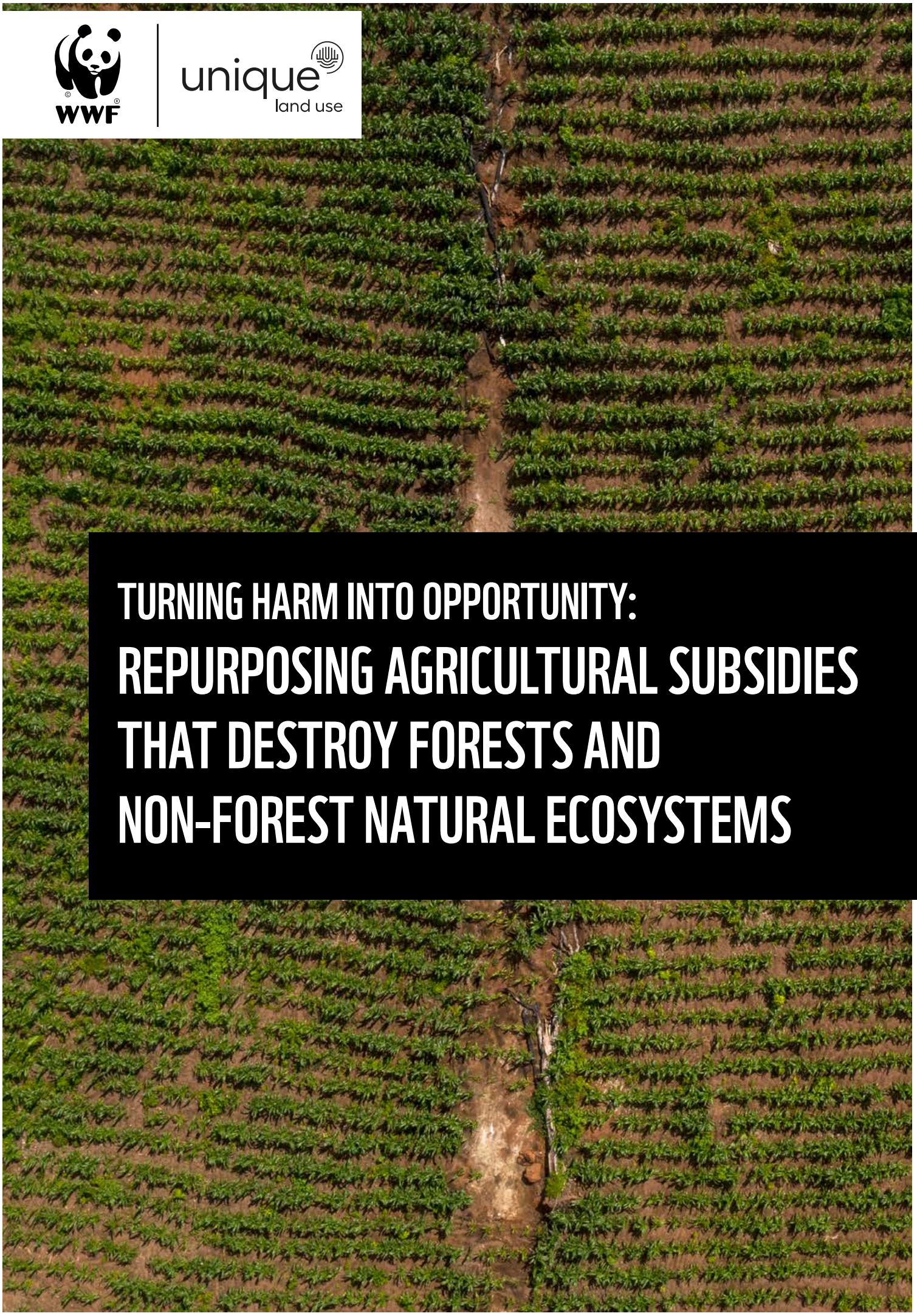

TURNING HARM INTO OPPORTUNITY:
REPURPOSING AGRICULTURAL SUBSIDIES THAT DESTROY FORESTS AND NON-FOREST NATURAL ECOSYSTEMS

CONTENTS

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EXECUTIVE SUMMARY

Soy monoculture in the Cerrado, Brazil.
© Adriano Gambarini / WWF-Brazil

INTRODUCTION

Every year, governments spend US$470 billion[1] on agricultural subsidies that harm biodiversity, and forests and other natural ecosystems. Repurposing these subsidies offers immense opportunity to halt and reverse the loss of forests and transition toward sustainable food systems.

Reforming harmful subsidies, conserving forests and other natural ecosystems, and transforming food systems are all high priorities on the international agenda:

- Under Target 18 of the Global Biodiversity Framework (GBF), 196 countries agreed to identify and eliminate, phase out or reform subsidies and other incentives that harm biodiversity and to scale up positive incentives.[2]
- Through the Glasgow Leaders' Declaration, 145 governments agreed to work collectively to halt and reverse forest loss by 2030, including by redesigning agricultural policies and programmes to incentivize sustainable agriculture.[3]
- At the 2023 UN climate conference in Dubai, the UAE Declaration on Sustainable Agriculture, Resilient Food Systems, and Climate Action emphasized the need to reorient policies and public support for agriculture and food systems to maximize the climate and environmental benefits and minimize harmful impacts, including by conserving and restoring natural ecosystems.[4]

Despite the widely acknowledged need to repurpose harmful subsidies, little has been done to define guidelines and criteria to guide this process. To reduce harm to nature and to achieve the socioeconomic and environmental targets of subsidies in a "just, fair, effective and equitable way" (GBF Target 18), repurposing strategies need to be carefully crafted. Essential components include reducing adverse impacts, safeguarding remaining forests and other natural ecosystems, empowering small producers, promoting research and innovation in sustainable production, and ensuring food security. Various enabling conditions need to be put in place, and trade-offs need to be carefully managed.

By scrutinizing how agricultural subsidies affect forests, this report aims to inform policy and subsidy reform processes. It introduces a framework for identifying and repurposing subsidies that harm forests and non-forest natural ecosystems and outlines potential repurposing options and complementary measures to support the shift to sustainable production systems that provide food security and resilient livelihoods, while contributing to carbon sequestration and biodiversity conservation. Two case studies from Brazil and Malawi offer an in-depth look into forest-harming subsidies and opportunities for reform. The report concludes with recommendations for action at international and national level.

Livestock in Acre, Brazil. © Greg Armfield / WWF-UK

FORESTS AND AGRICULTURE

Agriculture both depends upon and threatens forests and the services they provide.

Forests provide vital provisioning, regulating, supporting and cultural ecosystem services that we all depend on. These include food production, clean water supply, flood and erosion protection, and regulation of the Earth's climate and hydrological cycles. They also provide habitat for much of the world's terrestrial biodiversity. The value of forest ecosystem services has been estimated at US$7.5 trillion, or 9% of world GDP.[5] One in five people globally rely on forests for their livelihood,[6] and they play an especially vital role for sustaining the livelihoods of the rural poor.

Forests and their biodiversity are crucial to agricultural productivity. They help stabilize soils, prevent erosion and improve soil health and fertility.[7] They secure water supplies, improve water quality and reduce flood risk. They provide habitat for a wide range of pollinators that many food crops depend on. Forests are key for mitigating and adapting to climate change, and critical for preventing climate-related food insecurity. They store and sequester vast quantities of carbon, and act as buffers against extreme weather events, reducing the risk of agricultural losses from climate-related hazards.

But while agriculture depends on forests, it is also the greatest threat they face. The UN Food and Agriculture Organization (FAO) and UN Environment Programme estimate that cropland expansion accounts for 52% of forest loss, with livestock grazing contributing another 38%.[8] Between 2013 and 2019, commercial agriculture drove 60% of tropical forest loss, with more than two-thirds of this violating national laws and regulations.[9] After commercial agriculture, small-scale shifting agriculture has been the second largest driver of deforestation this century, accounting for 113 million hectares of tree cover loss between 2001 and 2023.[10] In certain regions, such as the Brazilian Amazon, the higher economic value of agricultural land compared to forest land incentivizes land conversion and land grabbing for private financial gain.[11]

In 2022, 4.77 million hectares of forest was permanently destroyed worldwide to make room for commodity production, mostly agriculture.[12] Despite global pledges to end deforestation, this represents a 5.6% increase compared to 2021 (4.52 million hectares) and only a slight decrease against a 2018-2020 baseline. The tropics, particularly the Amazon rainforest, have experienced high rates of land-use change due to the expansion of large-scale commercial agriculture and cattle ranching, with 10% more primary rainforest lost in 2022 than in the previous year.[13] Brazil accounted for 41-43% of the global total.[14] The conversion of other natural ecosystems such as savannahs, grasslands and wetlands to agricultural land is also a major concern, with negative impacts on biodiversity, climate resilience and the provision of ecosystem services.

THE ROLE OF ENVIRONMENTALLY HARMFUL SUBSIDIES

Understanding the role of subsidies in driving deforestation and ecosystem conversion, and how they can be reformed to support sustainable production, is an urgent priority.

Governments spend around US$540 billion per year in support for agricultural production, and this is set to increase to US$1.8 trillion by 2030, according to the FAO.[15] Most of these subsidies (87%) are classified as price-distorting or harmful to nature and health.[16] Although there are challenges with data availability and methodologies, various estimates provide insights into the size and nature of subsidies that can have negative environmental impacts in specific regions or in relation to the production of particular commodities.

Green subsidies, which are intended to support positive environmental outcomes, account for only 5% of total agricultural input subsidies, or US$29 billion.[17] These subsidies are primarily provided in high-income countries, and to some extent in China. Estimates indicate that annual financing to protect, restore and sustainably manage natural ecosystems and biodiversity needs to increase from US$166 billion to nearly US$1 trillion by 2030.[18] This includes an estimated US$460 billion per year for forests.[19]

Subsidies can cause a range of harmful environmental impacts; this report focuses specifically on how they incentivize practices that result in deforestation and ecosystem conversion. Incentives can directly promote expansion of production, increasing the strain on available land resources and encouraging encroachment into forests and other natural ecosystems. Subsidies may also reward farmers for practices that exhaust the land in the long run and threaten the long-term health and vitality of farming communities.[20] They can encourage unfair competition and distort market dynamics, which may reduce incentives for more environmentally friendly practices.

Subsidies that inflate market prices drive around 2.2 million hectares of forest loss annually, or 14% of all deforestation.[21] This estimate comes from a recent World Bank study focusing on the causal link between agricultural market price support and deforestation.

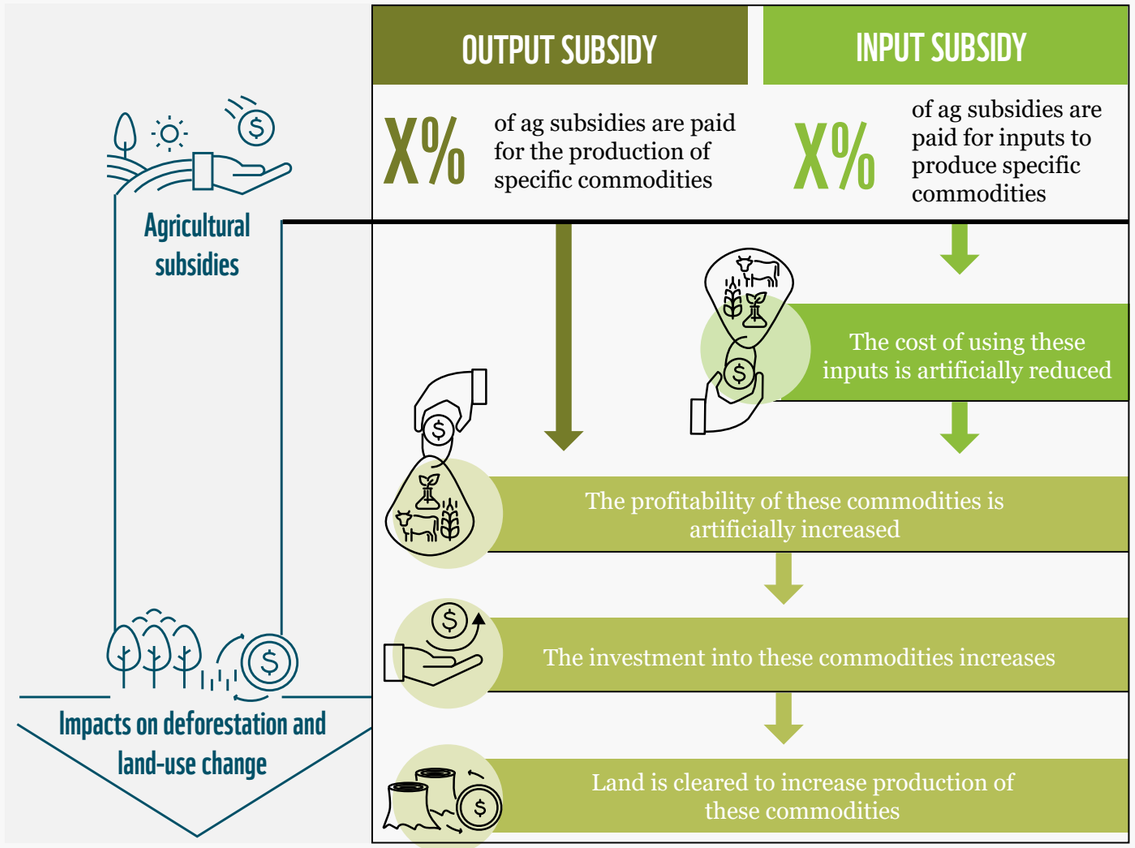
Soy beans. © David Bebber / WWF-UK

Agricultural support measures in importing countries can have strong spillover effects by influencing demand for agricultural commodities linked to deforestation in exporting countries. The primary example is the impact of livestock subsidies in the United States which increase animal production and therefore demand for soybeans as feed, driving soybean expansion and tropical deforestation in Brazil.[22]

In addition to their environmental impact, harmful subsidies often lead to unfair and inequitable socioeconomic development. While many agricultural support programmes are intended to bolster rural development and benefit low-income farmers, they are often more regressive and disproportionately go to wealthy landowners and larger farms.[23] Research indicates a correlation between levels of subsidies and agricultural sector lobbying power, benefiting large corporations and businesses while small-scale farmers and local communities are left behind.[24]

A narrow focus on economic indicators has (often unintentionally) sustained environmentally harmful practices, such as deforestation and conversion, and fails to capture the many negative externalities.[25] Various reasons exist for retaining environmentally harmful agricultural support measures. They include political economy considerations, policy priorities, powerful agricultural lobbies, targets and monitoring systems that fail to measure negative externalities, limited understanding of the value of ecosystem services for agriculture, limited knowledge of how subsidies affect forests, and a lack of knowledge and technical capacity on regenerative and nature-positive agriculture.

Figure 1: How agricultural subsidies drive deforestation and land-use change




Campo Grande, Brazil. © Jaap van der Waarde / WWF-Netherlands

SUBSIDIES AND THE NEED FOR REFORM

Subsidy reform offers a cost-effective strategy to achieve national and international environmental and climate goals and transition to resilient and sustainable food systems.

The Kunming-Montreal Global Biodiversity Framework recognizes the need for urgent action to reform subsidies that are harmful to nature. Target 18 sets clear requirements and steps to "identify by 2025, and eliminate, phase out or reform incentives, including subsidies, harmful for biodiversity, in a proportionate, just, fair, effective and equitable way, while substantially and progressively reducing them by at least $500 billion per year by 2030."[26] Countries must report on their progress under two headline indicators: the positive incentives in place to promote biodiversity conservation and sustainable use (18.1) and the value of subsidies and other incentives harmful to biodiversity that have been eliminated, phased out or reformed (18.2).[27] A complementary indicator looks at "trends in potentially environmentally harmful elements of government support to agriculture".[28]

Agricultural support measures and incentives, or agricultural subsidies, aim to promote agricultural activities or offset costs within the sector. They cover a wide range of financial benefits and support measures provided by public sector institutions to the agricultural sector. These come in direct or indirect forms, including as trade and market interventions (such as import/export bans, quotas and tariffs), direct cash payments, tax and fee exemptions or reductions, discounted credit/loans, price controls and regulations. Support measures may focus on inputs (e.g., fertilizer, irrigation, seeds, fuel and energy), outputs (e.g. tax refunds, preferential loans, crop insurance) or other production-related factors like machinery, land area, market prices, price floor guarantees and property taxes on farmland. Externalities, in the form of uncompensated indirect costs to society from the negative impacts of agricultural activities, can also be seen as a form of subsidy.

Our report looks specifically at subsidies based on a direct financial transfer from government bodies to private beneficiaries, through direct payments, preferential loans and other mechanisms. This narrower focus helps demonstrate the opportunities available from redirecting existing public funds.

Removing harmful subsidies can reduce negative impacts on forests, ecosystems and biodiversity, but the transition to sustainable agricultural systems must also be underpinned by behavioural and technological change. Redirecting subsidies from supporting environmentally harmful activities to supporting sustainable practices can drive shifts in behaviour, promote research and innovation, and empower smallholders.

From a social perspective, subsidy reform needs to be just and equitable. Repurposing can create both winners and losers, so there is a need to manage trade-offs and seek compromises between those affected. Sustainable development, social and economic fairness and inclusion, rural livelihoods and food security must be at the centre of any repurposing strategy.

Embarking on subsidy reform entails political and financial challenges. The effects – both positive and negative – may only become apparent in the medium to long term. Policymakers need to anticipate the environmental, social, political and economic repercussions of change, and construct a pathway that takes these issues and time realities into account. In evaluating repurposing options, policymakers also need to weigh up possible trade-offs between environmental outcomes, food prices, public health and economic factors, depending on the country's socioeconomic and environmental context.

A number of challenges also need to be addressed to create an enabling environment for reform and to reduce the risk of failure. These may include changes in the legal framework, institutional development, the introduction of new financial mechanisms and capacity development, among others.

Palm oil plantation in Central Kalimantan. © Matthieu Paley

RECOMMENDATIONS

Redirecting harmful subsidies toward sustainable practices is a pivotal strategy for combating deforestation and nurturing resilient food systems. Establishing an enabling environment for subsidy repurposing will mean addressing governance challenges and exploring complementary instruments. Consistent with Target 18 of the Global Biodiversity Framework, subsidy reforms must prioritize fairness and equity.

Political momentum and opportunities exist to redirect harmful agricultural subsidies toward protecting forests and other natural ecosystems and restoring degraded agricultural lands, or at least to reduce the harm they cause. Updates to nationally determined contributions (NDCs) under the UN Framework Convention on Climate Change (UNFCCC) and national biodiversity strategies and action plans (NBSAPs) under the Convention on Biological Diversity (CBD) provide opportunities for collaborative action across the climate and nature agendas.

Repurposing forest-harming subsidies requires strong action, properly resourced, from public and private sectors in both producer and consumer countries. At international level, we recommend the following actions:

- Establish an inter-ministerial working group that connects work and progress under the Glasgow Leaders' Declaration, the UAE Declaration on Sustainable Agriculture, Resilient Food Systems, and Climate Action, and the agenda of the UN Food Systems Summit to more explicitly link agricultural subsidies and forest-related goals.
- Create an intersectoral working group, with members from FAO's committees on forests (COFO) and agriculture (COAG), on subsidies, best-practice examples and incentives for agriculture and forests.
- Establish effective channels for collaboration across the UNFCCC and the CBD and adopt a joint programme of work on repurposing harmful agricultural subsidies.
- Establish dialogues and roundtables on sustainable agri-food repurposing of subsidies with finance ministers of forest-rich countries and key consumer governments. This could be facilitated through the Forest and Climate Leaders' Partnership.
- Establish a task team on the role and promotion of forests and ecosystems in the agri-food agenda under the Just Rural Transition initiative.
- Use the momentum of the recently adopted EU Deforestation Regulation and tailor agricultural repurposing programmes in producer countries to meet the EU's requirements.
- Channel international finance to support enabling conditions for efficient repurposing of harmful subsidies through multilateral reform programmes, such as under the World Bank, Global Environment Facility or Green Climate Fund. These could be supplemented bilaterally through, for example, the Forest and Climate Leaders' Partnership, the German International Climate Initiative (IKI) or Norway's International Climate and Forest Initiative (NICFI).

At national level, governments can start to identify and reform harmful agricultural subsidies and scale up policies and support for sustainable, deforestation- and conversion-free and forest-supporting agriculture. This should include the following actions:

- Use the framework presented in this report to trigger a broad reflection in government agencies on repurposing harmful subsidies, and use the predefined guiding questions and steps to operationalize the process.
- Take advantage of existing support programmes including FAO's Monitoring and Analysing Food and Agricultural Policies (MAFAP) programme and BIOFIN's new guidance on repurposing of subsidies.
- Update and strengthen NDCs by including emission targets for the agricultural sector that relate to deforestation and conversion of non-forest natural ecosystems.
- Include national targets and/or policies in national biodiversity strategies and action plans on sustainable agriculture (GBF Target 10) aiming at addressing deforestation and conversion in agricultural production.
- Explore how repurposing harmful subsidies can complement domestic resource mobilization in national biodiversity finance plans (GBF Target 19).

Village in Malawi, Africa. © Birkir Asgeirsson / Shutterstock

1. INTRODUCTION

Repurposing harmful subsidies involves the reallocation of existing financial resources for environmentally damaging practices to ensure that in the future they contribute to nature-positive, sustainable, fair and healthy outcomes (BIOFIN and UNDP, 2024). Target 18 of the Kunming-Montreal Global Biodiversity Framework calls for eliminating, phasing out or reforming harmful incentives by 2025 and reducing them by at least US$500 billion per year by 2030.

Target 18: Identify by 2025, and eliminate, phase out or reform incentives, including subsidies, harmful for biodiversity, in a proportionate, just, fair, effective and equitable way, while substantially and progressively reducing them by at least $500 billion per year by 2030, starting with the most harmful incentives, and scale up positive incentives for the conservation and sustainable use of biodiversity.

With this target 18, supported and driven by strong private and multi-party alliances,[29] the urgency of addressing this challenge has sparked global momentum. In addition, the G7 in 2022 committed to "redirect or eliminate incentives including subsidies harmful to biodiversity by 2030 at the latest".

Repurposing harmful agricultural subsidies holds huge potential to increase or refocus finance to meet the Glasgow Leaders' Declaration commitment to halt and reverse forest loss by 2030[30], and at the same time to promote sustainable food systems focused on nutrition and enabling an inclusive rural transformation. According to Koplow and Steenblik (2021), environmentally harmful subsidies amount to US$520 billion in agriculture and US$640 billion in fossil fuels annually worldwide. These subsidies contribute to deforestation and conversion, among other negative externalities.

Forests are diminishing at continuously high rates but still constitute 31% of the Earth´s land area (World Bank, 2023b) and provide vital provisioning, regulating, supporting and cultural ecosystem services. The value of forest ecosystem services has been estimated at US$7.5 trillion, or 9% of world GDP, and 21% of total land asset wealth (FAO and UNEP, 2022). These vital services support agricultural productivity, including food production and clean water supply, flood and erosion protection, biodiversity preservation, and regulation of the Earth's climate and hydrological cycles. One in five people globally rely on forests for their livelihood (IUCN, 2021), and they play an especially vital role for sustaining the livelihoods of the rural poor. Environmentally harmful subsidies not only have a negative impact on the environment but can also reinforce unfair and inequitable socioeconomic development pathways with long-lasting effects.

Despite their importance, forests continue to face significant threats from human activities, particularly from agricultural production systems, including livestock, which is the largest driver of deforestation on the global scale (FAO and UNEP, 2022). Forest transition varies over time, by country and region, and is intricately linked to economic development. In 2022, a total of 22.8 million hectares of tree cover was lost globally (Global Forest Watch, 2023). In that year, 4.77 million hectares of forests was permanently destroyed worldwide to make room for commodity production. This represents a 5.6% increase compared to 2021 (4.52 million hectares) and only a slight decrease compared to the 2018-2020 baseline (Forest Declaration Assessment Partners, 2023). The tropics, particularly the Amazon rainforest, have experienced high rates of land-use change due to the expansion of large-scale agriculture and cattle ranching. This resulted in 10% more primary rainforest lost than in the previous year, with Brazil accounting for 41-43% of the global total (World Resources Institute, 2022; Forest Declaration Assessment Partners, 2023). In addition, the conversion of other natural ecosystems to agricultural land is also a major concern, as it significantly impacts biodiversity and the provision of ecosystem services.

Annual funding for the protection and restoration of fragile natural ecosystems will need to increase from US$166 billion to nearly US$1 trillion by 2030 in order to sustainably manage biodiversity and ecosystem integrity (Cuming & Bromley, 2023). For forests in particular, funding is not on track to halt and reverse deforestation by 2030. The Forest Declaration Assessment estimates that annual funding needs to increase to US$460 billion[31] to protect, restore and enhance forests globally. Repurposing subsidies could make a significant contribution to providing these necessary funds.

Agricultural direct subsidies and market price supports play a key role in supporting and steering agricultural development globally by supporting farmers' income and boosting production of strategically important outputs. Specific reasons for establishing agricultural subsidies vary by political and socioeconomic context. Many subsidies are harmful to forests and other natural ecosystems (Gautam et al., 2022). A recent World Bank study estimates agricultural price support alone to be responsible for about 2.2 million hectares of forest loss per year, or 14% of annual deforestation (Damania et al., 2023). In addition, the report suggests that agricultural support measures can have strong spillover effects by influencing demand for agricultural commodities linked to deforestation in exporting countries. The primary example is the impact of livestock subsidies in the United States which increase animal production and therefore demand for soybeans as feed, driving soybean expansion and tropical deforestation in Brazil. The reasons for such subsidies still being in place are diverse, including political economy dynamics, national protectionism, powerful agricultural lobbies, and limited understanding and appreciation of ecosystems services' value for functional agricultural systems,[32] among others.

The FAO (2023) report on *The State of Food and Agriculture* used the concept of true cost accounting (TCA) to uncover the hidden environmental, health and livelihood impacts of agrifood systems. It emphasized the role of subsidies in supporting food production and agriculture, and the potential for repurposing to improve environmental sustainability and produce healthy food without reducing economic welfare. Informed by TCA assessments, existing levers such as subsidies can be redirected or reformed to support sustainable food systems.

Despite the widely acknowledged need to repurpose harmful subsidies, little has been done to define guidelines and criteria to guide. To achieve multiple social and environmental targets at different scales in a "just fair, effective and equitable way" (Target 18), repurposing strategies need to be carefully crafted. Essential components include reducing adverse external impacts, safeguarding the remaining forests and other natural ecosystems, empowering small producers, promoting research and innovation in sustainable production, and ensuring food security.

This report focuses on subsidies based on a direct financial transfer from government bodies to private beneficiaries, through direct payments, preferential loans and other mechanisms.

Direct financial transfers, a form of financial transfer incorporated into countries' budgets, can be reassigned to align with the commitments under Target 18. These direct subsidies are a highly visible policy instrument that is very relevant from a political economy[33] perspective. Shifting their allocation from one group of beneficiaries to another or one particular activity to another creates new winners and losers, so implementing these changes demands strong political will and durability. The ongoing farmers' protests in Europe[34] and other regions offer a striking demonstration of these challenges and the need for both clear political leadership and targeted educational and engagement campaigns.

By scrutinizing how agricultural subsidies affect forests, this report aims to inform political debate and support the needed shift from agricultural systems that drive forest loss and degradation to new systems which provide food security and resilient livelihoods in a sustainable manner, while contributing to carbon sequestration and preserving biodiversity.

The first section investigates the ecosystem services and functions that forests provide to farmers and agricultural systems. It highlights the global risks posed by forest-harming subsidies. The analysis centres on the impacts of subsidies on forests and related ecosystems such as savannahs. The second section explores various options for repurposing harmful subsidies and proposes a framework to support policymakers in doing so. It examines the benefits of repurposing, particularly in relation to forests, while promoting a fair and equitable rural transition. It also sets out the complementary measures needed to create the political, social and economic environment for successful repurposing. The third chapter provides two country case studies for Brazil and Malawi. They illustrate two practical applications of the repurposing framework and strategies presented in this report.

Methodologically, the content of this report is backed by a comprehensive review of existing literature, encompassing global and country-specific sources. In addition, 18 semi-structured expert interviews were conducted to validate cause-and-effect relationships and explore potential repurposing strategies globally and at country level.

Guarana fruit, Amazonas, Brazil. © Andre Dib / WWF-Brazil

Eggplant field, Madagascar. © iAko R. / WWF-Madagascar

KEY DEFINITIONS

Subsidies and agricultural subsidies:

OECD: "A subsidy is a measure that keeps prices for consumers below market levels, or keeps prices for producers above market levels or that reduces costs for both producers and consumers by giving direct or indirect support [direct or indirect subsidies]" (OECD, 2006).

World Trade Organization: Within the framework of the Agreement on Subsidies and Countervailing Measures, the WTO defines subsidies as "a financial contribution by a government, or agent of a government, that confers a benefit on its recipients" (WTO, 1995).

United Nations Environment Programme: "Agricultural subsidies aim to promote agricultural activities or to offset certain costs within this sector [...and...] can be categorized into (1) price incentives (trade and market interventions) and (2) fiscal support (monetary transfers or public expenditures)" (UNEP et al., 2021).

The analysis in Chapters 2 and 3 of this report covers the full range of subsidies as defined above. For the country case studies (chapter 4), the focus is on direct subsidies as defined by the OECD. Examples of direct subsidies include financial transfers to consumers or producers, buy-backs of production rights, preferential lending, loans, credits, etc. (OECD, 2006). In contrast, indirect subsidies include tax credits or exemptions, provision of low-cost inputs, infrastructure or services, preferential regulations, border measures, government inaction, etc. (OECD, 2006).

Environmentally harmful subsidies:

OECD: "All kinds of financial supports and regulations that are put into place to enhance the competitiveness of certain products, processes, or regions, and that, together with the prevailing taxation regime, (unintentionally) discriminate against sound environmental practices" (OECD, 2006).

CBD: The CBD classifies as "harmful" or "perverse incentives" to biodiversity those "that emanate from policies or practices that induce unsustainable behaviour that destroys biodiversity, often as unanticipated side-effects of policies designed to attain other objectives" (Secretariat of the Convention on Biological Diversity, 2011).

Deforestation, forest degradation and conversion of natural ecosystems are among the impacts of environmentally harmful subsidies. Such subsidies may also produce environmental and livelihood benefits, though these are often outweighed by the negative impacts. Methodologies, data availability and other factors can affect assessments of harmful subsidies. BIOFIN provides further information on the definition of both subsidies and harmfulness in its new guidance (BIOFIN and UNDP, 2024).

Burn forest next to standing forest in Brazil. © Day's Edge Productions / WWF-US

2. LINKS BETWEEN FORESTS AND AGRICULTURE

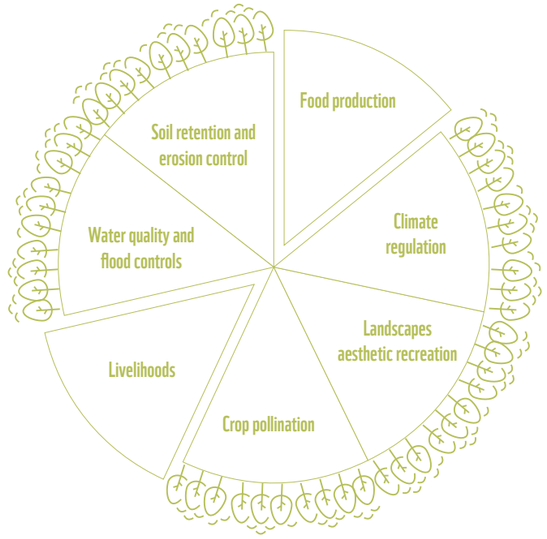
2.1 FOREST SERVICES FOR AGRICULTURE

Forests provide essential services and functions that contribute to the resilience and well-being of people, and which ensure the productivity and overall functioning of agricultural systems and land. These include climate regulation, erosion prevention, crop pollination, soil fertility, and hydrological services including flood control (see Figure 2) (FAO, 2015a). The monetary value of ecosystem services provided by forests is estimated to exceed US$607 per hectare per year (Ojea et al., 2016).

Shifting at scale to sustainable management practices and restoration can bring back services that have been impaired as a result of conversion and other environmentally harmful human interventions. For example, agroforestry techniques which combine trees with crops enhance soil health and resilience for farmers. Integrating trees on farms, fruit trees and other agriculture-related forest services not only bolsters the ecosystem but also provide direct livelihood, economic and nutritional benefits to communities (Shennan-Farpón et al., 2022). Trees along water bodies create buffers that effectively prevent erosion and filter water. Forests across larger regions aid in managing water flow, mitigating flood risks and preserving water quality. Biomes such as the Amazon rainforest have a global impact on rainfall patterns and can support agriculture in distant regions (WWF, 2020).

Although data limitations mean that some uncertainties remain about the directness and scale of the effects, there is clear evidence that healthy forest ecosystems can benefit on-site and off-site (downstream) land users, including farmers (Saad et al., 2021).

Figure 2: Ecosystem services provided by forests



Source: Authors´ illustration

Forests are key for mitigating and adapting to climate change, and critical for preventing climate-related food insecurity. Forests store and sequester a significant quantity of greenhouse gases, and act as buffers against extreme weather events, reducing the risk of agricultural losses from climate-related hazards. Forests could deliver up to 30% of the climate solutions needed by 2030 (WWF, 2018).

Deforestation and forest degradation reduce the provision of these vital services, sometimes requiring governmental intervention to cover the costs associated with their loss (World Bank, 2021). Forests play a critical role in supporting sustainable food production by providing habitat for a wide range of pollinators. Pollination by insects and animals, for example, supports over three-quarters of the world's food crops and contributes directly to approximately US$577 billion of annual food production (World Bank, 2021).

Recognizing the linkages between forests and agricultural systems and implementing sustainable practices that conserve forest biodiversity are critical steps in ensuring a resilient and productive future for both forest ecosystems and agriculture (FAO and UNEP, 2022).

2.2 DEFORESTATION FOR AGRICULTURAL PRODUCTION

FAO and UNEP estimate that expansion for cropland accounted for 52% of forest loss while expansion for livestock grazing contributed another 38% between 2000 and 2018 (FAO and UNEP, 2022). Between 2013 and 2019, commercial agriculture drove 60% of tropical forest loss, with at least[35] 69% of this (or 41% of total tropical forest loss) violating national laws and regulations (Dummett & Blundell, 2021). More recently, in 2022, 4.77 million hectares of forests were permanently destroyed worldwide to make room for commodity production, mostly agriculture (Forest Declaration Assessment Partners, 2023). Shifting agriculture has been the second largest driver of deforestation this century, accounting for 113 million hectares of tree cover loss between 2001 and 2023 (World Resources Institute, 2024). In certain regions, such as the Brazilian Amazon, the higher economic value of agricultural land compared to forest land incentivizes land conversion and land grabbing for financial gain, which is closely linked with uncontrolled deforestation (Pacheco et al., 2021). Insufficient enforcement of laws and regulations on land rights, land uses and environmental controls also enables deforestation.

Given the devastating impacts agriculture has on forests and other ecosystems, understanding the role of subsidies in driving conversion and how they can be reformed to support sustainable production is an urgent priority.

2.3 AGRICULTURAL SUBSIDIES AND THEIR IMPACTS ON FORESTS

2.3.1 Agricultural subsidies – concept, complexity and global scale

CONCEPT

Agricultural incentives and support, often interchangeably referred to as "agricultural subsidies", are specific financial benefits and support measures provided by public sector institutions to the agricultural sector. They come in direct or indirect forms, including as trade and market interventions, direct cash payments, tax and fee exemptions or reductions, discounted credits/loans, induced transfers, regulations[36], and (often unquantified) non-internalized externalities. The focus of this report is on price incentives and direct fiscal support specifically, rather than the much broader overall set of support instruments. While this chapter looks at both categories to analyse their impact on forests, the country case studies in chapter 4 focus on fiscal measures through public expenditure in the form of direct financial transfers, to demonstrate the opportunities of redirecting existing public funds.

COMPLEXITY

Governments may have good reasons to support private actors in a specific sector. Measures are often justified as a means of addressing market failures. They can also be used to promote positive externalities, for example by encouraging investment in research and development, or provision of ecosystem services. Investment in infrastructure and other public goods also indirectly benefits certain private sector actors.

Historically, public support to agriculture has been justified by protectionism, and by linking increased agricultural productivity to other goals, such as food security. Other

Soy production. Cerrado, Brazil. © Peter Caton / WWF-UK

socioeconomic goals include shrinking the rural-urban income gap, income redistribution, reducing rural poverty, rural development, and strengthening and strategically promoting exports as key economic drivers (World Bank, 2021).

Common measures to pursue domestic policy objectives include stabilizing agricultural commodity markets and prices; aiding low-income farmers and rural development; compensating for unduly low returns on agricultural investments; compensating for monopoly prices in farm input supply and marketing; and offsetting farm subsidies provided by other countries (Lubeniqi & Atanasov, 2019). However, Žičkienė (2022) found that direct payments, while boosting short-term income gains, lack the medium- to long-term benefits and pro-poor impacts of public investments (UNEP et al., 2021).

Research has also shown that it is impoverished farmers around the world who bear the brunt of the negative effects of global agricultural subsidies (Searchinger et al., 2020). In addition, policies that increase or stabilize the incomes of farmers at national level may reduce the incomes of farmers in other countries by changing international price dynamics (Anderson & Nelgen, 2010).

While many agricultural support programmes are intended to bolster rural development and benefit low-income farmers, particularly in developing countries, they are often more regressive and disproportionately support higher income groups, with the benefits typically going to wealthy landowners and larger farms (Ding, Markandya et al., 2021; World Bank, 2023b). Empirical research indicates that levels of subsidies track with lobbying capabilities of the agricultural sector (World Bank, 2023b). Uneven distribution of power leads to subsidies disproportionately benefiting large corporations and businesses, while small-scale farmers and local communities are "left behind". Given the short timescale of election cycles and the popularity of direct assistance, subsidies are often preferred over longer-term capital investments that could have longer lasting environmental and social benefits (World Bank, 2021).

Subsidies aimed at boosting productivity can also drive expansion into previously uncultivated land, as well as distorted and inefficient use of inputs (World Bank, 2023b). The adverse environmental impacts of agricultural support programmes often become apparent only years later, and climate and environmental outcomes have been underemphasized in the debate on agricultural subsidies in the past.

GLOBAL SCALE

During the period 2020-22, agricultural policies across 54 countries transferred an average of US$851 billion (€758 billion) per year to the agricultural sector, of which US$630 billion (€561 billion) went to individual producers (OECD, 2023a). Support remains highly concentrated in a few large economies, including some OECD countries and China.[37] Regarding the income of beneficiaries, in the US, for example, about 85% of programme payments for commodity production were concentrated in the highest-income farms (UNEP et al., 2021). Research on the EU found that €24 billion annually supports incomes in the richest farming regions with relatively low farm employment levels, which is about half of the whole farm income support budget of the EU (European Commission, 2023). The same analysis found that €20 billion could be redirected toward EU biodiversity targets that would provide added social benefits (UNEP et al., 2021).

In 2016, agricultural subsidies made up 25% of the value of agricultural production in OECD countries and 15% in non-OECD countries (Springmann & Freund, 2022). A breakdown by commodity group shows that 22% of subsidies go to staple crops, 22% to meat products, 24% to fruit and vegetables, 10% to milk and milk products, 10% to oil and sugar and 11% to other crops (Springmann & Freund, 2022). Globally, projected agricultural subsidies in 2030 show a similar distribution, with roughly two-thirds allocated to crop production and one-third to livestock (UNEP et al., 2021) – although support for crops, when used for feed, indirectly also contributes to support for the livestock sector.

A recent analysis reveals that agricultural support provides poor value for money, with a 35% return to farmers for every dollar of publicly funded support (World Bank and IFPRI, 2022). Significantly, public goods and services represented only 17% of the total amount of subsidies (World Bank and IFPRI, 2022).

BOX 1: THE IMPACT OF GLOBAL COMMODITY DEMAND AND ITS ASSOCIATION WITH DEFORESTATION

International demand for commodities such as palm oil, soy and beef has been steadily increasing. India is the largest market for palm oil (21.9% of all imports) and China leads the global demand for soy (60%) and beef (17%). In response to rising demand, producer countries increase agricultural subsidies to boost production. This leads to an intensification of competition for land resources, increasing the risk of agricultural land encroaching on forests (Ding, Markandya et al., 2021). Subsidies in consuming countries can also indirectly drive deforestation: for example, subsidies to the livestock sector in the USA increase demand for soy as feed, leading to deforestation in Brazil (Damania et al., 2023).

Commodity-driven deforestation and the conversion of other critical ecosystems cannot be treated in isolation: they sit at the heart of the challenges facing global food systems. The global north and other major importers have an important role to play in adopting demand-side measures (due diligence) that require deforestation- and conversion-free production and imports. In this respect, the EU Regulation on deforestation-free products (EUDR) is an important milestone in the global fight against deforestation.

The EUDR became effective on 29 June 2023, and the main requirements and prohibitions are set to apply from 30 December 2024. It applies to commodities linked to deforestation, such as cattle, wood, cocoa, soy, palm oil, coffee, rubber, and some of their derived products (such as leather, chocolate, tyres or furniture). Any operator or trader who places these commodities on the EU market, or exports from it, must prove that the products do not originate from land deforested after 2020, and have not contributed to forest degradation.

By increasing visibility within global supply chains, the EUDR presents a significant opportunity to add value in supporting smallholders and Indigenous Peoples and local communities. This can be achieved through investing in training on improved practices and technologies, and by integrating local and traditional knowledge.

2.3.2 Harmful agricultural subsidies and green finance needs

HARMFUL AGRICULTURAL SUBSIDIES

Two-thirds of the US$540 billion spent on agricultural producer support in 2021 is classified as price-distorting and environmentally harmful. This implies that harmful public support measures amount to approximately US$360 billion (FAO, 2021), about 15% of the total value of agricultural production. Agricultural producer support is projected to increase to around US$1.8 trillion by 2030 (FAO, 2021).

Despite challenges associated with data availability and methodologies, various estimations provide insights into the size and nature of subsidies that can have negative environmental impacts in specific regions, or in relation to the production of particular commodities. Annex A2 presents such estimates compiled from different sources.

Reasons for retaining environmentally harmful agricultural support measures over time have varied. They include political economy considerations, policy priorities, powerful agricultural lobbies, targets and monitoring systems that fail measuring negative externalities, limited understanding of ecosystem services' value for agriculture, limited knowledge of how subsidies affect forests, and a lack of knowledge and technical capacity on regenerative and nature-positive agriculture. A narrow focus on economic indicators has (often unintentionally) sustained environmentally harmful practices, such as deforestation and conversion, and fails to capture the many negative externalities (Dempsey et al., 2020),.

BOX 2: BIOENERGY SUBSIDIES, FOOD SECURITY AND DEFORESTATION

The International Energy Agency estimated that total global subsidies for biofuels were US$38 billion in 2017, of which about US$11.4 billion were paid in the EU and US$14.1 billion in the USA (Taylor, 2020). Bioenergy is often sourced from purpose-grown crops or trees in a highly land-intensive process. Unsustainable bioenergy production can have social consequences – such as impacts on food prices and competition for land use – as well as negative environmental externalities such as biodiversity decline and net increases in emissions. As both palm oil and soybeans are important biofuel feedstocks, subsidies for these commodities through support for biofuel production, processing and consumption may also be responsible for driving forest loss.

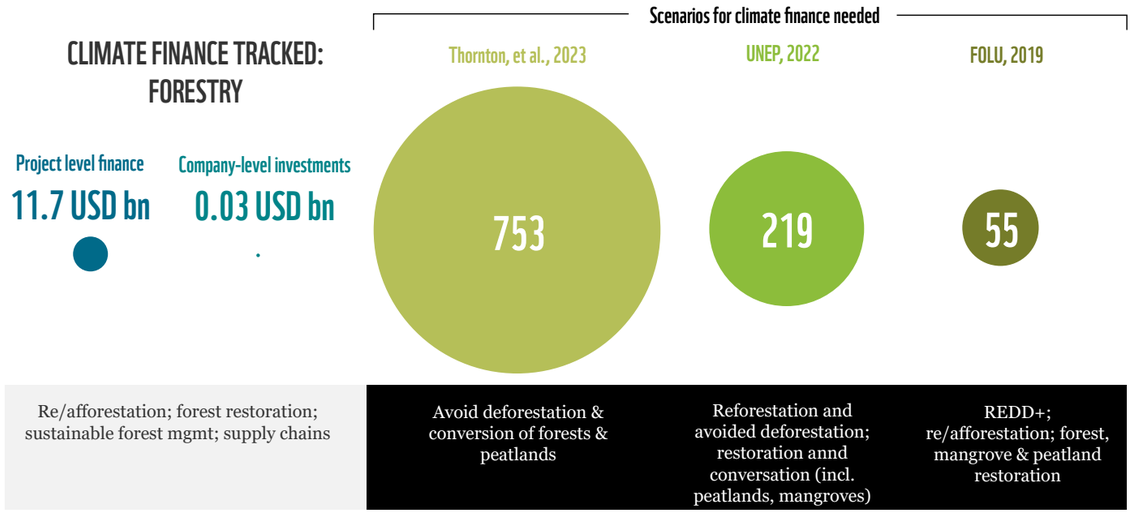
In addition to their environmental impact, harmful subsidies often lead to unfair and inequitable socioeconomic development. Given the social and economic impacts of a degraded environment, such as population displacement following a natural disaster, harmful incentives can have long-lasting effects on economic development (Oxfam, 2002; UNEP et al., 2021).

GREEN FINANCE FOR FORESTS

In contrast to harmful subsidies, green subsidies, which are intended to support positive environmental outcomes in agriculture and other sectors, account for only 5% of total agricultural input subsidies, or US$29 billion (Searchinger, 2020). These subsidies are primarily provided in high-income countries and to some extent in China (Altenburg et al., 2023).

Estimates indicate that annual financing to protect, restore and sustainably manage natural ecosystems and biodiversity needs to increase from US$166 billion to nearly US$1 trillion by 2030 (Cuming & Bromley, 2023). This includes a significant portion allocated to forest conservation, estimated at US$460 billion per year (Forest Declaration Assessment Partners, 2023). Figure 3 illustrates the example of climate finance, a sub-category of green finance, which currently covers only a fraction of the actual needs to avoid the conversion of forests and peatlands. This discrepancy is particularly evident in countries with high rates of forest loss, such as Brazil. The restructuring of agricultural subsidies is a lower-cost alternative that makes efficient use of scarce public resources, benefits the environment and national accounts, and aligns with global forest and biodiversity targets and goals. Public funds can also be repurposed to support green private finance (e.g. de-risking), which has the potential to channel additional resources toward priorities such as climate change, food systems transformation and land restoration.

Figure 3: Tracked climate finance for forestry compared with estimated annual needs



Source: Chiriac et al., 2023

2.3.3 How agricultural support causes deforestation

Government subsidies inadvertently incentivize producers to engage in practices that result in deforestation. These incentives can directly promote expansion of production, increasing the strain on available land resources and encouraging encroachment into ecologically significant areas. Subsidies that facilitate access to financial resources for crop and pasture establishment, cattle herd expansion and crop production and/or commercialization, tend to incentivize the clearing of land for agriculture or grazing, without consideration for the ecological consequences. Subsidies may also reward farmers for practices that exhaust the land in the long run and threaten the long-term health and vitality of farming communities (Ding et al., 2021). They can encourage unfair competition, and have an indirect impact by changing economic landscapes, which can distort market dynamics and reduce incentives for conservation-driven practices.

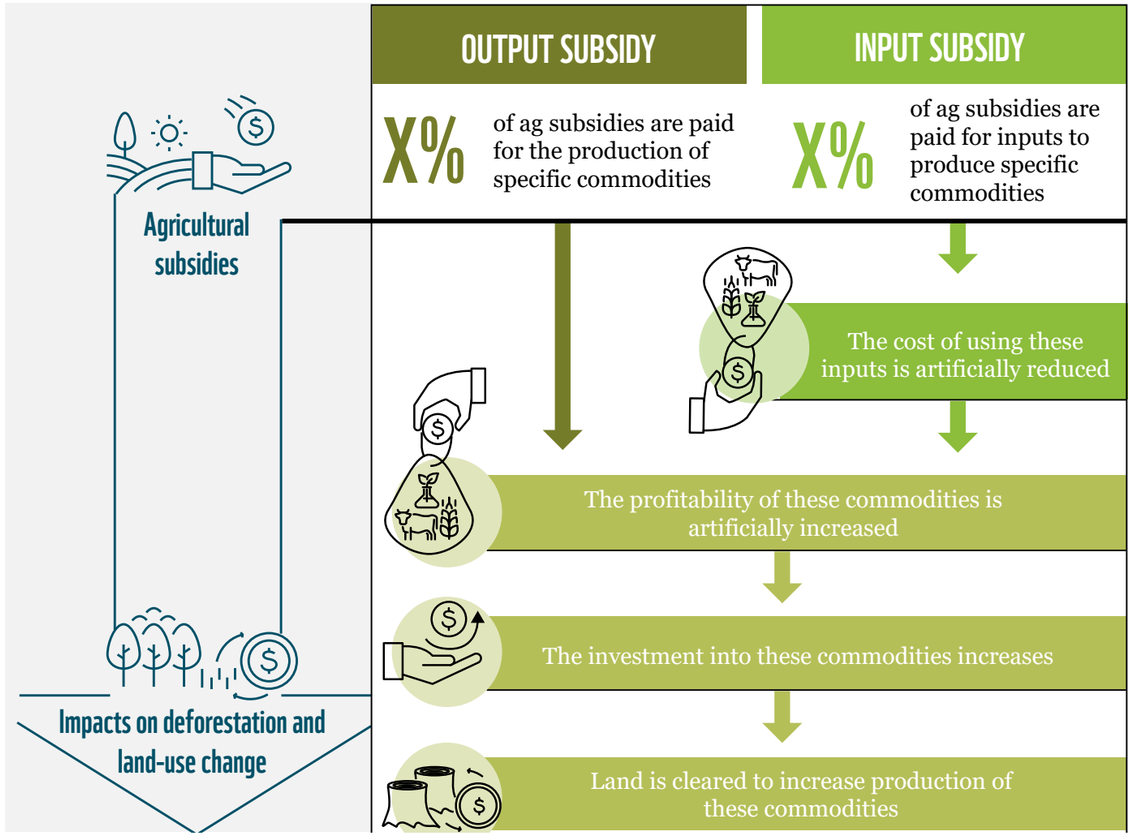
The complex interrelationships between agricultural support and deforestation become apparent when considered in a broader context, including elements such as land-use policies and regulations and policy distortions related to agricultural commodity markets. Within this complex network, agricultural support can have both direct and indirect impacts on deforestation, with immediate or delayed effects, making it difficult to track or predict their long-term effects. The type of subsidy also matters. The main negative impacts on forests come from coupled subsidies to producers – these are subsidies tied to using specific inputs or growing specific crops, or to the level of output, such as price support subsidies. Decoupled subsidies, which are independent of the level of output or farm size, have a negligible impact; examples include direct payments to producers, agricultural research and investments in infrastructure (Damania et al., 2023).

The complexity of the effects and transmission mechanisms of agricultural subsidies is also the result of the inherent difficulty in distinguishing the influence of more local (domestic) factors from global factors. Between 2000 and 2009, a third of global deforestation was embodied in agricultural exports, mainly to the EU and China. This is the result of the globalization of agrifood systems in which the beef, soy and palm oil industries are connected to high international demand and have been linked to crop extension in exporting countries, and subsequently to deforestation in critical forest regions (Damania et al., 2023; Gautam et al., 2022). However, this finding also implies that two-thirds of the observed deforestation is linked to national markets – confirmed by Pendrill et al. (2022) who estimate that 75-80% of deforestation and conversion is driven by domestic demand. This highlights the importance of national consumption in exporting countries when disentangling the link between subsidies and deforestation. An illustrative example of this is beef production in Brazil, which is mainly consumed in the domestic market (80%) while a limited share (20%) is exported (zu Ermgassen et al., 2020).

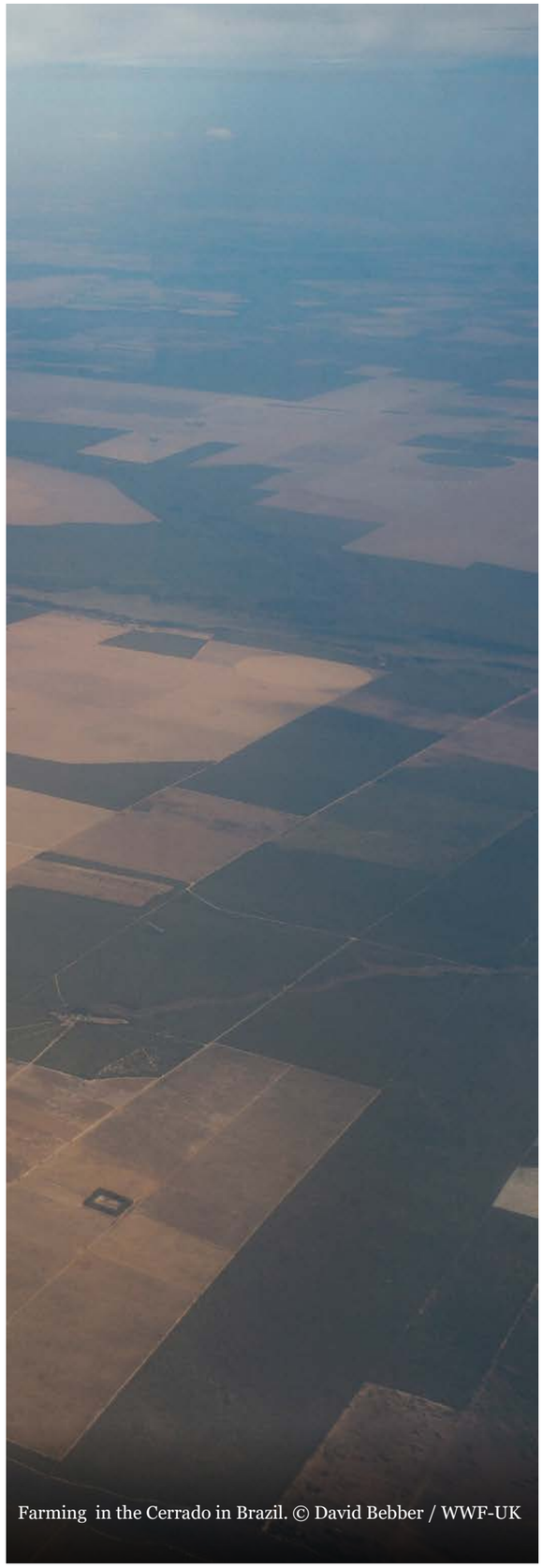
A recent World Bank study examines the causal link between positive agricultural market price support and deforestation. While focusing only on this specific measure, it estimates that such price distortions account for about 2.2 million hectares of forest loss annually, or 14% of annual deforestation (Damania et al., 2023).

Figure 4 below provides a simplified causal chain from agricultural subsidies to deforestation. The many external factors listed above can affect any of the logical steps (boxes) and interrelationships (arrows) in this diagram. This demonstrates the importance of developing complex models that can generate different scenarios of the impact of subsidies on deforestation, under changing conditions. For specific country examples, the case studies on Brazil and Malawi (sections 4.2 and 0) illustrate the complexity and diversity of causal chains between specific national subsidy programmes and deforestation in different political, legal, environmental and socioeconomic contexts.

Figure 4: Simplified representation of the causality between input and output subsidies and deforestation



Source: Authors´ illustration



Farming in the Cerrado in Brazil. © David Bebber / WWF-UK

3. REPURPOSING HARMFUL SUBSIDIES

Recognizing the need for urgent action to reform harmful agricultural subsidies, Target 18 of the Kunming-Montreal Global Biodiversity Framework sets clear requirements and steps toward the progressive "elimination, phasing out or reform of incentives, including subsidies, harmful for biodiversity, in a proportionate, just, fair, effective and equitable way, while substantially and progressively reducing them by at least $500 billion per year by 2030" (CBD, 2022). This target is currently the only international requirement for reporting on progress made by the parties to the CBD. Countries must report along two headline indicators on (18.1) positive incentives in place to promote biodiversity conservation and sustainable use, and (18.2) the value of subsidies and other incentives harmful to biodiversity that have been eliminated, phased out or reformed. Importantly, a complementary indicator looks at "trends in potentially environmentally harmful elements of government support to agriculture (producer support estimate)".

In addition, the G7 in 2022 committed to "redirect or eliminate incentives including subsidies harmful to biodiversity by 2030 at the latest". Subsidy reform offers a cost-effective strategy to achieve national and international environmental and climate goals and more resilient agricultural systems.

3.1 GENERAL APPROACH TO REPURPOSING

Removing harmful subsidies can reduce negative externalities, but more is needed to support the transition to sustainable agricultural systems, underpinned by behavioural and technological change (Damania et al., 2023). Redirecting subsidies from supporting environmentally detrimental activities to sustainable practices can drive shifts in behaviour, promote research and innovation, and empower smallholders. At the same time, any repurposing is likely to create both winners and losers, which underlines the need to manage trade-offs and seek compromises between those affected.

The effects – both positive and negative – of repurposing may only become apparent in the medium to long term. This underlines the political and financial investments – and risks – which policymakers have to accept when embarking on subsidy reform. Repurposing should anticipate the environmental, social, political and economic repercussions of change, and construct a pathway that takes these issues and time realities into account. Sustainable development, social fairness and inclusion, rural livelihoods and food security must be at the centre of any repurposing strategy (Damania et al., 2023; Ding et al., 2021).

From a social perspective, subsidy reform needs to be just, fair, and equitable. The Just Rural Transition (JRT) initiative has developed a set of 10 principles aiming at providing guidance and a framework to shift toward just rural food systems. This covers implications in terms of desired outcomes, planning and decision-making processes, systemic changes needed and tensions that must be managed (JRT, 2023).

BOX 3: 10 PRINCIPLES FOR A JUST RURAL TRANSITION

The 10 principles developed by the JRT serve as a roadmap for a just and equitable transition toward sustainable food systems.

PRINCIPLE 1: A just transition must move deliberately towards a global food system that works better for people, nature and the climate:

- meeting everyone's nutritional needs
- operating within planetary boundaries
- providing good livelihoods
- protecting the rights of people
- protecting animal welfare
- ensuring climate resilience
- avoiding and reversing environmental degradation
- avoiding and correcting power imbalances in food value chains and in rural areas.

PRINCIPLE 2: Structural changes in food systems must occur without delay, recognizing the urgency of the need for change.

PRINCIPLE 3: The planning and implementation of transitions must be socially inclusive, ensuring there are ongoing opportunities for wide stakeholder involvement in, and influence over, the transition process itself and ongoing socio-economic development planning.

PRINCIPLE 4: Food producers and their communities must be supported in bearing the costs of changing practices to align with a more ecologically sustainable food system, and in managing the wider socio-economic impacts of transition.

PRINCIPLE 5: Those who are unable to continue farming or working in food value chains should be supported to reskill and find new livelihood opportunities and have access to social safety nets.

PRINCIPLE 6: Consumers should be able to meet their nutritional needs during the transition, and not experience hunger or hardship due to increases in the cost of food.

PRINCIPLE 7: Historical environmental degradation associated with the food system should be remediated, with priority to reversing harm that continues to affect local people's health, livelihoods and/or ecosystems – applying the "polluter pays" principle.

PRINCIPLE 8: Priority for financial and other external support should be given to those regions, industries, workers and citizens who are most vulnerable and who face the greatest risks or challenges and have least capacity to fund transformation.

PRINCIPLE 9: On a global scale, in the near term, the burden of shifting to more sustainable, low-GHG food production and consumption should be borne mainly by those with the greatest resources and the most cumulative responsibility for environmental harm.

PRINCIPLE 10: Efforts to transform global food systems should address the root causes of social and economic inequality, food insecurity, environmental injustice, public health risks, and vulnerability.

Source: (JRT, 2023)

From an economic perspective, the private financial and social economic costs and benefits of reforming subsidies and repurposing options need to be fully considered. Tools such as FAO's Monitoring and Analysing of Food and Agricultural Policies (MAFAP) or BIOFIN's step-by-step guide (see Box 5 below) can help identify, analyse and monitor harmful subsidies, their current and true costs (including externalities) redesign options and socioeconomic and environmental trade-offs.

There are positive examples and studies on public incentive programmes that promote deforestation-free production and "forest-positive" land uses which can be drawn upon. In addition, there are examples of nature-positive subsidy reform in other sectors (Box 4), though such reforms have yet to materialize when it comes to forests (Box 5).

BOX 4: EXAMPLE OF NATURE-POSITIVE SUBSIDIES

In Guatemala, the government's PROBOSQUE programme incentivizes farmers and forest residents to provide essential ecosystem services. The programme provides US$2.45 per tree for reforestation and US$1.92 per tree grown under agroforestry systems on farmers' lands. The government also offers about US$900 for every hectare of forest preserved. This policy has made a significant impact, covering more than 3% of the nation's overall land area. Since 1997, over 135,000 hectares of land have been restored, 200,000 hectares placed under conservation and 4,000 hectares of natural forest sustainably managed by landholders. The programme's payment structure, offering consistent payments over a period of five to ten years, strategically incentivizes landholders to participate in long-term tree planting and maintenance (Zamora-Cristales et al., 2022).

The National Development Planning Agency and Ministry of Finance in Indonesia collaboratively devised a plan to reduce pesticide subsidies by nearly 50% within one year, with the ultimate goal of complete elimination within three years. This initiative aligns with a broader objective of promoting integrated pest management (IPM) practices. In the initial years of implementation, the IPM programme successfully reached hundreds of thousands of farmers, attaining its goals of pest reduction and concurrently offering essential extension services and technical support. These supportive measures played a pivotal role in facilitating the transition of farmers away from reliance on pesticides, marking a shift toward sustainable and environmentally friendly agricultural practices.

In Austria, subsidies promoting wetland drainage for agriculture were removed, and compensation for restrictions on land use and incentives for sustainable land use practices in a newly created national park were combined. This shows an example of subsidy reforms reconciling competing land uses and interests (Hubacek & Bauer, 1999).

In the fishing industry, countries including New Zealand, Canada and Norway have eliminated unsustainable fishing subsidies. These were replaced by individual support for those staying in the business and buying out those who wanted to leave (Kissinger, 2015).

Trade-offs exist between the potential impacts of different reform options. An analysis of various options for reforming agricultural subsidies shows that removing harmful agricultural subsidies could have economic and environmental benefits, but negative impacts on public health. Other scenarios which increase subsidies for the production of healthy and environmentally friendly food bring economic trade-offs (Springmann & Freund, 2022).

Any repurposing attempt should balance the pros and cons, depending on the country's socioeconomic and environmental context. A number of challenges also need to be addressed to create an enabling environment for reform and to reduce the risk of reform failure. These may include changes in the legal framework, institutional development, the introduction of new financial mechanisms and capacity development, among others. More information on these challenges and on the measures that need to be taken to create an enabling environment is provided in Section 3.4.

BOX 5: THE BIOFIN INITIATIVE AND HOW IT COMPLEMENTS THIS REPORT

The BIOFIN initiative was launched by UNDP and the European Commission and now operates under the UNDP global programme. It aims to help governments redirect financial resources, including subsidies, toward environmental goals. In 2024, BIOFIN published guidelines entitled *The Nature of Subsidies*, offering a step-by-step approach to redirecting subsidies that harm biodiversity and improving their impact on people and nature. These guidelines provide a framework for identifying, analysing and redirecting subsidies to enhance their positive impacts on biodiversity conservation and sustainable development.

While the BIOFIN guidelines touch on forests as a critical habitat for biodiversity, the framework in the current report places greater emphasis on analysing and redirecting subsidies that are specifically harmful to forests. Our framework is closely aligned with the BIOFIN guidance. The two frameworks complement each other, and policymakers and organizations engaged in redirecting harmful subsidies can use elements and tools from both to achieve more effective outcomes.

Source: The Biodiversity Finance Initiative (BIOFIN.org)

3.2 FRAMEWORK FOR IDENTIFYING AND REPURPOSING SUBSIDIES THAT HARM FORESTS

Given the complexities, challenges and risks associated with subsidy reform, repurposing needs to follow a sequential approach of identifying harmful subsidies; identifying enabling conditions for repurposing, including barriers, feasibility and scalability; and assessing potential social, environmental and economic impacts. Table 1 below provides a framework to help policymakers navigate this complex process. This table is an abridged version of the full framework, which can be found in annex A 3.

This framework follows the main objectives and assumptions of Target 18 and the principles of fairness and equity for a just food system transition (JRT, 2023). It is structured around simple guiding questions, illustrated by country experiences, and is deliberately broad to allow for adaptation in different contexts. It is a practical tool to drive the process of identifying subsidies that harm forests and designing options for repurposing them. To provide additional concrete examples, the framework has been used in the two country case studies for Brazil (section 4.2) and Malawi (section 4.3).

Table 1: Framework for identifying and repurposing subsidies that harm forests

TOPIC	SELECTED GUIDING QUESTIONS	ILLUSTRATIVE EXAMPLES
Identification of harmful subsidies		
What are the subsidies which could be repurposed?		
Existing subsidies	What kinds of support/subsidy exist in the agricultural sector? Who finances the subsidies (national government, sub-national or supranational authorities etc.)?	Malawi has a large input subsidy programme that consumes about 60% of the country's agricultural budget.
Effectiveness and efficiency of subsidies	What is the intended purpose of the subsidy programme? Does it achieve its targets and goals? What are the unintended adverse effects of the subsidy programme or subsidy? Do they outweigh the benefits?	A meta-analysis of multiple input subsidy programmes in eight African countries and one Asian country shows that input subsidies for fertilizer and improved seeds achieve an 18% increase in yield and a 16% increase in farming households' income (Nguyen et al., 2023). Simplified calculations for cost-effectiveness also had positive results. However, there is uncertainty about the long-term effects and opportunity costs of the subsidies, such as crowding out other public spending imperatives, and the social and inequality impacts were beyond the scope of the study.
Associations between subsidy and deforestation/ land-use change	To what extent does the subsidy programme contribute to deforestation and land-use change? What is the evidence to quantify this contribution? Is it a direct or an indirect contribution?	In the Amazon (Brazil), the majority of subsidized credits provided to farmers is allocated to municipalities facing a high deforestation rate.
Prioritization of subsidies according to level of harm	Which subsidies are identified as harmful? Is there a subsidy that needs to be tackled first because its impact is greatest? Which of the identified harmful subsidies is likely to meet the highest level of acceptance for repurposing, and under what conditions?	The most significant harmful impacts on forests result from coupled subsidies to producers, while decoupled subsidies have an insignificant effect (Damania et al., 2023).
Conditions and barriers for repurposing harmful subsidies		
What legal, political, economic, financial and technical conditions must be in place for repurposing to be successful? What are the barriers that prevent beneficiaries from adjusting their behaviour? How scalable are the options for repurposing harmful subsidies?		
Political and institutional motivation and feasibility	Is there an expressed political will for repurposing? Has the country committed toward repurposing in existing national development strategies, NDCs, NBSAPs or others? Are there cross-ministerial coordination mechanisms in place, e.g., with the Ministry of Finance? Are there debates at parliament level?	The UK government committed to review national subsidies and to redirect or eliminate all subsidies and incentives harmful to biodiversity, and for nature-positive incentives to be scaled up as soon as possible (UK Government, 2023).

Acceptance	What is the perception of fairness by beneficiaries on the repurposing option and the transition process? Are there vested interests, large groups or unions that may lobby against repurposing? Should compensation be provided to avoid strong opposition from these groups?	The agriculture lobbyist Copa-Cogeca and major players in the pesticides and food industries actively lobbied against the EU's Farm to Fork Strategy and Biodiversity Strategy, to limit the repurposing of public subsidies away from a destructive agricultural model (Corporate Europe Observatory, 2020).
Financial feasibility	Have the repurposing upfront costs and the complementary costs been assessed? Should these costs be borne from the reallocation of a share of the repurposed subsidy, or from external (additional) resources?	Prior to conducting fuel price subsidy reform in 2005, the Ghanaian government commissioned an independent poverty and social impact analysis to assess the costs as well as the winners and losers from subsidy removal. This enabled the efficient and visible repurposing of the funds toward more effective poverty alleviation measures, such as direct cash transfers (Alleyne & Hussein, 2013).
Technical/ knowledge feasibility	Are there sufficient knowledge and capacities in government institutions and among land users to shift from the previous subsidy system to the new one? Is data available to ensure an adequate selection of beneficiaries and a solid monitoring system to track the impact of the reform?	In Brazil, data on forest cover change and subsidized credit allocation on the municipal level make it possible to track the effect of subsidy policies on deforestation.
Scalability	What is the scalability/applicability of the new option to a large area and a large number of smallholder farmers?	Shifting subsidies from mineral to organic fertilizers is scalable only if the agricultural production systems and organic fertilizer usage are properly organized, programmed and implemented with a focus on scale (Epule et al., 2015).
What are the expected impacts of repurposing?		
Social impacts	What are the expected social impacts of the repurposing option, including equity, gender, employment, nutrition, health, poverty and interests of Indigenous people? Are there safeguards/mechanisms in place to ensure that vulnerable groups do indeed benefit from repurposing or are not negatively affected?	Support to agriculture is often inequitably distributed in favour of larger farms, particularly in high-income countries, because agricultural support is generally tied to production, or factors of production like land (UNEP et al., 2021).
Impacts on the environment	Is repurposing expected to promote production that is deforestation- and conversion-free and respects human rights (including in a third-party country for importing countries)? To what extent is repurposing expected to expand sustainable agricultural practices that restore land?	In Brazil, the government linked access to affordable agricultural loans to farms and municipalities that demonstrated efforts to curb deforestation and conversion (Searchinger, 2020).
Economic impacts	To what extent is the repurposing option expected to be less distortive than the previous subsidy system? And more cost-effective? What is the expected impact on employment and income for different population groups (e.g. middle class, disadvantaged communities)?	In Burkina Faso, forest cover has reduced by 50% since 2000, driven by growing demands for agricultural land and cattle pasture. In 2010, the government launched a US$30 million forest investment programme to incentivize individuals to cultivate trees on their farms, restoring the land and reducing food insecurity by 35-60% (Ding et al., 2021).

3.3 CATEGORIES OF REPURPOSING OPTIONS

Appropriate repurposing options may vary considerably from country to country, and also by region – one-size-fits-all solutions do not exist. By using the framework presented in the previous section, countries can identify and design repurposing pathways that are suited to their specific context and reform objectives, while being in line with Target 18 and the principles for a just rural transition. Examples of repurposing options can be drawn from the experience of countries that have engaged in a repurposing process and research findings. Table 2 below presents options that policymakers may consider, in line with Target 18 and its headline indicators, but also with other GBF targets such as Target 2 for restoration, Target 10 for sustainable agriculture and forestry, and Target 8 for nature-based solutions, depending on their objectives.

Table 2: Examples of positive incentives to guide subsidy reform

EXAMPLE	EXPLANATION
Objective: Strengthening nature-positive agricultural production	
Direct payment for the provision of ecosystem services (PES) through the introduction of regenerative agriculture and agroecological practices	Reallocating harmful subsidies to bolster funding for the provision of ecosystem services can scale up regenerative agriculture and agroecological practices. These include crop-livestock-forestry systems, agroforestry systems, and allowing natural regeneration.
Direct payment for the provision of ecosystem services through compensation for opportunity costs from the reduction of deforestation and degradation	PES can support conversion-free land-use practices by compensating for the financial loss farmers incur from keeping forests and natural ecosystems intact. These payments can also be linked to poverty alleviation for disadvantaged communities at the forest frontier.
Objective: Restoring degraded land for food production	
Direct payments for undertaking restorative farming practices on degraded lands for food production	Supporting agricultural practices that enhance soil fertility can help restore degraded land and make it suitable for food production. This decreases the need to convert forests and other natural ecosystems for new agricultural land.
Support for crop-livestock-forestry systems	These systems have proven to be an effective way to restore degraded pasture and diversify production. Subsidies taking the form of direct payments must be decoupled from production. Material support and guidance (extension services) are other possible forms of support.
Support for land restoration interventions (e.g., agroforestry, natural regeneration)	Restorative or regenerative practices can improve soil health, leading to better productivity and reduced need to open new lands, while providing many other co-benefits. Subsidies taking the form of direct payments must be decoupled from production. Material support and guidance (extension services) are other possible forms of support.
Objective: Promoting deforestation- and conversion-free agriculture	
Insurance and credit support based on environmental criteria	Stringent environmental criteria for allocating credit, combined with efficient monitoring systems, can steer conventional agriculture away from ecosystem degradation and promote sustainable and regenerative agricultural practices (e.g., soil conservation measures, trees on farms etc.).
Support to introduce traceability systems at farm level	Controlling production across supply chains is key to build and sustain deforestation- and conversion-free agriculture. Extension services and capacity building can support small producers to participate in traceability systems and ensure they are not left out of deforestation- and conversion-free supply chains. Support for traceability systems should align with the EU Deforestation Regulation.

Source: Damania et al., 2023; De Weerdt & Duchoslav, 2022; Ding, Markandya et al., 2021; Gautam et al., 2022; Pinto et al., 2023; interviews with key respondents

3.4 COMPLEMENTARY MEASURES

As outlined in the repurposing framework above, enabling conditions are key to the success of subsidy reforms. Important aspects to consider include an appropriate legal framework to channel the reformed subsidies, smooth inter-ministerial coordination, adequate data to select beneficiaries and monitor impact, technical knowledge among beneficiaries and a well-established extension service, and social systems to ensure equity between beneficiary and non-beneficiary groups. Neglecting any of these may result in a repurposing strategy not achieving its objectives, creating various unintended negative environmental or social externalities and distorting competition.

An important step is therefore to investigate whether all enabling conditions are already in place. If this is not the case, key bottlenecks should be identified and addressed through complementary measures. These measures can be financed either from the repurposed funds, or by using extra government funding or leveraging private investment (e.g., in research).

The broad categories of complementary measures arising from the framework can be defined as follow:

Institutional development: Weak collaboration between environmental agencies and other government bodies can be detrimental to the repurposing of subsidies due to the cross-cutting nature of environmental issues. The administrative capacity of these institutions and knowledge of the staff may constrain any reform. Functioning institutions are a precondition for a successful repurposing process. This may require specific resources to strengthen capacities at individual and organizational level in the institutions concerned.

Land regulations and law enforcement: Poor governance and lack of enforcement of environmental regulations (e.g. inadequate forest management plans, ineffective penalties for illegal logging) are a reality in numerous middle- and low-income countries. This can create an environment where illegal forest clearing and illegal logging are low-risk, low-cost activities, leading to more deforestation and forest degradation. Corruption is another limiting factor. Illegal logging is frequently accompanied by bribery and other corrupt practices, which can undermine efforts to enforce environmental regulations and prevent the destruction of forests and other ecosystems. Suitable safeguards and enforcement mechanisms may be required before any repurposing process starts.

Recognized Indigenous and community forest rights are strongly associated with lower rates of deforestation and higher levels of carbon storage (Baragwanath et al., 2023). Similarly, well-defined and enforced land tenure systems and associated titles may lead to higher incomes and increased productivity and therefore can play a significant role in combating deforestation (Bisiaux, 2022).

Planting native trees in the forest, Viet Nam.
© WWF-US / Justin Mott

Regulatory framework: Subsidies are diverse and require an appropriate regulatory framework. In contexts where sub-national jurisdictions are responsible for delivering the subsidy to beneficiaries, there must be clear mechanisms for transferring funds from the central budget to the local administration. Legal mechanisms must also be in place for the local administration to disburse and control the funds.

There are also situations where the subsidy is channelled from a national fund to many individual landowners. For example, mechanisms such as PES to compensate land users for the financial losses incurred by a reduction of tree harvesting require a comprehensive regulatory environment to become operational. This encompasses the selection of beneficiaries, disbursement procedures and various monitoring and reporting mechanisms. As presented in the Brazilian case in section 4.2, establishing a PES can require years of legislative development and important associated costs.

Research on deforestation- and conversion-free agriculture: Support provided to research programmes and companies to catalyse innovation can improve the productivity and competitiveness of conversion-free agriculture and reduce the need for opening new land. Examples of research include improving crop varieties, introducing new technologies to improve competitiveness, and experimenting with specific conservation agriculture or agroforestry practices. Not only can research help restore degraded agricultural land and release some pressure on intact forests, but it can also strengthen the resilience of farming systems to climate change (Ding, Markandya et al., 2021).

Education, training and capacity building: Conversion-free agriculture, agroforestry and other regenerative agriculture practices are not always known to farmers, in particular when they require a drastic shift from traditional farming practices. Knowledge gaps may prevent these practices from achieving their full potential. Training and information programmes are key to enabling farmers to implement conversion-free land-use practices, to take full advantage of input subsidies and increase productivity. Agricultural extension services in rural areas can play a key role in disseminating and consolidating knowledge. They are often provided in packages with other types of incentives (e.g., direct payments, preferential credits). These services need enough field officers with suitable qualifications and sufficient technical capacities (vehicle, equipment etc.). Technical, vocation and academic education should also support the transition to sustainable land-use practices.

Social policies: Subsidy reform needs to be accompanied by appropriate social policies. These include ensuring better access to social programmes for smallholders, preventing human rights violations and livelihood displacement, and providing social safety nets to the most vulnerable communities. Beyond supporting the successful implementation of the subsidy, social policies also provide long-term development impacts.

Improvement of data and monitoring systems: Public investments in data collection and monitoring systems are important in various ways. Firstly, data is needed to demonstrate and quantify the negative impact of a particular subsidy on the environment. This is key to justifying the process of repurposing. Secondly, data at the household or farm level, sufficiently disaggregated to provide information on disadvantaged groups, Indigenous and local communities and other aspects, is needed to properly identify beneficiaries and ensure the subsidy reaches those who need it most. Finally, a robust monitoring system should be in place to inform conditional funding for conservation and conversion-free agriculture, to measure progress and to enable peer learning. This should include data on land and land-use change, biodiversity or any other important aspect targeted by the subsidy, in order to monitor impacts and adapt over time. Suitable tools should be developed to enable low-cost and scalable, yet accurate, data collection. For this, new tools are emerging that combine remote sensing with self-reported data from farmers and general population data.

Functioning markets: Legislation, business rules, tariffs and taxes, and market distortions can impair the competitiveness of conversion-free agriculture. In contexts where the previous subsidy system has created a monopoly or oligopoly situation, market prices might be distorted (e.g., low payments to producers or, conversely, high input prices). An example of this is an input subsidy programme where inputs are provided by the government or by a few monopolistic actors who crowd out other potential input providers. In this case, moving to a less monopolistic system requires building a network of private companies: transporters, retailers, etc. This process can take time. A careful analysis of bottlenecks preventing a functioning market and the introduction of measures to counteract them may be required to support the repurposing strategy.

Corn from a sustainable farm, Cerrado. © Ana Paula Rabelo / WWF-UK

A dam made by a soy company. Cerrado, Brazil.. © Peter Caton / WWF-UK

4. CASE STUDIES

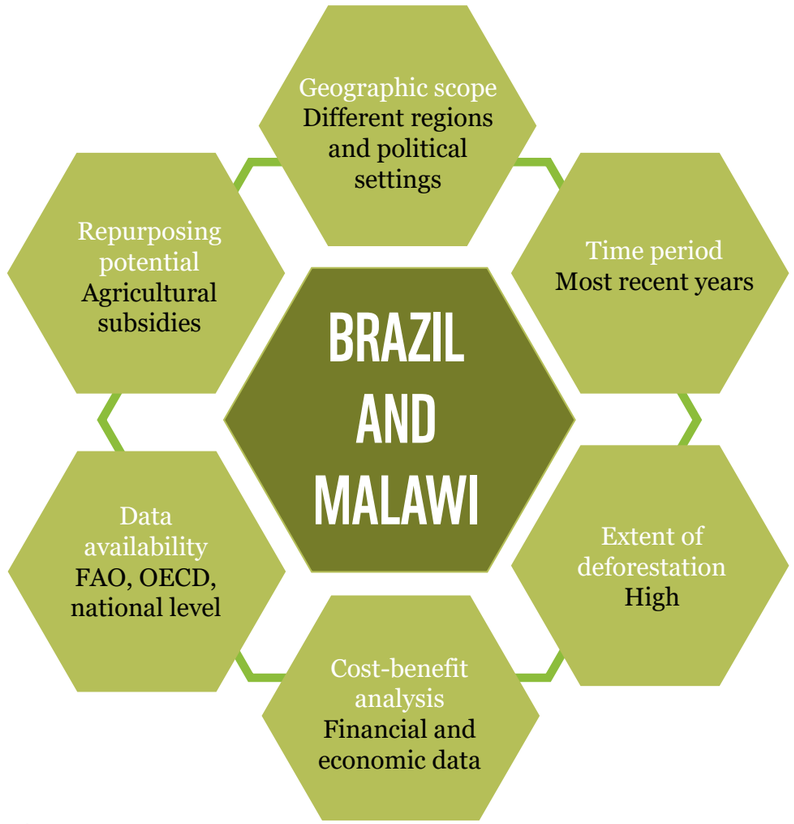
4.1 SELECTION OF COUNTRY CASE STUDIES

The relationship between public support for the agricultural sector, changes and innovation in agricultural systems, and tropical deforestation is a complex and multifaceted topic that varies greatly depending on the country and regional context. Different countries and regions have different agricultural practices, policies and socioeconomic conditions that can influence the impact of public support on deforestation. Factors such as land tenure systems, governance structures, market dynamics and cultural norms also contribute to the complexity of this relationship. Understanding the specific context of each country or region is essential when analysing the links between public support for agriculture, agricultural systems and tropical deforestation. To illustrate this, Malawi and Brazil have been selected as case studies based on the criteria shown in Figure 5 below.

Brazil plays a major role in global commodity production and is one of the world's largest producers and exporters of soybeans and beef. The country has faced significant deforestation in the Amazon rainforest and conversion of savannah in the Cerrado, driven by various factors, including agricultural expansion, logging and infrastructure development. Different government administrations have implemented various agricultural policies and subsidies over the years, including measures aimed at promoting and supporting agricultural expansion. These policies have implications for land-use change and deforestation rates.

In Malawi, maize is considered to be the most important crop for food security. Almost every farmer in the country allocates land and resources to its production. In 2013, maize accounted for as much as 80% of the cultivated land (USAID, 2013). Fluctuating trends in Malawi's GDP have been observed to partly follow those of maize production. Deforestation and forest degradation in the country has been driven by the expansion of small-scale agriculture, charcoal production and unsustainable logging practices. Malawi has implemented different types of agricultural support programmes and subsidies to address food security and rural development challenges. Most of this support has been directed to input subsidies, which represent a significant share of the total budget of the Ministry of Agriculture.

Figure 5: Criteria for selection of country case studies



Source: Author's illustration

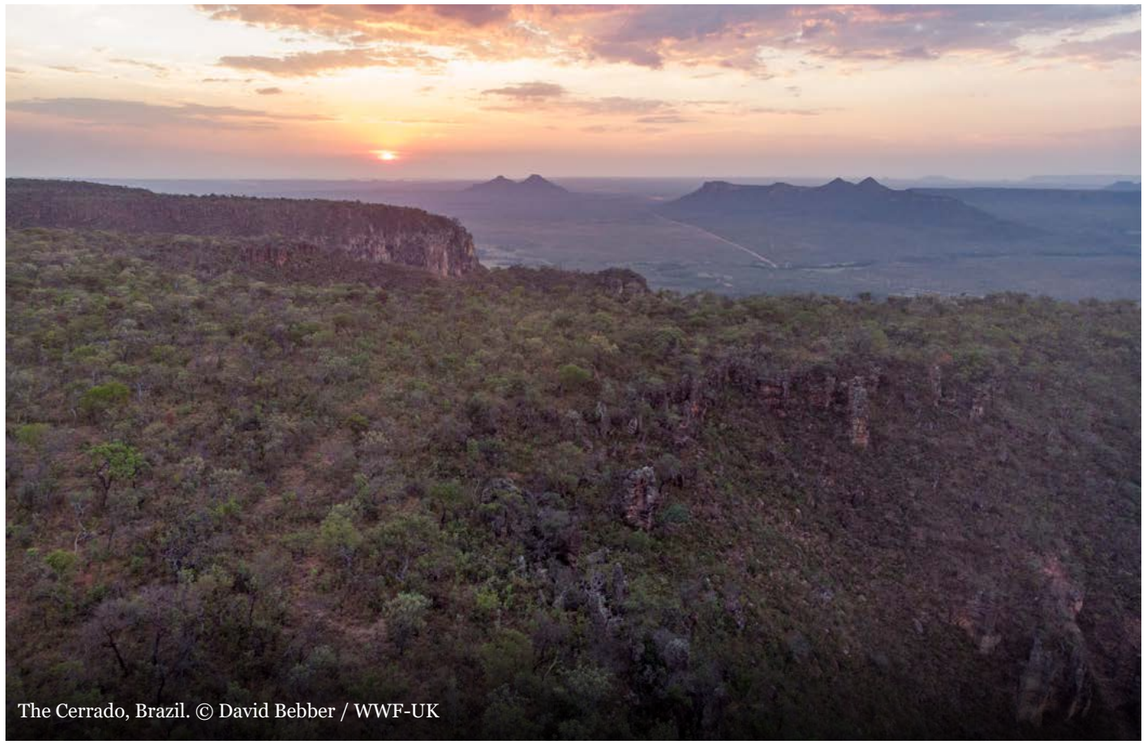
The agricultural policy landscapes in both countries present interesting contrasts. Understanding the effectiveness and potential unintended consequences of these policies is crucial for designing sustainable approaches that balance agricultural productivity and forest conservation. In addition, both countries have experienced substantial rates of deforestation, albeit with different drivers.

The cases of Malawi and Brazil illustrate the interconnections between agricultural subsidies, deforestation and conversion, and sustainable land-use practices, and outline options for repurposing subsidies. The proposed repurposing options should be regarded as examples of how the repurposing framework can be used in the respective country context, based on expert opinion and on high-level policy documents. A full-scale repurposing process in either country would require a comprehensive multistakeholder negotiation process, supported by in-depth socioeconomic and environmental analyses.

Soy harvested from an RTRS-certified farm, Cerrado. © Ana Paula Rabelo / WWF-UK

4.2 BRAZIL

- Deforestation and land conversion persist in the Amazon and Cerrado, with direct and indirect interactions between agricultural and pasture expansion.
- There are different sources of direct public support from the state to the agricultural sector, but subsidized rural credit is the main source of support to commercial farmers.
- While still significant, the share of public funding has declined in recent years and commercial loans have gained importance, notably in the Cerrado and for large-scale farmers.
- Public subsidized rural credit's contribution to deforestation and conversion is hard to isolate in a context in which commercial funding for agriculture dominates.
- Public funding could be used more strategically by targeting smallholders and medium-scale farmers who cannot access commercial loans for subsidized credit that supports sustainable agricultural practices.
- Alternatively, more fundamental repurposing of the public subsidized credit flows could result in more effective allocations of public money for achieving sustainability targets in the Brazilian Amazon and Cerrado.
- The proposed repurposing options include restoring degraded pasture through livestock-forest integration; expanding low-carbon agriculture; scaling agroforestry systems; strengthening bioeconomy value chains; financing land and forest restoration measures; providing direct compensation to farmers for ecosystem services; introducing de-risking instruments to enhance flow of financial resources; and improving risk coverage in agricultural insurance.


The Cerrado, Brazil. © David Bebber / WWF-UK

4.2.1 The context

Brazil spans an area of approximately 8.5 million square kilometres, encompassing critical biodiversity-rich natural ecosystems. Natural forest covers 58% of the country's total area. The country is home to the largest and most biodiverse tropical forests on the planet in the Amazon and other biodiversity-rich natural ecosystems such as the Cerrado, a mix of forest and savannah formations. The Amazon and the Cerrado are home to many plant and animal species, hold significant carbon stocks above and below ground, and play a critical role in regulating local and regional water cycles, climate and the global carbon cycle (Boulton et al., 2022; Rodrigues et al., 2022). The services that both ecosystems provide are vital for sustaining regional agriculture.

The conversion of forests in the Amazon and forests and savannahs in the Cerrado leads to cascading effects on climate and biodiversity loss (Wunderling et al., 2022). There is growing evidence of the impacts of forest loss on climate and hydrological cycles leading to more pronounced droughts and longer dry seasons that make forests more vulnerable to fires (Brando et al., 2020). The persistence of fires may also prevent regrowth across 56-82% of the potential natural forest area, contingent on atmospheric carbon dioxide levels (Drüke et al., 2023). Cerrado conversion also threatens regional climate and water availability for agriculture by reducing evapotranspiration, increasing land surface temperature and reducing precipitation (Rodrigues et al., 2022). Deforestation leading to decreasing rainfall may lower agricultural productivity (Leite-Filho et al., 2021).

These natural biomes face persistent pressure, though this oscillates over time. In the Amazon, from a peak in 2004, deforestation followed a declining trend until 2012, when it kept expanding until 2022, then decreased again in 2023. The conversion dynamics in the Amazon have implications for the Cerrado since the decline of forest loss in the Amazon tends to displace the pressure into the Cerrado biome (Levy et al., 2023), which has lost around 50% of its original vegetation (Klink & Machado, 2005). In the Cerrado, conversion of natural vegetation peaked in 2004 then began to slow until 2019, with another smaller peak in 2013; it has grown again since 2020 (Terrabrasilis, 2023). Forest degradation in the Amazon also contributes to, and is increased by, deforestation due to growing fragmentation and forest edge effects (Lapola et al., 2023). Long-term degraded forest areas exceed deforested areas in the Amazon (Assis et al., 2022). Concurrently, carbon losses from degradation constitute a significant and growing source of emissions (Qin et al., 2021).

The deforestation slowdown from 2004 to 2012 resulted from environmental law enforcement, the designation of a mosaic of conservation areas, improved monitoring, and commodity price declines (Assunção & Gandour, 2012). One historic landmark was the Action Plan for Prevention and Control of Deforestation in the Legal Amazon (PPCDAm) initiated in 2004. The PPCDAm aims to reduce illegal forest cutting through environmental control, monitoring, land-use planning and sustainable production. This included limiting credit-promoting interventions in the livestock and soy value chains (Reydon et al., 2023). Another critical measure was the Soy Moratorium, which avoided deforestation in the Amazon but was offset by increases in conversion outside (Villoria et al., 2022). The Amazon Fund, established in 2008, has provided financial support to promote sustainable development and

reduce deforestation in the Amazon (Ministry of Foreign Affairs, 2021)

After a period of relaxing environmental control under Bolsonaro (Duarte et al., 2023), there are growing investments in law enforcement under the new Lula administration. These have had a short-term effect in reducing deforestation in the Amazon, yet conversion of grasslands in the Cerrado continues to grow (Brown, 2023). There are also some more structural policy issues to address. The Forest Code, for example, requires landholders to set aside a certain percentage of forest cover on their properties. However, this is rarely monitored in the Cerrado biome, and monitoring in the Amazon has been erratic (Chiavari & Lopes, 2023). Landowners in the Cerrado have greater legal discretion on where to set aside natural reserves, often resulting in higher conversion rates (Bonanomi et al., 2019).

Public subsidies for agriculture, specifically preferential loans and tax exemptions, are a key policy instrument in the Brazil. Corcioli et al. (2022) found that 75% of subsidized operating credit is allocated to soy, cattle and corn farmers. While subsidized credit supports working and investment capital for agriculture and beef cattle production, it also places pressure on agricultural frontiers to the detriment of natural vegetation. According to our estimates, drawing on data from the System of Rural Credit Operations (SICOR), in the 10 years from July 2013 to June 2023, 72% and 42% of the total subsidized rural credit was allocated to municipalities with higher conversion of natural vegetation – forests and savannahs – in the Amazon and Cerrado biomes, respectively. However, while subsidized rural credit has oscillated between R$50 billion and R$60 billion per year, its relative share of total rural credit has declined over time, from 56% in 2013/14 to 29% in 2022/23.

This suggests that the role of subsidized public credit cannot be seen in isolation from the total finance for agriculture and cattle production driving deforestation and conversion in the Amazon and Cerrado. There is a need to better understand the interactions between subsidized rural credit and commercial credit and whether public money paves the way for a growing penetration of commercial credit into financially riskier agricultural frontiers. In addition, rural credit must be placed into the context of other factors triggering deforestation and land conversion.

4.2.2 Evidence of deforestation and conversion

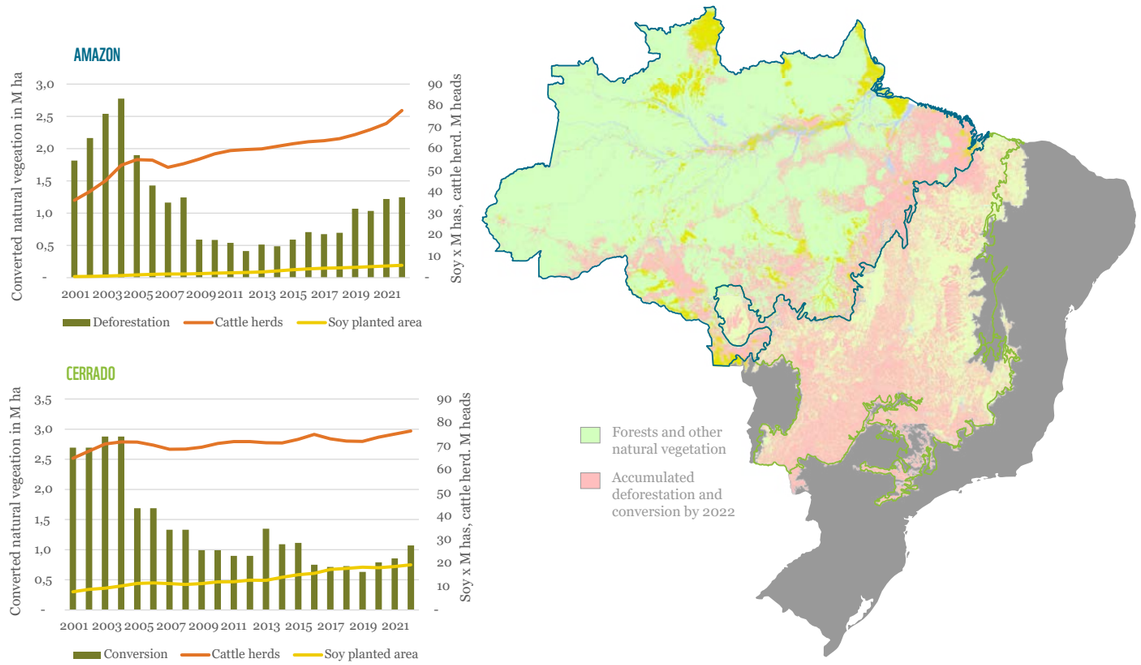
Historically, pasture has been the main driver of conversion in the Amazon, and pasture and agriculture – mainly soy – in the Cerrado. Brazil is the world's leading producer and exporter of soybeans, mainly concentrated in the Cerrado. It also holds one of the largest cattle populations, with a large growth in the Amazon and Cerrado, mainly targeting an expanding domestic market though also trying to expand its share in the global beef market.

MAIN TRENDS OF DEFORESTATION AND CONVERSION

In the Amazon, from 1985 to 2022, about 45 million hectares (79% of total deforestation) were converted to pasture and 10 million hectares (19%) to crops. In the Cerrado biome, during the same period, soy area expanded by 18 million hectares, out of which 1 million hectares (5.5%) was established in forests, 5.8 million hectares (32%) in savannahs, 3.7 million hectares (20.5%) in pastures, and 1.5 million hectares (8.3%) in *campestre* formations[38] (Mapbiomas, 2023). Most cleared forests end up as pasture in the Amazon, with only 2.1% of total deforestation attributed to soy, mainly because of the Soy Moratorium (ABIOVE, 2023). However, soy expansion on pasture lands may indirectly contribute to deforestation by pushing cattle production into newly cleared areas of forest (Arima et al., 2011). This is also the case in the Cerrado, where more than half of the soy expansion between 2001 and 2014 was on pastureland (Carneiro Filho & Costa, 2016).

According to PRODES estimates that focus only on deforestation, the deforestation rates have oscillated over time but have not surpassed the deforestation levels observed prior to the implementation of the PPCDAm in 2004. Policies and regulations led to a significant 84% decrease in deforestation rates in the Brazilian Amazon between 2004 and 2012 (from 2.7 million to 450,000 hectares); the trend reversed between 2012 and 2022, with deforestation rates more than doubling again, reaching 1.25 million hectares in 2022. This increasing trend was reversed during 2023. Deforestation rates fell by 42.5% from January to July 2023 compared to the same months in 2002 (Terrabrasilis, 2023). The decline from 2004 to 2012 was associated with law enforcement, enhanced monitoring and slow market demand for commodities produced in the Amazon (Assunção & Gandour, 2012). The reduction of fiscal incentives for producers operating in heavily deforested areas may have also played a role since the government denied agricultural credit access from producers located in municipalities blacklisted due to their elevated deforestation rates (Duchelle et al., 2014). The increase in deforestation from 2012 until 2022 is attributed to a lack of enforcement of laws and regulations that have encouraged deforestation, land grabbing and mining expansion (Human Rights Watch, 2020). From 2019, the Bolsonaro administration aggravated this trend by introducing various pro-agribusiness policies and rolling back environmental protections. These policies included cuts to funding for forest control, loosening environmental licensing, and a failed attempt to transfer Indigenous land demarcation under the Ministry of Agriculture, among others (Pereira, 2020).

Figure 6: Accumulated deforestation and conversion by 2022, and annual deforestation, soy planted areas and cattle herds in the Brazilian Amazon and Cerrado from 2001 to 2022



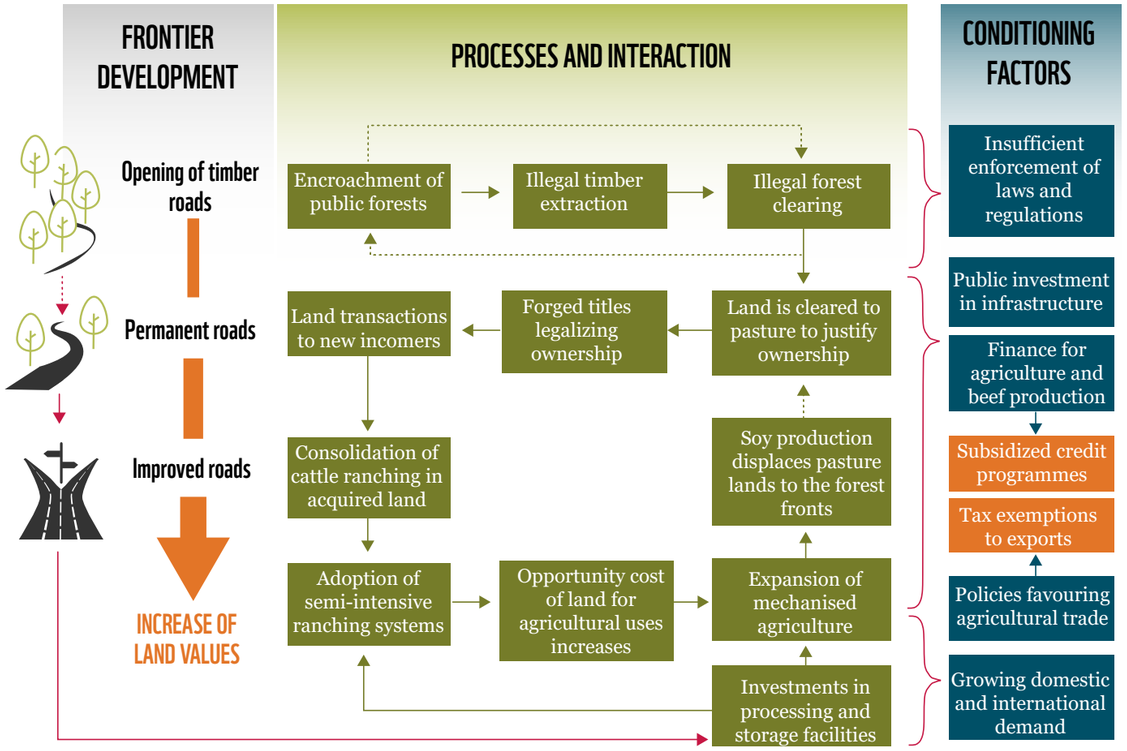
Source: authors' elaboration. Deforestation data from PRODES/Terrabrasilis (INPE), cattle herd data from livestock municipal reports from IBGE, and soybean land-use data from MapBiomas. Cattle herd and soybean data estimated at the municipal level considering municipality predominant biome from Embrapa. The map shows the spatial accumulated deforestation and conversion by 2022 in the Amazon and Cerrado biomes according to MapbBomas.

Deforestation in the Cerrado, as estimated by PRODES, shows a similar slowdown from a peak in 2004 (2.8 million hectares) to a lower rate in 2012 (900,000 hectares), which, after an increase between 2013 and 2016, was even lower in 2019 (630,000 hectares). Since 2020, deforestation in the Cerrado has increased again, reaching 1.07 million hectares in 2022 (Terrabrasilis, 2023). In contrast to the Amazon, where deforestation declined in 2023, the deforestation has continued expanding in the Cerrado, likely due to more relaxed land-use regulations. Deforestation in the Cerrado grew 26% from January to July 2023 compared to the same months during the previous year (Terrabrasilis, 2023) (see Figure 6).

The conversion of natural vegetation in the Amazon and Cerrado has followed some contrasting trends. According to Mapbiomas (2023), about 16% of the Brazilian Amazon has been converted to agricultural land uses, and half of the Cerrado natural vegetation has been lost. In the Amazon, the "arc of deforestation" has moved northwards and westwards along major road developments, following a trend of land occupation and de facto privatization of public lands (Carrero et al., 2022), along with the growing establishment of meatpacking plants and slaughterhouses closer to the supply zones, which created further incentives for cattle ranching expansion (Pacheco & Poccard-Chapuis, 2015). In the Cerrado, the expansion of the agricultural frontier has accompanied road development, and markets and logistics for grain storage and processing. Major expansion has been in central and northern Mato Grosso, and the region known as Matopiba, in the intersection of Maranhão, Tocantins, Piauí and Bahia states (Marengo et al., 2022).

The Amazon biome encompasses approximately 287 million hectares of public forest lands. These have been predominantly allocated for protected areas, Indigenous territories and concessions for forest management, while about 70 million hectares (~25%) remains undesignated. In 2019, state-owned land accounted for 27% of deforestation, primarily due to encroachment by land grabbers. This has resulted in social conflicts within these territories. Deforestation has been driven by land seizures across public lands, as well as conversion to pasture and crops across private lands (Moutinho & Azevedo-Ramos, 2023). In Brazil, it has been common for undesignated lands to be granted legal titles by the government, even if they had been illegally deforested before 2018. Legislative changes have led people to anticipate that the legalization processes could increase the land's value (WWF, 2022). Often, those who seize public lands, after engaging in forest clearing and/or raising cattle, expect to receive land titles to secure land ownership (Moutinho & Azevedo-Ramos, 2023). Figure 7 shows a simplified chain of causality that leads to deforestation in the Amazon biome, which is influenced by road development and several other factors.

Figure 7: Simplified representation of land-use change in the Amazon



Source: Authors´ elaboration based on expert interviews.

Unlike the Amazon, the Cerrado lacks significant state-owned undesignated land, and land-use regulations on private lands under the Brazilian Forest Code permit landowners greater discretion on where to designate legal reserves (parts of their land where natural vegetation must be maintained). This often results in higher conversion rates of open-area natural ecosystems into agricultural land than for forested areas (Bonanomi et al., 2019). Protected areas cover only 7.5% of the Cerrado (compared to 50% in the Amazon), leaving private landowners with the freedom to clear 65% to 80% of their properties under the Forest Code. Anecdotal evidence suggests that investors and land companies specializing in land transactions, including international investors seeking to engage in cattle and soy production, are drawn to the Cerrado region to capitalize on the increasing land value, which may lead to disputes with local communities. Furthermore, as tenure documents are often unclear, fake titles are created and later converted into legal titles, with some of those lands sold on the land market (WWF, 2022).

One important consideration is the leakage effect. When efforts are made to restrict or regulate deforestation in one area or for one commodity, there is a risk that production and associated deforestation may shift to other regions or commodities with less stringent regulations. Research indicates that 53% of the deforestation prevented in areas of the Amazon was offset by increases in deforestation in parts of the Amazon outside of the areas included in the Amazon Soy Moratorium (Villoria et al., 2022). Heilmayr et al. (2020) argue that indirect land-use change, or when agriculture establishment pushes cattle ranching into forested frontiers, was rare or declined after the Soy Moratorium. Yet there is still insufficient evidence to discard the indirect effects of soy expansion in pastureland expansion. Leakage can undermine the effectiveness of measures implemented in one location and highlights the need for a holistic and coordinated approach to address deforestation in global commodity supply chains.

MARKETS AND IMPORTERS´ ACCOUNTABILITY

About 80% of beef produced in Brazil is consumed in the domestic market (zu Ermgassen et al., 2020), but export volumes are growing, from 1.2 million tonnes in 2015 to 2.1 million tonnes in 2022 (COMEX STAT, 2023). Of the 19.1% of Brazilian beef production that was exported, nearly half (48.1%) originated from the Cerrado and a quarter (25.5%) from the Amazon (zu Ermgassen et al., 2020). Beef exports tend to be concentrated in a few vertically integrated companies that operate their own slaughterhouses.

In 2021, Brazil produced nearly 135 million tonnes of soy, out of which 105.5 million tonnes were exported to global markets, 82% as raw soybeans (UN Comtrade, 2022). High international demand for soy contributes to conversion, with consuming countries such as the EU and China being identified as drivers of conversion through their imports (Stockholm Environment Institute, 2022). EU imports were linked to 29,800 hectares of deforestation or conversion in Brazil in 2020, down from a peak of 201,000 hectares in 2015, while China's imports were linked to 229,000 hectares (Trase, 2022). About 177,000 hectares in the Cerrado and 28,000 hectares in the Amazon were identified as exposed to soy deforestation in 2020 (Trase, 2022).

Both global and domestic public and private initiatives have attempted to address deforestation and conversion driven by agriculture in the Amazon and Cerrado biomes. Initiatives include the Amazon Soy Moratorium and two cattle agreements to support the traceability of sustainable beef supply, though the latter have proven ineffective. For example, Brazilian meatpackers continued to procure cattle from inside the country's protected areas even after the cattle agreements were signed (West et al., 2022). This is due to the difficulties of controlling indirect suppliers (Brandão Jr. et al., 2023), meaning that "deforestation is most likely to occur on properties that sell fewer cattle, are located in remote locations, and have a high percent of remaining forest" (Skidmore et al., 2021).

Initiatives in consumer countries, notably the EUDR, aim to prevent the import of products related to deforestation. However, China has replaced the EU as the largest destination for Brazil's soy exports, accounting for 70% of the total in 2021, valued at approximately US$38.6 billion (Statista, 2022). Rising demand for soy, largely driven by China's growing demand for soy-based animal feed, has led to a spike in soy prices which are now at historically high levels (Colussi et al., 2024). High prices and demand may incentivize further deforestation and land conversion.

4.2.3 Subsidies and their impacts on forest resources

Deforestation and conversion are complex processes influenced by multiple factors. The specific impact of subsidies on agricultural expansion and their influence on deforestation and conversion can be difficult to isolate. This section offers an analysis of the different types of subsidies, with particular attention to subsidized public credit loans, and explores how they are correlated to spatial dynamics of deforestation and conversion at the municipality level.

SUBSIDIES CONNECTED TO LAND-USE CHANGE

Overall support for the agricultural sector in Brazil is relatively low compared with other OECD countries (OECD, 2021b). Searchinger et al. (2020), based on analysis for the period 2014-2016, indicate that Brazil has a wide range of agricultural support programmes but its total support is relatively modest at 10% of total agricultural value added. According to this analysis, 25% is directed at improving farm incomes through market price supports or direct farm payments, 50% consists of infrastructure and financial assistance to farmers (mainly low-interest loans), and 25% goes to research and technical assistance. Main direct subsidies in Brazil consist of subsidized loans including concession and preferential rate loans, insurance for lost income, and tax exemptions (McFarland et al., 2015). These subsidies are not specific to a single crop and benefit the whole agricultural sector (see Table 3). These subsidies, such as the rural insurance, are not well distributed since they concentrate on a few activities and regions (Souza, Oliveira & Stussi, 2023).

The National Rural Credit System, established in 1965, provides low-interest credit to support agricultural production by providing working capital, fixed capital investment and capital for the commercialization of agricultural products (Lopes et al., 2016). The sources of funding for rural credit originate from mandatory resources comprised of a fraction of deposits in financial institutions that have to be allocated to defined programmes, and from rural savings in some public banks and cooperatives. The Annual Agricultural Plan (Plano Safra) determines the yearly support to the agricultural sector, mainly through rural credits at preferential rates, market rates and crop insurance. From 2013 to 2021, 62% of these resources were allocated to agriculture and livestock. Within this allocation, two-thirds went to soy and cattle (Corcioli et al., 2022).

According to the World Bank (2020), producers' support as a share of gross farm receipts fell from 7.6% in 2000-02 to 2.3% in 2019-21. However, 2021 producer support estimates increased due to increased market price support, while domestic prices align almost fully with international prices (OECD, 2022). The direct support to agriculture consists of a complex credit system from public sources differentiated by programme and type of farmers. While public funding is still significant, in recent years the number of farmers obtaining credit though public programmes has declined, and market-based instruments, such as agricultural letters of credit, have tended to gain importance, notably for large-scale producers (World Bank, 2020).


Soy crops. Cerrado, Brazil.
© Peter Caton / WWF-UK

Table 3: Description of main subsidies favouring agricultural development in Brazil

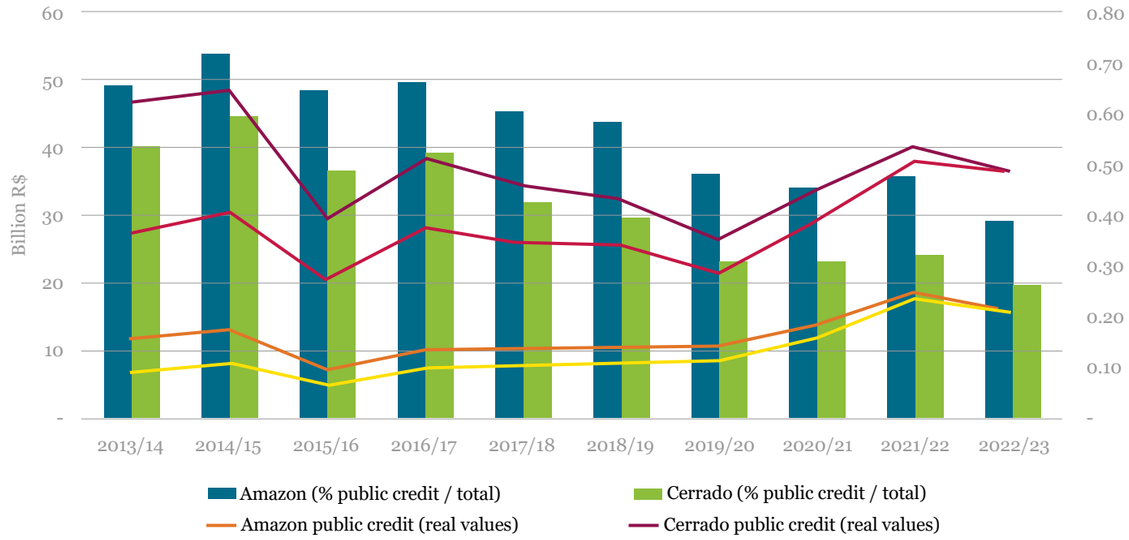
MECHANISM	TOTAL RESOURCES ALLOCATED	DESCRIPTION OF THE MECHANISM	MAIN BENEFICIARIES
Subsidized credit with concessional and preferential interest rates	In the 2023/2024 Plano Safra for Brazil allocates a total of R$364.22 billion in rural credit for agribusiness. This includes R$272.12 billion for operating costs and marketing, and R$92.10 billion for investments. Among these resources, R$101.48 billion is eligible for equalization subsidies, provided by the national treasury to 21 financial institutions. Approximately 28% of the total available credits fall under subsidized categories.	The controlled resources are offered at preferential rates, particularly through the Programme for Strengthening Family Agriculture (PRONAF) and the Programme to Support Medium-Size Rural Producers (PRONAMP), for working capital and commercialization. Free resources tend to be accessed by large-scale farmers for working capital and investments. The interest rates varied from 5.5% to 12% year in 2022/23 (MAPA 2023).	Small, medium and large agricultural producers, cooperatives, and those engaging in sustainable agricultural practices. The Plano Safra allocates funds for investment programmes like RenovAgro for sustainable practices, PRONAMP for medium-sized producers, and the Warehouse Construction and Expansion Programme, aimed at enhancing agricultural infrastructure.
Rural insurance subsidies	The insurance programmes PROAGRO and PSR primarily focus on soy, corn and wheat, which account for about 80% of the insured value. In 2021, PROAGRO insured value was US$3 billion (Souza et al., 2022), while PSR's reached US$12.1 billion, accompanied by a corresponding subsidy of US$219 million in 2021/22 (OECD, 2022).	Two major programmes in Brazil aim to mitigate risk in agriculture. The Agricultural Activity Guarantee Programme (PROAGRO) offers farmers partial compensation for investment losses incurred when using working capital loans in case of losses linked to weather events. The Rural Insurance Premium Subsidy Programme (PSR), subsidizes the rural insurance premium, reducing the cost of insurance policies.	PSR aims to support rural producers through financial recovery capacity in case of adverse weather events (Souza and Assunção 2020). However, small producers may be discouraged from applying due to the uncertainty surrounding insurance approval (Souza et al., 2022). PROAGRO presents two lines of beneficiaries: the Mais line, aimed at small producers, and the traditional line, mandatory for projects of up to R$335,000 (Souza et al., 2022). The Garantia-Safra benefits small producers in semi-arid regions who have suffered crop losses due to drought or excessive rainfall (Chiavari et al., 2023)

THE INFLUENCE OF RURAL CREDIT IN LAND-USE DYNAMICS

Rural credit is a significant factor supporting the consolidation and expansion of ranching and agriculture in the Amazon and Cerrado. An important source of credit is public financing at preferential interest rates that the Brazilian state provides farmers to finance their working and investment capital, registered by SICOR. The Brazilian Central Bank defines it as the loans financed with public (subsidized) credit sources or that received public assurance under PROAGRO, the rural credit public assurance programme. According to SICOR, from July 2013 to June 2023, contracted public credit for agriculture reached a total of R$494.2 billion in real values (adjusted using the National Consumer Price Index (IPCA) and indexed to July 2023). Of this, R$370.0 billion targeted the Cerrado (US$75.2 billion), and R$124.2 billion (US$24.8 billion) targeted the Amazon.

It is not surprising that credit volumes for the Cerrado are three times higher than for the Amazon, since the Cerrado has become the agricultural powerhouse of Brazil. Figure 8 shows the total contracted credit for the agricultural calendar from July 2013 to June 2023. The total volume of contracted credit has increased every agricultural year in nominal terms, but the actual value has fallen when considering real prices. Real prices were indexed to July 2023 and adjusted using the National Consumer Price Index (IPCA). Public sources of rural credit are still a significant proprotion of total rural credit contracted, particularly in the Amazon, but have tended to decline over time. This is similar to the trend observed for rural credit in Brazil as a whole.

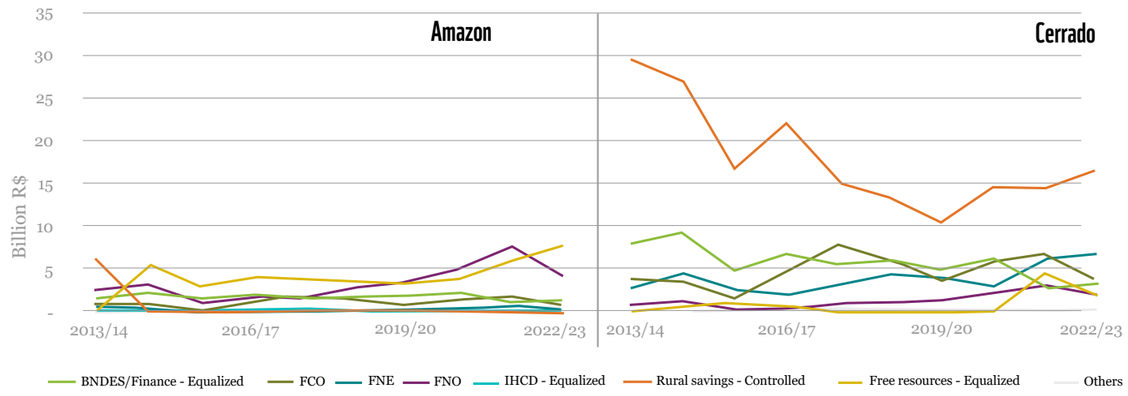
Figure 8: Volume of contracted public credit for the agricultural calendar from July 2013 to June 2023, and participation regarding total contracted credit by biome



Source: Authors' elaboration based on data from SICOR.
Note: Real values are adjusted to July 2023 prices using the IPCA.

The government provides multiple types of funding. Some have controlled interest rates below commercial rates, others follow market rates, and some offer counterparts to reduce lenders' amortization payments. The subsidized portion varies by funding sources and applies differently to farmers depending on their scale and other conditions linked to the source. An explanation of each of these sources is provided in Box 6. Figure 9 shows the credit sources that finance activities in the Amazon and Cerrado. In the Amazon, Rural Savings Controlled and FNO are significant funding sources. In the Cerrado, Rural Savings Controlled is a significant source of financing to rural producers, with oscillations over time (see Box 6).

Figure 9: Volume of contracted public credit by source of funding for the agricultural calendar from July 2013 to June 2023



Source: Authors' elaboration based on data from SICOR.
Note: Real values are adjusted to July 2023 prices using the IPCA.

BOX 6: MAIN SOURCES OF PUBLIC FUNDING TO SUPPORT AGRICULTURE

The funding system providing resources to the agricultural sector in Brazil is relatively complex (Assuncao & Souza, 2018) There are two types of resources:, those with controlled interest rates and those that follow market interest rates. Rates and amortization periods for public funding included in the Plano Safra are defined by the National Monetary Council (CMN). The conditions are defined by the programmes managed by the source of funding; credits not associated with any programme follow the conditions defined by the source of the resource. Below are the main sources of public funding:

Rural savings – controlled is a mechanism to ensure funding for the national system of rural credit (SNCR) associated with the collection of deposits in financial institutions. The CMN defines a percentage of deposits to target rural credit from Banco da Amazônia, Banco do Brasil, Banco do Nordeste, Bancos Cooperatives and financial institutions of the National System of Savings and Loans. The conditions and interest rates are defined every year in the Plano Safra.

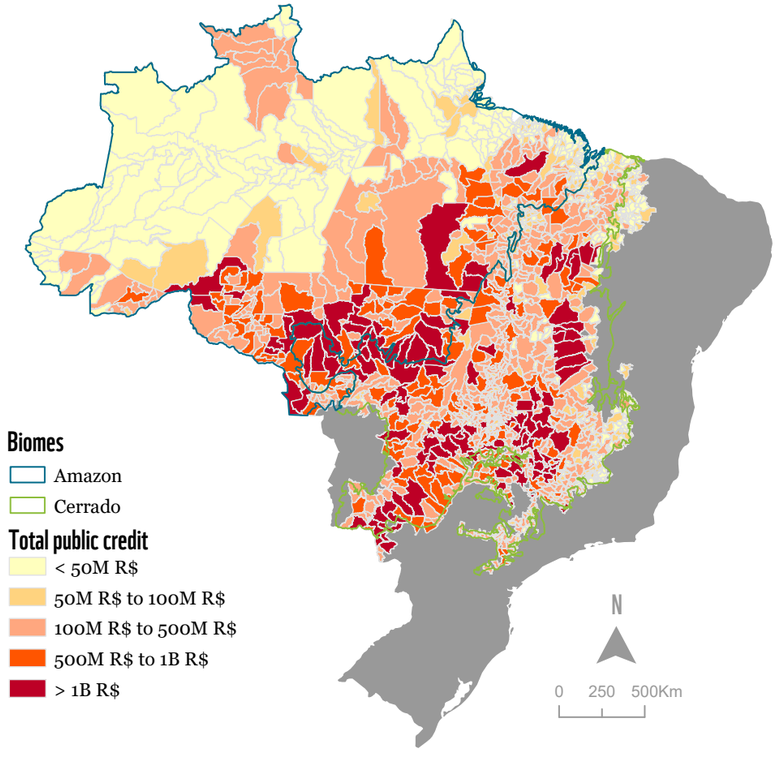
Free resources – equalized are resources from private sources backed by public funds to subsidize the interest rates, reducing the rate paid by the farmers. These resources are allocated to programmes supporting low-carbon agriculture (ABC), construction and expansion of storage facilities (PCA), technical innovation (INOVAGRO), family farming (PRONAF) and medium-sized farmers (PRONAMP).

Hybrid Instrument of Capital and Debt (IHCD) is mechanism to fund public banks through loans between financial institutions and the national treasury.

Constitutional regional financing funds include the funds for the north (FNO), northeast (FNE) and centre-west regions (FCO). These are public funds aimed at reducing the regional disparities in access to credit and investments for farmers. Funds originate from 3% of the Industrialized Products tax (IPI, a type of import tariff) and income taxes. Interest rates vary according to the region and farm size.

BNDES/Finame – equalized is a source of funding from the Brazilian Socio-economic Development Bank (BNDES). It is dedicated to industrial financing through the acquisition of equipment and machinery, and investment projects allocated through various programmes.

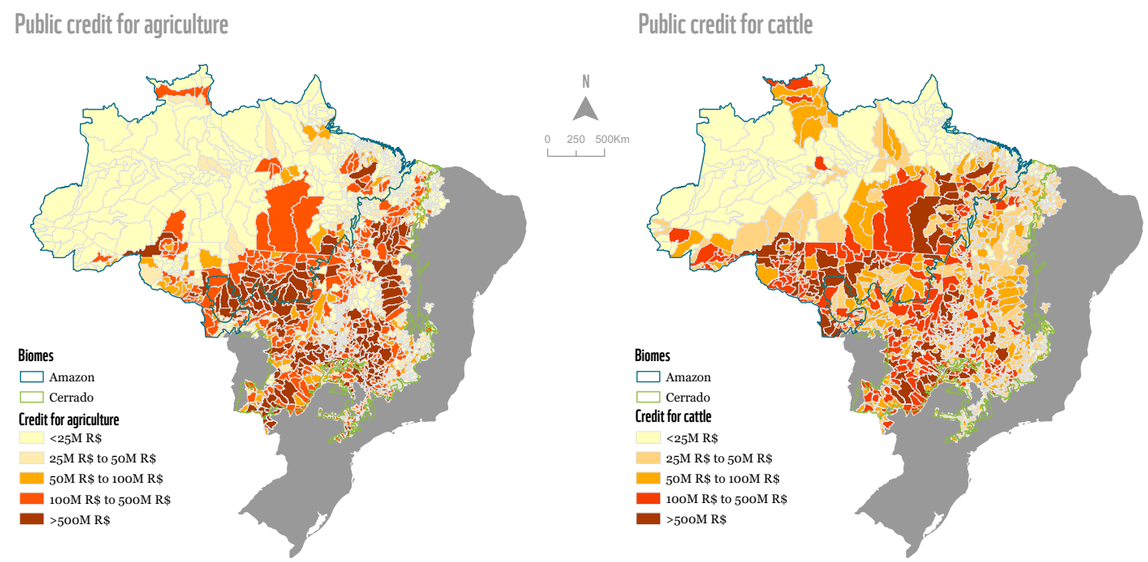
Figure 10: Volume of contracted public credit according to the agricultural calendar from July 2013 to June 2023



Source: Authors' elaboration based on data from SICOR. Note: Real values are adjusted to July 2023 prices using the IPCA.

Figure 10 shows the volume of credit contracted in the Amazon and Cerrado biomes from July 2013 to June 2023. Overall, the spatial distribution of rural credit volumes correlates with agricultural expansion trends. In the Amazon, the rural credit loans tend to concentrate along the "arc of deforestation" comprising the southern and eastern portions of the Amazon, with higher allocations in central and northern Mato Grosso and southern Para, coinciding with the most active cattle ranching frontiers. In turn, the allocation of rural credit in Cerrado is concentrated in the south, central Mato Grosso, and Matopiba.

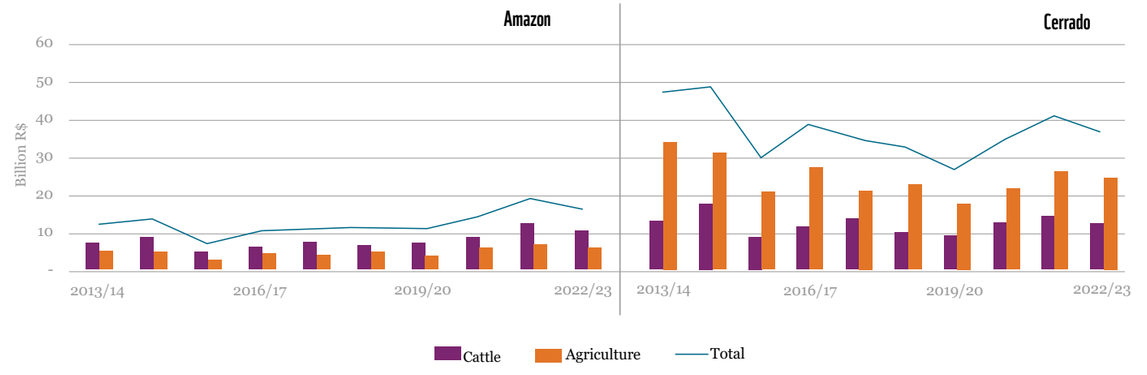
Figure 11: Total volume of contracted public credit from July 2013 to June 2023 according to predominant activity for municipalities in the Amazon and Cerrado biomes.



Source: Authors' elaboration based on data from SICOR.

Figure 11 shows the agricultural credit allocation for cattle and agriculture in the Amazon and Cerrado biomes. It shows the significant dominance of credit for cattle ranching in the Amazon and for agriculture in the Cerrado. Figure 12 shows that from 2013/14 to 2022/23, consistently, most of the rural credit contracted in the Amazon was targeted to finance cattle ranching operations (R$77.8 billion) and, to a lesser extent, agriculture (R$46.3 billion). By contrast, in the Cerrado, rural credit was mainly allocated to support agriculture R$247.2 billion, with R$122.8 billion allocated to cattle ranching. The data in Figure 13 shows that most rural credits are used as investment capital, with a significant proportion dedicated to financing operational farming expenses.

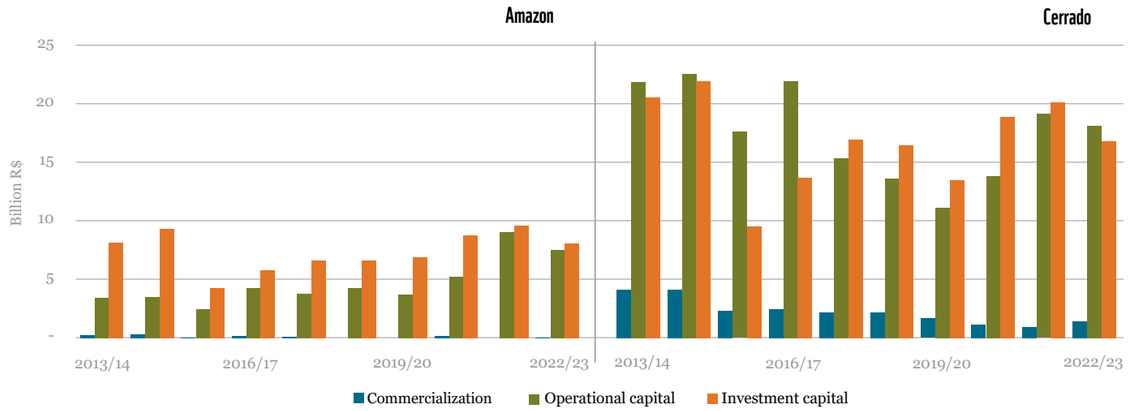
Figure 12: Volume of contracted public credit by sector for the agricultural calendar from July 2013 to June 2023.



Source: Authors' elaboration based on data from SICOR.

Note: Real values are adjusted to July 2023 prices using the IPCA.

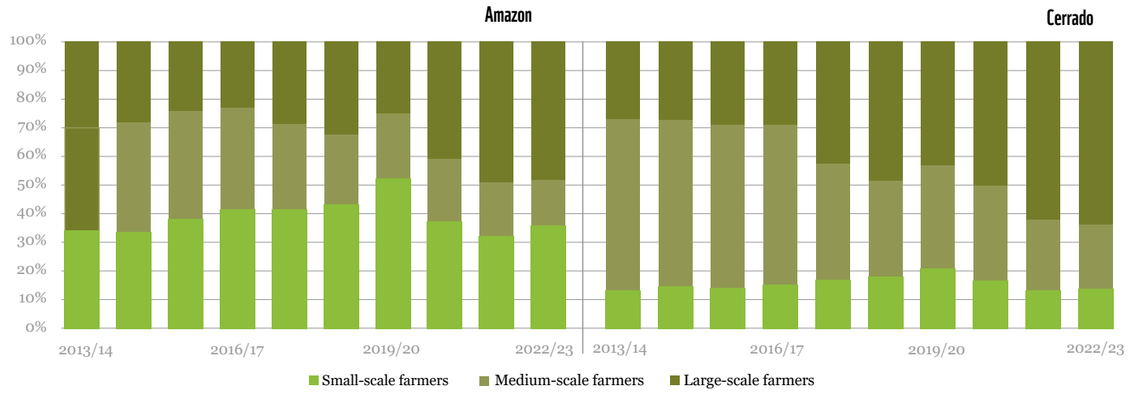
Figure 13: Volume of contracted public credit by sector for the agricultural calendar from July 2013 to June 2023 by type.



Source: Authors' elaboration based on data from SICOR. Note: Real values are adjusted to July 2023 prices using the IPCA.

Total rural credit contracted in the Amazon was not biased toward any farmers, unlike the Cerrado (Figure 14). In the Amazon, from 2013/14 to 2022/23, smallholders received 38% of the total contracted rural credit, large-scale landholders received 35%, and a relatively smaller proportion (27%) went to medium-size landholders. In the Cerrado, medium- and large-scale landholders received a higher share of the credit in the same period, 43% and 42%, respectively. The remaining 15% went to smallholders. Interestingly, the relative allocation of credit to large-scale farmers in the Cerrado has increased to the detriment of medium-scale farmers. The typology of farmers by size is based on financial institutions' classifications: by law, they rake as reference the farmer's gross agricultural income for the last two years when issuing credit. This classification may also determine the interest rates associated with specific credit lines. The distribution of total rural credit by the scale of farmers tends to reflect the tenure structure in the Amazon and Cerrado biomes.

Figure 14: Volume of contracted public credit by farmer type from July 2013 to June 2023



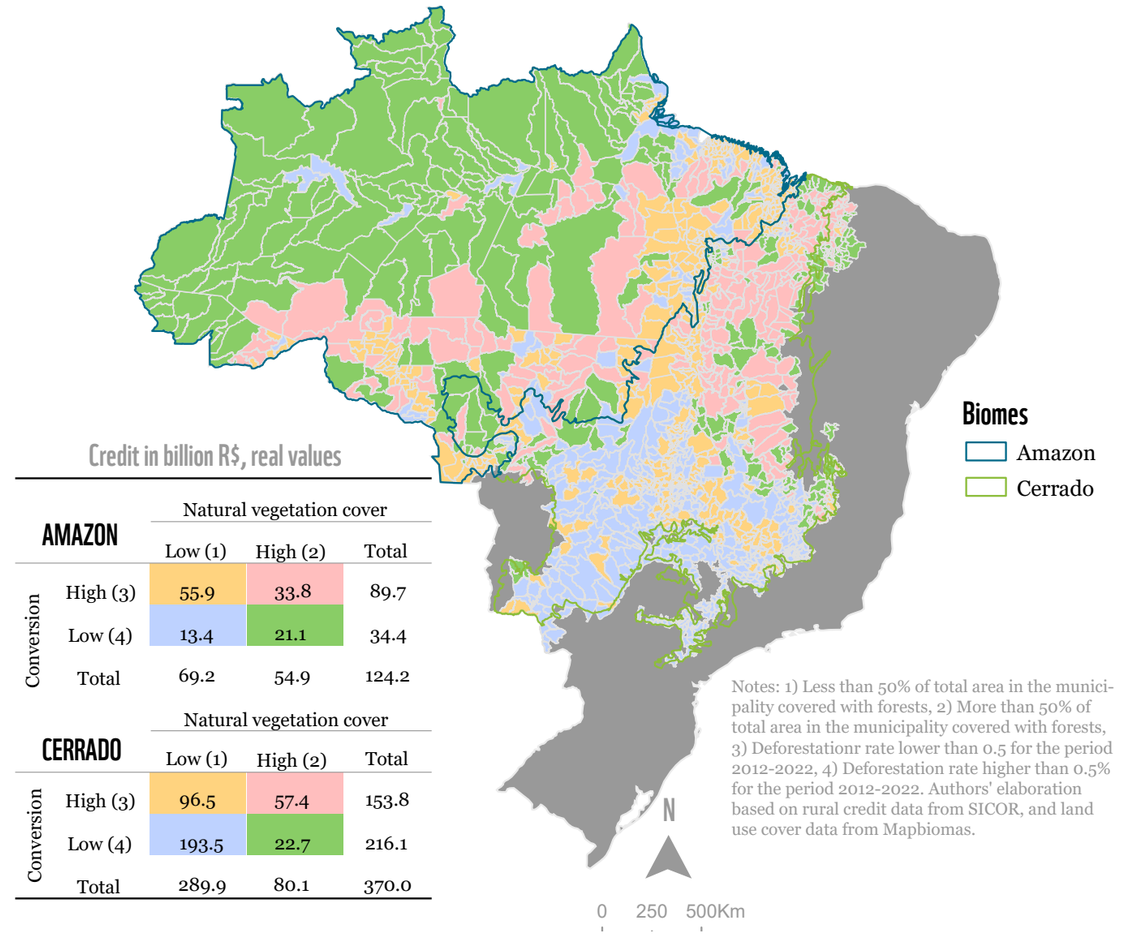
Source: Authors' elaboration based on data from SICOR. Note: Real values are adjusted to July 2023 prices using the IPCA.

Data estimates at the municipal level do not provide strong evidence of the influence of rural credit on deforestation and conversion but do suggest that a positive correlation exists in the Amazon; this is less evident in the Cerrado.

Figure 15 shows the allocation of credit for the Amazon and Cerrado by municipality, according to the proportion of natural vegetation cover – forests, savannah and grasslands – in 2022 with regards to the total area and the conversion rate for each municipality for 2013 to 2022 based on data from Mapbiomas. The distribution of credit in the Amazon suggests that 72% of credit (R$89.7 billion) is allocated to municipalities facing a high deforestation rate, R$55.9 billion to those with low forest cover and R$33.8 billion to high forest cover municipalities.

This suggests that rural credit may contribute to expanding the agricultural frontier and associated deforestation in those municipalities. In the Cerrado, most of the credit (58%) is allocated to municipalities with a natural vegetation cover (including forest formations, savanna formations and grasslands) lower than 50%, though a significant proportion (42%) is allocated to municipalities facing higher conversion rates. Subsidized credit loans likely play an important role in supporting the expansion of agriculture and savannah conversion in these municipalities, while the role of commercial credit is more significant.

Figure 15: Volume of contracted public credit by type of municipality in the Amazon and Cerrado biomes according to the remaining natural vegetation cover and land conversion rates from July 2013 to June 2023, expressed in billion R$ in real values.



Credit in billion R$, real values

AMAZON

Conversion	Natural vegetation cover: Low (1)	High (2)	Total
High (3)	55.9	33.8	89.7
Low (4)	13.4	21.1	34.4
Total	69.2	54.9	124.2

CERRADO

Conversion	Natural vegetation cover: Low (1)	High (2)	Total
High (3)	96.5	57.4	153.8
Low (4)	193.5	22.7	216.1
Total	289.9	80.1	370.0

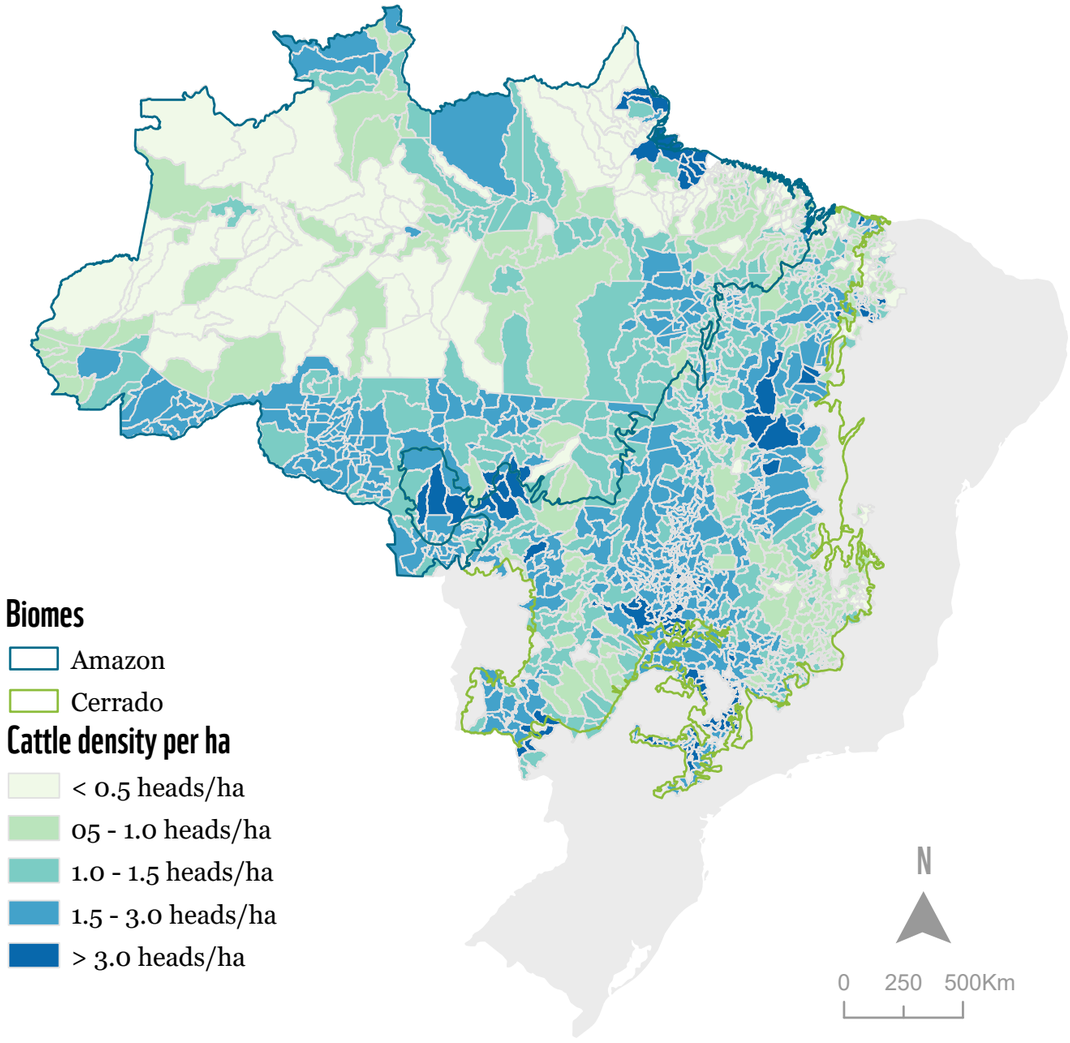
Notes: 1) Less than 50% of total area in the municipality covered with forests, 2) More than 50% of total area in the municipality covered with forests, 3) Deforestationr rate lower than 0.5 for the period 2012-2022, 4) Deforestation rate higher than 0.5% for the period 2012-2022. Authors' elaboration based on rural credit data from SICOR, and land use cover data from Mapbiomas.

Source: Author's elaboration based on data from SICOR, and land-use cover data from Mapbiomas.

As mentioned before, public credit constitutes only a portion of the total credit in the Amazon and Cerrado. Farmers and ranchers in the Amazon region tend to depend more on public subsidized credit than those in the Cerrado. From 2013 to 2023, about 54% of the total volume of credit originated from public subsidized sources in the Amazon, compared to 40% in the Cerrado. In the Amazon, 72% of the total public credit is allocated to municipalities facing high conversion rates (27% to municipalities with high natural vegetation cover and 45% to municipalities with lower natural vegetation cover). In the Cerrado, 42% of the total public credit is allocated to municipalities facing high conversion rates (16% to municipalities with high natural vegetation cover and 26% to municipalities with lower natural vegetation cover). This suggests that, in relative terms, municipalities in the Amazon which there is active conversion of natural vegetation tend to receive a higher proportion of public loans, compared to the Cerrado.

A characteristic factor of the expansion of the agricultural frontier is that land is often first occupied and appropriated through the establishment of pasture and low-production cattle operations, which may also be receiving credit support. This is challenging to demonstrate by looking at municipal-level data. However, stocking rates measured by cattle population by unit of land in hectares show that high-forest and high-deforestation municipalities in the Amazon have the lowest stocking rates (0.8–1.2 head/ha), with comparatively higher densities of cattle per hectare in municipalities with low forest cover, or where there is more consolidated cattle ranching. A similar trend is observed in the Cerrado where municipalities with high natural vegetation cover have on average lower stocking rates (1.4 head/ha) than other municipalities in the Cerrado, but relatively higher than those observed in the Amazon. In addition, higher cattle population densities are observed in municipalities closer to or hosting large urban centres. Figure 16 shows the stocking rates by municipality in the Amazon and Cerrado. This suggests that there is a significant potential for increasing the density of cattle per unit of land, and that public credit could become a more effective instrument for supporting cattle ranching (semi)intensification rather than supporting low-production ranching operations. This would avoid further pressure on land, in line with new conditions linked to public credit in Brazil (Harfuch & Lobo, 2023).

Figure 16: Stocking rates in head of cattle per hectare for the Amazon and Cerrado



Source: Author's elaboration based on total head of cattle from IBGE Municipal Livestock Research (PPM) for 2022, and pasture area by municipality based on Mapbiomas estimates, Level 3 land use classes for 2022.

The available data suggests that municipalities with active development of pastures for beef cattle production tend to attract public credit; the proportion is higher in the Amazon, with greater dependence on commercial credit in the Cerrado. Other factors besides the allocation of credit may also explain the expansion of agricultural frontiers with impacts on deforestation and conversion, even when these may be spatially correlated with the allocation of public credit. These include expanding land markets and growing pressure on public lands or lands of comparatively lower value, developing infrastructure, and growing private investments in productive infrastructure for storage and processing facilities. This means observing direct links between credit – including subsidized credit – and land-use change is challenging. Indirect impacts also occur, such as soy expansion into pasturelands triggering further expansion of cattle into forests.

4.2.4 Opportunities for repurposing

There are a few issues to consider when assessing the importance of repurposing subsidies in Brazil. As mentioned, overall support for the agricultural sector in Brazil is relatively low compared with other OECD countries. Yet agriculture and agribusiness have developed significantly, contributing to an increase in deforestation and conversion in the Brazilian Amazon and Cerrado. The main sources of direct public funding supporting agriculture are concessional credits allocated through a complex system of programmes. The growing relative share of commercial lending suggests the strategic importance of public funding through concessional loans for transforming agriculture.

Public sources of funding and concessional credits play an important role in supporting smallholders and middle-scale farmers, and less to large-scale farmers with access to commercial finance. These financial resources could favour small-scale agriculture more efficiently and support the uptake of more sustainable agricultural practices under more integrated and regenerative production systems without undermining overall productivity. This would reduce pressure on natural ecosystems and distribute economic wealth among farmers more equitably, while helping them adapt to a changing climate. This analysis provides a general assessment of options that should be prioritized in the allocation of public subsidized funds, considering that some of the existing subsidies should be kept, others improved and expanded, and others repurposed.

We applied the repurposing framework presented in Section 3.2 to the context of the Brazilian Amazon and Cerrado. Table 4 below provides an overview of the prioritized repurposing options. Complementary actions needed to create an enabling environment for successful repurposing are detailed in the following subsections. The information and assessment of feasibility and potential impacts are primarily based on interviews with national and international stakeholders, in the context of the Brazilian government plans and strategies. Relevant examples include a plan to support family agriculture (EMBRAPA, 2024), to reduce the loss of native vegetation (MMA, 2023), to restore native vegetation (MMA, 2017) and to support the transition to low-carbon agriculture (MAPA, 2021). This table should be regarded as an example of how the repurposing framework can be used in a country context, based on the opinion of a few experts and on high-level policy documents. A full-scale repurposing process would require multistakeholder negotiation, supported by in-depth socioeconomic and environmental analyses.


Cerrado, Brazil. © Andre Dib / WWF Brazil

Table 4: Assessment of repurposing options in the Brazilian Amazon and Cerrado (see A 5 for further assessment details)

REPURPOSING OPTIONS	ENABLING ENVIRONMENT (LOW/MEDIUM/HIGH)						EXPECTED IMPACTS (- - / - / NEUTRAL / + / ++)			
	Political and institutional feasibility	**Acceptance**	**Technical feasibility**	**Financial feasibility**	**Scalability**	**Enabling environment**	**Social impacts**	**Environmental impacts**	**Economic impacts versus BAU**	**Expected key impacts**
Support to sustainable agriculture										
Restoring pastures under sustainable cattle ranching	High	Medium	Medium	High	High	Investment in extension services for the introduction of improved practices, with associated investments in restoring soils and pastures, and traceability	+	++	+	Improved pasture management, and animal health with lower GHG emissions. Increased productivity with higher stocking rates. Improved productivity of existing pasture reduces pressure on forests.
Expanding regenerative low carbon-agriculture	Medium	Medium	High	Medium	Medium	Better technical support, tools, products and services to expand integrated crop-livestock forestry under low-carbon agricultural systems, including additional resources targeting the ABC credit programme	++	++	+	Reduction of GHG emissions associated with improved practices to restore soil nutrients and fertility. More integrated systems may need improved technological knowledge of farmers.
Support to the new bioeconomy										
Scaling agroforestry systems	Medium	Medium	Medium	Medium	Medium	Depends on the provision of technological assistance, markets, and finance. Experiences have been mixed, and results depend on farmers' knowledge, and adoption of species with commercial value, market development, good quality of seeds and networks for seedling supply.	++	++	+	Expansion should not happen in natural ecosystems. May have positive impacts on vegetation restoration and environmental services including biodiversity, water retention, soil nutrients, and carbon sequestration.
Strengthening bioeconomy value chains	High	High	Medium	Medium	Medium	Support to strengthening local capacities for collection and/or production of bioeconomy products. Improved market networks and value chains, with local processing capacities, and domestic and international markets offering fair prices.	++	+	++	Positive social and economic impacts due to increasing income flows to local communities for traditional extraction and production systems. Increasing incentives to conserve and restore forests and natural ecosystems should bring environmental benefits, but over-extraction of natural resources could have negative impacts.
Land and forest restoration										
Financing land and forest restoration measures	Medium	Medium	Medium	Low	Medium	Growing attention to restoration. Acceptance depends on financial feasibility and competition with productive agricultural and pasture lands – scope for restoration of degraded and abandoned lands. Good quality seeds and seedlings are required.	+	++	+/-	Soil restoration, water retention, carbon sequestration and income diversification. Environmental benefits of restoration accrue in the long term. Economic benefits depend on the restoration modality, and restoration objectives.
Providing direct compensation to farmers for ecosystem services	Medium	Medium	Medium	Low	Low	Experiences have focused on market-based mechanisms based on results, including the delivery of water services, some linked to forest conservation. Requires transparent negotiation, systems to measure actual delivery of ecosystem services, and agreed benefit-sharing mechanisms.	++	+/-	+/-	Additionality has been an issue, so uncertain environmental outcomes and difficult to reach scale. May enhance income streams but may lead to uncertain economic outcomes depending on the type of payments and contribution to total farmers' income.
Fiscal support to productive farms										
De-risking instruments	Medium	High	High	Medium	High	Additional resources are needed to enhance and expand partial credit guarantees, first loss capital and tools, aimed at reducing the risks to banks lending resources, particularly for small-scale farmers and local forest users engaged in riskier activities and less secure institutional contexts.	+	+/-	++	Growing flow of financial resources to small-scale farmers and forest users, enhancing income streams with positive social outcomes but lending criteria should include strong environmental considerations to avoid negative environmental outcomes.
Improving risk coverage in agricultural insurance	Medium	Medium	High	Medium	High	The well-established rural insurance system requires more efficient programmes stimulating modernization, innovation and sustainability efforts, with more resources earmarked for small-scale farmers, and for those engaged in more sustainable and regenerative agriculture.	++	+/-	++	Better coverage for small-scale farmers will translate into positive social benefits, and more stable income streams. Improved risk coverage in the context of growing climate risk will translate into reduced economic loss for farmers. Environmental impacts will depend on the insurance design and environmental conditionalities applied.

RESTORATION OF DEGRADED PASTURE THROUGH LIVESTOCK-FOREST INTEGRATION TO REDUCE DEFORESTATION AND BOOST LIVESTOCK HUSBANDRY

The Brazilian ABC Plan (Low Carbon Emission Agriculture Plan) aims to restore 15 million hectares of degraded pastures by promoting sustainable cattle ranching practices. Several strategies for pasture restoration are promoted, including silvo-pastoral or agro-silvo-pastoral practices, replanting of forage plants or livestock-forest integration (LFI) (Assad et al., 2020). LFI improves the quality, productivity and occupation rate of pastures, allowing for diversification of economic activities. Simultaneously, LFI contributes to biodiversity conservation and to the functionality of regulating ecosystem services (Assad et al., 2020).Through increased productivity of existing pasture, the expansion pressure on forests is reduced. Pasture restoration is a highly effective practice to mitigate biodiversity loss from agriculture. To create an enabling environment for successful pasture restoration, investments in extension services for the introduction of improved practices and investments into soil and pasture restoration are required. By reallocating harmful subsidies toward LFI, restoration of pastures can be supported, providing a sustainable solution for livestock husbandry while reestablishing and preserving natural ecosystems.

EXPANDING LOW-CARBON AGRICULTURE TO REDUCE GREENHOUSE GAS EMISSIONS

The ABC Plan aims to mitigate greenhouse gas emissions, combined with restoration of degraded lands and improved management of natural resources through enhanced production efficiency (de Magalhães & Lunas Lima, 2014). The technical framework to expand the ABC Plan and its associated programme already exists while its extent is substantial: in 2017, R$15.1 billion in funding supported a total of 31,400 contracts signed across 2,789 municipalities, benefiting an extensive area spanning over 8.4 million hectares (Ministério Do Planejamento, Desenvolvimento E Gestão, 2018). In order to expand low-carbon agricultural systems, better technical support and supply of tools, products and services are required. Redirection of harmful subsidies toward the expansion of the ABC programme can contribute significantly to boosting low-carbon agriculture and mitigating greenhouse gas emissions across Brazil. A major challenge is to reach farmers with limited access to infrastructure and market logistics, who may also lack complementary incentives to transition to more regenerative practices.

SCALING OF AGROFORESTRY SYSTEMS TO ENHANCE TREE COVER AND COMBAT DEGRADATION

While agroforestry does not recreate forests, it can be applied as a land restoration intervention that adds trees to the landscape. Agroforestry systems can be an effective strategy to restore forest cover on degraded soils in the Amazon and Cerrado, combining the restoration of ecosystem services and agricultural production (Celentano et al., 2020; Martinelli et al., 2019). Expansion should not encroach upon natural ecosystems and instead be directed toward restoration of vegetation and environmental services, encompassing biodiversity, water retention, soil nutrients and carbon sequestration. Currently, there is a deficiency in government support and funding at all levels for family farms and agroforestry systems, and a lack of community organizations dedicated to agroforestry. The successful implementation of agroforestry systems highly depends on technical assistance, markets and finance, while the results depend on farmers' knowledge, species with commercial value, market development, and good quality seeds and networks for seedling supply (Martinelli et al., 2019).

STRENGTHENING BIOECONOMY VALUE CHAINS AND LOCAL COMMUNITIES TO MAINTAIN MULTIFUNCTIONAL LANDSCAPES

Broadening support to the bioeconomy needs to encompass the concepts of socio-ecological diversity or a socio-biodiverse economy (Ollinaho & Kröger, 2023). These economies are associated with activities that maintain productive multi-functional landscapes, which are not the main priority of fiscal and credit incentive programmes. Transitioning beyond traditional crops and activities, though possessing substantial potential, requires significant investments in the development of financial, economic and business models (Hanusch, 2023). Institutional support to the bioeconomy should translate into increased demand, finance, markets and logistics for low-impact products that help conserve and enhance ecosystem services and support local people's livelihoods (Garrett et al., 2023). Positive incentives for a socio-biodiverse economy need to be expanded, including increased funds to dedicated credit lines, minimum price guarantee, preferential procurement and tax exemptions. This support may also include strengthening local production arrangements, use agreements and contractual agreements with fair business models for production, processing and trade (MMA, 2023).

FINANCING LAND AND FOREST RESTORATION MEASURES

The REDD+ framework (reducing deforestation and forest degradation and enhancing forest carbon stocks) exists to compensate climate mitigation efforts in the forest sector by developing countries. REDD+ operates through performance-based payments and requires reference levels, national monitoring systems and safeguards; however, funding currently relies on voluntary contributions that have proven insufficient. For instance, the donation-based Amazon Fund has only managed to finance approximately US$1.6 billion. This amount represents a mere 6% of the potential resources that could have been generated from possible emission reduction between 2006 and 2015 (Aliança REDD+ Brasil, 2017). Brazil's significant forest area, high emissions from land-use change and low land opportunity costs in agricultural frontier regions make REDD+ a promising strategy to finance climate change mitigation and biodiversity protection. Beyond REDD+, several other financing mechanisms can support land and forest restoration efforts in Brazil. PES schemes provide incentives to landowners for managing their lands in ways that restore and preserve ecosystem provided by forests. In 2023, Brazil launched its Sovereign Sustainable Bond Framework, enabling the country to issue green, social and sustainability bonds to finance government programmes that benefit the environment (World Bank, 2024). Additionally, multilateral funds like the Global Environment Facility (GEF) and the Green Climate Fund (GCF) provide financing for sustainable land use and forest conservation initiatives in developing countries.

An enabling environment requires growing attention to restoration efforts. Here, acceptance depends on financial feasibility and competition with productive agricultural and pasture lands. An expansion of land and forest restoration measures can be achieved through reallocation of harmful subsidies, with the potential to benefit communities engaged in reducing forest degradation, including Indigenous communities.

PROVIDING DIRECT COMPENSATION TO FARMERS FOR ECOSYSTEM SERVICES THROUGH THE INTRODUCTION OF REGENERATIVE AGRICULTURE PRACTICES

PES initiatives can offer financial incentives to families residing within conservation units and protected areas, encouraging their commitment to forest preservation. In return for their commitment, families receive monetary benefits, technical guidance and support for sustainable productive activities. In Brazil, initiatives for PES that link to poverty alleviation have proven effective. Two programmes – Bolsa Floresta and Bolsa Verde – exemplify the approach, though funding has been inconsistent and unreliable in the past. The incentive-based forest conservation initiative Bolsa Floresta reduced forest loss in the areas benefiting from the programme by 12% compared to other areas (Börner et al., 2013). Bolsa Verde, a cash transfer programme implemented from 2011 until 2018 that aimed to alleviate extreme poverty, benefited over 48,000 households and reduced deforestation while showing high cost-effectiveness (Alves-Pinto et al., 2018; Wong et al., 2019). There is a strong enabling environment for PES. Significantly, the National Policy on Payment for Environmental Services (Law 14,119/2021) has already been approved, but it needs to be regulated by official decree. There remains a risk that such programmes remain under-funded, so redirection of harmful subsidies could play a significant role in securing reliable PES funding.

DE-RISKING INSTRUMENTS TO ENHANCE FLOW OF FINANCIAL RESOURCES TO SMALL-SCALE FARMERS AND FOREST USERS

Various instruments can mitigate the risks associated with lending to sectors engaged in environmentally sustainable activities. These instruments aim to create an enabling environment for financial institutions, particularly those involved in riskier endeavours within less secure institutional contexts. Risk-sharing instruments pooling funds to absorb portions of project risks and credit guarantees offer assurances to lenders against potential default by borrowers, incentivizing financial institutions to extend credit to sectors traditionally considered high risk, such as small-scale agriculture and forestry (Gohdes & Christianson, 2017; OECD, 2023b). Reallocating harmful subsidies toward such de-risking instruments holds potential to promote forest restoration and the adoption of sustainable agricultural practices, as long as environmental criteria are applied.

IMPROVING THE RISK COVERAGE IN AGRICULTURAL INSURANCE TO REDUCE FARMERS' ECONOMIC LOSSES

Rural insurance can mitigate the risk inherent in agricultural production, primarily stemming from climatic and biological (e.g. pests and diseases) factors. This alleviates the impacts of events that may diminish production levels (Carrer et al., 2020). One primary mechanism addressing this issue is the Brazilian Rural Insurance Premium Subsidy Programme (PSR), which subsidizes a portion of insurance costs for farmers, lowering their financial burden (Braga et al., 2021). In 2022, subsidies for PSR amounted to US$215 million. This facilitated coverage for around 7.25 million hectares (approximately 3.1% of agricultural land) and benefited around 78,500 producers (OECD, 2023b). The low adoption rare suggests barriers that are likely linked to insufficient availability or inconsistent

Cerrado, Brazil. © Peter Caton / WWF-UK

continuity of government budget resources, alongside high transaction costs (Carrer et al., 2020).

Risk insurance and management programmes can incentivize farmers to adopt climate-smart and forest-preserving agricultural practices. While insurance and credit support have the potential to benefit a significant number of recipients, their effectiveness in fostering sustainable agricultural practices relies on the constraints and enforcement measures associated with initiatives that extend agricultural frontiers. Imposing environmental standards as conditions for contract approval can ensure the responsible allocation of credit. Continuous evaluation of the impact of environmental conditionality enforced through the Rural Environmental Registry (CAR), Agricultural Risk Zoning (ZARC) and the Forest Code is essential. Repurposed subsidies can play a significant role in expanding rural insurance, while promoting forest-preserving and restoring practices.

4.2.5 Complementary measures

The following complementary measures have been identified as important to create the conditions for a successful repurposing of public concessional loans in the context of government plans and strategies.

Land regularization and securing public lands: There is a need to advance land regularization to secure farmers' tenure rights, as well as the delimitation and designation of public lands, to avoid encroachment and further regularization of private occupations on public lands (Azevedo-Ramos et al., 2020). Effective measures penalizing invasion of public land are urgently needed to reduce forest clearing (Moutinho & Azevedo-Ramos, 2023). In addition, effective rules are need to plan allocation of public lands, respecting economic and ecological zoning processes. Ensuring transparency in the process of regularizing tenure rights is critical so that society has control over the allocation of public assets. In addition, regularizing and titling tenure rights for smallholders, medium-size and large-scale producers is critical to favour long-term investments in more sustainable agricultural systems. More clear and secure tenure rights and updated rural cadastres may also lead to more effective systems to increase tax collection from rural landowners (Pereira et al., 2019).

Institutional support to strengthen a socio-biodiverse economy: The ABC Plan could provide policy and programme support for a more socio-biodiverse economy in the Amazon and Cerrado. ABC aims to adapt Brazilian agriculture to climate change through integrated landscape management that associates production and conservation. Specifically, it provides incentives for environmental compliance, as well as the recovery and conservation of soil quality, water and biodiversity. It encourages the adoption and maintenance of sustainable production systems, practices, products and processes, such as practices for reclaiming degraded pastures, no-tillage systems and integrated systems (MAPA, 2022). The first phase of the ABC programme (2010-2020) led to visible environmental improvements. As of 2018, more than 4 million hectares of degraded pasture was recovered, about 5.8 million hectares of farmland adopted integrated crop-livestock-forestry, and no-tillage systems were adopted on nearly 10 million hectares, contributing to a CO_2 emission reduction of 100-154 million tonnes (Souza Piao et al., 2021). A challenge is to mobilize resources to support the market logistics and investments in processing capacities to support bioeconomy products linked to local economies.

Improved technical assistance and other support services: Technical assistance and other support services (e.g., financial, access to inputs, crop insurance) are unbalanced. There are very effective support systems for large-scale and medium-size farmers, yet they may not effectively reach small-scale farmers who in most need of these services. Meeting the needs of small-scale farmers for programmes supporting agroforestry, natural vegetation restoration, bioeconomy, and improved farming and ranching systems requires innovation, technical assistance appropriate to the regional realities, facilitators and training networks (MMA, 2023). In addition, agricultural services and technology transfer must consider the urgent need for the uptake of low-carbon production practices and strengthen the resilience of farming systems to future climate alterations. There is need to increase investments for developing technical packages that focus on innovation, climate change mitigation and adaptation, and increased productivity with potential to reach more farmers and accelerate the transition to an environmentally sustainable sector (OECD, 2022b).

Effective monitoring and improved accountability: A number of OECD countries use monitoring to ensure farmers adhere to environmental standards in order to be eligible for agricultural subsidies (OECD, 2010). This mechanism has proven effective in the short term and could serve as a transitional approach for implementing new agri-environmental measures (Meyer et al., 2014). However, using it as a long-term strategy may lead to crowding-out effects, as farmers might become less willing to comply with environmental rules in the absence of payments (Meyer et al., 2014). There has been important progress in national systems to monitor deforestation, though enforcement has been in question. In addition, traders and processors have invested in building traceability systems to ensure supplies comply with environmental standards. Besides these, however, there are not proper systems to monitor the cost-effectiveness of improved agricultural practices and progress towards adaptation. Support and adoption of tailored practices and their impacts on mitigation and adaptation must be monitored and evaluated to ensure progress in the sustainable transformation of production systems (OECD, 2022a). While there are systems to monitor agricultural development in Brazil, these lack granularity to evaluate specific interventions.

Indirect financial transfers through taxation: Reducing the costs of agricultural activities via indirect fiscal instruments represents an additional policy option to mitigate deforestation (Angelsen, 2010). In Brazil, the Rural Land Tax (Imposto Territorial Rural, ITR) aims to discourage the maintenance of unproductive pastures (Fendrich et al., 2022). Cost-effective models suggest that this type of taxation may yield more significant deforestation reduction than subsidies for semi-intensive production (Cohn et al., 2014). Increasing the taxation of unproductive pastures also has potential to control land speculation – a potent driver of land grabbing and deforestation (Fendrich et al., 2022; Reydon & Fernandes, 2014; Fearnside, 2008). As discussed in Fendrich et al. (2022), the ITR has the potential to enhance environmental protection at relatively small individual costs. However, despite its potential, this policy instrument currently faces challenges. These challenges include under-declaration of land value by landowners, outdated productivity criteria, and difficulties in monitoring compliance. Additionally, the policy is not entirely aligned with existing environmental laws and may prove ineffective in penalizing deforestation, leading to environmental distortions. Correcting these issues could strengthen the role of taxation as an additional fiscal instrument for preventing deforestation.

Soy industry workers. Cerrado, Brazil. © Peter Caton / WWF-UK

4.2.6 Impacts of repurposing – environmental, social, economic

ENVIRONMENTAL IMPACTS

Repurposing of agricultural subsidies can lead to multiple environmental benefits. Given the significant impact of beef production on deforestation and conversion, more sustainable cattle ranching will reduce the pressures associated with pasture expansion (Cohn et al., 2014), contributing to reduced carbon emissions and supporting climate mitigation (Bragança et al., 2022). The uptake of improved practices in cattle ranching has the potential to lower emissions linked to beef production: improved systems at scale could reduce greenhouse gas emissions intensity by an estimated 43%, reaching 55% when including changes in soil carbon stocks (Micol & Costa Jr., 2023). While avoiding deforestation (on and off-farm) constitutes the most cost-effective means to reduce emissions at scale, transitioning to low-carbon agriculture also contributes to reducing emissions (Rocha et al., 2022). In addition, the restoration of forests and other native vegetation constitutes an essential option for carbon removal, though restoration efforts must be implemented at scale to achieve their desired benefits (Lopes & Chiavari, 2024).

As well as maintaining carbon stocks (above and below ground) and regulating carbon flows, restoring and conserving forests regulates hydrological cycles, provides habitat for biodiversity, and provides other local environmental services (e.g., sediment retention, pollination). As part of a discussion on tipping points in the Amazon (Lovejoy & Nobre, 2019), there is a growing recognition of the cascading effects of forest degradation and conversion on climate, fires, and more accentuated and longer dry seasons leading to local climate change alterations (Flores et al., 2024). These climate change impacts can spread to better-conserved forest landscapes, causing a risk of forest shifts in the broader ecosystem (Wunderling et al., 2022). The intensification of the dry season is also occurring in the Cerrado (Hofmann et al., 2023). Avoiding deforestation and supporting forest restoration can therefore prevent a likely tipping point and help reduce the likely negative impacts of climate change and rainfall reduction on agricultural productivity. It has been estimated that reducing deforestation and conversion prevents agricultural losses in the southern Brazilian Amazon by up to US$1 billion annually (Leite-Filho et al., 2021).

Transitioning toward low-carbon agriculture and adopting integrated crop-livestock, silvicultural and agroforestry systems may have additional environmental benefits. Some studies have shown agroforestry increases the occurrence of native tree species and promotes forest succession (Leite, 2014).

Densely planted, pruned agroforestry systems that contain high species richness, including pioneer trees, support nutrient cycling (Steinfeld et al., 2024). A review of the environmental benefits of agroforestry systems in Brazil reports consistent positive effects on soil quality, habitat for biodiversity, and food provisioning (Schuler et al., 2022). In addition, more complex or highly diversified agroforestry systems seem most suitable to achieve essential ecological functions similar to those provided by native vegetation (Miccolis et al., 2019). This is backed by studies that, based on farmers' perceptions, highlight a higher occurrence of wildlife in agroforestry systems, as well as more species (de Abreu, 2023).

SOCIAL IMPACTS

Repurposing agricultural subsidies can bring social benefits by promoting inclusive and sustainable rural development. Technical assistance aimed at incentivizing the uptake of sustainable ranching and low-carbon agriculture will have a positive impact on improving producers' knowledge of better practices that lead to sustainable agriculture. This will result in better use of inputs, increased productivity and carbon sequestration (Bragança et al., 2022). Providing direct compensation to farmers for ecosystem services has the potential not only to improve smallholders' livelihoods but also to strengthen their social organizations (Brito et al., 2019). Expanding agricultural options that deliver social, environmental and economic outputs, such as agroforestry and integrated crop-livestock systems and bioeconomy value chains, may benefit farmers, particularly smallholders, by diversifying income streams, reducing market risks and improving food self-sufficiency (Garrett et al., 2023).

Expanding financial resources for small-scale farmers and improving conditions for accessing those resources will positively impact local producers and communities. However, smallholder support must be tailored to their needs, distinguishing subsistence and market-oriented farmers (Albuquerque et al., 2023). Some repurposing options should support smallholders to access markets, finance and technology, while others should try to reverse their socioeconomic vulnerability, such as by compensating their stewardship of nature. There is evidence that credit to smallholders has positive impacts on agricultural production, yet access is differentiated and linked to farmer education and farm technology (Maia et al., 2020). In addition, improving the coverage of agricultural insurance to smallholders could translate into social benefits and more stable income streams in the face of growing climate change.

To ensure a just transition, repurposing subsidies should be accompanied by social policies to mitigate any possible negative impacts on incomes, particularly for less skilled workers in the agriculture and beef production sectors. Repurposing subsidies can include equity considerations and provide broader and larger support to smallholders and local and traditional communities in transitioning to more diversified and sustainable livelihoods. Programmes that offer monetary benefits and technical guidance can encourage communities residing in conservation units to adopt sustainable practices and diversify their livelihoods and sources of income. Finally, it is critical that supporting policies fully recognize the rights of Indigenous peoples and local communities to their lands and territories.

ECONOMIC IMPACTS

A transition from traditional cattle ranching systems to more sustainable systems, accompanied by pasture restoration, can translate into improved yields since enhanced pasture management practices allow for an increase in the cattle stocking rate per hectare. Yet the incentives for cattle intensification are not homogeneous. In landscapes with low remaining forest cover and on properties with little current deforestation, intensification comes from a reduction in slaughter age (Skidmore et al., 2022), while better market access can also increase economic opportunities. In the case of soy, yield increases and soy expansion only in already converted pasturelands would allow Brazil to increase by production by 162 million tonnes without deforestation or conversion and with 58% lower global climate warming (Marin et al., 2022). More sustainable agriculture and cattle ranching systems may also involve a growing expansion of integrated crop-livestock systems, leading to potential increases in productivity and lowering production costs, which could result in a more profitable system (Elejalde et al., 2023). In addition, integrated systems tend to be less sensitive to price fluctuations and could help to diversify market risks and increase economic value at the regional level (dos Reis et al., 2023).

Benefits of shifting from traditional farming systems to more intensive ones are also associated with higher upfront investments in fixed assets and working capital. Due to higher input costs, there will likely be a transition from low-risk traditional cattle ranching systems to more intensive and riskier systems (Micol & Costa Jr., 2023). This is also the case for agroforestry systems. The benefits of agroforestry systems, including economic gains, depend on the specific agroforestry system and how it is managed and designed (Pashkevich et al., 2022). More complex agroforestry systems – including combinations of trees with perennial tree crops and annual crops – that could deliver greater environmental benefits may also require higher upfront investments and show low financial performance during the first years of implementation (Padovan et al., 2022). Yet experiences across various contexts show that the expectation of obtaining higher benefits can be a strong incentive for adopting these systems (Piñeiro et al., 2020). In addition, agroforestry systems absorb family labour (though labour intensity may decrease as the trees mature) and contribute not only to cash-income generation but also as a source of food supply. Agroforestry adoption may, however, accentuate economic and social differentiation, and the expectation of economic gains could increase pressures on primary forests (Ollinaho & Kröger, 2021).

Forest restoration has potential to generate up to 2.5 million jobs through the ecosystem restoration supply chain if Brazil meets its goal of restoring 12 million hectares of degraded land by 2030 (Brancalion et al., 2022). In addition to jobs, land and forest restoration expands the delivery of goods and services from natural ecosystems, some of which have economic value (e.g., timber). While most of the benefits do not have a direct economic value, they provide critical services which are essential to agriculture and the livelihoods of farmers and local communities, such as water retention, evapotranspiration and regulating hydrological cycles. Greater economic benefits could be obtained from restoration by integrating economic activities like agroforestry and sustainable livestock intensification (Rocha et al., 2022).

A nationwide PES programme could incentivize forest conservation and sustainable land management by ensuring additionality through result-based payments. Programmes like the Bolsa Floresta and Bolsa Verde have demonstrated the effectiveness of providing monetary benefits and support for sustainable and productive activities to families in conservation areas, with observed benefits in enhanced livelihoods and strengthened social organization but may not be enough to lift people out of poverty (Brito et al., 2019). A well-designed PES programme with sustainable funding sources could encourage environmental stewardship, particularly for local populations that depend on natural resources for their livelihoods.

4.2.7 Conclusions

The Brazilian case illustrates the complex processes that contribute to deforestation and conversion, with different dynamics between the Amazon and Cerrado, and the role that subsidized credit loans play. Among the different subsidies supporting agricultural expansion in Brazil, subsidized credit is the main source of support to commercial farmers. While public funding remains significant, the proportion of commercial finance has increased, especially in the Cerrado.

While the role of subsidized public credit is difficult to isolate from the other factors contributing to deforestation and land conversion, a significant portion of public credit loans is allocated to geographies with high rates of deforestation and conversion. This is more significant in the Amazon than in the Cerrado. While this does not demonstrate that subsidized credit directly triggers deforestation and conversion, support for agriculture and cattle production expansion may indirectly increase the pressure for further deforestation and conversion. If public credit is allocated in places with higher deforestation and conversion risk, this could pave the way for the deployment of commercial funds once the agricultural frontiers are established.

Reforming the scope and conditions of public subsidized credit could target a wider uptake of sustainable agricultural practices, more integrated agroforestry systems and strengthening the bioeconomy. Overall, public subsidies could play a more strategic role in facilitating the transitions required in the agricultural sector in the Amazon and Cerrado. Subsidy reform must be accompanied by more structural complementary measures, including land regularization and securing public lands, institutional support to strengthen a socio-biodiverse economy, improved technical assistance and other support services, effective monitoring and improved accountability, and indirect financial transfers through taxation.

Palmares soy farm, Cerrado, Brazil. © David Bebber / WWF-UK

Lujeri Tea Estate. © mhenrion / Shutterstock

4.3 MALAWI

- Deforestation and degradation are occurring at an alarming rate in Malawi, with available data showing that agricultural expansion is a key driver of both direct forest conversion and overexploitation of forest resources.
- The main source of public funding is the Affordable Inputs Programme, which subsidizes fertilizer and seed prices for rural households that meet certain socio-economic criteria, and who mostly grow the local staple crop: maize.
- The programme, in operation since 2005, comprises 9% of national spending and has crowded out other agricultural sector support, such as government programmes for on-farm services and capital support.
- The intended and unintended consequences of the programme for smallholder livelihoods and farming practices have had strong indirect impacts on Malawi's forests.
- Overuse of wood resources for firewood and charcoal production is not directly subsidized, but there are 'disincentives' for sustainable behaviour, such as taxation on legally licensed charcoal and a lack of alternative energy sources.
- The existing input-focused subsidy programme has not effectively improved smallholder agricultural production, incomes or food security, and represents a major drain on public resources that also causes harmful externalities.
- There are several options for repurposing public funds that could directly address agricultural drivers of forest conversion and degradation, which should be part of a coordinated sector-wide approach.
- The repurposing options include diversifying crop production to improve resilience to climate change and food security; supporting agroforestry systems for income generation and wood production; upscaling financing of landscape restoration measures; strengthening non-maize value chains; supporting the production of organic fertilizer; and supporting the country's fertilizer storage capacity.


Selling potatos along the road to Dedza. © https://www.shutterstock.com/g/DianaKykot

4.3.1 The context

Malawi is a small, landlocked, low-income country that is facing multiple challenges resulting from land degradation. The country has a total area of 118,500km² and an estimated population of 18.9 million (National Statistical Office of Malawi, 2022). Agriculture accounts for 30% of the country's GDP (CIAT & World Bank, 2018) and constitutes the main livelihood for more than 90% of the population (FAO, 2015b). The main crops produced in the country are tobacco, maize, rice, cassava, legumes, sweet potato and Irish potato. Tobacco is the main export crop (66% of agricultural export) (CIAT & World Bank, 2018).

Forests are important contributors to Malawi's economy. They account for 5% of the country's total wealth (World Bank Group, 2019). According to the national income accounts, the forest sector contributed only 1% of value added in 2010. However, if non-commercial uses are included, notably firewood and charcoal, this contribution rises to 7.9% (Hecht & Kasulo, 2013).

Land degradation is a widespread issue in the country. According to Asfaw et al. (2018), costs from soil loss in Malawi were estimated to be 0.42-2.1% of the agricultural GDP, and 0.25%-1.28% of the total GDP, depending on the severity of the soil loss scenarios. A UNDP report from 2016 estimated soil loss in Malawi to be between 5 and 10 tonnes per hectare per year, with an average of 7.5 tonnes (Vargas & Omuto, 2016). Forest loss and degradation are also major contributors to Malawi's greenhouse gas emissions. In 2011, land-use change and forestry accounted for 56% (of which forestry was responsible for 70%) of the total country's quantified emissions, and agriculture for 40% (World Bank Group, 2019).

Over the past 20 years, Malawi has lost significant portions of its natural forest ecosystems. According to recent studies and data available, the country has lost between 222,000 hectares of natural forest since 2000 (Global Forest Watch, 2022) and 435,312 hectares during the period 2000-2015 (Skole et al., 2021), equivalent to a reduction of respectively 7.9% and 19% of tree cover. The large difference between these two numbers shows the lack of consistent data in the country and the difficulty in obtaining a clear picture. On average, 33,000 hectares of forest is cleared every year (Ngwira & Watanabe, 2019) which partly corroborates the figure of 435,312 hectares of forests lost from 2000 to 2015. Forest degradation is also a widespread phenomenon with an estimated 815,531 hectares of forests degraded over the period 2000-2015 (Skole et al., 2021).

The main direct drivers of deforestation are agricultural expansion from various crops including maize, bush fires and infrastructure development. Regarding forest degradation, key drivers are overexploitation of biomass for charcoal and firewood production, tobacco cultivation which requires wood poles to build drying sheds, and timber production. The importance of these drivers varies from region to region (Ministry of Natural Resources, Energy and Mining of Malawi, 2017a; Ngwira & Watanabe, 2019; Nyengere, 2017). The Forest Landscape Restoration Opportunity Assessment for Malawi identified some of the key indirect drivers of deforestation and forest degradation as lack of alternatives to firewood and charcoal for household energy use;[39] inadequate policies and strategies to boost crop yields on existing agricultural land to prevent further forest clearing; adverse agricultural policies impeding the adoption of conservation farming; ineffective subsidies for mineral fertilizers; and inconsistent guidance from extension workers on sustainable land management practices (Ministry of Natural Resources, Energy and Mining of Malawi, 2017a).

4.3.2 Evidence of deforestation and forest degradation

There have been several remote-sensing mapping exercises to estimate the forest cover of Malawi. The results of these studies are inconsistent, ranging from 18.2% to 28.7% of the total country area covered by trees (Haack et al., 2015).

Loss of forest cover and degradation of remaining forests are occurring at an alarming rate, but data on current forest cover and on the rate of forest degradation vary. There is a lack of up-to-date, reliable and comprehensive data on the rate of deforestation. There are estimates that 47% of Malawi's forests were lost between 1972 and 1992 – a rate of 2.8% per year (Forestry Department of Malawi, cited in Kainja, 2000). This is corroborated by other sources which indicate that Malawi lost more than half of its forests in the last 40 years (World Bank, 2020b). Even less information is available on forest degradation (Skole et al., 2021), though the World Bank estimates that timber harvests exceed sustainable yield by about 71% (World Bank Group, 2019). Available data on changes in forest cover since 2000 is presented in Table 5 below.

One of the reasons to explain the difference between these estimations is the use of satellite imagery of varying quality and accuracy, and the chosen methodology which in most cases only quantifies forest cover/loss in forest reserves and protected areas, and does not include tree clusters, woodlots, agroforestry, and village forests on agricultural or customary land (Skole et al., 2021). However, trees outside protected areas constitute up to 42% of the total forest cover (Mauambeta et al., 2013) and are more subject to deforestation than forests of national reserves and parks (Skole et al., 2021). In this regard, the work of Skole et al. (2021) provided in the table below can be considered more accurate than the other sources, since it takes into account all forests, regardless of their ownership or protection regime. Their study also provides information on forest degradation which is missing in other sources.

Table 5: Extent of deforestation and forest degradation in Malawi

	DEFORESTATION				FOREST DEGRADATION	
Source	Time range[40]	Total forest loss (ha)	Annual average forest loss (ha)	Annual forest loss rate (%)	Total degraded forest (ha)	Annual degraded forest (ha)
Skole et al., 2021	2000-09	201,688	22,410	-	386,648	42,961
	2010-15	233,624	38,937	-	431,266	71,878
Ministry of Natural Resources, Energy and Mining of Malawi, 2019	2006-16	88,474	8,847	0.63	-	-
Global Forest Watch, 2022	2001-09	55,761	6,466	0.41	-	-
	2010-15	64,306	10,718	0.70	-	-
	2006-16	104,627	9,512	0.40	-	-

4.3.3 Subsidies and their impacts on forest resources

OVERVIEW OF THE MAIN SUBSIDIES CONNECTED WITH LAND USE CHANGE

In Malawi, the main subsidy connected with observed land-use change is the Affordable Inputs Programme (AIP). This subsidy programme is by far the largest in the agricultural sector. Input subsidies were provided for decades until they were removed in the 1990s. In 2005, Malawi faced a major food crisis and the Farm Input Subsidy Programme (FISP) was introduced to increase agricultural productivity and improve food security (FAO, 2015). The programme, renamed Affordable Inputs Program in 2020, has been in continuous operation since 2005. Its current objectives are to achieve food security, improve nutrition and reduce poverty by further increasing farmers' access to improved production inputs (Ministry of Agriculture of Malawi, n.d.). Some 57% of all public expenditure in support of food and agriculture is channelled through the programme, which makes up 64% of the Ministry of Agriculture budget and 9% of national spending (FAO, 2015b).

The AIP provides fertilizer and seeds at a subsidized price to rural households that are selected based on socioeconomic criteria. The proportion of the programme's budget allocated to fertilizer has decreased over the years from 96% in 2011 (Chibwana & Fisher, 2011) to 84% in 2020 (C. J. Nyondo et al., 2021). However, the focus of the programme remains on fertilizers and to a lesser extent on seeds. As shown in Table 6, the crops included in the programme have been changing. Maize remains the main staple crop supported by the programme, both through fertilizer and seeds of improved varieties. Between 2006 and 2013, an average of 71% of agricultural public expenditure went to maize. Tobacco received support from the programme only from 2006 to 2009, despite being the country's main export crop (FAO, 2015b).

Table 6: Key figures of Malawi's Affordable Inputs Programme

	FISP										AIP		
Year	05-06	06-07	07-08	08-09	09-10	10-11	11-12	15-16	18-19	19-20	20-21	21-22	22-23
Beneficiaries (million)	N/A	N/A	N/A	1.5	N/A	N/A	N/A	N/A	1	0.9	3.8	3.7	2.5
Fertilizers	50 kg urea + 50 kg NPK (until 2008, specific tobacco fertilizer was included too)												
Fertilizer voucher value (US$/bag)	1.7	2.5	3.2	7.7	3.7	5.1	6.4	16.5	15	15	4.4	N/A	N/A
Seeds	Maize		Maize, cotton		Maize, legumes, groundnut		Maize, legumes, groundnut, cotton	Maize, legumes, groundnut			Maize		
Seed voucher value (US$/bag)	N/A	N/A	N/A	N/A	0.15	N/A	N/A	0.5-1	2-5.8	5.8	1.9	N/A	4.9
Subsidy (percentage of input real cost)	64	72	79	91	88	91	93	N/A	N/A	N/A	N/A	N/A	68
Total programme budget (US$ million)	36.43	53.57	82.14	139.14	155.04	129.99	129.48	102	N/A	N/A	129	138	107

Source: Asfaw et al., 2017; Chibwana & Fisher, 2011; FAO, 2015; Malawi Nyasa Times, 2022; Mangazi, 2022; Ministry of Agriculture of Malawi, n.d.; Nyondo et al., 2021; The Nation, 2022

Farmer, Malawi. © Shutterstock.com

Until 2018, farmers also received additional public support that were not subsidies *per se*. These were on-farm services (extension etc.) and capital (including on-farm irrigation and infrastructure). Both combined accounted for only 4% of the total support, compared with 96% in the form of input subsidies through the AIP (FAO, 2015b). Capital support stopped in 2016 and on-farm services in 2018.

Processors used to receive support to improve agricultural processing through facilitated access to credit, equipment and technology. This support was terminated in 2013 (MAFAP Data Hub, 2022).

There are also other types of public agriculture-supportive expenditures that do not take the form of subsidies. Rural infrastructure accounts for 91% of these expenditures. Within this budget, 90% is spent on rural roads with the objective to facilitate the transportation of agricultural goods, improving incomes for producers in remote areas (FAO, 2015b).

This review of subsidies and other support programmes in the agricultural sector shows a clear dominance of the AIP, both in terms of the volume of support and the continuity over the years. The AIP has crowded out other support to the agricultural sector.

Although the focus of this report is on agricultural subsidies, the importance of firewood and charcoal production in forest degradation called for a rapid assessment of possible harmful subsidies in the energy sector. This assessment shows that there are no subsidies that drive the overuse of wood resources for charcoal and fuelwood production. However, there are a range of "disincentives", such as the taxation of legally licensed charcoal, which tend to favour illegal production and prevent the scaling up of sustainable charcoal production. In terms of incentives for alternative energy, the government removed VAT on liquified petroleum gas in 2019. Energy efficiency is also leveraged to decrease wood consumption, with import tax reliefs for improved cooking stoves and accessories. Despite these tax incentives, the demand for biomass remains high due to the lack of reliable alternative energy sources. Given that the demand for biomass is not driven by a specific subsidy programme, the analysis of the impact of subsidies on deforestation and forest degradation presented here does not include the energy sector. This sector is considered in repurposing scenarios outside the agricultural sector presented in Annex A4.

IMPACT OF SUBSIDIES ON DEFORESTATION AND FOREST DEGRADATION

Based on literature and interviews with experts, the transmission mechanism between the AIP and forest degradation mainly shows indirect impacts. These indirect impacts include the expansion of agricultural land due to loss of soil fertility from overuse of mineral fertilizer, the harvesting of wood for tobacco curing when inputs are diverted from their intended purpose of growing maize to growing tobacco, and the harvesting of firewood for quick cash income due to the failure of AIP to improve livelihoods (see Figure 17). To further explore these effects, we investigate the impacts of the programme on land-use patterns, production systems and local livelihoods under the influence of external institutional, economic and environmental factors, and how these can be linked with deforestation and forest degradation.

A number of researchers have examined the impact of input subsidies in Malawi. These studies investigate the performance of farms benefiting from the subsidies, changes in production systems, impacts of the AIP on livelihoods, and externalities such as environmental degradation, soil fertility depletion and deforestation resulting from increased use of mineral fertilizer. Some of the key studies date back to the early 2010s and must be considered carefully as the focus of the AIP has slightly changed. Socioeconomic conditions in rural areas have also evolved in response to changes in public policies, markets, and other influencing factors at global and national levels.

A study in Chimaliro and Liwonde forest reserves (Chibwana et al., 2012) shows that input subsidies induced the intensification of food crop production, in particular maize, which reduced the rate of forest clearing for agriculture expansion and income generation among households benefiting from subsidies. However, tree removal continued for the construction of tobacco drying sheds (the AIP ceased support of tobacco production in 2009).

The same author noted in 2011 (Chibwana & Fisher, 2011) that input subsidies partly changed the production system from a multi-cropping system to monocropping of maize, with households who received coupons for maize fertilizers and seeds allocating 45% more of their land to the crop compared to other farmers. This situation contradicts the policy objective to diversify agricultural production (FAO, 2015b). Due to the lack of crop rotation, especially with legumes, and the use of mineral fertilizers without the adoption of integrated soil fertility management techniques, significant soil nutrient losses have been reported, resulting in low maize yields. In 2016, a study confirmed the relationship between low productivity in the agricultural sector and soil degradation resulting from poor agricultural practices. In this case, the study found that low productivity combined with population growth resulted in farmers expanding farmlands at the expense of forests (Vargas & Omuto, 2016).

Several articles (e.g., De Weerdt & Duchoslav, 2022) and interviews with Malawian experts indicate that the targeting system of the AIP has not been able to reach the right beneficiaries, which prevents the programme from achieving its objectives and has negative externalities, including on forests. In theory, the AIP targets rural households that are dependent on agricultural production and have difficulties in purchasing inputs. In reality, there are many reported cases of households who do not have the financial capacity to redeem their vouchers, who receive the voucher at the time of year when they are most food insecure, or who do not have the labour to convert the inputs provided by the AIP into meaningful outputs. These households often sell their coupons to other farmers to meet urgent cash needs, and their individual yields remain low. The programme also regularly faces logistical problems that prevent fertilizers from being delivered on time or in sufficient quantities. As a result, the productivity of many farmers who should benefit from the programme remains low, as does their income. These farmers often turn to the forest for firewood and charcoal to meet short-term income needs.

In the Central region of Malawi where most tobacco is produced, the interviewed experts emphasized that some of the farmers who get maize fertilizers through the AIP apply it to tobacco fields. There are also reported cases of coupons being transferred by farmers unable to use them to tobacco growers, who further apply fertilizers for growing tobacco. As described in section 3.1, tobacco production is one of the main direct drivers of forest degradation. It is also a driver of deforestation through the expansion of production into forest lands.

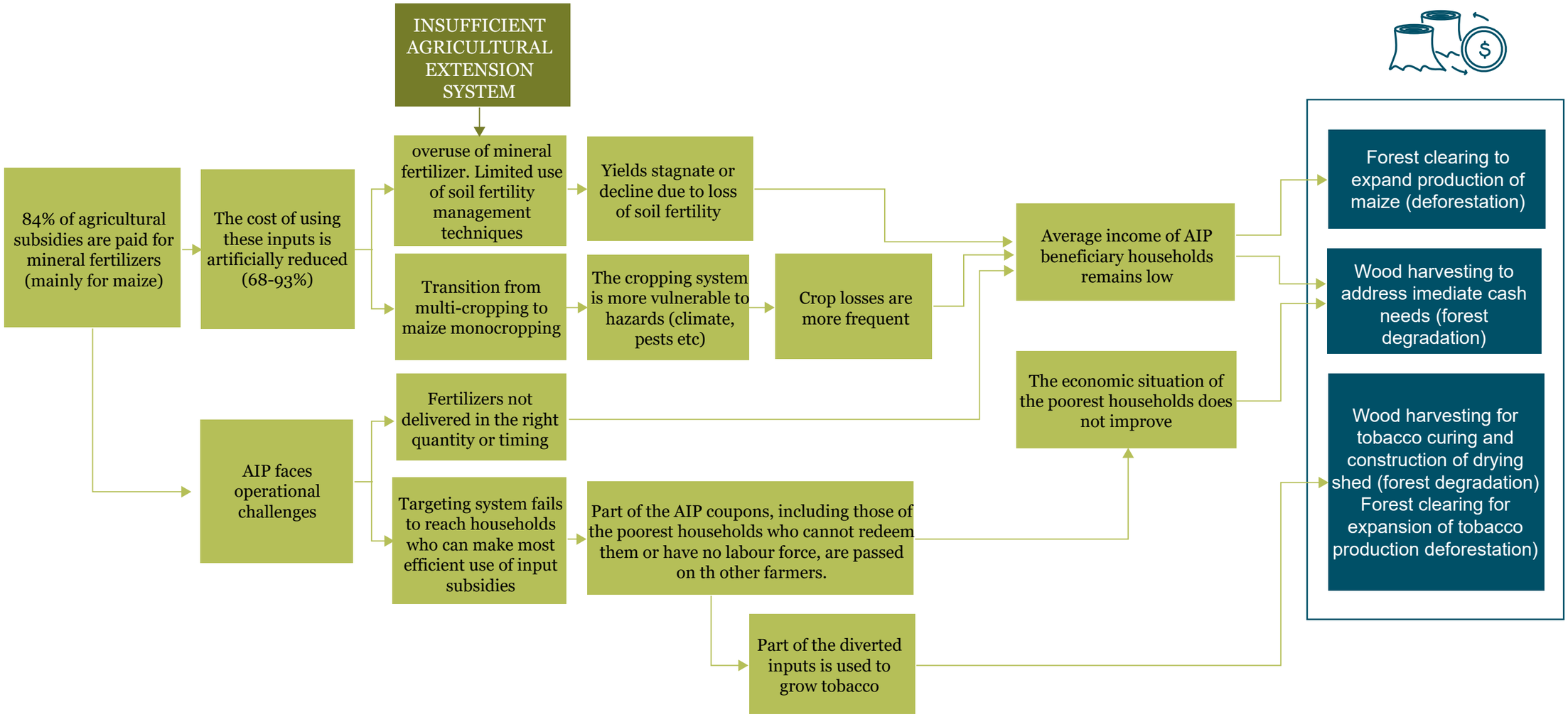
By promoting maize monoculture, the AIP has made farmers less resilient to hazards and more likely to experience crop losses. In this way, it has indirectly contributed to deforestation, as farmers tried to compensate for economic losses by expanding cropland. This is because households with maize monoculture become more vulnerable to climate variability and change, particularly as they grow fewer drought-tolerant crops such as cassava and sweet potato. They also become more exposed to pest and disease outbreaks (Chibwana & Fisher, 2011), and the occurrence of crop losses due to flooding, droughts, pests and diseases has increased. A positive correlation was found between forest clearing and the indicator of whether the household experienced a crop loss in the preceding year (Chibwana et al., 2012). The Malawian experts interviewed during the study contrasted this by saying that while crop losses do not always lead to complete deforestation, they often lead to forest degradation as firewood production is the primary and traditional way of meeting urgent cash needs.

A compounding effect to the impacts of the AIP on deforestation and forest degradation is the weak public agricultural extension system which faces severe budgetary constraints. In Malawi, extension is decentralized at the district level. The 11 districts in the country are divided into sections, where an agricultural extension development officer is responsible for capacity building for farmers. However, due to understaffing, from 24% up to 65% of all sections (depending on the district considered) have no officer (World Bank, 2020a). The fifth household survey (GoM, 2020) indicates that only 5.5% of the population is reached with extension services for agroforestry. It is not unusual to find communities that have never seen their extension officer (Unique Land Use GmbH, 2018).

Based on the various impacts of the AIP described above, the programme appears to be at least indirectly driving forest degradation and deforestation. Figure 17 below summarizes the transmission mechanism from the AIP to forest degradation and deforestation. It is important to note that the links between the boxes in the figure are based on assumptions that cannot be fully confirmed due to a lack of data and information. There is also little information available to weigh and quantify the different causal chains described in the diagram. Dedicated research in a specific region of the country would be needed to determine the relative importance of these causal chains.

Collection of tobacco. © Shutterstock.com

Figure 17: Transmission mechanism from agricultural subsidies to deforestation in Malawi



Source: Original elaboration for this publication

4.3.4 Opportunities for repurposing

FRAMEWORK AND RATIONALE

The AIP is a subsidy programme focused almost entirely on inputs, mostly fertilizer, and improved seeds to a lesser extent. The effectiveness of the programme in achieving its initial objectives – food security and poverty alleviation – has not been demonstrated (World Bank Group, 2022). Meanwhile, there are a number of externalities, including deforestation. Forests provide ecosystem services such as water cycle management, erosion control and biodiversity conservation which benefit agriculture. Lately, in the context of a sharp increase in the cost of fertilizers following Russia's war in Ukraine, the rationale of the AIP and in particular its benefits versus the costs for the government budget have been called into question. There have been discussions for more than a decade among academics and development practitioners about reviewing the focus and operational procedures of the AIP and coming to an exit or at least a scaling-down strategy for the programme. For example, in 2019, the World Bank emphasized the necessity to transform the AIP from being input-oriented to a sustainable land stewardship programme promoting agroforestry, forest restoration and sustainable land management practices (World Bank Group, 2019).

In 2022, the president of Malawi mentioned the necessity to reform the AIP. This was confirmed in a speech by the minister of agriculture at the 2023 Global Forum for Food and Agriculture held in Berlin. The government is therefore committed to reforming the programme by reducing its allocation and improving its efficiency, although concrete steps remain to be taken.

There are many proposals to reform the AIP and make it more effective. Some concern improving the programme's targeting system and some its operational processes, which do not require repurposing financial resources but rather political decisions. These proposals are not included in this report. Based on the literature review and the interviews, several repurposing opportunities in other sectors have also been identified, e.g., to support alternative sources of energy, and to strengthen the forest management framework, among others. Given the scope of this study, only the forest sector was considered relevant for the repurposing of AIP funds.

As for the need to reform other sectors that also drive forest degradation and deforestation, it is preferable that these options be financed from the budgets of the respective sectors. For this reason, repurposing opportunities outside the forest sector, like alternative energy sources, are not considered suitable repurposing options in this report but are included for information in Annex A4. In addition, the financing of different sectors would be more efficient if it were well coordinated. For example, it would be possible to focus electrification efforts in areas where irrigation networks are being expanded and the use of pumps is required. To harmonize investments and support programmes, interviewees emphasized that reviving the sector-wide programme approach used 10 years ago would be a first step.

Based on the literature review and interviews with national and international stakeholders, we applied the repurposing framework presented in Section 3.2 to the context of Malawi. This analysis led to the identification of appropriate repurposing options and complementary actions needed to create an enabling environment for successful repurposing. Table 7 below presents an overview of the prioritized repurposing options for Malawi. A detailed description of each of these options, as well as of the complementary measures, follows in the next sub-sections. The relevance of the proposed measures was triangulated during the interviews. Nevertheless, this table should be regarded as an example of how the repurposing framework can be used in Malawi, based on the opinion of a few experts and on high-level policy documents. A full-scale repurposing process in Malawi would require wide stakeholder engagement supported by socioeconomic and environmental analyses.

Table 7: Assessment of repurposing options in Malawi (see A 6 for further assessment details)

REPURPOSING OPTIONS	ENABLING ENVIRONMENT (LOW/MEDIUM/HIGH)						EXPECTED IMPACTS (- - / - / NEUTRAL / + / ++)			
	Political and institutional and feasibility	**Acceptance**	**Technical feasibility**	**Financial feasibility**	**Scalability**	**Conclusions enabling environment**	**Social impacts**	**Environmental impacts**	**Economic impacts**	**Expected key impacts**
Diversification of AIP support to increase productivity and restore the land										
Diversification of crop production	High	Medium	High	High	Medium	Production systems were more diversified in the past, knowledge exists. More diverse species in the AIP in the past was positively perceived. Different species/varieties can be proposed to match conditions in different regions. This requires stronger extension services and support of the respective value chains.	++	+	+ / -	Better nutrition, diversified income (safety net for crop failure), soil restoration (if legumes are used). Economic impacts may vary depending on whether value chains are in place.
Support for agroforestry systems	Medium	Medium-High	Low	Medium	Medium	Agroforestry is included as a target in land restoration strategies. Successful experience in the country exists. This requires stronger extension services, support of the respective value chains, and an efficient network of professional tree nurseries with good quality seed and seedling supply.	++	++	+ / -	Provision of alternative sources of energy (fuelwood), soil restoration, additional incomes from trees (fruits, firewood, timber). Trees take several years to generate income. Poor households may not have the capacity to invest in tree planting or may face economic hardship for several years, potentially leading to more forest degradation for quick cash.
Forest landscape restoration (FLR)										
Financing of landscape restoration measures	Medium	Medium	Medium	High	Medium	Momentum in restoration with large-scale investments from donors foreseen. Reducing the erosion rate is high on the political agenda. Acceptance by the population is not guaranteed if restoration measures conflict with traditional land uses. A network of professional tree nurseries with good quality seed and seedling supply is required.	+	++	+ / -	Soil restoration, reduction of soil erosion. Reduction of sedimentation in hydropower facilities. Income diversification from trees. Restoring degraded land requires investment and takes several years before the land user can expect an income.
Strengthening of agricultural value chains										
Strengthen non-maize value chains	Low	Medium	Medium	Medium	Medium	Political emphasis is on maize as the main staple crop. Other value chains (besides tobacco) are underdeveloped, and important investments are needed along other value chains. There might be political reluctance to invest into alternative value chains, as major efforts (infrastructure, knowledge) have been placed on maize.	+	+	+	The price and profitability of alternative crops will increase as value chains become structured. More diversified production systems are more resilient. Private businesses involved in the maize value chain may face economic difficulties or will need to diversify their activity, if public support shifts away from maize to other value chains,
Strengthening of domestic input supply										
Support for organic fertilizer production	High	Medium	High	Medium	Medium	Political declarations were made in this direction. FAO supports the development of standards for organic fertilizers. Precise data is needed to assess the volume of organic fertilizer which can be realistically produced in the country. Extension services are needed to boost acceptance. Capacity building is also necessary from biomass providers to organic fertilizer producers. Important investments are also required in processing equipment, transport etc. Businesses that are currently involved in transporting and storing imported mineral fertilizers can be negatively affected by this measure.	+	++	+	Organic fertilizers help restore soil while maintaining or improving yields. Less nutrient leaching. The use of organic fertilizers can have environmental externalities and may not produce the expected yield if not applied correctly.
Improvement of fertilizer storage capacity	Medium	High	Medium	Low	Medium	Domestic storage would avoid delays in delivery and dissatisfaction from the population. High costs connected with the infrastructure.	+	-	+	Mineral fertilizers delivered on time support good yield. Soil degradation will continue if mineral fertilizers remain used intensively. This measure does not end the monopoly position of certain businesses in the storage and distribution of fertilizers, which prevents the emergence of a dynamic network of private actors in the agricultural input sector.

REPURPOSING OPTIONS

Diversification of crop production to improve resilience to climate change and food security

In the past three years, the AIP has been restricted to providing maize seeds and mineral fertilizer that is suitable for maize production. As emphasized in 4.3.2, monoculture leads to soil degradation and makes farmers less resilient to climate hazards, which increases the risk of crop loss. This, in turn, leads to forest degradation. It is recommended to widen the number of species included in the programme, in particular legumes, and to make access to subsidies conditional to the use of a more diverse cropping system. It is also recommended to make a greater focus on seeds instead of fertilizer. Subsidizing legume seeds, for example, was found to increase the area planted with legume crops, yield and gross value of crop production, and to enhance consumption diversity and the intake of micronutrients by households (Khonje et al., 2021). The crop species proposed to farmers must match agroecological zones to ensure that crops are grown under optimal conditions.

This diversification process should be accompanied by complementary measures linked to supporting agricultural research and strengthening the value chain of non-maize crops.

Support for agroforestry systems for income generation and wood production

Agroforestry does not recreate forests *per se*, but rather adds more trees to the landscape. This has multiple benefits that can help address issues related to land degradation, fertility loss, and tree harvesting for charcoal production. A study carried out in the Ntchisi district on cash incentives for planting and caring for trees showed that 97% of the beneficiary farmers protected the trees during the period when incentives were being paid (Jack, 2010).

The 2017 National Forest Landscape Restoration Strategy recommends including fruit trees for income generation and nutrition, and timber trees for firewood provision and charcoal production. Both species types would also support the efforts to reduce land degradation. Subsidies can include the provision of seedlings (possibly for free during the first years, and then at a subsidized price), required inputs and extension related to tree care. In a scenario where trees are subsidized, a careful selection of the tree species will be needed to match the agroecological zones of the different provinces. To ensure farmer buy-in, it is recommended to package tree subsidies with crop input subsidies and extension services.

Upscaling of financing of landscape restoration measures

In Malawi, expenditure for forestry, land management and environmental protection increased by over 500% between 2012 and 2018, including major investments in rehabilitating forest plantations and land management research. However, in absolute value, it remained low and accounted for only 2% of agriculture public expenditure (2006-2018) (Pernechele et al., 2021).

In 2017, the Ministry of Natural Resources, Energy and Mining emphasized the need to create a fund to support the long-term financial needs of restoration projects (Ministry of Natural Resources, Energy and Mining of Malawi, 2017a). The ministry proposed that a fund be created to accumulate resources from tax revenues and other sources to finance restoration projects. In this regard, part of the AIP budget could be repurposed to finance forest restoration projects on farmlands, with the ultimate goal of increasing crop yields and making agriculture more resilient. If restoration measures are financed at the level of individuals, the (improved) targeting system of the AIP could also be used to channel the funding to the right beneficiaries.

Strengthening of non-maize value chains

Better-off farmers would benefit more from interventions for better agricultural commercialization than input subsidies (World Bank Group, 2022). In Malawi, the tobacco value chain, which is not subsidized, is the most developed among agricultural value chains, and is a significant driver of deforestation. The maize value chain is less structured, although there is some vertical integration. By strengthening the value chains for alternative crops, such as legumes, cassava and groundnuts, the price and profitability of these crops will increase. This will encourage farmers to cultivate more of these crops and diversify their production system, at the expense of maize monoculture and tobacco. Such diversified production systems will be less affected by hazards and related crop losses. This will therefore mitigate the risk of forest clearing by farmers who have experienced crop losses. The shift in certain areas from tobacco production to other crops will also decrease the demand for wood, which is high for tobacco curing (Ngwira & Watanabe, 2019).

Support for the production of organic fertilizer, and making it a key element of the AIP

At the 2023 Global Forum for Food and Agriculture held in Berlin, Malawi's minister of agriculture stated that the government was considering reforming the AIP, in particular by moving away from mineral fertilizer alone to include organic fertilizer. However, there is no approved quality standard for organic fertilizer produced domestically. FAO is currently working with the Ministry of Agriculture on this aspect, which is a first step toward the standardization of the composition of organic fertilizers in the country.

A major difficulty is that there is currently no large-scale plant in Malawi that could produce enough organic fertilizer to shift a significant proportion of AIP from mineral to organic fertilizer. Such a large-scale organic fertilizer production plant exists in Botswana, and this could serve as an example for Malawi to create a similar one. The government of Malawi should consider repurposing a share of the AIP budget to support private sector investment in the production of organic fertilizers. This could take the form, for example, of low-interest credits, state credit guarantee schemes for private investment in this business, or tax relief on the import of equipment to produce organic fertilizer.

Once there is a secure supply of organic fertilizer in the country, further conditionality can be introduced in the AIP to require recipients of mineral inputs to also use organic inputs.

Support for the country's fertilizer storage capacity

Even in a case where the AIP steadily phases out from providing only mineral fertilizers to a broader package of inputs and extension services, it is likely that mineral fertilizers will remain as one of the elements of the reformed programme.

Corn fields, Malawi. © https://www.shutterstock.com

Mineral fertilizers are imported every year, and one problem is the timing of their delivery into the country and further to rural areas. When fertilizers are not delivered on time, yields remain low, and farmers bridge this period of low income by harvesting more wood. This situation could be avoided if fertilizers were imported well in advance of the production season and stored in dedicated warehouses located in different regions. This implies increasing the fertilizer storage capacity in the country. It is recommended that a portion of the AIP budget be repurposed to increase fertilizer storage capacity in all provinces.

4.3.5 Complementary measures

The following complementary measures have been identified as important to create the conditions for a successful repurposing of the AIP.

Strengthening of agricultural extension services, training, and outreach programmes for improved agricultural technologies, soil and water conservation

The knowledge of what needs to be done to improve farming techniques in Malawi exists. Subsidizing fertilizer and investing in agricultural extension services are often seen as two substitutable options, competing for the same budget. Instead, these should be considered complementary support measures, as skilled farmers make more productive use of the subsidy they receive (De Weerdt & Duchoslav, 2022). There are positive examples of the impact of extension programmes, which underpin this observation: in a study looking at the joint adoption effects of input subsidies and soil fertility management techniques, Khonje et al. (2021) find a positive correlation between higher crop income and the joint use of input subsidies and soil fertility management techniques. Farmers who have access to extension services have a 4% higher maize technical efficiency than farmers who just receive inputs (Jolex, 2022). Kerr et al. (2007) showed that education about the nutritional benefits of legumes greatly enhanced the interest of farmers in growing them. This also had a positive side-effect on soil fertility. In another study, Chibwana et al. (2012) show that farmers tend to clear more forests after crop loss. Although such losses are generally due to climate hazards, the assumption of the authors is that farmers attribute them to fertility loss, and regard newly opened areas as more fertile than existing plots. In this context, education about the actual reasons for crop losses and suitable support to address them may positively influence this behaviour.

Malawi has a public extension system which is not financed by the AIP. It is understaffed and does not reach all rural communities, despite being decentralized to the district level. In 2020, extension services accounted for only 9.3% of public expenditure for the general support of the food and agriculture sector, and 3.6% of total public expenditure for the agriculture sector (MAFAP Data Hub, 2022). A study commissioned by the government of Malawi assessed that the uptake of agroforestry extension services is 50%, which means that only half of the trained farmers find it helpful and are willing to implement the farming practices they are taught (GoM, 2019). It shows that the quality of extension services requires improvement to achieve a greater impact.

Cattle farmer, Malawi. © mbrand85 / Shutterstock

In this context of scarce resources, FAO promotes capacity building of community-based (local) facilitators who can act as knowledge carriers and train other farmers at so-called farmer field schools. This approach has proven to be efficient and has got support from the Department of Agriculture Extension Services. However, financial and human resources are needed to replicate this model on a large scale.

Specific resources could be repurposed from the AIP to finance the following:

- Increase the capacity and outreach of the existing extension programme, potentially using community-based (local) facilitators. Costs for training a farmer on adopting agricultural practices range from US$29 to US$65 per year per farmer, depending on the approach used (Franzel et al., 2019). Once the extension system has reached sufficient capacity, it is recommended to package input subsidies with mandatory extension services. On this point, FAO is in discussion with the Ministry of Agriculture to add more conditionality to the AIP, for example by requesting beneficiaries to implement soil and water conservation interventions.
- Develop or strengthen existing extension training material and programmes to educate farmers on water and soil conservation, fertility enhancement techniques, crop rotation, etc. to limit soil degradation, raise yields and enhance resilience to climate and other hazards. Add to the extension programmes elements of agro-processing and commercialization, in connection with farmers' organizations (see section below).
- Consider using low-tech and low-cost digital technologies (e.g., SMS) to disseminate information and reminders about key production milestones.
- Add in the extension package easy access to climate information, in particular forecasts for the first rains and warnings about extreme climate events, such as cold spells. The One-Acre Fund has been successfully piloting such a programme that uses phone messages to disseminate information in rural areas. This example could inspire the government of Malawi.

Strengthening agricultural research

The price of seeds has tripled in the last 20 years. There is a need to increase funding for public agricultural research to create productive varieties that can be multiplied domestically at a lower cost than imported varieties. Fortunately, there are already strong institutions active in crop variety development that could be further supported: the Department of Agricultural Research Services and the International Crops Research Institute for the Semi-Arid Tropics. The multiplication and distribution of these varieties should be balanced between public institutions and private breeders to avoid a situation where monopolies drive up prices.

Strengthening farmers' organizations as an entry point to supporting local agro-processing and mechanization

Most farmers in Malawi are smallholders with limited investment capacities to improve production and post-production processes. Regarding production, mechanization is very limited, and smallholders do not have access to basic machinery, such as tillers. Concerning post-production, farmers in Malawi typically sell raw products to off-takers without adding value through, e.g., basic processing. Enabling small and medium-scale agro-processing would increase local value-adding and provide additional income to farmers. Agro-processing would need to be accompanied by support for commercialization and appropriate capacity building (see the section on extension). However, supporting mechanization and agro-processing does not seem to be a realistic option at the level of individual farmers. Instead, it is recommended to firstly support the creation or strengthening (where they exist) of farmer's organizations, which is one of the mandates of the government extension system. After they are established, support for mechanization and agro-processing can be provided through these structures at the community level.

Strengthening of the forest management framework

The monitoring and control capacities of forest institutions need to be strengthened. According to interviews, the Ministry of Forestry has a vacancy rate of 60% at national level and 80% at local level. This, combined with a lack of funding, prevents effective control of illegal logging and agricultural encroachment. It is therefore recommended to allocate more funding to strengthen forestry institutions with the following priorities:

Strengthening of district administrations to decentralize and make more effective the management of natural resources at local level (World Bank Group, 2022). Reinforcing the local presence of forest rangers is also needed to implement the existing legislation, for example, the obligation for tobacco producers who clear land to replant trees.

Scaling up the forest co-management approach and the development of forest management plans. The current centralized forest management framework does not actively involve communities in forest management planning, nor does it provide incentives for local communities to manage forests more sustainably (World Bank Group, 2019). Financing the development of forest management plans in collaboration with communities is an important activity toward sustainable forest management and awareness raising on issues connected with deforestation and on the need to restore forest ecosystems to increase the ecosystem services they provide, including for agriculture production.

Support commercial tree plantations

Establishing new plantations in suitable areas and reinvesting in existing tree plantations (to improve their management, replanting where trees have been harvested, and increasing productivity) is necessary to shift the supply of wood from natural forests to plantations. These plantations would also provide a source of energy from wood waste which could be used by the private sector and urban households instead of charcoal.

Other measures

The main direct drivers of deforestation and forest degradation in Malawi are charcoal and firewood production on the one hand, and tobacco production on the other. These activities do not receive any subsidies (except indirectly for tobacco production) but need to be considered in the design of supportive measures to avoid further damage to forests. These supportive measures should be financed by earmarked funds within their respective sectors. The following key measures have been identified:

- Support the sustainable production of charcoal through improved incentives to businesses in the sector. This includes tax incentives for certified charcoal producers and, if needed, targeted support to producers to invest in cleaner and more efficient charcoal production technologies.
- Subsidize access to alternative energy sources, such as electricity, particularly in areas where there are important remaining forests. In rural areas where firewood is the primary source of energy for cooking and heating, part of the AIP could be repurposed to provide energy efficient stoves, in packages with input subsidies and extension services.
- Shift the support to the poorest household from input subsidies (as they cannot efficiently turn it to outputs) to social protection, such as food aid.

4.3.6 Impacts of repurposing – environmental, social, economic

ENVIRONMENTAL IMPACTS

Section 4.3.3 details the linkages between the AIP and forest degradation/deforestation. In 2011, Mhango & Dick analysed the potential negative effects of the AIP on the provision of ecosystem services. The study examined, among other things, the reduction in ecosystem services associated with the loss of forest cover due to input subsidies (Table 8). Although there was little data available at the time to support these assumptions (a gap that persists), interviews indicate that these negative impacts are being observed on the ground.

Table 8: Predicted negative impacts of input subsidies on ecosystem services in Malawi

ECOSYSTEM SERVICES (SELECTION)	RATIONALE
Freshwater	Leaching of mineral fertilizer into aquifers and surface water bodies
Climate regulation	Increased emission of nitrous oxide (mineral fertilizer), greenhouse gas emissions due to land-use change
Erosion regulation	Forest clearing and consecutive ploughing
Biological control	Forest clearing reduced the occurrence of biological control agents for crop pests
Natural hazard regulation	Weakened resilience to natural hazards due to land clearing for cultivation

Source: Mhango & Dick, 2011; World Bank Group, 2019

The repurposing options listed in the previous section aim to reduce the rate of forest degradation and deforestation in Malawi by increasing the incomes of rural households and improving the resilience of agricultural systems to natural hazards, including the impacts of climate change. Farmers will be less distressed and food insecure, and tree harvesting to meet short-term cash needs is expected to decrease. Furthermore, in a situation where tree-based systems such as agroforestry are being promoted, the number of trees in the landscape will increase, supporting efforts to reduce soil erosion and fertility loss.

By reversing the adverse impacts of forest loss listed in Table 8, the proposed repurposing options are expected to lead to less soil fertility loss and erosion, more carbon stored, and higher biodiversity in better managed forests and agroforestry systems.

SOCIAL IMPACTS

The introduction of sustainable agricultural practices and the development of agroforestry, as promoted in the repurposing options, will improve the capacities of smallholders and enhance the provision of ecosystem services with significant benefits to people. Smallholder farmers and the general population will benefit through:

- Improved food security and nutrition
- Improved income from crop value chains and market access
- Reduction of labour intensity, especially for women, thanks to less time spent on sourcing firewood which will be available from branches and trees in the agroforestry system
- Improved skills of farmers and women's empowerment through capacity building
- Improved water quality and quantity in downstream areas.

It is also expected that by reducing the share of the distribution of agricultural inputs within the AIP, the proposed repurposing options will weaken the prevailing corruption and monopoly systems in the operational processes of the programme.

ECONOMIC IMPACTS

The government of Malawi estimates that restoring 2.4 million hectares of degraded cropland would increase maize production by 1.55 million tonnes per year, a 40% increase (Ministry of Natural Resources, Energy and Mining of Malawi, 2017a). Other estimates indicate that for each dollar spent addressing land degradation in Malawi, about US$4.30 would be returned over 30 years (Nkonya et al., 2016). The proposed repurposing and complementary options, including strengthening extension services, crop diversification, promoting agroforestry and supporting organic fertilizer production, are all measures that will play an important role in land restoration. Based on the estimates above, they are therefore expected to generate significant economic returns.

Repurposing input subsidies to other models, such as agroforestry and more diversified cropping systems will also generate economic benefits at farm level. In its National Guidelines for Implementing Conservation Agriculture in Malawi (2016), the Ministry of Agriculture indicates that conservation agriculture with legume intercropping could generate twice as much revenue as maize monocropping (US$998 compared with US$467 per hectare per year). An ongoing World Bank study (2023, unpublished) which aims to identify options for forest landscape restoration shows that the long-term (20-year) financial benefits to smallholders from agroforestry are significantly higher than from business-as-usual maize production. However, the break-even point of two years might be challenging to overcome for smallholders and require upfront government support (Table 9).[41]

Liwonde National Park, Malawi © Robin Bruyns /.Shutterstock.com

Table 9: Financial results of smallholder agroforestry versus business-as-usual maize

LAND USE	DISCOUNTED NET PRESENT VALUE (US$/HA)	DISCOUNTED BENEFIT-COST RATIO (US$)	BREAK-EVEN POINT (YEARS)
Smallholder maize	510	1.3	-
Smallholder agroforestry	1,189	1.7	2

Source: World Bank, 2023, unpublished

Another expected economic impact of the proposed repurposing scenarios is the reduction of costs from sedimentation. Deforestation, forest degradation and poor soil management are significant contributors to soil erosion. Agroforestry and croplands where sustainable agriculture practices are applied help buffer the impacts of rainfall, preventing water runoff and soil erosion. This, in turn, is expected to reduce clogging of downstream irrigation networks and sedimentation of hydropower reservoirs. Avoided costs to hydropower generation would be significant: in 2017, Malawi's power generation utility spent around US$150,000 per tonne on sediment management to enable the operation of hydropower facilities (World Bank, 2020a).

Finally, there are additional economic benefits from improved agricultural productivity and local processing, such as job creation at farm level and in other private enterprises involved in the processing and marketing of agricultural products and the production of organic fertilizers, among others.

On the negative side, the few actors who currently monopolize the distribution of inputs within the AIP will be affected by the diversification of AIP support and the greater involvement of other businesses. If needed, compensation measures should be designed to ensure a smooth transition from the current AIP to a new, less monopolistic system.

4.3.7 Conclusions

The Malawi case study shows an intricate, dynamic interaction between agricultural practices, subsidies and environmental impacts. Agriculture accounts for a significant portion of the country's GDP and serves as the primary source of livelihood for most of the population. Tobacco is the main export crop, while other crops such as maize, rice and cassava also have an important role in the domestic economy.

Land degradation has significantly affected agricultural productivity and the overall economy. Soil loss considerably affects both the agricultural and overall GDP of the country. Additionally, there are major environmental issues such as the contribution to greenhouse gas emissions from deforestation and forest degradation. The main drivers are agricultural expansion, biomass overexploitation for energy, and tobacco cultivation. Additionally, indirect drivers include lack of alternatives for household energy fuel, energy policies, inadequate agricultural policies and practices, ineffective subsidies to improve these practices, and lack of capacity building on sustainable management.

The AIP is the primary subsidy programme in Malawi, which focuses on providing fertilizers and seeds, mainly for maize cultivation. However, the AIP's design and implementation have led to increased pressure on forest resources with the promotion of maize monoculture and intensive agricultural practices, which has contributed indirectly to soil degradation, deforestation and forest degradation. Also, the AIP has led to reduced crop diversity and increased reliance on environmentally harmful practices such as tobacco cultivation, which requires substantial wood for drying sheds.

To address these challenges requires a multi-faceted approach, including the repurposing of the AIP toward more sustainable agricultural practices. This involves diversifying crop support to include legumes and other sustainable crops, promoting agroforestry systems, and financing landscape restoration efforts. Other key measures include strengthening non-maize agricultural value chains, transitioning to organic fertilizer usage and enhancing extension services. These measures collectively aim to improve agricultural productivity, reduce environmental degradation and promote sustainable land management.

The proposed changes to Malawi's agricultural subsidies and practices are expected to yield significant environmental, social and economic benefits. Environmentally, repurposing could reduce deforestation and soil erosion, improve biodiversity and increase carbon storage. Socially, the proposed changes promise to enhance food security, diversify income sources and reduce labour demands, particularly benefiting women, and weaken the prevailing corruption and monopoly systems in the operational processes of the AIP. Economically, the shift to more sustainable practices is projected to increase agricultural productivity, reduce operational costs for hydropower facilities due to decreased sedimentation, and create new employment opportunities in different sectors. However, this may need compensation measures to ensure a smooth transition from the current AIP to a new, less monopolistic system.

Cerrado, Brazil. © David Bebber / WWF-UK

5. TAKEAWAY MESSAGES AND RECOMMENDATIONS

TAKEAWAY MESSAGES

Expansion of agriculture has for decades been the most significant direct driver of deforestation and related greenhouse gas emissions. If the underlying causes, including harmful subsidies, are not addressed effectively, deforestation will not be halted and reversed by 2030[42] and global climate and environmental targets will not be achieved.

It is critical to identify and address unintended consequences of subsidies and to find ways to align them with sustainable practices to minimize their impact on forests, other ecosystems and nature more generally. Repurposing harmful agricultural subsidies is an opportunity to shift existing government resources to support equitable nature- and forest-positive production, resilient food systems and a just transition. Repurposing also has the potential to support or complement the greening of private finance, and to channel additional resources to key global actions such as climate change adaptation and mitigation, food systems transformation, and land restoration. The Brazilian case shows that available public resources could be directed more strategically to support the transition to sustainable agriculture that places less pressure on natural ecosystems and supports a more socio-biodiverse economy. The Malawi case illustrates the opportunity to shift government resources toward more sustainable and forest-positive practices, such as diversifying crop production and supporting agroforestry.

Identifying and quantifying existing subsidies for agricultural policies and support is an important but complex task. While international efforts like those by the OECD, FAO-MAFAP and AgIncentives provide some monitoring tools and data, obtaining detailed information, possibly commodity specific, is challenging. The case of Malawi underscores the difficulty in fully capturing the impact of agricultural subsidies on land use and forest cover, due to the lack of reliable data, complex land-use patterns, economic influences and environmental factors. Conducting primary research together with governments and public expenditure reviews can help identify and estimate harmful subsidies that may not have been captured in desk studies. Such in-depth analysis is crucial for gaining a comprehensive understanding of the full extent of subsidies in agriculture and for designing effective strategies, including policy interventions, to prevent deforestation. Adding to the complexity, information on subsidies is often only available at the country level, while deforestation is a region-specific issue in many countries.

The precise and full impact of agricultural subsidies on deforestation and land-use change remains elusive to some extent. Both producing and importing countries need to be considered, as well as the dynamics of commodity value chains and the potential spillover effects caused by other commodities. Crucially, the risk of leakage must also be considered: prohibitions on deforestation for a specific commodity in a specific region (like the Amazon Soy Moratorium) are likely to displace forest frontiers and shift product focus. The importance of domestic markets should also not be forgotten, which implies considering the issues of food security and employment. While there is a causality between distortionary subsidies and deforestation and land-use change, a comprehensive assessment of these factors (e.g., through spatial analysis, using GIS data to assess trends of impacts (BIOFIN and UNDP, 2024)) is crucial for a thorough understanding of the issue and to estimate the values and their precise impact on the production of specific products or forest loss.

Subsidies are just one aspect of a broader set of fiscal policies and measures that influence forest conservation and land use on a landscape or jurisdictional scale. Understanding the interplay of these various instruments is crucial for developing effective strategies to address deforestation. It is therefore important to look beyond direct government spending when examining the impact of forest-harming agricultural subsidies. Indirect subsidies such as tax credits, levies and border measures should also be considered. Regulatory instruments like property rights and land-use laws, and their level of enforcement, need to also be taken into account. As a basis, detailed data and analysis are essential, accompanied by strong leadership, a broad coalition and stakeholder engagement, as well as good communication and coordination between policymakers, decision-makers and other stakeholders (BIOFIN and UNDP, 2024).

The level of domestic subsidies provided to the agricultural sector surpasses the amount of finance allocated to the conservation and restoration of forests and other degraded ecosystems. This disparity highlights the need for a realignment of financial resources. By redirecting a portion of harmful domestic agricultural subsidies toward forest conservation and sustainable land-use practices, countries can make a substantial impact in combating deforestation and promoting climate action. Poor governance and weak enforcement of environmental regulations may undermine the impact of repurposing harmful subsidies. Inadequate forest management plans and ineffective penalties for illegal logging, lack of control and monitoring capacity, and a lack of cooperation between government agencies and with civil society organizations are major obstacles to effectively reforming subsidies and monitoring their impact.

The political economy, between and within countries, poses the biggest challenge to eliminating, reforming and repurposing subsidies. In many cases, reforming policies may generate economy-wide benefits, but certain social groups may gain while others may lose. The greater the benefits of subsidies to a large number of individuals and well-organized interest groups, the more difficult it is to achieve social acceptance of subsidy reform. As a result, subsidy reforms often face socio-political challenges. Shifting existing power dynamics and implementing incremental approaches, such as introducing first some conditionality to reduce the harm of subsidies before a full repurposing, or gradually moving to decoupled payments, could effectively mitigate the negative impacts of subsidies on forests while avoiding strong resistance from recipients. The case of Malawi, with its socioeconomic dependencies on agriculture and the political challenges associated with reforming the AIP, illustrates the difficulty in achieving social acceptance for subsidy reforms.

In the process of repurposing to greener subsidies, the payment structure is often maintained, while the purpose, conditions, rules and incentives are modified to reduce negative environmental impacts. Such approaches could be complemented by extension and research, as the Malawi example shows. Research efforts should prioritize a comprehensive examination of the consequences of specific land-use change scenarios for agricultural production, particularly taking into account the impact on different social groups. There are tools and databases that can help this process. For example, the Ecosystem Services Evaluation Database[43] provides data that can be used to assess the impacts of land-use change on the provision of ecosystem services and consequently on various stakeholders and economic activities. Policy- and decision-makers and other stakeholders can use this to make informed decisions and formulate effective strategies that balance trade-offs while leading to positive outcomes for sustainable development.

The identification of suitable repurposing options needs to be multidimensional to avoid future detrimental impacts, considering social, economic and environmental perspectives (Gagen et al., 2023). In line with target 18 of the Global Biodiversity Framework, subsidy reform needs to be just, fair and equitable and be primarily targeted at those who need it most. It must weigh up private sector finances and the socioeconomic costs and benefits of reform to ensure that employment and business development are given due consideration. It also needs to emphasize repurposing options that reduce deforestation and conversion and encourage restoration.

It is crucial to consider the anticipated impact of deforestation, climate change and environmental factors, as well as social components, when designing (repurposed) market support policies. This involves decoupling the subsidy system from agricultural outputs or inputs, ensuring that farmers benefit from repurposing if they choose to restore or conserve forests instead of converting them to agriculture. While there are other policies and incentive schemes with a more targeted focus, such as domestic and global forest carbon payments, combining these with domestic subsidy reform can achieve significant

reductions in conversion of natural ecosystems (Johnson et al., 2021).

There are ongoing initiatives that can serve as vehicles to further promote and implement the repurposing of harmful subsidies. The BIOFIN initiative, led by UNDP and the European Commission, aims to redirect financial resources, including subsidies, toward environmental goals. Expanding the BIOFIN initiative to prioritize critical ecosystems in its analytical framework would make a substantial contribution to the protection of forests and ecosystems. Integrating these efforts into an existing initiative will enhance the capacity to design and implement policy reforms and mobilize and align financial support. However, due to the need for high-level buy-in and strong stakeholder interests, it is critical to understand the trade-offs, opportunities and risks by analysing potential socioeconomic impacts, assessing political opportunities for actions, identifying potential supporters, and aligning plans with national priorities (BIOFIN and UNDP, 2024).

International funding support through vehicles such as the GCF, GEF or other multilateral programmes is essential to assist low-income countries to address direct and underlying drivers of deforestation and conversion and enable a just transition. Forest carbon finance, such as REDD+, must play a continuous role as national monitoring of forest cover and incentive programmes to address drivers of deforestation are closely related.

Global environmental standards, import regulations and due diligence procedures can effectively promote sustainable, deforestation- and conversion-free production. Incentives provided by consumer countries, including additional legislation like the EU´s deforestation-free regulations, play a critical role in global value chains. These measures not only establish barriers for commodities linked with deforestation, but also extend support, such as reduced tariffs, to countries that can demonstrate a genuine shift toward sustainable practices. Through such incentives, consumer countries actively contribute to the promotion of sustainable production and trade, fostering positive transformations throughout global supply chains.

Recommendations for action

Political momentum and an opportunity exist to redirect harmful agricultural subsidies toward protecting forests and other natural ecosystems and ensuring they maintain environmental and social benefits. However, repurposing options entail social, economic and environmental trade-offs, necessitating strong political will and societal acceptance. This requires dialogues among the public and private sector and civil society, including minorities.

There has not been a better time to drive this agenda forward, with international attention on the transformation of food systems and the urgency of repurposing environmentally harmful subsidies. In 2023 at the UNFCCC COP28 in Dubai, 159 governments agreed to work collectively "*to maximize the climate and environmental benefits – while containing and reducing harmful impacts – associated with agriculture and food systems by conserving, protecting and restoring land and natural ecosystems, as well as strengthen efforts to (…) revisit or orient policies and public support related to agriculture and food systems.*" In 2024, UNFCCC and CBD COPs will take place. Forest conservation, and thus the drivers of deforestation, including harmful subsidies, are highly relevant topics for both, but to date collaborative actions across the two conventions have been insufficient. The forthcoming updating of CBD national biodiversity strategies and action plans and UNFCCC nationally determined contributions (NDCs) provides a unique opportunity to break these silos, connect the dots and enhance synergies across the agriculture, food systems, land use, climate and biodiversity agendas.

Another opportunity to reconcile forests and agriculture is the Glasgow Leaders Declaration on Forests and Land Use. Under this, 145 government leaders representing 90% of global forests have committed to work together to halt and reverse forest loss and land degradation by 2030, including to "redesign agricultural policies and programmes to incentivize sustainable agriculture, promote food security, and benefit the environment."

New regulations also have potential to contribute to a shift away from harmful subsidies. The recently adopted EU deforestation regulation is a concrete example.

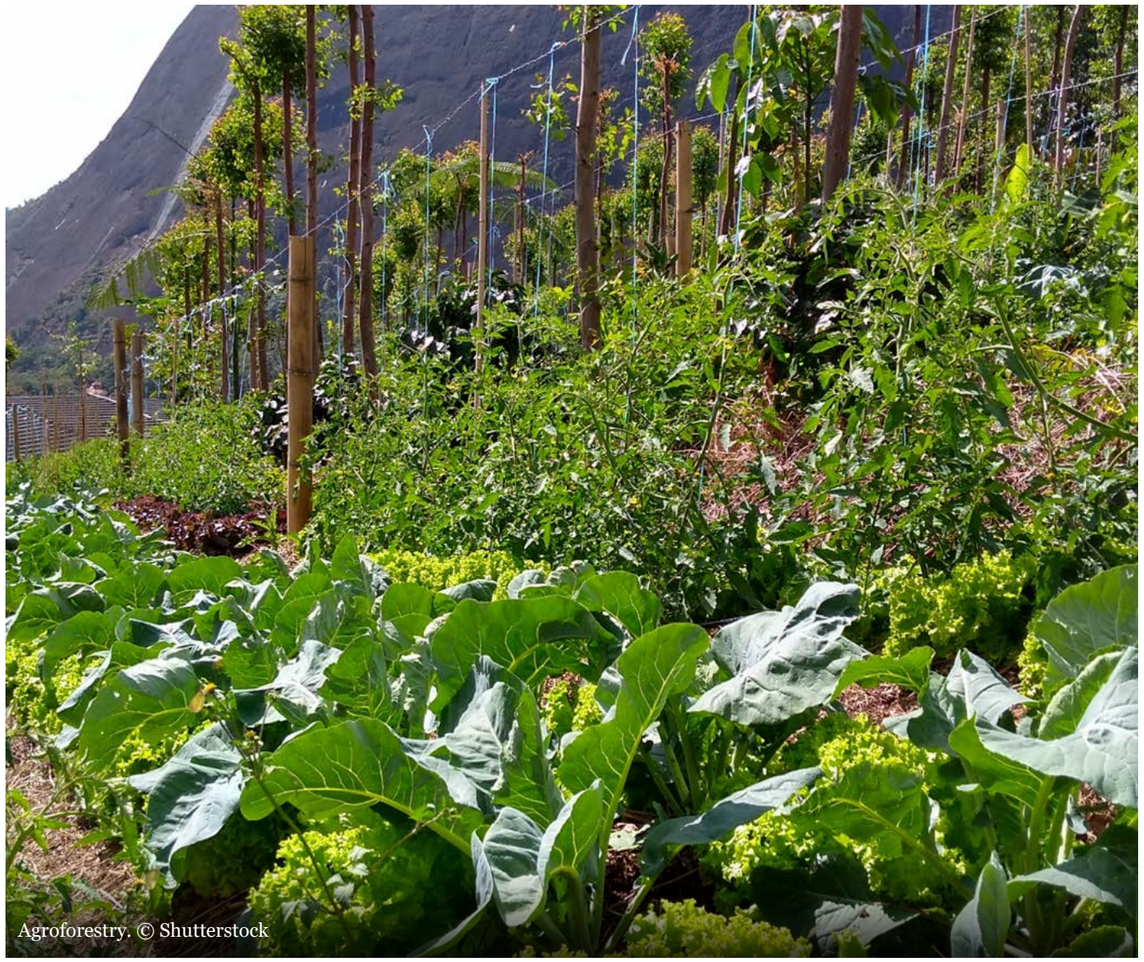
Subsidy reform should be implemented alongside a transition from nature-harming private investments toward a green finance agenda. In line with GBF Target 15, this transition should include public policy measures requiring corporate and financial institutions to assess, report and disclose their nature-related risks, impacts, dependencies and opportunities. Disclosure frameworks such as the Taskforce on Nature-related Financial Disclosures are available for this purpose. Additionally, institutions should be required to establish targets for reducing their impacts on nature and climate. Guidance and tools are readily available through initiatives such as the Science Based Targets Network.

Avenues to unlock greater collaboration include both the mitigation and adaptation agendas as well as strategic targets under the Global Biodiversity Framework (Targets 8,9,10, 15, 16, 18, 19). What is needed now is a strong action-oriented global agenda driven by ambitious public and private sector champions and scaled-up financial resources. At international level, such an agenda could pursue the following actions:

- Establish an inter-ministerial working group that connects work and progress under the Glasgow Leaders' Declaration[44], the UAE Declaration on Sustainable Agriculture, Resilient Food Systems, and Climate Action[45], and the agenda of the UN Food Systems Summit[46] to more explicitly link agricultural subsidies and forest-related goals.
- Create an intersectoral working group, with members from FAO's committees on forests (COFO)[47] and agriculture (COAG)[48], on subsidies, best-practice examples and incentives for agriculture and forests.
- Establish effective channels for collaboration across the UNFCCC and the CBD and adopt a joint programme of work on repurposing harmful agricultural subsidies.
- Establish dialogues and roundtables on sustainable agri-food repurposing of subsidies with finance ministers of forest-rich countries and key consumer governments. This could be facilitated through the Forest and Climate Leaders' Partnership.[49]
- Establish a task team on the role and promotion of forests and ecosystems in the agri-food agenda under the Just Rural Transition initiative.[50]
- Use the momentum of the recently adopted EU Deforestation Regulation and tailor agricultural repurposing programmes in producer countries to meet the EU's requirements.[51]
- Channel international finance to support enabling conditions for efficient repurposing of harmful subsidies through multilateral reform programmes, such as under the World Bank, Global Environment Facility or Green Climate Fund. These could be supplemented bilaterally through, for example, the Forest and Climate Leaders' Partnership, the German International Climate Initiative (IKI)[52] or Norway's International Climate and Forest Initiative (NICFI)[53].

At national level, governments can start to identify and reform harmful agricultural subsidies and scale up policies and support for sustainable, deforestation- and conversion-free and forest-supporting agriculture. This should include the following actions:

- Use the framework presented in this report to trigger a broad reflection in government institutions on repurposing harmful subsidies, and use the predefined guiding questions and steps to operationalize the process.
- Take advantage of existing support programmes including FAO's Monitoring and Analysing Food and Agricultural Policies (MAFAP)[54] programme and BIOFIN's new guidance on repurposing of subsidies[55].
- Update and strengthen NDCs by including emission targets for the agricultural sector that relate to deforestation.
- Include national targets and/or policies in national biodiversity strategies and action plans on sustainable agriculture (GBF Target 10)[56] aiming at addressing deforestation and conversion in agricultural production.
- Explore how repurposing harmful subsidies can complement domestic resource mobilization in national biodiversity finance plans (GBF Target 19)[57].



Agroforestry. © Shutterstock

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A.1 INTERVIEW PARTNERS

NAME	ROLE AND AFFILIATION	EXPERTISE
Global		
Gabrielle Kissinger	**Principal of Lexeme Consulting**	Global land-use and climate change, finance, REDD+, agriculture, national government processes, drivers of deforestation and degradation
Caroline Merle	Forestry Officer, FAO	Deforestation drivers and deforestation-free supply chains, including subsidy dimensions
Lucio Santos	Forestry Officer, FAO	Payments and public investments to reduce deforestation and forest degradation
Brazil		
Michel Santos	Public Policy Manager, WWF-Brazil	Influence of public policies with socioenvironmental impact, financial sector on the topic of deforestation
Maxime Garde	Green Finance Specialist, WWF-Brazil	Financial mechanisms connected to conservation of Brazilian biomes, financial sector related to deforestation
Thais LinharesJuvenal	Team Leader Forest Governance and Economics, FAO	Social and environmental governance and finance
Ricardo Woldmar	Project Manager, Produzir, Conservar e Incluir (PCI)	Climate change mitigation, forest conservation and corporate sustainability in Brazil
Lisa Rausch	Scientist, University of Wisconsin-Madison	Drivers of agricultural expansion
Juliano Assunção	Executive Director of CPI Brazil and Professor of the Department of Economics at the Pontifical Catholic University of Rio de Janeiro	Improving policies to increase land use efficiency; how to improve compliance with the new Forest Code; and the relationship between increasing productivity and protecting natural resources
David M. Lapola	Research scientist at the Center for Meteorological and Climatic Research Applied to Agriculture of the University of Campinas, Brazil	Indirect land-use change, institutional challenges
Vitor Bukvar Fernandes	Consultant at IGT (Institute of Land Governance)	Public policy, institutional dynamics, land economics, and development in Brazil
Gabriel Siqueira	President, IGT	Brazilian land governance and land markets
Malawi		
Juan José Egas Yerovi	Policy Analyst, FAO MAFAP	Economic analyses to assess the costs and benefits of policy reform options and formulate policy recommendations
Ramzy Kanaan	Chief of Party, Modern Cooking for Healthy Forests project Tetra Tech	Forest degradation and deforestation, energy policies
Hardwick Tchale	Senior economist, World Bank	Impact of subsidies on agricultural sector development, private sector development
Christopher Manda	Environmental Officer, UK Environment Agency	Land use and land use change expert; impact of input subsidies on natural resources
Priscah Munthali	Climate Change Adaptation Expert, FAO Malawi	Agricultural policies, extension services, land use and land use change
Lovemore Mtsitsi	Government Relations Analyst, One Acre Fund	Agricultural policies and economics, food systems and agribusiness

A.2 ESTIMATES OF ENVIRONMENTALLY HARMFUL SUBSIDIES, SOURCES AND VOLUMES

SOURCE	REGION	DESCRIPTION AND IMPACTS	REFERENCE YEAR(S)	ANNUAL SUBSIDY VOLUME
WRI: Ding et al., 2017; McFarland et al., 2015	**Indonesia**	Palm oil (including for biofuel), timber production	2010-2012 average	US$27 billion
Ding, Markandya et al., 2021	**Indonesia**	Agriculture (e.g., tax exemptions, rural credits, and concessional loans for palm oil production); agricultural subsidies contributing significantly to tropical forest loss	2015	US$20.4 billion
Ding et al., 2017	**Brazil**	Agriculture for soy (including biodiesel) and beef production	2010-2012 average	US$10 billion
Ding, Markandya et al., 2021	**Brazil**	Agriculture (beef and soy), disproportionally benefiting larger producers; agricultural subsidies contributing significantly to tropical forest loss	2019	US$5 billion
Ding et al., 2021	**India**	Agriculture, rice paddy and others; mostly input subsidies for irrigation, fertilizers and electricity; fertilizer subsidies as high as US$15 billion per year and electricity as high as US$12 billion per year 10% reduction in average subsidy would result in 6.6% reduction in water use	2019	US$22.6 billion
Ding, Markandya et al., 2021	**Worldwide**	Agriculture	2017-2019	US$708 billion – cost of deforestation and land degradation nine times that amount (US$6.3 trillion)
FAO and UNEP, 2022	**Worldwide**	Agriculture	2022	Net support to agricultural producers: US$540 billion Fiscal subsidies: US$245 billion
Gautam et al., 2022	**Worldwide**	Agriculture (input subsidies); only about 5% (US$29 billion) green subsidies or subsidies supporting environmental outcomes; except China, largely offered in developed countries; globally, this support mainly generates market distortions in the form of price support	2016-2018	US$86.3 billion
Gautam et al., 2022	**Worldwide**	Agriculture (output subsidies)	2016-2018	US$73.3 billion
BIOFIN, 2023	**OECD**	Support to agricultural production considered potentially environmentally harmful	2015	US$100 billion
BIOFIN, 2023 Sumaila et al., 2019	**OECD and worldwide**	Support to fisheries, including associated fuel subsidies	2018	US$7 billion (OECD countries) and US$35 billion (globally, in 2009 dollars)
BIOFIN, 2023 Parry et al., n.d.	**Worldwide**	Water use and treatment Harmful subsidies include implicit income transfers that do not price goods or services at the full provisioning cost (e.g. water, energy)	2012	US$450 billion
Taylor, 2020	**Worldwide**	Fuel (oil) Supplemented IEA and OECD fossil-fuel subsidy estimates with additional tax subsidy estimates; includes value of fossil-fuel subsidies from electricity underpricing	2017	US$220 billion
Konijnendijk et al., 2023	**Worldwide**	Fossil fuels Pollution and combustion byproducts create health problems; biofuel and woody biomass create forest clearing, nutrient loss in forests, and other land-use changes (e.g. arable land used to grow crops for biofuel) Overall costs US$5 trillion (IMF), including deterioration of nature externalities, where coal accounts for 52% post-tax subsidies, petroleum 33% and natural gas c.10%	2015	US$345 billion
Taylor, 2020	**Worldwide**	Fuel (electricity support to fossil fuels) Excludes negative externalities, though data still likely missing important implicit fossil-fuel subsidies (e.g., through weak environmental regulation enforcement, bankruptcy laws, environmental remediation liabilities transferred to the taxpayer, etc.)	2017	US$128 billion
BIOFIN, 2023	**Worldwide**	Support measures for fossil fuels	2015	US$373 billion
Parry et al., n.d.	**Worldwide**	Fossil fuel	2020	Explicit (undercharging for supply costs) plus implicit (undercharging for environmental costs and foregone consumption taxes): US$5.9 trillion Explicit alone: US$0.45 trillion
Taylor, 2020	**Brazil**	Fuel (subsidies to petroleum products, excluding negative externalities but likely missing implicit fossil-fuel subsidies, e.g., through laws on bankruptcy, weak environmental regulation enforcement, environmental remediation liabilities transferred to taxpayers, etc.	2017	US$5 billion
Taylor, 2020	**Indonesia**	Fuel (subsidies to petroleum products)	2017	US$14 billion
Koplow & Steenblik, 2022	**Worldwide**	Fossil fuels Excluding other large-scale finance for international fossil fuel projects via public lending institutions (~US$70 billion/ year, not included in total); heavily skewed to fossil fuel over clean energy 10x higher than all global carbon pricing schemes	2021	US$640 billion (exclusively environmentally harmful subsidies)

Koplow & Steenblik, 2022	**Worldwide**	Agriculture, including for **production** (import protection, tax subsidies, unfunded decommissioning/reclamation costs, underpricing for use of bulk fuel transportation infrastructure, below-market resource access, tax-favoured corporate structures), for **consumption** (government price controls, export restrictions, excise tax reductions/ exemptions for particular user classes, direct fuel subsidies or rebates), or **both** (government fuel stockpiling services, government-financed R&D)	2021	US$520 billion (exclusively environmentally harmful subsidies) Total support equalled more than 40% of total agricultural added value in OECD countries and 15% globally Externalities include air/water pollution, climate change, ecosystem damage, land subsidence, road damage
Koplow & Steenblik, 2022	**Worldwide**	Forestry, including for **production** (below-market concessions access and illegal harvesting, improper/subsidized reclamation, state-funded timber access road construction, tax breaks to land management and replanting, tax-favoured corporate structures; reduced property taxes on held forest lands) and **consumption** (subsidies for forest product producers, such as paper, cellulose-based ethanol, wood-fired power plants)	2021	US$155 billion (exclusively environmentally harmful), illegally harvested wood based on Interpol and World Bank Illegal logging lowers price of timber up to 16% Ecosystem value loss, including carbon sequestration, resulting from illegal cutting estimated to be US$840 –1,730 billion per year Externalities include biodiversity loss, replacement with monoculture timber stands, carbon sequestration loss, watershed runoff, soil fertility decline in tropical regions
Gautam et al., 2022	**Worldwide**	Agriculture, support to agricultural producers	2022	US$456 billion (not explicitly subsidies) 82% considered by OECD to be “potentially most distorting” Includes domestic support (subsidies connected with outputs, inputs, or production factors such as land area) and trade barriers (e.g., import tariffs, border measures)

A.3 FULL FRAMEWORK FOR IDENTIFYING AND REPURPOSING SUBSIDIES THAT HARM FORESTS

TOPIC	GUIDING QUESTIONS	EXPLANATION	ILLUSTRATIVE EXAMPLES
Identification of harmful subsidies			
What are the subsidies which should be repurposed?			
Existing subsidies	What kinds of support/subsidy exist in the agricultural sector? Who is financing the subsidies (national government, regional, budget from EU, etc.)?	Example of support types are monetary transfers, border measures, output subsidies (preferential lending, loans, credit), input subsidies, etc. Examples of policy instruments are sector strategies, economic and trade policies, conservation policies etc.	Malawi has a large input subsidy programme that consumes about 60% of the country’s agricultural budget. The EU’s common agricultural policy (CAP) provides various incentives to farmers with multifaceted objectives, including improving agricultural productivity, ensuring a stable supply of affordable food, maintaining rural areas and landscapes across the EU etc.
Effectiveness and efficiency of subsidies	What is the intended purpose of the subsidy programme? Does it achieve its intended targets and goals? What are the unintended adverse effects of the subsidy programme or subsidy? Do the adverse effects of subsidies outweigh their benefits?	Subsidy programmes can be inefficient or inadequately designed to achieve their original policy objectives. These programmes might be efficient for a certain time but become less effective and efficient over time due to adjustments in the sector, the economic situation etc. Subsidies may make beneficial contributions to their intended objectives (effective), but only at substantial costs (inefficient). Subsidies may make beneficial contributions or be harmful outside their direct sphere of influence (e.g., negative social impact, positive influence on consumer behaviour)	The input subsidy programme of Malawi has numerous environmental and social externalities, while not achieving its objectives of food security. An analysis of multiple input subsidy programmes showed an 18% increase in yield and 16% increase in farming households’ income (Nguyen et al., 2023)
Causality between subsidy and deforestation/ land-use change	To what extent does the subsidy programme contribute to deforestation and land-use change? What is the evidence to quantify and qualify this contribution? Is it a direct or an indirect contribution?	The transmission mechanism from a subsidy to the observed harmful impacts on forests and other land uses (or other types of environmental impacts, social impacts such as the exacerbation of inequalities etc.) needs to be examined/ analysed. Direct links are uncommon. An indirect transmission mechanism inevitably builds on assumptions that need to be backed by literature and evidence available. For example, remote sensing/satellite data that has become easily available for large areas can provide suitable evidence (see for example the spatial analysis provided for Brazil in section 4.2).	In the Amazon and Cerrado (Brazil), the majority of subsidized credits provided to farmers is allocated to municipalities facing a high deforestation rate, showing the probable contribution of these subsidies to deforestation.

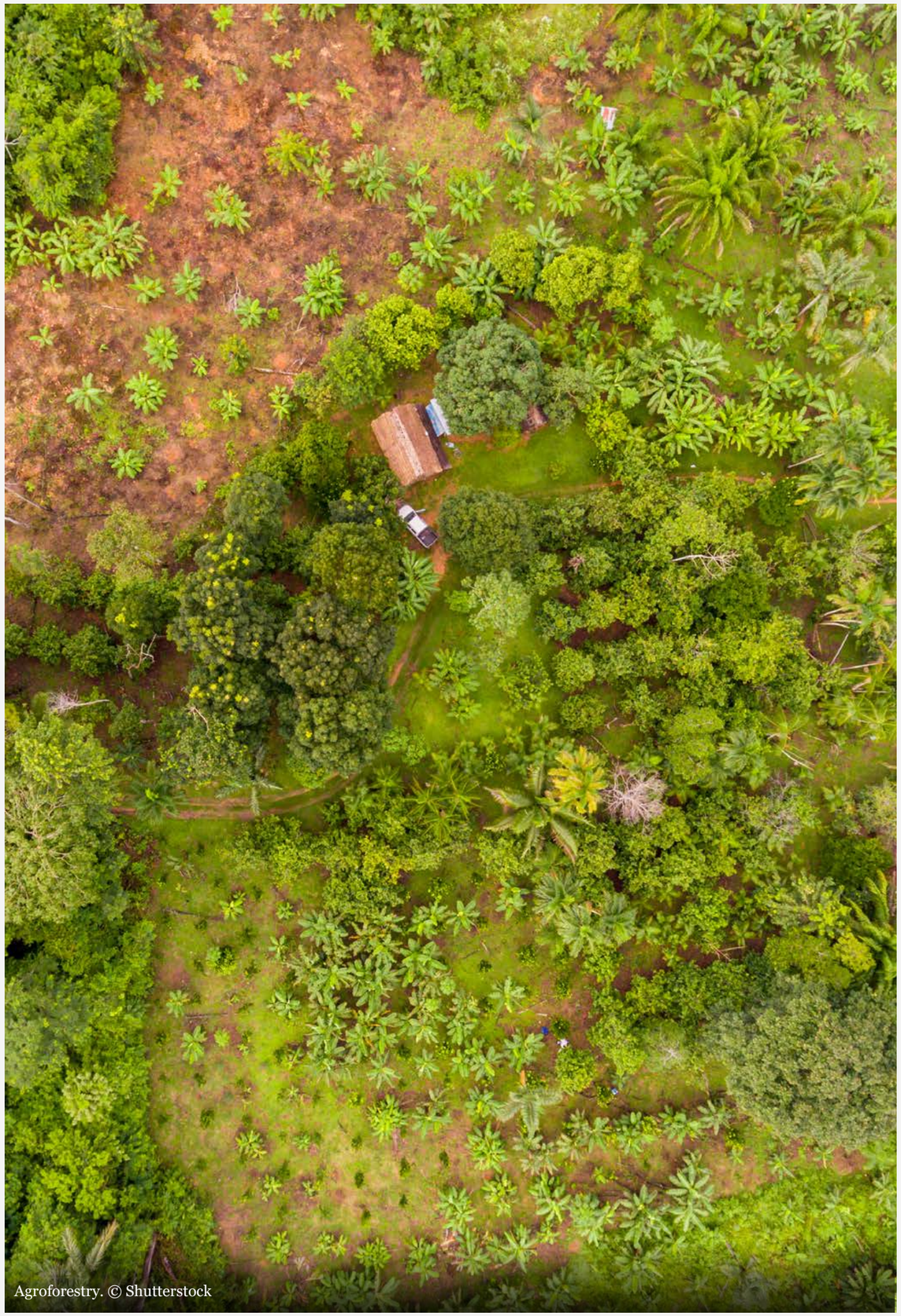
Prioritization of subsidies according to level of harm	Which subsidies are identified as harmful? (See Chapter 2) Which of the identified harmful subsidies is likely to meet the highest level of acceptance for repurposing? Can/should all these subsidies be repurposed? Or is there a subsidy that needs to be tackled first because its impact is greater than other subsidies? Or because it has harmful impacts beyond forests and other land uses (e.g., other environmental externalities, social impacts)?	Subsidies that are most harmful and which concern a large part of the country's agriculture area should be addressed first. Beyond their impacts on forests and other ecosystems, other unintended consequences of subsidies might be considered, depending on the objective of repurposing. Examples are other types of environmental degradation and the exacerbation of inequalities.	The most significant harmful impacts on forests result from coupled subsidies to producers, while decoupled subsidies have an insignificant effect (Damania et al., 2023).
Conditions and barriers for repurposing harmful subsidies			
What legal, political, economic, financial and technical conditions must be in place for repurposing to be successful? What are the barriers that prevent beneficiaries from adjusting their behaviour? How scalable are the options for repurposing harmful subsidies?			
Type of repurposing options	Should the subsidy be adapted (e.g., the selection of beneficiaries, eligibility) to reach the intended purpose (increase in production) without the unintended environmental harm (forest loss) and/or be restructured in a way that at the same time promotes a forest-positive outcome? What other types of efficient subsidy exist in the country/region and could serve as a blueprint?	Subsidies that are decoupled from production generally have less harmful impacts than coupled ones, so repurposing should give priority to decoupled options.	In India, the government conditioned the existing nitrogen fertilizer subsidies on use with an additive which was designed to reduce nitrogen losses to the environment (Searchinger, 2020).
Political and institutional motivation and feasibility	Is there an expressed political will for repurposing? Is the country engaged in key international initiatives, e.g., the Land Use Coalition or active participation in United Nations Food System Summit events? Has the country committed toward repurposing in existing national development strategies, NDCs or NBSAPs, others? Are there strong networks in the country (NGOs, academics, experts etc.) to accompany the process of repurposing? Are there cross-ministerial coordination mechanisms in place, e.g., with the ministry of finance? Are there debates at parliament level?	Evidence of political willingness to support the repurposing option is a prerequisite to engaging into such a process. The expertise and network provided by experts and civil society organizations is an advantage for effective implementation. Repurposing requires cooperation and dialogue between relevant ministries, including the finance ministry (Example: use existing cross-sectorial working groups, e.g. REDD+ coordination, national/regional land use planning, others and ensure dialogue with finance ministry). Oversight and approval of parliament plays a crucial role in authorizing public expenditure and shaping budgetary frameworks (OECD, 2019).	Costa Rica is the first tropical country to have stopped and reversed deforestation. Costa Rica has achieved this through innovative and progressive policies – particularly to eliminate cattle subsidies and introduce payments for ecosystem services – and consistent international support (OECD, 2020). The UK government committed to review national subsidies and to redirect or eliminate all subsidies and incentives harmful to biodiversity, and for nature-positive incentives to be scaled up as soon as possible (UK Government, 2023).
Acceptance	What is the perception of fairness by beneficiaries (e.g., smallholders and large-scale commercial farmers) on the repurposing option and the transition process? Are there vested interests, large groups or unions that may lobby against repurposing to favour their interest? Should compensation be provided to avoid strong opposition from these groups? Who should be eligible to receive compensation (equity perspective)? Are information campaigns needed to communicate the objectives and expected positive impacts of a subsidy reform?	Subsidy programmes are often linked to political interests. Powerful interest groups who benefit most from the subsidy may have a strong influence over policy processes and oppose the reform or amend it in a way that is beneficial to them. Any subsidy repurposing is likely to create losers and winners. Providing alternative support or compensation to the losers, in particular to Indigenous communities and people in poverty, may improve their acceptance and prevent them from opposing the reform. The perception of fairness by the beneficiaries is key to ensure the full and proper utilization of the subsidy. Public information campaigns can help improve public perceptions and build social acceptance.	The agriculture lobbyist Copa-Cogeca and major players in the pesticides and food industries actively lobbied against the EU's Farm to Fork Strategy and Biodiversity Strategy, to limit the repurposing of public subsidies away from a destructive agricultural model with a reduction in the use of pesticides, antibiotics and fertilizers (Corporate Europe Observatory, 2020).
Financial feasibility	Have the repurposing upfront costs and the complementary costs that are necessary to create an enabling environment been thoroughly assessed? Should these costs be borne from the reallocation of a share of the repurposed subsidy, or from external (additional) resources? Are they secured financial resources to cover these costs?	The costs of creating an enabling environment for repurposing, including building acceptance, compensation, developing specific tools and mechanisms, etc., should be taken into account when deciding whether or not to repurpose a subsidy. If these costs are financed by reallocating part of the repurposed subsidy, this may reduce public acceptance, as the total subsidy budget will decrease. If they are financed by other public funds, sufficient resources should be made available.	Rwanda has launched a new financing programme for climate resilience for farmers. The €100 million financing is made possible by a partnership between the European Investment Bank and the Bank of Kigali (Willis et al., 2023).
Technical/ knowledge feasibility	Implementation capacities: Are there sufficient knowledge and capacities in government institutions to shift from the previous subsidy system to the new one? Are there sufficient knowledge and capacities among land users to apply deforestation- and conversion-free practices? Are there behavioural biases among beneficiaries which may be a constraint for the implementation of the reform? Is data available to ensure an adequate selection of beneficiaries? Is there a solid monitoring system to track the impact of the reform, e.g., extent of forest degradation and land-use change, and allow for necessary adjustments?	Only repurposing options that are technically possible in the country context can be realistically and efficiently implemented. This requires sufficiently developed and strong institutions, consistent data on the beneficiary group, and the existence of financial and technical mechanisms to channel the subsidy. If there is not enough capacity to introduce new land-use practices, one way to address this is to introduce/strengthen extension services which can become part of the repurposing strategy (see complementary options in Section 3.4). Remote sensing is widely used and allows to track changes in land cover on a large scale and at limited cost. Where needed, mobile apps can be used by land users for data collection, although they require more resources for initial capacity building and require basic services, such as good mobile network coverage.	In Malawi, the undersized and underfunded agricultural extension system prevents the dissemination of sustainable land-use practices, which could become a condition for receiving input subsidies. In Brazil, data on forest cover change and subsidized credit allocation on the municipal level make it possible to track the effect of subsidy policies on deforestation.

Scalability	What is the scalability/applicability of the new option to a large area and a large number of people, especially vulnerable and marginalized groups? What is the estimated contribution of the repurposing option to the restoration of forests and other degraded lands? What share of the country's agricultural area should receive the repurposed subsidy?	Priority should be given to repurposing options that can be easily scaled up to cover large areas and/or large numbers of vulnerable communities (rather than just a few people who may not be the most in need of support).	Shifting subsidies from mineral to organic fertilizers is scalable only if there is a sufficient supply of organic fertilizers in the area. Providing subsidies for the use of deforestation-free agricultural practices in widely grown commodities such as maize and soy has greater scalability than focusing on small-scale commodities.
What are the expected impacts of repurposing?			
Social impacts	What are the expected social impacts of the repurposing option, including equity, gender, employment, nutrition, health, respect for internationally recognized rights, and interests of Indigenous people and local communities? Have situations improved as a result of these impacts compared to the initial subsidy? If the original subsidy did not have a social intent and no positive or negative social impact: how can the repurposed subsidy contribute to improve the life of vulnerable groups? To what extent would the repurposing option benefit poor, disadvantaged and vulnerable groups? Are there safeguards/mechanisms in place to ensure that these vulnerable groups do indeed benefit from repurposing? When marginalized communities are not direct beneficiaries, is there a clear way to identify the communities (Indigenous or otherwise) that would benefit? What are the implications of repurposing in terms of access to a clean and healthy environment for all?	To address equity and fairness (Target 18), the repurposed subsidies should benefit the most disadvantaged. The perception of fairness by the beneficiaries is key to ensure the full utilization and sustainability of the subsidy.	Often the support to agriculture is inequitably distributed across the sector in favour of larger farms, particularly in developed countries such as Canada, the US and in the EU – mainly because agricultural support is generally tied to production, or factors of production like land (UNEP et al., 2021).
Impacts on the environment	Is repurposing expected to promote agricultural production that is deforestation- and conversion-free and respects human rights (including in a third-party country for importing countries)? To what extent is repurposing expected to expand sustainable agricultural practices that restore land, including improvements in soil quality and health, and long-term productivity (agroforestry, climate-smart agriculture, conservation agriculture etc.)? What is the estimated area of forest and other ecosystems that is expected <u>not</u> to be converted, or to be restored thanks to repurposing?	Ideally, not only should the repurposing option have a significant impact on halting deforestation and conversion, but it should also contribute to the restoration of degraded forests and other types of land. By helping to restore soil health and improving the productivity of marginal agricultural lands, good repurposing options can decrease the pressure on intact forests and build resilience of the beneficiaries. Subsidy reforms which achieve a reduced impact of agriculture on forests and grasslands will not only benefit the farmers but also the general population through the provision of multiple ecosystem services. Subsidy reforms which expand sustainable agricultural practices can be expected to improve food availability and diversity, increase the provision of regulatory ecosystem services, such as water retention, and improve on-farm biodiversity (Ding, Markandya, et al., 2021).	In Brazil, the government linked access to affordable agricultural loans to farms and municipalities that demonstrated efforts to curb deforestation. While enforcement of these measures was not flawless, these programmes played a role in achieving a notable reduction in deforestation (Searchinger, 2020).
Economic impacts	To what extent is the repurposing option expected to be less distortive than the previous subsidy system? To what extent is the repurposing option expected to be more cost-effective? What is the expected impact on employment and income, and for which population groups (e.g. middle class, disadvantaged communities)? Is the repurposing option expected to contribute to private sector development/functioning markets (e.g., impact on competitiveness, on monopolies, oligopolies)? Is it expected to improve the country's fiscal balance? What are the expected/assessed costs and benefits beyond the repurposing option itself (in the long term and in areas where the subsidy is not provided)?	Repurposing options should promote the development of healthy markets (avoiding monopolies, etc.) and contribute to employment and income generation, in particular for disadvantaged groups, such as women, Indigenous people and local communities. Ideally, the repurposing option should contribute to increased productivity, increasing the revenue of land users. It is important to identify who will be the losers due to the subsidy and how much they will lose in order to design compensatory/mitigating measures, ensuring that the repurposing does not displace the problem from one group to another. Some subsidy impacts remain unmonetized and unmonetizable, such as the loss of biodiversity or the continued threat to endangered species. However, they need to be taken into account in the design of exit strategies, as they can have various long-term and indirect negative impacts, including on the environment and the socioeconomic conditions of vulnerable groups.	In Burkina Faso, forest cover reduced by 50% since 2000, driven by growing demands for agricultural land and cattle pasture. In 2010, the government took action by launching a US$30 million forest investment programme. This initiative incentivized individuals to cultivate trees on their farms. Beyond land restoration, the programme provided households with additional income, enabling them to allocate 12% more toward food expenses, reducing food insecurity by 35-60% (Ding, Anderson et al., 2021).

A.4 TEMPLATE TO RECORD INFORMATION ON SUBSIDIES BASED ON BIOFIN

HEADING	DESCRIPTION
Existing subsidy	Name of the subsidy analysed
Responsible stakeholder/ organization/agency	Stakeholders/organization and agency involved or related to the subsidy
Sector	Relevant sector(s)
Drivers	Describe the motivations explaining the introduction and continuation of the subsidy
Direct or indirect	Is it a direct or indirect subsidy?
Financial value	Financial value of the subsidy (if this information is available)
Description – intended objective and beneficiaries	Describe the main objectives of the subsidy and the intended beneficiaries
Benefits (social, environmental, economic)	Describe the benefits that the subsidy has and will have on social, environmental and economic aspects. Example: agriculture subsidy to support rural employment
Biodiversity benefits	How does the subsidy benefit biodiversity?
Biodiversity-harmful impacts	What harmful impacts on biodiversity can be expected or are known?
Is this potentially a "perverse" subsidy?	See definition above
Describe related legislation	Describe the main laws and regulation creating the subsidy
Additional notes	Additional notes
Links to related studies including CBA, economic valuation	Describe different sources of analysis related to the subsidy (e.g. any economic justification)

Source: BIOFIN, 2023



Agroforestry. © Shutterstock

A.5 REFERENCES FOR ASSESSMENT OF REPURPOSING OPTIONS IN BRAZIL (FOR TABLE 4)

	POLITICAL AND INSTITUTIONAL AND FEASIBILITY	ACCEPTANCE	TECHNICAL FEASIBILITY	FINANCIAL FEASIBILITY	SCALABILITY	SOCIAL IMPACTS	ENVIRONMENTAL IMPACTS	ECONOMIC IMPACTS VERSUS BAU
Restoring pastures under sustainable cattle ranching	**High**	**Medium**	**Medium**	**High**	**High**	+	++	+
Source	Assad et al., 2020	Assad et al., 2020	Assad et al., 2020	Assad et al., 2020	Assad et al., 2020	Feltran-Barbieri & Féres, 2021; Sekaran et al., 2021	Assad et al., 2020	Sekaran et al., 2021
Quote	"(...) the strategies and actions offered by the ABC Plan and Planaveg create the most suitable and resilient conditions for growth and development of crops, pastures and livestock" p. 38	"It is also important to show the farmer that he/she is the greatest beneficiary of ecosystem services and this is why he/she should value them for different types of actions (for example, restoration of degraded areas, conservation of native vegetation remnants, implementation of good agriculture practices, etc.)." (p. 39)	"Training, scientific research and technology, qualification of specialists and financial agents, extension activities and broad dissemination should all be intensified so that actions to adapt Brazilian agriculture to climate change can be expanded." p. 39	"A combination of economic instruments used worldwide is presented in Table 7, highlighting tax incentives (exemptions, reduced tax rates, tax credits, etc.), credit incentives, direct compensation (payment for environmental services) and disincentives." (p. 33)	"The country has robust technical knowledge and successful experience with commercial scale production systems of greater resilience and productivity" (p. 2) "The challenge is to convince the agriculture and financial sector that, by investing in the restoration of degraded areas and forests, a cost is avoided as a result of increased environmental resilience and decreased risk exposure to climate change, fundamental for agriculture production at the scale of the farm and for society at the scale of the landscape" (p. 32)	"Diversified cropping systems in ICLS can improve the productivity of the principal crop as well as enhance food security."(Sekaran et al. 2021) "Income stability, i.e. reduced economic risks through multiple production systems"(Sekaran et al. 2021) "Diversity in ICLS with the rotations of cover crops and nitrogen-fixing crops can increase protein content of vegetation and enhance the diets of livestock, thereby benefiting human health"(Sekaran et al. 2021) "Providing public resources or directing of private resources to agriculture via rural credit needs to be justified by the private and social benefits that result, including conservation of natural resources (...). Clearly, credit directed to pasture recovery meets these criteria (...)" (Feltran-Barbieri et al. 2021)	"Benefits of the CLFI system: provides greater adaptation and resilience to climate change, Provides more amenable temperatures, Provides less exposure to direct sunlight and/or high temperatures, Increases humidity in air and soil, Presence of trees protect against frost, winds, hail, storms and high temperatures, Expands the positive balance of energy." P. 14	"Diversified cropping systems in ICLS can improve the productivity of the principal crop as well as enhance food security" "ICLSs have greater soil quality, crop yield, and economic returns" "Continuous labor and infrastructure requirements, high capital investment, and increased nutrient losses through in-tensive recycling are also the major disadvantages of ICLSs."
Expanding regenerative low-carbon agriculture	**Medium**	**Medium**	**High**	**Medium**	**Medium**	++	++	+
Source	Villa Alves, 2021	Assad et al., 2020; Newton et al., 2020	Assad et al., 2020	Assad et al., 2020	Assad et al., 2020	Assad et al., 2020	Assad et al., 2020	Assad et al., 2020; Brakarz, 2020
Quote	"For the new cycle (2020-2030), strengthened institutional governance along with monitoring and evaluation systems will provide integrated data that will allow for continuous improvement and transparent management." "Measurement, Reporting and Verification (MRV) mechanisms, in accordance with internationally accepted scientific criteria, will supplement economic incentives for the set-up of new market instruments capable of delivering added value from sustainable production systems."	"Donors, investors, or tax-payers who might fund any such carbon farming project might reasonably expect the pro-ject to be associated with a Monitoring, Reporting, and Verification (MRV) system to measure and demonstrate the carbon sequestered by a given farmer, project, or area of land" (Newton et al. 2020) "environmental compliance is still seen as a burden for farmers, given the cost of restoration and reforestation, when it should be considered an investment and key part of the financial sustainability of their enterprises." (Assad et al. 2020, p. 38)	"The country has robust technical knowledge and successful experience with commercial scale production systems of greater resilience and productivity" (p. 2) "Training, scientific research and technology, qualification of specialists and financial agents, extension activities and broad dissemination should all be intensified so that actions to adapt Brazilian agriculture to climate change can be expanded." p. 39	"All these actions can be incorporated in the analyses of risk for investors, insurance companies, and financial institutions and, once quantified, can contribute to reducing interest rates or premiums based on the reduced risk of the investment and financing. Moreover, the additional revenue obtained from the economic exploration of the legal reserve and the use of low-carbon technologies will make the business model more attractive for potential investment and financing." p. 39	"The country has robust technical knowledge and successful experience with commercial scale production systems of greater resilience and productivity" (p. 2)	"In the literature, these additional benefits are considered co-benefits. They are aimed at sustainable development and involve environmental gains such as improved air and water quality, protection against floods, increased animal weight gain and crop productivity, generation of electric energy for rural or remote areas, and increased income and job opportunities" "contributing to increased productivity and net income for the farmer, and creating jobs in rural areas"	The known effects of good management and soil and water conservation practices that form the basis of low-carbon agriculture, together with the practices of recovery proposed by Planaveg, have a positive effect on the maintenance of biodiversity, on the availability and quality of water and on the incidence of natural disasters, primarily due to a reduction in landslides and flooding." p. 38	"All the works consulted point to economic advantages, whether they are integrated systems, pasture resto-ration systems or AFS;" (Assad et al. 2020) "These important services could be used to improve the cash flow of future agriculture and forest enterprises and, consequently, increase the attractiveness of investment in low-carbon agriculture and forest restoration due to the reduction of risk of non-payment of the principal." (Assad et al. 2020) "contributing to increased productivity and net income for the farmer, and creating jobs in rural areas" (Assad et al. 2020) "A recent survey involving more than 3,400 producers who were part of the project, has shown that 99% had in-creased incomes" (Brakarz 2020)

Scaling agroforestry systems	**Medium**	**Medium**	**Medium**	**Medium**	**Medium**	**++**	**++**	**+**
Source	Shennan-Farpón et al., 2022	Shennan-Farpón et al., 2022	Baumüller et al., 2020; Shennan-Farpón et al., 2022	Abdul-Salam et al., 2022; Do et al., 2020	Lacerda et al., 2020; Sekaran et al., 2021; Shennan-Farpón et al., 2022	Assad et al., 2020; Mukhlis et al., 2022	Assad et al., 2020	Assad et al., 2020; Mukhlis et al., 2022
Quote	“lack of government support (at all levels) and lack of community organizations—as the main barriers preventing or limiting their implementing agroforestry farming”, “lack of cooperatives dedicated to agroforestry products and the lack of institutional support and funding for family farms and agroforestry systems” "Our results show lack of policy support and initial investment needs are the biggest constraints to agroforestry, but opportunity cost is not considered a large barrier”	“lack of community organizations—as the main barriers preventing or limiting their implementing agroforestry farming” "Attitudes to agroforestry are varied, but common themes emerge including the high value of tree cover for shade and cooling effects, and the difficulties in selling agroforestry products."	"Our results show lack of policy support and initial investment needs are the biggest constraints to agroforestry, but opportunity cost is not considered a large barrier" (Shennan-Farpón et al. 2022) "complex agroforestry interventions may fail where farmers lack management skills and lack access to capacity building opportunities" (Baumüller et al. 2020, p. 66)	"Providing an upfront payment to farmers is shown to significantly increase in the likelihood of agroforestry adoption over range of different carbon prices and expected agricultural returns." (Abdul-Salam et al. 2022) "Agroforestry systems, on the other hand, return substantial profits in the long term, but they also incur high establishment and maintenance costs and can generate net losses in the first few years." (Do et al. 2020)	“ICLS often improve farmer's income and employment opportunities in rural areas [32]. However, benefits depend on crops, livestock, soils, local conditions, and management methods.” (Sekaran et al. 2021) “ICLS demands a greater knowledge (both crop and livestock) and commitment as livestock need continuous (constant) care from people involved in the operation [46]. “ (Sekaran et al. 2021) “agronomy is one of the prerequisite knowledges needed by rural communities in order to achieve successful agroforestry adoption. An extension of workers (…) are therefore important in order to perform knowledge transfer to the communities.” (Shennan-Farpón et al. 2022) "While the focus of our research is on small-scale farms, the models we are testing show potential for scaling-out, offering promising alternatives that landscape managers can use to support sustainable land use and land cover change" (Lacerda et al. 2020)	“From the perspective of socio-economic, agroforestry can potentially improve smallholders’ income, increase food security, promote gender equality and stimulate cultural activities in rural areas.” (Mukhlis et al. 2022). “The implementation of a diverse agroecosystem including trees (timbers, fruits) and livestock might provide alternative incomes for the community promoting economic resilience [19]. Furthermore, the system might improve household food security through diversified food sources [20,21]. Thus, agroforestry might also become a solution for the existing socio-economic issues.” (Mukhlis et al. 2022). "AFS also contribute social and economic value, since they reduce the vulnerability of families to climate stress, pest outbreaks, falling prices and food insecurity" (Assad et al. 2020, p. 15)	"AFS play an important role and their environmental benefits are: provide habitats to species that tolerate a certain level of disturbance; contribute to reducing rates of natural habitat conversion due to lower pressure for use as farmland; support the integrity of forest remnants, serving as ecological corridors or buffer zones; and provide ecosystem services, such as carbon sequestration, better air, water and soil quality, and conservation of biodiversity. AFS are used by farmers to adapt to climate change, considering, temperature and precipitation primarily" (p. 15)	“From the perspective of socio-economic, agroforestry can potentially improve smallholders’ income" (Mukhlis et al. 2022) "AFS also contribute social and economic value, since they reduce the vulnerability of families to climate stress, pest outbreaks, falling prices and food insecurity" (Assad et al. 2020, p. 15)

Strengthening bioeconomy value chains	**High**	**High**	**Medium**	**Medium**	**Medium**	**++**	**+**	**++**
Source	Rodriguez et al., 2018	World Bank, 2023a	World Bank, 2023a	World Bank, 2023a	World Bank, 2023a	World Bank, 2023a	World Bank, 2023a	World Bank, 2023a
Quote	"the Bioeconomy has been formally recognized as a strategic area, in the National Strategy of Science, Technology and Innovation 2016-2019, identifying strategic lines for its development in the use of biomass, processing and biorefineries and bioproducts."	"the bioeconomy has been identified as a driver of growth" (p. 103) "several activities linked to the bioeconomy have high cultural value in Amazônia" (p. 271)	"Policy makers must, however, remain vigilant about risks associated with the bioeconomy, such as the following: • Markets are relatively small, and overly promoting production could quickly result in falling prices for producers, both in Amazônia and in other parts of the world (which are often among the poorest). • There are also risks of slipping into monoculture production, which would belie the original idea of the bioeconomy and be harmful to forests. • Stimulating the bioeconomy (including associated processing industries) could raise demand for land, which, in an environment of weak land and forest governance, could indirectly harm forests."	"The remoteness of many small producers of bioeconomy products such as forest commodities means that transportation costs are high." (p. 198)	"the bioeconomy, unlocking the natural capital associated with the standing forest, is a small sector of the Amazonian economy. (…) Markets for sustainably produced forest products, as opposed to the same products produced as monocultures (for example, cocoa), remain small but they are growing. (…) At the same time, however, such markets are bound to remain niche given the steep marginal cost curves of commodities sustainably extracted from the forest" (p. xxx1) "The employment-generating capacity of rural diversification, including in the rural bioeconomy, is thus relatively limited" (p. 182)	"Bioeconomy production also holds considerable cultural value. Supporting these traditional livelihoods thus forms a key pillar of rural poverty reduction strategies. The bioeconomy can also play a central part in Amazônia’s structural transformation" (p. xxxi)	"Fewer transitions into unsustainable activities, and higher sustainable natural capital use ☐ higher forest cover and enhanced ecosystem services" (p. 270)	"the bioeconomy has been identified as a driver of growth" (p. 103) "although creating alternative employment options linked to sustainable production can reduce deforestation, it is unlikely to affect macroeconomic pressures that lead to deforestation (…)" (p. 117) "the bioeconomy based on the sustainable extraction of forest products has limited potential for contributing to economic growth and poverty reduction, especially where markets are not as dynamic as they are for açai" (p. 199)

Financing land and forest restoration measures	**Medium**	**Medium**	**Medium**	**Low**	**Medium**	+	++	+/-
Source	May et al., 2016	May et al., 2016	May et al., 2016	May et al., 2016	May et al., 2016	Feltran-Barbieri & Féres, 2021	Garrett et al., 2022	Legesse et al., 2022
Quote	"Despite continued weak governance problems, it should be noted that several Amazon states have tried to enhance Brazil's position with regard to forests in the UNFCCC, arguing that their need for financial resources to assume the role established by the decentralization can be met in part through access to REDD+ funding." (p. 35)	"due to the launch of the public call to select proposals to obtain non-repayable financial support for development and implementation of Land Management and Environmental Plans (...) in indigenous territories in the Amazon biome, the Amazon Fund, the MMA and FUNAI conducted several regional workshops focused on training and answering questions from potential bidders and interested parties. " (p. 96) "However, it is clear from the results of recent public hearings on the principles and criteria for REDD+ projects (...) that actors representing indigenous and traditional peoples in the Amazon are aware of the relevance of tenure security in obtaining access to benefits associated with REDD+ (...)" (p. 98)	"Brazil is one of the most advanced countries in the world in terms of its capacity to monitor its forest resources using remote sensing and GIS technologies" (p. 95) "However, this point raises concern, since it is unknown how different individual projects and local REDD+ initiatives ongoing in Brazil will be incorporated into the national strategy's accounting system" (p. 89) "Despite the need in some cases for the creation of new institutions to support REDD+ implementation, greater efficiency could be attained through targeted investments and staffing to improve the capacity of institutions already in place in Brazil, such as INPE, CONAFLOR, CONAMA and state environmental secretariats." (p. 94)	"Most deforestation control and REDD+ initiatives in Brazil are still financed by public resources" (p. 83) "Similar to debates on REDD+ at the international level, most critiques in Brazil have focused on: 1) the potential danger that a massive influx of REDD+ credits might depress international prices of carbon, making it unviable to cover the costs of emissions reductions through this means; 2) potential risks that industrial countries might use relatively cheap forest carbon credits as a means to circumvent urgently needed transitions to low carbon economies; and 3) difficulties in ensuring additionality, permanence and prevention of leakage" (p. 82)	"The lack of clarity about land tenure rights contributes to other problems, including obstacles to the legalization of forest management and protection on public and private lands" (p. 36) "A consensus on the best architecture to leverage finance and thereby to upscale REDD+ has yet to be reached, since there is still doubt if this would be possible through the exclusive use of specific public mechanisms" (p. 82)	"Providing public resources or directing of private resources to agriculture via rural credit needs to be justified by the private and social benefits that result, including conservation of natural resources, common goods and diffuse rights. Clearly, credit directed to pasture recovery meets these criteria, since it leads to a rise in productivity and reduced pressure to exploit new lands" (Feltran-Barbieri et al. 2021)	"Forest and landscape restoration practices have also proven to have significant benefits for addressing the impacts of climate change. These include carbon sequestration and reduction of greenhouse gas (GHG) emissions, improving the resilience of landscapes and reducing disaster risks. Forest and landscape restoration is therefore one of the key solutions of the agriculture, forestry and other land-use (AFOLU) sector (...)"	"Its economic benefits also encompass the improvement of human well-being through the provision of food and wa-ter from protected forest ecosystem and verified emission reduction payment that generates additional income for forest-dependent communities." (Legesse et al., 2022) (+)
Providing direct compensations to farmers for ecosystem services	**Medium**	**Medium**	**Medium**	**Low**	**Low**	++	+/-	+/-
Source	Dennis et al., 2011	Börner et al., 2013	Le et al., 2024	Dennis et al., 2011; Pinto et al., 2022	Alix-Garcia & Wolff, 2014; Dennis et al., 2011	Börner et al., 2013; Miranda et al., 2003	Börner et al., 2017; Le et al., 2024; Oliveira Fiorini et al., 2020	Börner et al., 2017; Duckett et al., 2022; Mikołajczak et al., 2022; Shaver & Avanzini, 2023
Quote	In the Brazilian Amazon in particular, the feasibility of PES is highly contextualized. Places that have institutional rules and the general capacity to foster markets might be best suited for PES schemes (Agrawal, 2001). In this light, many places in the Brazilian Amazon might not need markets per se, because there are PES□like schemes (e.g., ICMS) and forms of institutional Applied Biodiversity Sciences Perspectives Series knowledge already in place established through organizations such as farmer collectives or cooperatives that could pave the way for a PES. On the other hand, in less developed areas such as the Brazilian frontier, there may not be institutions present to govern where and how things are bought and sold, nor pre□market conditions. Therefore, it would be unrealistic and inefficient to establish markets, and therefore, PES schemes in these places." (Dennis et al. 2011)	"In our two case study reserves we find no evidence for common fears associated with incentive-based conservation initiatives, such as poverty-trap effects as a result of overreliance on cash transfers"	"designing PES schemes that both reduce negative environmental impacts and maintain socioeconomic development is a major challenge for most developing countries" (Le et al. 2023)	"it is necessary to ensure that financial mechanisms aimed at the PES agenda are effectively focused on forest maintenance and restoration, biodiversity and other ecosystem services in order to mitigate the climate change impacts on economic sectors." (Pinto et al. 2022) "There are multiple economic and social factors that influence the feasibility, implementation and impact of PES systems. Opportunity costs play an important role in determining service provider participation; service providers' land use decisions about accepting a form of PES are influenced by the forgone benefits of putting land to other uses." (Dennis et al. 2011)	"In the world of forest-PES, lack of secure tenure over the assets that produce the externality poses one of the biggest implementation challenges, particularly in developing countries." (Alix-Garcia & Wolff 2014) "Property rights, in particular, are an issue that we feel will influence the effectiveness and feasibility of PES schemes" (Dennis et al. 2011)	"The main impact on human assets relates to capacity building at different levels. There has been a substantial improvement in environmental education and solid waste management, involving schools, parents and civil society. (...) Landowners benefit directly from capacity building and advice (...). There are also important benefits in relation to capacity building in agro-conservation and integrated management of small farms (...)." (Miranda et al. 2003) "Over half of our survey respondents felt better off in our survey year than three years before, and cited the BFP as the most frequently mentioned reason."	"PES projects in Brazil are employed to promote sound agro-environmental practices, to reduce carbon emissions from deforestation and forest degradation, and to consolidate water management efforts" (+) (Fiorini et al. 2020) "Any cost of PES implementation above the minimum payment necessary to induce landowner participation in the PES program will indirectly reduce the environmental effectiveness of the program through a reduction in the number of PES contracts that can be secured for a given budget" (-) (Börner et al. 2017) "In other words, the contextual actors, design and conditions of implementation can all lead to positive or negative sustainable outcomes of PESPs" (-) (Le et al. 2024)	"Agricultural systems hold vast potential for reducing global greenhouse gas emissions, preventing land degradation, protecting terrestrial biodiversity and improving the livelihoods of farming communities." (Shaver & Avanzini 2023) (+) "(...) farmers can receive financial compensation for losses and can benefit from pro-environmental actions, for example, in the form of paid participation in conservation schemes or through eco-tourism. Benefits notwithstanding, many small farmers reported wild and rewilded nature as a constraint on production." (Duckett et al. 2022) (-/+) "If we are serious about promoting greater acceptance and uptake of rewilding through the ELMS package, the issues of social justice and cost redistribution mechanisms should be given ample consideration." (Mikołajczak et al. 2022) (-) "the impact of PES on welfare will be determined by a range of socio-economic and environmental factors" (+/-) (Börner et al. 2017)

De-risking instruments	**Medium**	**High**	**High**	**Medium**	**High**	+	+/-	++
Source	Gohdes & Christianson, 2017	Gohdes & Christianson, 2017	Gohdes & Christianson, 2017	Jena & Shrimali, 2024	OECD, 2021a	Feltran-Barbieri & Féres, 2021	OECD, 2021a	OECD, 2021a
Quote	"MDBs already have a range of de-risking tools and approaches at their disposal to help attract private sector investment."	"One answer: use risk-sharing instruments like insurance, guarantees, first-loss positions and more to grease the wheels for more private-sector investment. The importance of these tools came through in discussions at the G20 this summer and was reiterated at COP23. The topic further got more attention at the One Planet Summit (also called the "Macron Summit") that took place in Paris last week." "At the same time, the MDBs are also working to refashion de-risking approaches in ways that go well beyond guarantees."	"MDBs already have a range of de-risking tools and approaches at their disposal to help attract private sector investment."	"In the last two decades, international institutions and financial intermediaries innovated and deployed credit risk-mitigation instruments. However, these instruments are not currently being used to their maximum potential. The high cost of these instruments, cumbersome process, inflexibility, lack of awareness and slow decision-making by multilateral institutions and governments is limiting the use of existing credit risk-mitigating instruments — and slowing the energy transition."	"Latest OECD analysis estimates current infrastructure holdings by pension funds and insurers (...) at 4.1% of their investible AUM (...). This suggests large scope to increase institutional capital flows towards infrastructure development."	"Providing public resources or directing of private resources to agriculture via rural credit needs to be justified by the private and social benefits that result, including conservation of natural resources, common goods and diffuse rights. Clearly, credit directed to pasture recovery meets these criteria, since it leads to a rise in productivity and reduced pressure to exploit new lands"	"De-risking instruments (...) can facilitate institutional investment in green infrastructure." "Targeted de-risking by the public sector can capitalize on the current momentum towards green infrastructure and direct money towards green assets critical for sustained socio-economic growth."	"De-risking instruments (...) can facilitate institutional investment in green infrastructure." "Targeted de-risking by the public sector can capitalize on the current momentum towards green infrastructure and direct money towards green assets critical for sustained socio-economic growth."
Improving the risk coverage in agricultural insurance	**Medium**	**Medium**	**High**	**Medium**	**High**	++	+/-	++
Source	Carrer et al., 2020; World Bank, 2010	Carrer et al., 2020	World Bank, 2010	World Bank, 2010	World Bank, 2010	Carrer et al., 2020	OECD, 2023b	Carrer et al., 2020
Quote	"The Rural Insurance Subsidy Program (PSR) (...) aims to reduce the cost for producers to purchase rural insurance policies and consequently increase the use of this instrument for risk management (...). The federal government pays a portion of the cost of purchasing rural insurance, thereby reducing the effective cost to the producer and functioning as an incentive to use the insurance market. However, the adoption of rural insurance by Brazilian producers remains very low." (Carrer et al. 2021) "In Brazil the federal government has two special pseudo-crop insurance programs for small and marginal farmers: PROAGRO and SEAF." (World Bank 2010)	"We found that characteristics of the producer (education and risk propensity) and the business/the farm (use of technical assistance, management tools, soybean/ corn production and farm size) influenced the likelihood of using rural insurance."	"Agricultural insurance is available in most LAC countries. (...) Brazil, Colombia, Panama, Ecuador, Cuba, and República Bolivariana de Venezuela—have some experience in agricultural insurance."	"Assuming the current terms and conditions of insurance policies, it is estimated that the total agricultural insurance premiums in the region will increase US$65.3 million for each percentage point of increase in insurance penetration rates across all types of agricultural insurance."	"In Brazil, Alliança do Brazil—an insurance company linked to Banco do Brazil—has the single largest agricultural insurance portfolio in LAC (approximately US$150 million in premiums), which is linked to rural credit and is delivered to farmers solely through Banco do Brasil branches." "Forestry insurance is a well-developed agricultural insurance business subline in the Southern Cone countries. (...) Brazil and Argentina have significant potential to develop this business subline."	"When purchasing insurance, an individual trades unknown future costs and uncertainty (related to damages from a poor crop, which can potentially be very costly) for the anticipated and relatively lower cost of a premium. By reducing the consequences of adverse climate risks and contributing to the stability of agricultural activity, the contract in question provides rural producers with greater peace of mind and ensures the continuity of their production."	"Insurance and credit support are conditional on environmental criteria and zoning rules that promote environmental improvements such as preservation of forests and native vegetation. The impact of environmental conditionality set by the Environmental Rural Registry (CAR), ZARC, and the Forest Code should continue being assessed with respect to outcomes such as targets related to deforestation and GHG emissions."	"When purchasing insurance, an individual trades unknown future costs and uncertainty (related to damages from a poor crop, which can potentially be very costly) for the anticipated and relatively lower cost of a premium. By reducing the consequences of adverse climate risks and contributing to the stability of agricultural activity, the contract in question provides rural producers with greater peace of mind and ensures the continuity of their production."

A.6 REFERENCES FOR ASSESSMENT OF REPURPOSING OPTIONS IN MALAWI (FOR TABLE 7)

	POLITICAL AND INSTITUTIONAL AND FEASIBILITY	ACCEPTANCE	TECHNICAL FEASIBILITY	FINANCIAL FEASIBILITY	SCALABILITY	SOCIAL IMPACTS	ENVIRONMENTAL IMPACTS	ECONOMIC IMPACTS VERSUS BAU
Diversification of crop production	**High**	**Medium**	**High**	**High**	**Medium**	++	+	+/-
Source	Fatch et al., 2021	Fatch et al., 2021	Kankwamba et al., 2018	Mango et al., 2018	Kankwamba et al., 2018	Mango, Makate, et al., 2018	Njeru, 2013	Mango, Makate, et al., 2018
Quote	"Though the 2016 Malawi National Agricultural Policy recognizes the importance of agricultural diversification and outlines policy statements, objectives, and strategies to enhance diversification, it has been weak as will be shown. [...] Therefore, at the policy level, Malawi, it seems, has placed a high priority on agricultural diversification compared to its neighboring countries." (p.3)	"However, the HealthyLAND project intervention on agricultural diversification showed that it was possible to influence farmer appreciation of the importance of agricultural diversification within a short period." (p.19)	"We find that SID increases with agricultural extension. We argue that changes in SID appear to reflect regional differences in the way in which extension services are provided in different parts of Malawi. Therefore, it is important that agricultural extension policy is tailored to support crop diversification in local settings." (p.333) [SID is the *Simpson Index of Diversification*].	"Moreover, policies to ensure smallholder farming households' access to credit, education, and draft power are also recommended. For instance, the government in collaboration with the microfinance organizations can work possibility for offering small loans with low interest rates without collateral to smallholder farmers." (p.9)	"It is important that agricultural extension policy is tailored to support crop diversification in local settings. We also found that farmers' socioeconomic characteristics and circumstances determine crop diversification outcomes in Malawi." (p.333). "Considering that seed of most legumes can be recycled for several seasons, crop diversification is expected to spill over to non-beneficiaries due to peer effects." (p.334)	"Farmers who intensify crop diversification are better off than their counterparts as diversification is positively related to food consumption and negatively related to food insecurity mainly due to the benefits of crop diversification to include, raising farm productivity, income, and reducing production and price risks." (p.8)	"Crop diversification brings about higher and spatial temporal biodiversity on the farm and increases resilience" (p. 64)	"Crop diversification hence improves food security through improving food stocks in terms of quantity and variety and also in improving income through sale of crop produced from a variety of grown crop species which then is used to further improve consumption patterns." (p.9).
Support for agroforestry systems	**Medium**	**Medium-High**	**Low**	**Medium**	**Medium**	++	++	+/-
Source	Coulibaly et al., 2017	Araya et al., 2023; Kazcan et al., 2013	Ignaciuk et al., 2021	Ignaciuk et al., 2021	Kazcan et al., 2013	Araya et al., 2023	Garrity et al., 2010	Ignaciuk et al., 2021; Kpienbaareh et al., 2022
Quote	"There is first, a need to invest and develop institutional structures and mechanisms e.g., markets, road networks and policies that reduce bottlenecks that hinder farmers' uptake of appropriate agroforestry practices like fertilizer trees. Such bottlenecks include incomplete input markets that do not provide reliable and timely access to quality seeds or seedlings of agroforestry tree species and uncompetitive output markets for agroforestry products such as fodder and timber." (p.65)	"Agroforestry systems are becoming increasingly popular in Malawi, particularly those that promote soil fertility improvement and crop yields" (Araya et al., 2023: 2) "direct assistance [under Malawi's 'Agroforestry Food Security Program'] has allowed over 180,000 farming households to undertake agroforestry practices so far (Garrity, et al. 2010). However, the extent to which such success can be maintained or emulated without direct subsidy is unclear" (Kazcan et al., 2013: 19)	"The adoption of the climate-smart scenarios is associated with large initial investments for farmers, including [...] tree seedlings acquisition, and increased labour allocation. These adoption barriers are compounded by uncertainty over future benefits, lack of management information, and limited necessary infrastructure, such as tree nurseries and livestock services." (p.19)	**Programme-wide financing feasibility**: "Given that investments in agroforestry and improved tillage methods also generate GHGs emission reduction benefits, there is the possibility of leveraging climate financing to support this initiative, similar to a payment for ecosystem services scheme" (p.19) **And farm-level returns:** "The climate-smart agriculture scenarios considered in this analysis for Malawi, under a range of climatic and market conditions, generate higher returns over a 15-year investment period compared with conventional production systems" (p.19) although there are higher initial costs.	"Overall, smallholder farmers have been found to be prepared to adopt agroforestry but only at low levels. Adoption is based less on a desire for long term soil regeneration (and thus higher maize yields) and more on short term alternative food or fuel wood production. High labor requirements (even in densely populated areas), access to seed markets (for both purchasing and selling of seed), and access to improved legume genotypes are constraints to adoption." (p.22)	" it is evident that CSSA has significant potential to enhance food security and reduce poverty among macadamia producers in Malawi." [...] "Climate-smart sustainable agroforestry is also viable for empowering women and marginalized groups in Malawi" (p.5)	"In addition to increasing soil fertility and crop yields, these [Malawian] agroforestry systems were observed to suppress weeds (Sileshi et al. 2006), improve water filtration (Chirwa et al. 2007), and increase the amount of soil carbon (Makumba et al. 2007)."	"The adoption of the climate-smart scenarios* is associated with large initial investments for farmers, including livestock purchases, tree seedlings acquisition, and increased labour allocation." *the "climate-smart scenarios" included agroforestry. (Ignaciuk et al., 2021: 19) "Practising agroecology can potentially increase yield to address food needs, which would reduce dependence on livelihood systems that incentivize forest exploitation. If decent markets could be obtained for agroecological products, restoring agroecosystems/forests could in turn likely reduce poverty." (Kpienbaarah *et al.*, 2022:1098)

Financing landscape restoration measures	**Medium**	**Medium**	**Medium**	**High**	**Medium**	**+**	**++**	**+/-**
Source	Ministry of Natural Resources, Energy and Mining of Malawi, 2017b	Djenontin et al., 2022	Ministry of Natural Resources, Energy and Mining of Malawi, 2017b	Ministry of Natural Resources, Energy and Mining of Malawi, 2017b, 2017c	Ministry of Natural Resources, Energy and Mining of Malawi, 2017b	Ministry of Natural Resources, Energy and Mining of Malawi, 2017b	Ministry of Natural Resources, Energy and Mining of Malawi, 2017b	Ministry of Natural Resources, Energy and Mining of Malawi, 2017c, 2017b
Quote	"In terms of motivating factors, Malawi is well-positioned for recognizing the benefits of restoration, but the main barrier to implementation is that a strong and well-understood legal framework with sufficient economic incentives supporting restoration is not in place. [...] Government leadership and commitment to a national restoration target is not yet widely appreciated." (p. xiii)	"Findings suggest that the actual or tangible benefits from and the shared perceived value of the resources being restored are key drivers for both individual and collective restoration. First, the actual gains in specific ecosystem products such as firewood, NTFPs, and timber, are critical determinants, especially for farmlands restored with agroforestry and FMNR [Farmer-managed natural regeneration] practices, and even with SWC [soil and water conservation] techniques" (p.17)	"There is limited knowledge about restoration in the country at farm level, in the districts and the country a whole. There is experience within project and there is evidence of local level adoption of farmer managed natural regeneration (FMNR) and this presents a good opportunity. Restoration best practices and experience are now emerging from different countries but this remains a systemic gap in Malawi" (p.55)	The NFLRA assesses funding opportunities positively (pp.63-64) e.g.,"Malawi appears to be well positioned to acquire GCF and other climate change related funds for to support several aspects of designing and implementing a national restoration strategy" (Ministry of Natural Resources, Energy and Mining, 2017a: 64) "forest-based restoration interventions that promote the creation of public goods but lack conventional economic returns may require financing through public funds or novel investment schemes that generate financial returns on natural capital." (Ministry of Natural Resources, Energy and Mining, 2017b: 33)	"Scaling up FMNR and related restoration practices which directly increase the productivity of cropland could have a major impact on food security and rural incomes in Malawi. Restoration of millions of hectares could be achieved in less than 10 years with significant positive impacts and at relatively low cost by investing in a scaling up strategy based on expanded communications (with a focus on rural radio programs), peer to peer training and other practical interventions to facilitate and accelerate knowledge sharing by farmers and mobilization of grass roots support for the widespread adoption of FMNR" (p.83)	"Restoration can also contribute significantly to poverty alleviation. Cost-benefit analysis suggests that restoration activities with forest tree species could improve household incomes, in present value terms, by 1.5 to 2.1 million MWK over a twenty-year period." (p.7) "Currently most men and women live in degraded landscapes and are not enjoying the benefits of restoration. Natural resource benefit flows are not equitable and are contributing to degradation. Over half of Malawi is considered degraded and while in theory men and women could and will benefit from restoration generally they are not" (p.54)	"Preliminary analysis has shown that if Malawi achieves 12% of the Bonn Challenge pledge (4.5 million) in degraded areas important for biodiversity, all Malawi's high priority degraded terrestrial Key Biodiversity Areas can be restored." [...] ". Significant gains for biodiversity through landscape restoration can be achieved by targeted FLR interventions in just three districts (Mzimba, Rumphi, Nkhata Bay) and nearly all of these areas occur in less than 10 land use/land cover categories" (p.40)	"Many restoration strategies and technical packages exist [...] that both meet the short-term economic needs of landowners and build in diversified income-generating products based on ecological succession in the mid-term, all the while contributing to long-term public and private economic and ecological sustainability." (Ministry of Natural Resources, Energy and Mining, 2017b: 26) **However**, the necessary market conditions are missing (competing demands for degraded or lost forest lands are **not** declining, and value chains for products and services from restored forests **do not yet** exist) (Ministry of Natural Resources, Energy and Mining, 2017a: 54).
Strengthening non-maize value chains	**Low**	**Medium**	**Medium**	**Medium**	**Medium**	**+**	**+**	**+**
Source	Benson, 2021	Matita et al., 2024; Muyanga et al., 2020	Gelli et al., 2020	Branca et al., 2021	Branca et al., 2021; Donovan & Gelli, 2019	Tuni et al., 2022	Branca et al., 2021; Kpienbaareh et al., 2022	Donovan & Gelli, 2019
Quote	"Given the perceived advantages of maize production and consumption and in a context of limited land availability, a farmer's decision to plant some of their land in crops other than maize is not taken lightly. In the absence of locally adapted information for both producers and consumers on the benefits of alternative food crops; with weak markets that constrain commercial production of maize also constraining such production of other food crops; and with continuing low maize productivity levels leaving relatively little cropland available for the production of other crops, **maize will continue to dominate most smallholder fields, food systems, food policies, and political discourse in Malawi**." (p.41)	"This speaks to **the importance of maize** relative to other energy giving food and beverage products in the diets of Malawians, as described in other studies [...] although diets are dominated by maize in rural Malawi, **households desire and often consume a range of other nutritious foods** including vegetables and small-dried fish." (Matita *et al.*, 2024: 11) "If smallholder farmers could be guaranteed of food access at affordable prices, then they would be motivated to put their land under high value crops thereby increasing land productivity. If not, they will continue growing maize in their tiny pieces of land even in situations where it does not make economic sense to do so." (Muyanga *et al.*, 2020: 31)	Gelli *et al* (2020) provide a number of examples in Table 5 for feasible interventions in non-maize value chains: e.g., **beans and legumes**: "Although consumers are willing to purchase and prioritize beans and legumes over other foods (except maize), they face limited purchasing capacity during peak demand periods. Production bottlenecks limit availability during certain periods of the year, and there are limited incentives for traders to engage in supplying local markets. For these constraints, intervention options include innovation in production technologies to expand availability and improved coordination and other measures (e.g., storage) with traders to reduce costs." (p.6)	"To increase smallholders' market access, national policies are oriented towards increasing efficient use of inputs through public extension service support and subsidy systems, enhancing market infrastructure and storage facilities, and promoting the cooperative system to engage smallholders in profitable agricultural markets. However, **inadequate financial capacity**, an inefficient public extension services system, limited involvement of the private sector in extension services provision, poorly developed managerial practices that cooperatives often adopt, poor market coordination and development and limited engagement of investors in market infrastructure are the most relevant factors limiting the effectiveness of policy supporting value chain inclusion." (p.18)	"Malawi presents an especially challenging case for market-oriented approaches to improved diets given the pervasiveness of rural poverty, the existence of localized markets for more perishable foods, and the limited capacity of the market actors to invest in upgrading their production and market systems." (p.6) [...] "Extensive coordination and cooperation across NGOs, government agencies, and the private sector would be needed for value chain engagement, more than has been traditionally present in Malawi or elsewhere." (Donovan & Gelli, 2019: 7) "Smallholders' heterogeneity requires differentiated interventions tailored to value-chain-ready and non-value-chain-ready household conditions." (Branca *et al.*, 2021: 18)	"An increased market participation by Malawian smallholder farmers is critical to the rural development in the country, as commercialization is positively associated to improved food security (Ragasa and Mazunda, 2018), dietary diversity (Jones, 2017; Koppmair et al., 2017), agricultural productivity (Ragasa and Mazunda, 2018), asset ownership (Muriithi and Matz, 2015), sustainable agricultural practices, including crop diversification (Ortega et al., 2016), hired labour opportunities (Wiggins, 2014) and income (Wiggins, 2014), therefore significantly contributing to the reduction of poverty (Sibande et al., 2017) and stimulating inclusive rural growth." (p.11)	"Legume diversification in Malawi has been found to build up soil quality, reduce fertilizer application, increase soil cover, maintain higher yields, and reduce yield variability." (p.2) Kpienbaareh *et al* (2022) identify (a) tobacco production and (b) government subsidies for staple crop production inputs (maize) as key drivers of deforestation.	"Achieving win–win outcomes for both the smallholders that the engage in the [Local Value Chains] for the selected food products and the poor consumers that potentially consume these products are not certain, and the potential trade-offs across at multiple levels among development goals made explicit here require careful consideration. For example, at the boarder community level, prioritizing interventions with consumers might not be compatible or cost efficient, at least in the short term, with sourcing locally from smallholders." (p.7)

Support for organic fertilizer production	**High**	**Medium**	**High**	**Medium**	**Medium**	+	++	+
Source	Ministry of Agriculture of Malawi, 2021	Benson, 2021	Ministry of Agriculture of Malawi, 2021	Khonje et al., 2022; Nyondo et al., 2022	Benson, 2021; Holden & Lunduka, 2012	Benson, 2021	Benson, 2021	Ministry of Agriculture of Malawi, 2021; Nyondo et al., 2022
Quote	"The NFP will also facilitate reforms of various institutions, organisations, public and private entities engaging in the fertiliser industry of Malawi." (p.1)	"In consequence, inorganic fertilizer is viewed by most farming households in Malawi as critical to realizing improved livelihoods from their farming activities and to assuring their own food security. Moreover, ensuring that all smallholder farmers have access to fertilizer consistently figures in the election platforms of political candidates in Malawi." (p.46) i.e., use of **in**organic fertiliser is heavily ingrained, so the shift to organic may come with acceptance challenges.	"Much of the production of fertilisers in Malawi is in the form of organic. These include liquid fertilisers, manures such as composts, green manure, and tobacco pellets. In addition, there are bio-fertilisers, such as inoculants. Prior to 2015, [the Department of Agricultural Research Services] was conducting research, producing and selling legume inoculants. In 2015 the private sector took up commercialisation of inoculants. Since then there has been an increase in the production and uptake of inoculant for soya bean and groundnut production. Overall, the challenge with the organic and bio-organic fertiliser subsector is that they have not been regulated and quality standards need to be established, especially for commercial production." (p.5)	"However, local OF suppliers may have limited capacity to produce large quantities of OFs. For this reason, providing these input suppliers with credit facilities may ease challenges related to production capacity." (Khonje *et al.*, 2022: 890) "it may be sensible to explore the possibility of producing fertilizers locally in the long-run if this can be more cost effective than importing. However, it is not immediately apparent that this would be cost effective; the country would still rely on imported fertilizer production inputs and be required to generate a great deal of energy to convert atmospheric nitrogen into fertilizer" (Nyondo et al., 2022: 6)	"Making efficient and profitable use of these organic approaches for field crops requires farmers to surmount significant knowledge barriers and make often limited labor available at specific times. Without site-specific knowledge built through farmer experience and experimentation or obtained through advice from agricultural extension experts, the risk is high that adopting farmers will realize poor crop harvests" (55) "The preparation, transportation, and application are labor demanding considering the scarcity of easily available organic matter and the much lower nutrient concentration in organic manure than in in organic fertilizers." (Holden & Lunduka, 2012: 304)	"Under current price patterns and farming systems, fertilizer subsidies remain the principal way in the near term for the government of Malawi to assure national food security, reduce its dependence on international humanitarian assistance for famine relief, and (partially) address degradation of the soils on which the country depends for its food." (p.60). *Assumption that the positive social impacts of increased inorganic fertilizer availability would also hold for increased organic fertilizer availability.	"Among these benefits are, most notably, improved soil health (primarily due to increased soil organic matter of higher quality compared with what can be realized with inorganic fertilizer alone" (p.52)	"The domestic production of both inorganic and organic fertilisers will result in reduced cost of fertilisers, increased job creation, increased participation of local Malawians at all fertiliser value chain, reduced imports and increased exports leading to increased foreign exchange earnings." (NFP, 2021: 5) "it may be sensible to explore the possibility of producing fertilizers locally in the long-run if this can be more cost effective than importing. However, it is not immediately apparent that this would be cost effective; the country would still rely on imported fertilizer production inputs and be required to generate a great deal of energy to convert atmospheric nitrogen into fertilizer" (Nyondo *et al.*, 2022: 6)
Improvement of fertilizer storage capacity	**Medium**	**High**	**Medium**	**Low**	**Medium**	+	-	+
Source	Ministry of Agriculture, Irrigation and Water Development (Malawi), 2018	Benson, 2021	Fuentes, 2013	Mango, Mapemba, et al., 2018	Fuentes, 2013	Nyondo et al., 2022	Mhango & Dick, 2011	Kaiyatsa et al., 2019; Mango, Mapemba, et al., 2018
Quote	"Timely access to agricultural inputs (seeds, fertiliser [...]) that are well-suited to local conditions is critical for enhancing productivity and adapting to climate change. The importance of access to inputs is recognised in the SADC Regional Agricultural Policy and accompanying Investment Plan, as well as the NAP under Policy Priority Area IV. " (p.47)	"In consequence, inorganic fertilizer is viewed by most farming households in Malawi as critical to realizing improved livelihoods from their farming activities and to assuring their own food security. Moreover, ensuring that all smallholder farmers have access to fertilizer consistently figures in the election platforms of political candidates in Malawi." (p.46). (i.e., increasing the consistent avalability of inorganic fertilisers likely to be well-received).	"In terms of storage infrastructure in the rural sector, the government should take the initiative to create a public-private partnership for the use of existing public storage facilities by the private sector, at least during market expansion, and eventually privatize the public facilities or provide incentives for them to invest in their own facilities as the market matures. These incentives should be accompanied by public investment in road infrastructure that will further facilitate private sector expansion in underserved rural areas." (p.44) i.e., the technical feasibility, much like the scalability, relies on the government's active support of infrastructure (but a private sector does exist that could then capitalise on this).	"Malawi faces relatively higher trader margins and intermediation costs along the value chains. Inorganic fertilizer and other agricultural inputs are costly, mainly due to high international and domestic transportation costs, as well as high trader margins as a result of high transaction risks associated with agricultural input trading." [...] "Furthermore, there is a need to consider implementing innovative approaches to supply chain management for fertilizer and other inputs, such as timely procurement" (p.13) (i.e., even with better storage, inorganic fertiliser imports remain a costly product).	"In terms of storage infrastructure in the rural sector, the government should take the initiative to create a public-private partnership for the use of existing public storage facilities by the private sector, at least during market expansion, and eventually privatize the public facilities or provide incentives for them to invest in their own facilities as the market matures. These incentives should be accompanied by public investment in road infrastructure that will further facilitate private sector expansion in underserved rural areas." (p.44)	"There are several reasonable arguments for subsidizing inputs like fertilizer and hybrid seeds, such as promoting more self-sufficiency and employment compared to, say, food aid. [...] These theoretical benefits notwithstanding, there is a great deal of evidence supporting the inclination to reform or exit from subsidy policies, and that the benefits of previous subsidy programs in Malawi have been considerably smaller than anticipated. [...] Household food security and national food selfsufficiency have also generally not been achieved as maize imports and persistent food insecurity continue to rise, requiring distribution of food aid." (p.2) the implication is that if the goals of improving fertilizer storage are increasing fertilizer access, then evidence from the subisidies suggests this has limited social benefit.	"it is estimated that more intensive agriculture will reduce soil formation, photosynthesis and water cycle especially when inorganic fertilizers from subsidies are used exclusive of organic amendments such as applying green manures from agroforestry. Our assessment suggests that overall around 50% of the ecosystem services considered in Table 2 may be negatively affected by agricultural input subsidies if Malawi embraces the use of inorganic fertilizer as seen in other countries around the world" (p.205)	"Malawi faces relatively higher trader margins and intermediation costs along the value chains. Inorganic fertilizer and other agricultural inputs are costly, mainly due to high international and domestic transportation costs, as well as high trader margins as a result of high transaction risks associated with agricultural input trading." (Mango, Mapemba *et al.*, 2018: 13) "Since timely application of fertiliser is crucial for maize yields, private sector distribution efficiency should be a positive strategy for boosting agricultural production in Malawi." (Kaiyatsa *et al.*, 2019: 349)

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY ENDNOTES

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32 Such as soil nutrient retention, pollination, natural pest and disease control, climate regulation, the provision of water for downstream agriculture, etc.

33 Bridging the traditional concerns of politics and economics, it focuses on how power and resources are distributed and contested in different contexts, and the implications for development outcomes.

34 www.euractiv.com/section/agriculture-food/news/snapshot-of-farmers-protests-and-its-not-over/

35 35Estimates of illegal deforestation are likely an underestimate because of severe data limitations. Even if evidence of illegality is missing, it should not be assumed that conversion is legal.

36 Support measures can be focused on inputs (e.g., fertilizer, irrigation, seeds, fuel and energy), on outputs (e.g. tax refunds, preferential loans, crop insurance), or other production-related factors like machinery, land area, market prices, price floor guarantees and property taxes on farmland. General service support does not directly alter producers' incomes, and includes support for public goods, such as infrastructure development, research and knowledge transfers, inspection services, etc. Border and market measures include import/export bans, quotas and tariffs, and market price controls and interventions.

37 China, representing 36% of this total, provides the most support, displacing large OECD economies which have historically held this role, followed by India (15%), the US (14%) and the EU (13%).

38 natural grassland vegetation

39 Biomass accounts for 97% of the total primary energy supply in Malawi, which is one of the highest dependency rates in the world. Firewood is the most used cooking fuel (88% of households), in particular in rural areas. Charcoal predominates in urban areas (54%) for households and industry use. Alternative fuel sources such as electricity (only 11% of the population has access to electricity) are underdeveloped (Ngwira & Watanabe, 2019).

40 The time range for data from Skole et al. (2021) and Ministry of Natural Resources, Energy and Mining of Malawi (2019) is presented as it was published. Data from Global Forest Watch (2022) has been adjusted to similar time ranges to allow for comparison.

41 These calculations are based on a 20-year time horizon with a discount rate of 24%.

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