



REPURPOSING PERVERSE INCENTIVES FOR LAND RESTORATION





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Key messages

Perverse incentives are policies or practices that encourage resource uses that lead to the degradation of biological diversity. They include subsidies, policies and the lack of regulation, and market failures leading to under- or overpricing of products.

This working paper categorizes perverse incentives, discusses how to measure land degradation and the effect that perverse incentives have, and suggests how to remove or counteract them. The key messages and the relevant stakeholders (in **bold**) are as follows.

- The costs of land restoration are invariably lower than the costs of inaction in preventing land degradation (**governments**).
- To assess costs versus benefits, accepted standards in natural capital accounting are needed. These would make it possible to measure and mitigate the damaging effects of perverse incentives on the environment. (international organizations, **governments**).
- Concerted efforts are needed to verify the scale and rate of environmental degradation, such as through natural capital accounting to assess how urgent action is needed in light of future land productivity to feed the world (**international organizations, governments**).
- There is need to rethink or remove entrenched incentives that no longer serve their original design. Reforms that result in non-distortionary market impacts and which are supported by strict legal enforcement would be conducive to environmental sustainability (**governments**).
- Voluntary action and community-led activism can be a powerful catalyst in land restoration as well as voluntary participation in international certification schemes that attest to sustainability (**communities**).

- The appropriation and development of prospective technologies in accurately mapping and monitoring land degradation for structured accounting is a promising way forward. Where anthropogenic degradation is suspected, this could then be mapped back to perverse incentives that are probable in cause (international organizations, international consortia of governments, technical institutions).
- Advanced technologies such as precision agriculture have enormous potential to optimize input and resource use with respect to the environment, while being compatible with farmers' profit-maximization goals (private sector, land users).
- Low-level technologies, such as good agricultural practices, organic farming and no-till agriculture can markedly lower environmental impacts from land use, and mitigate or remove the need for harmful subsidies (international non-governmental organizations, extension workers).
- Repurposing environmentally harmful subsidies (reform or removal) can provide redirected fiscal support towards land restoration and higher land productivity, which can ensure food security, job creation and the improvement of rural livelihoods – the so called “double dividend” (governments).
- To meet the needs of a growing population, it is vital to restore productivity of the Earth's land base and environmental assets. This can only be addressed by concerted action by all stakeholders. Governments do not have a monopoly on intervention, for there is need for collective responsibility to be adopted by all. The notion of “our world” can incentivize all to protect and restore the planet's land base (all of us).
- Climate change and naturogenic processes, which have not been addressed in this working paper is a further cause of land degradation, and are often induced by anthropogenic (human-induced) activity. Measures towards climate change mitigation constitute a further need for action.





1. INTRODUCTION

The global economy has become reliant upon extensive government intervention in the form of subsidies, both direct and indirect, to support specific economic sectors (e.g., agriculture) or to support a policy objective (e.g., food security, self-sufficiency). Paradoxically, many of these interventions can be labeled as “perverse,” in that rather than helping society to achieve their intended goal, they work in the opposite direction, causing harm to the economy, the environment and to land productivity. In the longer run they may undermine food security and rural income objectives.

Recipients of an intervention are often incentivized to put their self-interest, such as productivity and profitability, before the longer-term consequences of their actions on the environment. For instance, a farmer who buys a subsidized chemical pesticide (i.e., at a lower cost than the market price) may excessively or irresponsibly use the input, resulting in the destruction of local biodiversity. Generally, subsidies may create “perverse incentives” for those to over-exploit or over-intensify use of natural resources, leading to environmental degradation. Non-monetary interventions, such as laws and regulations intended to encourage economic development (e.g., rights and concessions granted to extractive industries), can also perversely incentivize habitat and land destruction. In addition, markets may fail (owing to externalities) when prices do not reflect the environmental costs of production and consumption, yielding a direct causal relationship between mispricing and (incentivized) unsustainable models of land-based production activities. Ultimately, the lack of enforcement of environmental laws and regulations can exacerbate land degradation in the face of perverse incentives.

While models show that the costs of land restoration are invariably lower than the costs of doing nothing to prevent land degradation,¹ strong political incentives inhibit change.² These include an “entitlement” or “dependency” culture, which can impede land users from investing in

productivity-enhancing technologies that could equally sustain their incomes without recourse to the subsidy. A fear of marginalizing the electorate stifles political parties in addressing the harmful role of subsidies, which is often exacerbated by lobbyists and special-interest groups who seek to maintain the status quo and to promote opaqueness when their clients are major beneficiaries of subsidies. Governments may also be concerned that the removal of subsidies can thwart trade competitiveness, leading to adverse income impacts such as on food security, rural employment and economic growth.

Despite international efforts (e.g., the Convention on Biological Diversity, CBD), anthropogenic activity is complicit in the destruction or degradation of large swathes of the world’s ecosystems.³ For example, natural forests declined by 6.5 million hectares per year between 2010 and 2015 (an area larger than the UK), while natural wetland areas fell by 35 percent between 1970 and 2015. Anthropogenic activities are also destroying biodiversity, which is the bedrock of ecosystems vital for human well-being, such as crop pollination, water purification, flood protection and carbon sequestration. Globally, these services are estimated to be worth USD 125–140 trillion per year, i.e. more than one-and-a-half times global GDP. Between 1997 and 2011, the planet lost an estimated USD 4–20 trillion per year in ecosystem services owing to land-cover change, and USD 6–11 trillion per year from land degradation.⁴ Biodiversity conservation is fundamental to achieving the UN’s Sustainable Development Goals, especially on food security (Goal 2), poverty reduction (Goal 1) and the land base (Goal 15). In order to halt and reverse these losses, actions need to be scaled up dramatically and urgently.

Deutz *et al.* (2020)⁵ argue that subsidy reform represents the single biggest opportunity to restore the planet’s ecosystems. They estimate that nearly USD 542 billion is currently spent each year on agricultural, fisheries, and forestry subsidies that are environmentally harmful. Redirecting those

payments, especially those considered most harmful to the environment, to incentivize more sustainable practices would benefit the land base and land productivity while also mitigating climate change, improving food security and poverty reduction.

Further precision in assessing the monetary extent of the problem, as well as reporting the annual physical rates of land degradation, can be addressed through international natural capital accounting standards, such as the Central Framework of the System of Environmental-Economic Accounting (SEEA-CF) and more importantly, Experimental Environmental Accounting (SEEA-EEA), which seeks to directly measure ecosystem extent and condition.⁶ A parallel framework to quantify environmental degradation is the Paris Collaborative on Green Budgeting.⁷ While both frameworks are at a nascent stage in terms of implementation, they have already generated progress in the contextualization and quantification of fiscally driven policy impacts on environment assets. Technology, such as earth observations and remote sensing, have also been applied to natural capital accounting to assist in assessing budgetary impacts on the health of environmental assets. Other noteworthy frameworks include the TEEBAgriFood Evaluation Framework⁸ and the 6+1 framework of the Economics of Land Degradation.⁹ The evidence base must still be established to show policymakers the physical and monetary harm of perverse incentives.

Notwithstanding the formidable political economy of subsidies, the multitude of case studies presented in this working paper illustrate that positive action can be taken now. For instance, subsidies can be targeted better by ensuring that input supply is matched with actual productivity needs¹⁰ and land health. Access to capital and other input markets can be granted contingent

on the land user engaging in sustainable land management practices. Such approaches can mitigate the damage from perverse incentives. On the other hand, the use of advanced technologies such as precision agriculture, the move towards alternative farming paradigms such as organic farming, and the use of integrated pest management all circumvent the need for perversity-inducing subsidies.

The case studies show that reform is greatly dependent on communities to catalyze change.¹¹ Their voluntary participation in international certification schemes, community-led action and activism, along with transparency as to what is at stake, are powerful forces in advocating and achieving reform. The notion of “our Earth” can be the all-important transformative pathway towards land restoration when land is appreciated by direct users.

Phasing out public support for subsidies and the business models that lead to perverse incentives, and instead implementing corrective policy and legislative changes, would free up resources that could be repurposed to conserve, sustainably manage and restore land and ecosystems. The argument that subsidies are needed to safeguard food security and rural livelihoods is a fallacy; repurposing the costs of subsidies towards land restoration can increase food productivity as well as creating rural jobs.

In consultation with stakeholders such as governments, businesses, farming associations, civil society, indigenous peoples, women and local communities, under the guidance of international organizations, such policy reform will promote and scale up activities along the land-restoration continuum. It will contribute to climate resilience and the achievement of land degradation neutrality¹² and a host of sustainable Development Goals and other internationally agreed targets.



2. WHAT ARE PERVERSE INCENTIVES?

The phenomenon of perverse incentives is firmly grounded in wide variety of social, economic and environmental disciplines. In the realm of the environment, the Convention on Biological Diversity describes perverse incentives as:¹³

...A policy or practice that encourages, either directly or indirectly, resource uses leading to the degradation of biological diversity. Hence, such policies or practices induce unsustainable behavior that reduces biodiversity, often as unanticipated side effects as they were initially designed to attain other objectives. Several common types of perverse incentives are usually identified as: environmentally perverse government subsidies; persistence of environmental externalities; and, laws or customary practices governing resource use.

This definition can be applied to any environmental asset, including land and its degradation. Two classic examples shed light on the phenomenon and are often cited in the literature to illustrate the problem.

- In the colonial era, authorities in British-controlled **India** were alarmed at the growing population of wild cobras. Authorities offered a financial reward to the local population to eradicate cobras. However, enterprising locals began farming cobras to reap further financial benefits. When the exploitation of the scheme was uncovered by the authorities, financial rewards were immediately suspended, along with the scheme itself. The farmed cobras were set free, exacerbating the problem of the wild cobra outbreak, much to the consternation of the local community.¹⁴
- Similarly, in French-occupied **Vietnam**, a severe outbreak of rats in the city of Hanoi led the French authorities to offer a bounty to those who provided the pelts of dead rats. Again, the

program incentivized locals to farm rats for further financial reward. Likewise, when their enterprise was exposed, French authorities dismantled the program, which led to a greater rat infestation than hitherto.¹⁵

These examples show that the financial incentives produced unintended and undesirable results that were contrary to the goals of the original policy. Their unintended consequences led to more harm to society than prior to the intervention. It is for this reason that these incentives are termed “perverse.”

For this working paper, it is necessary to frame the many types and sources of perverse incentives and their negative effects on the environment. We can then use examples and case studies to show how repurposing or removing them can lead to positive effects for land restoration. There follows a broad categorization of the sources of perverse incentives, and then a set of examples of how such incentives can result in land degradation. In later sections, we show that incentives can also be employed towards land restoration, through mechanisms such as regulation, the creation of positive externalities through markets and the price system, as well as voluntary efforts such as community activism.

Perverse incentives appear in the entire spectrum of economic activity. We can identify three broad categories:

- **Subsidies.** These are one of main instruments of direct intervention. Perverse incentives are often cast in a narrower sense such as “perverse subsidies,”¹⁶ or “environmentally harmful subsidies.”^{17,18}
- **Laws and regulations** or their lack of enforcement.
- **The price system**, or negative externalities associated with market failures.

BOX 1

Chemical pesticides, often subsidized, may contaminate environmental assets



Pesticides are a broad class of chemical-based substances intended for preventing, destroying, repelling or mitigating pests. Common pesticides include herbicides, insecticides, rodenticides, bactericides and fungicides. Pesticide applications are prolific in global agriculture in attracting subsidies. However, they may contaminate soil, water systems and vegetation and are invariably toxic to a host of other non-targeted organisms, including birds, fish, beneficial insects (pollinators) as well as non-targeted plants.

Source: Aktar *et al.* (2009).

2.1 Subsidies

Subsidies are a form of financial benefit provided by the government (e.g., cash transfers and tax concessions) conferred on producers and consumers of goods and services, that render the value of the output lower than its full economic cost, i.e., lower than the market price.

Subsidies normally aim to promote activities that governments deem beneficial to the economy and society, such as food security and improving rural livelihoods.

Subsidies form a prime feature of the economic landscape in many countries, both developed and developing. They can be found in most sectors of the economy, from agriculture to energy, from road transportation to water. But subsidies may be detrimental to society's overall interests in terms of the economy, the environment and society.¹⁹ Such subsidies are deemed "perverse." They qualify as perverse incentives for the purposes of this

working paper if they deplete natural capital by over-exploiting or damaging the environment or biodiversity. Arguably, the most evident forms of perverse subsidies can be found in agriculture. They often cause the over-intensification of land use, especially when agricultural inputs are subsidized.

Over the past several decades, higher harvests have been achieved by more irrigation, the greater application of pesticides and chemical fertilizers, and the substitution of labor by machines, which raises the demand for fossil fuels. These trends have been widely fostered by subsidies. Many, if not most, of these subsidies are costly in the fiscal sense to the economy, and their mismanagement is often harmful to the environment. Subsidies are commonly used to pay farmers to raise productivity, increasing the returns of agricultural production and attracting further investments and resources into the sector. When environmental regulations are not in place, or when regulations

BOX 2

Runoff from chemical inputs is a major source of environmental contamination



Subsidies and market incentives can lead to a greater use of fertilizer and pesticide applications in farming. However, without proper knowledge or management, “runoff” – the draining away of water – can occur. Runoff from agricultural land can carry large amounts of nitrogen and phosphorus from fertilizers, pesticides and sediment into lakes, aquifers, wells and waterways. These substances can cause algal blooms, which can poison fish and wildlife, contaminate food sources, and destroy the habitat that animals use for protective cover.

Source: EPA (2015).

are not effectively enforced, marginal land may be converted into cropland²⁰ in order to benefit from subsidies. Thus a “perverse” scenario – a vicious cycle – of over-intensification and expansion transpires, which almost always compounds environmental stress.

Below we describe the most common types of subsidies and how they can have detrimental impacts on the environment. These subsidies can, and need, to be remedied by stakeholders, not just by governments but by those communities that depend on the land whose livelihoods are threatened.

Fertilizer and pesticide subsidies

Subsidies encourage waste.²¹ When an input is subsidized below its market price, evidence suggests that they are potentially applied at above optimal rates.^{22, 23} Overexuberance and a lack of

knowledge on the part of farmers on the quantities and types of chemicals to apply are both to blame.²⁴

The overuse of chemical fertilizers and pesticides poses major threats to the environment. These threats concern the loss of biodiversity, the collapse in ecosystems, land degradation and the concomitant decline in the productive capacity of the land. The overuse of agrochemicals is commonplace throughout the world, but in some countries the situation is severe. China, with 8 percent of the world’s total arable land, typically accounts for 32 percent of the world’s aggregate consumption of synthetic fertilizers and 43 percent of the pesticides.^{25, 26, 27} The application intensities of these agrochemicals are four and five times that of the world average. However, the efficiency of agrochemical use is low.²⁸ A recent study by China’s Ministry of Agriculture²⁹ examined fertilizer efficiency for the country’s main strategic crops –

BOX 3

Irrigation subsidies encourage excessive use of water, leading to runoff and water scarcity



Irrigation subsidies can lead to an over-intensification of the input, which may deplete scarce water reserves, run rivers and waterways dry, as well as lowering levels of fossil aquifers, harming future land productivity, biodiversity and the accompanying ecosystems. Leaching and runoff from poorly managed irrigation is also a key concern in the excessive use of irrigation.

Source: Sur *et al.* (2002).

rice, corn and wheat – and found that average efficiency to be in the order of 38 percent, while the use efficiency of pesticides was around 39 percent.

Without proper management, or the absence of enforceable environmental regulations, the excessive and even regular use of agrochemicals can lead to soil pollution and the contamination and eutrophication of water bodies through runoff. Again, looking at China's track record, the country's first National Census on Pollution Sources identified synthetic fertilizers and pesticides from agricultural activities as a greater source of water

contamination than were industrial discharges. In terms of the data, nonpoint source pollution (i.e. runoff) from agriculture alone is responsible for approximately 44 percent of the nation's chemical oxygen demand, around 67 percent of the phosphorus discharge, and roughly 57 percent of nitrogen discharge.³⁰

Water subsidies

Drought stress is major challenge for farmers because it may severely reduce crop yields. Rainfed crops are significantly exposed to the vagaries

BOX 4

Soil salinity is often a byproduct of irrigation subsidies in dry zones



Soil salinization occurs when water-soluble salts accumulate in the soil to a level that impacts on agricultural production and environmental health. Salinity initially affects the metabolism of soil organisms and reduces soil productivity, but in later stages it destroys all vegetation and other organisms living in the soil, consequently transforming fertile and productive land into barren and desertified lands. While often a natural phenomenon, soil salinization can be caused the excessive irrigation subsidies in dry climates, with heavy soils and poor drainage, that causes salt accumulation because they are not washed-out by rainfall.

Source: Recare (2018).

of the weather, and when seasonal rains fail, the risk of crop failure dramatically rises. However, irrigation circumvents these risks. The total global area equipped for irrigation is estimated to grow to 314 million hectares by 2030 from 141 million hectares in the early 1960s.³¹ As a percentage of global arable land area, this represents a rise from around 10 percent in the early 1960s to a projected 20 percent in 2030. Much of this growth has taken place, and future growth is likely to take place, in developing countries, on the back of subsidies. Indeed, water-related subsidies in irrigated agriculture are virtually universal. It has been estimated that farmers receiving water from government irrigation projects across the world seldom pay more than 20 percent of the water's real cost and often much less.³²

While water subsidies are integral to food-security policies in many developing countries and also for strategic crops in developed countries, these

subsidies can encourage inefficiency through overuse, and can incentivize farmers to grow water-inefficient crops that are not suited to their environment or the country's factor endowments.³³ The poor management and wastefulness of irrigation can also lead to runoff and leaching of chemical inputs.

More worrying is when non-renewable water sources, such as fossil aquifers, are used in subsidized irrigation, which can lead to their depletion.

Preferential credit, leasing and capital-intensive agriculture

The rapid rise of highly productive, capital-intensive agriculture throughout the world has been a major factor in providing affordable domestic food to rising populations, and in supplying international markets from which competitively priced food can

BOX 5

Access to cheap capital incentivizes industrial farming may have negative environmental consequences



Capital-intensive or industrial farming is the bedrock model of agricultural systems in the developed world, but is growing rapidly in emerging countries and in developing countries. Preferential access to credit markets including subsidized interest rates and favorable loan conditions is often the precursor to the shift towards industrial farming. Industrial agriculture is characterized by low fallow ratios. It uses large amounts of irrigated water, energy, and chemicals, which tend to produce higher crop yields per unit of land at the expense of sustainability. Industrial agricultural practices are also one of the main drivers of global warming, accounting for 14–28% of net greenhouse-gas emissions.

Source: Mbow *et al.* (2019).

be purchased. Capital-intensive farms substitute labor with a high degree of mechanization in all stages of cultivation, from land preparation, seeding, applying fertilizers, pesticides and irrigation, all the way to harvesting. This farming model requires substantial investment, principally in the acquisition of land for attaining economies of scale as well as for purchasing machinery.³⁴ In many developed and emerging countries, dedicated agricultural banks are available to finance these investments, often with preferential terms.³⁵ For instance, the United States Farm Credit System has a client portfolio of USD 335 billion³⁶ in loans to qualified farmers. It provides loans at competitive rates, as well as insurance and related services.

Capital-intensive farming is not without controversy. The drive for maximum productivity places undue stress on cropland, through monocropping and large applications of inputs, the use of heavy machinery in field operations, and the

minimization of fallowing. This can create a vicious cycle of degradation since more and more inputs, especially fertilizers, will be needed to maintain soil fertility and productivity.^{37, 38}

The use of heavy machinery in cultivation and harvesting can compact soils, reducing their ability to store water, decreasing water infiltration and impeding the penetration of crop roots.³⁹

Crop-specific subsidies

Crop rotation and diversification can deliver significant gains to soil health as well as improving farmer incomes and reducing the risks of market and climatic exposure.⁴⁰ Crop rotations can break insect and disease cycles, circumvent soil erosion, supplement soil nutrients, improve soil structure and conserve soil moisture. Avoiding high-yielding monocultures can prevent genetic loss among old varieties of plants.

BOX 6

The “industrialization” of livestock farming through market incentives poses similar environmental hazards



The large-scale intensification of livestock farming in many parts of the world poses threats to the environment. Pigs are fed and reared on an industrial scale to meet the growing demand for animal proteins, especially in East Asia. “Pig factories” house thousands of swine in confined areas, where feces and waste are often spread to the surrounding environment, polluting air and water. Waste from these farms have the potential to carry pathogens, bacteria (often antibiotic resistant), and heavy metals that can be toxic when ingested. Unlike human sewage, which is always treated with chemical and mechanical filtration, the animal waste is often untreated when it is released back to the environment.

Source: Nicole (2017).

Different crops require different quantities and mixes of nutrients, and they vary in their immunity to pests and diseases. Consequently, changes in crops may affect the demand for fertilizers and other agrochemicals. Cultivating legumes and pulses can replenish soil fertility, thus reducing the need for nitrogen fertilizers in subsequent rotations and adding to the resilience of agroecosystems.⁴¹

However, when subsidies targeted towards specific crops are in place, e.g., market-price support or crop-payment programs, these provide an incentive for the farmer to continuously cultivate the subsidized crop. This in turn drives agricultural intensification with higher use of inputs⁴² in order to receive more crop-specific subsidies. Farmers may respond to the incentive by allocating additional land at the expense of other crops, or they may seek to convert additional, including marginal, lands to cultivating the subsidized crop.⁴³ When farmers are monetarily disincentivized to diversify or rotate crops, they take on the

BOX 7

Countries that subsidize crops render an unlevel playing field for others, who may be incentivized to circumvent sustainable land management practices



Subsidies for domestic United States cotton, once an institutional feature of the sector, resurfaced in the US 2018 Farm Bill. Cotton is an export-dependent commodity for some of the poorest countries in the world, particularly those situated in West and Central Africa. US subsidized cotton keeps international prices artificially low, trapping poor farmers into production choices that do not reflect their comparative advantage, thereby depriving them of much needed improvements in their livelihoods and leading them to engage in potentially environmentally harmful practices.

Source: The Guardian (2014) and Voora *et al.* (2020).

considerable risks mentioned above. In other words, subsidies can alter risk appetite. Specific crop subsidies in developed countries also make it difficult for developing countries to compete in international markets, thus reinforcing the inefficiency of their agriculture⁴⁴ and distorting trade.

Untenable are crop subsidies that encourage over-production, for the sake of self-sufficiency, or preserving producer incomes, or to appease farmer groups with political influence.^{45, 46} The Common Agricultural Policy of the European Union led to the infamous milk and wine lakes, and butter and beef mountains. Although subject to significant reform over the past few decades, certain commodities (e.g., dairy products) still attract support within the Common Agricultural Policy, with excess production at the expense of the environment and the need for costly storage.

2.2 Policies and the lack of regulation

“There can be little environmental justification for subsidies and policies that foster the cultivation of crops grown in regions with poor or non-existent factor endowments, had there been a free market in existence.”⁴⁷

Agriculture

Many examples are at hand. California in the United States, for example, traditionally produces two-thirds of the nation's fruits and nuts and more than one-third of its vegetables. However, a prolonged drought throughout much of the last decade led to many small farmers to succumb to exit strategies, while larger producers with financial means began drilling deeper and more extensively to access aquifers to sustain cultivation. In response,

BOX 8

Policy-driven subsidies can lead to unneeded surpluses that are environmentally wasteful



The Common Agricultural Policy is the agricultural policy of the European Union. It implements a system of agricultural subsidies and other programs, in which intervention and private storage aid are key parts of the European Commission's market support program. Policy intervention is used to stabilize the market by purchasing surplus supplies, which are then stored. Intervention stocks are then sold through public tenders when market prices increase. Private storage aid provides support payments for storage due to the seasonal nature of dairy production. It helps to stabilize the market for a product in the event of a surplus, and is available at the discretion of the Commission. Surplus production places additional stress on the environment, especially in terms of inputs, while storage is costly notwithstanding the invariable losses of foodstuffs of prolonged storage.

Source: Agriculture and Horticulture Development Board (2020).

BOX 9

Incentives for economic growth often come at the expense of environment and conservation regulations



In July 2020, US authorities announced an overhaul of the National Environmental Policy Act, a key conservation law, to speed up construction permitting for freeways, power plants and pipelines. The change in policy “would save hundreds of millions of dollars over almost a decade by significantly reducing the amount of time allowed for completing reviews of major infrastructure projects”.

Other examples include the pursuance of food self-sufficiency without any recourse to comparative advantage, such as the lack of factor endowments and the cost of production compared to that of prices of internationally traded commodities.

Source: New York Times (2020).

California passed a regulation – the Sustainable Groundwater Management Act – which governs the extraction of water. But the policy is orientated towards increasing water supplies rather than limiting demand. This is in spite of an estimated 200,000 to 315,000 hectares that would need to be fallowed in order for the state’s natural aquifers to come back into balance.⁴⁸

There are many other examples of regulatory failure. For instance, the Endangered Species Act in the United States imposes development restrictions on landowners who find protected species on their property. While this policy is well-intentioned and has some positive effects for wildlife, it also encourages pre-emptive habitat destruction (draining swamps or cutting down trees and vegetation that might host endangered species) by landowners who fear losing the use of their land because of the presence of such species.

The species might even be deliberately killed to avoid their being discovered.⁴⁹

Extractive industries

While agriculture is a primary cause in the degradation of land and ecosystems, extractive industries can be of equal concern. The extractive sector involves removing, processing and transporting finite, non-renewable resources from the earth. Often, financial incentives are needed to attract the huge amounts of private-sector investments needed for mining the resource in question.⁵⁰

Globally, the extractive sector is associated with a range of serious environmental challenges: land clearance and ensuing environmental degradation, the use of dangerous chemicals, acid drainage from mine sites, the loss of biodiversity, intensive water use, pollution from poorly disposed waste,

BOX 10

Perverse policy initiatives to cultivate land when factor endowments are non-existent can stress natural capital



Food self-sufficiency has emerged as a strategic priority in Saudi Arabia. However, owing to insufficient rainfall, only irrigated crops are grown in the country. Since 2015, domestic wheat production, which used to be on average about 2.5 million tons from 500,000 hectares, was gradually phased out in an effort to limit the depletion of local water reserves. From 2018, however, the government reintroduced support for wheat production. Not only has it caused a serious drain on the kingdom's water resources, drawing mainly from non-renewable aquifers, but it has also required the use of massive amounts of chemical fertilizers to boost yields. Farmers are incentivized to cultivate the crop with a support price that is around 3 times the world price.

Source: FAO (2020).

dust and airborne pollution, as well as the contribution of mining to global climate change. These impacts almost never appear in isolation, and their cumulative, and even transboundary, impacts can severely affect entire landscapes and habitats.⁵¹ Mining often results in soil compaction because of the use of heavy machinery.⁵² It can generate extreme acidity in soils. Acidic drainage water from mines can have harmful effects on-site for revegetation, and off-site when the contaminated water discharges into surface and groundwater.

Trade policies

High import tariff regimes are used to protect inefficient or unsustainable domestic productive sectors and also to shield them from subsidized exports. Import tariffs may disincentivize producers from investing in more efficient and sustainable technologies and land management practices. Export subsidies, generated with market price support (e.g., minimum prices) often creates excess production that cannot be consumed in the exporting country, leading to unwanted and unsustainable pressures on the environment in the form of land intensification and the additional use of harmful chemicals. In both cases, these trade policy measures can be highly distortive and can have adverse environmental effects.

BOX 11

Tax concessions that incentivize foreign investments in extractive sectors can lead to significant environmental damage when environmental standards are lax



Research by the Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development (IGF) and the OECD reveals that tax concessions are used widely to attract private investment in mineral-rich developing countries. The loss in public revenues coupled with weak enforcement of environmental standards leads to significant environmental threats to the detriment of societies.

Source: IGF (2018).

2.3 The price system (unaddressed market failures)

In market-based economies, prices convey all the necessary information to guide producers and consumers in making rational decisions. When demand for a commodity rises (or falls), the price of that commodity rises (falls), sending a signal to producers to produce more (less) of the scarce (abundant) commodity. The market system guides productive resources to their optimal use. However, when prices do not reflect the true costs of production and consumption, resource scarcity and environmental impacts will not be known. This can result in environmental degradation. Consequently, there is a direct causal relationship between mispricing and unsustainable development.⁵³ Such cases are known as negative externalities, and appropriately, market failures.

Externalities have always been inherent in the market economy, but it was not until the 1920s that the economist Arthur Cecil Pigou highlighted their presence.⁵⁴ Mechanisms to correct for market failures are not without controversy, given the complexity in measuring the cost of externalities, and designing optimal policy, such as a targeted tax that will not further perturb markets. But to put provide a sense of scale: negative environmental externalities are currently thought to exceed the cost of all environmentally harmful subsidies.

The next chapter lays the foundation for remedial action, namely in measuring the scale of degradation in order to build an evidence base. The focus is on the tools, frameworks and approaches that can be used to assess the fiscal burden of perverse incentives (especially environmentally harmful subsidies), as well as innovative tools in the realm of natural capital accounting that can quantify degradation to environmental assets.

BOX 12**Markets can incentivize environmental degradation without recognition of externalities**

Palm oil is a very productive crop. It offers a far greater yield at a much lower cost of production than other vegetable oils. The market-led production of and demand for palm oil is increasing rapidly. Plantations are spreading across countries with comparative advantage in Asia, Africa and Latin America. But such expansion comes at the expense of tropical forests – which form critical habitats for many endangered species and a lifeline for many human communities. The clearing of these forests is a big factor in global warming, given how much carbon dioxide trees can store when left alone. Once forests are cut, tons of CO₂ are released into the atmosphere. Also, intact rainforests help maintain water resources by absorbing rainfall and then releasing it into streams and rivers, thus minimizing flooding and soil depletion.

Source: Scientific American (2008).

3. MEASURING LAND DEGRADATION DUE TO PERVERSE INCENTIVES

Policymakers have long recognized the importance of sound data on which to make decisions about policies and regulations, programs and fiscal interventions. Evidenced-based policymaking incorporates the best available scientific evidence from data collection and research to shape policy development and implementation, and to provide a reliable means to monitor progress and outcomes. With land degradation – or its opposite, land restoration – several questions form the heart of any policy response. Aside from the issue of a universally accepted definition of land degradation:

- What is the scale of degraded land in the world that is linked to perverse incentives?
- How much land can effectively be restored by removing perverse incentives?

Answering these questions presents an enormous challenge because of the need to produce reliable and timely assessments on the state and rate of global land degradation. Even more problematic is linking the scale and rate of land degradation to perverse incentives, which to date has appeared an insurmountable task. The most recent literature on these issues underscores the conundrum. Gibbs and Salmon (2015)⁵⁵ provide a quantitative synthesis of different frameworks in estimating how much land is degraded globally. Estimates range from 470 million hectares⁵⁶ to 6,140 million hectares⁵⁷ – a difference of 13 times. The spatial distribution of land degradation is equally divergent according to the frameworks examined. Gibbs and Salmon (2015)⁵⁸ offer a succinct synopsis of the challenges and importance of measuring land degradation:

Simply to define “degradation” is challenging and likely contributes to the apparent variance in estimates. The term degradation is often used as an umbrella term that encompasses a wide variety of land conditions, such as desertification, salinization, erosion, compaction, or encroachment of invasive species... Development of relevant and consistent definitions of degradation is increasingly important as we attempt to establish policy and market-based incentives to encourage production on these lands ... The risk of overestimating the availability and productive potential of these areas is severe, as it may divert attention from efforts to reduce food and agricultural waste or the demand for land-intensive commodities.

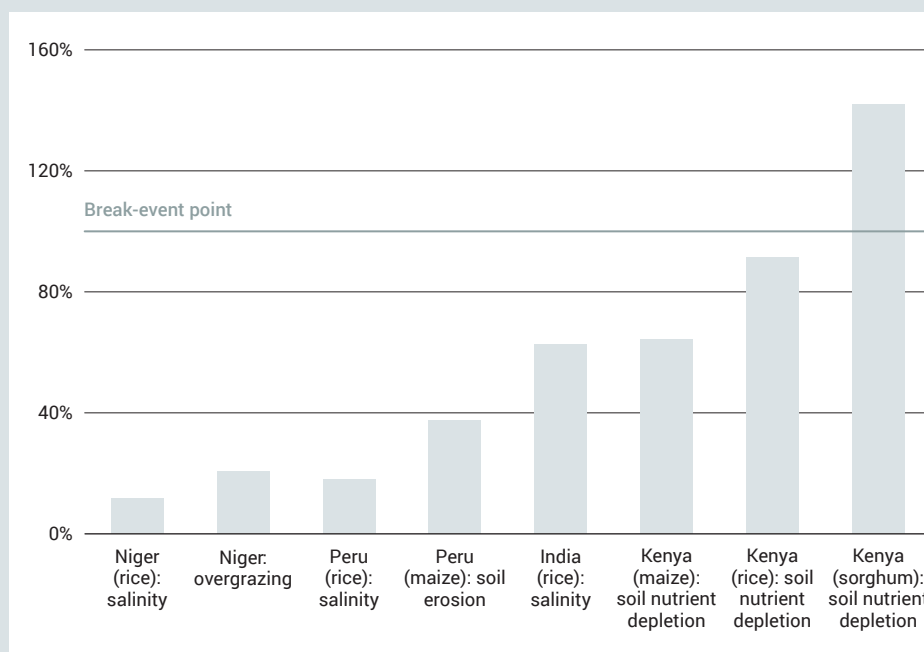
The stakes are much higher. Ascertaining the quantity and rate of land degradation and how degradation is caused has important ramifications for feeding the planet. The latest United Nation's Population Prospects estimates that between 9.5 and 10 billion people will need to be fed by 2050.⁵⁹ Understanding how much productive land will be needed, or the required yield increases to ensure food security for all, is an important question for policymakers and the global community at large. Uncertainty about the breadth, depth and rate of land degradation, especially in population growth hotspots, raises concerns on whether the land base can sustainability deliver on this target. It also raises concerns about the urgency, degree and ubiquity of interventions needed to prevent further, or to reverse, land degradation, especially in the context of perverse incentives and their removal or reform.

Land degradation is a result of both natural and anthropogenic causes. To neutralize or reverse the former, deep interventions will be required. For anthropogenic-induced land degradation, which is predominantly a result of perverse incentives, is more amenable to remedy. This brings forth an important measurement dimension, in the form of valuing subsidies and their potential impact for harm on the environment, especially with respect to agriculture. The rapid expansion and

BOX 13**Costs of action versus inaction in preventing land degradation in India, Kenya, Niger and Peru**

Simulation models were employed to measure the costs of prevention versus the projected costs of inaction in several important developing countries, where agriculture is important to GDP, including India, Kenya, Niger and Peru.

Cost of action
as percent of
cost of
inaction



India. About 2 percent of crop area in India is affected by salinity, which reduces crop rice yields by as much as 22 percent, while the cost of desalinization mechanisms was estimated at only 60 percent of the costs of inaction. This suggests that profit incentive is not the reason for inaction.

Kenya. As with most African countries, soil-nutrient depletion is a major problem. In the cases of maize and rice, the costs of action to prevent nutrient depletion were less than the costs of allowing the depletion to continue. For sorghum, however, the price of prevention was more than the price of nutrient depletion.

Niger. Soil-nutrient depletion, overgrazing and salinity in irrigated plots are major land-degradation problems, which result in losses to Niger's GDP in the order of about 8 percent. The cost of preventing salinity in irrigated rice is only about 10 percent of the cost of not preventing it per hectare, and the cost of preventing overgrazing is just 20 percent of the cost of allowing overgrazing to continue.

Peru. Soil erosion afflicts the Andean region, which makes up about 30 percent of the country. Soil erosion reduces maize yields by 2 percent on slopes. While the cost of establishing terraces to reduce the effects of erosion is estimated at USD per hectare, the net present value of plots with terraces is about USD 984 per hectare. The cost of creating terraces is actually even lower when looked at as a long-term investment. The cost of salinity in the irrigated crops of the arid and semiarid coastal region (about 34 percent of the land) was also evaluated using rice yields. Crop simulation results showed that salinity reduced rice yields by 22 percent, which led to a loss of USD 402 per hectare. The cost of desalinization methods was USD 69 per hectare, which is only 17 percent of the cost of not taking any action.

Source: Nkonya *et al.* (2011)⁶²

BOX 14

Potential impacts of agricultural producer support measures on the environment

All other things being equal, the main categories of producer support measures can be ranked according to their relative impacts on the environment, as follows:

Market price support and payments based on output both increase the price received by producers for a specific commodity such that the more the commodity is produced, the more will be the support received. Thus, the higher these forms of support, the greater is the incentive for monoculture, involving more harmful inputs (such as chemicals), and/or using environmentally sensitive land, which all places undue pressure on the environment. Moreover, these payments have the lowest effectiveness in achieving environmental goals, since being sector-wide, they cannot be targeted to any environmental goal.

Payments based on input use reduce the cost of inputs used by producers such that the more the input is used the higher will be the support. When the payment is specific to a variable input (e.g., fertilizer or a pesticide) the greater is the incentive for production intensification, resulting in harmful impacts on the environment. For example, the negative environmental impact of a credit subsidy for purchasing fertilizers or pesticides is potentially higher than a credit subsidy for acquiring farm land or extending farm buildings.

Payments based on area planted/animal numbers reduce the cost of land/livestock for current plantings/animal numbers. As producers cultivate crops or own livestock, these payments may be an incentive for keeping environmentally sensitive land in production, or producing environmentally unsound commodities on the same land. Although these payments may be targeted to a specific environmental goal, they provide an incentive to bring additional land or animals into specific production and encourage monoculture in the same way as the payments based on output. However, as producers are not encouraged to increase yields and to produce as intensively as they are with the forms of support outlined above, the environmental impact of these payments is potentially lower.

Payments based on non-current entitlements: to receive these payments producers are not obliged to plant, own animals, or produce any particular commodities. Therefore, the impact of these payments on the environment are relatively benign or lower than the other forms of support.

Source: Honkatukia (2002)⁶⁴

unsustainable management of croplands and grazing lands is the most extensive global direct driver of land degradation.⁶⁰

Looking at the issue from another perspective, Nkonya *et al.* (2011)⁶¹ raise the all-important questions on “why countries do not take commensurate action to prevent or mitigate land degradation? Are the benefits worth the additional costs, or are the costs of action greater than the costs of inaction?” Box 13 summarizes the results from their analysis.

Nkonya *et al.* do not attribute types of land degradation to harmful subsidies or other perverse incentives. But their takeaway message is that most often the cost of prevention is less than the cost of land degradation. This should send a forceful message to policymakers in those countries that are registering a decline in land productivity through unsustainable land management practices.

3.1 Measuring agricultural subsidies and their potential harm

OECD

The OECD is the established authority in measuring and monitoring the level and composition of agricultural support. While not global, support is measured among the OECD countries, several non-OECD EU member states as well as in major emerging economies. Its producer support estimate and related indicators (Table 1) provide measures of the level of subsidies, and the degree of protection and market orientation of agricultural policies.⁶³ The relevance of the indicators to environmental harm is detailed in Box 14.

A further indicator monitored by the OECD is the consumer support estimate, which constitutes another measure of agricultural subsidies. This indicator provides estimates of the value of gross transfers from or to domestic consumers of

TABLE

All countries*: Latest estimates of support to agriculture (million USD)

	2017/19	2017/19	2017	2018	2019 ^p
Total value of production (at farm gate)	1,195,766	3,571,747	3,503,131	3,561,521	3,650,590
of which: (%) of market price support (ed) – MPS commodities	72.40	75.00	74.60	75.50	74.90
Total value of consumption (at farm gate)	1,180,619	3,348,913	3,260,847	3,344,489	3,441,404
Producer support estimate (PSE)	241,131	446,424	466,296	437,050	435,925
Support based on commodity output	142,998	205,118	234,550	197,478	183,824
Market price support**	127,629	193,372	224,987	180,648	174,481
Positive price support	151,850	282,715	296,708	277,512	274,136
Negative price support	-24,221	-89,413	-71,720	-96,864	-99,655
Payments based on output	15,369	11,746	9,063	16,830	9,344
Payments based on input use	36,843	92,425	92,198	94,027	91,051
Based on variable input use	19,491	51,908	50,971	52,276	52,476
With input constraints	342	1,807	2,419	1,604	1,398
Based on fixed capital formation	9,545	29,784	30,101	31,118	28,133
with input constraints	630	4,071	4,428	4 267	55
Based on on-farm services	7,807	10,734	11,126	10,634	10,441
with input constraints	967	1,577	1,515	1,623	1,593
Payments based on current A/An/R/I, production required	43,329	78,427	73,017	75,659	86,603
Based on receipts/income	3,986	6,126	5,753	6,515	6,109
Based on area planted /animal numbers	39,343	72,301	67,264	69,144	80,494
with input constraints	18,032	39,640	33,639	36,180	49,101
Payments based on non-current A/An/R/I, production required	71	2,277	2,017	2,447	2,367
Payments based on non-current A/An/R/I, production not required.	14,091	61,418	58,169	60,038	66,048
With variable payment rates	4,318	3,495	3,640	3,021	3,826
With commodity exceptions	4,079	3,346	3,486	2,864	3,689
With fixed payment rates	9,773	57,923	54,529	57,017	62,223

Note: p: provisional. NPC: nominal protection coefficient. NAC: nominal assistance coefficient A/An/R/I: Area planted/animal numbers/receipts/income.

* The All countries total includes all OECD countries, non-OECD EU member states, and the emerging economies: Argentina, Brazil, China, Colombia, Costa Rica, India, Indonesia, Kazakhstan, the Philippines, Russian Federation, South Africa, Ukraine and Vietnam. The All countries total for 2000-02 includes data for all countries except Latvia and Lithuania, for which data are not available.

** Market price support (MPS) is net of producer levies and excess feed cost.

Source: OECD (2020b).

TABLE

All countries*: Latest estimates of support to agriculture (million USD) (continued)

	2017/19	2017/19	2017	2018	2019 ^p
With commodity exceptions	6,081	2,539	2,574	2,510	2,532
Payments based on non-commodity criteria	3,664	5,333	5,826	5,466	4,707
Based on long-term resource retirement	3,358	3,876	4,530	3,940	3,157
Based on a specific non-commodity output	237	1,389	1,225	1,451	1,491
Based on other non-commodity criteria	69	69	71	75	60
Miscellaneous payments	136	1,426	1,019	1,934	1,324
Percentage PSE (%)	18.40	11.70	12.50	11.40	11.10
Producer NPC (coefficient)	1.14	1.06	1.07	1.06	1.06
Producer NAC (coefficient)	1.23	1.13	1.14	1.13	1.13
General services support estimate (GSSE)	55,290	1,064,160	108,179	107,205	103,865
Agricultural knowledge and innovation system	10,996	26,219	26,347	26,428	25,790
Inspection and control	2,719	7,550	7,055	7,822	7,375
Development and maintenance of infrastructure	23,354	44,681	44,734	45,945	43,364
Marketing and promotion	5,602	5,319	5,285	5,209	5,463
Cost of public stockholding	10,144	20,544	22,326	19,503	19,802
Miscellaneous	2,475	2,104	1,941	2,298	2,073
Percentage GSSE (% of TSE)	17.00	17.20	16.80	17.60	17.30
Consumer support estimate (CSE)	-120,358	-173,358	-191,073	-159,485	-169,515
Transfers to producers from consumers	-128,519	-201,147	226,362	-191,993	-185,084
Other transfers from consumers	-21,823	-47,749	-43,708	-44,413	-55,126
Transfers to consumers from taxpayers	28,315	65,974	69,762	66,532	61,628
Excess feed cost	1,669	9,663	9,234	1,058	9,067
Percentage CSE (%)	-10.40	-5.30	-6.00	-4.90	-5.00
Consumer NPC (coeff.)	1.15	1.08	1.09	1.08	1.08
Consumer NAC (coeff.)	1.12	1.06	1.06	1.05	1.05
Total support estimate (TSE)	324,737	618,814	644,237	610,787	601,419

Note: p: provisional. NPC: nominal protection coefficient. NAC: nominal assistance coefficient A/An/R/I: Area planted/animal numbers/receipts/income.

* The All countries total includes all OECD countries, non-OECD EU member states, and the emerging economies: Argentina, Brazil, China, Colombia, Costa Rica, India, Indonesia, Kazakhstan, the Philippines, Russian Federation, South Africa, Ukraine and Vietnam. The All countries total for 2000-02 includes data for all countries except Latvia and Lithuania, for which data are not available.

** Market price support (MPS) is net of producer levies and excess feed cost.

Source: OECD (2020b).

TABLE

All countries*: Latest estimates of support to agriculture (million USD) (continued)

	2017/19	2017/19	2017	2018	2019 ^p
Transfers from consumers	150,342	248,895	270,070	236,406	240,211
Transfers from taxpayers	196,218	417,668	417,876	418,794	416,334
Budget revenues	-21,823	-47,749	-43,708	-44,413	-55,126
Percentage TSE (% GDP)	1.00	0.80	0.90	0.80	0.80
Total budgetary support estimate (TBSE)	197,108	425,442	419,250	430,139	426,938
Percentage TBSE (% GDP)	0.60	0.60	0.60	0.60	0.60

Note: p: provisional. NPC: nominal protection coefficient. NAC: nominal assistance coefficient A/An/R/I: Area planted/animal numbers/receipts/income.

* The All countries total includes all OECD countries, non-OECD EU member states, and the emerging economies: Argentina, Brazil, China, Colombia, Costa Rica, India, Indonesia, Kazakhstan, the Philippines, Russian Federation, South Africa, Ukraine and Vietnam. The All countries total for 2000-02 includes data for all countries except Latvia and Lithuania, for which data are not available.

** Market price support (MPS) is net of producer levies and excess feed cost.

Source: OECD (2020b).

agricultural products. When negative it signifies a tax on consumers, which mostly reflects price supports to farmers.

As can be seen in Table 1, the total support estimate (TSE) of subsidies to agriculture in the 54 monitored countries (see notes to the table) amounted to around USD 601 billion in 2019, of which USD 436 billion (73 percent) was provided by way of estimated direct producer support (PSE). Over the past two decades or so, the share of the potentially most distorting forms of payments, especially market price support (MPS) and payments based solely on the quantity of output have fallen somewhat, but these transfers continue to account for approximately 69 percent of gross producer transfers (namely, the monetary value of total transfers from consumers and taxpayers to support agricultural producers) across all of monitored countries. Offsetting the decline in MPS are subsidies for unconditional or unconstrained input use (e.g., a general fertilizer subsidy) that are particularly harmful, and steadily rising, which constituted 12 percent of total PSE. Analysis by several authors have attempted to link changes in PSE with changes in input use. An example is from Wu *et al.* (2019)⁶⁵ who cited previous research that in a sample of 40 countries, when PSE increased by one-unit, synthetic fertilizer use would increase by 15.4 kg per hectare per year.

Concerning the remaining forms of support to producers, the most prominent are those based on area planted, animal inventories (18 percent of all producer support), and payments based on historical parameters not requiring production. The importance of these latter payments, which are decoupled (not linked with market prices) from

current production are considered less distortive, but have increased significantly and currently represent 14 percent of all producer support.

Figure 1 provides a synthesis of the estimated share of environmentally harmful subsidies in PSE for OECD countries.⁶⁶ The potentially most harmful forms of subsidies are in long-term decline, falling from 88 percent in 1990 to under 50 percent in 2015. The authors add an important caveat to their estimates:

While it is true that market price support mechanisms and payments based on output are potentially the most harmful for the environment, whether they actually are harmful depends on a host of other factors, including whether production quotas are attached to them and whether they incorporate strong cross-compliance requirements, or are constrained by agri-environmental regulations independent of the support payments.

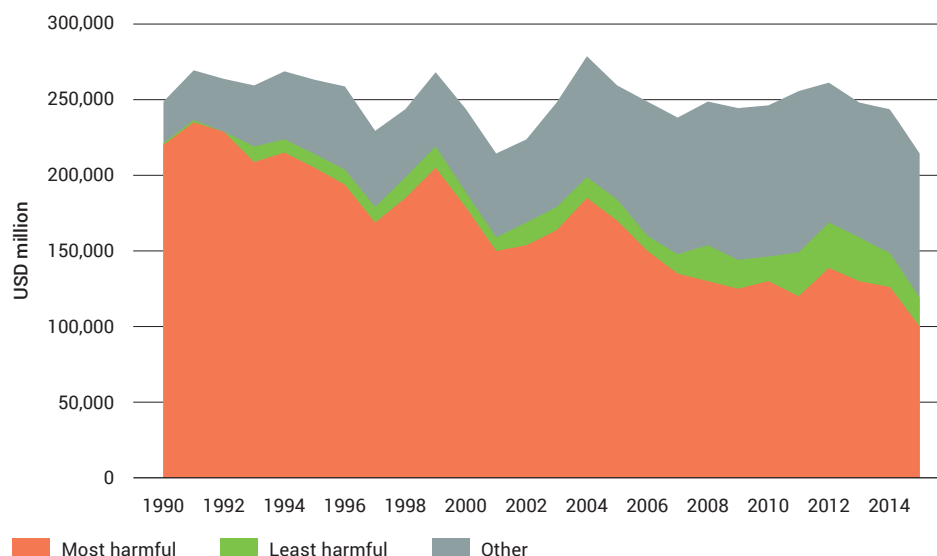
Indeed, there can be little doubt about the direction of the effects of subsidies, but the precise quantification of the environmental impacts is much more difficult, given that there are many other variables that shape environmental change.

Monitoring and Analyzing Food and Agricultural Policies, MAFAP

Initiated in 2009, the Monitoring and Analyzing Food and Agricultural Policies (MAFAP) program of FAO seeks to establish country-owned, sustainable systems to monitor, analyze, and reform food and agricultural policies to enable more effective, efficient and inclusive policy frameworks in a number of countries in sub-Saharan Africa.⁶⁸

FIGURE 1

Evolution of producer support in OECD countries by potential environmental impact



Source: OECD (2017)⁶⁷

The initiative has an explicit component to measure different types of producer subsidies, but as in the case of the OECD- producer support approach, no effort is made to explicitly link how such subsidies instigate harmful environmental impacts. But the impacts may be inferred from the type of subsidy such as payments on inputs and minimum support prices (Box 15).

The conception of MAFAP is premised on the fact that in sub-Saharan Africa, agricultural subsidies were removed in the 1980s and 1990s as part of a conditionality for debt relief and loan assistance under structural adjustment programs⁶⁹ that were administered by the International Monetary Fund and the World Bank. But, in the past decade or so, subsidies, especially for agricultural inputs have been re-instituted, given the renewed importance of food security and the concomitant need to bridge significant yield gaps, notwithstanding the importance of the contribution of agriculture to GDP. The re-introduction of input subsidy programs, however, was generally not accompanied by environmental regulation or enforcement. It is therefore conceivable that where subsidies matter the most, in alleviating food insecurity and lifting the rural populous out of poverty, these subsidies, especially on inputs (such as fertilizers), are often likely to have perverse consequences on the environment.

3.2 Measuring other perverse incentives

Perhaps the largest gap in the measurement of anthropogenic environmental degradation is for those driven by the market or price-based incentives. One example of negative externalities arising from the marketplace was given in the previous chapter: palm-oil expansion at the

expense of forests to participate in the lucrative export market for the commodity. Another is the discharge of agricultural waste or chemical fertilizers in waterways. In such cases, subsidies may play no role in the decisions of producers to intensify resource use, and producers may disregard harmful impacts on the environment and the longer-term consequences on productivity, in their sole pursuit to maximize profits. Typically, negative externalities are common where there are no property rights over environmental assets and resources. This means that producers can abuse them without worrying about litigation since there is nobody to file a lawsuit against them. Possibly, among all categories of perverse incentives, negative externalities are currently the costliest to the environment in their sheer terms of pervasiveness, but measurement of their impacts remains elusive.

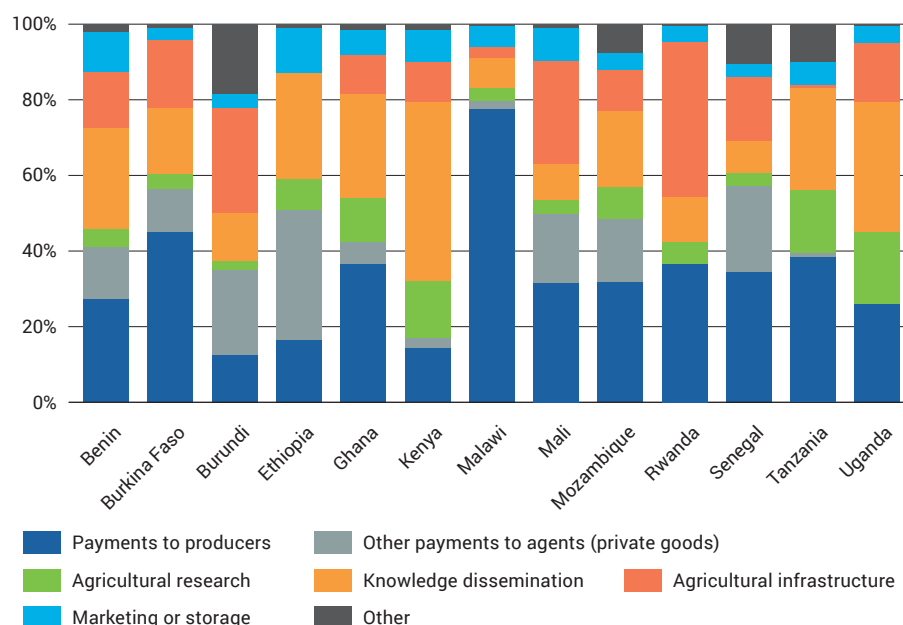
Similarly, environmental laws and regulations that perversely incentivize habitat destruction and environmental degradation also fall into the realm of measurement problems. The cost of their enactment bears no resemblance on the actual expense to the environment, and are feasibly several orders of magnitude greater in terms of cost. The cost of environmental accidents such as crude oil spills are typically measured in terms of the monetary cost of the clean-up, and seldom account for the wider and long-lasting damage to the environment. This discussion emphasizes the need for a more holistic framework to measure the health of land and the environment.

BOX 15

Measuring agricultural subsidies in sub-Saharan Africa: The MAFAP initiative

As shown in Figure 2, the composition of agriculture-specific expenditures in the MAFAP countries is varied, but with a significant producer bias in general (payments to producers – dark blue bars). Agricultural infrastructure (red bars) and activities dedicated to knowledge dissemination (orange bars) also received a large proportion of the spending in several countries. Research expenditures (green bars) are frequently neglected, with the exception of Kenya, Uganda and Tanzania, while very few public investments are targeted towards marketing or storage (light blue bars).

FIGURE 2
Composition of agriculture-specific expenditures in 13 African countries, average 2006-15, actual spending, national and external resources



Note: The "knowledge dissemination" category is the sum of technical assistance, training, extension/technology transfer and inspection

Source: Authors' calculations based on MAFAP public expenditure database, as of February 2018.

Figure 3 reveals the importance of input subsidies (e.g., on fertilizers, pesticides) in producer payments. These are measured as percentage of total public expenditure specifically on agriculture (the blue bars), as a share of agriculture's contribution to GDP (the green bars) and as a share of the country's GDP (the orange bars).

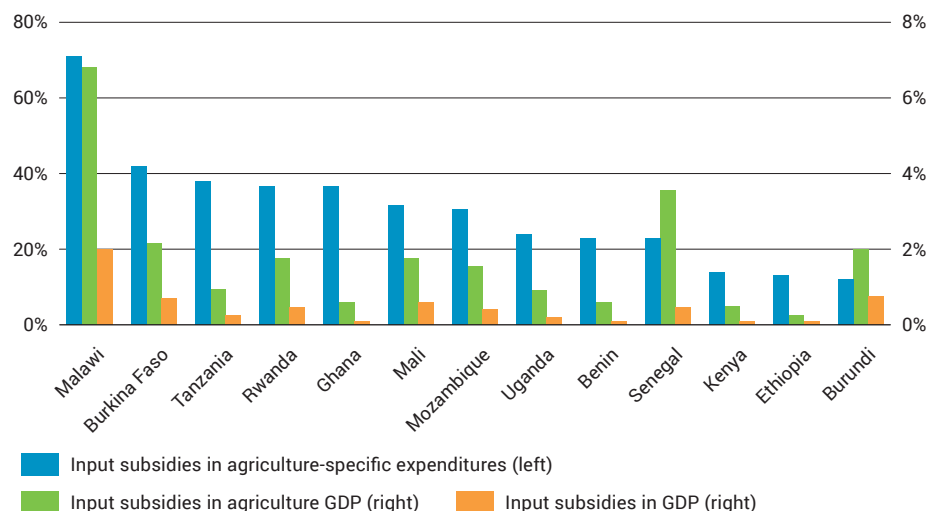
Computing the share of input subsidies within agriculture-specific expenditures leads to a characterization of four groups of countries. Low spenders are Burundi, Ethiopia and Kenya, with respective shares of 12, 13 and 14 percent on average for the period. Average spenders are Senegal, Benin, Uganda, Mozambique and Mali, with shares oscillating between 23 and 32 percent. Higher spenders are Burundi, Ghana, Rwanda, Tanzania and Burkina Faso, with shares ranging between 35 and 42 percent. Malawi forms its own high-spending group, with a very large average share of 70 percent. A similar pattern can be observed when considering average shares of input subsidies in gross domestic product (GDP) and agricultural GDP. Ghana and Senegal are somehow outliers in this regard. In Ghana, input subsidies represent a large proportion of agricultural expenditures, but only account for 0.2 percent of GDP and 0.6 percent of agricultural GDP. In this case, there is a substantial imbalance between public spending in agriculture and the value added it produces. By contrast, input subsidies in Senegal are about a fifth of agriculture-specific expenditures but represent more than 3 percent of agricultural GDP.

BOX 15

Measuring agricultural subsidies in sub-Saharan Africa: The MAFAP initiative (continued)

FIGURE 3

Share of input subsidies in agriculture-specific expenditures, agricultural GDP and overall GDP in 13 African countries, actual spending, nation and external resources, average 2006-2015



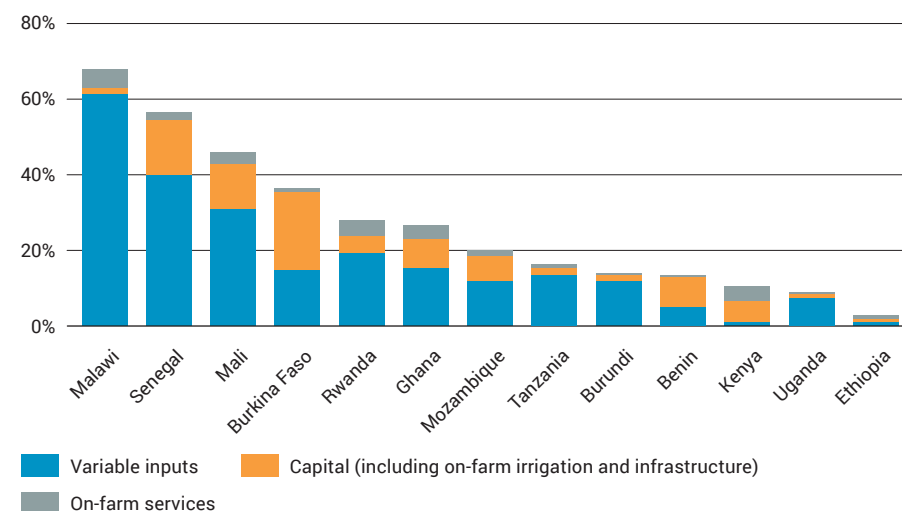
Note: Expenditure and GDP expressed in current local currency units were used to compute the ratios. Countries were ranked according to the share of input subsidies into agriculture-specific expenditures

Source: Authors' calculations based on MAFAP public expenditure database, as of February 2018.

Examining the composition of subsidies (Figure 4), 61 percent of input subsidies earmarked variable inputs – the blue bars, which are applied in proportionate to the level of the production such as seeds, while significant shares went to capital subsidies – the orange bars (29 percent) for machinery and equipment or on-farm irrigation, and for on-farm services – the grey bars (10 percent) such as technical assistance, veterinary services and inspection. West African countries such as Senegal, Mali and Burkina Faso have been particularly keen to subsidize on-farm capital, which is mainly attributable to spending on on-farm irrigation, and of crucial importance to the often drought-stricken Sahel region.

FIGURE 4

Composition of input subsidies in 13 African countries (actual spending), average 2006-2015

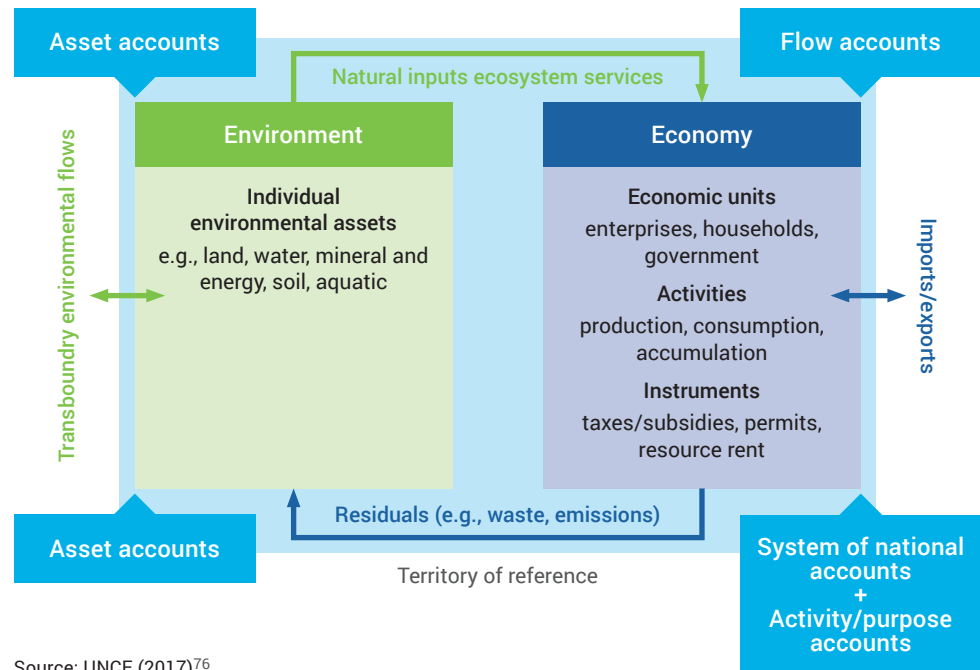


Note: Expenditure and GDP expressed in current local currency units were used to compute the ratios. Countries were ranked according to the share of input subsidies into agriculture-specific expenditures

Source: Authors' calculations based on MAFAP public expenditure database, as of February 2018.

Source: Adapted from Pernechele *et al.* (2018)⁷⁰

FIGURE 5
Structure of
SEEA-Central
Framework



Source: UNCE (2017)⁷⁶

3.3 Measuring environmental degradation

Natural capital accounting, NCA

The fiscal value of a perverse subsidy does not directly translate to the cost of environmental degradation. The true cost of the subsidy or other perverse incentive needs to account for the long-term impact on the environment. This section presents international efforts to harmonize the measurement of the observed effects of perverse incentives on environmental assets, both in physical and monetary terms.

A solution is provided by natural capital accounting: the use of an accounting framework to provide an organized way to measure and report on stocks and flows of renewable and non-renewable resources (e.g., plants, animals, air, water, soils, minerals) that combine to yield a flow of benefits to society.⁷¹ The rationale for natural capital accounting is premised on the cognizance of the environment as an important contributor to society and the economy, and hence as an asset. There is thus a need to account for and monitor it through a relevant framework.

System of environmental-economic accounting, SEEA

Conceived in 1993 and formally adopted by the United Nations Statistical Commission (UNSC) in 2012, the System of Environmental-Economic Accounting (SEEA) has emerged as the international standard⁷² for natural capital accounting. The SEEA is an “environmental extension” of the UN’s System of National Accounts, employing the same accounting approach, concepts and classifications.

The System of National Accounts is also an international standard for the compilation of national accounts, and by 2017 it had conceptual compliance with 180 countries.⁷³

In supporting policy and analysis of the environment in relation to economic and human activity, the main strength of SEEA is in its capacity to integrate environmental information into standard measures of economic activity. It can facilitate the mainstreaming of environmental information in economic development and planning discussions and serve to recognize the connections between environmental policy objectives and broader societal outcomes.⁷⁴ There are two components of SEEA: the Central Framework and Experimental Environmental Accounting.

Central Framework. This covers measurement in three main areas:

- **Environmental flows.** These are the flows of natural inputs, products and residuals between the environment and the economy, and within the economy, measured in both physical and monetary terms.
- **Stocks of environmental assets.** This concerns the stocks of individual assets, such as water or energy assets, and how they change over an accounting period due to economic activity and natural processes, again measured in both physical and monetary terms.
- **Economic activity related to the environment.** These are the monetary flows associated with economic activities related to the environment, including spending on environmental protection and resource management, and the production of environmental goods and services.

FIGURE 6

Countries that have compiled SEEA-Experimental Environmental Accounts



Source: Hein *et al.* (2020)⁷⁸

The Central Framework employs supply-use accounts for the above that draw information together into one coherent system. This is done by applying the same accounting concepts, structures, rules and principles to different sets of environmental information. Figure 5 provides an overview of the structure of the Central Framework. A 2017 survey⁷⁵ on the uptake of the Central Framework revealed that a total of 69 countries (37 developed and 32 developing) had implemented it, mostly focusing on a limited set of accounts.

SEEA-Experimental Environmental Accounting.

Drafted in 2014,⁷⁷ this is still in a nascent stage. Whereas the Central Framework focuses on individual environmental assets, such as water and energy resources, and how those assets move between the environment and the economy, Experimental Environmental Accounting takes the perspective of ecosystems and considers how individual environmental assets interact as part of natural processes within a given spatial area. It takes the view that ecosystem assets provide ecosystem services, which are the contributions and benefits of ecosystems to economic and other human activity. It also has a system of accounts that present a coherent and comprehensive view of ecosystems:

- **Ecosystem extent account.** This account serves as a common starting point for ecosystem accounting. It organizes information on the extent of different ecosystem types within a country in terms of area.
- **Ecosystem condition account.** This account measures the overall quality of an ecosystem asset (e.g., the health of vegetation, biodiversity, soil, and reserves of water and carbon) and captures, in a set of key indicators, the state or functioning of the ecosystem in

relation to both its naturalness and its potential to supply ecosystem services.

- **Ecosystem services accounts.** This set of ecosystem accounts measures the supply of ecosystem services as well as their corresponding beneficiaries, classified by broad national accounting categories or other groupings of economic units.
- **Monetary asset account.** This account records the monetary value of opening and closing stocks of all ecosystem assets, including land, within an ecosystem accounting area and additions and reduction to those stock.
- **Thematic accounts.** This set of accounts, which cover land, water, carbon and biodiversity, are standalone accounts on topics of their own right and are also of direct relevance in the measurement of ecosystems and in assessing policy response.

Of direct relevance to this paper is the ecosystem condition account. This account can place a monetary value on the degradation of an ecosystem asset, e.g., land and soil condition, and to contrast it with the value of a perverse incentive, such as an input subsidy.

Being relatively new, experimental and yet to be adopted as an international standard, only 27 countries have so far published SEEA-Experimental Environmental Accounts (Figure 6), at varying spatial scales. The UNSC is currently working with the scientific community towards addressing gaps, such as standardized metrics to assess ecosystem condition, biodiversity, and the capacity of ecosystems to supply services. It is anticipated that SEEA- Experimental Environmental Accounts will be adopted as an international statistical standard by 2021.

BOX 16

Piloting earth observations for ecosystem extent mapping in Liberia

This case study shows how remote sensing is being in Liberia used to build, as a starting point, various SEEA-Experimental Environmental Accounts for environmental targeting.

As part of Liberia's GEF-funded project, the government of Liberia, Conservation International and NASA are developing an ecosystem extent map based on SEEA guidelines. The ecosystem extent map is viewed as a starting point to establish the other ecosystem accounts. The initiative combines a SEEA compliant landcover map which generates a SEEA land account; with mapping of ecosystem types using generalized dissimilarity modeling to ascertain biological uniqueness based on paired site comparisons, then modeled using environmental attributes. Once the extent account has been established, it will be employed to derive ecosystem services assessments and accounts, and to formulate a program of ecosystem accounting and national statistics, including Sustainable Development Goals indicators.

The pilot initiative also constitutes a government-endorsed program for the spatial planning of biodiversity, ecosystem services, and sustainable production options at the landscape level. The results will then be compared across scales using the GEO-ECO framework and integrated with the IUCN Red List of Ecosystems (a global standard to assess the conservation status of ecosystems) an initiative sanctioned by UN-SEEA to provide global ecosystem maps. It is hoped that this comparative study will provide guidance to countries how to best utilize the global product as a starting point to develop their own national level maps.

Source: EO4EA (2019)⁹⁰

Already, countries have used the Experimental Environmental Accounts to provide a cost-benefit analysis of environmental pressure, leading to changes in policy. In the Netherlands, for example, Experimental Environmental Accounting shows that in peat areas used for dairy farming, the combined costs of maintaining infrastructure and controlling water levels and carbon dioxide emissions considerably exceed farmers' profits. This has led to new policies aimed at reducing drainage in peatlands and converting farmland back to natural ecosystems.⁷⁹

Data collection. The most pressing challenge in the country implementation of both the Central Framework and Experimental Environmental Accounts concerns data collection and statistical capacity. Data availability, data quality and lack of human resources are the top three major constraints in compiling (current) environmental-economic accounts.⁸⁰

Data collection through ground surveys is highly costly, while the capacity to process raw data requires a high degree of statistical proficiency. It is likely that in many countries, especially developing nations, these activities are beyond the fiscal means and technical knowhow of governments.

To assess land degradation, expert opinion-based frameworks are prone to both subjectivity and error. Unstructured ground-truthing is costly and logistically infeasible. Predictive biophysical models are subject to parameter constraints and

are prone to error. So, is there any way to obtain an accurate estimate of the extent and depth of land degradation and its evolution over time? Remote sensing or earth observation⁸¹ is promising, being both cost-effective and timely. This approach has already been applied to estimate soil erosion and land degradation, albeit at a sub-national level.^{82, 83, 84, 85} The approach can be potentially scaled up to the country level and through aggregation, to the regional and global levels.

Ground-truthing could be carried out on remotely-sensed data that pre-identify environmental hotspots to ascertain whether land users are recipients of subsidies and to verify their excessive or inappropriate use of fertilizers, irrigation or other inputs. This would be the lowest-cost way to link perverse incentives with land degradation.

Earth Observation for Ecosystem Accounting, EO4EA

To begin the facilitation and eventual implementation of the proposal, the institutional set-up of the G20's Global Agricultural Monitoring (GEOGLAM) consortium-based initiative⁸⁶ could be replicated. GEOGLAM involves 138 contributing institutions, including governments, international organizations, intergovernmental organizations and academia for remote sensing and earth observations. At the minimum, earth observations are the way forward for countries to implement and publish SEEA-Central Framework and Experimental Environmental Accounts.

BOX 17

The Paris Collaborative on Green Budgeting

This case study introduces another approach to natural capital accounting, through green budgeting, which integrates fiscal components such as environmental taxes, subsidies and other expenditures to inform decision-making and progress towards environmental targets.

The OECD's Paris Collaborative on Green Budgeting was conceived in 2017. It recognizes the important role of domestic budgetary and fiscal policy in resourcing and implementing environmental goals. The Paris Collaborative helps (OECD) countries by integrating an environmental perspective into existing budget processes, including evidence-generation, feedback, reporting and decision-making processes, and supports environmental mainstreaming across policy areas along the budget cycle. An integrated approach comprises fiscal measures, including environmental taxes, subsidies, expenditures and regulation and increases the transparency of the progress made towards the government's commitment to climate and other environmental goals, and supports communication on environmental policies and actions implemented via the budget.⁹⁴ The Collaborative is still at a development stage and foresees the processes and outputs depicted Figure 7.

FIGURE 7

Processes and outputs of the Paris Collaborative on Green Budgeting

Progressively integrating environmental costs and benefits into medium and longer-term fiscal planning and financial reporting	Mainstreaming sustainability perspectives within budgetary and broader policy-making, including alignment of incentives	Developing methodologies and guidelines towards internationally recognised standards
• A green Budget Baseline Analysis providing a "heat-map" of the environmental impact of various areas of the expenditure and tax policy baseline. • Cost-Benefit Analysis and the Environment, a major update of this OECD reference publication. • A Green Balance Sheet valuing environmental assets and liabilities.	• A Tax Decarbonization Country Scan gauging the impact of carbon pricing and decarbonization on fossil fuel use and tax revenues. • A Green Fiscal Sustainability Report highlighting long-term budgetary implications of environmental transitions and pathways.	• Green Budget Benchmarks to provide cross-national indicators of progress against various international environmental goals. • A Green Budgeting Toolkit providing core reference and guidance on applying analytical tools and techniques.

Source: OECD (2018)⁹⁵

The Collaborative does not endorse an explicit framework for environmental accounting, such as the SEEA- Experimental Environmental Accounting, but targets the alignment of green budgeting with domestic accounting frameworks.

Through various scientific efforts connected to the EEA, such as the Earth Observation for Ecosystem Accounting (EO4EA) initiative of the Group on Earth Observations, tests are being done to examine how ecosystem extent, condition, and regulating services can be modeled across large countries or even continents at high resolution using data from remote-sensing and global datasets.⁸⁷

What remains is to intersect anthropogenic activities to ecosystem condition, and then to identify the impact of subsidies or other perverse incentives on the latter.

EO4EA⁹¹ provides a synopsis of its objectives and workstreams. The objective is to utilize Earth observations for natural capital accounting consistent with SEEA-Experimental Environmental Accounts. EO4EA represents a diverse consortium including participants from both the public and private sector, academia, the ecosystem accounting community, international agencies and non-government organizations. Using a systematic and repeatable accounts-based approach allows the state and trends of resource stocks and conditions to be tracked over time, which enable post account assessments such as the efficacy of programs, projects and policies. There are four workstreams in the pipeline:

BOX 17

The Paris Collaborative on Green Budgeting (*continued*)

Implementation has mainly been confined to the developed members of the OECD. Some examples, which account for the impact of perverse include:⁹⁶

- Systematic assessment of tax measures and use of evaluation results in the decision-making process (e.g., Netherlands); involvement of parliament to monitor the budget's alignment with the country's climate commitments (e.g., Scotland).
- Ex-post cost-benefit analysis for environmental policies (e.g., France).
- Stocktaking of public expenditure in support of environmental objectives (e.g., Ireland and EU).
- Categorization of potentially harmful budget support, in particular fossil fuel subsidies (e.g., G20 peer review process).
- Qualitative presentation of budgetary impacts of climate change in long-term fiscal sustainability analysis (e.g., Switzerland).
- Development of a *jaune budgétaire* (yellow budget) to provide an overview of climate related budget measures (e.g., France).
- Cataloguing tax expenditures with respect to their environmental impact, classifying them into environmentally harmful, friendly, uncertain or neutral subsidies (e.g., Italy).
- Multi-stakeholder approach to the development of a climate strategy (e.g., Netherlands).
- Experiences with green budgeting at the urban level, that can provide a valuable input when developing green budgeting strategies at national level.

- **Case studies and synthesis.** EO4EA aims to shed light on successful country experiences to inform other countries in developing their earth observation strategy for natural capital accounting.
- **Ecosystem extent and condition.** This involves the development and testing of methods for delineating the extent of ecosystems and assessing their condition, including vitality and their ability to deliver ecosystem services.
- **Identification, measurement and monitoring of ecosystem services.** This includes advancing ecosystem service identification, measurement and monitoring through the application of Earth observation, and exploring the range of approaches and tools that can be used to measure and model ecosystem services and how Earth observation data can be used to inform such estimates.
- **Implementation and capacity building.** This means providing capacity building, pilot testing and implementation of ecosystem accounting at the sub-national and national scale, with focus on identifying implementation barriers, developing materials for outreach and education, and advancing the application of ecosystem accounting with Earth observations.

Liberia has begun on this path (Box 16). The next step after building ecosystem extent accounts, is for the country to construct the all-important

eco-system condition account, which can be used (independently) to assess how perverse subsidies and incentives have potentially degraded environmental assets of the country.

Green budgeting and other initiatives

Green budgeting adapts conventional budgeting tools to help align national expenditure and revenue processes with climate and other environmental goals, which requires establishing clear connections between public finance and environmental impacts.⁹² In doing so, green budgeting systematically examines existing and potential fiscal measures and policies to mainstream an environmentally-informed approach – contributing to an evidence-based debate on sustainable growth or the lack of it, owing to the existence of environmentally perverse incentives.

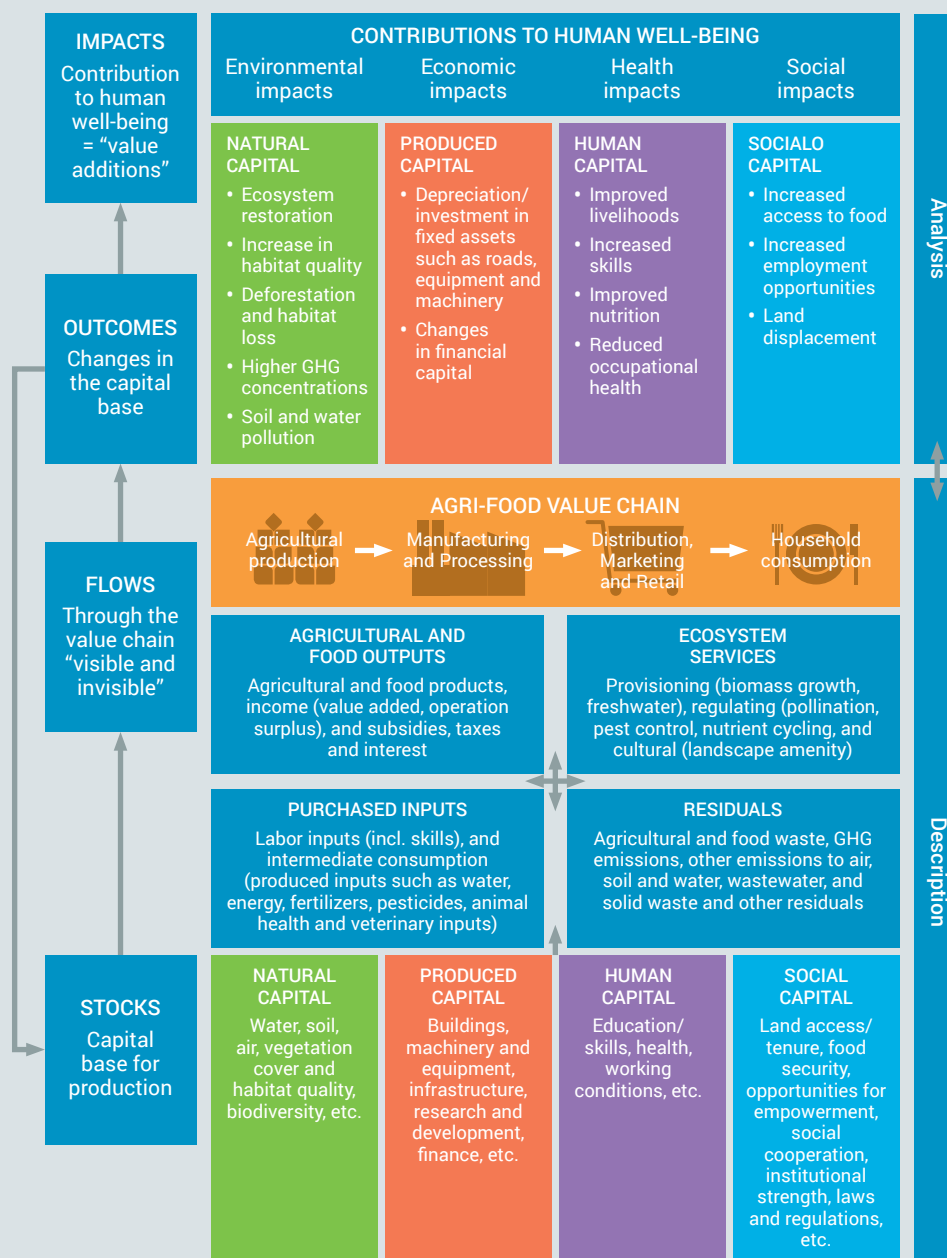
At the heart of green budgeting are the following components:

- Anticipated environmental impacts of existing or new policies (e.g., subsidy withdrawal, reform or introduction).
- An assessment of the use of the tax system to price environmental externalities.
- A cross-country comparison of selected environmental benchmarks (e.g., progress toward achieving biodiversity targets), and the volume of spending on environmental protection and resource management.

BOX 18
TEEBAgriFood evaluation framework

The TEEBAgriFood evaluation framework sets forth the relevant components of eco-agri-food systems that may be assessed within a holistic evaluation. The framework does not focus on how assessments should be undertaken, nor does it prescribe methods for assessments. The choice of methods will depend on the focus and purpose of any given assessment, the availability of data, and the scope of analysis.

FIGURE 8
TEEBAgriFood evaluation framework



At each boundary, the flows depicted in Figure 8 can help in the identification of the pathways through which the four types of capital stock can contribute to agri-food value chains, and how in turn feedback may materialize. The next step is then to select the evaluation techniques that would help the policymakers assess and measure the interactions within a given system. Here, the primary focus is on assessing impacts as contributions to human well-being. Other evaluation methodologies may include life cycle assessment, value chain analysis, and various modelling tools and techniques including partial and general equilibrium models and system dynamics.

Source: <http://teebweb.org/our-work/agrifood/understanding-teebagrifood/evaluation-framework/>

BOX 19

Piloting earth observations for ecosystem extent mapping in Liberia

The Economics of Land Degradation Initiative was established in 2011 by the United Nations Convention to Combat Desertification. It uses a “6+1” approach to establish a scientifically based cost-benefit analyses of six possible steps, plus one additional step. The six steps are:

1. **Inception:** scope, location, spatial scale, and strategic focus guided by stakeholder consultation.
2. **Geographical characteristics:** an assessment of quantity, spatial distribution, and ecological characteristics of land cover types that are categorized into agro-ecological zones and analyzed through a geographical information system.
3. **Types of ecosystem services:** for each land cover category identified in step 2, identification and analysis of stocks and flows of ecosystem services for classification along the pre-identified categories of the ecosystem service framework: provisioning services, regulating services, cultural services and supporting services.
4. **Roles of ecosystem services and economic valuation.**
5. **Patterns and pressures of land degradation patterns and drivers,** including the determination of the role of property rights and legal systems.
6. **Cost-benefit analysis and decision-making** to assess whether land management changes that can reduce or remove degradation pressures and the identification of “on-the-ground” actions that are economically desirable.

The “+1 step” is Take action by land users, the private sector, policy/decision-makers.

Source: www.eld-initiative.org/en/knowledge-hub/6-1-step-approach/

While the OECD is at the forefront in advancing green budgeting in member nations (Box 17), other countries are beginning to embrace green budgeting, albeit at a rudimentary level. For instance, Indonesia requires that all budgeted policy proposals include an assessment of green impacts and calculates the “green economy weight” (green economy expenditures as a proportion of total budget expenditures).⁹³

Other frameworks in the realm of natural capital accounting include the TEEBAgriFood Evaluation Framework (Box 18) and the framework of the Economics of Land Degradation Initiative (Box 19).

Box 21 gives an example of how green budgeting can guide mineral-dependent developing countries towards balancing investment returns with environmental prerogatives. Mining sectors in many developing countries provide tax incentives to attract foreign investment for the extraction of minerals, in which concessions can be perverse.

This section has presented natural capital accounting as a basis with which to measure the health of a country’s environmental assets. The fiscal value of an environmentally harmful subsidy, or other perverse incentive, bears little or no reflection of the true cost of the damage to

the environment, and more importantly the costs of land restoration. While they are at a nascent stage, natural capital accounting frameworks form a harmonized basis to begin to address the problem. A structured measurement of the health of natural capital at a chosen spatial scale along with the identification of anthropogenic activity as a cause of any degradation, would then lead to an investigation whether a perverse incentive (such as an environmentally harmful subsidy) is at play. The challenge is not to be underestimated. However, technology can greatly assist. Earth observations in the form of remote sensing would significantly narrow the time and cost of identifying “environmental hotspots,” which would then allow ground teams to assess the underlying cause of degradation and also the required remedial action. Recent measurement initiatives such as the EO4EA are a promising way forward. Model-based evidence already points out that the cost of no action exceeds the cost of action.

The next section outlines a theoretical basis for the identification and subsequent removal of environmentally perverse incentives. It also presents case studies that reflect a broad array of transformative pathways by which perverse incentives can be repurposed to restore land.

BOX 20

The extractive sector: How green budgeting can balance the need for investment returns against environmental restoration in developing countries

This case study showcases how green budgeting, as complementary to regulation, can be used to fully cost landscape destruction and the impacts of environmentally damaging inputs in the extractive sector. The case study has particular relevance for mineral-rich developing countries.

Placing environmental protection alongside revenue generation and investor returns as an objective in the design of fiscal regimes in the mining sector marks a major change to current practices. Mineral-dependent economies currently design fiscal regimes based on maximizing revenue generation subject to the need to attract and maintain investment, while environmental concerns are considered separately as a regulatory issue.

A green fiscal regime would incentivize mining companies to set aside funds for post-project decommissioning and rehabilitation, costs which can run into the hundreds of millions of dollars. Designing the tax treatment of such provisions effectively can avoid situations where mining sites are abandoned without mitigation of potentially substantial environmental damage. At the operational stage, the implementation of “green taxes” on environmentally damaging inputs such as chemical pollutants, fossil fuels and excessive water usage would discipline companies to minimize the use of such inputs and to invest in pro-environmental alternatives. Ensuring that such fiscal measures do not reduce mine profitability and cause investors to delay or cancel planned investments could be avoided if the green taxes were balanced with reduced taxes on other inputs, such as payroll taxes. Alternatively, royalties could be reduced as part of broader fiscal reform, which considers environmental impacts alongside revenue generation and investor returns. Such an approach can be viewed as an alternative or a complement to traditional regulatory approaches to protecting the environment.

In Colombia, 80 percent of registered mining companies integrate green accounting in their management system.⁹⁷

Source: UNEP (2019)⁹⁸



4. REPURPOSING PERVERSE INCENTIVES

The reform of perverse incentives, including their outright removal, is a powerful instrument that can yield a transformative pathway to land restoration. However, removing farming subsidies would seemingly run counter to policies to improve food security. But the apparent “trade-off” between food security and subsidy removal is misleading. The fiscal savings from repurposing subsidies, if redirected towards restoring land health, would provide crop productivity gains to farmers.⁹⁹ Also, food-insecure or vulnerable rural communities could be provided with social safety nets, while land-restoration projects would lead to significant job creation, providing a much-needed boost to rural incomes.

This chapter begins with a schema that guides policymakers in justifying the removal of perverse subsidies and what the consequences might be. The political economy of subsidies is a powerful force against their reform and removal. But an evidence-based approach to the benefits of subsidy reform can provide an overarching mechanism in circumventing land degradation and setting economies on course to long-term environmental sustainability. The evidence base can be formed by natural capital accounting green budgeting (Chapter 3), and supported by case studies that demonstrate successful pathways to land restoration. In any event, removing an environmentally harmful subsidy requires transition, which may be in the form of short-term compensation programs, investment in alternative (sustainable) land-use technologies, and accompanying capacity-building.

Even if subsidies are not removed, the effective implementation and enforcement of environmental laws and regulations could constitute another mechanism to counter land degradation, removing the “harmful” from the subsidies. This chapter proceeds with a discussion on environmental taxes that seek to internalize externalities that arise from perverse market incentives. The following section shows that setting appropriate taxes is complex, and explains the lack of implementation to date. However, leveraging access to input markets

(for fertilizers, pesticides, capital, etc.) for producers who demonstrate sustainable land management can also act as a transformative pathway towards land restoration.

The chapter concludes on how voluntary action, in the form of community activism and voluntary participation in international certification schemes promoting environmental sustainability, can make perverse subsidies and incentives redundant. This is especially pertinent given the inherent difficulty in doing away with the culture of subsidies.

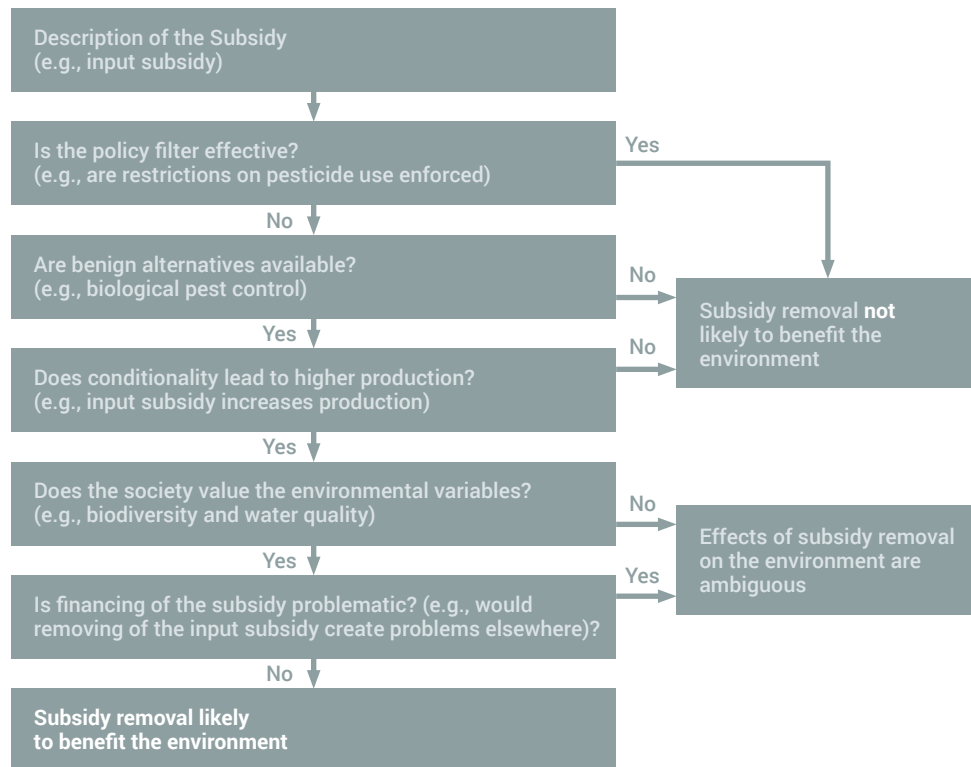
4.1 Removing environmentally harmful subsidies

An important step in reforming environmentally harmful subsidies is to identify them. Figure 9 goes beyond the aggregate measures of producer support (see section 3.1) in scrutinizing individual subsidies that may be potentially harmful, even in non-OECD countries, such as those highlighted in the MAFAP initiative. Figure 9 shows there are two criteria that are fundamentally important in identifying whether a particular subsidy is environmentally harmful:

- **Policy filter.** This refers to legal measures that impose limitations on the application of a subsidized input (e.g., chemical fertilizer) that will effectively limit environmental damage caused by the subsidized activity. If an accompanying environmental policy is effective in mitigating the adverse impacts of the subsidy, then removing the subsidy is not likely to bring environmental benefits. An example is the regulation of runoff from subsidized fertilizer.
- **Conditionality of the subsidy.** This refers to the degree to which a subsidy incentivizes an increase in unsustainable production, leading to further environmental degradation. For example, a subsidized chemical fertilizer may lead to unsustainable increases in productivity and output. Or a crop-specific subsidy, which incentivizes growing more of the subsidized

FIGURE 9

The OECD checklist for identifying environmentally harmful subsidies



Source: Institut for Miljøvurdering (2005)

crop, may result in the encroachment into marginal lands (requiring more harmful inputs).

A further step in moving towards transformative pathways to land restoration concerns what we can expect, a priori, from the removal of environmentally harmful subsidies. Prioritizing subsidy removal for those which have the largest, unambiguous, harmful effect on the environment would make the most sense. Box 20 assesses the relative impacts on the environment on removing the most prominent types of harmful subsidies.

New subsidies are not as problematic as those that are entrenched, because “exit strategies” for novel subsidies can be designed. An allied measure is to introduce “sunset” provisions that require long-term subsidies to be re-justified periodically, thus circumventing their possible environmental harm, dependence and entrenchment (Box 22).

To summarize, subsidy removal is likely to have a larger (positive) impact on land restoration if:

- The subsidies have been implemented for a long time.
- They have been targeted at variable costs, linked to the level production, and which have the potential to cause environmental harm, e.g., fertilizers and pesticides.
- They benefit industries that are relatively polluting or resource-intensive by themselves.
- They have been applied to existing production capacity, not just new additions.

By contrast, subsidy removal is likely to have a lesser impact on land restoration if:

- There are other environmental constraints that are not removed together with the subsidy.
- They have been in place for a short time; and they have not affected polluting or resource-intensive sectors.

4.2 The political economy of environmentally harmful subsidies

There is a strong potential for a win–win outcome for both the environment and the economy in reforming or removing environmentally harmful subsidies, in that subsidies are often fiscally wasteful, environmentally damaging and counterproductive. For instance, fertilizer subsidies can result in their overuse, bringing about further environmental degradation. Yet many governments around the world, e.g., India¹⁰⁴ and China,¹⁰⁵ have been reluctant to dismantle harmful subsidies, despite growing environmental awareness and pressures on government budgets.¹⁰⁶ Hence there are strong political incentives that inhibit change:

- **Growth of a culture of “entitlement” to subsidies and fear of change.** High dependency by farmers on subsidies can result in their entrenchment. Farmers may not have the capacity to shift to alternative modes of cultivation or to attain sufficient productivity for maintaining incomes, when subsidies are removed or reformed.

BOX 21

What can be expected from the removal of environmentally harmful subsidies

Removing a subsidy conditional to quantity of output

Market price support encourages excessive production through ensure a price level above the free market level. Removing such subsidies will reduce output of the previously subsidized product. The removal equates to the decrease in environment harm associated with the previously subsidized economic activity. Removing market price support will lead to shifts in the geographical distribution of production locations with the associated changes in local environmental quality and also which products or crops will replace the previously subsidized ones. In agriculture this is likely to lower the prices of farmland that may in turn stimulate farmers to produce less intensively.

Subsidies (not only market price support) are not applied in a vacuum. In a number of cases, they are accompanied by environmental laws and regulations, such as quotas. Assuming laws and regulations are enforced, and maintained, it may be them that determine the overall effect of subsidy removal. For example, if production limits have been set to circumvent over-production (such as a milk quota), and market price support is subsequently removed, production will fall. In contrast, removing the subsidy together with the production limit will result in an increase in production volumes, if this limit was below the market equilibrium price and output.

Removing a subsidy to input use

The removal of **input subsidies** (including water, fertilizers, pesticides and energy) is likely to have substantial environmental benefits. Their removal increases (variable) costs since these are dependent on the level of production, and will likely lower land use intensification and even prompt a shift to the cultivation of more environmentally sustainable crops.

The removal of **capital equipment** subsidies may slow down new investments that could have a negative impact on the environment if those new investments would have been more environmentally benign. Removing such subsidies may also have environmentally beneficial effects if the previously subsidized capital equipment has become relatively environmentally harmful, such as heavy machinery that disturbs soil structure. Whether the environment will benefit from higher costs of equipment in the long run depends on two other factors as well: its effect on total production levels and substitution of factors of production towards more labor or more inputs, or both.

Access to natural resources below opportunity costs (e.g., exploitation concessions below opportunity costs – forestry, mining, water extraction etc.). Removing such subsidies decreases the rates of exploitation of the natural resources concerned. They may have an immediate effect or a long-term effect (e.g., if governments sell new concessions at higher prices). Eliminating such subsidies will often have a decisive effect, either at the start of the activity or during the life cycle of the economic activity.

Low-interest loans are a subsidy to capital and usually lower the (sunk) cost of fixed assets as well as the internal rate of discount. They also make funds available for other acquisitions. Whether their removal results in an increase of fixed or variable costs is difficult to determine. Since these subsidies (if not conditional on specific types of equipment) leave the rural entity free to choose more environmentally benign modes of production, they may not have been as environmentally damaging as their effects on production volumes might suggest. As a consequence, it is more difficult to assess beforehand whether their removal would benefit the environment. However, preferential access to credit has often financed heavy machinery for land clearing that could degrade land. Hence, the removal of subsidized capital, or putting conditionalities on what is being financed, could have environmental benefits.

- **Policy convergence stifling debate between political parties.** The farming sector often has a powerful political voice, especially in countries where the agrarian society forms a large part of the population. Political parties of any type are generally reluctant to reform subsidies for fear of marginalizing the electorate.¹⁰⁷
- **Lack of transparency, sectoral competitiveness and income distribution concerns.** A lack of transparency on the size of subsidy programs, the beneficiaries of the subsidies, and the economic, environmental and social effects of subsidies on the part of the broader electorate, can lessen pressure for reform. Governments

BOX 21

What can be expected from the removal of environmentally harmful subsidies (*continued*)

Removing a subsidy to profits and income

Historical entitlements are subsidies that are independent of the level of production. However, subsidies for historical entitlements are often capitalized in the prices of factors of production, particularly land in the case of agriculture. In this instance, removing the subsidy may have a downward price effect and might instigate adverse changes in modes of production and production levels to maintain profitability. Assessing the environmental effects of removing these subsidies, however, requires a fairly detailed analysis that takes into account the details of production functions of individual firms.

Preferential low rates of income tax or capital taxation and debt write-offs are subsidies that improve the profitability of the firms concerned (assuming that they are not also conditional on particular technologies and input uses) and will prolong the life-span of firms that would not be economically viable in the absence of these subsidies. Examples are prolific in the extractive sectors. Consequently, removing them will make the least-efficient firms (possibly also the most polluting ones) leave the sector, potentially reducing the total output of the sector with favorable environmental consequences (if the reduction in output is not replaced with supply from other even more polluting or resource inefficient firms). Furthermore, removing subsidies that permit insufficient provision for future liabilities and exemptions from (environmental) standards, is likely to have strong beneficial effects on the environment. They contain examples of measures to shore up the profitability of economic activities that would not otherwise have been economically viable, deliberately at the expense of the environment.

Source: adapted from OECD (2005)¹⁰⁰

BOX 22

Sunset clauses are effective against subsidy entrenchment

The insertion of sunset clauses into regulation can set an explicit expiration date and prevents subsidies from operating indefinitely. It also gives stakeholders a clear expectation about when a subsidy would end, reducing the risk of dependency and lock-in.¹⁰¹ The United Kingdom placed a sunset clause on the reintroduction of coal subsidies in 2000 – intended to bolster the competitiveness of the mining industry – explicitly stating that those subsidies would expire in 2002. Similar sunset clauses and clear expiration dates have existed for production tax credits for both nuclear power and renewable energy in the United States, implemented under the Energy Policy Acts of 1992 and 2005. Sunset provisions could also be an early step towards complete elimination of such support.

Source: Sovacool (2017)¹⁰²

may also be concerned that the removal of subsidies can thwart trade competitiveness, leading to adverse income impacts such as those to food security, rural employment and economic growth.¹⁰⁸ Subsidies that are applied to exporting countries, which boost their trade, can also assist them in improving their balance of trade that can bring about significant (macro)economic benefits, especially in the strength and stability of their currency.

- **Special interest groups and lobbying for retaining subsidies.** A lack of political will to undertake reform of environmentally harmful subsidies is often linked to the strength of

lobbyists in the role of rent-seeking in gaining and retaining subsidies. The benefits of subsidies tend to be highly concentrated in the hands of specific groups, rendering lobbying highly profitable for these groups.¹⁰⁹

Furthermore, subsidies incentivize entities to sustain inefficiency, by under-investing in more environmentally-friendly practices and technologies, resulting in an environmentally damaging culture of subsidy dependence. For land users, notwithstanding dependence and entitlement, the longer the subsidy has been in place, there is a tendency for the subsidy to become capitalized into the prices of factors of

BOX 23

France: The fallacy of subsidized chemical pesticides

This case study shows the misconceived benefit of chemical pesticides to farmers' profitability in French farms. The Common Agricultural Policy of the European Union, of which France is a member, contains provisions for the subsidization of input use, including pesticides (Box 14). Granting such subsidies has the effect of signaling to the farmer the essential importance of the input, leading to its potential excessive use, when in reality the need for the input may tend towards redundancy.

The reduction of chemical pesticide use is one of the critical drivers to preserve the environment and human health. In a sample of 946 non-organic arable commercial farms in France, low pesticide use rarely decreases productivity and profitability in arable farms. An apparent failure emerged to detect any conflict between low pesticide use and both high productivity and high profitability in 77 percent of the farms. It was estimated that total pesticide use could be reduced by 42 percent without any negative effects on productivity or profitability in 59 percent of farms in the sample. This corresponded to an average reduction of 37 percent of herbicide use, 47 percent of fungicides, and 60 percent of insecticides. The potential for reducing pesticide use appears higher in farms currently with high use than in farms with low use. The results demonstrate that pesticide reduction is already accessible to farmers in most production situations.

While profitability is under-maximized in a small percentage of farms, the environmental costs of chemical pesticides would undoubtedly exceed any gap in profitability.

Source: Foley *et al.* (2011)¹⁰³

production (for example, in the value of land). The Common Agricultural Policy of the European Union is a prime example.

The literature tends to focus on highlighting the obstacles to the reform of environmentally harmful subsidies, as opposed to laying out the mechanisms that can be used to deliver reform. The much-needed empirical evidence for demonstrating the economic and environmental benefits of removing environmentally harmful subsidies is scant, especially in developing countries where subsidy dependence and entrenchment is common, and where a lack of public transparency is rife. Such evidence though, could provide a compelling case for policymakers in ensuring subsidy transparency and adhering to the voice of the general public to press for reform (Box 24).

The political economy of subsidies is overarching in many countries, which often overwhelms calls for their reform or removal. This is typically the case when agriculture and the rural economy are important in contributing towards GDP growth and also when those who derive their livelihoods from the land are a dominant constituency in the electorate. In other cases, subsidies can provide a competitive edge in international trade, adding to the reluctance of governments to eliminate them. Dependency, entrenchment and entitlement to subsidies tends to follow, thus making their removal a formidable task. In the many instances of subsidies that prove harmful to the environment,

better targeting can be a pathway to reform as shown by Box 24. Alternatively, enforceable regulation on the use of subsidies can negate harmful effects to the environment.

4.3 Environmental policy and law to address perverse incentives

Environmental law is an umbrella term that describes the network of treaties, statutes, regulations, and common and customary laws addressing the effects of anthropogenic activities on the natural environment and environmental assets.

International (binding) laws that attempt to discipline environmentally harmful subsidies are mostly directed towards the fossil-fuel sector, such as the Kyoto Protocol, which 156 countries have ratified. The only notable exception is the Convention on Biodiversity, which 195 nations have ratified (the United States has signed but not ratified). At the national level, a broad array of potential provisions to protect against environmental harm can be legislated. If such environmental laws were backed by strict enforcement, perverse incentives would have minimal impacts on the environment. The threat of litigation coupled with fines (however calculated) would pose a strong incentive for land users to abide by practices that respect the environment, such as ensuring preservation and long-term

BOX 24

India: Fiscally unsustainable fertilizer subsidies, transparency and reform: Reducing fertilizer subsidies through real demand based on soil health

This case study shows the increasing fiscal untenability of India's fertilizer subsidy program, showing how better targeting can lower the demand for fertilizers, which have all too often been a major source of environmental harm. A key driver of reform has been public awareness of escalating budgetary outlays needed to finance the program and the inefficiencies in its implementation.

Agricultural input subsidies have been an important instrument to raise crop productivity in India. They were integral to the Green Revolution, which began in the mid-1960s. In response to a series of drought-induced famines, the Green Revolution put the country on a rapid path towards the industrialization of its agriculture sector, especially grains, in the use of high-yielding seeds, tractors, irrigation, pesticides and fertilizers. These inputs were heavily subsidized, allowing farmers cheap access.

The decades that followed have led to a subsidy culture, in which dependency on input subsidies (such as those on fertilizers, pesticides, water, etc.) have been entrenched in the country's agricultural sector. Owing to a lack of training on fertilizer application, the agricultural sector has been held accountable for the pollution of many water systems; while the shift to intensified monoculture has led to the loss of biodiversity, and over-irrigation that has resulted in soil degradation.^{110,111} Underscoring the imbalanced and inefficient use of fertilizers, a declining productivity response to the subsidy in terms of kilograms of grain produced to kilograms of the subsidized fertilizer consumed has been reported.¹¹² As a result, authorities began subsidizing neem-coated urea at a higher rate, since such treatment slows the release of fertilizer and reduces losses, while acting as a natural pesticide.¹¹³

The environmental degradation caused by India's subsidy program is not the only reason that many in India are demanding reform. Of all the current input subsidies, fertilizer support is by far the greatest, accounting for 35 percent of the country's total input subsidies. In 2019, the government likely exceeded its fertilizer subsidy bill to the tune of USD 4.2 billion. A rise in fertilizer prices on world markets and a fall in the value of the Indian rupee rendered imported fertilizers more expensive, lifting the total subsidy requirement for that year to USD 14.4 billion (1 trillion rupees), the highest ever recorded.¹¹⁴ As a result of price caps, retail prices of fertilizer, especially urea, are among the lowest in the world, with farmers only paying 30 percent of the market price.¹¹⁵ The low procurement price of fertilizers has also incentivized farmers to engage in illegal exports. One study estimated that over 2015–2016, 65 percent of fertilizers did not reach the intended beneficiaries.¹¹⁶

Environmental concerns and fiscal constraints have led India to reform its fertilizer subsidy program by way of better targeting. Hitherto, fertilizer subsidies were transferred to manufacturers on the basis of their output, but under the direct benefit transfer system, the fertilizer subsidy is now transferred according to the volume of sales. Point-of-sales machines have been installed and are equipped with fingerprint scanners which access India's national, biometric personal identification system. The key innovation is that the point-of-sale machines integrate farmers' soil health cards that measure nutrient balance as well as the size of holding, which determines how much fertilizer a farmer can buy. The purpose is to prevent illegal trade and excessive use.¹¹⁷

While the results of the reform, both in terms of fiscal and environmental impact, are yet to be known, the ambitious use of technology has the potential to redress India's perverse fertilizer subsidies and to limit environment degradation.

Source: UNEP (2018)¹¹⁸

land sustainability. The reality, though, is that environmental policing is costly, and litigating against those who are complicit in degrading the environment is difficult, especially in developing countries, where legal systems can be weak.

International environmental laws

International efforts have been undertaken to either remove or discipline environmentally harmful subsidies (Box 25). Many such efforts have been targeted at the fossil-fuel sector, since it is the

BOX 25

International initiatives to counter environmentally harmful subsidies

There has been longstanding recognition for the need of agreed-upon international laws (“soft” or otherwise) to eliminate environmentally harmful subsidies. However, progress to date has been exceptionally limited in scope, by virtue of targeting specific sectors (especially the fossil-fuel sector) rather than the environment itself.

Sustainable Development Goals

While not legally binding, the Sustainable Development Goals of the UN acknowledge the importance of the land base in realizing a number of development goals. However, the only Goal that explicitly attempts to address environmentally harmful subsidies is Goal 12 – **Ensure sustainable consumption and production patterns**. The Goal contains 11 targets, of which 12.C calls on the nations of the world to:

Rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption by removing market distortions, in accordance with national circumstances, including by restructuring taxation and phasing out those harmful subsidies, where they exist, to reflect their environmental impacts, taking fully into account the specific needs and conditions of developing countries and minimizing the possible adverse impacts on their development in a manner that protects the poor and the affected communities.

Goal 2, which aims to **End hunger, achieve food security and improved nutrition and promote sustainable agriculture** has a target (2.4) to:

Ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.

More explicit mention of the importance of the land base is provided by Goal 15, **Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss**. It has the following targets:

- 15.1: Ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements.
- 15.2: Promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally.
- 15.3: Combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world.
- 15.4: Ensure the conservation of mountain ecosystems, including their biodiversity, in order to enhance their capacity to provide benefits that are essential for sustainable development.
- 15.5: Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and protect and prevent the extinction of threatened species.
- 15.9: Integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts.

Although there is recognition by Goals 2 and 15 of the contribution of ecosystems in improving land productivity and soil quality, and the need to restore land and biodiversity, there is no mention made to about the role of environmentally harmful subsidies or other forms of perverse incentives that can hinder the targets of both Goals. Reference is made in Goal 2 target 2b, to the World Trade Organization’s ministerial decision of December 2015, which seeks to eliminate.

BOX 25

International initiatives to counter environmentally harmful subsidies (continued)

All forms of agricultural export subsidies and all export measures with equivalent effect, in accordance with the mandate of the Doha Development Round.

While the focus is on trade-distorting measures, the UN report on progress towards the Sustainable Development Goals mentions that “those subsidies [...] can lead to environmental damage and the inequitable distribution of benefits”. However, in the latest progress report of 2020,¹²⁰ there is no mention of subsidies in the context of trade and the environment.

WTO Agreement on Agriculture

The only other international agreement on agricultural subsidies is the WTO Agreement on Agriculture, but does not identify those subsidies that may have environmental impact. Rather, it classifies subsidies according to their potential impact on trade distortion, via colored “boxes”: green (permitted), amber (to be reduced), and red (forbidden). However, Article 12 of Annex 2 of the Uruguay Round Agreement exempts payments under environmental programs from domestic-support-reduction commitments. In simplified language, countries can offset environmental payments against their commitments to reduce total agricultural measurement of support.¹²¹

Convention on Biological Diversity

Other international institutions have also been active in goal setting. For instance, Target 3 of the Convention on Biological Diversity’s Strategic Plan 2011–2020, began considering subsidies that could undermine the convention’s goals, as well as positive incentives that could promote the convention’s goals for conservation and sustainable use of biodiversity. By the time it issued its Strategic Plan, environmentally harmful subsidies and positive incentives were squarely in its sights. Target 3 of that plan foresees:

By 2020, at the latest, incentives, including subsidies, harmful to biodiversity are eliminated, phased out or reformed in order to minimize or avoid negative impacts, and positive incentives for the conservation and sustainable use of biodiversity are developed and applied, consistent and in harmony with the Convention and other relevant international obligations, taking into account national socio-economic conditions.

OECD

Drawing on its experience in measuring subsidies and analyzing their effects, the OECD took the lead in this area in 1990s, undertaking a series of studies on various aspects of environmentally harmful subsidies, culminating in the 2001 OECD Ministerial Declaration and the 2009 Declaration on Green Growth. At the 2001 ministerial meeting, ministers considered a major document on sustainable development and called on the OECD to identify obstacles to policy reforms, the better use of market-based instruments, and how the reduction of environmentally harmful subsidies can be overcome; supported by a deepening of its analytical work on these initiatives. Several years elapsed, when at the June 2009 Ministerial Council meeting, ministers representing many OECD states and affiliated nations, declared that:

We ...ENCOURAGE domestic policy reform, with the aim of avoiding or removing environmentally harmful policies that might thwart green growth, such as subsidies: to fossil fuel consumption or production that increase greenhouse gas emissions; that promote the unsustainable use of other scarce natural resources; or which contribute to negative environmental outcomes.

European Union

The European Union’s broad initiative on environmentally harmful subsidies represents a long-standing commitment to remove or phase out such subsidies, with particular emphasis on fossil fuels. In 2010, for example, the Council of the European Union issued a declaration requiring that by the end of December 2018, (i) public aid to the coal industry to be phased out; and (ii) closure of uncompetitive hard coal mines. Current efforts are guided by the “Roadmap for a resource efficient Europe” (EC, 2011), which includes a milestone that “by 2020 [environmentally harmful subsidies] will be phased out, with due regard to the impact on people in need”.

BOX 25

International initiatives to counter environmentally harmful subsidies (continued)

Regional trade agreements

A recent review of regional initiatives¹²² finds that the incorporation of specific environmental provisions in the plethora of current regional trade agreements related to subsidies has been very limited so far. A few such agreements provide commitments on subsidies, mostly on fossil fuels, and only one has direct provisions for the general environment, which is the Caribbean Community and Common Market (CARICOM) Agreement. This has been in force since 2002 and sets forth a non-actionable set of subsidies with stated environmental objectives with a clear set of safeguards and limitations against their misuse. To date, however, there has been little action against non-compliance.

Source: Adapted from OECD (2017)¹²³ and Yamaguchi (2020)¹²⁴

largest beneficiary of support throughout the world. However, progress in addressing harmful agricultural subsidies has been less pronounced, particularly in developing countries.

Environmental laws at the national level

The classification of perverse incentives, introduced in Chapter 2, tend to manifest in a number of adverse environmental impacts. Environmental law at the national level has evolved to regulate and litigate against such impacts, but mainly in those countries with strong legal systems coupled with those that possess the capacity to monitor activities that can induce environmental degradation. Environmental laws typically contain the following provisions to address anthropogenic consequences.¹²⁵

Pollution and contamination

Contaminant clean-up, prevention and mitigation.

This involves determining what actions are required from the responsible party to ensure that contamination is first limited and controlled, and then removed from an environment to avoid longer-term or large-scale damage. Regulations can also include determining liability, response, guiding the process of investigation, monitoring before, during and after clean-up, and the risk assessment of long-term effects (Box 26). Contaminants often result from the extractive and agricultural sectors.

Waste management. This concerns the governance of many aspects of waste including treatment (neutralizing harmful materials), transportation and storage, and procedure on disposal, e.g., animal waste from (intensified) livestock enterprises.

Water quality. Various national and international laws govern human activities that interfere with sources of water. Pollutants can contaminate drinking water and can also cause wide-scale environment damage if the pollutant infiltrates

water systems. Consequently, environmental law decrees that substances must be chemically altered and rendered inert before disposal. This includes agricultural waste and runoff from agricultural land.

Sustainability of resources¹³¹

Forestry and landscape sustainability. Nature reserves and protected areas fall under the auspices of forestry and landscape sustainability. Environmental law governs proper procedures to be undertaken in land clearance and aims to ensure that activities such as extraction, construction and farming do not encroach on forests and landscapes (Box 27).

Mineral resource sustainability. Finite resources that are extracted from the earth require licensing and protection for proper management, and for the sustainability of the resource in question.

Water resource sustainability. In areas where drought is likely or where water can only be sourced from non-renewable fossil aquifers, environmental laws are instituted to manage the resource to ensure efficient usage. In the case of transboundary water sources, international laws come into place, to safeguard both conservation and, especially when there are competing claims to the water source, e.g., the Nile in Africa.

Biodiversity sustainability. Laws protecting biodiversity seek to control and limit the impact of human activity on animal and botanical species that are deemed vital to ecosystem functioning or those that are endangered or threatened.

This section has presented a review of both international and national legal instruments that seek to discipline subsidies that are harmful to the environment. In the case of international law, it is seen that fossil-fuel subsidies attract the greatest attention given their size and prevalence, and their role in accelerating climate change through CO₂

BOX 26

Chile: Enforcement of environmental regulations to close a mining company complicit in environmental destruction

This case study shows that when environmental regulations are enforced, they can have a powerful influence on preventing and limiting further degradation to the environment. The subtext is that extractive sectors are often recipients to a host of financial incentives to attract capital inflows, which are often perverse, given that mining places more costs on the environment, which outweigh the overall cost of the financial incentives.

Chile has an abundance of minerals such as copper, gold, silver, zinc, iron, lead and manganese, especially in its northern region. Mining is a highly important sector of the country's economy. Copper is the most critical metal in Chile's mining industry. The country is the world's largest producer of this metal, with a global share of approximately 34 percent, and according to latest estimates, Chile has more than 100 million tons of fine copper reserves.¹²⁶

Chile's free market economy, sound macroeconomic environment and a strong enabling environment for business make the country a potentially lucrative destination for major foreign mining investments. This is supported by a flat 4 or 5 percent rate under tax-stability agreements for larger mining operations, and they can apply for special VAT exemptions related to investments in fixed assets and for exportations.¹²⁷ In 2006, Canadian-based Barrick Gold, the world's largest gold-mining company, was awarded a concession to develop the Pascua-Lama open pit mining project, involving the extraction of gold, silver, copper and other minerals over a 25-year cycle. Pascua-Lama is located in the Andes mountains at an altitude of over 4,500 meters, and encroaches the Atacama Desert, overlapping the border between Chile and Argentina. Pascua-Lama contains estimated deposits of 17 million ounces of gold and 635 million ounces of silver, with 75 percent of the total deposits in Chile and 25 percent in Argentina.¹²⁸ In 2011 two public banks based in North America were set to provide Barrick Gold with USD 500 million start up loans for the project, earmarked to begin in 2012, but found that Barrick Gold had violated due diligence obligations regarding environmental safety and protection. The start-up financing did not materialize.

One of the most contentious issues of the project was the prospective removal of 20 hectares of glacial ice since the open pit lay partially under two small glaciers which eventually feed into the rivers of the Huasco Province, potentially affecting the water supply of the 70,000 farmers in the Huasco valley. The mine risked releasing cyanide, sulfuric acid (vitriol) and mercury into the valley's rivers. Water scarcity in Chile has been a long-standing issue, but nevertheless, after a two-year environmental review by Chilean officials, the project was given the go-ahead with over 400 conditions placed on the company to mine. At the same time, Barrick made a provision to farmers for "social assistance" and promises of USD 60 million for infrastructure work. However, the sensitivity of clearing glacial fields is evident by the fact that other mining operations had already been linked to a 56 to 70 percent depletion in the three glaciers nearest to the mine site.

emissions. Attempts to regulate the use of harmful subsidies in land-based activities are few, with the Convention on Biological Diversity being a notable exception. At the national level, however, many provisions to protect against environmental harm can be legislated, and would serve as a powerful instrument to mitigate environmental degradation. The reality, though, is that environmental policing is costly, and litigating against those who are complicit in degrading the environment is difficult, especially in developing countries, where enforcement is rare and legal systems are weak. Paradoxically, environmental regulations can themselves be perverse, as was seen in the case study of Niger.

In the next section, the case for environmental taxes is made in the context of market failure. In terms of "economy equilibrium," economists view taxes as a superior instrument to regulation.

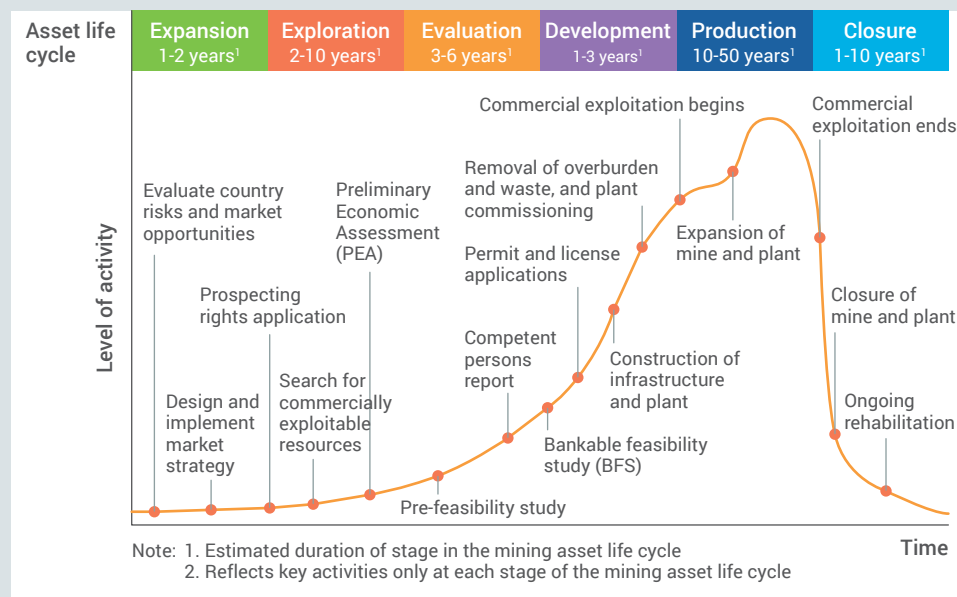
4.4 Addressing market failure: Internalizing externalities

The market-driven approach for correcting negative externalities is to "internalize" third-party environmental costs. The concepts of negative externalities and market failure were introduced in Chapter 2, bringing forth the arguments of Pigou,¹⁴¹ who recognized the environmental and societal costs of pollution and further prescribed fiscal remediation.

BOX 26

Chile: Enforcement of environmental regulations to close a mining company complicit in environmental destruction (continued)

FIGURE 10
Chile's mining
asset life cycle



Source: KPMG (2014)¹²⁹

Pascua-Lama had caused great damage to native plants and animals with the indigenous peoples of the region having had documented the contamination of a river and impacts on glaciers. After forceful petitions from local communities, environmental groups and other stakeholders, in October 2018, the company was fined USD 11 million for 33 violations of Chilean environment regulations, and Chilean authorities confirmed the definitive closure of Pascua-Lama.

Source: adapted from (AIDA, 2018)¹³⁰ together with supplementary material.

Accurate price signals are essential for the economy to produce an optimal quantity of goods and services. When the production or consumption of a product, such as timber from unregulated deforestation, incurs costs in the form of soil erosion and climate change (lower carbon sequestration), which are not reflected in its market price (they are “external” to the market), the product is said to contain an external cost or an “externality”. The fact the market price does not reflect the environmental externality means the price of that product is too low, and too much of the product is produced.¹⁴²

In this instance, internalizing the externality in the form of a Pigovian tax would be justified. Allied to the “polluter-pays principle,”¹⁴³ a Pigovian tax reflects the cost of the externality to be levied on the price of the product. A higher price would reduce demand for the product, leading to a fall in its production, thereby ensuring that the economy produces the “right” amount of goods.

The economic literature makes clear that correcting market prices through a tax is far more economically efficient than (enforceable)

regulation in reducing environmental harm, so that a given level of degradation is achieved at a lower cost. The efficiency gain stems from giving market participants the ability to choose the least-cost path for corrective action, i.e., the threat of an immediate penal tax is deemed higher than litigation costs, forcing those to respect the environment.¹⁴⁴

Indeed, compared to regulation, a market-based tax approach can incentivize those who environmentally degrade to reduce their harmful activities at a lower cost than the tax. This can spur investment in new technologies that minimize degradation to the environment. As an additional benefit, the increased tax revenue can be used for public spending, such as reducing other distortionary taxes or re-investing in environmental assets. This is known as the “double-dividend” hypothesis, which emphasizes that environmental taxes can improve the environment and increase economic efficiency simultaneously.¹⁴⁵ It is for this reason that many economists advocate taxation over regulation. For instance, the seminal economist Greg Mankiw states:

BOX 27

Niger: Relaxation of perverse regulations to increase tree cover on farms

This case study shows that perverse regulations are culpable in land degradation. In Niger, farmers foresaw the benefits of regreening farming lands through tree planting, but were confronted by regulatory obstacles in the form of re-classifying land, which subjected farmers to another set of other regulations in the form of the country's forestry code. However, relaxation of the forestry code has allowed Niger's farmers to continue to restore productive land.

In recent years several studies have reported a long-term increase in vegetation greenness in some parts of the African Sahel, in contradiction of a prior assertion that desertification is an irreversible consequence in the region.¹³² While increased rainfall was thought to have been a major contributory factor to the Sahelian “re-greening”, subsequent studies suggest that rainfall is insufficient to explain the extent of the change in vegetation, positing anthropogenic-induced changes as a possible explanation.¹³³

Among the Sahelian countries, Niger, one of the world's most impoverished nations, is a standout case where such re-greening has occurred. Research has suggested that widespread changes in farmers' management of the indigenous trees in their fields has resulted in a greater number of trees planted and improvements in the local environment,¹³⁴ particularly in the Region of Maradi. The prevailing narrative of Niger's anthropogenic re-greening depicts a situation in which environmental degradation has induced farmers to change their land-management practices so as to protect and manage indigenous trees, with the potential to reverse degradation. As tree cover increases, benefits have also accrued in terms of increased crop yields and additional income from tree products.¹³⁵

Niger's success has not been achieved without significant regulatory obstacles. Incentives to plant and manage trees have run counter to incongruous and perverse regulations. Ambiguity in Niger's forest code discouraged farmers from planting and managing trees on their farms because a higher amount of tree cover could put their farms at the risk of being declared a “forest,” and forest tenure regulations required approval and license fees for the felling or commercialization of certain parkland tree species, even if they were growing on farm land belonging to households. While no formal policy change resulted, forestry officials relaxed their policing role regarding the cultivation of trees on agricultural land, thus incentivizing farmer-managed natural regeneration.¹³⁶

The result of the relaxation of forestry policing was at least 4.8 million hectares regenerated, and farm-household incomes increasing 18–24 percent over those households that did not respond to the change.¹³⁷ Roughly 62,000 households in the region of Maradi practiced farmer-managed natural regeneration,¹³⁸ which was also conditioned by soil type, market access, and the education level of the head of household. Adoption appears to have improved household incomes, increased crop diversity and risen the diversity and density of trees on farmlands.

Farmer-managed natural regeneration is premised on a low-cost method of land restoration, in which the only costs associated with the practice concerns the time it takes farmers to prune/protect trees and the time and expenses an extension service may incur during the process of teaching and promoting the practice. Moreover, because this type of regeneration requires only the awareness, skills, and will of the farmer, once adopted it does not depend on continued support from programs, projects or extension services.¹³⁹

Source: Kissinger (2015)¹⁴⁰

Pigovian taxes are popular among economists. First, they are often the least invasive way to remedy a market failure. They can restore an efficient allocation of resources without requiring a heavy-handed government intervention [e.g., regulation] into the specific decisions made by households and firms. Second, they raise revenue that the government can use to reduce other taxes, such as income taxes, which distort incentives [double-dividend].¹⁴⁶

A major obstacle to the implementation of a Pigovian tax concerns its measurement. Pigovian taxes encounter what is known as “calculation and knowledge problems.”¹⁴⁷ A government cannot levy the correct Pigovian tax without knowing in advance what the most efficient outcome is. This would require knowing the precise amount of the externality imposed by the producer, as well as the correct price and output for the specific market. If authorities overestimate the external costs

involved, Pigovian taxes cause more harm than good.¹⁴⁸

The scant number in the literature¹⁴⁹ of empirical applications of Pigovian taxes to address environment externalities, other than taxes on fossil fuels, attests to these calculation and knowledge problems.¹⁵⁰ The greater the complexity in measuring the cost of environmental damage, the less likely will be the institution of Pigovian taxes. For example, soil erosion may be the result of both naturogenic and anthropogenic causes. Attributing culpability is difficult as is measuring the cost of restoring soils. Another example is “attributing blame” when there are multiple entities that are potentially culpable of contaminating a water source.

Some of the problems associated with measurement could be overcome with natural capital accounting, especially SEEA-environmental-economic accounting and the Paris Collaborative on Green Budgeting (section 3.3). Setting international standards and methods on monetizing the value of environmental assets could provide a pathway to establishing optimal levels of Pigovian taxes. However, these accounting frameworks are still at the conceptual stage, having only been conceived recently, and considerable time can be expected before for practical guidance emerges.

Market-induced perverse incentives can be addressed without the need for an environmental tax. In the case when land users are dependent on markets for critical inputs (such as fertilizers, pesticides and capital), which are not necessarily subject to subsidies, conditionalities can be placed on access to those inputs, incentivizing land users to comply with sustainable land-management practices (Box 28).

This section has reviewed how environmental (Pigovian) taxes can address market failure by deterring entities from harming the environment. The revenues raised from taxes can be recycled towards land restoration bringing about what is known as a “double dividend”. The threat of a tax can incentivize land users to invest in new technologies that eliminate damaging impacts to the environment.

Pigovian taxes are commonly applied to the consumption of harmful products, e.g., tobacco, alcohol and fossil fuel, since their adverse effects are amenable to measurement, thus enabling authorities to set an appropriate level. In the case of the environment, however, measurement is exceptionally problematic. The difficulty arises from measuring the cost of ecosystem or land restoration that could be reflected in a befitting tax. For this reason, Pigovian taxes are rarely applied to cases involving environmental degradation.

Market failures can be addressed through other mechanisms, such as putting conditionalities on the acquisition of inputs, required for land activities. This was seen in the case study of Vietnam (Box 28), in which coffee producers could only access capital if they had adopted sustainable land management practices.

Another market-compatible mechanism that can provide a transformative pathway to land restoration relates to voluntary initiatives, such as land users enrolling in sustainability-certification schemes. This can bring about a strong sense of community-led action in protecting and defending environmental assets. The next section shows, that in both cases, harmful subsidies emerge as redundant, as do other perverse incentives.

4.5 Voluntary initiatives

Voluntary initiatives are gaining ground in many countries. One of the key drivers is to achieve conformity with international standards such as ISO 14000,¹⁵⁹ Fairtrade,¹⁶⁰ the Forest Stewardship Council,¹⁶¹ the Rainforest Alliance¹⁶² and ISEAL.¹⁶³ These initiatives ensure that products made from environmental assets comply with national and international value-chain requirements – that they are socially responsible and environmentally sustainably – as well as meeting consumer demands and expectations.¹⁶⁴ In this regard, there is often a strong incentive to seek voluntary certification and standards to enable enterprises to penetrate national and lucrative global markets that they would not be otherwise be able to access. For instance, a number of multinational furniture manufacturers accept only wood products that are certified by the Forest Stewardship Council. As another example, palm oil (which has attracted adverse publicity in the conversion of forest land) is currently the only vegetable oil that can be certified by the Rainforest Alliance, while the Roundtable on Sustainable Palm Oil,¹⁶⁵ supported by transnational food companies, promotes the sustainable production and trade of palm oil worldwide. Both certification schemes are a basic requirement for entry into the global marketplace.

Indeed, there is a substantial body of literature attesting to these voluntary initiatives in bringing about environmental improvement in developing countries. For instance, ISO 14001 certification has improved firms’ compliance with mandatory regulations,¹⁶⁶ leading to a reduction in natural resource use, waste generation, wastewater effluents, and emissions of toxic chemicals, in Latin America and South, Southeast and East Asia.

In South and Southeast Asia, in spite of statutory regulation, many firms employ pro-environment production methods, driven by new production technologies and media-informed community

BOX 28**Vietnam: Leveraging credit to encourage greener farming practices in coffee plantations**

This case study shows how export incentives for coffee have led to severe environmental degradation in Vietnam, especially in land-use change and excessive input use (especially fertilizers and irrigation) that has led the country's expansion in coffee cultivation to environmentally unsustainable levels. However, placing conditionalities on the much-needed credit for coffee tree replacement in the form of sustainable land management practices, has put the sector on a more ecologically sound footing.

Vietnam is endowed with significant comparative advantage in agriculture and over recent decades has emerged as a major exporter of many tropical commodities. While government support remains comparatively low for the agricultural sector,¹⁵¹ the expansion in the cultivation of commodities has been mostly export-driven, responding to international price signals, and contributes substantially to the country's export earnings and foreign exchange reserves. But the pace of the expansion has come largely at the cost to the environment. The export-led, rapid rise of coffee production,¹⁵² in the absence of sustainable land management practices, serves as an example of anthropogenic-induced environmental degradation.

The expansion of coffee has not been a model of sustainability in Vietnam. Over-irrigation resulting in groundwater depletion and the overuse of nitrogen-based fertilizers have become the standard, as has been deforestation, conversion of natural landscapes, habitat destruction and encroachment on unsuitable land (soil type, land slope, climate, and water availability). In spite of Vietnam having the world's highest yields for Robusta coffee, unsustainable land management practices began to impinge on coffee productivity, through acidifying soils, higher exposure to disease, groundwater shortages and constraining irrigation in drought years. With poor land-management practices leading to diminished yields, profitability and commercial viability has been put at risk over the natural lifespan of coffee trees. While lucrative international markets have sent price signals to cultivate and export more coffee, the need to produce more sustainably is met with myopia. Premiums for sustainability certified coffee are low compared to its costs, and these standards permit a number of environmentally questionable practices such as excessive and poorly timed irrigation.¹⁵³ For these reasons, farmers do not factor in the detrimental effects of their farming practices on trees' productivity and lifespan, on their farms' input costs, and ultimately on sustainability.

Physiological properties of coffee cultivation include the time required between planting and for the tree to bear fruit (approximately 3-4 years), and the longevity of the tree in terms of optimal productivity before replacement is needed (coffee trees can remain profitable between 20 and 25 years).¹⁵⁴ New cultivation and tree replacement generally require substantial investment, necessitating the need for the availability of credit markets and access to such credit for growers, who are mostly smallholders.

The World Bank-supported Sustainable Agriculture Transformation project, initiated in 2015, identified that one-third of total coffee trees in the country were approaching the end to their productive life. Moreover, many coffee farmers were experiencing declining productivity after just 15 years.¹⁵⁵ Recognizing the need to help farmers finance tree replanting on the one hand, and the need to incentivize greener farming practices on the other, the government, supported by the project, has established a program that gives farmers access to preferential credit with sustainable land-management conditionalities. These conditions require growers to undertake training in green production methods and to plant on suitable land. Through the project, farmers were also gaining access to higher-quality planting materials as well as credit for higher-efficiency irrigation equipment. At the end of 2017, sustainable coffee had been cultivated on 9,250 hectares of participating farmland, with profits increase rising by 23 percent before the implementation of the program.¹⁵⁶

In tandem, the Vietnamese government released the "Sustainable Coffee Plan" up to 2020, setting specific environmental directives, including capping nationwide coffee cultivation at 600,000 hectares,¹⁵⁷ exploring water-saving irrigation methods, as well as using environmentally friendly fertilizers and pesticide inputs that are safe for humans.

Source: Adapted from Cassou (2018)¹⁵⁸

BOX 29

Jordan: Rangeland restoration through a community-driven approach

This case study shows how pastoralist communities in Jordan have shouldered responsibility to sustain their livelihoods through pursuing sustainable land-management practices in rearing livestock. Their endeavors negate the need for heavily subsidized feed ingredients and overdependence on scarce fossil aquifers, and provide a transformative pathway to restoring degraded pasture land.

Animal production typically accounts for more than 60 percent of agricultural GDP in Jordan, predominantly in the rearing of sheep and goats. Livestock production continues to be highly subsidized, through imported feed ingredients as well as for veterinary services that are free.

Over the past five decades, indigenous plant species have disappeared and rangeland productivity in Jordan has more than halved due to overgrazing, declining rainfall, high runoff, changes in tenure regimes and the abandonment of natural water harvesting. To reverse this tendency, there is a growing interest in reviving the “*Hima*”¹⁶⁹ approach within pastoralist systems in the country. The large-scale adoption of the *Hima* approach¹⁷⁰ based on improved local governance to enable pastures to be grazed and rested systematically may deliver up to USD 400 million worth of net benefits (based on 2015 values), as well as benefits from carbon sequestration and savings on the consumption of water, which is very scarce, to the tune of 14 percent. An effective *Hima* system requires clarity over rights of access and management of rangeland resources – for example, the ability to exclude grazing during designated periods of fallow. Evidence shows that developing *Hima* sites is consistent with experiences in a wide range of countries, in which strengthened common property regimes, and addressing land tenure is effective in reviving rangeland-management strategies.

Without recourse to subsidies or other perverse incentives, international research on rangeland management suggests that much more innovation is possible that could lead to greater pasture productivity and faster rates of recovery using improved knowledge of grazing cycles, timing, improved use of herd movements for selective seed dispersal, and concentrated herd impacts for rapid soil formation. Other technologies and approaches have been demonstrated as useful for rangeland rehabilitation, including planting nutritious, drought-tolerant shrubs combined with water-harvesting structures. Rangeland restoration can be considered an incentive scheme for pastoralists to ensure the long-run productivity of livestock systems.

The high numbers of livestock currently managed depend upon high levels of imported fodder, which via subsidies come at a high cost to the national treasury. In order to generate viable capital for investing in *Hima* restoration, one could contemplate a cross-compliance scheme where feed subsidies to pastoralist communities are conditional on improved rangeland management. This could incentivize a change in management practices, with livestock grazed for appropriate periods according to fodder availability and then removed from the rangelands during the recovery period.

Source: Myint and Westerberg (2015)¹⁷¹

activism.¹⁶⁷ Many polluting industries in developing countries (with reference to India) fall under the rubric of the unorganized sector. Despite limitations of formal regulations to stem pollution and environmental degradation, remedial practices may be influenced by public discussions and reports on pollution in the vernacular press. Using water-pollution data in Gujarat, Kathuria (2007)¹⁶⁸ shows that the press can function as an informal regulator if there is sustained interest in news about pollution.

Clearly, community activism can be a voluntary driver in pathways for land restoration. The important elements for the success of this “model” include a strong sense of stakeholdership

(Box 29). Another example (Box 30) reinforces the importance of community activism in land restoration and sustainable productivity to strengthen livelihoods. Finally, Box 31 shows that voluntary compliance with international certification can be a significant driver towards both land restoration and environmental sustainability in the context of market acceptance, especially in gearing up for exports.

A scoping review¹⁷⁴ examined the evidence from around 18,000 papers on whether incentive-based program leads to the adoption of sustainable practices and their effect on environmental, economic and productivity outcomes. Its conclusion finds that:

BOX 30**Peru: Sustainable landscapes through voluntary community-led action**

This case study shows that when communities are granted entitlement in owing lands, a strong sense of stakeholdership arises in protecting their land from exploitation while ensuring that the adoption of sustainable land management practices can enhance their livelihoods.

The last two decades have seen a marked shift towards decentralized forest management in developing countries with recent estimates pointing to 30 percent of forests in the tropics under some form of local control. Most of this area is located in Latin America, but the trend is increasingly taking hold in parts of Africa and Asia as well. Mounting evidence shows that community-managed forests can perform as least as well as strictly protected areas in conservation, empowering rural development via locally driven enterprise. Yet, at the same time it is also increasingly evident that without strong government support and local capacity to defend rights, there may be increased risks for forest conversion.

The Peruvian Amazon forms an important case in this regard. In the Madre de Dios region of southeastern Peru, as with other “native communities” in Peru, Tres Islas has seen considerable deforestation since its title was issued, above all due to mining. Based on the community’s desire to defend its territorial rights, halt deforestation on its lands, and harness its considerable natural resource base to improve community well-being, the Rainforest Alliance engaged in a three-year process with Tres Islas to improve resource governance and community forest enterprise.

The core finding is that integrated, participatory landscape-scale planning and forest management within titled indigenous lands forms the fundamental building block for defending forest rights, strengthening local governance and generating increased economic benefits. Using a landscape-based approach to territorial zoning, and focusing on community institution building as well as market-based sustainable forestry, significant improvements have been achieved in governance, resource management and livelihoods.

Source: <https://www.rainforest-alliance.org/case-studies/tres-islas>

...Independent of the incentive type, in the long-term it seems that one of the strongest motivations for farmers to adopt and maintain sustainable practices is the perceived positive outcomes of these practices for their farm or the environment. For example, the greatest motivating factor for participation in a forest conservation scheme in Kenya was the “will to conserve,” influenced by the local communities’ concern for the degradation of their environment and their perceived dependency on natural resources. The will to participate was based on the perceived benefits of conservation, especially changes in water availability, which were reinforced by the potential benefits of new income-generating activities. This suggests that incentives can lead to the adoption of sustainable practices and have positive effects on ecological services, even without subsidies. If participants perceive future benefits of sustainable practices, the likelihood of adoption increases.

The examples above of voluntary action show that community activism, instilled by an ensuing sense of obligation to protect and restore their own lands for perceived future benefits, can be a powerful incentive for land restoration. The media can also galvanize communities towards activism in exposing polluters who threaten the degradation of their resources or entitlement to resources. Participation in voluntary initiatives may also be incentivized by the marketplace through compliance with internationally accepted standards concerning sustainability, allowing farmers and land users to penetrate lucrative global markets. In all of these cases, the strive for voluntary action or compliance does not rest on subsidies or perverse incentives. On the contrary, communities and farmers recognize the importance of independent choice in ensuring that the land base in question can deliver benefits without the need for harmful subsidies. The next chapter also focuses on the redundancy of environmentally harmful subsidies and the dissolution of perverse incentives through the adoption of new technological farming paradigms.

BOX 31**India: Market-led certifiably sustainable and subsidy-free sugar production with smallholder buy-in**

This case study shows how market-led voluntary certification can incentivize smallholder sugar producers to adopt sustainable cultivation practices that mitigate the need for subsidies.

In 2015, an Indian sugar refiner became the first company in Asia to obtain sugar-mill certification under the international Bonsucro Production Standard¹⁷² – a global, metric-based standard for improving the social, environmental and economic sustainability of sugarcane farming and sugarcane derived products. One of the challenges that the company has overcome in its attempts to mainstream sustainability is that all of the sugarcane it processes is procured from approximately 100,000 smallholder farmers. The company recognizes the importance of sustainable cane production, and is sampling soil nutrients to help farmers fine tune their fertilizer use, mitigating the use of fertilizer subsidies, while its extension officers teach farmers sustainable practices such as composting and intercropping, which are low-cost ways to increase productivity. The company does not recommend pesticides, which do not attract government subsidies and are expensive for smallholders while posing considerable health and environmental risks. Instead, it promotes biological alternatives. The company's research and development department has developed and distributed more robust, pest-resistant sugarcane varieties, while raising several species of parasitoids that prey on major cane pests for release on farms.

The company also has convinced farmers to abandon a tradition of burning the stalks and leaves left behind by the sugarcane harvest, and to instead shred the organic matter and mix it into the soil. This makes farms more productive over the long term (an additional 2–5 tons per hectare), while helping the soil retain water, thereby reducing the need for (subsidized) irrigation during the dry months.

While farmers reap better harvests and higher returns through cost savings, the company is also assured of the supply of cane with higher sucrose content, and is also able to compete in the international marketplace, especially exports to the EU, where the Bonsucro Production Standard is mandatory.

Smith *et al.* (2019)¹⁷³ find that global compliance with the Bonsucro environmental standards would reduce current sugarcane production area (–24%), net tonnage (–11%), irrigation water use (–65%), nutrient loading (–34%), and greenhouse gas emissions from cultivation (–51%), while having little impact on producer returns.

Source: <https://www.isealalliance.org/impacts-and-benefits/case-studies/bonsucro-standard-sweetens-parrys-sugar-brand-india>



5. THE ROLE OF TECHNOLOGY AND ALTERNATIVE FARMING

Land-based and earth observation technologies, capacity-building and alternative farming paradigms could also negate the need for potentially harmful subsidies – all in market-compatible setting. Existing subsidy programs could then be repurposed into providing capacity-building and investments in the alternative technological paradigms. Another example of a “double-dividend.”

One of the most promising technologies used today is precision agriculture. “Precision” is the operative word, in that the technology utilizes the most efficient levels of inputs (fertilizers, pesticides and irrigation) on the field and at the appropriate time for maximizing crop productivity (Box 32).

Precision agriculture can provide a significant boost to profits through cost savings on the reduction of the use of (subsidized) harmful inputs,¹⁷⁶ notwithstanding the recuperative effects on the environment. For example, reducing excessive applications of inputs such as fertilizer and irrigation water would be hugely beneficial to the environment in lowering runoff and soil erosion.

The wide adoption of such technology could lead to the wholesale removal of environmentally harmful subsidies and other perverse incentives, while enhancing rural livelihoods and food security – the *raison d’être* of subsidy programs of many governments.

*Precision agriculture in general ... (is) likely to make farms more competitive and less dependent on politically troublesome subsidies ... Perhaps most of all, precision agriculture has the potential to help make farm production more efficient and better for the environment at a time when there will be more mouths to feed on Earth.*¹⁷⁷

A more concrete case is given by post-Brexit United Kingdom, which is no longer eligible for the USD 4 billion of agricultural subsidies awarded under the European Union’s Common Agricultural Policy. However, precision agriculture is being proposed to neutralize the subsidy gap, with no impact on farming productivity in the UK.¹⁷⁸

Such is the promise of precision agriculture, it is widely viewed as a future cornerstone of sustainable agriculture throughout the world. Artificial intelligence in the form of machine learning is also an emerging pillar of precision agriculture. The entry point of artificial intelligence and machine learning is in the use of drones, robots and other devices that gather data from soil structure and crop cycles, which is then used to predict with a greater degree of accuracy the optimal mix and quantity of fertilizer, the exact timing and volume of irrigation to be applied and the optimal application of pesticides in relation to their emergence and peak prevalence. Artificial intelligence has also the potential for reducing input costs and input subsidies for the benefit of higher returns and environmental sustainability.

As a further example of the role of precision agriculture in transforming the environment from a pathway of degradation to restoration, on 5 November 2019, an open letter¹⁸⁰ endorsed by 2,500 scientists, pressed for the reform of the European Union’s Common Agricultural Policy:

The [Common Agricultural Policy] has led to an intensification of agricultural practices, including landscape simplification and consolidation, drastic increases in the use of pesticides and mowing frequency, irrigation expansion and the destruction of pasture lands. The unequivocal scientific consensus is that in concert these activities have led to a decline of European farmland bird populations of more than 55% between 1980 and 2015, and a decline of insect population abundance of more than 76% in a study of 63 nature reserves in Germany between 1989 and 2016. These declines are linked, and are pushing the remaining populations to critical levels... The [Policy] is turning rural areas into green deserts of uninhabitable maximum-yield monocultures... Models show that if [reform] implemented correctly, measures could contribute to the recovery of biodiversity...

BOX 32**Technologies to limit land degradation: Precision agriculture**

Precision agriculture is

An integrated information- and production-based farming system that is designed to increase long term, site-specific and whole [emphasis added] farm production efficiency, productivity and profitability while minimizing unintended impacts on wildlife and the environment" (US House of Representatives 1997).

Precision agriculture also encompasses site-specific crop management, whereby decisions on resource application and agronomic practices are improved to better match soil and crop requirements as they vary in the field. The focus here is on decision-making with regard to resource use. The decisions can be in regard to changes across a field at a certain time in the season or changes throughout a particular season or successive seasons. Site-specific crop management can be considered as the application of information technologies, together with production experience, to:

- optimize production efficiency
- optimize quality
- minimize environmental impact
- minimize risk – all at the site-specific level.

In general, the aim of site-specific crop management is to optimize returns across a field. Unless a field has a uniform yield potential (and therefore a uniform yield goal), the identification of variability in yield potential may offer possibilities to optimize production quantity at each site or within each "zone" using differential management techniques. The initial emphasis is on optimizing the agronomic response to the manageable input with the most impact on production and costs. Many inputs will impact on quality as well as quantity. In production systems where quality premiums exist this may alter the amount of input required to optimize profitability and agronomic response.

If better management decisions are being made to tailor inputs to meet production needs, then by default there must be a decrease in the net loss of any applied input to the environment. This is not to say that there is no actual or potential environmental damage associated with the production system; however, the risk of environmental damage is reduced. Site-specific crop management provides producers with physical evidence to contest any claims against negligent management. In many developed countries, particularly within the European Union, there are financial incentives for producers to collect and use this information by linking environmental issues to subsidy payments.

Risk management is a common practice today for most farmers and can be considered from two points of view: income and environment. In a production system, farmers often practice risk management by erring on the side of extra inputs: a farmer may employ extra pesticide spray, add extra fertilizer, buy more machinery, etc. Generally minimizing income risk is seen as more important than minimizing environmental risk but site-specific crop management attempts to offer a solution that may allow both positions to be considered in a risk management context. This improved management strategy will come about through a better understanding of the environment–crop interaction such as short- and long-term weather predictions and agro-economic modelling. The more that is known about a production system the faster a producer can adapt to changes.

The truly enabling technology of site-specific crop management in its present form is the global navigation satellite systems of which GPS is the most widely used at present. The ability to geo-reference activities gives producers insights into both production variability as well as inefficiencies in crop production and farming operations. Many sensors and monitors already exist for in-situ measurement for a variety of crop, soil and climatic variables. These include yield sensors, biomass and crop response sensors.

Source: Adapted from Taylor and Whelan (2018)

BOX 33**Nigeria: Precision agriculture in maize cultivation**

This case study shows the promise of precision agriculture in increasing maize productivity in Nigeria, with results that show lower adverse environmental impacts, especially in the reduction in the usage of subsidized inputs such as fertilizer. While it is argued that precision agriculture is more costly than the advantages that the technology proposes to confer, previous applications have shown that in some parts of the world, it possesses advantages that by far surpass postharvest losses, pest and disease attacks, non-uniform plantings and also savings from the lower application of inputs, which are often heavily subsidized.

Many Nigerian farms are fragmented and are small-scale. An estimated 90 percent of arable land in Nigeria is dependent on fertilizers for nutrient supply, with farmers benefitting heavily from subsidies on fertilizers and other inputs. Using remote sensing technology combined with fuzzy classification (artificial intelligence), the degree of spatial and temporal variability in maize yields was analyzed. Precision agriculture then applied optimal quantities of inputs (fertilizers, pesticides and water) at the right time, in equal proportion to every portion of the field. Evidence from aerial imagery showed areas of little variation in the growth rate of maize. Farmers minimized on costs (also lessening the fiscal burden of subsidized inputs), maximized profits all with minimal environmental impact.

Source: Abdullahi and Sheriff (2017)¹⁷⁹

BOX 34**Benin: Organic cotton cultivation cuts environmental impacts**

This case study provides evidence of the financial, environmental and health benefits of organic cotton farming in Benin, especially since chemical inputs are subsidized in conventional cotton farming, and have been blamed for soil degradation.¹⁸⁴

In the Benin municipality of Banikoara, the annual environmental and health-related costs of chemical pesticides are estimated in the order of EUR 2.9 million per annum distributed over some 16,600 cotton-producing households for the crop season 2015/16. The value of cotton production is reduced by an estimated 66 percent for an average sized farm when accounting for government subsidies for inputs and environmental degradation. This is an important finding, since if significant outlays are spent inefficiently, then public funds should be diverted to other sectors in need.

In particular, it is argued that this is the case for adopting sustainable land management practices such as crop rotation and direct seeding mulch-based cropping, as these practices can help reduce farmer's reliance on costly inorganic inputs. While international demand for organic cotton is on the rise, it is demonstrated that the average per-hectare income of organic farmers in Banikoara is nearly twice as high as those of conventional cotton farmers, and triple those of farmers who are not recipients of subsidies, conferring considerable comparative advantage benefits to organic farmers. It is also shown that sustainable land management practices by organic farmers assist in the building-up of soil organic matter that is highly complementary to pastoralist activities, which make organic farming systems more resilient to climate variability. As such, organic farming can help contribute to the Sustainable Development Goal "life on the land", in particular target 15.3, by restoring degraded land and promoting land-degradation neutrality.

The government's initiative to reduce subsidies for conventional cotton inputs is deemed a step in the right direction, though attention needs to be paid in that farmers do not replace subsidized inputs with informal market chemicals. The reduction of distortionary subsidies should go hand-in-hand with the provision of extension services, informing farmers about the necessary ways to adopt integrated pest management and soil fertility management. Moreover, health costs of illness from the manual spraying of pesticides spraying can immediately be reduced through the use of high-precision low-volume spraying tools such as ULVA+, which again reinforces the need for informed extension services.

Source: Westerberg (2017)¹⁸⁵

BOX 35**Indonesia: Removing subsidized chemical pesticide and shifting towards integrated pest management**

This case study shows how harmful chemical pesticides were traditionally used to underpin Indonesia's Green Revolution towards greater food self-sufficiency, particularly in rice. Subsidized chemical pesticides were applied overabundantly, and often without need, which led to adverse environmental impacts especially biodiversity loss, to the extent that natural predators of rice pests were exterminated. Rice yields went into decline, leading authorities to look for alternative methods of pest control. Recognition of the role of integrated pest management has negated the need for chemical pesticides and the attached subsidy.

Following episodes of severe food shortages, Indonesia embraced its own Green Revolution in the early 1970s to achieve greater food self-sufficiency at the expense of large-scale imports, targeting the country's staple of rice. At the core of the Food Intensification Program was the widespread adoption of high-yielding seed varieties, development of irrigation systems, expansion of food-crops acreage, increased use of chemical fertilizers and pesticides. Thanks to the discovery of oil, which brought in large revenues, the Program was also supported by generous input subsidies (e.g., 80 percent of their market value), and the stabilization of national food prices.¹⁸⁹

Farmers were instructed to use these inputs as much as possible. In the case of pesticides, farmers were required to spray pesticides on their rice fields regularly, even if there were no pests.¹⁹⁰ Cast as food intensification, the program was considered successful as rice production in the 1970s and 1980s grew at an annual rate of approximately 4.7 percent, well above the annual population growth of approximately 2.3 percent during this period. For the first time in its history, the country became self-sufficient in rice for the first time in its history.¹⁹¹

Despite the remarkable success of the food intensification program, the excessive use of inputs caused serious environmental problems. In the case of pesticide resistance, brown planthoppers (*Nilaparvata lugens*) became resistant to pesticides and damaged more than 450,000 hectares of rice fields between 1976 and 1977, and destroying approximately 200,000 hectares in 1986.^{192, 193} Both episodes occurred in Java. The yearly USD 100 million in pesticide subsidies promoted such large-scale use of pesticides by farmers that natural predators of the pest were exterminated as well, increasing the crop devastation from the next wave of the pests hatching from eggs in the rice stems.¹⁹⁴

In the aftermath of the 1986 episode, subsidy reform was used to promote more ecologically attuned agricultural production systems. Indonesia's National Development Planning Agency and the Ministry of Finance developed a plan to reduce pesticide subsidies by almost a half within one year and eliminate them entirely within three years, through the promotion of integrated pest management. The program reached hundreds of thousands of farmers within the first few years, achieved pest-reduction goals, and provided the extension and technical support for farmers to transition away from harmful pesticides. The upshot has been the restoration of biodiversity as well as putting the country's rice sector on a more environmentally sustainable trajectory.

Source: adapted from Kissinger (2015)¹⁹⁵

Common Agricultural Policy subsidies currently amount to nearly €60 billion every year, much of which funds intensive land use and factory farming. The letter states that this money could instead be used for the recovery of biodiversity. Many stakeholders, including the agri-food industry and farmers' associations, suggest that one way this could be achieved is with precision agriculture, based on the principle "producing more with less [input]", through the use of new technologies such as remote sensors, satellites, and drones.¹⁸¹

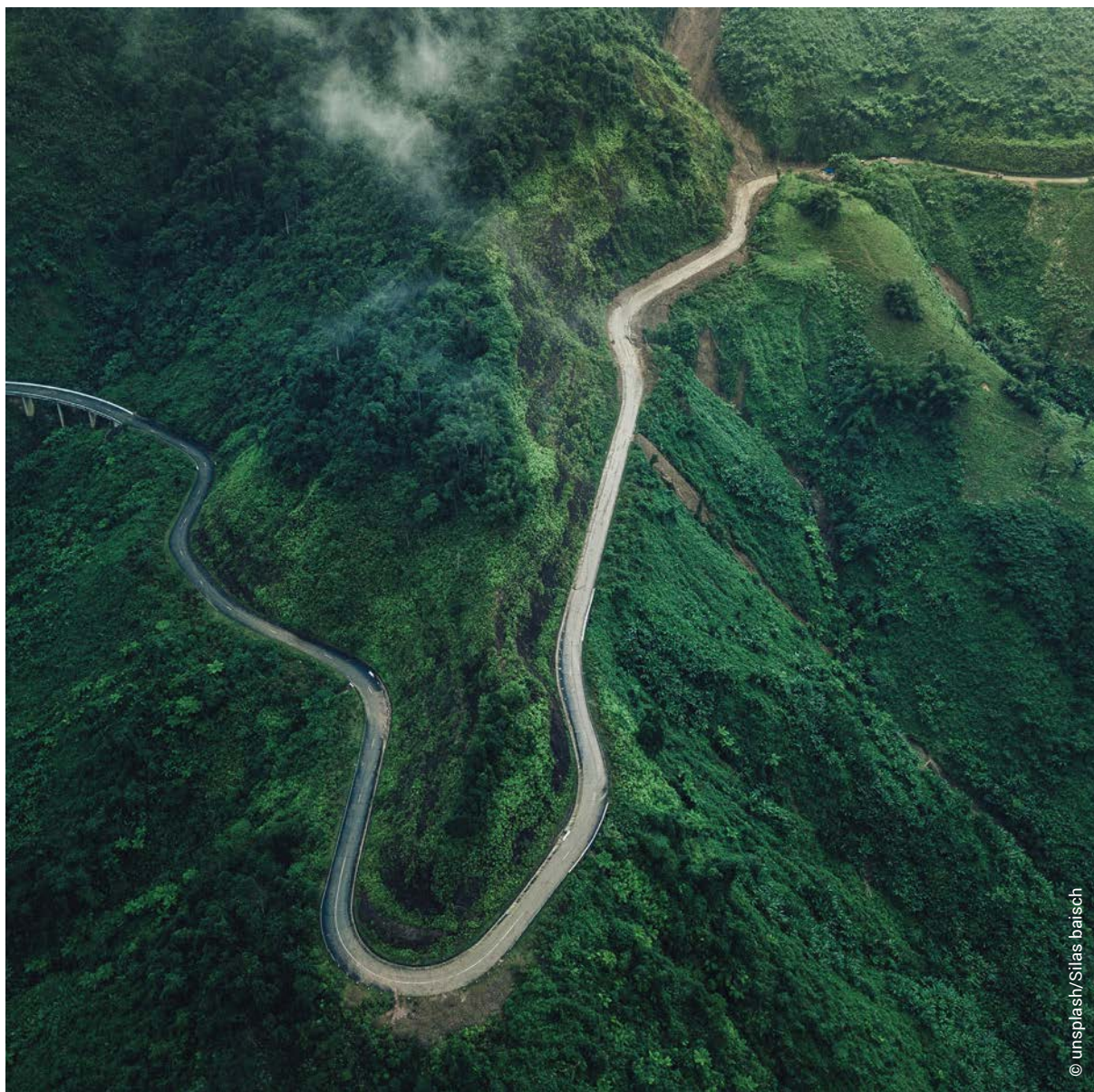
Several low-tech solutions to preserving the environment, which are also compatible with markets, include organic farming¹⁸² (Box 34), no-till farming¹⁸³ and those producers who are compliant with international sustainability certification (section 4.5). Market-based incentives can thus provide a powerful force in mitigating perverse incentives that result in environmental degradation. For instance, research by the Institute of Organic Agriculture (FiBL) and the International Federation of Organic Agriculture Movements show that in

2018, around 71.5 million hectares of farmland were under sustainable organic land management (FiBL and IFOAM, 2020). While still a fraction of the world total's agricultural land of 4,889 million hectares (FAO, 2020), the share of organic farming is rising, and is in response to shifting consumer preference towards environmental sustainability.

Imparting good agricultural practices, which is the work of extension services as well a strong component in internationally-funded development projects, can also mitigate excessive and irresponsible use of over-intensified input applications, which are at the heart of perverse incentives in land users' desire to maximize economic returns. As an example, crop diversification has long been recognized to lower ecological damage while even increasing farm profitability. Farmers diversify crops on their land base, such as through intercropping¹⁸⁶ or crop rotation, lowering the ecological risk of crop failure and low productivity, thereby reducing exposure

to food insecurity¹⁸⁷ and market risk. Crop diversification can create a biologically dynamic and diverse agricultural ecosystem, which can contribute to agroecosystem resilience while maintaining soil fertility, which reduces the need for subsidized fertilizers, pesticides and other agrochemicals.¹⁸⁸

While maintenance of crop health is essential for successful farming for both yield and quality of produce, it requires long-term strategies for the minimization of pest and disease occurrence preferably by enhancing natural control mechanisms. Specific measures include the use of disease- and pest-resistant crops, rotation of crops, including those with pasture, to provide disease breaks for susceptible crops, applying non-chemical control practices as applicable and as a last resort the tactical use of agrochemicals to control weeds, pests, and diseases following the principles of integrated pest management.



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6. CONCLUDING REMARKS

Subsidies are at the core of the sustainable development paradigm in a complex and paradoxical manner.¹⁹⁶ On the one hand, while it is largely recognized that sustainable development implies, *inter alia*, well-functioning and non-distorted markets, subsidies constitute a prominent form of market distortion in that they distort prices, affect resource allocation decisions and change the amount of goods or services produced and consumed in an economy. On the other hand, support measures and incentives alike may be needed to start a virtuous cycle of sustainable development.^{197, 198}

While the design and introduction of subsidies in many instances were to guarantee access to affordable and stable food supplies and to ensure that the land base maintained its pivotal role in sustaining rural livelihoods, support to agriculture and other land-based activities in the forms of subsidies has become entrenched in many countries throughout the world, obviating their initial purpose. In the absence of effective monitoring and regulation, these subsidies, especially on inputs (e.g., fertilizers, pesticides, irrigation), have evolved to become perverse, in incentivizing land users to use more and more of the subsidized input without due respect to their adverse environmental impacts. What is more, farmers have become extremely powerful politically, leaving governments with the notion that to reduce subsidies would be to alienate a strategically important part of the electorate.¹⁹⁹ Ultimately, perverse subsidies run counter to the global imperative of sustainable development and are paradoxical in their initial design.

This is not to say that perverse subsidies cannot be reformed, or that the negative environmental consequences of other perverse incentives can be circumvented. The multitude of case studies presented in this working paper attest to this evidence, in that land productivity can be restored, biodiversity reclaimed and ecological systems placed on a pathway towards recovery and restoration.

Subsidies that are accompanied by stringent policy filters, such as the strict enforcement of accompanying environmental laws and regulations can serve as a malignant force in ensuring that recipients of subsidies adhere to environmentally sustainable practices in the use of environmental assets, such as in Chile with tax concessions (Box 26) or in the better targeting of inputs, as in India (Box 24).

Another powerful mechanism is the promotion of transparency on subsidies, especially their adverse impacts on natural capital, and their costs to taxpayers, as in India (Box 24). The more citizens know that their tax coffers are being drawn in to a void of perverse subsidies, the more there will be political support for reform. These constituencies – with an interest in the public good rather than sectoral benefit – can engage in information campaigns about the perversity of certain subsidies. If they were to be reduced, a double dividend would transpire: there would be an end to the formidable obstacles imposed by perverse subsidies on sustainable development; and there would be a large stock of public funds available to give renewed impetus to sustainable development.^{200, 201}

Rethinking perverse environmental regulations and policies on the part of governments can also have transformative effects that foster environmental sustainability, e.g., the switch from unconstrained pesticide use to integrated pest management in Indonesia and incentivizing farmer-managed natural regeneration in Niger (Box 27), through relaxing (perverse) environmental policing. In Vietnam (Box 28), “green” conditionalities on the financing of coffee plantations are seen as a success in addressing the negative externalities associated with the country’s export-led coffee boom.

An important way to overcome impediments to reform is to build local support constituencies, especially among communities who bear the brunt of the adverse environmental impacts, as in Chile

(Box 26). Community-led action and activism can be a powerful voice in advocating and achieving reform. Credence to the notion of “our Earth” can be an important transformative pathway towards land restoration when land is appreciated by direct stakeholders, as in Jordan.²⁰²

Is restoring equilibrium via the price mechanism a viable solution? Moore and Calamai (1997)²⁰³ give a definitive yes. The authors, along with other proponents of free markets, argue that interventions which use the market, rather than trying to replace it, can play a vital role in addressing perverse incentives in sustainable development because they help reconcile environmental concerns and development needs. The authors state that:

...Economic incentives are ideal for shifting behavior as well as production and consumption patterns towards sustainability; cost-effective and flexible, these policies can also correct markets and adapt easily to changing circumstances. To promote sustainable development, it is essential that government policy establish the right incentive structure. To start, governments should identify the existing policy distortions – interventions that warp the economy and subsidize waste and environmental degradation. With this information, governments can begin to reduce subsidies that have adverse effects on the environment and on the overall efficiency of the economy.

In this spirit, the Pigovian solution to internalize externalities via a tax equal to the cost of the environmental harm and the closely allied principle of the “polluter pays” are compatible with market functioning and can be an effective instrument to address perverse incentives. However, the inherent problem is in the complexity in the measurement of damage and degradation to environmental assets. While an introductory tax could be introduced, natural capital accounting in the context of SEEA-environmental-economic accounting (section 3.3), the Paris Collaborative on Green Budgeting (Box 17), TEEBAgriFood Evaluation Framework (Box 18) or the framework of the Economics of Land Degradation (Box 19), could provide guidance on optimal levies. But these are all still at a very nascent stage. That said, the case study of Liberia (Box 16) shows that thanks to the EO4EA initiative, work on SEEA-environmental-economic accounting is progressing through employing a multidisciplinary approach for establishing environmental-economic accounts using advances in mapping technologies, especially in the use of Earth observations.

Technology and different farming paradigms can also play an important role in negating perverse incentives within a market commensurate context. Precision agriculture, which seeks to maximize

farmers’ revenues against the minimization of costs, is a promising way forward as was shown in Nigeria (Box 33). Through the use of remote sensing and artificial intelligence, precision agriculture can inform on the optimal “package” of inputs, on where to apply them, when to apply them and on how they should be distributed. This technology could render subsidies obsolete, as long as the crop is compatible with the surrounding agroecology and the country’s factor endowments.

Organic farming – a low technology paradigm – is consistent with the negation of harmful inputs and can be profitable given shifting consumer preferences towards organic or bio-products, that attest to environmental sustainability (e.g., in Benin, Box 34). In a similar vein, farming that is compliant with voluntary regulation towards sustainability, such as participation in the Rainforest Alliance, Fairtrade or conformity with ISO 14000, can be effective in mitigating the need for harmful subsidies.

The overarching problem is that the breadth and depth of anthropogenic-induced degradation is unknown. Nor is naturogenic degradation without any precision since models that proclaim to provide any empirical tractability are either outdated, or questionable as they lack convergence with other, competing models.

It is a global imperative to understand the prevalence of land degradation in order to ascertain whether the world can deliver on food security and the security of other land-based outputs. This is a particularly pressing problem to address in order for the world’s capacity to meet the needs of a population expected to reach 10 billion people by 2050. What is needed is to exploit technological advances in the mapping of land degradation at a sufficient spatial scale, e.g., through EO4EA. This could also link particular perverse incentives to environmental impacts, via natural capital accounting. It is noted that while anthropogenic activities constitute significantly towards environmental degradation, seemingly naturogenic degradation can be induced via channels of climate change that are also anthropogenic in cause. These outcomes require constant monitoring and timely congruent or consensus-based estimates of land degradation. Recent initiatives that use state-of-the-art technologies such as the EO4EA can provide consensus on this issue, in the framework of natural capital accounting, explicitly the SEEA-environmental-economic accounting.

The global imperative also applies to national authorities and policymakers to take affirmative action on environmentally harmful incentives, mostly through their outright removal or better targeting. The voices of the community should not be underestimated as a powerful voice in the advocacy of sustainable land management.

Together with their voice, the media (e.g., in India, Box 24) can play an important role in raising public awareness as illustrated in several case studies of this working paper.

With these findings, the following key messages emerge for distinct stakeholders:

- The costs of land restoration are invariably lower than the costs of inaction in preventing land degradation (**governments**).
- To assess costs versus benefits, international stakeholders need to expedite accepted standards in natural capital accounting to measure and subsequently mitigate the damaging effects of perverse incentives on the environment, especially the ecosystem condition account of SEEA- environmental-economic accounting, the Paris Collaborative on Green Budgeting, TEEBAgriFood Evaluation Framework and the framework of the Economics of Land Degradation (**international organizations, governments**).
- In this context, concerted efforts are needed to verify the scale and rate of environmental degradation, such as again through NCA (e.g., SEE-EEA or PCBG) to assess how urgent action is needed in light of future land productivity to feed the world (**international organizations, governments**).
- There is need to rethink or remove entrenched incentives that no longer serve their original design. Reforms that result in non-distortionary market impacts and which are supported by strict legal enforcement would be conducive to environmental sustainability (**governments**).
- Voluntary action and community-led activism can be a powerful catalyst in land restoration as well as voluntary participation in international certification schemes that attest to sustainability (**communities**).
- The appropriation and development of prospective technologies in accurately mapping and monitoring land degradation for structured accounting is a promising way forward, e.g., earth observations from the EO4EA. Where anthropogenic degradation is suspected, this could then be mapped back to perverse incentives that are probable in cause (**international organizations, international consortia of governments, technical institutions**).
- Advanced technologies on the ground, such as precision agriculture have enormous potential to optimize input and resource use with respect to the environment, while being compatible with farmers' profit maximization (**private sector, land users**).
- Low-level technologies, such as good agricultural practices, organic farming and no-till agriculture can markedly lower environmental impacts from land use, and importantly mitigate or remove the need for harmful subsidies (**international non-governmental organizations, extension workers**).
- Repurposing environmentally harmful subsidies (reform or removal) can provide redirected fiscal support towards land restoration and higher land productivity, which can ensure food security, job creation and the improvement of rural livelihoods – the so called “double-dividend” hypothesis (**governments**).
- To meet the needs of a growing population, there is seemingly paramount pressure to restore productivity of the Earth's land base and environmental assets, which can only be addressed by concerted action by all stakeholders. Governments do not have a monopoly on intervention, for there is need for collective responsibility to be adopted by all. The notion of “our world” can incentivize all to protect and restore the planet's land base (**all of us**).

Climate change and naturogenic processes, which have not been addressed in this working paper, are a further cause of land degradation, and are often induced by anthropogenic (human-induced) activity. Consequently, measures towards climate change mitigation constitute a further need for action.

The world needs to be set on a transformative pathway towards sustainable land management, the protection of environmental assets and the reversal of land degradation. This working paper has provided numerous examples of perverse incentives and their mitigation (or in the case of environmentally harmful subsidies, their reform or outright removal and the subsequent repurposing), to put our world on a trajectory of restoring land productivity for future generations.

Recognition of these messages will set the planet on course for enhanced food security and securing the current and future demand for other land-based outputs, all in a sustainable manner.

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- 161 The Fairtrade standard seeks to empower smallholder cooperatives with a guaranteed minimum price reflecting fair wages as well as a social premium. Fairtrade has also adopted environmental sustainability objectives as part of their certification system. FSC promotes environmentally appropriate, socially beneficial, and economically viable management of the world's forests. <https://www.fsc.org/en>

- 162 The Rainforest Alliance standard incorporates the demonstration of ecosystem health, human rights, and improved rural livelihoods, with respect to farm, forest, or tourism enterprises that are subject to audit against rigorous certification standards that require meaningful steps toward long-term environmental, social, and economic sustainability.
- 163 The creation of the ISEAL Alliance in 2002 was the first collaborative effort amongst a group of sustainability standards organizations to agree to follow common good practices in how their standards are implemented and also to work together to drive up the use of standards and certification globally. <https://www.isealliance.org/>
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