WORLD BANK GROUP

Designing Fiscal Instruments for Sustainable Forests

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Agriculture, Subsidies, and Forests

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Introduction

The significant role agriculture plays in driving deforestation is now widely recognized. Until the early 1990s, most analyses focused on conservation and protection strategies to avoid deforestation. Since then, the focus has shifted toward the need for a multisector approach (for example, World Bank 1991), with rising attention paid to the role of agriculture and "land-saving" approaches (that is, increasing productivity on existing land to avoid expansion into forests). In reality, most of the gains in global food security over the past 60 years have been achieved through higher productivity, despite a doubling of global population, with physical area expansion contributing significantly less than might have been the case without technology advances, for example, from the green revolution (Fuglie et al. 2020). This global picture, however, needs to be nuanced as the "net saving" of land at the global level masks a large variation in land use change at the local level across individual countries, often with significant environmental costs such as forest loss (Byerlee, Stevenson, and Villoria 2014). Experience shows that intensification by itself has proven not to be a panacea for reducing deforestation (Byerlee, Stevenson, and Villoria 2014): Along forest frontiers, the higher profitability of intensified (that is, more productive) cropping systems can provide a strong incentive to expand further into forests (a phenomenon often referred to as the rebound effect or the Jevons paradox).[1]

More broadly, and looking ahead, the evolving global trends present a worrisome picture. The world population is expected to reach 10 billion by 2050. Incomes are rising and consumer tastes are changing, often rapidly. This means that the world will need to produce approximately 50–80 percent more calories (as estimated by various studies) by 2050 (compared to 2010) while meeting the growing demand for diverse foods. The biggest challenge facing the global food system is to meet these needs in the face of climate change and from an increasingly stressed and severely limited natural resource base.

The IPCC Special Report (2019) on global warming of 1.5°C notes that climate impacts are occurring faster than anticipated and that the Paris Agreement is insufficient to prevent a disastrous 3°C warming of the Earth. This has dire implications for the world's poor and

1 Especially when intensification is not accompanied by additional, complementary policy interventions, such as strengthened enforcement of forest boundaries.

undernourished as the impacts are likely to be most prominent on agriculture and food security. Such impacts are likely already being felt—the Food and Agriculture Organization of the United Nations notes an alarming reversal in the global trend of the number of undernourished—rising for a third year in a row since 2014 to 826 million people, reversing a steady decline since 2000 (FAO et al. 2019). Reduced yields and growing food insecurity will put additional pressures on extensification of agriculture in some areas to meet basic food needs.

Public support for agriculture around the world has historically been focused on improving food security and making progress on other socioeconomic indicators, but with insufficient focus on climate and environmental outcomes. Countries around the world have long provided public support for agriculture. Food security remains a priority for many emerging and developing economies, and it also continues to be the main rationale for high levels of public support in many developed countries. The motivations for public support have also broadened over time—to accelerate the pace of structural transformation, to deal with persistent rural poverty, to bridge a widening rural-urban income gap, as well as to provide strategic support to promote exports (or substitute for imports). The economic and food security imperatives, typically in poor and early development settings, are to trigger a quick boost in food production. Political and social imperatives compel policy makers to find ways to boost the incomes of a large share of the population engaged in agriculture. "Visible" public support that benefits producers financially is often seen as an expedient way of doing both.

The form that agricultural support takes can have potentially large impacts on environmental outcomes. At worst, direct input subsidies to producers may encourage production through area expansion (for example, into forest, ecologically sensitive, or marginal areas) or excess use of inputs that generate a great deal of pollution (for example, nitrogen fertilizers) while discouraging production in areas that generate smaller environmental externalities. In an intermediate case, support that is partially decoupled (for example, transfers without distorting input or output prices, but with use or production conditions) still creates incentives to encourage excess production of targeted commodities or overuse of certain inputs, and eventually for expansion. At best, fully decoupled support might encourage producers to move in a direction that is economically efficient (through income transfers not tied to any inputs or outputs) or environmentally efficient (through transfers as payments for environmental services or conditional on climate-smart production practices).

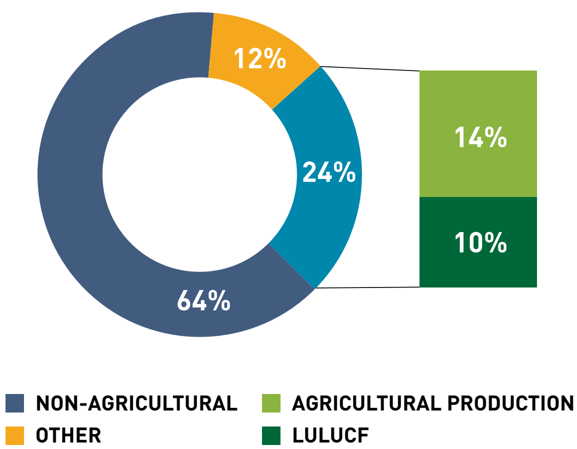
This chapter focuses on the likely links between agricultural fiscal policies and forest loss through land expansion or conversion. Fiscal instruments, and in particular public support for agriculture, can play a greater role in ensuring that public policies are aligned to reduce deforestation and achieve more sustainable outcomes. Sectoral policies should be reformed not only to promote climate-smart agriculture (CSA) practices but also to limit expansion into forests as part of both climate mitigation and adaptation strategies.

Agriculture and the Environment

Agriculture is both a victim and a major culprit of climate change. The most severe impacts of climate change are expected to be felt in agriculture, threatening hard-fought gains in global food security. Among the countries expected to be hit hardest are also some of the poorest, generally in the tropical belt. Yet agriculture itself is a major contributor to climate change, accounting for 24 percent of global emissions (figure 12.1). Emissions from agriculture fall into two broad categories: the conversion of land from forests and other natural habitats to agriculture (10 percent) and harmful methane and nitrous oxide emissions from livestock, rice cultivation, and fertilizer application (14 percent) (Searchinger et al. 2018).

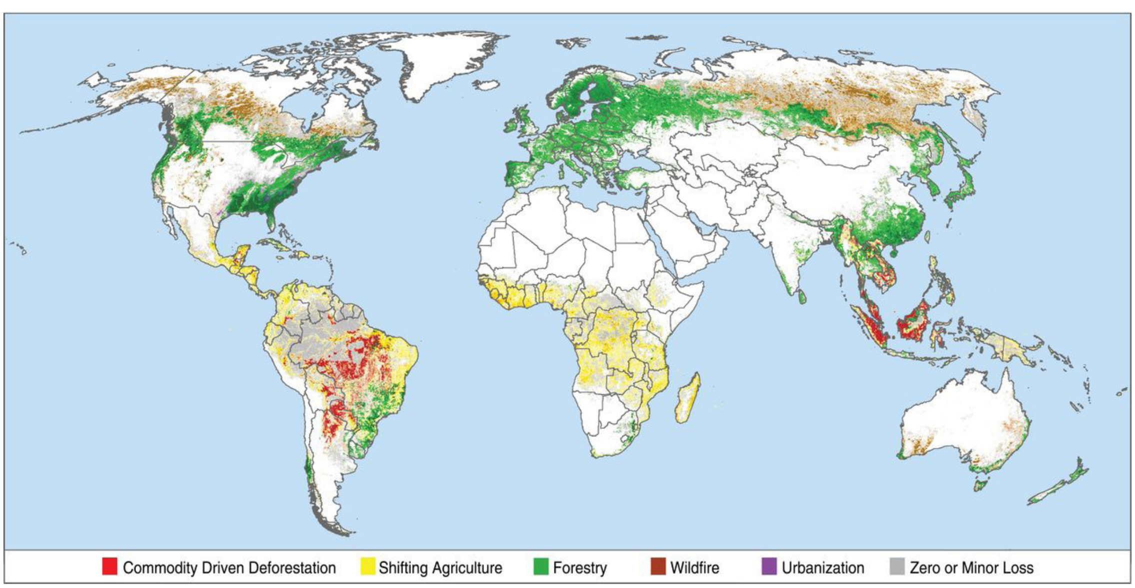
To understand the potential interactions between agricultural policies themselves and forest loss through land expansion or conversion, it is first important to understand where deforestation is concentrated. A recent study identifies the significant role of agriculture as a primary driver of deforestation (figure 12.2). It differentiates between permanent conversion of forests (that is, deforestation) and temporary loss of tree cover (from forestry activities or wildfires). This distinction is important because the latter does not entail land conversion since the affected areas are expected to recover, and as such, should not be considered as deforestation. The study finds that while there is a significant amount of forest disturbance globally, almost all deforestation per se is directly associated with agriculture—either from commodity (or commercial crop) production or from subsistence agriculture.

FIGURE 12.1
SOURCES OF GLOBAL GREENHOUSE GAS EMISSIONS



Source: Searchinger et al. 2018.
Note: LULUCF refers to emissions from land use, land use change, and forestry.

FIGURE 12.2
PRIMARY DRIVERS OF FOREST COVER LOSS, 2001–2015

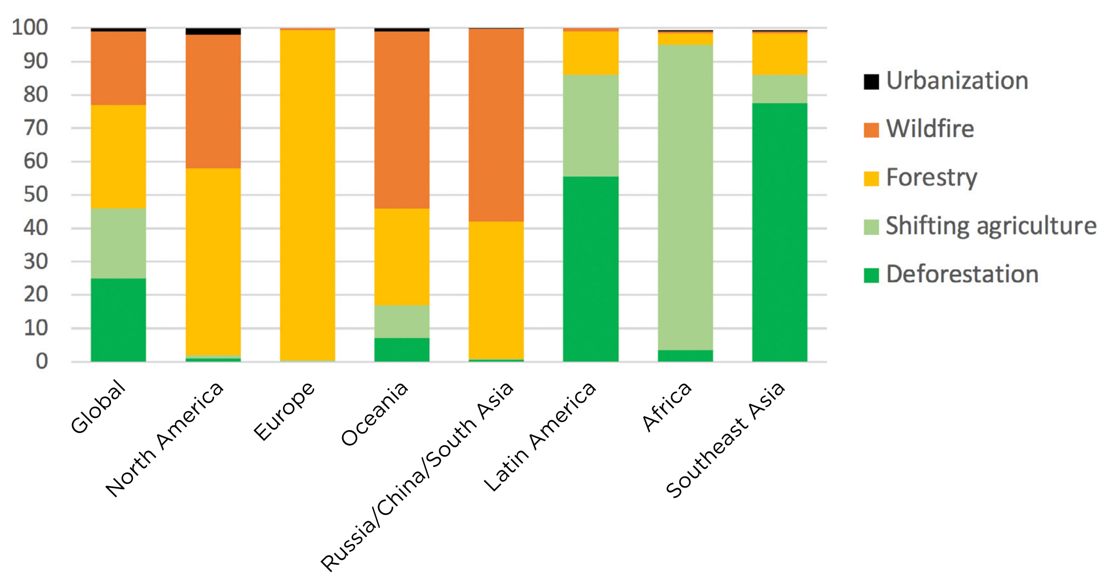


Source: Curtis et al. 2018.
Note: Darker color indicates greater intensity of forest cover loss.

Deforestation is highly concentrated in tropical forests. Differentiating across regions, figure 12.3 shows that about 46 percent of total forest disturbances across the globe are caused by agriculture. The role of urbanization, despite the pace at which it is progressing in many countries, is minimal. The impact of subsistence agriculture, primarily in Sub-Saharan Africa, is also found to be low—shifting cultivation is seen as a temporary loss of tree cover, but the affected forest is expected to eventually regrow. As such, the main driver of global deforestation (98 percent) is agriculture. The picture is, however, vastly different across regions. The impact of wildfires or forestry is very low in tropical forests (in Latin America, Africa, and Southeast Asia), while these two sources dominate in the temperate and boreal forests of other regions. In the tropics, deforestation accounts for 89 percent of all forest disturbances (nearly 95 percent in Africa and 86 percent in the other two regions).

A second important dimension is the extent of forest loss by region. The largest loss between 2001 and 2015 in millions of hectares (mHa) was in Latin America (78 mHa), followed by North America (70 mHa) and Russia/China/South Asia (64 mHa). Africa and Southeast Asia each experienced a loss of 39 mHa. Combined with the shares from different sources, these statistics indicate that commodity-driven deforestation outweighs shifting cultivation as the main driver of deforestation—accounting for 54 percent of the tree loss resulting from agriculture.

FIGURE 12.3
DISAGGREGATION OF GLOBAL AND REGINAL TREE COVER LOSS BY DRIVER, 2001–2015



Source: Curtis et al. 2018.

A third important dimension is to understand the factors behind the drivers of deforestation. Many commodities linked to deforestation are exported, primarily from Latin America and Southeast Asia. As such, the analysis of the impact of domestic policies and support for agriculture on deforestation becomes complicated—the proximate trends in the nature of local subsidies or agricultural policies may not be sufficient to explain the dynamics of deforestation.

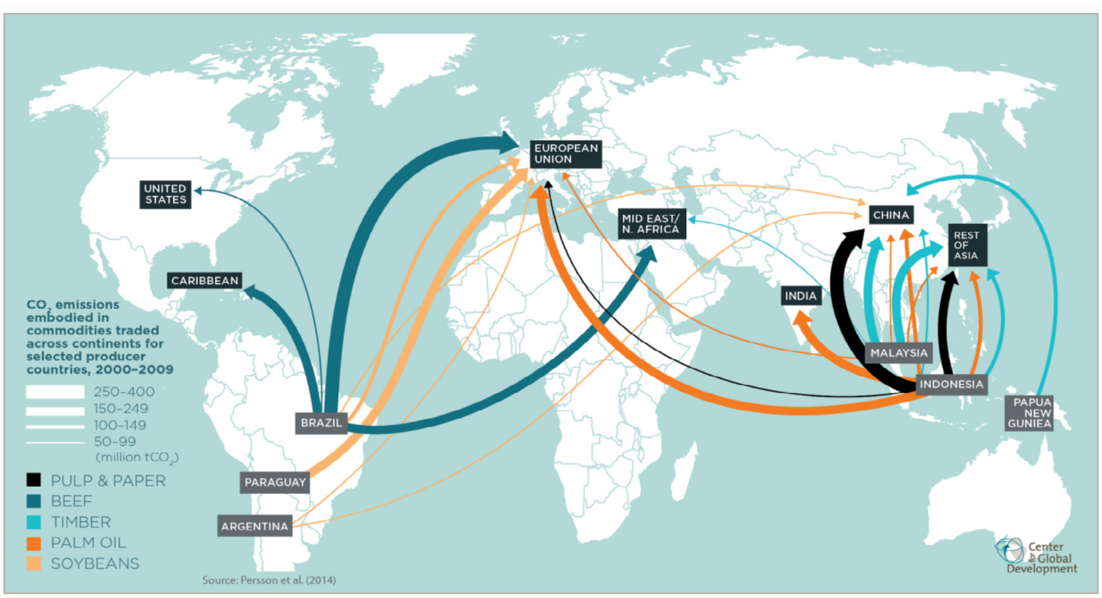
As a purely hypothetical example, suppose country X provides market price support for cereals; this price distortion creates a disincentive for the production of oilseeds (and hence cooking oil). Also assume that cereal production areas are far from the forest frontier, so in principle the domestic price distortion does not drive deforestation. Country X, however, then has to import oil from producers in country Y (widely recognized as "efficient" producers of oilseeds but with significant forests and production situated at the forest frontier). Therefore, even if country Y was to have no distorting policies, it is clear that the subsidies embedded in market support policies in country X (and for non-oilseed crops in this hypothetical case) create strong commercial incentives to drive global demand for country Y's oilseeds and thus play a major role in deforestation in country Y.

More generally, trade policies of both exporting and importing countries become important as potential drivers of deforestation. The analysis of the relation between domestic agriculture support policies and forest degradation and loss becomes complicated as it needs to account for the potential "offshoring" of environmental externalities through trade—often possibly in countries with weaker (public or private) governance systems.

The importance of trade and global consumption in driving deforestation-related carbon emissions is highlighted in a study by Persson, Henders, and Kastner (2014), who looked at global trade for just four commodities—beef, soybean, palm oil, and wood products (commodities with the largest impact on tropical forests in terms of deforestation or degradation)—originating in eight tropical countries (Argentina, Bolivia, Brazil, the Democratic Republic of Congo, Indonesia, Malaysia, Papua New Guinea, and Paraguay). Their results show that between 2000 and 2009, a third of the deforestation in the study countries was embodied in agricultural exports, mainly to the EU and China (figure 12.4). With the exception of Bolivia and Brazil (which have large domestic markets), exports are the dominant driver of deforestation. Excluding Brazil, on average 57 percent of the deforestation observed in this period was due to the export of the studied commodities. Importantly, other than Bolivia and Malaysia, all countries showed an increase in the share of emissions embodied in the exported commodities over the study period.

FIGURE 12.4

TRADE IN DEFORESTATION-DRIVING AGRICULTURAL COMMODITIES, 2000–2009



Source: Persson, Henders, and Kastner 2014.

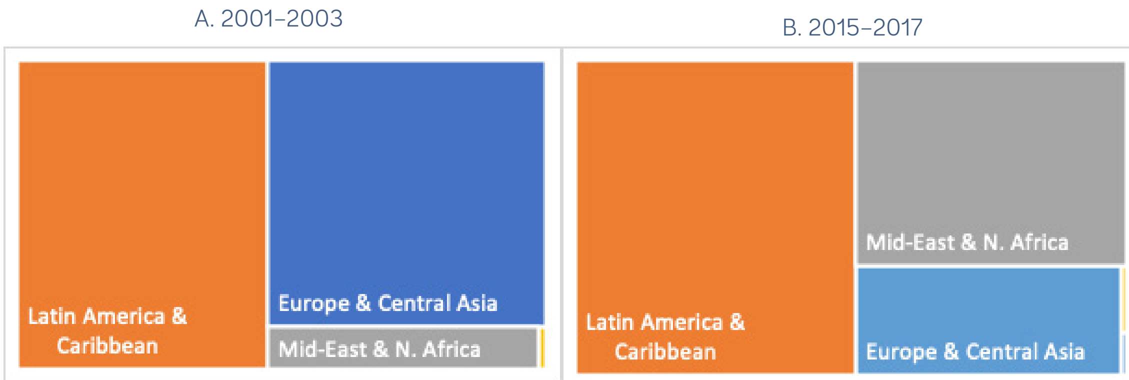
Finally, establishing links between specific policies and deforestation is further complicated by the potential substitution and displacement effects that policies targeted at specific areas or actors might trigger. This is highlighted by the Brazilian experience with environmental regulations aimed at reducing loss of Amazon forests from soy and cattle production (de Waroux et al. 2019). While Brazil had the laws and regulations in place to protect and regulate forests (such as the Forest Code), deforestation of the Amazon continued because of low enforcement. To address this, under pressure from environmental activists, a number of private industry-led initiatives were developed in the 2000s to curtail sourcing of first soy, then beef from illegally forested areas. The Soy Moratorium was signed by several multinational traders in 2006. This was followed by commitments from a number of countries, companies, and civil society organizations to ensure their supply chains were deforestation-free.[2]

The Soy Moratorium was effective in reducing the direct impact of soy in the Amazon despite the strong growth in international demand for soy (driven by the livestock industry, particularly in China). However, the area under soy cultivation expanded rapidly outside the Amazon forest at the expense of pastures, displacing cattle ranching into the forests (Arima et al. 2011). Thus, while improved governance in supply chains and regulations was successful for one segment of the soy supply chain in reducing its direct impact on the forests, it triggered strong indirect impacts on forests as the (strengthened) regulations did not impact the overall expansion of soy area (de Waroux et al. 2019).

The experience with Brazilian beef agreements demonstrates similar frustrations: (i) Pasture expansion was reduced in the Amazon biome as a result of the 2009 G-4 cattle agreement, but investments in cattle ranching shifted to regions with less restrictions. And while deforestation initially declined in the more regulated biomes, and specifically the Amazon, it started to increase again in 2012. (ii) With 80 percent of Brazilian beef destined for domestic markets, and with significant scope for "leakage" through a very large number of relatively small processors who are difficult to effectively monitor, de Waroux et al. (2019) also find significant substitution effects with local market suppliers sourcing more beef from the restricted biomes, while international importers switched to beef sourced from other regions. Thus, despite a reduction in Brazilian beef imports by some countries, such as in Western Europe, the UN COMTRADE data show that overall Brazilian exports increased (in quantity terms) by 86 percent between 2004 and 2017, with a rapid growth in exports to countries within South America and the Middle East and North Africa region (figure 12.5), which may also perhaps reflect less stringent sourcing conditions.

2 The meatpacking companies signed the Terms of Adjustment of Conduct ("MPF-TAC") and the G-4 zero-deforestation agreements in 2009. In 2010, Banco de Brasil also signed the agreement to limit public credit to farmers who deforested after 2006. A number of countries, including most Western European countries, also committed themselves to reduce deforestation from their supply chains by signing the 2014 New York Declaration on Forests (for details, see de Waroux et al. 2019).

FIGURE 12.5
DESTINATION OF BRAZILIAN BEEF EXPORTS BY REGION, 2001–2003 VS. 2015–2017 (%)



Source: Original calculations using UN COMTRADE data.

Nature of Public Support to Agriculture

Public support for agriculture can take different forms:

- Expenditures on pure public goods and services required to promote and sustain productivity growth
- Input subsidies (funded by public expenditure, that is, by taxpayers) in the form of transfers to producers to finance part of the input costs—often referred to as "coupled subsidies"
- Income transfers not tied to any inputs or outputs—often referred to as "decoupled subsidies"
- Indirect subsidies through market price supports,[3] either by maintaining minimum price supports for certain strategic food crops (typically food grains) or by tariff and nontariff barriers restricting imports (or effectively raising the domestic price of agricultural commodities)

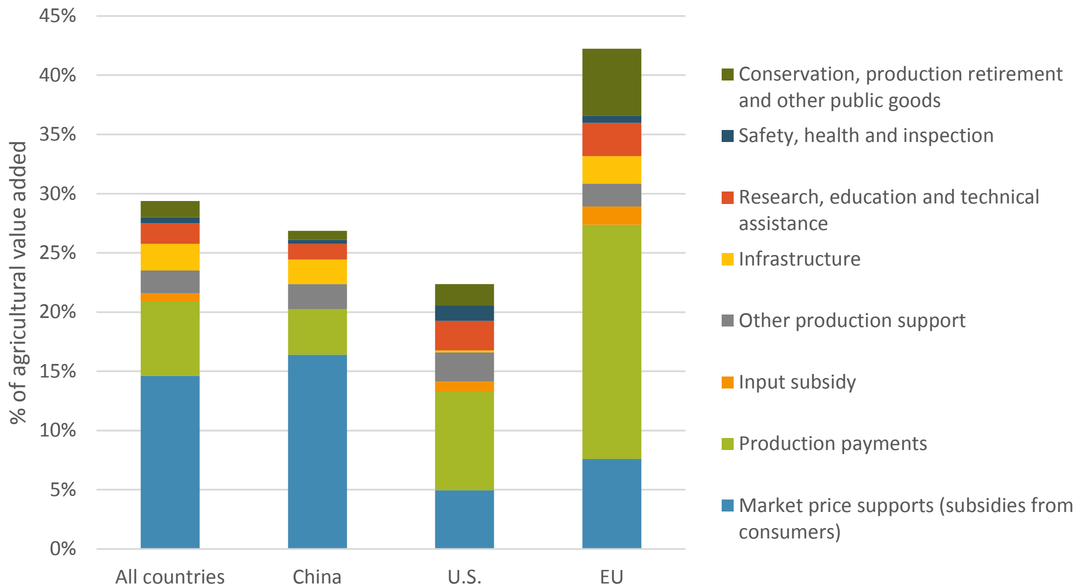
What is the magnitude of support to agriculture? Lack of reliable data prevents an estimate of the totality of this support across all countries; however, data are available for 53 countries (all the OECD countries plus 10 other emerging and large agricultural economies) that account for two-thirds of global agricultural output. These data show that as a group this subset of countries provided a total of $560 billion annually (on average between 2016 and 2018) to agricultural producers, equivalent to about 15 percent of gross farm receipts (OECD 2018).[4]

A breakdown by the type of support provided, by all countries as a group and by the countries with the largest level of support, is given in figure 12.6 for the period 2014–2016. The OECD estimates that two-thirds of the current support to farmers is in a form that strongly distorts farm business decisions. To put this in perspective, the total amount of global climate finance invested in 2014 was $391 billion, of which only a small fraction (about $6 billion to $8 billion) was directed at agriculture, forestry, and land use. In other words, the amount of funding that distorts agricultural production decision-making far outweighs the funding provided to reduce the impact of agriculture, including land use change and deforestation, on climate change.

3 These subsidies are "indirect" in the sense that they are implicit transfers to farmers from consumers (who have to pay a higher price than they would otherwise have had to) but do not place any financing burden on the government budget (that is, taxpayer).
4 These 53 countries account for about two-thirds of global agricultural output.

FIGURE 12.6

AGRICULTURAL SUPPORT AS A FRACTION OF AGRICULTURAL VALUE ADDED, AVERAGE FOR 2014–2016



Source: Searchinger et al. 2019 using OECD 2018, PSE and GSSE databases.

Given the large environmental footprint of agriculture, directly as well as indirectly through induced changes in land use, the potential impact of climate-friendly agricultural support policies could be very large. With only 15 percent of current producer support directed at public goods and a small 1 percent directed toward promoting environmental protection (conservation, production retirement, and so on), the majority of the support provided to agriculture in the 53 countries included in the OECD's analysis has potentially substantial implications on economic and environmental outcomes. The incentive distortions that such support policies create for farmers impact the food system by changing not only *what* commodities are produced (the production patterns), but *how much* is produced (the scale of production), *how* they are produced (with artificially inflated returns diminishing the focus on efficiency in favor of extensive cultivation), and *where* they are produced (geographical pattern).

Evolution of agricultural subsidies

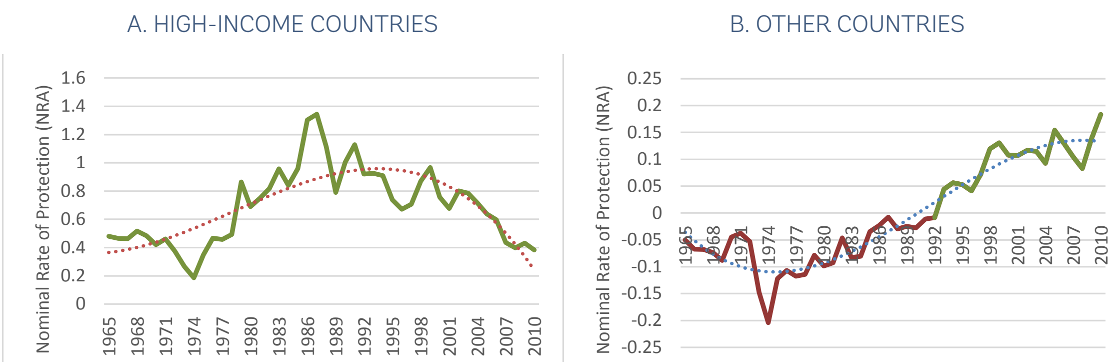
Government interventions in agricultural markets are a global phenomenon, making agriculture the most distorted sector of the world economy (Panagariya 2005). Agricultural policies have shown two distinct patterns of intervention—the developmental pattern and the anti-trade pattern (Lindert 1991). The former shows a switch from taxation in the early stages of development to subsidization as the economy develops. The latter shows a general tendency of taxing exportable commodities and subsidizing importable commodities—using various measures to restrict trade. One or both of these patterns have endured and are observed consistently across the spectrum of economic development (Anderson 2009; Krueger, Schiff, and Valdes 1991).[5]

5 The taxation to subsidy pattern was observed in medieval European times to ensure low food prices for the fast-rising urban populations and to extract surplus from agriculture for investment in other parts of the economy. The notable exception to this pattern were England's Corn Laws (in effect from 1660 to 1846), which raised domestic grain prices in favor of the dominant landed aristocracy, until they were repealed as the political landscape changed in favor of industrial interests (Lindert 1991).

High-income countries heavily subsidized their agriculture in the post–World War period, initially to stimulate production and later to maintain farm incomes, with significant impacts on world agricultural markets (Sumner 2007). The levels of subsidies in OECD countries have moderated over the past two decades but remain high (see figure 12.7). This is despite commitments by OECD countries to improve the functioning of world agricultural markets through reduced distortions (Legg 2003).

Agricultural protection and barriers to trade are not just a developed-country phenomenon, nor are they the only source of problems for developing countries' agricultural development. Various subsidies for inputs, price supports, and trade interventions have been an integral part of the economic policy landscape of developing countries themselves at least since the 1960s. These policies have been equally distortionary and harmful to developing countries' own interests (Panagariya 2005). These trends are evident in figure 12.7, which shows that on average, developing countries have followed a pattern remarkably similar to Lindert's historical developmental pattern observed in developed countries.[6]

FIGURE 12.7
NOMINAL RATES OF PROTECTION IN HIGH-INCOME AND OTHER COUNTRIES, 1965–2010



Source: Based on data from Anderson and Nelgen 2012.

The discussion above is based mostly on indirect subsidies resulting from market price supports. Direct subsidies for agriculture have a relatively shorter but still quite long history. The documented modern agricultural subsidy programs date back to the United States in 1933 with the enactment of the Agricultural Adjustment Act in the wake of the Great Depression (Sumner 2007). US farm programs since have included commodity price supports, stock acquisition, import barriers, production controls, marketing orders, and crop insurance (Edwards 2009; Sumner 2007). While distortionary input subsidies have not been part of farm programs in the United States in recent decades, price supports for specific commodities have proved to be highly distortionary by encouraging overproduction of the targeted commodities.

To reduce the distortionary effects of the farm subsidy programs, in recent years the United States has shifted toward farm income support programs. In practice, however, the overall negative impact of distortions remains significant, their benefits regressive, and the programs

6 See Lindert (1991). Note that individual countries and regions are at different stages on the stylized evolutionary path, depending on their level of agricultural development. African counties, with a generally lower level of agricultural development, heavily taxed agriculture until the recent food price spikes in 2007/2008 and have since exhibited a generally neutral policy stance. Asian countries (excluding Japan and Korea) moved from taxing to favoring agriculture around 1990.

overall a heavy drain on the public budget (Edwards 2009). Similar reforms have taken place in the EU, with farm support shifting from distortionary subsidies toward decoupled payments. The effectiveness of farm subsidy programs, however, remains questionable. The transfer efficiency of such programs (that is, net gains in farmer incomes relative to the amount of the public resources spent on various subsidies) is found to be low: Less than half of the transfers result in incremental gains for farmers even with the most efficient support measures (for example, area-based payments); price supports (less than a fourth of transfers) and input subsidies (less than a third of transfers) are significantly less efficient (OECD 2003).

The bottom line is that not only are various subsidy and market price support programs likely to have large environmental impacts, but the intended farmer or production benefits are likely not being realized either. Many agricultural support programs provide very poor value for money. Thus, there is evidence to suggest that agricultural expenditures could be substantially reduced without reducing actual and effective support to the agriculture sector. Reducing such inefficient expenditures would then free up resources that could be used for other purposes.

Conceptual foundations for subsidies

Welfare economics has long recognized the potential usefulness of subsidies in situations where the social benefits of individual actions exceed purely private benefits. The conceptual underpinnings of the debate stem from the standard economist's benchmark of perfect and complete markets, which is useful to evaluate the impact of policy interventions such as subsidies. On the one hand, under perfectly competitive markets, no case can be made for a subsidy. On the other hand, economic theory also recognizes market failures (that is, incomplete, imperfectly functioning, or missing markets), which are a reality in many settings. The markets for environmental services are a good example of such market failures. It has long been understood that in the presence of externalities, a judicious mix of taxes and subsidies could be applied to correct for negative (GHG emissions, loss of biodiversity, and so on) and positive externalities (payments for environmental services, sustainability of natural resources, and so on), respectively (Pigou 1920).

In developing countries, persistent concerns with food insecurity are the main rationale for a resurgence of subsidies. These are often justified to promote productivity growth in the face of multiple failures or to overcome the impacts of other constraints (Morris et al. 2007; OECD 2006; World Bank 2008).[7] These arguments include the following:

- Lack of awareness of technology: Prevents adoption of productivity-enhancing innovations.
- Insufficient knowledge: Constrains the effective use of inputs or technology.
- Learning by doing: Efficiency and productivity improve with experience.
- Risk: Producers reduce input use in response to weather/market risks to limit financial exposure, especially for inputs that increase both rewards and risks.
- Non-affordability: Credit/liquidity constraints limit input use or critical investments.
- Accessibility: Logistical barriers/poor infrastructure raise costs of inputs.

7 Specific circumstances also exist, including in more developed economies and nonagricultural settings, in which subsidies are justified to exploit potential economic of scale, the potential for innovations with large transformative impacts, strategic trade intervention opportunities, or environmental benefits, as well as for social equity considerations.

- Market "thickening": Low demand constrains the viability of investment in input marketing, while low volumes prevent exploiting economies of scale to lower input supply costs.

These constraints often bind farmers in a low-level productivity trap. Relieving these constraints would not only improve agricultural productivity but also potentially unleash strong dynamic general equilibrium impacts—boosting nutrition and incomes; lowering food prices; raising real wages, employment, and broader economic growth through forward and backward links; promoting structural transformation; and strongly contributing to poverty reduction (World Bank 2007, 2008). The dynamic gains associated with subsidies could potentially far outweigh the short-term costs, as is often associated with the green revolution in Asia (Chirwa and Dorward 2013; Hazell and Rosegrant 2000).

Nevertheless, it is important to reiterate that even in such a suboptimal setting, social gains from subsidies may accrue only under certain circumstances (Gautam 2015). Several pitfalls in the application of subsidies are often overlooked and could undermine their potential benefits or contribute to an overall net social loss:

a. For most agricultural situations, the gains (in excess of the associated costs, say due to deadweight losses or administrative and implementation costs) depend on market conditions, and specifically the magnitudes of supply and demand elasticities (Dorward 2009). Inelastic demand tends to generate consumer gains, while supply shifts (outward or downward) tend to favor producers/suppliers. It thus follows that, in many developing settings, subsidies may be useful for food staples in countries/regions with large import-export parity price differentials.

b. Many developing situations are beset by multiple market failures. In such circumstances, a specific input subsidy may address a particular constraint, but its effectiveness and impact may crucially depend on making complementary investments to address the other binding constraints.

c. Long-term development and efficiency also require that care be taken to ensure that subsidized inputs do not substitute for market demand for those inputs: Inframarginal transfers are essentially a waste from a budgetary resource-efficiency point of view (the inputs would have been purchased and used in any case, so subsidies are a pure income transfer). More important, they may have large associated economic and developmental costs because they disrupt and impede market development and crowd out the private sector—a clearly negative long-term outcome, especially in economies with nascent markets and a fragile private sector.

d. Finally, important choices need to be made between input and output subsidies, and whether to subsidize a single or multiple inputs. There may be exceptional conditions when a single input subsidy may be optimal, such as to offset a distortion that affects a specific input, or if there are large positive externalities associated with the use of a specific input (for example, modern seed varieties). In general, however, output subsidies are argued to be relatively less distortionary because they do not alter producer incentives in the use of inputs. But there is no guarantee that they are less costly in terms of budgetary resources. Output subsidies can also hugely distort the patterns of production, often resulting in overproduction of targeted commodities. Further, output price and income support subsidies often manifest as rents for fixed factors, which means they disproportionately benefit factor owners, such as landowners, and not the renters.[8] The choice of subsidies for a single or multiple inputs will depend on their impacts on budgetary outcomes as well as the degree of input substitutability—which need to be carefully analyzed to determine the final impact on production, the ultimate objective (Parish and McLaren 1982). Under certain, but not all, circumstances single input subsidies may be more cost-effective and efficient.

Political economy considerations

As noted earlier, food security along with inclusive growth and poverty reduction objectives keep agriculture high on policy makers' agendas. Rising rural-urban income inequality makes it politically necessary for policy makers to devise mechanisms to support the incomes of a large, rural, and mostly agricultural constituency. The rekindling of food security concerns in the post-2007 period and continuing weather-related anomalies (likely a reflection of a changing climate) provide a renewed impetus to improving agricultural productivity and domestic availability of food.

These aspects shape the political economy of decision-making in most settings, with government "support" often translating into budgetary allocations—a clear signal of the government's commitments (Jayne and Rashid 2013). Input subsidies are very visible in demonstrating tangible and direct support to the rural population and are thus popular among policy makers and politicians. But the incidence of subsidies is often regressive, resulting in less developmental and distributional gains than political and patronage ones. Such programs persist, as the political science literature highlights, because a vocal and politically aligned minority can often influence policy decisions and emerge as winners as other actors are very often too dispersed or otherwise much less visible and so lose out in this process.

The second important aspect of political economy is the timing of benefits accruing from public expenditures: Here, subsidies provide instant (or almost) gratification to the beneficiaries, while most public capital investments (for example, expenditures on public goods such as roads and R&D) or environmental benefits (such as improved soil, water, or climatic conditions for production growth and stability) are realized only over a much longer period, are often widely diffused, and are not clearly attributable to the original decisions or decision-makers. The myopic financial (and the associated political) benefit thus often overshadows the well-demonstrated and large benefits from investments in public goods. Clearly, the timing of benefits from long-term investments does not fit well with the logic of politics, with its much shorter time horizon, typically tied to the electoral cycle in functioning democracies. The result is that political economy more often than not trumps economic or technical considerations.

8 The impact of indirect subsidies with output price and income supports on land values has been rigorously shown for the United States (Goodwin, Mishra, and Ortalo-Magne 2011).

The bottom line

The efficacy of subsidies in achieving desirable development objectives continues to be vigorously debated (for example, Chirwa and Dorward 2013; Jayne and Rashid 2013; Morris et al. 2007; Wiggins and Brooks 2010; World Bank 2008; Fan, Gulati, and Thorat 2008). Despite the conceptual rationales provided in specific circumstances, the empirical evidence on the impact of subsidies is not encouraging. The criticisms of subsidies reflect real and serious implementation problems as well as design shortcomings—issues that are observed with a remarkable degree of consistency across countries and settings (Gautam 2015). On implementation, the problems have been extensively analyzed and documented, including issues related to targeting, political patronage, leakages, elite capture, distorted incentives (through prices) encouraging overuse or imbalanced use of inputs, crowding out the private sector, opportunity costs in terms of foregone investments on essential public goods (such as infrastructure), and often the sheer size of program costs (Chirwa and Dorward 2013; Jayne and Rashid 2013; Wiggins and Brooks 2010). The experience shows that subsidy programs are difficult to implement in the best of circumstances.

The debates on agricultural subsidies and their potential impacts, however, have not yet paid sufficient attention to the "hidden" costs of subsidies. Environmental impacts have not been a big part of this debate, though this is starting to change as the role of agricultural policies and support programs is increasingly scrutinized given the large environmental and climate footprint of the agriculture sector. The long-term impacts, while recognized at times, have also yet to be rigorously estimated in terms of the potential negative impact of environmental and resource degradation on future agricultural productivity itself; in other words, whether the short-term productivity gains (assuming that they indeed materialize) justify the likely substantial longer-term decline in productivity, potentially compromising food security itself.

Yet there are political and social reasons many governments provide agricultural support to producers, raising the question of whether this support can be provided in a manner that does not generate the externalities associated with distorting forms of support. This idea is now taking root at the global level through the idea of repurposing agricultural policies and support programs to deliver the "triple wins"—higher productivity (and hence incomes and food security), increased resilience to climate change, and reduced impacts on negative environmental externalities. It is against this backdrop that this chapter explores the complexities of the links between support policies and deforestation.

Link between Agricultural Support Policies and Deforestation

Despite a growing consensus that agriculture plays a significant role in global deforestation, few analyses examine the role of agricultural support policies in deforestation. The consensus among these limited analyses is that deforestation is strongly linked to agricultural commodity prices (Busch and Ferretti-Gallon 2017). Previous studies have therefore used the impact on agricultural prices as a proxy for the impact of various policies on deforestation (see table 12.1). However, studies linking specific agricultural support policies to the environment generally focus on greenhouse gas emissions or the link between input subsidies and resource overconsumption (for example, water or fertilizer use).

TABLE 12.1
EXPECTED EFFECTS OF SELECTED POLICIES ON DEFORESTATION

POLICY	INSTRUMENT	EFFECT ON DEFORESTATION	COMMENTS
Fiscal	Devaluation	Increases	Raises agricultural prices of commodities
	Restricted monetary supply	Indeterminate	Has conflicting effects
Commercial	Trade liberalization	Indeterminate	Has conflicting effects
	Export incentives	Increases	Improves agricultural products terms of trade
	Agricultural export taxes	Reduces	Lowers agricultural products terms of trade
	Agricultural import restrictions	Increases	Raises agricultural prices
Agricultural	Price controls on food	Reduces	Lowers agricultural prices
	Agricultural price supports	Increases	Raises agricultural prices
	Credit subsidies for crops	Indeterminate	Has conflicting effects
Other	Increased road investment	Increases	Lowers agricultural prices and increases access to land
	Spending on settlements	Increases	Motivates migration to the agricultural frontiers
	Securing land tenure	Indeterminate	Has conflicting effects

Source: Adapted from Pacheco 2006.

With the rise of climate change on the global agenda, greater attention is now focusing on how best to harmonize agricultural policies with simultaneously achieving the goals of raising productivity (and hence incomes and food security), increasing farmer resilience to climate change, and reducing emissions associated with agriculture, half of which arise from deforestation and forest degradation. In terms of financing (despite the high levels of subsidies relative to financing in support of REDD+) and the need for reform, there has been limited focus on the identification, estimation, and reform of subsidies and their role in deforestation (McFarland, Whitley, and Kissinger 2015). For example, many countries do not establish REDD+ interventions that address deforestation drivers, including agricultural expansion (Carter et al. 2015; McFarland et al. 2015; Pirard and Belna 2012; Salvini et al. 2014). While this idea has been largely absent from climate finance discussions (Whitley 2013), this issue is now starting to be raised and needs to be pursued vigorously.

Attention is increasingly being focused on how to sustainably deliver and increase agricultural yields without requiring additional land expansion. In response to a growing appreciation of the impact of agricultural expansion on deforestation (Geist and Lambin 2002; Gibbs et al. 2010; Hosonuma et al. 2012; Houghton 2012; Kissinger, Herold, and De Sy 2012) and biodiversity (Balmford, Green, and Scharlemann 2005), research is starting to focus on policies and essential public goods investments (such as agricultural R&D) to reduce pressures for agricultural expansion while assuring needed food supply. Inferences can then be made from these results regarding specific agricultural support policy effectiveness at achieving environmental, economic, and social goals.

Several policy approaches have attempted to influence agricultural expansion onto forestlands (Angelsen 2010). These have included policies to reduce rents from extensive agriculture (for example, by reducing support for extension by promoting intensive agriculture, or through land tenure reforms, marketing, infrastructure, and alternative livelihood investments). A second group of policies aims to increase forest rents and their capture by land users (for example, community forest management or payment for ecosystem services programs). The final set involves regulatory policies that directly limit forest conversion (for example, protected areas). Keeping rents from extensive agriculture low may be effective in conserving forests (Wunder 2003), but such policies tend to be socially, economically, and politically unacceptable—see, for example, World Bank (2007) and Kaimowitz, Byron, and Sunderlin (1998)—and are not considered here. The feasible approaches can be classified under two main competing hypotheses: land sparing and land sharing.

Land-sparing hypothesis

Targeting intensive agriculture[9] is an intuitively appealing way to reduce the expansion of agricultural land (that is, producing more from same or less land), promote forest conservation (Angelsen 2010), and mitigate carbon emissions (Burney, Davis, and Lobell 2010; Carter et al. 2015). The land-sparing (or Borlaug) hypothesis argues that for a given level of consumption, there is a one-to-one trade-off between increased yields and demand for cropland (Angelson and Kaimowitz 2001; Borlaug 2007; Grau, Kuemmerle, and Macchi 2013). A major strategy to accomplish land sparing is to promote the intensification of agricultural production on a given area of land.

While widely cited and used to justify policy interventions (Carter et al. 2015; Green et al. 2005; Stevenson et al. 2013), the simple land-sparing hypothesis does not hold up under theoretical or empirical analysis (Angelsen 2010; Angelsen and Kaimowitz 2001; Barbier 2001; de Waroux et al. 2017; Ewers et al. 2009; Phalan et al. 2011; Phelps et al. 2013; Pirard and Belna 2012; Rudel et al. 2009; Udondian and Robinson 2018).[10] The impact on expansion depends in part on production factor intensities: Farmers tend to adopt extensive systems to compensate for the relative scarcity of labor and capital (Angelsen and Kaimowitz 2001; Boserup 1965). The impact on expansion also critically depends on demand responses—a fall in food prices might invoke a "rebound" effect, where a lower cost of food increases consumption (Desquilbet, Dorin, and Couvet 2016; Matson and Vitousek 2006; Pirard and Belna 2012).

9 Here, intensive is understood as intensive in production factors other than land (that is, labor or capital).

10 However, imperfect markets may moderate the tendency toward expansion: Factors of production may be scarce, transaction costs of technological adoption may be high, or risks may be high enough to influence investment decisions (Pirard and Belna 2012). Additionally, in subsistence farming, intensification may enable smallholders to meet subsistence needs with less land (as demand remains stable).

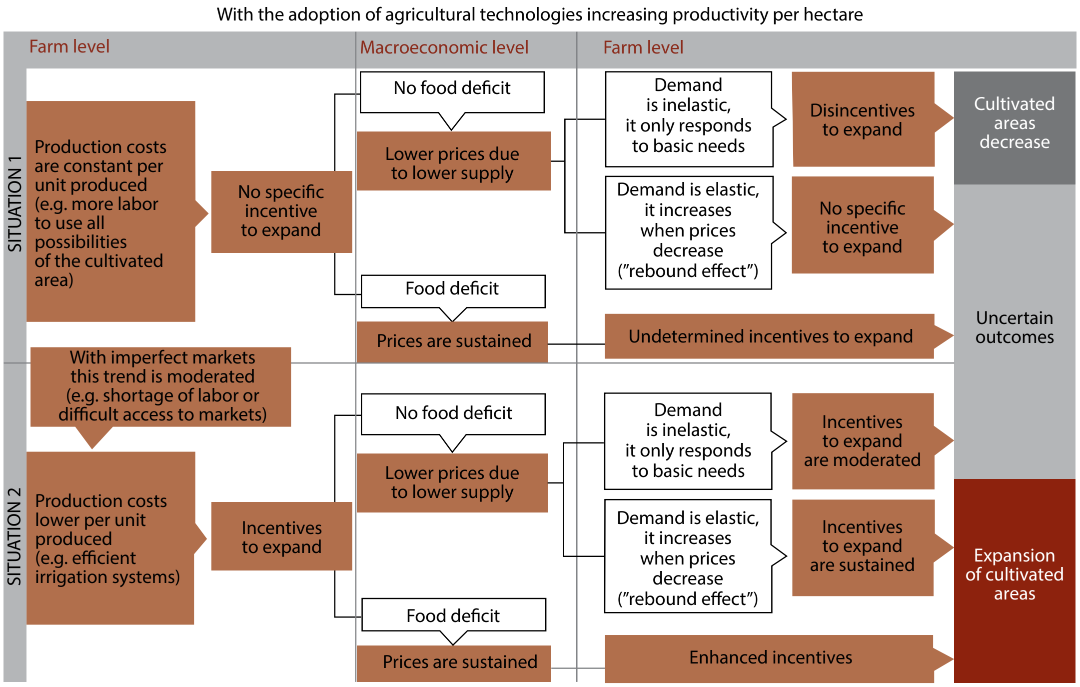
In a global analysis of agricultural cropland changes in 161 countries, Rudel et al. (2009) found no significant correlation between productivity and land use change.[11] Indeed, agricultural land area declined with intensification *only* when complementary conservation programs and import substitution of grain occurred. Ewers et al. (2009) examined the impact of the rebound effect and found that agricultural subsidies created surplus production in non-staple crops, negating the positive effects from intensification. In the Hua Meuang District of northeastern Lao PDR, intensification led to agricultural expansion and forest loss (Vongvisouk et al. 2016). Intensive production has also been found to be more likely than smallholder production to expand into forests (Gutiérrez-Vélez et al. 2011).

However, land sparing as a result of intensification is seen in some cases, but usually in combination with other policy measures (Cohn et al. 2011; Minang et al. 2011). For example, in the Philippine lowlands, improvements in small-scale irrigation led to increases in labor demand and wages, which drew labor from more extensive regions and reduced forest clearing by almost 50 percent (Shively 2001; Shively and Pagiola 2004).[12] In the case of slash-and-burn farming, land expansion was reduced through investments in new higher-yielding varieties in Zambia, and agroforestry in Borneo (Angelsen and Kaimowitz 2001). A recent study found that intensifying Brazilian cattle production (in combination with new and existing command-and-control measures, financial instruments, PES programs, and compensation for potential distributional impacts on low earners) would lead to zero deforestation with low overall economic impacts and virtually no social losses (Instituto Escolhas 2017).[13] Figure 12.8 diagrams the effectiveness of the land-sparing hypothesis under different scenarios.

Many agricultural interventions have various impacts on forest cover that are dependent on external factors (for example, Singer 2009). Without strong enforcement against expansion and other policies, there is no guarantee that an increase in agricultural productivity on its own will result in less agricultural expansion (Byerlee, Stevenson, and Villoria 2014; Pirard and Belna 2012). For example, higher profits in intensive agriculture could be used to fund further expansion as was seen in Indonesia in the 1990s (Ruf 2001). The land-sharing hypothesis can then be updated to this: *Intensification in itself does not result in land sparing, unless accompanied by specific policies and measures, such that expansion can be controlled.*

11 A negative (but insignificant) correlation was found in 34 countries, consistent with the land-sparing hypothesis.
12 However, if policies promote labor-saving technologies, the labor pull effect may be negligent or reversed (Angelsen 2010; Angelsen and Kaimowitz 2001).
13 According to the study, on average, Brazilian cattle production would need to improve by 0.29 percent and 0.13 percent for beef and milk, respectively, annually between 2016 and 2030.

FIGURE 12.8
WHEN IS THE LAND-SPARING HYPOTHESIS VALID?



Source: Pirard and Belna 2012.
Note: The figure above presents a diagram of the conditions under which land-sparing approaches might work. Note that production costs, demand, and relative prices—along with technology availability—play a particular role.

Land-sharing hypothesis

Another main policy response to limit deforestation from agricultural expansion is built on the idea of land sharing (Balmford, Green, and Scharlemann 2005; Green et al. 2005). Land sharing implies that production and conservation are integrated on the same land through biodiversity-friendly production methods (Jiren et al. 2017). Land sharing has been shown to have reduced deforestation (in addition to improving tree cover on participating farms) in at least one case (Palmer 2014; Lerner et al. 2017). While there is some debate on how land sharing should be implemented (Vongvisouk et al. 2016), a consensus is emerging on the need for a mixed approach based on the specific context (Fischer et al. 2014; Grau, Kuemmerle, and Macchi 2013).

Policies to promote land sharing include land use planning and management and the promotion of environmentally beneficial agricultural technologies (for example, CSA), among others. And while technically much more needs to be done to develop and improve CSA technologies and practices, a number of options are readily available. If extended and adopted by farmers, CSA practices can contribute significantly to the triple wins of higher productivity, reduction of agriculture sourced greenhouse gas emissions, and adaptation by making agriculture more resilient. A relevant question then is whether public policies and support for the agri-food system are aligned to achieve these outcomes.

Repurposing Agricultural Policies and Support

There is no simple, unequivocal relationship between changes in agricultural systems and tropical deforestation. In land sparing, sustainable intensification is not a self-sufficient condition for success. Moving forward, the expected impact on deforestation, climate change, and the environment should be factored into the design of market price support policies (World Bank 2015). Agricultural support policies need to be carefully designed to promote environmentally beneficial outcomes, especially through CSA. Support policies also need to be complemented with institutional reforms, such as strengthened enforcement (of protected areas, environmental regulations, and so on) and the provision of conservation incentives through PES and other programs (see table 12.2 for a brief review of forest conservation policy instruments).

TABLE 12.2
OVERVIEW OF FOREST CONSERVATION POLICY OPTIONS

POLICY	EFFECTIVENESS (FOREST CONSERVATION)	DIRECT COSTS OF POLICY (EFFICIENCY)	EFFECT ON INEQUALITY/ POVERTY	AGRICULTURE YIELD (NOT PRODUCTION)	POLITICAL VIABILITY
1. Reduce (extensive) agriculture rent					
Depressing agriculture prices	High	Negative	Negative	Very negative	Very low
Creating off-farm opportunities	High	Medium/high	Neutral/positive	Uncertain	High
Support to intensive agriculture sector	Moderate/high	High	Uncertain	Positive	High
Selective support to extensive agriculture	Uncertain/moderate	High	Positive	Positive	Moderate
Ignore extensive road building	High	Negative	Negative	Negative	Low/moderate
More secure property rights	Uncertain	Medium	Uncertain	Positive	Moderate/high
2. Increase forest rent and its capture					
Higher price of forest products	Moderate	Low	Positive/uncertain	Small	Moderate
CFM: Capture local public goods	Moderate	Low/medium	Positive	Small	Moderate
PES: Capture global public goods	Potentially high	Medium/high	Uncertain/ positive	Small	Moderate/high
3. Protected areas	Moderate/high	Medium	Uncertain	Small	Moderate

Source: Angelsen 2010.
Note: CFM = community forest management; PES = payments for ecosystem services.

While direct and definitive links cannot yet be made between specific agricultural support policies and levels of deforestation and forest degradation, there are some best practices policy makers should adhere to in order to promote economically, socially, and environmentally sustainable agricultural systems. The rest of this section outlines various agricultural support policies and how policy makers can optimize each not only to reduce agriculturally driven deforestation and forest degradation but also to promote the adoption of more environmentally beneficial practices.

Research and development. Governments could make public investments in agricultural R&D and extension services (NRC 2010). In addition to environmental benefits, investments in R&D may be one of the most cost-effective policies to mitigate agriculturally driven deforestation (Lobell, Baldos, and Hertel 2013) as well as climate-related sectoral challenges, as underinvestment in R&D is one of the most significant barriers to the implementation of CSA (Sova et al. 2018). R&D should be inclusive of smallholders and focus on important non-staple, nutritionally dense foods and integrated production systems (FAO 2018). R&D should also be promoted within the context of REDD+, keeping in mind lower yields associated with tropical crops (Streck and Zurek 2013).

"Green" credit. Governments could provide support for green credit and input support programs, like those available for the preservation of other natural resources (for example, water, biodiversity). Green credit mechanisms include funds or credit lines that support small projects and aggregate risk, made available for specific investments and linked to changes in practice (Streck and Zurek 2013). This type of funding can facilitate the adoption of new technologies, cover increased labor costs, or provide capital for smallholders to invest in improved agricultural practices.[14] Support programs that reduce transaction costs and risks could facilitate farmer engagement; credit support may be a particularly effective policy to influence agricultural impact on deforestation (Assunção et al. 2016). Credit programs that fund activities requiring deforestation should be removed (as done for agricultural producers in Brazil).

14 Such policies would also help improve PES-related outcomes, as farmers previously unable to invest in ex-ante investments to implement new practices would be able to do so.

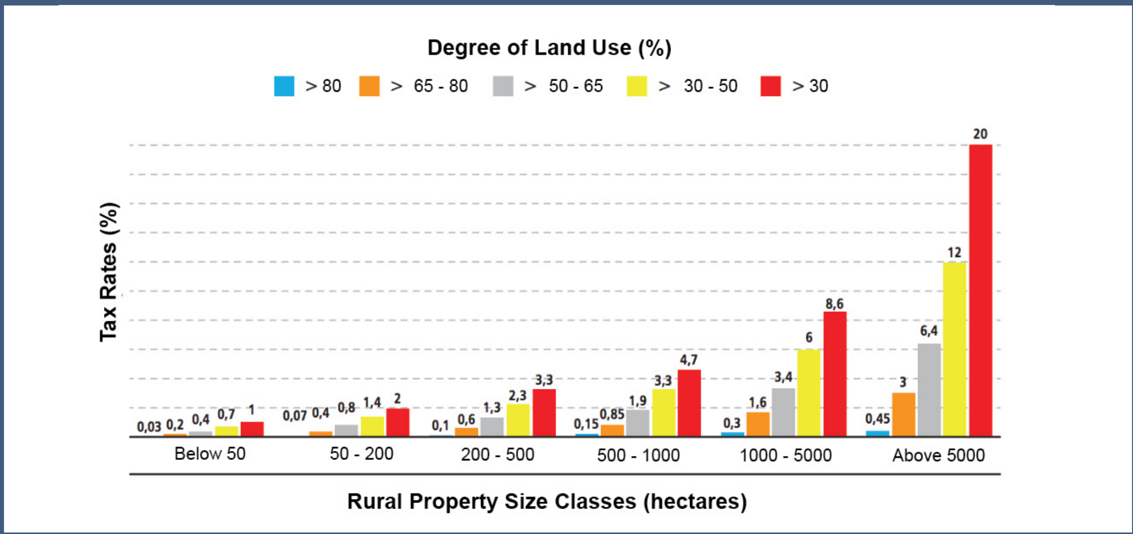
BOX 12.1 INCREASING AGRICULTURAL PRODUCTIVITY THROUGH LAND TAXES

Land taxes are one avenue through which policy makers can reduce agricultural land expansion and associated deforestation.[a] One example that has the potential to influence forest conservation in the Amazon biome is the Rural Property Tax (ITR), which is levied on local landowners in Brazil.

In addition to public revenue goals, the ITR was created to increase agricultural land productivity. Low agricultural productivity means that increased production requires the expansion into new (forested) areas. Land taxes can create an incentive against such expansion and therefore stimulate improvements in productivity. The ITR charges larger, low-yield properties a higher tax rate than smaller, more productive land (figure B12.1.1). Beyond its effect on land productivity and expansion, the ITR can also have a broad effect on rural development; by encouraging more productive use of land, the tax can stimulate increases in production, income, and jobs.

FIGURE B12.1.1

PROPERTY TAX RATES ON RURAL PROPERTY ACCORDING TO DEGREE OF LAND USE AND SIZE OF PROPERTY



ITR revenues increased after federal reforms allowed municipalities a greater role in tax administration and collection. In 2003, Brazilian municipalities gained the right to oversee the administration and collection of the ITR and can keep 100 percent of the revenues collected if they enter into an agreement with the Special Secretariat of the Federal Revenue of Brazil (RFB).[b] Largely as a result of this reform, the amount of revenues collected through the ITR in the Legal Amazon jumped from $17 million in 2000 to $240 million in 2017.

Despite this increase in revenues, ITR collection is still below its potential. Not all municipalities have taken advantage of their ability to oversee and keep tax revenues: In 2018, only 38 percent of municipal governments had signed the agreement with the RFB. If ITR collection were improved, it has the potential to improve conservation outcomes for 93 million out of 110 million hectares of deforested land in agricultural use in the Amazon. Low collection also limits the ability of municipalities to provide goods and services, which to a large extent depend on tax transfers collected by state and federal governments. To improve ITR collection, administrators should focus on technical adjustments to the tax calculation process[c] and measures to prevent political barriers to tax enforcement, among other actions.

Source: Based on Pereira, Barreto, and Baima 2019.

a. See box 3.1 in chapter 3 for more details on land taxes.
b. Before this policy reform and without entering an agreement with the RFB, municipalities keep only 50 percent of the ITR.
c. For example, the land value index (VTN) used to calculate the ITR does not correspond with current market values; in 58 percent of municipalities, the VTN used in ITR calculations was 25 percent below the market average. Updates should also be made to the land productivity index: The current index is based on data from 1985 so that even low productivity lands meet the minimum degree of utilization and therefore pay lower tax rates.

Taxation and tariffs. Governments could use taxation and tariffs (as well as tax expenditures) to create incentives for producers to engage in more environmentally friendly and climate-smart practices. For example, the Brazilian Rural Property Tax (ITR) was established not only to raise revenues but also to act as a regulating force, taxing unproductive property at a higher tax rate than productive property.[15] Taxes and tax expenditures can also be used to make targeted technologies more attractive and create a network of agencies responsible for disseminating agricultural technologies (Pirard and Belna 2012). For example, taxes on fertilizers or pesticides can be used to promote input efficiency (Vermeulen et al. 2012). In particular, export taxes that penalize agricultural exports may be able to discourage expansion of agricultural commodities (Pacheco 2006).[16] Furthermore, combining taxation with voluntary instruments like sustainability certifications may be able to reduce agriculturally driven deforestation even in countries with limited administrative capacity.[17] See boxes 12.1 and 12.2 for a discussion of various fiscal policy instruments used to reduce deforestation in Brazil.

15 Unfortunately, the ITR has been largely ineffective as a result of several design flaws: (1) the Livestock Capacity Table (which sets the minimum levels of productivity) has not been updated since 1980, and (2) the land value is self-declared by the landowner and is often depreciated, rather than based on the market price of the land. However, these problems could be addressed relatively easily by updating these parameters, along with other measures to increase compatibility with environmental legislation (Instituto Escolhas 2019).

16 For a more detailed discussion on export tariffs, see chapters 8 and 11.

17 See chapters 6 and 7 for more details.

BOX 12.2 FISCAL POLICY TO REDUCE DEFORESTATION FROM CATTLE RANCHING: THE CASE OF MATO GROSSO, BRAZIL

AVERY COHN, CORNELIUS FLEISCHHAKER & GABRIEL ABRAHÃO

Given its role as home to much of the Amazon rain forest as well as the largest commercial cattle herd in the world, Brazil plays a crucial role globally for GHG emissions from deforestation linked to cattle ranching. Ex-ante models of fiscal policy suggest that taxes and subsidies aimed at incentivizing intensification of cattle ranching in Brazil could lead to considerable sparing of forests and GHG abatement. Such policies are starting to be put into practice.

Cattle ranching intensification is a promising option for reducing deforestation and GHG emissions. The typical Brazilian cattle ranching system is extensive, with large extensions of pasture with little management, supporting very few heads of cattle per hectare. Most emissions linked to cattle in Brazil do not come directly from the ranching activity but from the substitution of natural vegetation with pastures to support these extensive systems (Bustamante et al. 2012; Cederberg et al. 2011), as pastures are the main destination for deforested land in Brazil (Arvor et al. 2012; Byerlee et al. 2010; Macedo et al. 2012). Although a reduction of pasture area cannot be directly attributed to a proportional reduction in deforestation as a result of the complex land use and land tenure dynamics in the region (see for example, Bowman et al. 2012; Cohn et al. 2016; Morton et al. 2006), promoting more intensive cattle ranching systems has been advocated as one of the most promising options for reducing GHG emissions in Brazil (for example, Byerlee et al. 2010; Gouvello 2010; Stocco and Ferreira Filho 2019), and is a central part of the country's actions to achieve its GHG mitigation targets (De Oliveira Silva et al. 2018; UNFCCC 2015).

If these more intensive systems were widely adopted throughout Brazil, it could be possible to increase cattle production without deforesting more land. Intensification of cattle ranching could even free up land for the expansion of other crops, further increasing production (Gouvello 2010; Strassburg et al. 2014). As they still rely on pastures, these systems are commonly called semi-intensive to distinguish them from full confinement systems that, although growing, are still relatively uncommon in Brazil (Vale et al. 2019).

Relatively simple management practices can more than double productivity with fertilization, rotational grazing, feed supplementation, and reproductive management (EMBRAPA 2011). More complex integrated crop-livestock-forestry systems can lead to even higher improvements in stocking rates, among other benefits such as the revenue from alternative land uses, risk amortization, breaking of pest cycles and better soil quality (Gil, Siebold, and Berger 2015). All those systems use more inputs but can be much more profitable despite the higher up-front costs. Besides using less land per head of cattle, in some cases those systems also emit less direct GHGs per kilogram of meat produced (for example, Bogaerts et al. 2017), and integrated systems promote carbon storage in the soil (Brazil 2012). However, important questions remain as to which policies can be implemented to achieve large-scale adoption of more intensive systems and how effective they can be.

Fiscal policies designed to foster adoption of intensive systems must make them more attractive than the extensive systems, either through incentives to intensive systems or disincentives to extensive ones (Cohn et al. 2014). Taxes per unit of product and on inputs to production are examples of the former (Gerber et al. 2010). Either way, these policies promote intensification but also generate market-mediated changes that can lead to side effects undermining the GHG mitigation potential of the policy. For example, a policy that disincentives low productivity systems by increasing their cost increases the price of the agricultural product, which can stimulate more production locally and in other regions (Cohn et al. 2014), possibly leading to more emissions as well as compromising food security by making the product less affordable for consumers. Also, stimulating intensification in regions near deforestation frontiers and far from markets can lead to increased land rents and stimulate more deforestation in the region instead of sparing land (Fontes and Palmer 2018; Stevenson et al. 2013).

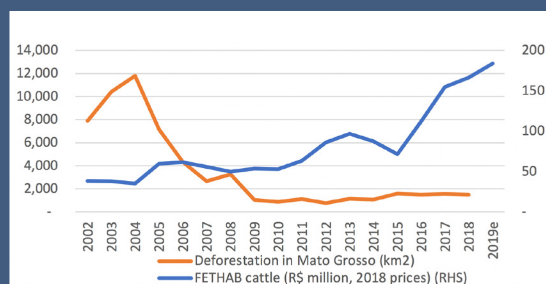
Both taxes and subsidies can be effective in incentivizing intensification. Cohn et al. (2014) studied the net effects on agricultural outcomes, land use changes, and GHG abatement resulting from two potential targeted policies in Brazil: a tax on cattle from conventional pasture and a subsidy for cattle from semi-intensive pasture. Under either policy, Brazil could achieve considerable sparing of forests and abatement of GHGs, in line with its national policy targets. The land spared, particularly under the tax, is less than proportional to the productivity increased, indicating leakages due to a rebound effect. However, the tax, despite prompting less adoption of semi-intensive ranching, delivers slightly more forest sparing and GHG abatement than the subsidy. This difference is explained by increased deforestation associated with increased beef consumption under the subsidy and reduced deforestation associated with reduced beef consumption under the tax. Complementary policies to directly limit deforestation could help limit these effects. GHG abatement from either the tax or subsidy appears inexpensive, but over time the tax would become cheaper than the subsidy. A revenue-neutral combination of the policies could be an element of a sustainable development strategy for Brazil and other emerging economies seeking to balance agricultural development and forest protection.

An existing per head cattle tax in the state of Mato Grosso could have some of the attributes of a tax that favors intensification. Mato Grosso has, since 2000, collected per unit fees on agricultural commodities under a program named FETHAB (Fundo Estadual de Transporte e Habitação–State Fund for Transportation and Housing). Commodities produced for export are exempt from the States' Goods and Services Tax (ICMS) by Federal legislation. The FETHAB therefore is a tool for the Mato Grosso government to obtain revenue from the highly productive, export-oriented agriculture sector in the state. Rather than charging an ad valorem tax, the FETHAB applies a fixed fee (adjusted regularly for inflation) per unit of agricultural product (for example, per tonne of soy beans, per head of cattle), thus resembling the setup of a tax on externalities (see chapter 1 for more details on environmental taxation).

Although not by design, it is expected that this levy contributes to the intensification of livestock practices and therefore to a reduction in deforestation and GHG emissions.

The introduction of the levy on wood in 2000 is cited as having contributed to reduced deforestation.[a] The levy on cattle is estimated to amount on average to a tax per tonne of CO_2-equivalent of up to \$7.80.[b] Since the tax on cattle is a per head levy, the effective tax rate varies significantly depending on the weight of the animal and quality (value) of the beef. The effective tax rate is highest on cattle produced by inefficient farms that produce low-weight, low-value cattle, which is the case of low-input extensive systems. Therefore, the introduction of the tax and increases in the per unit levy are an incentive for intensification of livestock production, which can lead to a reduction in carbon emissions through land sparing.

FIGURE B12.2.1
FETHAB CATTLE REVENUES AND DEFORESTATION



However, economy-wide responses to the tax, such as changes in consumption, will affect its net ecological and economical effects. Those will depend on several factors, such as how prices will respond to such a tax, how producers and consumers will respond to price changes, the distribution of specific systems across the state's territory, and how the government will use the tax revenue. As agriculture in the state is relevant to both global food production and the Brazilian economy, effects on other sectors and the global economy can also be important (Cohn et al. 2014; Zech and Schneider 2019). Fiscal and environmental effects of the tax will also depend on how revenue from the tax is deployed. In the case of the FETHAB, part of the revenue is earmarked for investments in transportation in the municipalities where the tax has been collected.

TABLE B12.2.1 TAX RATES ON VARIOUS AGRICULTURAL PRODUCTS IN MATO GROSSO

PRODUCT	TAX UNIT	LEVY AS OF 2019 (R$)	ESTIMATED AD VALOREM (%)	ESTIMATED CARBON PRICE (US$ PER tCO_2E)
Cotton	R$ per ton	104.60	1.63%	16.41
Soy	R$ per ton	27.86	2.51%	40.82
Maize	R$ per ton	8.36	2.35%	7.08
Cattle (for slaughter)	R$ per ton	32.17	1.2%–3.1%	2.0–7.8
Semi-processed beef	R$ per ton	42.18	0.55%	0.50
Wood	R$ per ton	13.99	2.73%	—

Source: Original calculation based on Mato Grosso data and emissions estimates reported in Cerri et al. 2016 and Raucci et al. 2015.
Note: — = not available.

As part of the revenue from FETHAB is directed at transportation investments, interactions between transportation costs, deforestation, and intensification have the potential to both undermine and enhance the environmental effects of the tax. Although roads are generally associated with deforestation (see, for example, Casella and Paranhos 2014; Soares-Filho et al. 2004), both economic theory and empirical evidence suggest a more complex relationship (Weinhold and Reis 2008). In very remotes areas that have seen little human activity, roads are indeed likely to induce deforestation. However, in regions where a greater proportion of the land is already cleared, reducing transport costs has a much weaker effect and might actually slow the rate of future clearing. Similarly, promoting intensification in remote, pristine areas can lead to more deforestation through land tenure effects, while intensification in areas with lower transportation costs is not only easier to promote but also more likely to have a land-sparing effect (Fontes and Palmer 2018). With such considerations in mind, investments in transportation infrastructure can be planned to maximize positive impacts and avoid environmental impacts (Laurance et al. 2014). Investments should prioritize improving networks in already settled areas. When developing infrastructure in more remote regions, delimitation of protected areas can help minimize negative impacts (Barber et al. 2014).

Applying the tax by land area instead of by unit of product could lead to better mitigation outcomes without compromising its revenue. A land tax applied to pastures (but not to protected areas) would create a direct disincentive for expansion, thus favoring intensification. This would be an incentive for intensive cattle ranching systems, but it would also put a disproportionate burden on activities with less potential earnings per hectare, such as cattle ranching, and favor activities that are more profitable per hectare, such as soybean cultivation. To balance this effect, a combination of per unit and per hectare levies can be conceived not only to generate the same revenue but also to have the same proportion of effective rates between activities.

Despite these caveats, the literature and initial results in Mato Grosso suggest that fiscal policies that incentivize the intensification of cattle ranching can contribute to reduced greenhouse gas emissions. The intensification of cattle ranching, by increasing the stocking rate (animals per hectare), is linked to reduced GHG emissions through avoided deforestation (land sparing) as well as, in some cases, through lower enteric emissions per unit of beef produced.

a. Impacts on cattle are based on discussion with agricultural associations. The impact on wood is studied by Dalfovo (2016).
b. Based on enteric emissions estimates in Cerri et al. (2016) and exchange rate of June 2019.

Subsidy reforms. Even though public spending can yield high returns,[18] governments tend to favor subsidies over public good investments for various reasons. Subsidies such as price supports (51 percent) and producer transfers linked to input or output (34 percent) make up most of the current farm support, whereas only 15 percent is allocated to public goods, such as R&D, infrastructure, and food safety and standards (World Bank 2018).

In terms of efficiency, market price supports tend to be the easiest to implement, with low budget outlays (World Bank 2018); however, these tend to be highly distortionary as they restrict imports or exports, which impacts relative prices and hence deforestation. Governments have recently been shifting from market price supports to less distortionary, direct payments to farmers. In the United States and the EU, these policy shifts have resulted in increased yields and reduced fertilizer use (World Bank 2018). Recent reforms that link payments instead to environmental objectives have been done successfully in Brazil, China, EU,[19] India, and Kenya (World Bank 2015, 2018).[20]

Direct payments, while still encouraging overuse of resources, are less distortionary. Decoupled direct payments to farmers, which are not linked to input or output, tend to be the least impactful on prices and production decisions. Efficiency-enhancing investments in public goods can increase agricultural intensification, and when combined with reforms of preexisting distortionary policies, they can positively influence input use and production decisions (Sova et al. 2018).

Support should be tied to environmental outcomes (Hunter et al. 2017). Farm assistance should be contingent upon compliance with mitigation standards (Vermeulen et al. 2012) and contingent upon environmental practice (Angelsen and Kaimowitz 2001). Direct payments to farmers should be conditional on the adoption of environmentally friendly practices, such as CSA, sustainable intensification, SFM, and enhancing ecosystem services (World Bank 2015).

In addition to the abovementioned specific policy reforms, a number of beneficial agricultural practices and technologies can move agricultural production onto a more sustainable path. To reduce deforestation from agricultural production and expansion, policy makers should consider programs that promote the following:

Climate-smart agriculture. Governments should foster awareness of CSA and "save and grow" models to build natural capital while improving yields and enhancing resilience against climate change (FAO 2011, 2013; Garnett 2012). In particular, investments in capacity building through information and training services would help overcome a major barrier to CSA implementation (Sova et al. 2018). This involves more support for sustainable intensification as well as other interventions (World Bank 2018). Policies to support CSA adoption include R&D investments toward new and better plant varieties (for example, heat-tolerant seeds), extension services and other programs to spread awareness of CSA practices, land use planning, and management, engagement with the private sector to encourage adoption and innovation, institutional reforms, increasing farmer access to input and output markets, and risk-sharing programs (Sova et al. 2018).

18 Subsidies can yield net negative impacts, that is, overuse of resources (World Bank 2018).
19 Under the EU Common Agricultural Policy, 30 percent of direct farm payments require the adoption of environmentally beneficial practices (World Bank 2015).
20 Other environmentally beneficial subsidy reform is already taking place as well. For example, Brazil reformed rural credit to exclude activities that relied on deforestation, invested in stronger enforcement, and provided support (including technical assistance) to sustainable agricultural practices (McFarland, Whitley, and Kissinger 2015); the robust policy combination was successful in reducing forest loss (Assunção et al. 2016).

Sustainable intensification. Governments should promote a wide variety of productivity investments. Policies aimed at agricultural intensification[21] include credit programs, subsidized fertilizers and seeds, irrigation, marketing assistance, and extension programs (ADF 2003; Awotide et al. 2015; Rudel et al. 2009; Udondian and Robinson 2018; You et al. 2011).[22] Subsidies should target distribution of improved crop varieties, and ensure that smallholders have access to techniques and inputs required to increase productivity (McFarland, Whitley, and Kissinger 2015). Policies that target low-forest areas or crops and production methods unsuitable for the agricultural frontier are more likely to reduce deforestation pressures (Angelsen 2010).[23] For example, policies that promote perishable crops and irrigation investments and crop varieties suited for already-deforested areas increase agricultural output in nonmarginal lands, depressing prices and discouraging expansion in other areas (Angelsen and Kaimowitz 2001). Fertilizer subsidies can help promote intensive agricultural practices if they are below market prices (to discourage farmers from using standing forests as a cheap alternative) (Angelsen and Kaimowitz 2001). Input support should be reformed[24] and tied to efficiency (Cohn et al. 2014; Vermeulen et al. 2012). Efficiency gains can be made through promoting smart resource links and enhanced nutrient flows in integrated farming systems, better quality feeds and animal diets, improved energy use, and use of information and communication technologies to facilitate technology transfer (FAO 2019).

Labor-intensive technologies. Labor- (and even capital-) intensive technology may slow rates of deforestation, even if it increases profitability at the same time (Angelsen 2010). Labor-intensive technologies (for example, replacement of shifting cultivation by sedentary annual crop production) reduce pressure on forests while benefiting the poor (Angelsen and Kaimowitz 2001). While labor-intensive technologies can reduce pressure to clear forests when labor is scarce (ibid.), improved agricultural technology (combined with market integration, strong commodity prices, and easy access to land) has led to rapid deforestation (Pfaff et al. 2010). However, labor-saving technologies can promote expansion as a result of lower production costs (Angelsen 2010; Seidl, dos Santos Vila de Silva, and Moraes 2001); therefore, policy reforms that promote labor- (or capital-) intensive technologies should be considered carefully and in conjunction with other reforms.

Targeting commercial versus subsistence agriculture

Agricultural support reforms targeted at limiting agricultural expansion and thus deforestation and forest degradation can be divided into two groups: those appropriate in the case of commercial agriculture and those better suited for subsistence agricultural production (Streck and Zurek 2013). Policy makers should carefully consider which sector is being targeted during the design or reform of agricultural support policies, as the same policy may have contrasting impacts depending on whether it targets smallholders or large operations. For example, in commercial agriculture, a reduction of credit or an increase in input costs may reduce deforestation, whereas the same policy would increase deforestation from subsistence farmers—

21 Such policies have also been called reduced emissions agricultural policy (REAP) (Rudel 2009).

22 Agricultural support policies that increase the expansion of agriculture include government subsidies targeting agro-industrial actives and cattle production, agricultural price support, and government-sponsored resettlement programs (Barbier 2004; Pacheco 2006).

23 In contrast, agricultural support policies (that is, subsidized credit, price supports, infrastructure investment) in forest margin areas with rapidly growing labor forces tend to increase forest clearing (Angelsen and Kaimowitz 2001).

24 "An example of this could include increasing the costs of accessing land, or in the case of timber the price per stump, and simultaneously reducing the overall costs of commodity production by reducing post-production taxes or increasing post-production subsidies. This way the overall level of support to commodity production can be maintained, but a greater emphasis would be placed on investment in productivity without expansion" (McFarland, Whitley, and Kissinger 2015).

for example, by encouraging migration to the forest frontier (Pfaff et al. 2010). The following paragraphs outline key practices in each sector that policy makers should promote to reduce negative environmental impacts from agriculture.

Commercial agriculture

- **Sustainable intensification and CSA.** Policy makers can promote sustainable intensification and CSA by supporting conservation agriculture and no-tillage practices, cover crops and crop rotations, integrated soil and pest management, agroforestry and the use of improved and better adapted crop varieties and new technologies.[25] Policy makers should design intensification policies with appropriate safeguards and regulations to protect forests and avoid negative environmental outcomes. Strong land tenure security and land use planning and zoning as well as strong regulatory measures are necessary to ensure that intensification does not increase expansion into forests (Streck and Zurek 2013).
- **Shifting production to degraded land.** Specially designed lending schemes, tax breaks, and low-interest funding can be implemented to encourage farmers to shift production to already-degraded lands (Angelsen and Kaimowitz 2001). Investments in R&D as well as extension services are another important component of this policy goal.
- **Enacting demand-side measures.** Market incentives (for example, public procurement, eco-labeling, consumer awareness campaigns) as well as supply chain links (for example, certification systems, responsible sourcing policies) and accountability and transparency networks (for example, MRV systems, information sharing) are all important policies for influencing commercial operators and their commodity chains (Streck and Zurek 2013). See box 12.3 for examples of demand-side reforms in France.

Subsistence agriculture

- **Addressing market constraints.** Policies that address the market constraints faced by smallholders and subsistence farmers include land tenure reforms ensuring rights to land, strengthened institutional arrangements (for example, credit services, extension programs), enhanced access to resources, increasing smallholder productivity, and building local capacities for sustainable management.
- **Sustainable intensification and CSA.** Policies for subsistence and smallholder agriculture should encourage labor-intensive innovations to avoid increased expansion pressure on forests. Whereas capital-intensive technologies allow farmers to expand the area under cultivation (Angelsen and Kaimowitz 2001), labor-intensive policies tend to benefit the poor more than capital-intensive policies, which tend to displace labor to the agricultural frontier (Streck and Zurek 2013). Capital-saving technologies include those which improve input efficiency, erosion control measures, and integrated pest management practices. Government-supported fertilizer programs in combination with support for sedentary agricultural systems are potentially effective in encouraging intensification without expansion but are less suited to the forest frontier region (Angelsen and Kaimowitz 2001). Agroforestry should be promoted among subsistence and smallholder agricultural producers as it has been shown to both reduce costs and increase yields. In addition, a number of environmentally beneficial practices are available

25 New technologies include high-yielding varieties, introduction of new crops, integrated fertilizer application and pest control, and improved fallows.

and should be promoted for smallholders (World Bank 2015). Information campaigns and training programs can overcome barriers related to capacity (Sova et al. 2018), while tax expenditures or subsidized credit can provide incentives needed for smallholders to adopt beneficial technology.

Complementary policy to reduce deforestation from agricultural expansion

A number of broader policies and institutional reforms are necessary to reduce deforestation from agricultural production and promote climate-smart agriculture, including "sustainable intensification" (World Bank 2015). In particular, policies that enable land users to capture a higher share of the benefits provided by forests (such as protected areas, institutional arrangement reforms, and payment mechanisms) are particularly effective for forest conservation (Angelsen 2010).

Most important, strong enforcement against encroachment into forests is needed (Angelsen and Kaimowitz 2001; Byerlee, Stevenson, and Villoria 2014; McFarland, Whitley, and Kissinger 2015). A range of regulatory policy measures are necessary to complement agricultural intensification support policies, including protecting high conservation value forests, regulations on forest clearing, land use zoning, and satellite monitoring of forest cover.

Policy makers should ensure that sectoral public policy is harmonized, including agriculture, trade, infrastructure, regional control, migration programs, and so on. For example, the Selva Lacandona region in Chiapas, Mexico, restructured rural development policies to adhere to its REDD+ readiness framework (Pirard and Belna 2012).

Infrastructure policies should be evaluated to ensure they do not inadvertently promote deforestation. Agricultural infrastructure investments have mixed impacts on deforestation. Transport infrastructure investment decisions need to consider the potential impacts on forests (Angelsen 2010). In particular, policies that encourage migration toward the forest frontier tend to increase deforestation (Pfaff et al. 2010) and should be managed cautiously. However, if carefully designed and accompanied by complementary measures, improved infrastructure can play a role in intensification by lowering the effective costs of inputs to farmers (Byerlee, Stevenson, and Villoria 2014).

The adoption of payments for ecosystem services programs is one of the most effective policies in reducing deforestation and forest degradation; see chapter 1 for more details (Angelsen 2010; Pirard and Belna 2012; Vermeulen et al. 2012). In addition to providing important incentives to landowners for preservation, results-based conservation payments (that is, PES or REDD+) can compensate for certain agricultural support policy reductions. For example, in areas where agriculture is marginally profitable and forest encroachment is a high risk, subsidies can be reduced and PES can compensate for this reduction (Pfaff et al. 2010).

Policy makers can implement measures to act on global demand.[26] To address potential rebound effects from lower agricultural prices, policies are needed that can impact global demand. Not all countries will need to follow the same food transition (Chaumet et al. 2009), and efforts need to be made to reduce food demand by reducing waste (West et al. 2014) and shifting diets (Davis et al. 2016). Taxes based on carbon content may be effective in shifting demand (Zaks et

26 Particular policy mechanisms that address international demand are discussed in chapters 7, 8, and 11.

al. 2009); see chapter 6 for more details. Voluntary markets and consumer-related incentives (for example, eco-labeling) are additional options that can help influence demand (Byerlee, Stevenson, and Villoria 2014; Tilman et al. 2002).[27] See box 12.3 for examples of demand side and other agricultural policy reforms undertaken in France.

BOX 12.3 THE ROLE OF GLOBAL DEMAND ON DEFORESTATION: THE CASE OF FRANCE

NICOLETTA BATINI

As major importers and consumers of many commodities that include embodied deforestation, **advanced economies are both responsible and a potential solution to halting deforestation by adopting more coherent approaches, including via shifts to consumption**.

France is an interesting example. The French forest area has increased significantly since the mid-19th century, partly as a result of the progressive abandonment of total land farmed, and it continues to grow, gaining on agricultural lands, wastelands, and heathlands, albeit at a slowing pace. However, France's demand for forest products outstrips supply, and the sector is in difficulty (Solagro 2016), generating increasing imports of wood from tropical forests. In addition, to feed its huge bovine herd—the largest in the EU—France imports large volumes (1.5 million tonnes yearly) of genetically modified organism (GMO) soybeans grown by permanently displacing tropical rain forest. Europe's imports of agricultural products—ranging from beef and soybeans from Latin America to palm oil from Southeast Asia and cocoa from Africa—are responsible for more than a third of deforestation (EC 2013).

To fight imported deforestation, France recently adopted an ambitious new national strategy (*Strategie Nationale de Lutte contre la Deforestation Importée 2018–2030*), using trade to help decouple economic development from tree-cutting and unsustainable agriculture in poorer countries. The plan, which pioneers the implementation of a European plan advocated by a wider coalition including Denmark, Germany, Italy, the Netherlands, Norway, and the United Kingdom to eliminate deforestation from agricultural commodity chains and move to a fully sustainable palm oil supply, proposes to stop **importing commodities linked to deforestation and unsustainable agriculture by 2030**.

The strategy includes practical measures to help companies meet their own goals for combating the import of products linked to deforestation and encourage financiers to take environmental and social issues into account for investment decisions. But while the plan promises key regulatory changes from origin certification to consumers' sensitization, reducing imports of wood and soybeans implies primarily changing production systems in France to (i) reduce France's bovine herd by shifting production from animal-based to plant-based proteins; (ii) validate the new supply with a shift in demand via a shift in diets; and (iii) develop French agroforestry and the production and harvesting of associated crops.

To this end, existing French-specific agri-food and forestry transition scenarios could be used to set up production and consumption targets for the agri-food market in 2030 and 2050. Among these, Afterres2050, the most comprehensive study currently available, can provide both practical benchmarks for interim (2030) and final (2050) supply and demand levels and an analysis of socioeconomic outcomes associated in expectation with the recommended sectoral shift. Batini (2019) examines several policy tools to accelerate the country's ambitious agri-food reform agenda, comprising a range of interventions that financially motivate (fiscal levers) as well as nudge and empower (structural reforms) firms and individuals to make the required behavioral changes will be necessary.

27 Fiscal policies to promote eco-labeling and sustainability certification are discussed in chapters 7 and 8.

ON THE SUPPLY SIDE, SPECIFIC INTERVENTIONS TO CHOOSE FROM INCLUDE THE FOLLOWING:

i. A recalibration of direct and indirect taxes and social security contributions on agri-food production and agri-food sales based on the level of externalities these generate. For example, net profits from conventional animal farming (which involves feed crops from deforested areas) should be taxed more than net profits from pasture/raised organic animal farming, as the former are associated with deforestation externalities, whereas the latter are not. By the same token, a recalibration of the system of subsidies to agri-food production to better reflect the level of externalities it generates on global deforestation. For example, animal-based protein production from faming livestock in excess of transitional targets should receive no subsidies or relatively less subsidies than plant-based protein production that implies no deforestation.

ii. A recalibration to the way subsidies from the Common Agricultural Policy are allocated in France once received using the flexibility in the allocation of subsidies to member countries in the context of both pillar 1—funded by the European Agricultural Guarantee Fund—and pillar 2—that is based on Rural Development Programs cofinanced by the European Agricultural Fund for Rural Development and EU member states. Main areas of flexibility include (a) transfer of funds from pillar 1 to 2 or vice versa to shift support in favor of low- or no-deforestation-externality-generating activities; (b) targeting to desired commodities commodity-specific payments funded from the national budget in addition to SAPS aid, including through the transitional national aid scheme; (c) leveraging of rules under the Common Agricultural Policy's new voluntary coupled support to allocate a larger subsidy envelope to desired production (that is, low-deforestation-externality crops and breeds) subsectors or regions (to better tailor the use of domestic resources/energy to low-externality crops and breeds).

ON THE DEMAND SIDE, POLICY MEASURES COULD FOCUS ON THE FOLLOWING:

i. A recalibration of indirect taxes on consumption and retailing based on the level of deforestation externalities these generate. For example, a (Pigouvian) tax on meat and dairy for livestock fed with crops from, or directly imported from, deforested areas, calibrated to the elasticity of French-specific demand and the desired quantity equilibrium for these foods, along the lines of what was proposed by Simon (2013) and Joyner and Warner (2013) for the United States. The success of these taxes in shifting consumption is well known for tobacco smoking. Tax credits could be introduced to offset the potential extra tax burden on each taxpaying individual or family (after adjusting for lower consumption) from the recalibration of indirect taxes so that consumers' ability to eat will not be diminished. The credit could be funneled via tax credits on specific plant-based foods or foods not associated with deforestation, to ensure proper targeting to consumers who have embarked in an actual demand shift toward sustainable produce.

Structural reforms to shift supply and demand could include a combination of regulatory, education-reinforcing, and financially incentivizing steps. Prominent examples comprise (a) incentives for all voluntary greening schemes beyond those linked to direct payments under the Common Agricultural Policy and in line with the "4‰ Initiative" under the 2015 Lima Paris Agenda for Action; (b) food-waste reduction schemes beyond those provided in the 2018 Food and Agriculture Bill; (c) sponsoring food-industry businesses initiatives to research, test and scale up new strategies and plans that help consumers select sustainable foods; (d) public campaigns to raise awareness about the public environmental impact of alternative food choices beyond existing government plans; (e) more ambitious mandatory targets for the type, combination and quantity of food served in public canteens; and (f) regulatory marketing and retailing reforms to encourage the demand of deforestation-free food and/or discourage the demand for deforestation-generating food.

Land tenure and migration policy reforms can also be used to reduce agriculture's environmental impact on forests. While land reforms that strengthen tenure rights can contribute to higher yields (Holden, Deininger, and Ghebru 2009), they can actually increase deforestation by increasing the net present value of land clearing (Angelsen, 1999; Araujo et al. 2009). However, *insecure* tenure may also contribute to forest degradation and agricultural expansion (Angelsen 2010). Net impacts of tenure reforms are therefore context specific. Often, forest conversion is used to establish property rights (Alston, Libecap, and Mueller 2000; Araujo et al. 2009; Rudel 1993); thus, at minimum, provisions linking property rights with forest clearing should be removed. Additionally, migration policies that encourage resettlement into forest margins should be reformed so that policies attempting to promote rural development do not do so at the expense of forest landscapes (Peres and Schneider 2012).

Policy makers should ensure stakeholder participation and coordination during reform processes (Elgert 2015). Stakeholders may vary in their strategic preferences regarding policy responses to agricultural expansion. For example, in an empirical analysis in Ethiopia, *policy* stakeholders preferred a land-sparing approach, while *implementation* stakeholders preferred a land-sharing approach as it aligned with existing informal institutions (Jiren et al. 2017).[28] This preference alignment is reflected across developing countries; while land-sharing policies are present, the land-sparing approach dominates (Loconto et al. 2019; Mertz and Mertens 2017). It may also be more appropriate to implement a mixed approach (Habel et al. 2015; Law et al. 2015; Mertz and Mertens 2017). Agricultural landscapes are complex systems; in addition to ecological aspects, social and institutional dimensions need to be considered in land use strategies.

28 Furthermore, preferences were influenced by household income levels; poor farmers tended to prefer land sharing, while richer landholders preferred land sparing, presumably because richer households are more able to afford more expensive inputs and produce for market exchange. See Jiren et al. (2017) for more details.

TABLE 12.3
ADVANTAGES AND DISADVANTAGES OF DIFFERENT FOREST CONSERVATION POLICIES

INSTRUMENTS	STRATEGIES	ADVANTAGES	DISADVANTAGES	APPLICATION
Payments for services	Payments for conservation efforts, tree planting, improved agricultural management, etc.	Increases financial attractiveness of alternative practices; results based	Relies on local institutions, implementation and enforcement capacities	Policies Programs
Payments for GHG emission reductions and removals	Market transactions for emission reductions credits; monetization of (future) emission reductions	Increases financial attractiveness of projects that might not otherwise be feasible; direct link to mitigation benefits	Requires significant area as well as effective management and benefit sharing	Programs Projects
Debt	Preferential loans that subsidize particular inputs/practices	Sources of financing for technology, labor and other investments	Requires collateral and revenue stream; repayment risk; difficult to find local lenders	Programs Projects
Tariffs and taxes	Tax incentives to support policy objectives; enhanced tax deductibility and tax rebates; removal of taxes that create perverse incentives	Steers investment into activities that would otherwise be economically unrewarding	Relies on tax discipline and collection; limited relevance for smallholders	Policies
Grants	Financial support to projects that serve the public interest, often provided by governments or not-for-profit organizations	Increases the financial attractiveness of projects that might otherwise not be economically feasible; comes at no cost for smallholders	Availability is limited and continuity is uncertain; unlikely to cover entire investment costs	Programs Projects
Insurance	Weather, political, and crop insurance; other risks	Shifts investment and adoption risk away from smallholders	Inappropriate use distorts markets; excessive risk taking	Policies Programs
Loan guarantees	Mitigation of political or credit risks in public or private sector loans	Effectively mobilizes co-financing from external sources; leverage potential for long-term debt finance for development	Risk of principal loss for issuer of guarantee	Policies Programs

Public-private partnerships	Financial and policy support for targeted investments	Flexible model accommodates multiple instruments; proven in large-scale project investments	Historically favored larger investment projects; risk of benefits accruing to larger private players rather than smallholders	Policies Programs
Labeling and certification	Voluntary initiatives; supply chain investments	Pilots can inform public policy; can result in large investment if high market demand	Transaction costs of verification and certification may be prohibitive for smallholders; price premiums uncertain	Policies Programs

Source: Adapted from Streck and Zurek 2013.

Conclusion

The agriculture sector is a major driver of deforestation. While there are substantial (international) market forces that affect agriculture's impact on forests, domestic decisions made by policy makers may also be able to influence this impact. Policies and programs designed to promote commercial agriculture often result in rapid expansion with significant consequences for converting forests and other natural habitats to agricultural production. In other circumstances, insufficient public policy support—typically investment in essential public goods such as R&D, advisory services, connectivity (roads and communication)—or the enabling environment through which appropriate policies for attracting private investment in value chains can perpetuate subsistence agriculture and, with continued population growth, put a different pressure on natural habitats for subsistence agricultural expansion.

Agricultural support policies thus play a significant role in driving deforestation from the expansion of agriculture in various ways. For example, public support policies can promote expansion through their impact on prices and in combination with low capacity to enforce other policies, or by allocating limited public expenditures toward subsidies that crowd out public goods investments. Policy planning and evaluation do not usually consider the impact on forests (though this is recently changing to include environmental impacts), nor do they pay needed attention to the long-term and hidden costs of the distortions such policies create.

Reforms to agricultural support policies may be able to help reduce agriculture-driven deforestation. Removing coupled (for example, input- or production-based) subsidies, replacing them with decoupled transfers (for example, income), or explicitly tying payments to environmental outcomes (as payments for environmental services) would remove the distortionary impacts on producer decisions and encourage environmental stewardship, including preservation of natural forests. Such reforms would go a long way in moving toward economically, socially, and environmentally sustainable agricultural systems.

An important message from the experience so far is that complementary measures in addition to fiscal reforms will be necessary to limit deforestation from agricultural expansion. Fiscal policy is not a panacea. In particular, strengthened enforcement against forest encroachment will be essential to limit forest destruction.

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