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Compensating farmers for ecosystem services

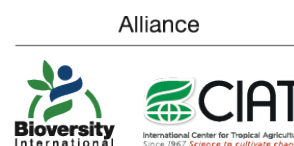
Lessons and an agenda for innovation

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Key messages

- The **CompensACTION Initiative** aims to promote payments for ecosystem services (PES) to improve smallholder farmers' incomes at large scales while incentivizing climate action, sustainable farming and other environmental outcomes.
- Key drivers for scaling up PES programs are increasing farmers' benefits in PES schemes, using public finance to leverage private sector capital, and facilitating PES project readiness.
- Priority areas for action to meet the **CompensACTION Initiative** objectives are to:
 - Foster technical innovation and disruption to support low-cost, high-volume PES transactions.
 - Increase public and private investment to scale up PES programs.
 - Support public policy reform to establish national frameworks for PES schemes.
- G7 members and other countries can play a leadership role in mobilizing action.



Executive summary

Payments for ecosystem services (PES) to smallholder farmers in low- and middle-income countries (LMICs) can increase and diversify farmers' income while also incentivizing practices for ecosystem services, including climate change mitigation and adaptation. The world's 480 million smallholder farmers produce one third of the world's food supply on one quarter of global agricultural area and often earn less than USD 1.25/day. Yet schemes for paying smallholder farmers in LMICs for ecosystem services have been limited.

The **CompensACTION Initiative** seeks to promote PES innovation at large scales to increase the incomes of smallholder farmers in LMICs while incentivizing climate action and environmental outcomes. The Initiative has five objectives:

1. Increase and diversify the incomes of smallholder men and women farmers, while also supporting long-term investment by farmers.
2. Incentivize practices for sustainable farming practices that lead to resilient and low-emission food systems, as well as other ecosystem services on- and off-farm.
3. Deliver co-benefits with compensation mechanisms such as improved credit ratings and easy access to finance for farmers.
4. Diversify financial instruments and increase public and private funding in addition to climate finance.
5. Attract international climate finance for adaptation and mitigation action in the agricultural sector that leads to improved ecosystem services maintenance.

The unique feature of the CompensACTION Initiative is its emphasis on improving smallholders' income from PES and on smallholders' contribution to the supply of carbon credits and other ecosystem services at large scales. It focuses on increasing the supply of ecosystem services from smallholder agriculture at large scales and better linking this to public and private finance mechanisms. Implementation should be highly cost efficient to deliver maximal benefits to farmers and have robust measurement, reporting and verification (MRV) to ensure environmental integrity. The Initiative will prioritize climate change mitigation and adaptation, while aiming to compensate for multiple ecosystem services.

CompensACTION will build on the experience of existing PES schemes (Table 1). Based on this experience, three levers can help achieve the objectives of the Initiative at scale: improving benefits captured by farmers; blending public and private finance for large-scale action; and supporting readiness for implementation of PES mechanisms. Three corresponding priority actions are recommended for scaling up PES schemes:

1. Foster technical innovation and disruption in PES to support low-cost, high-volume transactions that make agriculture a competitive sector for purchase of carbon and other ecosystem service credits. These actions can enhance readiness and farmers' capacity to capture a higher proportion of benefits. More private investment is likely where major disruptions or game-changing solutions occur.

Novel, low-cost MRV for multiple ecosystem services is a priority for reducing costs. Digital resources and remote sensing for monitoring ecosystem services are promising areas for MRV innovation. Cooperation across projects or countries to develop affordable MRV could help drive down the future costs of these approaches. Harmonized standards for MRV would help reduce costs of project design and integration with national reporting. In many places, activity data will continue to be the major source of data and can be delivered using voice recognition or SMS texts by phone.

2. Increase public and private investment to scale up PES to mobilize the large-scale action needed to meet climate targets, governments and public finance institutions. Investment can start by building on and complementing existing payment programs. Governments can redirect agricultural subsidies to ecosystem services and use public finance to develop innovative and diversified approaches. In addition, public finance can be used to attract and de-risk private capital. These actions should enhance the volume of finance available for payments and further strengthen readiness.

Better understanding the business case for private sector involvement and developing different options for private sector finance will be necessary to create viable investment models. Monitoring the costs and

Executive summary

benefits of blended finance arrangements and their impacts can support improvements over time.

Setting benchmarks for blended finance performance can encourage high standards of efficiency and impact. Improved standards and transparency for corporate insetting schemes will enable these credits and payments to be more robust.

3. Support public policy reform. Overwhelming evidence suggests that the largest scale of impacts occur where policies for PES are well developed. Policies can establish 1) goals for the provision of multiple ecosystem services (e.g., carbon, water quality, soil health, agrobiodiversity, community well-being), 2) institutions for benefit distribution, 3) the setting of fair and minimum prices for carbon and other ecosystem services, 4) the enabling conditions for compensation, especially legal rights to the ecosystem services being traded and conflict management, and 5) nested accounting for project outcomes at subnational and national levels. More advanced policy options include harmonizing payment schemes, MRV methods, and ecosystem valuation within and across countries. More exploration and exchange among LMICs is needed to support integrated policy development across these five areas. Improved assessment of PES schemes can inform the development of subsequent interventions.

Beyond the three action areas, research priorities to support the CompensACTION Initiative are to better understand how PES influences farmers' incentives to use practices that support climate change mitigation, adaptation and environmental sustainability. Questions include which interventions support farmers to change their practices in different places, the resulting quality and quantity of ecosystem services delivered, who benefits, and by how much. The percentage of PES benefits captured by farmers and the percentage of added income will be important indicators. Other questions include 1) how to determine fair prices for ecosystem services, 2) what proportion of ecosystem payments should go to farmers and how can such targets be used as industry benchmarks, 3) what safeguards are needed to minimize unintended negative social or environmental impacts, and 4) how can farmers generate higher incomes from multiple ecosystem services?

The recommendations and analyses in this paper are intended to serve as the basis for engagement by the G7 members and other countries and development partners to catalyse support for the CompensACTION Initiative. The Initiative is open to all countries.

Examples of actions include:

- Champion a priority action area and mobilize cooperation.
- Co-invest in a network of pilot projects with common methodology.
- Contribute to multilateral action on climate finance
- Support a common set of CompensACTION indicators or thresholds.
- Conduct research on fair prices, target levels for farmer benefits, novel MRV technology.
- Facilitate exchanges with partner countries, convene stakeholders, and encourage discussions with the financial sector.

The G7 countries can play a leadership role in payments for ecosystem services in ways that improve farmers' livelihoods, ensure food security, meet climate change mitigation and adaptation objectives, foster sustainable land management and deliver on further Sustainable Development Goals. Payments can provide much needed incentives for climate action in the agriculture sector, while also helping to diversify and enhance farmers' livelihoods.

1. Introduction: A lack of compensation for ecosystem services in agriculture

Payments for ecosystem services (PES) to smallholder farmers in low- and middle-income countries (LMICs) can increase and diversify farmers' incomes while also incentivizing practices for ecosystem services, including climate change mitigation and adaptation. Yet mechanisms for payments to farmers have been limited. While compensation programs exist for farmers in some high-income countries, smallholder farmers in LMICs are rarely compensated for their actions.

The world's 480 million smallholder farmers produce one third of the world's food supply on one quarter of global agricultural area while often earning less than USD 1.25/day [1,2]. As smallholder farmers' productivity depends on healthy ecosystem services such as soil health, water provisioning, pollination and pest and disease control [3], maintaining these services is essential to their livelihoods and broader food security. Smallholders' practices can also contribute to climate change mitigation and adaptation and other public ecosystem services such as conserving forests and sequestering carbon.

A new generation of innovation is expanding opportunities for PES in agriculture [4]. Examples include (Table 1):

- In the Rimba Collective, palm oil buyers and processors in Indonesia contribute to a conservation fund based on the level of palm oil they procure. A collective then allocates the funds to conservation and reforestation projects.
- A national law in Colombia enables companies to support to ecosystem service projects in exchange for their tax payments.
- The ProSoil development project is facilitating the sale of carbon credits from improved soil health to support sustainable agro-advisory services in seven countries.

Finance for smallholder PES schemes can draw on the resources allocated to global, national, and private sector policy targets related to the Paris Agreement and Sustainable Development Goals. In 2020, USD 133 billion was spent on nature-based solutions, 86% from public sources and 14% from private ones [5]. Total spending needs to increase to USD 536 billion annually to achieve

global targets for climate change, biodiversity and land degradation by 2050, a USD 4.1 trillion gap in investment compared to 2020 [5]. Payments to smallholder farmers in LMICs, as stewards of significant areas of land, can help to jointly meet environment and development goals.

Despite this opportunity, the demand for ecosystem services is increasing faster than the marketable supply [4]. Private sector demand is growing rapidly as companies seek to meet their climate commitments, especially for carbon credits in the food supply-chain. A McKinsey report estimates that by 2030, carbon credit demand across all sectors will reach 1.5 to 2 billion tons of carbon dioxide and the value of carbon credits will increase by at least 15 times, creating a carbon credit market value of USD 5 to 50 billion [6]. By 2030 there could be a total potential supply of carbon credits of 8-12 billion tons of CO₂ per year, of which more than half could be from nature-based sequestration or avoided nature-based carbon loss. However, the difficulty of mobilizing these credits reduces the credits likely to be available to 1-5 billion tons of CO₂ per year.

The availability of structured and investable ecosystem service projects for agriculture in LMICs is particularly low. Few mechanisms exist to reliably aggregate, manage, and deliver results on the ground at large scales for smallholder farmers. Most smallholder farmers and agricultural development projects are not "market ready" and cannot afford the transition to PES market participation. As a result, PES programs for agriculture in LMICs remain limited in scale. Many farmers and agricultural development projects are also likely to be better suited to non-market mechanisms using public funding or corporate insetting that has lower transaction costs and more conservative levels of compensation.

To scale up farmers' incentives to deliver critical ecosystem services in agriculture, there is a need now to develop the secure financial, commercial, and legal arrangements for linking demand to a flexible and diverse supply of carbon and other environmental outcomes. This must be done together with interventions that support farmers' technical, institutional, and financial capacities to engage in these transactions. Programs should be highly cost efficient to deliver maximal benefits to farmers.

A compensation program developed at scale could enhance and diversify smallholder farmers' incomes as part of a just rural food systems transformation.

The G7 Food Security Working Group (FSWG) initiated the CompensACTION Initiative for Food Security and

a Healthy Planet with the aim to 1) facilitate discussions among stakeholders from the policy, science, and private sector, and advance globally relevant recommendations for compensation mechanisms driving food system transformation, and 2) foster implementation partnerships in piloting and scaling-up compensation mechanisms. A workshop of the G7 Food Security Working Group, with leading experts in the field was held 5-6 July 2022.

This paper is part of the CompensACTION Initiative. The recommendations and analyses serve as the basis for engagement by the G7 members and other development partners to catalyse support for large-scale payment programs for carbon and other ecosystem services for smallholder farmers in LMICs. The CompensACTION Initiative has five objectives:

1. Increase the incomes of smallholder men and women farmers to meet or exceed a minimum living standard, diversify incomes (smart income mix) and support long-term investment by farmers. This includes providing fair compensation and a target proportion of PES benefits (e.g., 90%) to farmers for the ecosystem services they steward.
2. Incentivize practices for sustainable farming practices that lead to resilient and low-emission food systems, as well as other ecosystem services on- and off-farm.
3. Deliver co-benefits with compensation mechanisms, such as improved credit ratings and easier access to finance for farmers; strengthened advisory services and access to markets.
4. Diversify financial instruments and increase public and private funding in addition to climate finance (e.g., official development assistance, tax revenue) by developing and testing compensation mechanisms that are scalable. Use public sector finance to manage risk and attract private capital to smallholder farmer systems. Incentivize governments to redirect subsidies for agricultural inputs to ecosystem services, for example, by reducing the cost of inputs where ecosystem service outcomes are delivered.
5. Attract international climate finance for adaptation and mitigation action in the agricultural sector that leads to improved ecosystem services maintenance.

The unique feature of the CompensACTION Initiative is its emphasis on improving smallholders' incomes from PES and on smallholders' contribution to the supply of carbon credits and other ecosystem services at large scales. Policy and finance support will be needed to achieve scale. Implementation should be highly cost efficient to deliver maximal benefits to farmers and have

robust monitoring, reporting and verification (MRV) to ensure environmental integrity. The Initiative will prioritize climate change mitigation and adaptation, while aiming to compensate for multiple ecosystem services.

2. Background: State of ecosystem services payments in agriculture and lessons learned

Payments for ecosystem services are defined as incentives provided to farmers or land managers in exchange for benefits from nature such as the provisioning of food and fiber, water, genetic resources or biodiversity; regulating services such as ecosystem-based adaptation, and control of climate, floods, landslides, waste management, or pest and diseases and supporting services such as nutrient cycling; or cultural services. They closely align with the concept of nature-based solutions, defined as "Actions to protect, conserve, restore, sustainably use and manage natural or modified terrestrial, freshwater, coastal and marine ecosystems, which address social, economic and environmental challenges effectively and adaptively, while simultaneously providing human well-being, ecosystem services and resilience and biodiversity benefits" [7].

PES is used in this paper to refer to all potential ecosystem services from smallholder agriculture, including services related to climate change mitigation and adaptation. In this section we review the general case of PES and then give special attention to the carbon market as a priority component of the CompensACTION Initiative.

The benefits of ecosystem services can be substantial. According to the World Economic Forum (WEF) half of global GDP (USD 44 trillion) depends on ecosystem services, including USD 2.5 trillion from agriculture and USD 1.4 trillion in the food and beverages industry [8]. The cost of degraded ecosystems is also significant. The estimated loss of ecosystem services due to land degradation is USD 6.3-10.6 trillion annually. Every year land degradation costs about 10% of global GDP in lost ecosystem services [9].

PES schemes are diverse in design, payment type, payment sources and regulatory context. Incentives for ecosystem services may be provided to farmers through direct payments, subsidies, the provision of goods or services; permits to resource rights, price premiums, or markets [4]. Enabling conditions for PES schemes include

legal regulations, public budget allocations, private contracts, certification and voluntary and educational approaches. Buyers of ecosystem services may be an individual, government entity or corporation. Schemes that require compliance with a policy are more likely to achieve larger scales of implementation than those that are voluntary.

2.1 State of payment for ecosystem services in agriculture

Public funding has been the most common source of finance for PES, accounting for 65% of projects in Latin America, and 70% of projects in Europe and North America [10]. Subsidies and national regulation have been a common PES approach for services that provide a public good, such as “greening payments” in the European Union for arable land set aside for biodiversity, creation of permanent grassland or crop diversification. Other PES approaches for public goods have included collective payments into a fund, such as the Latin American Water Funds Partnership; the purchase of resource entitlements such as Australia’s Restoring the Balance program, which purchases water rights from farmers to ensure instream water volumes; and offsets, such as Costa Rica’s national PES program for forest conservation.

According to a 2018 review, there were 550 active PES programs globally generating an estimated USD 36–42 billion each year for services related to water, forests and land use, and biodiversity or habitat provision [11]. Most schemes compensated farmers for the foregone use of a resource rather than providing additional income. The value of payments for non-carbon services has been most often linked to the beneficiaries’ opportunity cost of foregoing use of a resource or the cost of resource conservation. Prices for services such as water and biodiversity are more often locally determined compared to carbon payments, which tend to be traded globally and linked to global policy targets. Methods for PES in agriculture are underdeveloped. While more than 50 different methods are available to assess ecosystem values, only 16% of these methods apply to cultivated areas [12].

The water sector, which has generated a market of USD 13.7 billion in 2015, is the most mature and widely distributed set of PES programs geographically, with an emphasis on watershed protection. China has been the largest supplier of PES subsidies for water with 69 programs. China’s Sloping Lands Conversion Program

has paid ~53 million farmers to stop cultivating on steep slopes to control water quality and flooding.

PES for biodiversity, including habitat conservation, has been the least developed and transparent sector, due to a lack of metrics, the difficulty of assigning rights, and a lack of institutions for collecting fees. Biodiversity programs generated an estimated USD 2.5–8.4 billion by 2016 [11]. For example, the Malua Biobank in Sabah, Malaysia secured private investment expected to be sufficient to restore and maintain 34,000 ha of rainforest habitat for orangutans for 50 years.

The size of the market for forestry and land use carbon was about USD 11.6 billion by 2016, with forest-based credits predominating [11]. Development of this market introduced the use of credits for avoided deforestation through programs such as Reduced Emissions from Deforestation and forest Degradation (REDD+), and the provision of readiness funds, for example by the World Bank Forest Carbon Partnership Facility. Readiness funds build capacity of local entities to distribute finance, deliver results, and account transparently for the funds used. While avoided deforestation by agricultural commodity producers remains a priority, the credibility, transparency and effectiveness of payment schemes has remained an issue.

Trends in PES for agriculture include: 1) increasing pressure on governments to redirect agricultural subsidies toward ecosystem services and other environmental outcomes [13]; 2) coupling PES with other incentives and enabling conditions such as certification or crop insurance to enhance benefits for farmers; 3) an increasing role of the finance and corporate sector in providing payments; and 4) a predominance of interest in buying carbon, with other ecosystem services seen as providing co-benefits.

2.2 State of carbon credit mechanisms in agriculture

Carbon credit mechanisms include 1) international UNFCCC mechanisms such as the Clean Development Mechanism and the Paris Agreement’s provisions for internationally traded mitigation outcomes; 2) national and subnational government compliance markets such as California’s 2006 cap-and-trade regulation; 3) voluntary markets guided by standards such as the Verified Carbon Standard; 4) corporate action to offset emissions within their supply chain or sphere of influence, an approach referred to as carbon insetting (e.g., Livelihoods Fund),

and 5) international funds (e.g., BioCarbon Fund).

Climate finance for agricultural carbon credits has been limited compared to other sectors. In 2021, only ten of 29 carbon credit market initiatives around the globe included agricultural practices, with the largest being the Verified Carbon Standard [4,14]. Five initiatives were independent crediting systems (i.e., American Carbon Registry, Climate Action Reserve, Verified Carbon Standard [14], Gold Standard, and Plan Vivo) and five were domestic programs (i.e., Alberta, British Columbia, Australia, California, Kazakhstan, and Thailand).

Increased corporate interest in offsets from carbon sequestration is driving higher demand for carbon credits, including in the food and agriculture industry. Carbon credits from the land use sector increased 159% between 2021 and 2022 and accounted for more than a third of total credit issuances in 2021. Most credits (~ 70%) were generated in Asia, predominantly in Cambodia, Indonesia, and China, followed by Latin America, particularly in Brazil and Peru [4]. Projects to sequester carbon through afforestation, carbon sequestration in agriculture and improved forest management contributed to a fifth of this growth.

Trends in the carbon market for agriculture include: 1) demand is expected to exceed supply in the near future; 2) consumer-facing corporations are more likely to buy credits with co-benefits that contribute to the Sustainable Development Goals (SDGs) than to buy credits only for carbon, even if the latter are at a lower cost; 3) voluntary markets are becoming more diverse, reflecting diverse buyer preferences, in comparison with compliance markets; and 4) buyers are seeking carbon removals to achieve their net-zero emissions goals, rather than emission reductions, yet emission reductions will be necessary to ensure long-term structural shifts to low emissions production systems [4].

2.3 Current PES projects

A summary of selected successful PES projects is provided in Table 1 to highlight the range of current PES schemes. They emphasize projects that include carbon payments. Examples are provided for the private voluntary carbon market, fees based on commodity sales, impact investment funds, public PES policy, multilateral development bank projects, and private sector service providers that bundle technical assistance, payments and monitoring. Costa Rica's PES program, established in 1996, was the first large-scale ecosystem payment

scheme to landholders of its kind, as was the Kenya Agricultural Carbon Project, established in 2009, for carbon payments in smallholder agriculture. The largest impacts for climate change mitigation appear to be associated with government compliance programs, such as California's cap-and-trade mechanism. The State of Finance for Nature report provides additional case studies, including business cases [5].

2.4 Challenges and success factors in PES programs

Table 2 summarizes the challenges and success factors, based on the literature and experience to date.

While interest to bundle or stack benefits from multiple ecosystem services remains a goal of many PES developers, combining benefits has proven difficult due to differences in methods and buyers among ecosystem services. Methods for equivalent accounting, and transparency in recording benefits and demonstrating additionality has been proposed as a way forward [23].

If revenues are sufficient, PES may, in the future, increasingly provide an alternative source of development funding for sustainable agriculture. As part of the ProSoil project, GIZ, on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ), is setting up a soil carbon certification and technical assistance scheme to foster sustainable land management in Western Kenya. The soil carbon payments set incentives for sustainable land management and finance results-based agro-advisories for small-scale farmers. The carbon credits will be offered to private sector enterprises with a credible carbon neutrality plan to offset their residual emissions [24].

3. The solution: Improving farmers' compensation

Three levers can help achieve the objectives of the CompensACTION Initiative at scale: 1) improving benefits captured by farmers, 2) blending public and private finance for large-scale action, and 3) enhancing project readiness. The information below reflects input on these three topics from participants at the CompensACTION Workshop on 5-6 July 2022.

TABLE 2: Challenges and success factors in PES programs

Challenges
<p>High costs: High set-up, monitoring, reporting and verification (MRV) and benefit distribution costs, especially where large numbers of smallholders are involved [15]. Low prices for ecosystem services make these costs unaffordable.</p>
<p>Need for upfront finance: Inadequate upfront finance to cover set-up costs and the investments needed for practices and technologies that are capital intensive or require technical assistance.</p>
<p>Low benefits: Low market and social value of ecosystem services and asymmetric power relationships among farmers and buyers of ecosystem services that limit farmers' ability to negotiate higher payments [16].</p>
<p>Market complexity and uncertainty: Globally, ecosystem service markets are fragmented, decentralized, complex, and diverse, and ecosystem service prices are uncertain due to market shocks, input supply chain problems, weather and climate variability, global economic and political crises [17].</p>
<p>Low capacity: Inadequate technical and large-scale implementation capacity among farmer-support organizations, including lack of expertise, finance, or capacity among program implementers to use new digital technologies that could reduce some costs.</p>
<p>Limited public policy or finance: Poor integration of PES in public policy and public finance, especially when compared to policies and subsidies for agriculture that have aggravated environmental impacts.</p>
<p>Lack of information: Poor data and high uncertainty for the finance needed [5] and costs and benefits of practices and their environmental or social impacts in specific contexts, despite efforts to systematize this information [18].</p>
Success factors
<p>A usable supply of ecosystem services: A supply of ecosystem services that is structured to facilitate cost-effective investment and accountability for results [19].</p>
<p>Activities that enhance ecosystem services: Well-tested and clearly identified agricultural practices that enhance ecosystem services, such as avoiding conversion of forests and high carbon landscapes, agroforestry, use of cover crops, efficient use of nitrogen fertilizers, soil and water conservation, and buffer zones around waterways.</p>
<p>Incentives for farmers to act: Sufficiently competitive benefits that incentivize farmers to use sustainable practices. Enhanced agricultural productivity and land use benefits, including climate change adaptation, rather than payments based on low carbon prices are the strongest incentives for farmers to change their behavior [15]. Farmers' values, opportunity for improved human or social assets, and peer pressure may also provide incentives [20].</p>
<p>Steady finance: A sustainable source of finance for payments [19]. National tax revenues (e.g., fuel tax) or international assistance have been typical sources of finance, but private sector finance is generally expected to drive more scale due to the larger volume of private sector finance available [21].</p>
<p>Bundled services: Coordinated provision of technical advice, finance, and MRV [22].</p>
<p>Comprehensive monitoring: Efficient monitoring of the full range of generated benefits [15].</p>
<p>Policy support: National legal frameworks for PES that provide regulatory and institutional support, including secure property rights to land or ecosystem services, valuation methods or prices, public budget, establishment of special-purpose funds, fair distribution of benefits, conflict management, prohibition of land-use change, or creation of protected areas, for example. National policies should coordinate PES and carbon markets for non-agricultural land uses to avoid perverse effects on food production. For example, in New Zealand, carbon prices for forests are leading to the planting of trees on low-value agricultural land.</p>
<p>Attentive to smallholder farmers: Recognition of smallholder farmer's needs, use of participatory approaches and a strong relationship between project organizers and farmers [15]. PES markets should work to include smallholder farmers and not lower incomes or weaken their assets [16].</p>
<p>Aggregation: Organized farmer groups or jurisdictions that help reduce the costs from delivery of support services and allow delivery of aggregated benefits.</p>
<p>Adaptive learning: Readiness to experiment, adapt, and learn by doing, including scientific evidence and site-specific information for land use impacts on ecosystem services [21].</p>

3.1 Improving benefits to farmers

Farmers' incomes from carbon markets or other PES are low, typically less than 5% of total incomes. High transaction costs and low prices are the primary constraints. To overcome these challenges, PES project developers usually aggregate payments to deliver goods, services or income at community scales rather than pay farmers directly, which can be costly and provide insignificant incentives. These aggregated benefits include improved input supplies, input substitution, technical assistance, soil health improvement, land titling, or infrastructure.

Price premiums to farmers for certified products are one area where individual farmers have received direct benefits. However, price premiums for carbon benefits have been most significant only for a few well-structured and internationally traded commodities such as coffee, cocoa, and palm oil. Price premiums are not likely to be sufficient to incentivize producers for staple food crops and livestock, the largest part of the agriculture sector, towards low carbon and more sustainable agricultural practices.

Low carbon prices have meant that prospective agricultural benefits are a stronger driver of farmers' behavior change than the income from carbon credits. Farmers often see carbon credit income as a secondary benefit.

Promising areas of innovation to enhance farmers' incomes include:

- Setting target levels of benefits to be delivered to farmers. For example, Acorn promises USD 15-20 per ton of carbon and 90% of benefits going to the farmer. As costs vary by context, defining a process or methodology for setting maximal benefits to farmers may be a more practical alternative approach.
- Improving farm and value chain climate resilience and productivity, such as drought tolerance through improved seed and irrigation systems.
- Reducing MRV costs, for example by 1) modeling rather than measuring impacts, 2) using digital technology, including remote sensing, 3) building local technical capacity, or 4) linking smallholders with larger landholders that are also participating in the carbon market to gain efficiencies of scale.
- Enhancing MRV robustness to deliver higher quality carbon credits and other ecosystem services that can be sold at higher prices.

- Prioritizing projects in areas with high levels of carbon or other ecosystem services can support higher benefits and early success. Carbon farming likely works best in agroecosystems with high production potential and levels of biomass, involving trees or forests.
- Creating business opportunities in PES operations that reduce costs and provide local employment. For example, FMO, the Dutch Entrepreneurial Bank, created local finance distribution services to deliver PES benefits in a project area. The Naandi Foundation used PES to support farmers to more successfully market produce through cooperatives. A project of the European Forest Institute engaged local timber companies to plant shade trees for cocoa systems.
- Stacking or bundling carbon benefits with water, biodiversity, or other ecosystem services. A shopping basket approach, which allows sellers to sell specific services to different buyers may enable more efficient targeting of buyers and generate higher returns [16].
- Saving costs by selling carbon directly to the end user rather than through a broker.
- Setting benchmarks or standard methods for the value of ecosystem services to encourage fair food prices and payments.
- Improved recording of costs and impacts of payments, particularly for poor farmers.
- Using true cost of food accounting to integrate environmental costs into the product price and generate higher prices to farmers for their produce and ecosystem services. As this approach also raises the cost of food, it is not appropriate in places with food insecurity.

3.2 Blending public and private finance to achieve large-scale action

Low-income smallholder farmers often require low-interest and long-maturing loans to adopt new sustainable farming practices but lack collateral and access to these types of finance. Blended finance can help attract both public and private investment at scale in forms that can support farmers. Twenty-eight percent of blended finance occurred in the agriculture sector in 2020 [25]. Four models of blended finance are most common: 1) concessionary capital, 2) guarantees or insurance, 3) grant-funded technical assistance, and 4) grant-funded transaction design of new investment vehicles [25]. Funds may be applied to finance stress points, such as support for value chain or business development, linking of investors and PES projects, technical assistance

facilities, incentive payments, risk sharing, or grants and concessional funding in an investment fund to lower the cost of capital [25].

Increased public finance for ecosystem services can help catalyze these models at scale, including climate finance (Figure 1). Only 3% of USD 580 billion in climate finance in 2019/20 was allocated to agriculture and of that about half (~USD 10 billion) was allocated to small-scale agriculture. Funding for adaptation was more than twice that of mitigation.

Sources of public finance include national budgets, development finance institutes, international finance institutions, and regional development banks. Re-purposing government subsidies could be an important source of public funding for PES, although political will and experience are limited, and more proof of concept is needed. Governments provide on average USD 600 billion/year in agricultural subsidies [13]. This support is concentrated in the countries that produce 66% of the world’s crops and livestock. Yet only 5% of government subsidies support conservation, while 70% directly support farmers’ incomes [13]. Per dollar of public spending, farmers receive only 35 cents [26], so farmers’ capture of subsidies remains low.

Coordination beyond the scope of a single program or policy can support synergies and avoid unintended consequences. To enhance the efficiency of public funding, PES and agricultural development should be aligned. In sourcing private sector funds, care should be taken not to use funding from companies that contribute to environmental loss in the first place.

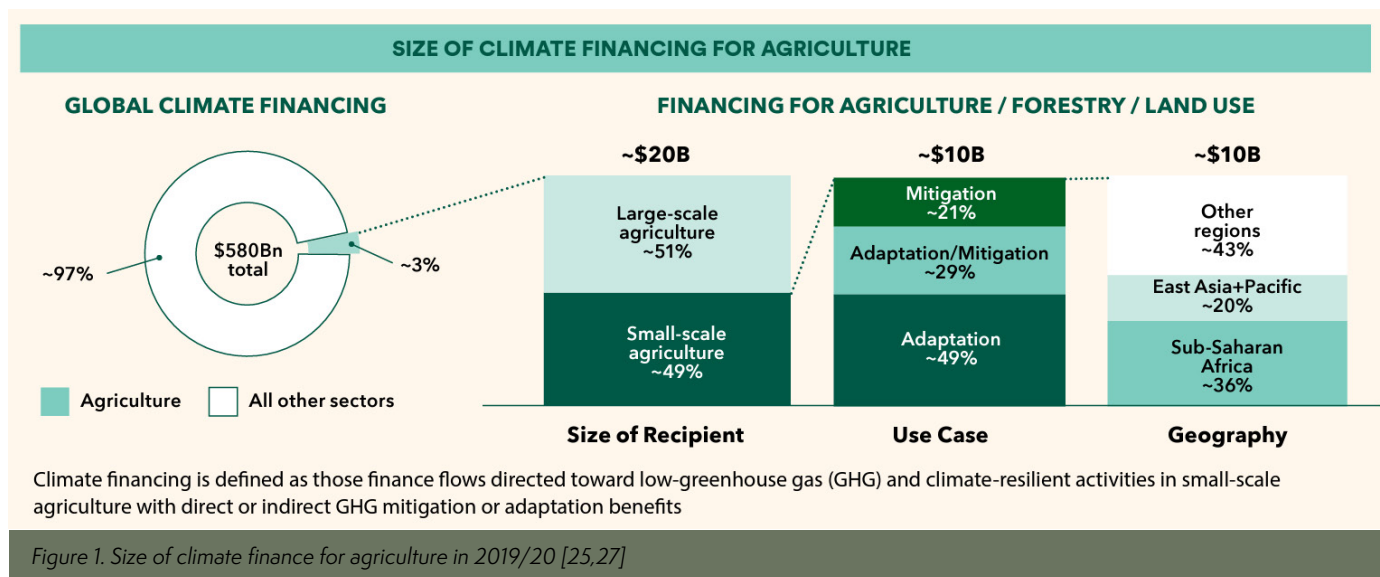
The impact and efficiency of different models for blended finance should be tested and improved over time. Industry benchmarks could be established for blended finance’s economic impacts and efficiency in smallholder agriculture.

3.3 Building national and project readiness

Building the capacity of countries and projects for finance, technical assistance, MRV, and institution strengthening will enable more successful finance, ecosystem services delivery, markets, and transparent, robust accounting of outcomes. A clear and stable regulatory environment is needed to attract investment [16]. Agility in project development and implementation is essential. Building capacity at both national and sub-national levels will be important to support implementation at scale.

Carbon farming and PES will require a different policy framework than REDD+ because of the need to aggregate smallholder farmers, the role of private versus public land management, the higher cost of MRV, and the land use practices involved. REDD+ readiness conditions are therefore not necessarily transferable to PES. One lesson from the experience of REDD+ readiness funding, however, is that countries did not always act upon readiness funding once received and thus better vetting and evidence of the country’s commitment and capacity is needed to ensure better use of readiness investments.

While MRV can be costly and a challenge to establish, data on how much more farmers earn and environmental outcome is crucial for learning and further political



CompensACTION Initiative

Challenges

Agricultural practices that lead to ecosystem degradation

Smallholder farmers lack income to meet basic needs

A lack of compensation mechanisms in low-income countries

Low market value for carbon and other ecosystem services

Actions

- 1 Increase benefits to farmer: Lower MRV & aggregation costs
- 2 Scale up with blended public-private finance
- 3 Use policy to set targets and standards, increase capacity and reach scale

Impact

Increased ecosystem services: climate change mitigation, resilience, biodiversity, water quality

Improved smallholder incomes, food security, well being

Our aim

Enhance payments to farmers to incentivize best practices and increase incomes



support. Building sustainable, cost-effective MRV services and securing the needed funding is an area that requires ongoing attention and new business models. Standardizing MRV and valuation of ecosystem services could accelerate the integration of ecosystem accounting into national policy [12].

Investors will need to balance the benefits of building readiness against the need to deliver ecosystem service outcomes, especially given the urgency to deliver carbon reductions quickly.

4. Recommendations for catalyzing farmer compensation for ecosystem services

To achieve the objectives of the CompensACTION Initiative, priority actions are identified below. The Initiative seeks to complement existing international PES programs by focusing on **increasing the supply of ecosystem services from smallholder agriculture at large scales and better linking this to public and private finance mechanisms**. While ecosystem services and PES mechanisms are defined broadly, and should be addressed comprehensively, **climate change mitigation and adaptation** are a priority in the near term. Agroforestry and avoided deforestation are included in the scope of agriculture. The focus is on payments in exchange for a quantified provision of ecosystem services.

Actions were selected that can best drive the leverage points of 1) increasing farmers' proportion of benefits, 2) catalysing private investment through blended finance, and 3) supporting readiness for implementation of PES mechanisms that integrate carbon and other ecosystem service payments.

Research on PES for smallholder farmers in LMICs is needed to validate its impact and guide its design. Establishing strong MRV systems can help eliminate greenwashing and inform how to best support long-term environmental integrity. A better understanding is needed of how PES influences farmers' incentives to use sustainable practices, the resulting quality and quantity of ecosystem services delivered, who benefits, and by how much. The percentage of PES benefits captured by farmers and the percentage of added income will be important indicators. Other questions include 1) how to determine fair prices for ecosystem services,

2) what proportion of ecosystem payments should go to farmers and how can such targets be used as industry benchmarks, 3) what safeguards are needed to minimize unintended negative social or environmental impacts, and 4) how can farmers generate higher incomes from multiple ecosystem services? For example, global prices or standardized accounting and methods for bundling and stacking ecosystem services may incentivize programs to include multiple services. Global trends in demand and supply for ecosystem services should also be differentiated for LMICs.

The design of compensation mechanisms and support for enabling conditions should anticipate future needs and trends in markets, food systems sustainability, agricultural conditions, and climate policy. Compensation mechanisms and enabling conditions should be designed to be inclusive of more vulnerable and low-income farmers, as well as avoid corruption or increase of conflict. Monitoring of quantified costs and benefits should enable learning and adjustment.

We recommend three umbrella areas for priority actions:

1. Foster technical innovation and disruption in PES to support low-cost, high-volume transactions that make agriculture a competitive sector for purchase of carbon and other ecosystem service credits. These actions would enhance readiness and farmers' capacity to capture a higher proportion of benefits. More private investment is likely where major disruptions or game-changing solutions occur.

Novel, low-cost MRV for multiple ecosystem services is a priority for reducing costs. Digital resources and remote sensing for monitoring ecosystem services are promising areas for MRV innovation. Relevant technologies include 1) use of hyperspectral scanning to produce high resolution ground truthing of satellite imagery and reference points; 2) use of artificial intelligence and machine learning to use novel indicators from remote sensing to model carbon sequestration; and 3) detection of greenhouse gas emissions and other ecosystem services through improved sensors and remote sensing. Cooperation across projects or countries to develop affordable MRV could help drive down the future costs of these approaches. Harmonized standards for MRV would help reduce costs of project design and integration with national reporting. In many places, activity data will continue to be the major source of data and can be delivered using voice recognition or SMS by phone.

Digital resources are increasingly available as a low-cost way to provide technical assistance to farmers for new practices, although human intermediaries are still recommended to answer farmers' questions and provide coaching and follow-up. Digital Green is a potential partner that has had success with video extension. The Global System for Mobile Communications Association (GSMA) would provide an entry-point to their initiatives for digital innovation and responsibility.

Integration of finance, technical assistance and MRV services, such as the services promoted by Indigo, can provide a one-stop shop for farmers and investors/buyers that reduces the complexity and transaction costs of engaging with the market. Other innovations that decrease market fragmentation and facilitate suppliers and buyers to connect will similarly reduce this hurdle.

The level of MRV and associated payments should differentiate between the uncertainty of the level of ecosystem services delivered. For example, more robust MRV yields high quality carbon credits and can command higher prices. For many smallholders, less robust MRV and lower prices are likely. Maintaining environmental integrity in cases with less robust MRV can be more challenging.

2. Increase public and private investment to scale up PES to mobilize the large-scale action needed to meet climate targets, governments and public finance institutions. Investment can start by building on and complementing existing payment programs. Governments can redirect agricultural subsidies to ecosystem services and use public finance to develop innovative and diversified approaches. Public finance can also be used to attract and de-risk private capital. These actions should enhance the volume of finance available for payments and further strengthen readiness.

Better understanding the business case for private sector involvement and developing different options for private sector finance will be necessary to create viable investment models. Monitoring the costs and benefits of blended finance arrangements and their impacts can support improvements over time.

Setting benchmarks for blended finance performance can encourage high standards of efficiency and impact.

Improved standards and transparency for corporate inssetting schemes will enable these credits and payments to be more robust.

Building new businesses that support ecosystem service provision and their compensation can increase the proportion of income flowing to the community and readiness. Businesses may support the value chain directly, such as through marketing of farm produce, or via services related to PES, such as finance distribution, technical advisory consulting, and MRV. Businesses that can drive future emissions reductions, such as methane-reducing feed additives should be a priority. In these efforts, targeting youth for employment can generate co-benefits. New business opportunities can further diversify rural livelihoods and may enable smallholders to exit from agriculture.

Though the Forest, Agriculture and Commodity Trade (FACT) Dialogue Action Group on smallholders, the United Kingdom has been exploring delivery of the FACT Roadmap action to 'Improve access to and availability of finance for smallholders, including to support the transition towards sustainable production; and strengthen enabling conditions including through living income, security of tenure, capacity building, training and technical assistance [28].

3. Support public policy reform. Overwhelming evidence suggests that the largest impacts occur where policies for PES are well developed. Policies can establish 1) goals for the provision of multiple ecosystem services (e.g., carbon, water quality, soil health, agrobiodiversity, community well-being), 2) institutions for benefit distribution, 3) the setting of fair and minimum prices for carbon and other ecosystem services, 4) the enabling conditions for compensation, especially legal rights to the ecosystem services being traded and conflict management, 5) nested accounting for project outcomes at subnational and national levels. More advanced policy options include harmonizing payment schemes, MRV methods, and ecosystem valuation within and across countries. More exploration and exchange among LMICs is needed to support integrated policy development across these five areas. Improved assessment of PES schemes can inform the development of subsequent interventions.

Experience with PES policy development in countries like Costa Rica, Mexico, Colombia, and Peru can guide policy reform in terms of sources of finance, the role of the private sector, accountability mechanisms and how to decentralize programs.

Current efforts by the World Bank and others to repurpose subsidies provide an entry point for developing

policies for public funding of results-based payments for ecosystem system services. The United Kingdom (UK) has provided £3.5m in seed funding since 2020 to support the World Bank's Food Systems 2030 Trust Fund. The UK is now developing a program for Just Rural Transition Support in which repurposing of subsidies is a lever to accelerate the transition to resilient sustainable agriculture. Since April 2021, the UK Presidency of the UNFCCC Conference of the Parties and World Bank have co-convened a Policy Dialogue on Accelerating Transition to Sustainable Agriculture through redirecting public policies and scaling innovation. Over 40 countries have engaged to raise ambition, share experience and mobilize action to deliver triple-win outcomes for people, climate and nature. The UK plans to maintain the Dialogue as an ongoing forum for government-to-government peer learning and knowledge exchange on experiences, including the delivery of PES schemes. The African Union's Comprehensive Africa Agriculture Development Programme (CAADP) similarly provides a process for deliberating and facilitating new policy measures.

5. Conclusion

The G7 countries can play a leadership role in payments for ecosystem services in ways that improve farmers' livelihoods, ensure food security, meet climate change mitigation and adaptation objectives, foster sustainable land management, and deliver on further sustainable development goals. Payments can provide much needed incentives for climate action in the agriculture sector, while also helping to diversify and enhance farmers' livelihoods.

This paper has outlined the priority actions for scaling up PES schemes as part of the CompensACTION Initiative. The Initiative is open to all countries. The G7 members and other countries are invited to develop goals and programs for improved farmer compensation through actions such as to:

- Champion a priority action area and mobilize cooperation.
- Co-invest in a network of pilot projects with common methodology.
- Contribute to multilateral action on climate finance
- Support a common set of CompensACTION indicators or thresholds.
- Conduct research on fair prices, target levels for farmer benefits, novel MRV technology.
- Facilitate exchanges with partner countries, convene stakeholders, and encourage discussions with the financial sector.

Building on existing programs will lead to faster action. The CompensACTION Initiative's objectives can provide a sustainability lens to augment existing bilateral food security programs such as those of the Canadian International Development Agency (CIDA), the UK Foreign, Commonwealth & Development Office (FCDO), the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), the Japan International Cooperation Agency (JICA), and the U.S. Agency for International Development (USAID). Multilateral sources of results-based finance include the World Bank's new trust fund, the Climate Emissions Reduction Facility (CERF), and the Green Climate Fund. Global research programs, such as the Coordination of International Research Cooperation on Soil Carbon Sequestration in Agriculture (CIRCASA) led by France's National Research Institute for Agriculture, Food and Environment (INRAE), can include CompensACTION indicators and track information on PES program cost and effectiveness.

Some aligned actions are already in the pipeline. As a first step, BMZ has established a set of pilot projects with the International Fund for Agricultural Development (IFAD) in Lesotho, South Africa, Ethiopia, and Brazil that support Priority Area 2 on public-private investment. FCDO is developing a program for sustainable land use that builds on the work of the Rimba Collective to scale up support to smallholders in tropical forest landscapes to make the transition to more sustainable and forest-positive outcomes. Table 1 provides a summary of PES projects and programs for investment or that can inform the design of new CompensACTION Initiative projects.

Ongoing assessment of the impacts of projects aligned with the CompensACTION Initiative objectives can help stakeholders to learn about how to cost-effectively achieve impacts at scale and achieve environmental integrity. A common set of CompensACTION indicators and thresholds can show to what extent the Initiative objectives are being reached. Methods for analysis of costs can provide a consistent basis for developing finance approaches and business models.

Collaboration around the CompensACTION Initiative can help focus resources, provide economies of scale, and accelerate momentum globally. Such collective action among countries aligned around a common vision for PES to farmers can lay the foundation for a new generation of payment programs.

TABLE 1: Selected existing private and public carbon and ecosystem services programs

Case name	PES/C benefits compensated	Notable features, business models and payment arrangements	Start date, number of beneficiaries, ha	Location
PRIVATE VOLUNTARY MARKET				
Scolec'te, Plan Vivo	Agroforestry and reforestation	<p>Plan Vivo focuses on smallholder farmers. Scolec'te is the longest running environmental services project on the voluntary market globally. It has been commercially self-sufficient since 2002 under the leadership of AMBIO, a Mexican environmental organization.</p> <p>USD 789,219.69 in payments to date and 684,030 Plan Vivo Certificates issued (2021)</p> <p>Contact: AMBIO at ambiofb@prodigy.net.mx, Plan Vivo Foundation at projects@planvivofoundation.org</p>	<p>1997</p> <p>1438 households on 9,668 ha (2021)</p>	Chiapas, Mexico
Kenya Agricultural Carbon Project (KACP) Vi Agroforestry, World Bank BioCarbon Fund, Verra	Soil and tree carbon through sustainable agricultural land management	<p>BioCarbon fund uses a portfolio approach and moves large amounts of finance. KACP was the first carbon project in Africa for agriculture and land. Verra buys credits, which fund project operations and serves as bonuses to farmers. Key institutions included village saving and loan associations and field advisors. Uses mulching cover crops, avoided burning, soil conservation, agroforestry.</p> <p>A total of 800,000 VCUs will be issued including the 4th verification (nd)</p> <p>Contact: Vi Agroforestry Regional Office Eastern Africa at info@viagroforestry.org; Timm Tennigkeit, UNIQUE at tim.tennigkeit@unique-landuse.de</p>	<p>2009</p> <p>30,000 farmers and 22,000 ha (nd)</p>	Nyanza and Western Province, Kenya
Agroforestry in Action /Acorn (7 projects) Rabobank with Solidaridad, Kaderes, Farmstrong Foundation, Renature and others	Agroforestry carbon storage	<p>Acorn is an agroforestry marketplace created by Rabobank that aims to lower transaction costs and raise carbon prices. Will be based on actual, not promised, or avoided removal of carbon. Remote-sensing-based measurement, reporting and verification (MRV), using Lidar and satellite imagery. Aims to provide 90-95 % of the credit revenue to the farmer.</p> <p>116,169 carbon removal units sold (nd)</p> <p>Contact: https://acorn.rabobank.com/en/contact/</p>	<p>20,895 farmers on 59,589 ha (nd)</p>	Peru, Tanzania, Ivory Coast, Nicaragua, Brazil, Colombia, Uganda

TABLE 1: Selected existing private and public carbon and ecosystem services programs (continued)

Case name	PES/C benefits compensated	Notable features, business models and payment arrangements	Start date, number of beneficiaries, ha	Location
PAYMENTS BASED ON COMMODITY SALES				
Rimba Collective, Lestari Capital	Protection and restoration of large natural forest and peatland ecosystems and habitats and resilient livelihoods for local communities	<p>Palm oil buyers and processors contribute payments based on the level of palm oil they procure. A collective then aggregates the private and public (FCDO) funds via the Sustainable Commodities Conservation Mechanism (SCCM) and channels the funds to conservation and reforestation projects in Southeast Asia.</p> <p>Projects are prioritized based on the potential to protect and restore large, continuous areas of natural ecosystems and critical habitats, such as primary rainforest, peatland and mangroves, as well as the potential for generating measurable ecosystem service benefits (such as carbon sequestration, water purification and soil health) and resilient livelihoods for local communities.</p> <p>Aims to provide USD 1 billion to protect or restore 500,000 hectares of forest.</p> <p>The Rimba Collective is supported by the Foreign Commonwealth and Development Office (FCDO) through Partnerships for Forests. Contact: hello@lestaricapital.com, Michael Zrust <m.zrust@lestaricapital.com></p>	<p>2021</p> <p>Aims to reach 32,000 individuals in forest communities over 25 years, covering 500,000 hectares of forest</p>	Indonesia, Malaysia, Papua New Guinea
IMPACT INVESTMENT FUND				
<p>Livelihood Funds Livelihoods-Araku 1 and 2 Projects, Naandi Foundation, FFEM</p> <p>See also Livelihoods Carbon Funds and Livelihoods Fund for Family Farming</p>	Sustainable agricultural land management, tree planting, large-scale regenerative agriculture	<p>Livelihood Fund aims to support large-scale projects that enable agricultural and rural communities to live in sustainable ecosystems that serve as resources for food security and livelihoods. Investors include 21 corporations, including Danone, Mars, and the German Investment Corporation, a German Financial Cooperation (KfW) subsidiary.</p> <p>The Araku projects combine large-scale replantation (15 million trees, including coffee trees, mango trees, cashew trees, moringas, teak) by the communities and improvement of their revenue and food supply.</p> <p>Araku 2: 6 million trees planted and 6000 ha restored. 96,386 Verified Carbon Units (VCUs) issued (2022.) Aims to mitigate 1 MtCO₂e over 20 years (nd).</p> <p>Contact: Bernard Giraud, contact@livelihoods.eu</p>	<p>2010</p> <p>Araku 2 aims to reach 40,000 farmers and 18,000 ha (nd)</p>	Araku Valley, Andhra Pradesh, India

TABLE 1: Selected existing private and public carbon and ecosystem services programs (continued)

Case name	PES/C benefits compensated	Notable features, business models and payment arrangements	Start date, number of beneficiaries, ha	Location
PUBLIC PES POLICY				
<p>PES Program, Pago por Servicios Ambientales, Costa Rica, Fondo Nacional de Financiamiento Forestal (FONAFIFO).</p> <p>See also GGGI report 2016, and a 2009 case study</p>	<p>Carbon, biodiversity, water, landscape beauty (forest protection, reforestation, sustainable forest management and agroforestry)</p>	<p>Financial compensation to owners of forested lands for the provision of ecosystem services from their lands. Uses blend of payment and regulation established in Costa Rica’s third Forestry Law (7575), which recognized four forest environmental services and created the National Forestry Financing Fund (FONAFIFO). First major public PES program in Latin America.</p> <p>Direct cash transfers are provided to private landowners for 5-10-year contracts for different activities. Payments differ according to the strategic value of the environmental service and contracts can be adapted, if the legal framework is met. National and international investors offset impacts of productive activities. Sources of funding have included a fossil fuel tax, forestry taxes, hydropower companies, a national private brewery, a World Bank loan and a contribution of KfW.</p> <p>New “Mixed Systems” program is underway for farmers with <10 ha. In 2009, landowners received about 65 US dollars per hectare and year. Stability of program is attributed to its financial sustainability, legal framework, capacity and credibility of institutions and individuals who administer the program, and political support from the ground to national levels, including participation of civil society.</p> <p>Demand is higher than supply – current budget is enough for only 42% of applicants.</p> <p>Contact: fonafifo@fonafifo.go.cr or Mauricio Chacón <mchacon@mag.ho.cr></p>	<p>1996</p> <p>18,000 families and 1.3 million ha (nd)</p>	<p>Costa Rica</p>
<p>Policy for Payment of Ecosystem Services (PPSA) Colombia</p> <p>See also Cañon 2019</p>	<p>Strategic ecosystem conservation</p>	<p>PES law that provides framework for publicly funded, but decentralized local, regional and national PES programs in contrast to Costa Rica, Mexico, Ecuador, which only have national programs. Program is funded by Colombian Peace Fund and carbon taxes on oil and gas. Private sector also provides payments or exchanges tax obligations for ecosystem programs through a “work for taxes” program. Payments are based on local opportunity costs to farmers and aim to compensate for lost livelihood opportunities rather than increase incomes. Projects are located in conflict zones, places with illicit crops and strategic ecosystems where farming is not permitted. Includes ethnic and indigenous beneficiaries.</p> <p>Contact: Carlos Borda, Alliance of Bioersivity and CIAT <c.borda@cgiar.org></p>	<p>2017</p>	<p>Colombia</p>

TABLE 1: Selected existing private and public carbon and ecosystem services programs (continued)

Case name	PES/C benefits compensated	Notable features, business models and payment arrangements	Start date, number of beneficiaries, ha	Location
EU Carbon Farming Initiative INTERREG Carbon Farming project (European Regional Development Fund)	Agroforestry, selected agricultural practices, peatland and wetland restoration, afforestation, reforestation	Financed via the Common Agricultural Policy and other public funding instruments such as state aid, private initiatives linked to carbon markets, or through a combination of these funding options. Financial support for pilot initiatives on carbon farming through the LIFE programme and the European Regional Development Fund. Agricultural practices covered include: catch crops, cover crops, conservation tillage, protecting soils, reducing soil loss, enhancing soil organic carbon on degraded arable land; converting cropland to fallow, and conservation set asides. Contact: carbon@enrd.eu	2022 New program	European Union
California Climate Investments Government of California, USA	Soils, dairy digesters, manure management, equipment, farm worker housing energy, food waste prevention, community, composting	Statewide initiative that uses cap-and-trade dollars to fund portfolio of public grant funding and technical assistance programs to farm and ranch owners, managers, operators and agricultural workers for equipment and management practices that reduce greenhouse gas emissions. Emissions reduction periods of up to 100 years. Seeks to include benefits to underserved communities. USD 5.4 billion in funds provided to date and 78,377,742 MtCO ₂ e reduced (2022). Contact: GGRFprogram@arb.ca.gov	2013 567,134 projects implemented 763,587 acres (309,013 ha) land	California, USA
MULTILATERAL DEVELOPMENT BANK PROJECTS				
Participatory Agriculture and Climate Transformation (PACT) – IFAD	Rangeland management	Irrigation development and watershed management, with carbon finance. Contact: Mawira Chitima, IFAD m.chitima@ifad.org	New project Aims to reach 150,000+ households and 50,000 ha rehabilitated	Ethiopia

TABLE 1: Selected existing private and public carbon and ecosystem services programs (continued)

Case name	PES/C benefits compensated	Notable features, business models and payment arrangements	Start date, number of beneficiaries, ha	Location
RoLL project (Regeneration of Landscapes and Livelihoods)- IFAD	Watershed restoration (no carbon)	Resources are drawn from different stakeholders to replace donor finance for development projects. In this way, the community is more self sustaining (pooling resources). Contact: Philipp Baumgartner p.baumgartner@ifad.org	2021-2029	Lesotho and South Africa
PRIVATE SECTOR: INTEGRATED CREDITING AND TECHNICAL SERVICES				
Carbon by IndigoAg	Soil carbon and reduced agricultural emissions	Indigo is innovative for combining technical assistance, monitoring and facilitation of payments from corporate buyers. Agronomists support farmers to adopt new practices for soil health. Soil samples and farm data are used to support verification and credit issuance. Indigo facilitates payment, delivering 75% of the carbon price to the farmer. Requires and 150 acre (ac) minimum and five-year contracts with vesting to ensure levels are maintained over time. Digital and tailored agronomic support is provided. Registry-issued carbon credits. Generates social and environmental co-benefits. Growers are guaranteed a minimum payment of USD 20 per carbon credit, starting with the 2021 crop. Credits have been pre-ordered for as high as USD 40 per credit. Potential gross income of USD 30/ac/yr paid over five years. 2 credits earned per ac/yr. 20,000 carbon credits issued (2022) Contact: info@indigoag.com	2019 2,000 farmers and 5 mil acres (2 mil ha) and (2022)	28 states in USA
Sustainable Futures Carbon Bank Bcarbon (BC) and Future Food Solutions (FFS)	Cover crops in no-till farming systems.	A carbon bank that sells credits on the voluntary carbon market. Supply chain partners, business and organizations purchase credits to offset their carbon footprint. Based on a partnership of a sustainable agriculture and food consulting company (FFS) and carbon credit registry company (BC). FFS conducts soil analyses and tests for carbon. Rolling 10-year commitment, buffer account to manage risk of failure. Third party assembles credits. Ecological integrity is viewed as more important than marketing carbon credits. One UK farm enrolled to date. Contact: info@sustainablefutures.uk.com	2022. New program that aims to reach 10,000 carbon credits in next 12 months	United Kingdom

TABLE 1: Selected existing private and public carbon and ecosystem services programs (continued)

Case name	PES/C benefits compensated	Notable features, business models and payment arrangements	Start date, number of beneficiaries, ha	Location
<p>Western Kenya Soil Carbon Project</p> <p>An activity of the Soil Protection and Rehabilitation for Food Security Program ("ProSoil")</p> <p>GIZ on behalf of BMZ</p>		<p>Results-based carbon finance scheme, which in turn fund agro-advisories. Carbon credits will be offered to private sector enterprises with a credible carbon neutrality plan to offset their residual emissions. Revenues from sale of the credits will be used to finance agricultural advisory services. A technical cooperation project is strengthening MRV and establishing a non-profit enterprise to obtain certification from Verra VCS and manage the investment of carbon revenues in advisory services.</p> <p>Contact: David Kersting, GIZ, <David.kersting@giz.de> and Juliane Wiesenhuetter, GIZ juliane.wiesenhuetter@giz.de</p>	<p>2022</p> <p>New project targeting 40,000 farm families on 32,000 ha</p> <p>Expects to generate 93,690 carbon credits per year, or 1,873,798 over 20 years</p> <p>Price is currently being negotiated</p>	

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Acronyms

Ac	Acre
Bil	Billion
BMZ	German Federal Ministry for Economic Cooperation and Development
CAADP	Comprehensive Africa Agriculture Development Programme
CIRCASA	Coordination of International Research Cooperation on Soil Carbon Sequestration in Agriculture
CO ₂	Carbon Dioxide
CO ₂ e	Carbon Dioxide equivalent
FMO	Dutch Entrepreneurial Development Bank
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GSMA	Global System for Mobile Communications Association (Industry association)
Gt	Gigatons (billion tons)
Ha	Hectare
IFAD	International Fund for Agricultural Development
KfW	German Financial Cooperation
Mil	Million
MRV	Measurement, reporting and verification
nd	No date
PES	Payments for ecosystem services
USAID	United States Agency for International Development

For a glossary of terms related to carbon and climate change mitigation in agriculture, see the AgLEDx Resource Guide glossary at <https://agledx.ccafs.cgiar.org/glossary/>

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