosystems – measured by biophysical or economic indicators – with other more socio-cultural values, such as the relation of land users to the land (Pascual et al., 2023).

Process considerations

Across all of these activities, experience has shown that it is key to involve farmers and other affected parties at each stage, both to get their buy-in but also to ensure that proposed schemes address the main issues and concerns of producers. This helps to sustain good practice if participants perceive the decision-making process and distributional aims and impacts to be fair (Gaworecki, 2017; Porras et al., 2017). Some examples of participatory design include:

- **UK:** while the UK Government set the overarching policy framework on the Environmental Land Management Scheme, such as designed legislation and defined environmental targets, farmers were asked which measures would work for them and which not, that way increasing feasibility and acceptance of policies.
- In the current process of designing a PES scheme for soil health in **Malawi**, farmers have participated in a series of workshops to discuss the best way to structure such a scheme and will continue discussions throughout its implementation.

Key initiatives

Table 1. Examples of PES initiatives

Scale	Country	Focus	Description
National	Mexico	Water and biodiversity	Programme has combined different funding sources: the government offers cash payments to land owners for watershed services and payments for biodiversity conservation using revenues from a variety of sources – water tax, annual budget allocations, and contributions from local governments and the private sector.[1]
Watershed	South America	Water	Reciprocal Watershed Agreements, e.g., WATERSHARED – grassroots approach to conditional transfers that aim to help land managers located in upper watershed areas to sustainably manage their forest and water resources in ways that benefit both themselves and downstream water users. Funds are sourced locally from institutions or individual downstream water users.[2]
Farm-level/project	Kenya	Biogas and carbon	Household biodigesters produce biogas from cattle manure, replacing firewood and reducing emissions from burning wood. Bioslurry produced as a by-product replaces need for purchasing inorganic fertilizers and increases farm productivity. Funding from carbon credits.[3]
National	United States	Soil health and ecosystem conservation	The Conservation Reserve Program seeks to preserve soil quality by reducing erosion and protecting soil productivity in fragile croplands, but it aims to protect a variety of ecosystem services across the US, including water resources, wetlands, wildlife habitat, honey bee and pollinator protection, climate change mitigation through greenhouse gas emissions reductions, soil health and flood prevention. The government pays farmers to remove environmentally sensitive land from agricultural production and instead plant species to help improve environmental quality.[4]

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Endnotes

[i] However, there has been debate about whether carbon offsets meet the criteria of bringing additional environmental benefits.

[ii] There is some discussion about whether soil health is a public good, given that farmers themselves benefit from improvements (Wunder et al., 2020).

[iii] See Soil Health Policy Brief for more detail.

[iv] There are long-standing lessons about the need to strengthen institutional systems for delivering social assistance to enable a more effective combination of social and environmental objectives which could be applied (Norton et al., 2020).

[v] These can use ''Pay-as-Bid'' pricing, in which successful participants are paid the amount stipulated in their bid(s). An alternative pricing approach, the ''Uniform Price'' rule – in which each successful bid is paid the amount specified in the marginal (either last winning or first losing) bid – has been shown to cost less (Balmford et al., 2023; Leimona et al., 2023).

[vi] So-called "leakage".

Policy Pathway Brief

Promoting Healthy Soils and Land

AGRICULTURE POLICY DIALOGUE

Foreign, Commonwealth & Development Office

WORLD BANK GROUP

Just Rural Transition

In brief

Agriculture and food systems are both drivers and victims of escalating climate and nature crises, in turn increasing the risks to healthy diets, livelihoods and economies. Public policies can set incentives for farming and market practices that further exacerbate these trends, but they can also play a role in reversing them. The global Agriculture Policy Dialogue on Transition to Sustainable Agriculture is a peer-to-peer platform to share experience, facilitate partnerships and catalyse policy leadership to accelerate the transition to sustainable agriculture and food systems that benefit people, prosperity and the planet.

Policy Pathway Briefs provide an overview of emerging experiences and lessons on policy approaches that contribute to this transition, covering a series of topics requested by Policy Dialogue members, to support peer leaning and knowledge exchange. The briefing notes are in no way exhaustive. The options facing governments will be context specific and look different across and within countries. The notes aim to act as a discussion starter and to facilitate exchanges between countries engaged in the Agriculture Policy Dialogue and with other global initiatives, drawing on the experiences presented by members and examples identified through further research.

This brief focuses on soil health, identifying policy instruments and actions for governments to provide incentives and support to farmers to protect and restore agricultural soils.[i]

Key messages

- Unsustainable agricultural practices have increased soil erosion and weakened other aspects of soil health, undermining soils' ability to sustain the productivity, diversity and environmental services of terrestrial ecosystems.
- There are clear financial and environmental benefits to protecting and enhancing soil health – and a range of tested practices to protect and restore soil health.
- However, there are few policies that directly incentivize farmers to take these actions in a sustained way, and several barriers and disincentives to doing so, including culture, habits or early training; financial constraints and opportunity costs; and lack of information on soil health.
- Governments can step in to incentivize large-scale adoption of sustainable soil and land management practices through:
    - Providing access to information and technical support to farmers to learn about and adopt new farming methods;
    - Supplying finance to enable farmers to transition to different agricultural practices, rewarding farmers for protecting and restoring soil health;
    - Establishing and enforcing regulatory standards on soil health; and
    - Monitoring soil characteristics by mapping and testing soils and making that information easily available to farmers and those supporting them.
- Engaging a range of affected stakeholders throughout the design and implementation of policies to improve soil health can ensure that proposals are feasible, take account of risk appetite and support equitable change to more sustainable practices that benefit everyone.

Background

The importance of healthy soils for people, climate and nature

Healthy soils provide the basis for food production and vital ecosystem services, including flood regulation, nutrient cycling and carbon sequestration. As such, soil health underpins goals of food and nutrition security, improving livelihoods, addressing climate change mitigation and adaptation, and enhancing biodiversity both above and below ground (Lal et al., 2021).

Understanding soil health

Healthy soil is soil that has the ability to "sustain the productivity, diversity and environmental services of terrestrial ecosystems" (FAO, 2020). Topsoil erosion is the most widespread form of soil and land degradation (Vågen and Winowiecki, 2019) and this is also the most widely used metric of soil health for global comparison, partly because it is the only one with at least basic estimates available with global coverage, by country and for multiple years.

Other indicators of soil health include the degree of preservation of above and below-ground biodiversity, nutrient balance (fertility), pollution, salinity, acidity, compaction and sealing, water regulation and soil organic carbon (SOC), all of which provide a set of ecosystem services.

The challenges facing soil health

It takes hundreds of years for topsoil to form and only a moment for it to be lost through erosion. Unsustainable agricultural practices[ii] have increased soil erosion: loss of topsoil from agricultural fields is estimated to be more than 100 times higher than the soil formation rate under conventional tillage systems (IPCC, 2019).

Globally, soil erosion from cropland results in the loss of 17 billion tons of topsoil each year. This causes farmers to forgo the equivalent of USD 300 billion in agriculture production annually (Coalition of Action 4 Soil Health, undated), as productivity falls and farmers have to turn increasingly to mineral fertilizers to bolster yields.[iii] This has resulted in a triple cost of increased greenhouse gas emissions from agricultural production, reduced biodiversity of croplands and weakened resilience of agriculture to shocks and stresses, undermining food security and farmer livelihoods, and climate and nature goals.

While there are clear benefits to protecting and enhancing soil health – and concrete measures that farmers can take – there are few policies that directly incentivize farmers to take these actions in a sustained way, and several barriers and disincentives to doing so (Masikati et al., 2022):

- **Culture, habits or training** received at earlier stages of a farmer's career can cause farmers to see agro-chemicals as the main source of fertility and pest/disease control (Payton, 2016) or to continue particular practices that undermine soil health.
- **Financial constraints and opportunity costs**: farmers – focused on output and income – may not consider broader environmental services provision when choosing cultivation practices:
    - Financial costs and benefits of farming often do not include externalities that affect other people and activities. Government policy itself may create price distortions that indirectly incentivize practices that undermine soil health, such as fertilizer subsidies that lead to inefficient fertilizer application.
    - Even where changing practices can boost yields over the longer term, farmers need support to transition through a potential period of additional costs and fall

in yields that can occur in the short term (the “valley of transition”) and to manage risks. For some smallholders in low-income countries, the opportunity costs of investing money, labour, knowledge and other inputs to change their practices may be relatively high, and they put significantly more weight on short-term benefits compared to long-term benefits and sustainability.

- **Lack of information on soil health**: many farmers lack access to affordable and accurate data on the properties of their soils. This makes it difficult for them to understand and track the state of their soil health. This is particularly acute in low-income countries where famers may not have access to up-to-date soil maps. Even in high-income countries, information can be dispersed and soil testing can be expensive (de Bruyn et al., 2017).

Improving soil and land health

There is an urgent need to address these challenges in order to manage soils sustainably and restore the soil ecosystem. A range of well-proven and emerging technical solutions exist; however, without appropriate policy interventions, many of these technical solutions can lie unused.

Technical solutions

Farmers can undertake a range of practices to protect and retore soil health, with high potential to rebuild SOC, biodiversity and soil structure (Beillouin et al., 2023). These include (Lamanna, 2018; Pittelkow et al., 2015; Ogle et al., 2012) mulching, composting and reduced tillage; reducing soil compaction from machinery, particularly when soil is wet; covering bare soil with continuous plant cover and contouring sloping land; application of farmyard manure and/or compost; rotating crops and intercropping; and improving fertilizer use efficiency (see Box 1).

Several of these practices are often implemented together, e.g., reducing tillage, adding crop residue and diversifying the crop mix; anecdotal evidence supports this approach, although more field research needs to be done to assess how effective it is.

Policy solutions

Governments can incentivize large-scale adoption of sustainable soil and land management practices that benefit climate, nature and people through four areas of policy measures that can be translated into solutions tailored to different farms:[iv] 1. access to information and technical support to farmers to learn about and adopt new farming methods; 2. finance to enable farmers to transition to different agricultural practices; 3. regulatory standards on soil health; and 4. soil monitoring.

Technical support to farmers

Through funding public or third-party extension services, governments can provide farmers with training, advisory services and on-field measurements of soil health to enable them to adopt better practices. Extensive outreach and engagement activities – including peer-to-peer learning and neighbour demonstration effects – can nudge farmers towards changes in culture and habits, particularly if they are given information on why such changes could benefit them economically.

Such services are best complemented with affordable access to soil health information to help inform farmers' choices:

- Under the **UK** government's Environmental Land Management Scheme, farmers can research the characteristics of their land using a private database (the Addland Professional map layers) that brings together existing government land information.
- **India's** Soil Health Card Scheme (Reddy, 2019) introduced in 2015, provides farmers with crop-specific fertilizer recommendations, based on soil testing, to enable more efficient fertilizer use that improves productivity and/or reduces costs.[v]

Transition finance

Funds for financing the transition to better soil health can come from several sources, including:

- **National government budgets**: governments could repurpose existing public support to agriculture to pay farmers for ecosystems services from soil health (Campbell, Bruce et al., forthcoming), rather than, e.g., subsidizing inorganic fertilizers or linking support to outputs or outcomes (see Policy Brief on Payments for Ecosystems Services for more details on opportunities and challenges).
    - **Canada** has introduced a new ecosystem services programme to incentivize conservation of grasslands and other systems and is assessing an approach to look at biodiversity and soil health together.
    - In **Malawi**, the government is reforming the Agricultural Inputs Program to reduce funding on inorganic fertilizer subsidies and discussions are ongoing on how to redirect finance to rewarding farmers for soil health outcomes.
- **Voluntary carbon (and biodiversity) markets**: soil carbon sequestration can become a potential income source for farmers through the use of verifiable, creditable carbon markets. However, while such credits may add money at the margins, they are not judged to provide sufficient incentive in themselves to lead to sustained behavioural change[vi] particularly as much of the credits' value can be absorbed in monitoring, reporting and verification and by credit intermediaries.

These approaches can also be combined, e.g., the **Netherlands** government is working with Rabobank on a carbon scheme and the best way to reward farmers for moving away from deep ploughing to reduce SOC loss.

Regulatory tools

While technical and financial support to farmers are key to changing soil management practices, these can be voluntary and may need to be complemented by regulations that set minimum soil standards and apply penalties for not meeting them (British Society of Soil Science, 2023). However, globally, few countries regulate and enforce soil use and protection in the common interest. Where such protections exist, they are normally embedded in other types of legislation – environmental, agricultural or spatial planning – and often without direct reference to soils (Peake and Robb, 2022). Nonetheless, some examples do exist:

- Farmers in the **European Union (EU)** receiving support from the Common Agricultural Policy must comply with EU standards on good agricultural and environmental condition of land, such as maintaining minimum soil cover and land management practices (European Commission, 2023).
- **New Zealand** was one of the first countries to pass soil-related laws and continues to take a leading role in some aspects of soil governance (Peake and Robb, 2022).

- **Australia** released its first National Soil Strategy in 2021, setting out how it will value, manage and improve its soil for the next 20 years (DAWE, 2021). From 2012 to 2023, the government established a Soil Advocate position in the Ministry of Foreign Affairs, which aimed to raise awareness on the role of healthy soils and provide leadership and advocacy across government for appropriate legal and regulatory frameworks to improve the sustainable management of soil (Department of Agriculture, Fisheries and Forestry, 2023).

Developing soil monitoring

Efforts to support farmers and hold them accountable for soil health outcomes need to be underpinned by effective systems to monitor practices and outcomes:

- Mapping soils – their characteristics and health – is an important starting point to identify locally-appropriate practices and achievable results.
- Advances in soil testing – including in the lab and via satellite imagery – have the potential to reduce costs and make more detailed soil information available for understanding and tracking soil health, although this varies, depending on the availability of open-source data, labour costs and the state of existing information.

Examples of emerging tools and data for soil monitoring include:

- In **Rwanda**, the Rwanda Agricultural Board aims to provide an open-access soil information system populated with data on basic soil properties, analysed using soil spectroscopy, an innovation to assess multiple soil properties simultaneously.
- The **Land Degradation Surveillance Network** (World Agroforestry, 2023) produces digital maps providing farm-level assessments, using remote sensing data, systematic field sampling and citizen data. These are then fed into an open-source Ecosystem Health Surveillance System.
- The **Ghana** Agriculture and Agribusiness Platform aims to centralize data and information with a digital platform on weather data, soil and fertility mapping, and a digital database recording farmers' cropping decisions.

Tracking soil health in a comparative way at the local and global levels will require agreement on soil health indicators that capture the range of soil health characteristics across a wide range of soils, climates and production systems. Three have been proposed (Soil Health Institute, undated): **organic carbon concentration or SOC**;[vii] **carbon mineralization potential**;[viii] and **aggregate stability**,[ix] which acts as a proxy for **soil structure**. Including soil health indicators in the Global Biodiversity Framework and countries' Nationally Determined Contributions will also be key.

Process considerations

Policy Dialogue discussions acknowledge that a transition to low emission, climate resilient agriculture practices needs to centre on people and engage stakeholders at all stages. This recognizes that stakeholders have vested interests and may have a significant stake in existing agriculture production systems or stand to lose from changes in the short term. It is important to engage stakeholders in policy design, rather than imposing policy on them, to ensure that proposals are feasible, take account of risk appetite and support equitable change through the "valley of transition" to more sustainable practices that benefit everyone.

Key initiatives

Box 1. Examples of soil health initiatives

Coalition for Action on Soil Health (CA4SH): emerging from the UN Food Systems Summit in 2021, CA4SH aims to catalyse multi-stakeholder action to address food and nutrition insecurity, land degradation, biodiversity loss and climate change by investing in healthy soil ecosystems.

Global Soil Partnership: hosted by FAO, and established in December 2012, this aims to improve the governance and promote sustainable management of soils. It does this through: convening a wide range of stakeholders, including governments and land users to pool knowledge and collectively act through developing charters, guidelines and partnerships (e.g., the **Voluntary Guidelines for Sustainable Soil Management)**; providing technical knowledge on improving soil health; and building capacity for soil mapping and information systems.

Soil Investment Hub: organized by the World Business Council for Sustainable Development to be a resource for knowledge and expertise. The hub connects businesses to existing platforms, initiatives, and coalitions that can mobilize finance, engage with farmers and drive value chain collaboration.

4 per 1,000: an international initiative launched by France during COP 21 that aims to demonstrate that agriculture, and in particular agricultural soils, can play a crucial role in food security and climate change. It convenes voluntary public and private stakeholders (national governments, local and regional governments and authorities, companies, professional organizations, NGOs, research establishments, etc.) within the framework of the Lima-Paris Action Plan.

EU Soil Observatory: this regional initiative was launched in December 2020 to generate and disseminate harmonized EU-wide soil data and indicators in support of the European Green Deal, in particular the new Soil Strategy and the Mission on Soil Health and Food. It is developing an EU-wide soil monitoring system to assess progress towards soil-related targets, to support research and innovation and establish a European Soil Forum dedicated to a broad user base (citizens, farmers, land planners, scientists). It aims to develop a comprehensive dashboard containing indicators that present data on soil-related issues within and, in some cases, outside of the EU, e.g., soil erosion, soil carbon, pollutants and soil nutrients.

World Soil Day: held annually by FAO on 5 December to raise awareness of the importance of healthy soil and to advocate for the sustainable management of soil resources.

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Endnotes

[i] While not part of this Brief, soil health is also affected by mining, logging (deforestation), pollution, construction and other activities.

[ii] Such as continuous monocropping or leaving soil bare.

[iii] An under-reported but increasing issue is the presence of micro-plastics – less than 5 mm in size – in agricultural soil where plastic products are used to boost productivity, e.g., using nets to protect plants and extend cropping seasons. Soils contain larger quantities of microplastics than oceans and have the potential to be affect human health through consumption of agricultural products (FAO, 2021).

[iv] Interview with Dr. Leigh Winowiecki, CIFOR-ICRAF.

[v] The soil health card does not look at soil carbon.

[vi] Interviews with Bruce Campbell and Rattan Lal, October 2023

[vii] This reflects the soil's capacity for nutrient cycling and retention, and available water holding capacity.

[viii] Linked to the soil's ability to cycle carbon and nutrients.

[ix] Including resistance to wind and water erosion, and soil water infiltration and storage.

Please contact jrt@merid.org with any questions about the compendium.

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