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Saving farmers and the forest. Interventions to reduce deforestation, encourage sustainable farming, and enhance farmer welfare in and around moist tropical forest. A rapid evidence assessment.

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Abbreviations

ABC	Federal Government's Strategy for Low-Carbon Agriculture, Brazil
AELBI	Agro-Eco Louis Bolk Institute
AFS	Agroforestry farming systems
ASCI	Africa Sustainable Commodities Initiative
BMPs	Best management practices
BMUV	German Ministry for the Environment, Nature Conservation, Nuclear Safety, and Consumer Protection
BRAC	Bangladeshi non-governmental organisation for rural development, operates internationally
CASA	Commercial Agriculture for Smallholders and Agribusinesses
CDM	Clean Development Mechanism
CFI	Cocoa & Forests Initiative
CFM	Community forest management
CLA	Communal Land Association
COCOBOD	Cocoa Marketing Board, Ghana
CPO	Crude palm oil
CSA	Climate-smart agriculture
CU	Credit Union
CX Impact Fund	Consensus Impact Fund, Brazil
DECOFOS	Community-based Forestry Development Project in Southern States, Mexico
DFI	Development Finance Institution
ERPA	Emissions Reduction Purchase Agreement
ETS	Emissions Trading System
EUDR	EU Deforestation Regulation
FAO	Food and Agriculture Organization of the United Nations
FC	Forestry Commission, Ghana
FCDO	Foreign, Commonwealth and Development Office (UK)

FCI	A PES for forests, Ecuador
FDA	Forest Development Authority
FFB	Fresh fruit bunches
FIFFA	First Investment for Financial Assistance
FMNR	Farmer-managed natural regeneration
FOLUR	Food Systems, Land Use and Restoration (World Bank-led programme)
FPD	Forest Protection Department
FPIC	Free Prior Informed Consent
FSC	Forest Stewardship Council
GAP	Good Agricultural Practices
GHG	Greenhouse gas
GIZ	German technical assistance agency
GVL	Golden Veroleum Liberia
ha	Hectare
HCS	High Carbon Stock
HCV	High Conservation Value
HICs	High-income countries
IAASTD	International Assessment of Agricultural Knowledge, Science and Technology for Development
ICCA	Indigenous and Community Conserved Area
IFAD	International Fund for Agricultural Development
IFSLU	Investments in Forests and Sustainable Land Use
IIED	International Institute for Environment and Development
ILO	International Labour Organisation
IPCC	Intergovernmental Panel on Climate Change
ISLA	Initiative for Sustainable Landscapes
ISPO	Indonesia Sustainable Palm Oil
LDC	Least Developed Countries

LLDC	Landlocked Developing Countries
LMICs	Low- and middle-income countries
LULUCF	Land Use Change and Forestry
MARENA	Manejo de Recursos Naturales en Cuencas Prioritarias, Honduras
MSPO	Malaysian Sustainable Palm Oil
NCBA	National Cooperative Business Association
NDVI	Normalised difference vegetation index
NGO	Non-governmental organisation
NK-CAP	Noel Kempff Mercado Climate Action Project
NOPLF	Northwest Oil Palm Landscape Forum
NOPPOL	National Oil Palm Platform of Liberia
ODA	Official Development Assistance
P&C	Principles and criteria
P4F	Partnerships for Forests
PDR	People's Democratic Republic (Lao)
PES	Payments for Ecosystem Services
PICO	Population, Intervention, Comparison, Outcomes
PICOS	Population, intervention, comparator, outcomes and study
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RCT	Randomised controlled trial
REA	Rapid Evidence Assessment
REDD	Reducing Emissions from Deforestation and Forest Degradation
ROI	Return on investment
RRC	Rural research centre
RSPO	Roundtable on Sustainable Palm Oil
RSS	Responsible Sourcing from Smallholders
RTRS	Round Table on Responsible Soy

SACCO	Savings and Credit Cooperative Organisation
SAPs	Sustainable Agricultural Practices
SAX	Samartex Timber and Ply-wood Company Ltd, Ghana
SHARP	Smallholder Acceleration and REDD+ Programme
SIDS	Small Island Developing States
SMEs	Small and medium enterprises
SMPEI	Sustainable Management of Peatland Ecosystems in Indonesia
tCO2e	Tonne of carbon dioxide equivalent
TFGB	Trees for Global Benefits
ToC	Theory of change
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
VER	Verified emission reduction
VSLA	Village Savings and Loan Association
WATC	Wassa Amenfi Traditional Council
ZDC	Zero-deforestation commitments

Contents

Acknowledgements i
Abbreviations ii
Executive summary 1
1. Background 1
2. Scope and objectives of the review 4
3. Methods 5
3.1 Search methods for identification of studies 5
3.2 Inclusion and exclusion criteria (PICOS) 6
3.3 Data collection and analysis 7
3.4 Limitations 12
4. Findings 13
4.1 Landscape analysis 13
4.2 Overarching theory of change 17
4.3 Findings by intervention type 19
Regulation 19
Economic incentives 25
Market creation 52
Technology and know-how 61
Access to capital 70
Rights and empowerment 77
4.4 Findings on scaling up 82
5. Conclusions 84
5.1 Summary 84
5.2 Key lessons learned and their implications 86
Programming and process 86
Programme content 90
Fairness and equity 92
Learning from experience 93
Annex 1. List of countries included in the study 95
Annex 2. Search terms and summary of steps taken to search each database 98
Annex 3. List of backward citations 100
Annex 4. Quality appraisal tool 102
Annex 5. Data extraction form 103
References 115

Figures

Figure 1: PRISMA diagram 10
Figure 2: Number of studies from each region 14
Figure 3: Number of studies in each country, categorised by region 14
Figure 4: Number of studies that referenced crops and commodities 15
Figure 5: Number of studies within each intervention type 16
Figure 6: Number of studies within each scale of intervention, including those that occur at multiple scales 16
Figure 7: Number of studies with each type of funding partner 17
Figure 8: Overarching Theory of Change 18
Figure 9:Households surveyed in six countries affected by REDD+ schemes who received incentives or disincentives, 2013/14 20
Figure 10: Annual tree cover loss by dominant driver in Brazil 22
Figure 11: Incidences of reported outcomes against reported activities 85

Tables

Table 1: Policy options to combat deforestation and forest degradation and to foster sustainable agriculture 3
Table 2: Economic incentives to conserve forest and farm sustainably 26
Table 3: Summary of experiences with certification 37

Boxes

Box 1: Controlling forest clearance in Brazil 21
Box 2: Conservation basic income 34
Box 3: Good intentions in certification 38
Box 4: Different experiences in long-running conservation projects (SHARP, 2015) 54
Box 5: Humbo Community-Managed Natural Regeneration Project, Ethiopia 57
Box 6: Creating extension networks in Cameroon 67
Box 7: Examples of farmer cooperatives in Vietnam and Guatemala 68
Box 8: Accessing small-scale loans in Cameroon 72
Box 9: Increasing access to finance in the coffee sector in Vietnam 74
Box 10: Combining farmer training with financial and technical assistance in Mexico 76
Box 11: Collective forest enterprises: promises and pitfalls 79
Box 12: Social difference and tropical forests 86
Box 13: How much is a tonne of carbon worth? 91

Executive summary

Background

Small-scale farmers who clear forest to expand their fields accounted for more than two-thirds of deforestation between 2000 and 2018 (Branthomme et al., 2023; Din et al., 2024). Deforestation, in turn, is a major contributor to greenhouse gas emissions: increased production of agricultural commodities from cleared forest has been estimated to emit 444 million tCO2e (tonnes of carbon dioxide equivalent) per year (Mueller and Vasconcelos, 2023) — equivalent to the entire annual emissions of the UK (Friedrich et al., 2023).

Scope

This rapid evidence assessment (REA) explores what deters smallholder farmers in the global south from clearing forest to produce commodities or encourages the practice of sustainable agriculture.

The findings of this study will inform FCDO's Investments in Forests and Sustainable Land Use 2 (IFSLU2) programme, which aims to support smallholder farmers at scale to move to sustainable production at the same time as enhancing the welfare of farmers and their communities.

To do this, the research a) maps and identifies the landscape of interventions (policies, projects, programmes, investments) directed to smallholder farmers living in or close to tropical moist forests; b) assesses the extent to which these interventions help prevent forest clearance, support a transition towards more sustainable agricultural practices, and improve smallholder farmer welfare; and c) identifies gaps in the literature and priorities for future FCDO research, policy development and Official Development Assistance (ODA) programming.

Methods

To identify relevant studies, academic and peer-reviewed literature from 2014 to 2024 was accessed through the Scopus, Web of Science and EBSCO databases. Grey literature was identified through Google Scholar and selected institutional websites, and by interviews with selected experts and practitioners. We identified 800 candidate studies including backward citations. Studies were screened against an agreed population, intervention, comparator, outcomes and study design (PICOS) framework at title and abstract level. The remaining studies were screened for quality, to leave 122 studies for review.

While this approach ensures quality, it may exclude relevant studies which are not published in English or are published in places that academic databases ignore. The overall effect is to bias the evidence base towards publications from the global north and from academic researchers.

Data analysis and synthesis applied both framework analysis — as a structure for organising, analysing and presenting the evidence — and thematic analysis to delve into specific areas of interest.

Findings

Studies were concentrated geographically on Southeast Asia (especially Indonesia), South America (especially Brazil), and West Africa (especially Ghana), with far fewer studies from the Caribbean, Southern Africa, South Asia and the Pacific Islands. The studies covered 23 different crops and commodities, with oil palm the most common, followed by cocoa, maize, cattle, coffee and soybean.

To categorise the many interventions recorded, we sorted them into six groups based on the type of incentive or enabler at the heart of the intervention:

- Regulation on use of land and forests;
- Economic incentives — including Payments for Ecosystem Services (PES) and certification of produce;
- Market creation — for goods and services not normally traded, such as carbon;
- Provision of technology and know-how;
- Improved access to financial capital;
- Establishing rights (largely to land) and empowerment of forest users.

The most frequent category was economic incentives, followed by technology and know-how, access to capital, and regulation. Fewer studies were found to include interventions focused on rights and empowerment, and on market creation.

In most cases, interventions were combined. For instance, economic incentives — such as PES and certification — or increasing smallholder farmers' access to capital, often paired with provision of technology and know-how such as farmer training or technical assistance. This made attribution of effect more difficult: which of the several interventions in a programme were responsible for the outcomes observed? Moreover, the studies demonstrate how much context and circumstances affected the design, implementation and outcomes of programmes. What works in one time and place may not be effective in another. Nevertheless, the intervention categories proved useful for structuring analysis and findings.

Regulation: Determined regulation can curb deforestation. Much depends, however, on the political will to police regulation: when the stick of regulation is not accompanied by the carrot of incentives, regulation will likely be resisted. The effect of regulation needs to be weighed against the effect of other policies and programmes that may apply, the costs and benefits of intensifying agricultural production from already cleared land, and the availability of non-farm incomes. Put simply, regulation alone occasionally works. This thinking is reflected in the trend since the late 2010s to combine multiple interventions in programmes that include dialogue among diverse stakeholders, not least the farmers themselves.

Economic incentives: Incentives can work to conserve the environment and raise returns to farmers in and around tropical forests — but all forms of incentives have requirements in their design, time, and cost to implement if they are to function as intended.

Payments for Ecosystem Services, for example, require several demanding conditions to be met: land users must understand the contract; payments must be sufficient to compensate users to forgo any actual or future potential use of forest; and land users must have access to technical knowledge and the means (inputs, credit) to adjust their farming systems to the requirements of the scheme

Certification similarly requires that farmers be made aware of the schemes and that time and effort is spent negotiating their inclusion. Certification can be costly to smallholders, however, and the rewards to farmers, in price premia or access to premium markets, may not compensate for costs.

Environmentally sustainable farming systems on former forest land — systems that yield attractive returns for farmers and mimic some of the ecosystem services of the forest — have been developed for some areas, with varying degrees of effectiveness. The fact that some systems are effective both ecologically and economically suggests that further research, probably participatory research that combines formal science with recovering Indigenous technical knowledge, will very probably pay off.

Overall, there are no blueprints that provide ideal incentives to land users: interventions must be tailored to context. Policymakers should not underestimate the time and costs needed to set up PES and certification. For sustainable farming methods, research is indicated — agricultural research has been evaluated to have very high returns (Alston et al., 2009; Fuglie and Rada, 2011). For better supply chains, monitoring initiatives to learn which are succeeding, and how, will generate lessons for effective public action to scale out innovations to benefit both farms and firms in the supply chains.

Market creation: Engaging with markets, and particularly the voluntary carbon market, to fund projects to reduce deforestation is an attractive way to close an already large smallholder finance gap. How effectively projects can engage with markets, however, varies greatly between project approaches, market type and value chain. The approach needs adapting to both the market and the farmer at the same time — not addressing both is likely to lead to failure. Policymakers need to understand both buyers and sellers, the need for secure tenure and land rights, and the need for smallholder farmers to receive adequate support and assistance to move towards a new business model and to meet market demands.

Technology and know-how, including research, extension and training, can enable farmers to farm sustainably, achieve higher yields and hence reduce the pressure to clear more forest. In practice, technology and know-how are components of programmes with other interventions, obscuring technology's contributions to outcomes. Research needs to be coupled to extension, and often to some training as well. Most of the studies reviewed highlight a network of actors

involved in extension: knowledge platforms and multi-stakeholder partnerships to connect with the private sector, as well as initiatives to build the capacity of local government to disseminate knowledge and new technology, can all improve the effect. Ensuring that better agricultural practice leads to reduced deforestation requires cross-sector planning and policymaking, targeting buyers as well as farmers.

Access to capital: Limited access to finance can hamper smallholders trying to move to more sustainable practices. While efforts are being made to address barriers through more innovative finance models that reduce transactions costs for financial agencies and farmers, a systematic, general way to do this remains elusive. Appropriate safeguards should be in place to ensure that finance supports sustainable practices and does not inadvertently lead to more deforestation. Improved monitoring of the environmental impacts of increased access to capital among smallholders in different contexts and locations is indicated.

Rights and empowerment: Ensuring that smallholder farmers, local communities, Indigenous people and women have a voice in policymaking and implementation for land use and resource management is repeatedly seen as essential for encouraging sustainable agriculture and forest management.

Participatory approaches can lead to more effective and locally adapted strategies for sustainable agriculture and forest conservation, but take time and resources to implement, are often difficult to navigate, and face considerable barriers from some social, political and economic forces. A caution: interventions in this area do not always lead to positive outcomes; empowering one party may disempower another.

Theory of change

An overarching theory of change (ToC) was developed, drawing on findings from the studies to demonstrate how interventions can contribute to the desired outcomes of reduced deforestation, adoption of sustainable agricultural practices, and improved farmer welfare. It shows how different interventions can complement each other and, significantly, identifies the contextual factors that enable or hinder progress towards outcome- and impact-level results.

Enablers include both hard enablers, such as strong property rights, high price premia and stable commodity prices, and soft enablers, including stakeholder engagement and trust building, strong social structures and peer-to-peer networks to support knowledge exchange. Another important set of enablers is linked to earnings and investment costs. Applying mixed approaches helps ensure a set of complementary input types and activities that best support progress towards desired outcomes.

Barriers, on the other hand, arise from the complexity of certification processes, lack of finance for obtaining and managing certification, lack of access to international markets, low technical and managerial capacity of smallholder farmers, and the administrative complexities of working at community and household scale. Regulation can matter: contradictory or misaligned regulatory

frameworks can prevent smallholder farmers from accessing the resources needed to shift to more sustainable farming practices. This, combined with insecure land tenure and poor enforcement of existing regulation, can increase smallholders' vulnerability and in turn decrease their appetite for the risk of investing in new farming practices.

Key lessons learned and their implications

Four sets of lessons stand out from this review, concerning: programming and process; programme content; fairness and equity; and learning from experience.

a.) Programming and process

Most of the initiatives reviewed confront at least three challenges. One concerns the lack of knowledge of both natural and human systems in and around tropical forest: it is far from clear what the results will be from intervening in some part, or several parts, of these systems. Exacerbating this is the fact that the forests are often physically large, quite remote and difficult to access.

A second challenge is that forests, and the economies and societies within them, are diverse: the context and circumstances of the Amazon basin, the forests of southern Côte d'Ivoire and Ghana, and the jungles of Indonesia all differ markedly.

A third challenge arises from the numerous actors of very different social backgrounds found in and around tropical forest: Indigenous forest dwellers; longstanding immigrants to the forest who harvest forest produce (for example, rubber tappers); more recent immigrants seeking to clear forest to create farms; and large-scale farmers and companies also interested in the forests for crops, livestock and mining. Understanding their different interests and motivations is no mean task.

Implications for practice

Effective programmes are **unlikely to be blueprints**: not only do programmes need to be designed to reflect local circumstances, but also, because not enough can reasonably be known before intervening, the initial plan will almost certainly need modification as the programme proceeds and early lessons become apparent. Programmes thus need to be designed as learning processes, with effective monitoring of progress, linked — and this is more challenging — to management structures and processes that allow for learning and adaptation.

Programmes of this nature can involve considerable time and effort to design, to mobilise and to run through pilot phases. One requirement above all demands time and patience: convening the different actors. Designing programmes that can accommodate the needs and wishes of the different groups requires some skill. It will take time: time to meet with representatives of different parties to understand their concerns, to discuss potential actions, and to assess what has been learned and understood — a process that probably involves several rounds of

discussions. The time needed for effective and productive negotiation may be longer than fits with business and political cycles, where results are often expected in the short term.

Professional facilitators exist: there is a science and practice to negotiating when the parties involved differ in many ways and hold positions that may be all but irreconcilable. Such professionals are commonly used to intermediate in conflicts, or in commercial disputes that are about to be elevated to the courts. The differences between parties to the use of forests are comparable to those seen in conflicts and legal cases. Professional facilitators could very usefully deploy their skills when creating programmes that bridge across different parties, and where the non-monetary returns to the environment and financial returns to unsustainable land use may be in opposition.

Some of the time and trouble taken in intermediation can be trimmed by adopting **jurisdictional approaches**, where programmes are created that align with administrative units such as local or regional government. Although ideal units for environmental intervention may not align with administrative divisions, in practice the economies of only having to intermediate with one political division compensate for whatever is lost by not programming at the environmental unit.

Considerations of lengthy design and pilot phases raise questions about **scaling such programmes out**. More than one route to scale can be seen. One is commercial, as may happen with certification: if a programme can be devised that is simply good business for all along the supply chain, from farmers through to supermarkets and consumers, then business leaders will scale the scheme because it generates earnings and profits.

Another path exists for interventions that generate public goods and services. If some (largely) successful intervention, probably a component of a wider programme, can be translated into a regular public programme with standard operating procedures — the kind of procedures that apply, for example, to road maintenance or rural health clinics — then if public policymakers can see that the intervention is effective and efficient, there is a good chance it will be adopted and funded. Examples of this were not common in the review, but Brazil's rural land register, which facilitates monitoring of environmental regulations, might be an example.

A third path to scale, and one that may well apply to many of the interventions reviewed, applies when the intervention generates largely public goods and services, but it cannot readily be run by standard public operating procedures. Scaling then requires the intervention to be taken up by a public agency that does not have to conform to normal bureaucratic practice: the agency might be a non-governmental organisation (NGO) or some semi-public quango or possibly even a firm whose owner has a social mission. Such agencies start local, but some find ways to operate at considerable scale: Bangladesh's BRAC and the USA's One Acre Fund would be examples of social enterprises driven by a mission, with successful and proven technical programmes, backed by some public subsidy — government grants, charitable donations, etc., which have scaled from district pilots to national level and beyond.

Such agencies are often led by committed and talented individuals and their close-knit teams. Identifying such people is the key to supporting and investing in them — a lesson that venture capitalists know well (Roe, 1985). Backing individuals on character assessment goes against the grain of most formal public administration (which is built on professional structures and procedures), but in these cases, it is critical: leadership matters (Korten, 1980).

Only a few examples of scaling up forest interventions were reviewed: most studies concerned initiatives running at sub-national scale, often at the third tier of administrative division, or an even smaller scale. While some of these initiatives were effective or promising (in conserving the environment, or raising farmer incomes) at limited scale, there were no accounts of such initiatives being taken to substantially greater scale. This does not mean that interventions do not and cannot scale up, only that accounts of scaling are so rarely documented and published. But we have two insights into scaling from this review: insights on certification and on replication across contexts.

Some **certification** schemes — Fairtrade, Rainforest Alliance, Forest Stewardship Council, for example — have gone to scale. As recently as the 1970s, certification of agricultural and forest products from the global south began in earnest. From very small-scale trials, involving growing and supplying to what were, at the time, some very small niche markets in the global north — few consumers in the 1970s were concerned about the conditions under which items in the supermarket were produced — certification has become common in global north supermarkets. Even when the produce on the shelf is not formally certified, labels reassure customers about (some) standards of production and trading that the supermarket upholds.

A few of the papers reviewed recorded **replications of innovations across several countries**. Examples include the SHARP partnership (2013-2019), which brought together a large oil palm production and processing corporation, Sime Darby, with three NGOs: Proforest, Solidaridad and Earthworm. They jointly developed a set of guidelines to be used by any private enterprise wishing to show that it was sourcing from smallholders responsibly. The guidelines consider three sets of issues for sustainability: land rights and land conflict, deforestation and land conversion, and labour rights and working conditions; plus three issues for smallholder suppliers: better crop yields and food security, improved livelihoods and institutions, and better agricultural practices. Proforest developed templates and other materials for companies to download to create their own procedures for responsible sourcing. The guidelines have been applied in contexts as diverse as oil palm in Indonesia, sugar cane in the Philippines, and soybeans in Brazil (Proforest, 2021)

A second case is that of the Initiative for Sustainable Landscapes (ISLA) programme (2021-2025) taking place in Mato Grosso, Brazil; Grand Mbam, Cameroon; Cavally, Côte d'Ivoire; Dembel-Shalla sub-basin, Ethiopia; West Kalimantan, Indonesia; southwest Mau Forest, Kenya; and Central Highlands, Vietnam (Schouten et al., 2023).

ISLA operates at the landscape level by convening multi-stakeholder coalitions at multiple jurisdictional levels of government. These coalitions agree on and commit to sustainability targets for the jurisdiction in question through a Production-Protection-Inclusion Compact.

> "Pilot projects are co-developed with the public and private sector to test innovative business models that can contribute to the compact's goals. Landscapes with a compact are linked with potential commodity buyers and (green) investors through the online platform SourceUp, but also through other linking activities (technical assistance, preparing investment plans, searching for investors, etc.). This should help in scaling-up sustainable business models and incentivize the landscapes to become self-sustaining." (Schouten et al., 2023, p. 3)

Both these examples of first steps towards scale concern, above all, processes: processes that the originators hope and believe can be applied to specifics of particular settings.

A third reflection concerns **private enterprise**. Considerable and diverse efforts are being made by some large commercial enterprises to meet society's expectations for decent and sustainable business. The number and diversity of these initiatives suggest that at least some of them will succeed. Business does not invest much in reviewing, evaluating and publishing their experiences: some enterprises, but not all, treat their experience as a commercial secret. There is scope to keep track of promising private initiatives and to review them, to learn lessons. [This point applies equally in the fourth set of lessons, on learning.]

b.) Programme content

Lessons about process are so important that they appear before lessons about the actual content of the programmes. On content, two considerations stand out from this review: some (simple) economic aspects; and changing behaviour.

Economics

Simple **economics** often greatly affect the success of interventions. Time and again, evidence confirms that forest users will only conserve forests and the environment if it is financially worth it to them. Whether users see the forests as worth conserving depends in large part on the difference in returns per hectare of crops and livestock on cleared forest versus returns to conserved forest, net of any payment made to land users to conserve forest and environment. [Economic motivations are strong drivers of behaviour, but not the only ones: forest users can and often do recognise ecological and cultural values of the forest.]

In financial terms, clearing tropical forest to plant crops — above all oil palm — or to graze livestock almost always trumps the returns to activities that conserve the forests such as hunting and gathering (rubber, Brazil nuts, etc.). The difference between returns to use of forests versus use of cleared forest has to be bridged by some form of payment, such as PES, if the forest is to be conserved. If PES payments per hectare are not large enough to rival or surpass those of the use of cleared forest, land users will not necessarily conserve the resource. To be specific,

payments of under US$350 per hectare per year will usually be less attractive than the earnings from clearing the forest for crops and grazing (Wiggins et al., 2022).

In cleared or secondary forest, the issue may be less about preventing forest clearance, but rather about conserving biodiversity and providing ecosystem services that mimic those of the former forest through production systems such as agroforestry. Once again, the same calculus applies of comparing returns from conventional crop and livestock systems (that all too often exhibit low biodiversity, produce few other ecosystem services, degrade soils, overuse water and pollute air, soil and water) to returns from systems that are environmentally sustainable, net of payments made to farmers for environmentally sustainable farming. Any such payments are likely to come either from price premia that apply to certified produce, or from payments for capture of carbon. Payments seen so far have often been small: too small to encourage farmers to farm sustainably.

That said, returns to land uses are not fixed: technical advances can improve returns. This applies especially for agroforestry, where a combination of formal research and recuperation of Indigenous knowledge has led to the creation of production systems that not only generate the non-monetary values sought but also raise financial returns.

Implications for practice

Simple evaluation can deceive. When a payment is made for ecosystem services but land users do not change their behaviour, one cannot conclude that payments are ineffective; leastways, not without considering whether the payment was large enough to compensate land users for forgoing the option of clearing forest.

Sufficient payment tabulations need not be complicated. Agricultural economists have been computing gross margins per hectare of crops (and similar measures for livestock) since the 1940s if not earlier. Similarly, appraisal of the non-monetary value of forests and their ecosystem services needs to be assessed — and taken seriously. We have 40 years or more of environmental and ecological economics which provide guides on how to estimate the values of forest, biodiversity and, above all, the costs of greenhouse gases.

Research into agricultural systems that are sustainable can, as with agricultural research in general, pay off handsomely. Research is routinely underfunded compared to the returns it can generate. When it comes to researching more sustainable farming systems, technical advances are likely to have to be tailored to local circumstances — at the level of the agroecological zone, the village, and often even to the farm itself. Participatory research that brings together formal researchers and extensionists with local farmers will probably make the most progress. Farmer field schools, for example, can be a way to bring participation into research and extension.

Behaviour change

Conserving the forest and environment is about changing the behaviour of land users directly, and the behaviour of consumers and the global public less directly.

Regarding land users, although it is convenient to consider the effects of drivers of behaviour change individually, it may well be that combinations of incentives act (far) more strongly to change (longstanding) behaviour than any single incentive. For example, rules and regulations may limit land use; financial payments can be made for sustainable practice; training and extension to endow land users with useful skills may be provided; and some empowerment that instils a sense of responsibility for the environment may be encouraged. Each of these alone might not be sufficient, but when several act simultaneously on land users they may indeed be sufficient.

Similar considerations may apply to consumers and their willingness to pay more for goods and services produced sustainably, and to pay taxes that can finance PES or payments for carbon capture. Awareness and education, governments setting rules (e.g., taxes on imports of produce from cleared forest), labelling on supermarket shelves that records certification — each alone may not be sufficient, but these may work in combination to change attitudes and behaviour.

Implications for practice

Learning about combined interventions is not straightforward. In social science, assessing combinations runs against the grain of conventional experiments (including randomised control trials) that typically assess the effects of a single factor; it lends itself better to other approaches, which could include those rooted in the complexities of context.

To have enough power to judge what combinations work, and perhaps the contributions of different elements, we need many more evaluations of observed models and practices that consider complex relational dynamics.

The evaluation gap in development practice is wide. There is no point in calling for policy to be based on evidence if investment in evidence runs at a fraction of the level it might and should.

c.) Fairness and equity

The studies reviewed show that processes and outcomes can work against people on low incomes and people with little political power. Three points stand out.

One, the design of some programmes tends to (inadvertently) exclude those people on low incomes with few assets. They are often also disadvantaged in education and knowledge, and they are the most likely not to see how they might benefit from programmes — and indeed to misinterpret some interventions. They are the least likely to have the means to respond to incentives, lacking land, labour and capital, and they are the least able to defer immediate returns in favour of future rewards.

Two, and perhaps more important, social differences among actors in forest zones are often wide and deep. Rights and entitlements — primarily to land, but sometimes also to public services — may be weakly defined in formal law, giving those with political connections, able to hire amoral

lawyers, the chance to take over land that has customarily been used by others less powerful. The fears of the less powerful as to what may lie behind schemes such as PES and certification are not imaginary: some of them know from experience how well-meaning interventions may play out in practice — to their disadvantage.

Three, when diverse goals are pursued — including environmental conservation, livelihoods improvement and social equity — collective enterprises can be a way to meet the different objectives, in ways that private firms often find hard to emulate.

Implications for practice

When people have few assets, programmes should include components to support them — with capital grants and technical assistance. An alternative is social protection for those unable to participate, but that is second best to an attempt to endow the assetless with the assets by which they can participate.

The marginalisation and powerlessness of some forest actors may be more difficult to remedy, but it is possible to work to strengthen the rights to land of people with customary tenure — for example, by pressing for legal recognition of such rights, and helping people register their longstanding claims.[1] Similarly, work with grassroots groups can help to raise the voices of the marginalised and give them a say in decisions that affect them, decisions in which they are entitled to have a say.

Collective enterprise deserves equal consideration to that given to private enterprise — when setting economic policy, creating economic institutions and otherwise encouraging enterprise, collectives need to be considered, not just private firms.

Social differences and their implications are typically elements of systems that reveal themselves only after programmes begin, reinforcing the message about managing programmes through adaptive learning.

d.) Learning from experience

The review shows that public and private initiatives are underway that potentially conserve tropical forests and enhance the livelihoods of those living in and around the forests. The number of publications describing plans and pilots suggests that such initiatives may be gathering pace — to be expected given increasing awareness of the value of forests and their ecosystem services in a world facing biodiversity and climate emergencies.[2]

[1] Registering rights is not without danger: handled badly, the rights of elites and of men are written down, while those of women and socially excluded groups are not, thus worsening inequality of rights.

[2] Because we could only review initiatives documented to set standards, other initiatives that have not been documented in this way were not considered. That there may be other, valuable initiatives underway only strengthens the point we make.

Implications for practice

The more initiatives that are underway, and the more diverse those initiatives are, the greater the promise that some will succeed and that valuable lessons can be harvested in the near future. Public agencies should search out and learn these lessons, investing in reviewing and assessing these initiatives. Action-focused programmes need to be accompanied by commensurate efforts to gather, manage and disseminate knowledge.

Advances in physical science and technology (remote sensing, use of drones, etc.) are making it easier to assess changes to forest cover at the local scale. Increasingly, it should be possible to monitor forest clearance within weeks or months of it taking place. Complementary advances in gathering economic and social data are necessary to enhance our understanding of how natural systems are changing in tandem with changes in human systems. There may be scope for crowdsourcing information from forest actors in sentinel sites to register events and trends in near real time. Pilot experiences in the drylands of Ethiopia and Kenya provide models of how this may be done (Chelanga et al., 2022).

1. Background

The world is not currently on track to meet the goals set out in the 2015 Paris Agreement. The Intergovernmental Panel on Climate Change (IPCC) warns that the rise in global temperature could reach or surpass 1.5 degrees Celsius by 2040, if not sooner (Boehm and Schumer, 2023). The IPCC's AR6 Synthesis Report of March 2023 — the IPCC's clearest and most urgent assessment of agriculture's significant contribution to emissions of anthropogenic greenhouse gases (GHGs) — makes clear that human-induced global warming is already causing unprecedented changes to the Earth's climate, with widespread harm to nature and people (IPCC, 2023).

Small-scale agriculture has a significant impact on deforestation and associated GHG emissions. An estimated 32% of GHG emissions from agriculture can be related to smallholder farming (McKinsey, 2023). Small-scale farmers cause most deforestation for agriculture: they are linked to many commodity supply chains associated with deforestation (Branthomme et al., 2023; Aung Din et al., 2024). Analysis of commodity-linked deforestation, caused by both large-scale agriculture and smallholders, shows that deforestation to grow agricultural commodities generates emissions equivalent to 444 million tCO2e per year (Mueller and Vasconcelos, 2023). This is equivalent to the entire annual emissions of the UK (Friedrich et al., 2023).

This study is motivated by environmental and social concerns over the clearance and degradation of tropical forests. Forests are being lost at an alarming rate:

> "[Forests] cover 31 percent of the Earth's land surface (4.06 billion ha) but the area is shrinking, with 420 million ha of forest lost through deforestation between 1990 and 2020. The rate of deforestation is declining but was still 10 million ha per year in 2015-2020. Some 47 million ha of primary forests was lost between 2000 and 2020." (FAO, 2022b, p.xiii)

Between 2000 and 2018, 90% of forest conversion was for agriculture (Branthomme et al., 2023). Forest is cleared for agriculture to generate returns to labour and capital. This profit motive has two variants. One is investment by large commercial farmers and companies. These take the opportunity to clear forest to plant crops, or grass to graze cattle, knowing that it will adequately pay off against the capital invested. The other variant is forest cleared by small-scale farmers who need more land to make a living. This second variant may account for most — 68% — of tropical forest converted to agriculture between 2000 and 2018 (Branthomme et al., 2023). For smallholders clearing forest, the critical factor is the return to their labour, given that their cash investments tend to be limited.

Some observers see the former as pull, the latter as push, but the distinction obscures the logic of forest removal: whether for corporations or smallholders, clearing the forest often pays off, whether as return to capital invested or as implicit returns to days worked. The returns to forest

crops can be handsome: a hectare of oil palm in Southeast Asia, for example, could generate revenues of US$2,760 a hectare against production costs of under US$230 a hectare.[3]

Against these private rewards, the value of tropical forest is less easily measured in money.[4] Most of this value arises in public benefits, some global public goods; when forest is cleared, these lost benefits are externalities to farmers, costs that they do not pay.

Forest clearance can lead to forest-dependent communities losing their rights and access to forests from which they derive livelihoods in hunting and collecting produce, including fruits, fungi and vegetables. Forest clearance eliminates these sources of income and subsistence, exacerbating existing inequalities and increasing poverty.

We draw on a rich and growing literature on the driving forces of deforestation, especially studies of forests converted to agriculture. From this working understanding, we seek to identify effective interventions to:

- reduce deforestation and prevent its undesirable environmental consequences;
- arrest and counter further degradation of previous forests, to promote sustainable use of former forests;
- promote the livelihoods and incomes of people on low incomes living in and around tropical forest, through livelihoods that use natural resources sustainably.

We review different types of intervention and what is known about their effectiveness in different contexts and circumstances. Interventions can be seen as belonging to six groups, which reflect different drivers of behaviour: the first three deal with disincentives and incentives; the second three deal with enabling factors.

- Regulation
- Economic incentives
- Market creation
- Technology and know-how
- Access to capital
- Rights and empowerment

[3] "Dubbed 'green gold', Indonesian oil palm yields a phenomenal 17.8 tons per hectare and presently commands a price of more than US$750 per ton. Though Malaysian yields are higher on average, Indonesia benefits from abundant land resources and lower wages. Production costs in Indonesia are around $185 per hectare, compared to $226 per hectare for Malaysian palm oil." (Naylor et al., 2007) Prices of palm oil in Jan 2024 were over US$800 a tonne. Five tonnes of oil palm fruit are needed to extract one tonne of palm oil. Naylor is very probably reporting costs and returns for a well-run operation: it may well overstate what the average grower experiences.

[4] But considerable effort is being made to estimate the value of forests and express it in dollars. For example, "The wealth represented by certain forest ecosystem services (recreation and hunting, habitat, the provision of non-timber forest products, and water services) is estimated at US$7.5 trillion, which is 21% of the total wealth in land assets and about 9% of world gross domestic product. The absence of natural asset stock in national wealth accounting risks policy errors, with a decline in natural assets likely to affect other assets in the longer term. Efforts are underway to improve estimates of the value of nature, including forests." (FAO, 2022a)

Table 1 illustrates the different kinds of activities and approaches that fall under each intervention type.

Table 1: Policy options to combat deforestation and forest degradation and to foster sustainable agriculture

Intervention type	Examples of activities and approaches
Regulation	Protected areas, land zoning Moratoria on land conversion Tenure laws that stipulate land use
Economic incentives	Paying farmers to conserve specified land uses Payments for Ecosystem Services (PES) Voluntary schemes that reflect social and consumer preference: ● Industry roundtables ● Certification
Creation of a market or quasi-market	Debt-for-nature swaps Land swaps Biodiversity offsets Carbon trading
Technology and know-how	Public investment in agricultural research Agricultural extension Farmer training
Access to capital	Encouraging Village Savings and Loan Associations (VSLAs), Savings and Credit Cooperative Organisations (SACCOs)/Credit Unions (CUs) [Grants, training, regulation, etc.] Lowering transaction costs to allow formal financial providers to extend services to forest areas [Grants, credit bureaus, etc.] Public underwriting of lending to smallholders Accessing international climate funds and channelling to smallholders
Rights and empowerment	Conferring rights to use forest to active farmers Indigenous and Community Conserved Areas (ICCAs) Empowering local land users through cooperation, and access to technical and market knowledge.

2. Scope and objectives of the review

This rapid evidence assessment (REA) explores what deters smallholder farmers in key forest-risk commodities from clearing forest or encourages the practice of sustainable agriculture. Our approach is based on the principles of a systematic evidence review, allowing a policy-relevant synthesis of the evidence base over a relatively short time.

The research a) maps the current landscape of interventions and incentives (including finance) for smallholder farmers, with a focus on key forest-risk commodities; b) explores the extent to which these interventions and incentives prevent forest clearance, support a transition towards more sustainable agricultural practices, and improve smallholder farmer welfare; and c) identifies gaps in the literature and priorities for future research, policy development and Official Development Assistance (ODA) programming.

The findings of this study will inform implementation of Component 2 of FCDO's Investments in Forests and Sustainable Land Use 2 (IFSLU2) programme, intended to run between December 2023 and December 2034. As a global public good, the study will contribute to the evidence base on the effectiveness of interventions intended to support smallholder farmers to transition to sustainable agricultural practices and reduce tropical forest clearance.

The study answers the following questions, developed in collaboration with FCDO's International Forest Unit and Research and Evidence Directorate:

1. What deters smallholder farmers from clearing forest or encourages the practice of sustainable agriculture?

    a. What interventions (policies, projects, programmes, investments, etc.) and other incentives and support (regulations, finance, skills and awareness training, property rights and tenure, etc.) have been effective in stopping or reducing the rate of clearance of tropical forests, and in encouraging more sustainable agriculture? How and why have these been effective? In what circumstances are they more likely to work, or more likely to fail?

    b. What innovative schemes to reduce or prevent forest clearance hold promise for sustainable agriculture?

For each of the above questions, we examine the effects of interventions on (a) forest clearance and sustainable agriculture; and on (b) smallholder farmer welfare (quantity and variability of income, food security and nutrition, reduced vulnerability to climate change).

2. Based on 1(a) and 1(b) above, how can FCDO improve knowledge and practice around encouraging smallholders to adopt sustainable agriculture?

    a. What gaps in the evidence should be addressed through new research?

b. What policies and programmes should FCDO consider to encourage smallholder farmers to adopt sustainable practices?

c. What conditions enable or hamper the effectiveness of interventions?

3. Methods

This REA borrows from established systematic review methods adopting search, screening and quality appraisal drawing on framework analysis (Thomas et al., 2017) and thematic analysis approaches. The inclusion and exclusion criteria for the study are informed by the Population, Intervention, Comparison and Outcome (PICO)[5] model to enable a focus on how, for whom, and under what circumstances interventions can be successful (see 3.2 below).

3.1 Search methods for identification of studies

A multi-pronged search strategy was adopted, enabling the team to explore bibliographic databases as well as grey literature. The following bibliographic databases were searched for academic articles published in journals, with duplication of literature across the databases screened out:

- Scopus
- Web of Science
- EBSCO
- Google Scholar (used selectively only to manage volume[6])

The following institutional and programme websites were also hand-searched for relevant grey literature, including technical reports, working papers, pre-prints and discussion papers, with time reserved for snowballing to expand coverage as needed:

- ACDI VOCA: https://www.acdivoca.org/
- AgriProfocus: https://www.snv.org/project/agriprofocus-apf-making-agribusiness-work-development
- The Center for International Forestry Research and World Agroforestry (CIFOR-ICRAF): https://www.cifor-icraf.org
- Food Systems, Land Use and Restoration (FOLUR): https://www.folur.org/
- Forest and Farm Facility: https://www.fao.org/forest-farm-facility/en/
- International Fund for Agricultural Development (IFAD): https://www.ifad.org/en/
- National Cooperative Business Association (NCBA) Clusa: https://ncbaclusa.coop
- ProForest: https://www.proforest.net
- SNV Netherlands: https://www.snv.org

[5] The Population, Intervention, Comparison and Outcome (PICO) model is commonly used in systematic reviews to define the scope of studies to be potentially included in the review. See guidance on this model in Chapter 3 of the Cochrane Handbook v6.5 (2024) here. We added Study Design (S) to the inclusion/exclusion criteria, so throughout the REA we refer to PICO**S**.
[6] See Annex 2 for a detailed discussion of how the team managed volume on Google Scholar.

- TechnoServe: https://www.technoserve.org
- Tropical Forest Alliance: https://www.tropicalforestalliance.org
- USAID Learning Lab: https://usaidlearninglab.org

Searches were conducted in Scopus, Web of Science and EBSCO during study design. Literature searches then ran from June to August 2024. Grey literature that did not contain sufficient information to conduct a quality appraisal, such as briefs or presentations, was excluded. Due to budget and time limitations, the team began by searching academic databases in English and then sought to widen the search to include material published in French and Spanish.

Key informants from the following institutions were interviewed, enabling the research team to draw on their knowledge of innovative practice in the field:

- Acumen Trellis Fund
- FOLUR, World Bank
- IDH Farmfit Fund
- International Institute for Environment and Development (IIED)
- Partnerships for Forests (P4F)

A limited backward citation strategy was applied to further investigate leads from the key informant interviews and key areas of interest identified in academic and grey literature as the research progressed. Backward citations from academic and grey literature were collected during the data extraction phase (detailed in section 3.3 below).

3.2 Inclusion and exclusion criteria (PICOS)

Participants/population

The study focused on smallholder farmers (aged 18 and above) living in forest communities in low- and middle-income countries (LMICs, as defined by the World Bank) with a significant amount of tropical forest coverage (see Annex 1).[7] Studies of interventions taking place in high-income countries (HICs) and countries without a significant amount of tropical forest were excluded from the research. Because some studies include evidence from more than one country, only studies where the majority (>50%) of most results come from LMICs were included.

Intervention(s)

A wide range of interventions (see Table 1) were considered in the study, provided they aimed at stopping or reducing the rate of tropical forest clearance and supporting sustainable agricultural practice. Where an intervention had multiple components, if at least one substantial component addressed deforestation of tropical forests and sustainable agricultural practice, it was included.

[7] Author's compilation of countries where over a third of territory is presently or formerly covered in tropical forest.

Comparator(s)/control

Studies exclusively focusing on quantitative methods were included if they constructed a counterfactual scenario — that is where they compared programme participants with control/comparison groups: comparisons with no intervention, business as usual, and placebo or similar. This does not apply to studies focusing on qualitative or mixed methods.

Main outcome(s)

We examined the effects of interventions on (a) forest clearance and sustainable agriculture; and (b) smallholder farmer welfare (in terms of quantity and variability of income, food security and nutrition, and reduced vulnerability to climate change). The primary focus was on forest clearance.

Specifically, studies focusing on the following outcomes were included:

- **Forest clearance:** first and foremost, defined by whether forest is continuing to be cleared or degraded; and in some cases, quantified by rate of forest clearance, as well as quantification of reforestation.
- **Sustainable agriculture:** adoption of sustainable farming practices including conservation of soil and water, nutrient recycling, integrated pest management and, in general, working with ecological processes.
- **Smallholder farmers welfare:** including a focus on income, household consumption, savings, food security, nutrition, health, and resilience to climate change.

Study designs

Studies across the methodological spectrum were included, including purely quantitative studies where they constructed a counterfactual scenario (see above), and experimental and quasi-experimental designs drawing on statistical analytical methods. Purely qualitative studies as well as mixed methods designs were also included.

Studies that failed to describe their methodology adequately were excluded.

3.3 Data collection and analysis

3.3.1 Screening

After completing the database search, the team first collated and removed duplicate records. Trained reviewers then assessed the remaining studies against the REA's inclusion and exclusion criteria at title and abstract level — managed using a shared Excel spreadsheet. For each study, a team member checked to see if the study met the PICOS criteria and should proceed to quality appraisal and data extraction. Where it was not possible to tell from title and abstract screening

whether a study met all the PICOS criteria, the study was automatically put through for further screening at the quality appraisal and data extraction stage — i.e., when the full text was found and read. Selected studies were independently spot-checked by a second reviewer to confirm the decisions of the first reviewer. Any disagreement was resolved through discussion to reach consensus.

An adapted research protocol was applied for grey material, with selected websites manually searched for relevant literature and information. Selected literature was automatically put through quality appraisal and data extraction, given that it had already been subject to a manual search based on the PICOS criteria. The name of the organisation/institution, the URL link, the date the website was accessed and bibliometric data for any material accessed were logged in an Excel spreadsheet. Any relevant material identified and extracted was logged under this initial entry.

3.3.2 Quality appraisal

A pragmatic quality appraisal tool developed by Mader et al. (2022) was applied to this study, allowing quality appraisal of both quantitative and qualitative studies without the need to use different appraisal tools. A representation of this tool is presented in Annex 4. This tool encompasses the following three domains:

i. **Cogency:** Is the study causal? Is it theoretically grounded? Is it convincing?

ii. **Transparency:** How was the data collected? How was the sampling conducted? How was the data analysed?

iii. **Credibility:** Are the findings generalisable? Is the research process logical, traceable and clearly documented? Is there a clear description of how conclusions and interpretations were reached?

Each included study was assigned a grade for each of these domains; a study could be awarded a grade of up to 6 (i.e., 2 points per domain). If a study only partially met a dimension within one of these domains, then a point of 1 was assigned, or 0 if it failed to meet any of the dimensions within the domain. If a study scored 0 in any domain, it was excluded.

Quality appraisal was conducted by individual reviewers, with a flagging system for a second reviewer to weigh and resolve doubts where scoring was uncertain.

Details of the backward citation screening and quality appraisal process can be found in Annexes 3 and 4.

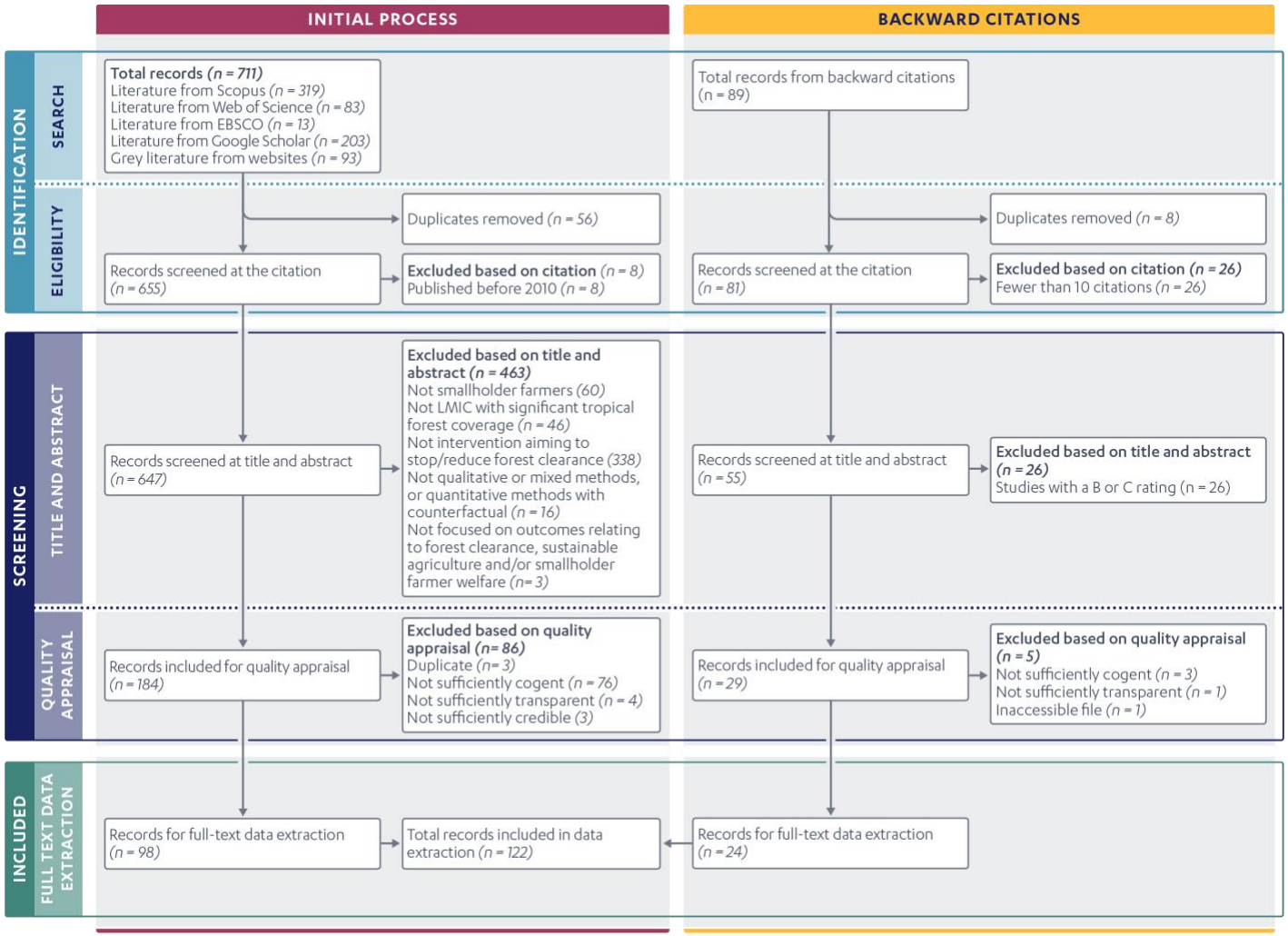
After going through these steps (Box 1), some 122 studies remained for review. Reasons for exclusion of candidate studies varied (Figure 1). Some 338 studies were excluded because they did not focus on interventions aiming to stop or reduce forest clearance (many studies described

the topic broadly or gave recommendations based on secondary literature). Some studies explored sustainable agriculture more generally, but did not focus on forest clearance. Sixty studies were removed because they did not focus on smallholder farmers; 46 were excluded because they did not include LMICs with significant tropical forest coverage. Sixteen studies were excluded for methodological reasons (i.e., not applying qualitative or mixed methods, or quantitative methods with counterfactual), and a handful were excluded because they did not focus on the outcomes outlined in the PICOS criteria.

During quality appraisal, a further 86 studies were excluded for not meeting standards in one of the three domains (cogency, transparency or credibility).[8]

[8] There are two main reasons for excluding such a large portion of the studies at quality control. First, the team was more generous in passing studies through title and abstract screening, including studies that seemed likely to explore interventions aiming to stop or reduce forest clearance and support sustainable agriculture. In several cases, it was only on reading the full text that the absence of an intervention became clear. Second, some of the academic studies did not explain their methodologies in sufficient detail or did not score high enough on credibility to be included.

Figure 1: PRISMA diagram



3.3.3 Data extraction

A data extraction form was developed by the team (see Annex 5) and converted into a Google Form that automatically collated all extracted data in one database. The data extraction form focused on collecting relevant information on the following areas:

- Context, i.e., type of participant, geographical context, etc.
- Intervention(s)
- Facilitators and deterrents of the intervention(s)
- Study designs and analytical methods
- Outcome measures
- Results and findings

The team also captured relevant backward citations from bibliographies and reference lists at the end of each data extraction form to support further snowballing by the team. The list of backward citations identified and included in our evidence base is shown in Annex 3. Studies identified through backward citations went through quality appraisal.

3.3.4 Data analysis and synthesis

Our approach to data analysis and synthesis sought to combine knowledge and generate new insights, so that the synthesis is more than the sum of its parts. We applied both framework analysis and thematic analysis as below:

- Framework analysis provided a structure for organising, analysing and presenting the evidence according to intervention types (see Table 1 and the ToC).

- Thematic analysis then allowed the team to draw on the intervention types identified in the framework analysis, delving deeper into specific areas of interest, including barriers and enablers, effectiveness, and policy considerations.

We first analysed the landscape of the 122 studies, summarising headline characteristics to show the distribution of studies by geography, intervention type and scale, and type of crops/commodities (see section 4.1).

The team then assessed each group of interventions, looking for common and contrasting reports of the effectiveness of interventions to limit deforestation and other environmental harm, promote sustainable farming, and enhance smallholder farmers' welfare — and the conditions under which interventions were effective.

Analysis was done at two levels, including analysis of findings under each of the six intervention types identified in Table 1, followed by an overarching synthesis of key findings across the study.

3.4 Limitations

One major limitation of this study relates to the considerable heterogeneity in intervention types, outcomes, and study designs. Across the literature, we found that more than one intervention type may apply to smallholder forest farmers in any given place and time. These may be stand-alone interventions with multiple components, or they may be coordinated within a scheme that combines different measures. This makes comparison of the effectiveness of interventions harder, given the number of potential intervention types and schemes that have been used over the last decade. If a scheme combines, for example, farmer training with capital grants with a price premium for sustainable production, attribution of any impact to the different components becomes difficult.

Addressing issues of heterogeneity, or intersectionality, is challenging in the context of an REA that covers a broad remit. Ideally, reviews should be focused on a narrower topic and methods, thus allowing for disaggregated sub-group analysis to tease out which intervention combinations are more effective than others. But if that ideal were applied, the number of eligible studies would be very few.

A second limitation is the rapid nature of the study and what the team could achieve with the time and resources available. While this REA has enabled the team to produce policy-relevant findings in a short period, the streamlined methodology has limited our ability to explore in more depth which intervention types work best when combined. More time would have allowed us to explore complementarities of interventions that would potentially enhance impact.

The rapid nature also explains the focus on English-language publications, thereby introducing a language bias, as well as the choice of grey literature sources that are weighted towards the global north. With limited time, these publications were relatively easy to identify and access. These biases may explain the dominant presence of a particular set of interventions more consistent with the thinking of institutions based in the global north. Incorporating voices from the global south and broadening the scope of the evidence beyond English-language material required more time than was available.

A third limitation is a narrower than expected evidence base of reporting on forest outcomes. Despite all interventions included in the review being implemented in forest locations, or within forest-risk value chains, outcomes reported were more often on economic and livelihoods impacts, with reporting on forest impacts being less prominent. This may be linked to the long-term nature of forest interventions: it takes time to see impacts on deforestation. Forest projects typically take between five and ten years to report results and it can be even longer — after the project has ended — before significant outcomes or impacts can be recorded. Because many studies observe current projects, they are not able to measure and report on long-term outcomes.

4. Findings

This section starts by summarising the landscape of studies identified, highlighting the diversity of findings across different geographies, scales, commodity types and intervention types. The landscape analysis highlights the complexity of identifying which intervention types have been most effective in deterring smallholder farmers from clearing forest or encouraging the practice of sustainable agriculture.

We then look at overall findings, presenting an overarching theory of change (including barriers and enablers) developed to summarise how the range of activities and inputs identified across the literature can contribute to the desired outcomes of reduced deforestation, sustainable agriculture and improved farmer welfare (see section 4.2). This is further supported by activity-to-outcome mapping that helps to identify the incidence of activities against individual outcome areas, showing where the evidence is strongest.

The remainder then assesses findings by intervention type, as set out in Table 1, exploring the different intervention types identified in the literature and how these are combined in different contexts to generate outcomes and learning. For each intervention type, we examine the effects of interventions on forest clearance and sustainable agriculture, and (where reported) on smallholder farmer welfare, with a focus on income and food security. We found very little reporting on reduced vulnerability to climate change.

Innovative schemes to reduce or prevent forest clearance are highlighted throughout, along with considerations for policy and decision-makers.

4.1 Landscape analysis

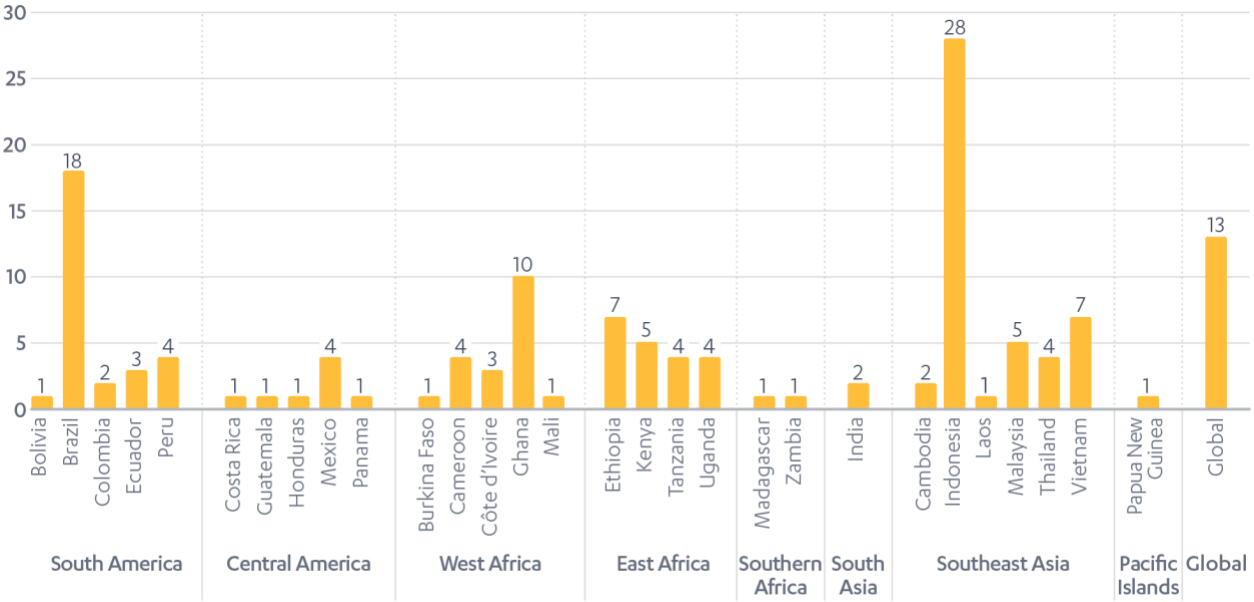
Geography

While the selected studies covered all regions of the world with significant tropical forest coverage, the most prevalent regions are Southeast Asia and South America (Figure 2). There were far fewer studies in the Caribbean, Southern Africa, South Asia and the Pacific Islands, but these regions do have fewer countries with significant tropical forest coverage (see Annex 1 for a complete list of countries included in the study). In the Caribbean, only Cuba and Belize were represented in the search results, similarly only Madagascar and Angola were identified in Southern Africa, and Papua New Guinea in the Pacific Islands.

Figure 2: Number of studies from each region

The 122 studies covered 29 countries, including 13 studies that covered several countries or regions. The most prevalent countries (Figure 3) were Indonesia (28 studies), Brazil (18 studies), and Ghana (10 studies). But it was not just these countries: five or more countries represented South America, Central America, West Africa and Southeast Asia.

Figure 3: Number of studies in each country, categorised by region[9]

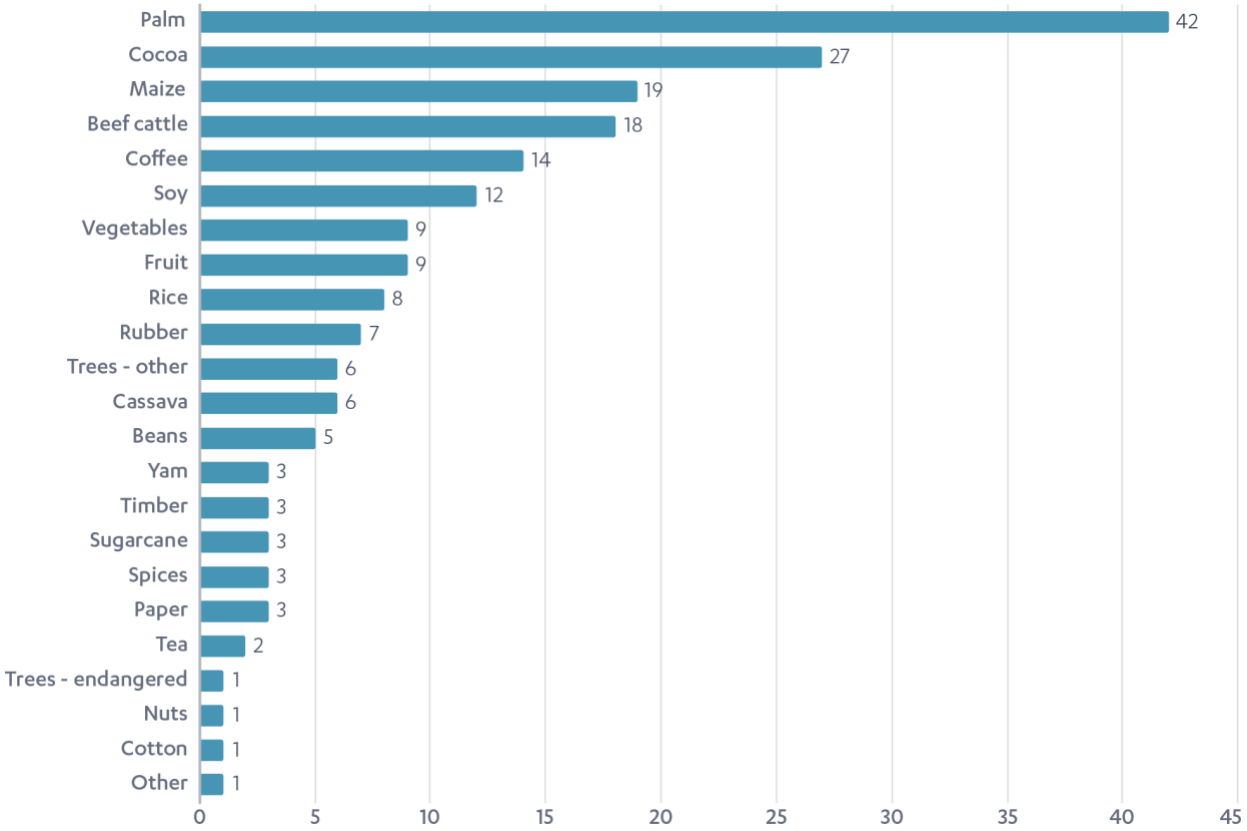


[9] Some studies are double-counted because they covered more than one country, so the total is higher than the total number of studies.

Crops/ commodity types

Twenty-three different crops and commodities (or categories of crops) were represented in the studies (Figure 4). Oil palm was the most commonly studied crop, with 42 mentions. Other well-represented commodities include cocoa (27 mentions), maize (19 mentions), beef cattle (18 mentions), coffee (14 mentions), and soy (12 mentions). Some studies explored more niche crops, including tea, various spices, nuts, bamboo and teak.

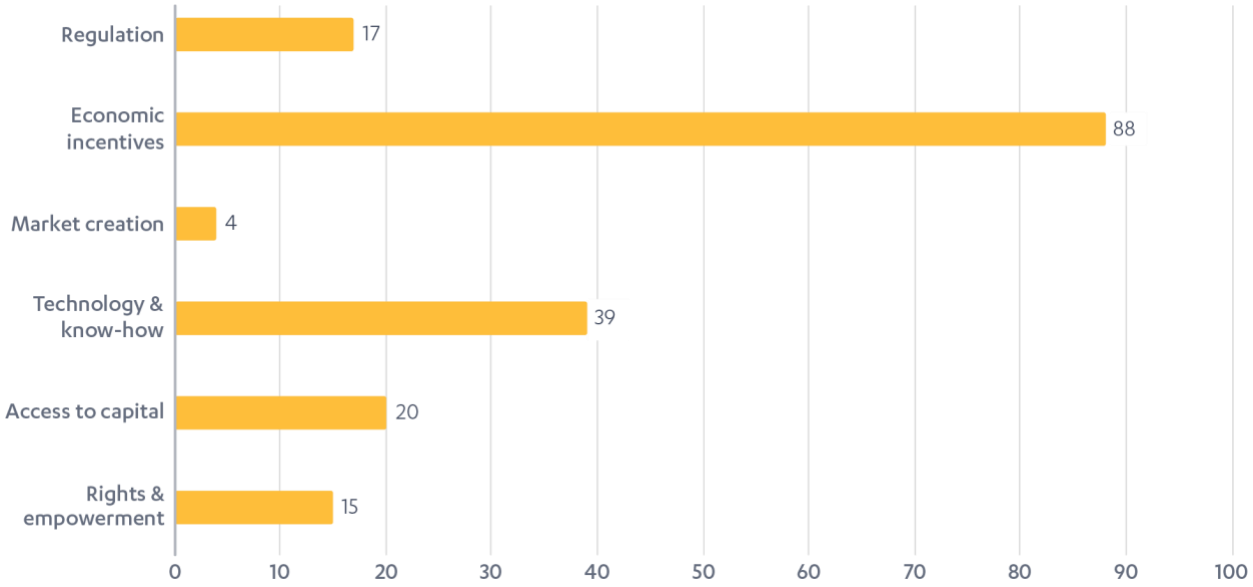
Figure 4: Number of studies that referenced crops and commodities



Intervention type and scale

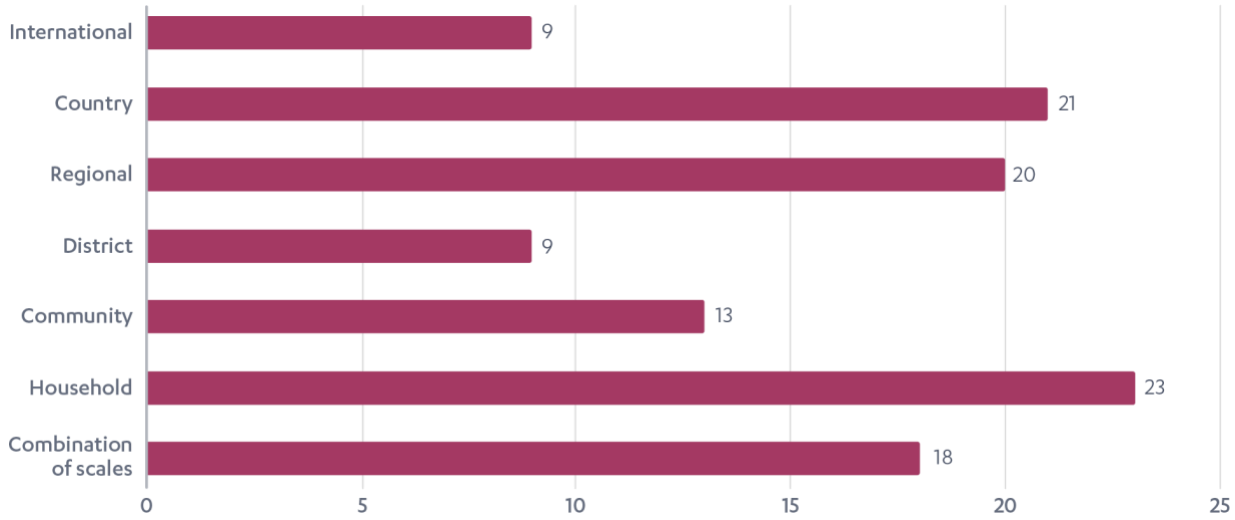
The largest intervention category identified in the studies (Figure 5) was economic incentives, with 88 studies identifying these interventions, followed by technology and know-how (39 studies), access to capital (20 studies) and regulation (17 studies). Fewer studies were found of interventions focused on rights and empowerment (15 studies) and market creation (4 studies). Many combinations of interventions were also identified across the literature.

Figure 5: Number of studies within each intervention type



Interventions took place at various scales, from international programmes to community- and household-level interventions (Figure 6). The largest number of interventions were identified at household level, followed closely by country- and then regional-level interventions. We also found that several interventions took place across multiple scales, for example at both country and international levels or at country and regional levels.

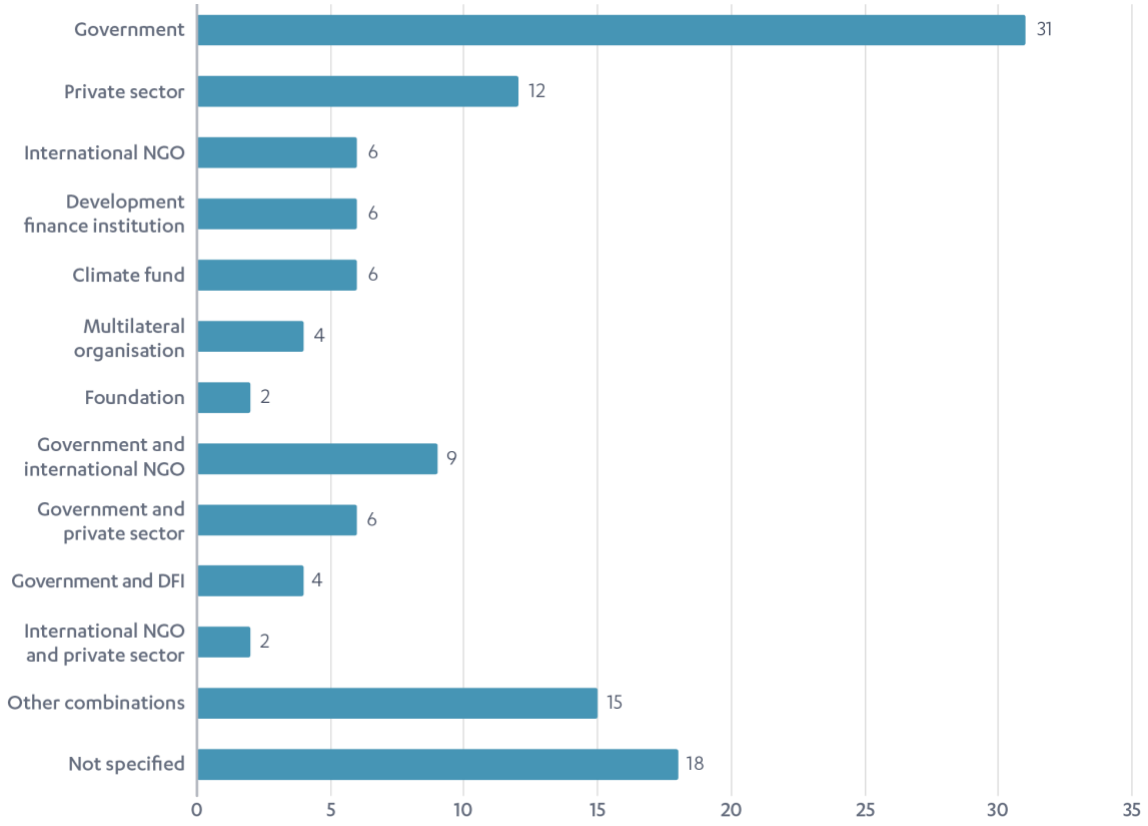
Figure 6: Number of studies within each scale of intervention, including those that occur at multiple scales



Funding partners

The studies identified funding partners (Figure 7). The most identified funding partner, by a significant margin, was government, followed by the private sector and then by international non-governmental organisations (NGOs), development finance institutions, and climate funds. We also found several studies where a combination of funding partners was identified, most commonly government and NGOs, followed by government and the private sector. Eighteen studies did not include information on funding partners.

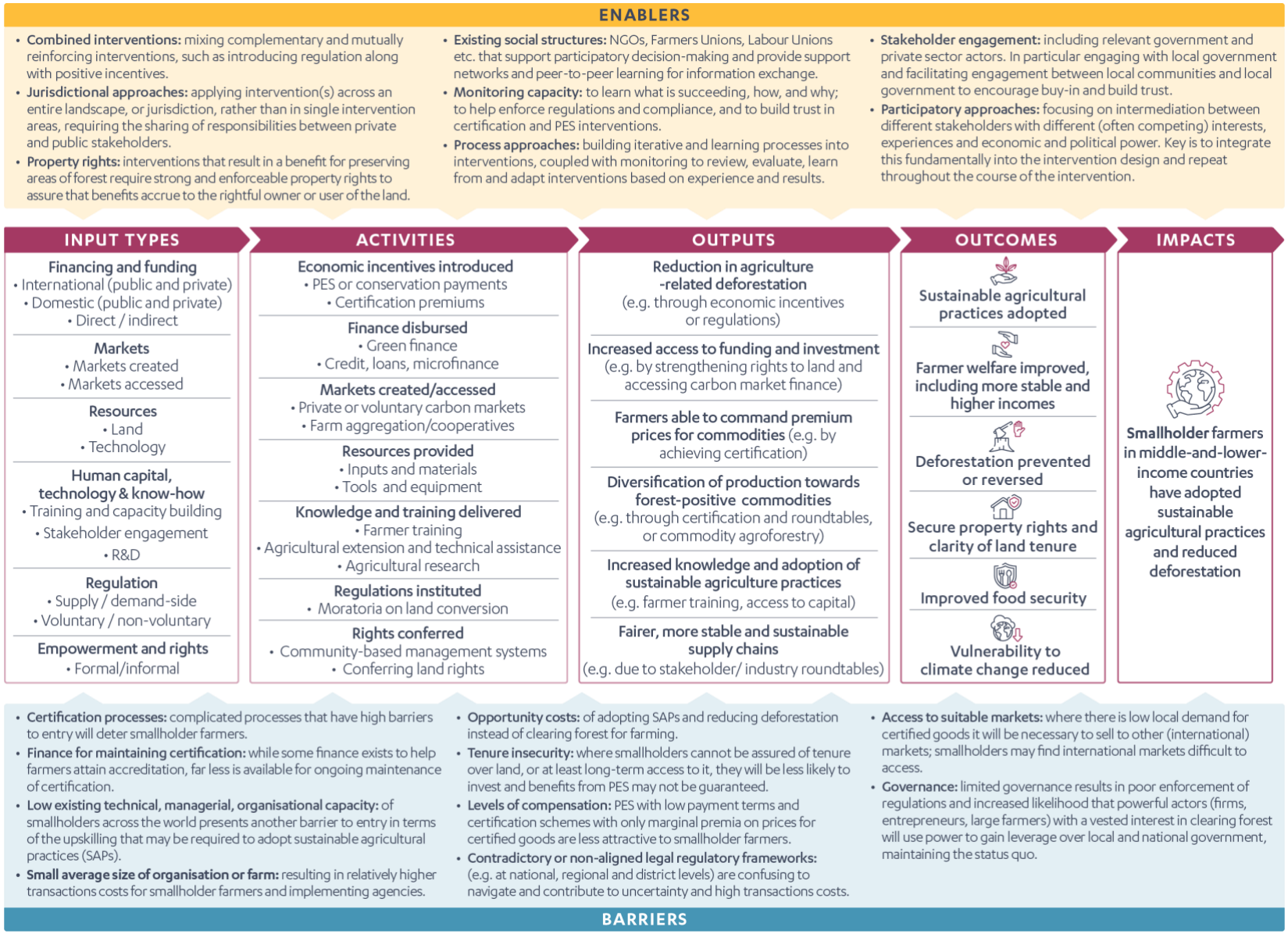
Figure 7: Number of studies with each type of funding partner



4.2 Overarching theory of change

An overarching theory of change (ToC) (Figure 8) was developed to demonstrate how the interventions and approaches set out in Table 1 may contribute to the desired outcomes of reduced deforestation, adoption of sustainable agricultural practices and improved farmer welfare. The ToC draws on findings from the studies included in the review. It does not show direct causal pathways for each intervention type but instead shows how different interventions can complement each other and identifies the contextual factors that can enable or hinder progress towards outcome- and impact-level results (barriers and enablers). Given the range of intervention types included in this study, the ToC is necessarily high-level, even though findings from the included studies were often more specific to their scale and context.

Figure 8: Overarching Theory of Change



Given the variety and number of approaches captured in this study, which can make it difficult to draw conclusions on effectiveness across different intervention types, scales and geographies, the ToC includes a strong focus on the enablers and barriers that ultimately influence the effectiveness of inputs and activities described in the ToC; enablers and barriers to consider when designing future programmes targeting smallholder farmers. These enablers and barriers are discussed in more detail in section 4.3, which synthesises findings by intervention type and sets out key considerations for policymakers.

While the ToC illustrates how interventions contribute to outcomes and outlines the conditions — in terms of enablers and barriers — that help or hinder interventions, it does not present, within the ToC itself, pathways to scale or routes for catalysing large-scale impact through interventions. This is because we found only limited evidence of scaling up from the studies included in our review. That said, some regard to scaling should be paid when reviewing the ToC.

When piloting innovative interventions, exceptional resources need to be focused on a programme for it to generate results. Hence most pilot and early-stage programmes are limited in scale to contain costs. To move from a successful pilot to a scaled-up intervention that is economical and runs under normal conditions may lead to some (small) loss of effect, compensated by gains in economy of resources and effort. This matters: small pilots may result in successful outputs and achieve significant outcomes, but on a limited scale. A larger programme may not be quite so effective relative to its size, but by its sheer scale may achieve more — and be economical.

Another consideration for scaling is the delivery vehicle. If the intervention is profitable, it can be delivered by private enterprises. Otherwise, it must be done by a public agency, either governmental or non-governmental. If looking to private markets to achieve scale through profit, there may still be a role for government; if taking the intervention to scale allows a firm to earn monopoly rents, it will be necessary to either regulate the market or encourage competition by licensing the innovation to multiple firms.

More detail on examples of scaling up taken from the studies reviewed can be found in section 4.4 of our findings.

4.3 Findings by intervention type

4.3.1 Regulation

Characteristics of regulations

Regulation can cover a wide range of interventions, but those reported in the studies can be grouped into rules:

- to prevent clearance of forest;
- to contain expansion of crops onto forested land;
- to stop imports of produce from (recently) cleared forest land;

- to forbid (indiscriminate) burning of forest lands — a particular danger when the lands are peat which can catch fire.

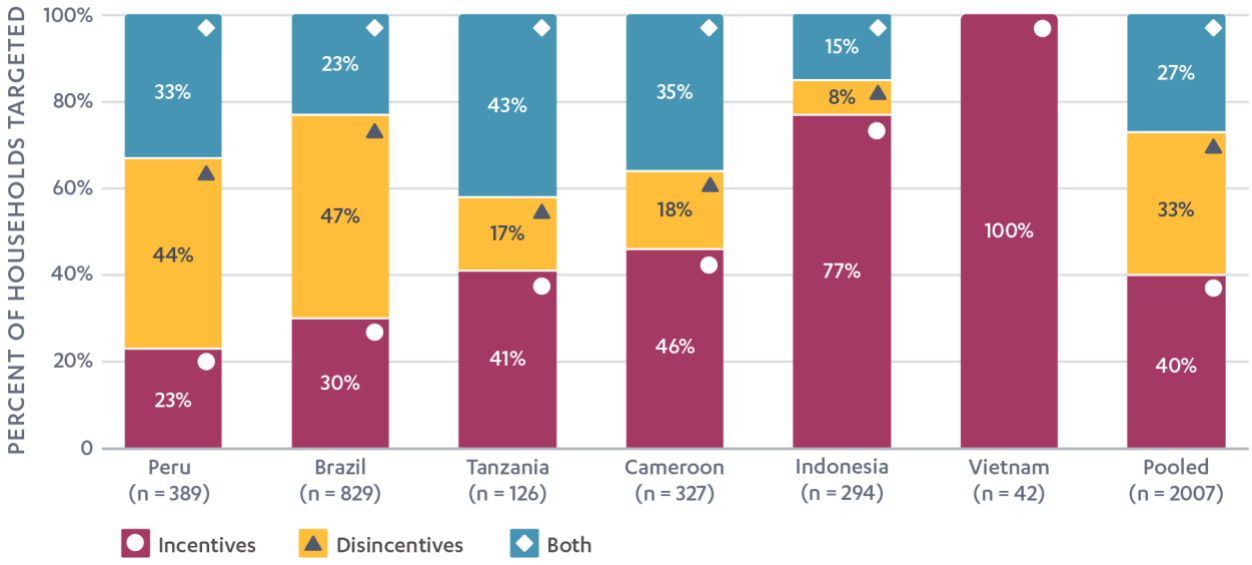
Those setting and implementing regulations range from local community to local government to national government and even external governments — where trade regulations stipulate that produce imported to the government's jurisdiction cannot come from cleared forests.

Regulations are often part of a package of measures. For example, when forest clearance is forbidden, farmers who might otherwise have cleared forest may be offered technical advice on how to intensify production from their current cleared land, credit to invest in intensified production, and even help to market their produce to get a better income from their fields.

In a 2013/14 survey of nearly 4,000 households in six countries (Brazil, Cameroon, Indonesia, Peru, Tanzania and Vietnam) affected by REDD+[10] schemes, regulation (called disincentives in the article) was less common than incentives (Duchelle et al., 2017). The balance of incentives and disincentives varied considerably by country — regulation was far more common in Brazil and Peru than elsewhere, while in Indonesia and Vietnam regulation was limited or absent (Figure 9).

Examples of regulation of forest use seen in the Duchelle et al. (2017) survey include:

Figure 9: Households surveyed in six countries affected by REDD+ schemes who received incentives or disincentives, 2013/14



[10] REDD stands for 'Reducing emissions from deforestation and forest degradation in developing countries'. The '+' stands for additional forest-related activities that protect the climate, namely sustainable management of forests and the conservation and enhancement of forest carbon stocks (UNFCCC, 2023).

- **Brazil:** Monitoring of deforestation and forest fires by national and state environmental agencies through helicopter flyovers and patrols, followed by fines on offenders.
- **Cameroon:** Restrictions on local forest clearing and bush burning; conservation and monitoring activities in the buffer area of a national park.
- **Indonesia:** Community participatory mapping to clarify village boundaries and establish village land use plans; community-led forest patrols.
- **Peru:** Land use restrictions in Brazil nut concessions based on approved management plans; forest monitoring and surveillance in Indigenous territories by the REDD+ implementer, a regional Indigenous organisation, and the national park service.
- **Tanzania:** Restrictions on forest use through implementation of village forest management plans. (Duchelle et al., 2017)

Effectiveness of regulations

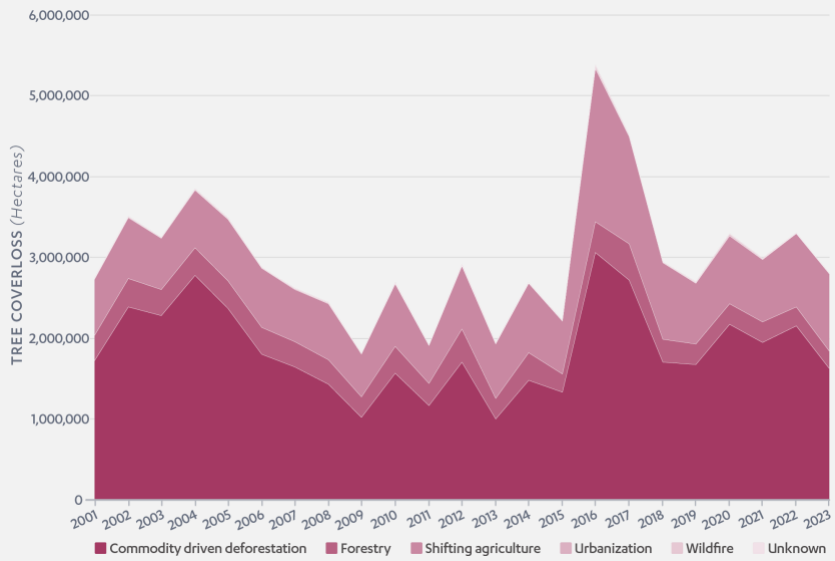
Regulations have the advantage that they give clear and often precise instructions on the management of natural resources: they tend to be highly visible and easily understood. If they are implemented with monitoring and policing of the regulation, they can be highly effective. Brazil from 2007 to 2017, for example, is a case in point (Box 1).

Box 1: Controlling Forest clearance in Brazil

Legal restrictions apply to deforestation across almost half (44%) of the Amazon ('Legal Amazon') within Brazil. Protected areas comprise Indigenous Territories and Conservation Units. Another 6% of the Amazon is under special tenure, including colonisation settlements promoted by the government in the 1970s and 1980s to provide farms for land-poor farmers and labourers, above all from the Nordeste. Some 23% of land is privately owned; 27% is either unclaimed or the status is unclear.

Regulations also apply to private farms in the Amazon. The 2012 Forest Code requires private farms to keep 80% of the land under forest — with 50% as an exception applying in designated agricultural zones. The same Forest Code also set up a national Rural Environmental Registry whereby all rural holdings would be registered to monitor deforestation. In addition, the federal government listed municipalities ranked by deforestation: farmers living in municipalities high on the list were penalised in the allocation of state credit for agriculture.

Figure 10: Annual tree cover loss by dominant driver in Brazil



Source: Curtis, P.G. et al., 2018

From the mid-2000s these legal protections and obligations were implemented through campaigns. The effect was substantial: from 2005 to the mid-2010s, deforestation was much reduced, from almost 3 million ha cleared in 2005 to under 1 million ha by 2010 (Figure 10). Regulations were complemented by public-private initiatives such as the Soy Moratorium of 2008, which prevented the legal sale of soybeans from lands cleared of tropical forest. That success, however, was not maintained: by 2016 deforestation had risen back to almost 3 million ha a year.

The surge in deforestation from 2016 onwards has seen rising amounts of forest lost to wildfires — losses which may be over and above those recorded, as some monitoring agencies only track felling. The cause of the surge has also been attributed to political change within Brazil that has seen agribusiness interests prevail in Congress, leading to cuts in the budgets of environmental protection agencies and amnesties for those fined for illegal clearance of forest:

> *"This new rise in deforestation is resulting from the coming together of multiple factors, say experts, especially a perfect storm that has made it easier for politically well-connected wealthy land-grabbers to convert native forest to pasture and for croplands, with little fear of punishment. The power of the majority bancada ruralista, agribusiness lobby, in Congress, and its similar strength in the Temer government, has led to major legislative and administrative setbacks for the environmental movement and for Indigenous groups." (Branford and Torres, 2018, online)*

A March 2018 ruling by the Supreme Court redefined the New Forest Code largely in favour of Brazil's ruralists and endorsed an amnesty of 8.4 billion reais (US$2.2 billion) in fines for illegal deforestation.

Sources: (Brandão et al., 2020; Seymour and Harris, 2019; Branford and Torres, 2018)

Effective implementation of regulations is not easy. Forests cover large areas, areas that may be hard to access due to lack of roads, so knowing if rules are being followed may be difficult and costly. That said, satellite images can reveal forest clearance, and illegal burning sends columns of smoke into the air that can be seen from miles away. Technical advances in satellite imagery are making monitoring of land use ever more possible, at lower cost and promptly:

> *"The monitoring of cocoa farms faces technological challenges. However, advances in machine learning and artificial intelligence, along with images with greater resolution, are proving helpful, particularly with private monitoring service providers being used by government and the private sector." (Proforest, 2022, p.13)*

Monitoring is of little use if the rules are not enforced. Ghana has commendable rules restricting logging from primary forest, but logging is profitable: deep in the forest it is easy for loggers to pay off forest officers and local authorities to turn a blind eye to their felling.

> *"People in every community stressed that endemic corruption facilitated illegal tree harvesting. They reiterated that the very authorities charged with protecting them from such illegalities (i.e., FC [Forestry Commission] officials at district offices and FC forest guards) were complicit in damages incurred because officials received bribes from illegal fellers." (Gaither et al., 2019, p.344)*

Duchelle et al. (2017) observed correlations between regulation and outcomes for the farm households in REDD+ schemes in six countries. Regulation tended to affect households that had cleared more forest at a baseline survey in 2010/12: by 2013/14 they reported clearing less forest than other households in the survey. Almost all of this, however, was driven by observations in Brazil. While regulation had apparently saved forest in Brazil, households experienced less tenure security and lower household well-being:

> *"In Brazil, where disincentives were correlated with fewer hectares of forest cleared, they were also correlated with decreased tenure security and negative effects on household well-being. In Peru, disincentives had no bearing on forest clearing, and concurrently there was no change in household well-being, but were correlated with a decrease in tenure security, possibly due to increased surveillance of local landholdings." (Duchelle et al., 2017, p.9)*

Lower well-being, according to the authors, was not surprising: the households depended heavily on farm income which came from cleared forest, and so restrictions on clearing meant restrictions on potential incomes (Duchelle et al., 2017). When regulation was combined with incentives, however, well-being did not fall. Indeed, the effect of regulation depended in part on who was policing the regulation: in Brazil it was mainly federal agencies, in Tanzania it was local authorities and communities. Given a say in the rules and their enforcement, locals in Tanzania were likely to respect the rules. In Brazil, local people had much less voice and saw the rules as being imposed on them (Duchelle et al., 2017).

Studies also considered trade regulations. The EU Deforestation Regulation (EUDR) approved in 2023, for example, will restrict imports of products of cocoa, coffee, cattle, rubber, timber, soy and palm oil if they have been produced from deforested land. However, because the EUDR will only come into effect in 2025 and 2026, its effects are currently unknown (Proforest, 2022; Tropical Forest Alliance and Preferred by Nature, 2024). The same applies for the planned initiative of the China Meat Association to import only from producers of cattle who respect human rights, employ labour decently, and do not deforest. How this will affect beef exports from Brazil remains to be seen (Tropical Forest Alliance, 2022).

Considerations for policymakers

Regulations against deforestation can be effective when and where it is possible to enforce them — which is neither often nor widespread. Enforcement depends on having the means to monitor compliance with regulations and to act against offenders. Monitoring is becoming easier with satellite imagery and the use of drones to detect recent felling of forest.

Enforcement, however, requires having staff on the ground to warn offenders and, if necessary, to sanction them. In Madagascar, swidden farming is forbidden, but the state lacks the capacity to enforce this (Rakotonarivo et al., 2021). Similarly, in Pará state, Brazil, the public agency for control of forests in 2018 had only 20 forest guards to safeguard all of Pará (Branford and Torres, 2018).

More important, however, is the will to impose regulations and enforce them. Some people who clear forest are wealthy and politically well connected. They may have the means to bribe enforcement officers to ignore their activities — see, for example, the case of illegal forestry in Ghana (Kansanga and Luginaah, 2019). When power is so unevenly distributed, regulation has the potential to be deployed against the poor and powerless but set aside when it comes to the rich and powerful (Pacheco et al., 2017).

Regulation by central governments is thus likely to fail in many contexts. A better option is to work with communities, to negotiate rules acceptable to local people as well as to central government and leave enforcement to peer pressure.[11] But that implies a meeting of minds between government and local people. If local people are to accept rules that restrict their use of land, they will expect something back in return — which leads to considerations of (economic) incentives, as covered in the next section.

[11] This is similar to the story of forest conservation in general. In many parts of the global south, not least in states conquered and administered by the UK, colonial administrations sought to protect forests from the imagined depredations of local populations by imposing strict rules, often complete exclusion from forest, and hiring forest guards to enforce them. This rarely worked well: the rules and the guards led to resentment among local populations that had long used forests to gather and hunt. With the forests alienated to the state, local communities came to see the forest as an enemy: a resource to be pillaged when the guards' backs were turned. From the 1970s onwards, forest departments began to rethink conservation, turning to include local communities in agreed use and management and trusting that local peer pressure would lead to compliance (Arnolds, 2001).

Conclusions on regulation

Determined regulation can curb deforestation, as seen in Brazil in the early 2010s. Much depends, however, on political determination to police regulation: when the stick of regulation is not accompanied by the carrot of incentives, regulation will likely be resisted. Much depends then on the effect of regulation versus, variously, the effect of other policies and programmes that may apply, the costs and benefits of intensifying agricultural production from already cleared land, and the availability of non-farm incomes.

This thinking is reflected in the trend in the late 2010s and early 2020s towards programmes that combine multiple interventions; interventions designed at least in part by dialogue among diverse stakeholders, not least the farmers themselves.

4.3.2 Economic incentives

Characteristics of interventions using economic incentives

The logic behind economic incentives[12] is straightforward: reward those using forest lands to conserve the environment for the environmental services they provide — services which invariably benefit many more people beyond the farms and forests (Table 2).

Economic incentives divide into two streams: those that directly reward land users for conservation of the environment, as seen with Payments for Ecosystem Services (PES); and those that reward land users by raising returns to environmentally sustainable production — a less direct way to incentivise land users. These indirect economic incentives have three variants:

- **Certify produce as being grown and processed sustainably**, with minimal environmental harm, for sale to consumers who are prepared to pay a premium to know that their consumption is not harming the environment.[13]

- **Develop production techniques** that conserve the environment while either increasing returns to the producer or cutting their costs: agroforestry is a prime example.

- **Improve supply chain functioning to cut costs** by, for example, connecting growers and buyers by mobile phones, or investing in storage, processing, transport and logistics of any kind — which should raise effective prices to growers.

[12] Incentives are not just economic: some mechanisms appeal to other values, such as pride in producing in accord with longstanding (ancestral) traditions that value the natural world, or the social status of being seen to be an environmentally responsible producer. These will not be covered in this section. Appeals to values are rarely first and foremost in the interventions documented, although they may form part of other interventions — and especially those that focus on rights and empowerment. See participatory decision-making in section 4.3.6.

[13] Certification typically includes environmental requirements, but also, and often as or more important, stipulations on child labour, decent work, health and safety, and fair trade.

The three variants are not exclusive. Interventions often combine these elements; for example, certification can involve improvements to supply chains.

Table 2: Economic incentives to conserve forest and farm sustainably

Intervention	Mechanism
Payments for Ecosystem Services (PES) [14]	These directly reward land users for the environmental services their land provides
Conservation basic income (a)	Direct income payments to land users in conservation-critical zones, partly in the hope and expectation that this will encourage land users to conserve their (valuable) environment
Certification of produce	Producers are rewarded for adhering to the conditions set in the standard by a premium price, or access to a premium market, leading to higher returns
Generate and disseminate methods of production which both conserve the environment and raise returns to land and labour	Producers are motivated to adopt such methods, changing from less sustainable methods. Higher returns to land may ease pressure to clear forest for additional fields and pastures
Improve the efficiency of agricultural supply chains, cutting costs of supply of inputs, technical know-how, and finance, and reducing costs of processing, storage and transport	Improved supply chains lead to lower farm-gate prices for inputs, and higher farm-gate prices for produce. Farmers gain higher incomes: this may reduce pressure to clear forest for additional fields and pasture

Source: authors' own elaboration. Note that (a) is included as an option, although none of the studies observed this measure.

Before examining specific forms of incentives, one study reviewed incentives overall. An appraisal of REDD+ initiatives in six countries — Brazil, Peru, Cameroon, Tanzania, Indonesia and Vietnam — records many kinds of incentives, each of which in practice has features adapted to local circumstances (Duchelle et al., 2017). With so many variations, assessing which incentives are effective, why, and in what settings is no small exercise. The authors were not able to reach more than general observations about incentives. In contrast to disincentives (to clear forest), incentives tended to raise the welfare of farmers. That said, the authors saw that, in some cases, payments were too small to affect farmer behaviour:

> *"However, monetary incentives to curb traditional swidden practices were often too small to adequately compensate farmers for the loss of agricultural income, and*

[14] Sometimes the services are described as 'ecosystem', sometimes 'environmental': the two adjectives refer to the same things and can be used interchangeably.

> *technical assistance was lacking to help them engage in new production techniques." (Duchelle et al., 2017, p.10)*

That raises the issue of the strength of incentives: a topic to be revisited as we review specific interventions in the rest of this section.

i. Payments for Ecosystem Services (PES)

Nature of PES interventions

Paying for ecosystem services is a common and growing measure to prevent deforestation. Salzman et al. (2018) record more than 550 active programmes worldwide, with annual transactions worth an estimated US$36-42 billion. Forest environmental services have been the focus of many PES schemes:

> *"The forest and land use carbon market has received the most attention of any PES sector. A policy instrument to combat climate change, US$2.8 billion has been spent since 2009 for forestry and land use practices that sequester carbon and quantify carbon benefits in the form of a standardized offset." (Salzman et al., 2018, p.138)*

Worldwide, the same study reported 48 forest and land use carbon PES programmes, including 31 government-financed programmes and 17 compliance programmes (Salzman et al., 2018). PES schemes can be private and voluntary, or run by international public funds, or be part of international agreements such as the Clean Development Mechanism (CDM) (Salzman et al., 2018).

For forests, PES measures include planting more trees, better forest management, and avoided deforestation — all of which fall under the heading of REDD+ (Salzman et al., 2018).[15]

Effectiveness of PES

While 16 studies reported outcomes, albeit with markedly different appreciations, an evaluation deficit may exist for PES:

> *"It is still too early to draw externally valid conclusions from the young field of PES impact evaluation: few rigorous studies have been undertaken, and in addition those are too concentrated on a small number of countries (e.g., Costa Rica, Mexico)." (Börner et al., 2017, p.367)*

Of the studies reporting on outcomes, those with positive outcomes outnumbered those with negative outcomes. Results for PES may be better when the scheme is evaluated for its local

[15] "Neither the Clean Development Mechanism nor the European Union Emissions Trading Scheme has directed large investment flows to forest conservation. The Paris Agreement explicitly recognized the importance of forests in mitigating climate change, but subsequent negotiations have not yet resulted in agreement on the role for forest and land-use carbon offsets in meeting emissions reduction targets." (Salzman et al., 2018)

impact, rather than diluted by considering effects nationally, according to a cross-country study (Börner et al., 2017):

> *"Low effectiveness at the country level notwithstanding, PES schemes can be effective at the local scale. During 2007-13, payments avoided 12-15% forest cover loss in participating PES communities… A PES program in the southern state of Chiapas, Mexico, found that forest use restrictions coupled with a PES for forest conservation in the Monarch Butterfly Biosphere Reserve, an area with relatively high deforestation rates in central Mexico, lead to significantly lower forest loss and degradation. Similarly encouraging findings of effective PES at the local level have been published for the Costa Rican PES program." (Börner et al., 2017, p.365)*

Returns to PES depend in part on baseline compliance with the provision of ecosystem services — if most land users are already conserving such services, the scheme will have little room for improvement; and in part on the degree of adverse selection into the scheme — referring to land users signing up to the scheme who would have maintained the ecosystem services in any case and hence did not need payments to do so (Börner et al., 2017). Expect, then, low returns to PES when compliance is already high and adverse selection into the scheme quite likely.

Not much is apparently known about whether environmental benefits last when payments end, but a case from Colombia shows sustained benefits, albeit in part likely due to continuing technical assistance (Börner et al., 2017).

An NGO in Pará, Brazil ran a small (350 households) programme, with land registration, technical assistance and PES. The scheme was well funded, with annual payments reaching a maximum of US$626 for each participating household when all criteria were met: 30% of the payment was contingent upon forest conservation on at least 50% of land as Legal Reserve, 30% on the conservation of 15 metre-wide forest riparian zones, and 40% on the adoption of fire-free production systems (Simonet et al., 2019). The programme helped to reduce deforestation and save carbon, at the (seemingly very low) cost of less than US$1 per tonne of carbon.

> *"… we can thus safely conclude that the Projeto Sustainable Settlements in the Amazon … project had a significant impact on forest cover by curbing deforestation, and that this change occurred to the detriment of new pastures, not cropland. We failed to detect any significant impact on other variables like livestock or wage labor outside the farm… the project led to the reduction of around 639,000 tons of CO2 over the first two years of implementation, resulting in a cost of 0.84 USD per avoided ton of CO2 emissions. Over the first two years of the project, the total cost of the project is thus $0.84 per tCO2 emissions avoided." (Simonet et al., 2019, p.13)*

A randomised controlled trial (RCT) in rural Uganda also showed how PES could reduce deforestation. Participants typically received US$113 from PES: enough to compensate them for any forgone returns to forbidden activities, but not enough to boost their incomes. A benefit-cost analysis of the programme showed good returns of up to 12:1, depending on assumptions over what happens when payments end (Jayachandran et al., 2017).

An RCT in Burkina Faso paid farmers near forests a small amount, US$0.71, for each tree, planted by a forest programme, that was still alive a year later. Average payments were just US$14.80 per farmer, but that was enough to cover a week's worth of household food — some 22% of payments were spent on food. Improvements in food security were measured by the household food insecurity assessment score.[16] In Burkina Faso, incentives were greater if the payments were made during lean seasons when food is scarcer (Adjognon et al., 2021). In Colombia's highlands, a systems dynamics analysis investigated changes to livestock systems that would conserve forest and grazing. One option lost more than would be gained through PES, but another, which involved intensifying grazing on a smaller area, releasing land for conservation, did pay off for farmers. PES with technical change could therefore be effective (Barro-Chale et al., 2023).

Simulations were run with villagers in Bolivia, Indonesia, Peru, Tanzania and Uganda. Despite fears that a PES could displace non-monetary incentives to conserve, leading to less conservation, the study found that PES could work:

> *"… we found that (1) during the intervention, PES increased forest conservation behaviour; (2) after payments stopped, users continued to harvest less on average than they did before the PES intervention, especially when they were able to communicate; and (3) trust amplified the lasting conservation effects of PES interventions in the post-treatment stage." (Andersson et al., 2018, p.129)*

In Costa Rica and Mexico, both countries with long experience of PES schemes, it was found that even if national outcomes were limited, at sub-national level, PES schemes were significantly effective in limiting deforestation:

> *"Evidence from Mexico and Costa Rica shows that their respective PES national programs have had a limited impact on avoided deforestation because, in their early years, payments were allocated to areas with low deforestation risk … However, analyses performed at sub-national level in regions with higher deforestation have found more significant positive impacts on avoided deforestation." (Costedoat et al., 2015, p.4)*

Results show that Mexico's PES programme for biodiversity conservation has been effective in enrolling areas that generally show high deforestation risk, leading to additional forest cover protection compared to expectations in the absence of payments (Costedoat et al., 2015).

PES alone in these cases did not stop deforestation, it only decelerated its rate: additional measures were needed for full conservation of forest. More detail can be found, for example, from the Costa Rica experience of PES, where in Sarapiqui, Heredia Province, PES (since 1996) had helped farmers to increase their forest cover. Rather than a net loss of forest cover, as implied by trends in matched control farms, there was a net increase in total forest cover on farms

[16] This score (HFIAS) is commonly used across the world to assess food insecurity.

participating in a PES [Programa de Pago por Servicios Ambientales — PSA]. The PES's impact was equivalent to about 10-15% of the farm's pre-scheme forest cover:

> *"Our estimate of 8.5-12.7 ha of additional forest cover per farm for payments on about 75.5 ha of forest per farm implies that Costa Ricans (and donors) paid approximately $255 to $382 annually per hectare of additional forest induced by the PSA." (Arriagada et al., 2012, p.393)*

National results may have been lower than regional results, but that arose from poor targeting of payments (Arriagada et al., 2012).

In Ecuador, colonists in the forests were offered a 20-year contract to conserve forest, with incentive payments based on the amount of land enrolled rather than its value (Jones et al., 2017). Participating farmers had to have a clear and uncontested land title and had to commit to not cutting down any trees — violation resulted in loss of a payment and ultimately (after three violations) contract termination and a fine to pay back a percentage of what they had received through the programme (Jones et al., 2017). The colonists enrolled almost 50 ha on average, releasing a payment that was not far short of the regional average income, given the lack of off-farm work in the area:

> *"Each landowner in the FCI program enrolled an average of 49 ha, or 77% of their parcel. At US$30 ha-1 year-1, this is an average annual payment of US$1470; [the] amount of annual payments ranged between US$510 and US$2970." (Jones et al., 2017, p.57)*

Poorer farmers, however, were less interested in PES as they needed the forest to generate income to pay for household emergencies.

Several other studies highlight similar challenges to PES. Experiments show, for example, that PES schemes are not sufficiently attractive for farmers in the Atlantic Forest region of Brazil, in São Paulo state (Richards et al., 2020), while choice experiments showed that farmers in northern Thailand liked the idea of PES but did not like agroforestry as it limited their earning potential (Kanchanaroek and Aslam, 2018). A PES for water in the Cidanau basin, Indonesia, also led to little or no improvement to the welfare of farmers being paid as payments were too small to compensate for the loss of potential access to land (Biru et al., 2023).

Other negative effects linked to PES have also been reported. REDD+ in Ghana, for example, has seen land allocated to companies to replant trees, while farmers have been marginalised:

> *"Despite the promise that stimulating private sector investment in forest plantation development and carbon financing will yield sustainable benefits to local farming communities and enhance carbon stocks, the outcome of close to a decade of implementation of REDD+ in Ghana is arguably the reverse." (Kansanga and Luginaah, 2019, p.132)*

The problem was that those investors getting forest concessions, with grants and interest-free loans to develop tree plantations, had little incentive to bring in local farmers:

> *"… we argue that a 'carbon Green Revolution' is underway in the forest belt of Ghana – an agenda whose tenets and underlying politics are geared towards producing forest and greening forest landscapes at the expense [of] local farming livelihoods... Through the REDD+, private capital has now moved into forest landscapes in the ecological sphere and forestlands that were previously under state control have been privatized for carbon forest plantation development activities." (Kansanga and Luginaah, 2019, p.137)*

Unsurprisingly, mixed outcomes are reported for several PES programmes. In Brazil's Amazon, the municipality of Alta Floresta was especially favoured by Amazon Fund grants. The Fund wanted to stop deforestation, but in Alta Floresta the local priority was to get off the blacklist of municipalities with high rates of deforestation, which led to farmers being disqualified from public loans. Most of the Amazon Fund money went to register properties on the Brazil land register: this effectively got them off the blacklist. But paradoxically, once registered, some properties were then able to clear more forest legally (Correa et al., 2020). The Fund made little difference to deforestation, which had already slowed by the time the Fund began to disburse in Alta Floresta. The Fund also paid for training to help farmers intensify and diversify, but little was reported about how effective this was:

> *"Incentives mattered, e.g., for cattle-production intensification and agricultural diversification to financially offset production losses due to restoration. Notably, the project included only positive incentives for deforestation reductions, without mechanisms to punish farmers who kept deforesting illegally, even though the municipality had the authority to issue fines. According to a project manager for Olhos D'Água [the implementing NGO] sanctioning rules were left for state and federal authorities to avoid local conflicts.*
>
> *This model effectively outsourced uses of 'deforestation-based sticks' to external actors… while locally dispensing 'carrots' for intermediate steps.*
>
> *With the help of universities, NGOs, and the Brazilian Enterprise for Agrarian Research (EMBRAPA), 1720 farmers were trained in related techniques: rotational pasture management; soil quality testing; installation of irrigation systems; protective fencing; planting of seedlings; and supplementary feeding to maintain milk production throughout the year, with a focus on small properties under 55 ha." (J. Correa et al., 2020, pp.2-3)*

The Amazon Fund is a major programme in scale, time and funding. Yet questions arise over its focus by geography and its focus by intervention. With many variables in play, a review found it hard to distinguish which factors were affecting the mixed outcomes seen (Correa et al., 2019).

Other experiments with farmers in two very different contexts, Kenya and Madagascar, showed just how much context matters to PES (Rakotonarivo et al., 2021).

> *"… we used a dynamic interactive game framed around farmer land use decisions to examine farmer responses to two new policy options, financial incentives under individual and communal forest ownership.*
>
> *We found that their effectiveness in preserving forestland varied across contexts; the individual right treatment had no effect on participant decisions in Kenya, but in Madagascar, it led to much better conservation outcomes than the communal rights treatment." (Rakotonarivo et al., 2021, p.13)*

While incentives increased farmers' willingness to support conservation interests in both countries, its effect was four times greater in Kenya. Land rights and production systems made the difference: in Kenya farmers had secure rights and their farming was permanent, while in Madagascar rights were uncertain and agriculture was swidden (shifting cultivation). The study authors concluded that while subsidies could "play a major role in encouraging proconservation behaviour", no single set of institutions generates better outcomes for the resource and for the users under all conditions (Rakotonarivo et al., 2021).

In Chiapas, Mexico, for those farmers who understood the PES scheme and enrolled, PES conserved the forest they paid for. But far from everyone was enrolled, so elsewhere in the ejido [community], forest was cleared for cattle grazing (Corbera et al., 2020).

Considerations for policy and decision-makers

PES schemes may be little known or understood by land users, who may not fully understand the contracts involved, or have access to technical knowledge and the material means to meet the requirements of the scheme. In the Cidanau Watershed, Banten Province, Indonesia, a PES was started in 2004 by a water company wanting to abstract from a watershed. But 20 years later, most farmers not enrolled in the scheme did not know about it, despite their neighbours being enrolled (Biru et al., 2023). In Chiapas, Mexico, the logic of PES was also not understood by many farmers: those that joined the scheme belonged to social networks with leaders who had better information about the world outside the village and understood PES (Corbera et al., 2020).

In other areas of rural Mexico — one in Jalisco, one in Colima, and two in Oaxaca — an experiment showed that farmers responded better to a collective PES than to individual agreements. Not only did the collective payment reduce transaction costs, but also it seems that peer pressure to conform to the agreement increased adherence (Kaczan et al., 2017).

Yet the reverse was seen in Africa, where community-based payments are common, and collective agreements may invite free-riding. An experiment in rural Uganda, for example, showed that individual payments based on performance worked better than collective payments, or equal payments to individuals (Gatiso et al., 2018). When an RCT was run in Uganda to test acceptability of payments in return for conserving forest, only 32% of farmers enrolled. Many did not enrol because they did not understand the contract: worse, some farmers feared the contract was a

land grab, and that by signing up, they were signing away their land rights (Jayachandran et al., 2017).

In Madhya Pradesh, India, similar fears of land loss were voiced in an experimental study:

> *"Respondents also feared land use change would result in interference, control, or illegal acquisition of private land by the forest department, which is consistent with previous findings that lack of trust in government impedes voluntary participation in conservation programs…" (Puri et al., 2021, p.9)*

In Ecuador, forest colonists were also concerned about the risks of a PES contract, especially the risk that they might be held responsible if some other persons were to enter their property and extract what was meant to be conserved. They also feared loss of property linked to a general mistrust of government, fearing that at the end of the contract the land would revert to the state (Jones et al., 2017).

Several factors can encourage farmers to accept PES. One is the reward offered. In Ethiopia, for example, a discrete choice experiment showed that farmers wanted up-front payment in food to plant fertiliser trees in their crop systems — although preferences varied among farmers (Haile et al., 2019). In the Uluguru mountains of central Tanzania, in the upper catchment of the Ruvu river, farmers received inputs, technical assistance and payments for conservation, including agroforestry and *fanya juu* terraces (Kwayu et al., 2014).

Another enabler was the degree of dependence on land. In Ecuador, farmers with off-farm income were less likely to deforest than those dependent on farming alone. Sustainable intensification helped reduce pressure on land, but farmers needed subsidies to invest in more intensive farming:

> *"We found that both sustainable intensification strategies strongly reduced the conservation payments required to stop deforestation, from US$79 (pure forest conservation strategy) to US$46-47 per hectare natural forest per year (the required payments varied slightly from period to period). Integrating nitrogen-fixing tree species that are native to the region, such as Andean alder (Alnus acuminata) in local pasture systems could help save artificial fertiliser and provide a range of ecosystem services, such as carbon sequestration." (Knoke et al., 2022, p.1987)*

In Madhya Pradesh, India, landowners and farmers close to protected areas were asked about enrolling their land into agroforestry. A stated preference choice experiment showed that they wanted large payments and loose conditions:

> *"On average, landowners required Rs. 66,000 (ca. $940 USD) per acre per year to modify their land use and adopt agroforestry. Our finding that respondents preferred to enrol smaller percentages of their land for shorter contract durations (see also Ruto and Garrod 2009) was consistent with comments by several landowners during field research that they would prefer to choose the least restrictive program design (25%*

> *land enrolled for 4 years). Respondents were most concerned that agroforestry trees would not grow or fruit, and that they did not have the skills or necessary irrigation to successfully implement agroforestry. The 12% of respondents who rejected all agroforestry programs were primarily concerned about their ability to meet their household's subsistence needs and ensure their food security. Financial incentives were insufficient to overcome these concerns." (Puri et al., 2021, p.1)*

Choice experiments in India's Western Ghats showed that farmers were interested in being paid to conserve forest, but payments needed to be sufficient to offset loss of commercial crops. They also needed technical assistance to move to diversified livelihoods, including tourism services (Mariyam et al., 2021).

Conclusions on PES

While the evidence confirms that PES can work, care must be taken in designing and implementing the PES scheme. Key requisites include: the need for land users to understand the contract, not least to allay fears that users are signing their land away; that payments are high enough to compensate users for any loss of use of forest lands; and that land users have access to technical knowledge and the means (e.g., inputs and credit) to adjust their farming systems to the requirements of the scheme. Where PES has failed, it seems that one or more of these conditions has been breached.

Some observers of PES see so much disappointment with the schemes that they contemplate a more radical approach, that of conservation basic income. An intriguing idea, but one that has yet to be trialled (Box 2).

Box 2: Conservation basic income

Some observers (de Lange et al., 2023; Fletcher and Büscher, 2020) conclude that PES rarely works: it is, they argue, a market-based instrument that cannot work because the demand for environmental services, expressed through markets, is too weak.

> *"This common evolution of PES and REDD+ results in large part from these mechanisms' failure to generate sufficient revenue via market engagement to achieve either conservation or poverty reduction on a significant scale. We have argued that this is due to [market-based instruments'] intrinsic inability to compete with much more lucrative extractive activity within neoliberal markets." (Fletcher and Büscher, 2020)*

Rather than a market, many PES schemes have been heavily subsidised by public agencies, such that there is little difference between PES and cash transfers. In both cases, the state or civil society agency is simply paying for what is desired: protection of the environment in the case of PES; relief of poverty in the case of cash transfers. Given this similarity, observers argue, why not just pay a basic income to people in conservation-critical areas to recognise their services as stewards of a valued habitat? This proposal echoes wider calls for payments of basic income: whereas those proposals are to make such

payments universal and unconditional, in this case the proposal is to direct payments to people in critical habitats.

The proposal has not yet (2024) been piloted or trialled: there is certainly no experience of conservation basic income at scale. Would it work? The question is, if paid a living income, would people in valued habitats conserve them? They may feel obligated to conserve: but they may equally use their payments to invest in land use that degrades the environment. It is unclear how proposals for conservation basic income would discipline any recipient who felt no obligation but had their eye on immediately profitable uses of the forest.

Conservation basic income is radical and intriguing, but untested and unproven.

Sources: de Lange et al., 2023; Fletcher and Büscher, 2020

ii. Certification

Nature of certification interventions

Certification applies to products sold to end consumers to reassure them that the product meets certain standards and has been grown and produced in specified ways. Typically, certification covers the following areas:

- for foods, that the product is safe to eat (for example, free from contamination by toxic chemicals);
- the product has been grown and processed by labour which has been treated decently (to ILO standards), adhering to norms of health and safety at work, with no forced labour (modern slavery) or use of children;
- production and processing have not harmed the environment through pollution, clearance of valued habitat, degradation of soils, or loss of biodiversity.

In addition, some certification schemes confirm that:

- the growers are small-scale farmers on low incomes who have received a fair price for their produce (Fair Trade); or
- the produce has been grown organically.

Certification schemes may be operated by civil society, industry and government — for example, by:

- International NGOs (Fairtrade, Rainforest Alliance, Utz Certified, etc.);
- individual companies, usually large multinationals (for example, Starbucks);
- industry forums which bring together (large) companies engaged, variously, in growing, processing and marketing produce with other stakeholders such as farmer groups and civil society (Roundtable on Sustainable Palm Oil (RSPO), Bonsucro, Round Table on Responsible Soy (RTRS), Forest Stewardship Council (FSC), Better Cotton, etc.);

- governments setting national standards for particular crops (Indonesian Sustainable Palm Oil (ISPO), Malaysian Sustainable Palm Oil (MSPO).

Certification schemes began more than 50 years ago as NGOs sought to help growers in the global south to market to consumers in HICs concerned about decent treatment of growers in the global south as well as consumers who wanted organic produce. Growing consumer awareness and interest led to private certification schemes as multinational companies sought to reassure customers about their products. Private certification schemes have multiplied, not least for schemes that aim to reduce or eliminate deforestation:

> *"The number of private commitments to reduce deforestation from supply chains has greatly increased in recent years, with at least 760 public commitments by 447 producers, processors, traders, manufacturers and retailers as of March 2017." (Lambin et al., 2018, p.1)*

More recently, some governments in the global south have instituted sustainability standards for the produce they export, partly to make sure they can export to countries that set conditions and standards for imported produce, and partly to express sovereignty in response to standards being set by industry bodies beyond their frontiers. A prominent case is Indonesian palm oil, where the government has established its own ISPO scheme to replace to the RSPO standards (Putri et al., 2022; Pramudya et al., 2022; Wijaya and Glasbergen, 2016). In 2025, certification as ISPO will become mandatory for oil palm growers in Indonesia.

A final distinction between schemes is whether they are voluntary schemes, as applies to those operated by international NGOs, or mandatory schemes as in the Indonesia ISPO case. While the voluntary schemes encourage participation in anticipation of incentives, usually a price premium that results from selling into a market segment where consumers are prepared to pay more for certified products, mandatory and semi-mandatory schemes involve compulsion and market exclusion. Being excluded from a market usually results in having to sell at a discount.[17]

Effectiveness of certification

Given the range of certification schemes and the many contexts in which they have been used, it is not surprising that reports of their effectiveness are disparate. Overall, from the incomplete evidence, successes are more common than disappointments, but only by a small margin.

[17] A typical example is being unable to export fresh produce from the global south to a high-income country, so that produce then has to be sold in the domestic market where prices are significantly lower. This happened to many smallholder growers in Kenya when it became necessary to comply with GlobalGAP standards if they were to sell to exporters: most small-scale growers switched to selling locally (Ashraf et al., 2009).

Table 3: Summary of experiences with certification

Scheme	Environmental effects	Socio-economic effects
Some success		
[Certifying agency not stated] Coffee Eastern Andes of Colombia Lambin et al., 2018	More tree cover	
RSPO Oil palm Indonesia Lambin et al., 2018	Led to reduced deforestation. Fire activity in Sumatra and Kalimantan was significantly lower on RSPO-certified concessions than non-RSPO-certified concessions, but only for years and locations with a low likelihood of fire	
FSC certification Timber Chile, Indonesia	Reduced deforestation in certified forests in Chile and Indonesia — although certified plantations were also those with the least remaining forest area	
Rainforest Alliance Cacao Ghana Astrid Fenger et al., 2017	Certified farmers planted shade trees, did not use fire, did not deforest: soil fertility and yields rose	Farmer incomes up
Fairtrade Coffee and silkworms Peru Barro-Chale et al., 2023		The price premium put a floor in prices, preventing them falling too low
Disappointment		
FSC certification	No or minimal effect on deforestation	

Timber Cameroon, Mexico, Peru Lambin et al., 2018		
Utz Cocoa Sulawesi, Indonesia Kelley, 2020	Deforestation continued	Falling cocoa yields, falling farmer returns
RSPO Oil palm Indonesia Pacheco et al., 2017	Little evidence that certification had arrested deforestation and environmental degradation	
CFI Cocoa Côte d'Ivoire and Ghana Teague, 2022	No signs of farmers taking up agroforestry	

Sources: evidence reviewed in text.

Nor is it surprising that clear, precise and conclusive evidence is rare: most of the literature provides glimpses of effectiveness, and much is about good intentions rather than experience (see Box 3).

Box 3: Good intentions in certification

Several recent papers set out new initiatives to certify production of forest produce. While the proposals sound promising and some sound near-ideal, they are currently either plans or pilots with no reports of monitored outcomes.

Some initiatives concern better organisation of certification, seeking to reduce transaction costs by improving communication across parties. Examples include sustainable palm oil sourcing in Indonesia by companies allied to a global initiative, the Green Fund (Tropical Forest Alliance, 2021a). In Africa, the Africa Sustainable Commodities Initiative, which started in the 2010s and dates from 2022 in its current form, has local buy-in (Proforest, 2024). In Sabah, Malaysia, the intent is to have all oil palm RSPO-certified by 2025 using a jurisdictional approach (Tropical Forest Alliance, 2021c).

Some papers describe the potential of new technology. For example, in Jambi, Indonesia, drones will be used to monitor forest removal (SNV Netherlands, 2016). In Brazil, to comply with the Forest Code, farmers will be given easier and cheaper access to credit and crop insurance. Blockchains will be used to monitor produce (Chiriac and Byrd, 2021), including in the Indonesian palm oil industry (Sabhlok, 2019).

To judge by the number and variety of documented initiatives that can be found — it is likely that other initiatives are underway, but not published — there is much private and public interest in making certification work effectively. It is likely that some of these will succeed; but which ones remains to be seen.

Despite limitations, the literature does report several findings on the effectiveness of certification, albeit mixed.

In a multi-country and multi-product survey of certification, Lambin et al. (2018), for example, report mixed evidence on environmental impact:

> *"Tree cover in certified coffee farms in the eastern Andes of Colombia increased significantly more than tree cover on non-certified farms. FSC certification had no or minimal effect on deforestation in Mexico, Cameroon and Peru but reduced deforestation in certified forests in Chile and Indonesia. In Indonesian oil palm plantations, RSPO certification led to reduced deforestation, though certified plantations were also those with the least remaining forest area. Fire activity in Sumatra and Kalimantan was significantly lower on RSPO-certified concessions than non-RSPO-certified concessions, but only for years and locations with a low likelihood of fire." (Lambin et al., 2018)18*

Another study found that Utz certification for cacao growers in Sulawesi, Indonesia, had failed to prevent cacao yields from falling, despite farmers having also received technical assistance and training since the 1990s. In this case, certification also failed to save the forests because growers, seeing their yields and returns to cocoa fall, had cleared forests to support a switch to other crops:

> *"While cacao was a primary driver of tree clearance prior to 2000, lands cleared for other commodity investments in the four villages since 2000 now exceed all remaining land in cacao by 369%.*
>
> *Household survey data show that 10% of cacao fields were sold between 2010 and 2015 while 44% of households opened forested land for alternative crops and 36% of households divested from all production inputs for cacao, either synthetic or organic." (Kelley, 2020, p.9)*

A survey of Indonesian oil palm reported little evidence that certification had arrested deforestation and environmental degradation: the authors attribute that in large part to so much

[18] The studies of the effect of FSC certification considered evidence on certified zones versus evidence from comparable, non-certified zones.

oil palm being grown and processed by companies and farmers who are linked to politicians in networks of patronage (Pacheco et al., 2017).

Certification has also been promoted in Côte d'Ivoire and Ghana — in this case a private-public set of standards — but to limited effect, although intentions sound promising:

> *"The CFI, an agreement between a group of cocoa suppliers and chocolate companies and the governments of Côte d'Ivoire and Ghana, was formalised in November 2017... The [Cocoa and Forests Initiative] CFI is patterned on other commodity-based zero-deforestation commitments (ZDCs) elsewhere in the tropics like soy, cattle, and oil palm... The CFI promotes agroforestry by providing for plant material to incorporate into agroforestry systems and bolster food production, financial incentives for the adoption of shade-grown cocoa, and the training of farmers and cooperatives through extension agents." (Teague, 2022, p.411)*

Implementation, however, has been uneven, not least because environmental standards were less enforced than those applying to labour:

> *"Across the standards, compliance with agroforestry requirements is less important than rules related to higher priority issues like child labor or the health and safety of workers, and producers are not required to meet all lower priority requirements to be considered compliant." (Teague, 2022, p.413)*

Not surprisingly, the CFI had not succeeded in getting farmers to take up agroforestry:

> *"Although certification is seen by policymakers and cocoa companies as a mechanism for promoting agroforestry, interviews revealed little evidence that certification programs are directly incentivizing agroforestry expansion." (Teague, 2022, p.420)*

Part of the reason is that certification comes with a context: that of government programmes that promoted monoculture, of cooperatives with their services.

> *"… one of the major reasons farmers adopt certification standards is to improve production through access to cooperative services." (Teague, 2022, p.422)*

While certification made farmers more knowledgeable and aware, it did not lead to more agroforestry.

Other reports are more positive. A Rainforest Alliance certification of cocoa growers in two villages in Ghana, for example, found that certified farmers had planted shade trees, had not used fire, had not deforested, and had seen soil fertility and yields rise (Astrid Fenger et al., 2017). In Sumatra, Indonesia, researchers running an experiment with rubber farmers also found that offering a premium of 50% to the price encouraged certification, as did raising awareness of the environment (Sarwosri et al., 2020). A counterintuitive result from the experiment, however, was that women farmers were more likely than men to deforest — apparently because women in

Jambi were more focused on making profits than men, as also seen in another study (Villamor et al., 2014).

For certification to attract farmers, it either has to offer growers a premium price or to deliver some other tangible benefit — such as access to technical assistance, inputs or credit. FSC certification, for example, has led to a price premium and access to credit for some:

> *"FSC [Forest Stewardship Council] certification has reduced social conflict and reduced environmental risk. This in turn has provided more access to bank loans with better terms. Depending on the timber product produced, FSC certification has generated a price premium of 10-15%." (Stanley et al., 2013, p.5)*

Similarly in Ghana, Rainforest Alliance-certified farmers gained in technology, inputs and finance:

> *"… a positive influence on the certified farmers in terms of cocoa production, yield, income and farmers' perception of changes in their natural and financial capitals. The positive influence is a result of inputs from the [Rainforest Alliance] certification, including financial support, information and knowledge, technical assistance, and increased access to farm inputs and credit." (Astrid Fenger et al., 2017, p.1)*

Farmer incomes improved as well:

> *"Conventional farmers in Akofudi-Abuoho only mentioned negative changes, highlighting reduced cocoa production and lower income. In contrast, the certified farmers have experienced an increase in cocoa production, a higher income, and the ability to pay off debts, save money and plan for income, savings and spending for a longer time span than before." (Astrid Fenger et al., 2017, p.15)*

But in other cases, any premium to prices from certification has been meagre and insufficient to attract farmers, as found for Indonesian oil palm sold under RSPO (Wijaya and Glasbergen, 2016). Financial returns were sometimes better for less environmentally sustainable production. Indonesian oil palm is an example, with oil palm monocropping paying better than more diversified farming "combining perennials such as coffee, cocoa and rubber, with rice and other cash crops" (Pacheco et al., 2017).

Certification has also led to concerns over equality. For example, in Indonesia, the directive for growers to register with ISPO by 2025 provokes concern for small, independent growers who may not be able to comply. They face being excluded from markets, or perhaps even being fined (Hidayat et al., 2018). The same source doubts that price premia from ISPO will be more than marginal.[19]

Concern has also been voiced that certification may introduce additional uncertainty over price premia, price volatility, and market and credit access — as expressed for RSPO-certified palm oil

[19] Currently, ISPO standard is not recognised in consumer markets, so there is little demand to pay more for produce certified as ISPO.

in Indonesia (Börner et al., 2017). This may be stretching the point: does certification really make market access less certain? In Peru, Fairtrade-certified farmers of coffee and silk(worms) reported that while market prices still varied, the premium put a floor in prices, preventing them from falling too low (Barro-Chale et al., 2023).

Considerations for policy and decision-makers

Farmer awareness and knowledge of schemes

In some cases, it seems that growers do not know about certification, or do not know how certification works. For example, oil palm growers in Colombia who had not joined certification schemes simply did not know about the schemes. Those who had joined had done so because the mill buying their fruit had encouraged them to join (Furumo et al., 2020). Similarly, in Malaysia, whether smallholders joined the MSPO depended in considerable part on knowledge of the scheme and farmer education (Ni et al., 2016). It is government policy that all growers be certified to MSPO, but, despite rigorous efforts, by 2021 only 30% of smallholders were certified (Ahmad et al., 2019).

In Indonesia, oil palm farmers grasped the economic potential of certification but were not interested in the environmental requirements of the scheme:

> *"The independent smallholders entered the RSPO scheme after being made aware of the certified market by an NGO: WWF Indonesia. For both groups, certification was something new; a program that came from abroad and that was introduced to them by an external actor. In fact, the smallholders were unaware of the philosophy behind sustainability certification and the concept of the RSPO. For them, certification was (and still is) a set of technicalities that need to be fulfilled to improve their production and get a better price for their FFB [fresh fruit bunches].*
>
> *… all smallholders mention financial considerations as their main motive for joining RSPO. Motives related to social and environmental improvements did not play a significant role in their decisions." (Hidayat et al., 2015, p.34)*

Lack of information around certification raises transaction costs, whether this is a lack of farmer knowledge, processing mills that know too little about how their supplier farms, or local authorities that navigate a thicket of policies written in distant capitals while not knowing to whom land belongs. One potential answer is to convene forums to exchange information and views between stakeholders, including farmers, processors, government and civil society. Jurisdictional approaches are one example of such forums:

> *"Jurisdictional approaches apply certification across an entire administrative area, such as districts or provinces, as a means to reduce deforestation and lower GHG emissions. This approach has various advantages such as lower costs of monitoring and the ability to account for leakage, and may be able to take advantage of REDD+ funds allocated to local governments. Central Kalimantan in Indonesia is an example of a provincial*

> *level jurisdictional approach where the governor issued a decree requiring oil palm concessions to be certified within a set period. If successful this initiative would greatly reduce deforestation while generating very significant emission reductions." (Stanley et al., 2013, p.4)*

Cost of being certified

Certification can be expensive for smallholders because it requires changes to practices and documenting standards. For example, for smallholders in highland Kenya growing vegetables for export to Europe, the introduction of adherence to Good Agricultural Practices as a requirement for exporters was estimated to cost the farmer US$580: 75% in the cost of infrastructure lasting seven or eight years and 25% in annual operating costs. The only growers who could afford this were those assisted by donors; other farmers gave up on exporting and switched their focus to the domestic market, albeit getting lower prices (Ashraf et al., 2009).

In Indonesia, the producer organisation for palm oil, the Indonesian Palm Oil Association (Gabungan Asosiasi Pengusaha Kelapa sawit Indonesia GAPKI), objected to the high cost of RSPO certification:

> *"GAPKI is particularly disappointed about the implementation of RSPO because of the high cost of obtaining the certificate, what is regarded an unbalanced position in the decision-making process between producers and other private actors, the uncertainties about a premium price for sustainable Crude Palm Oil (CPO), and the low uptake of sustainable certified CPO." (Wijaya and Glasbergen, 2016, p.231)*

In Thailand, oil palm growers sell into the domestic market and little is exported, so international norms do not apply. Few growers have bothered to seek certification owing to cost and sacrifice, with any price premium too small to compensate (Nupueng et al., 2022).

Indonesia provides examples of the obstacles that farmers face to conform to ISPO by 2025, starting with their technical capacity to meet standards, including knowledge and skills gaps, as well as financial and organisational constraints (Pramudya et al., 2022). Consequently, very little (0.19%) of the area farmed by smallholder oil palm growers had been certified as ISPO by the end of 2022 (Pramudya et al., 2022). In Indonesia it also does not help that certification requires a formal record of land tenure; something that many independent smallholders lack. In the absence of land maps, the status of some land is unclear (Putri et al., 2022).

Certification costs can also be socially regressive because small-scale growers lack the knowledge and funds to achieve and document the standards necessary, while plantations are more able to meet the requirements (Hidayat et al., 2018).

Even formal companies can struggle to meet the requirements for certification, as seen among palm oil processors in Southeast Asia:

> *"A recent article in the Oil Palm Industry Economic Journal assessed RSPO member companies' ability to comply with the principles and criteria (P&C) and found that of the 36 assessed companies, only two had established in-house capacity to fully implement the P&C." (Stanley et al., 2013, p.5)*

Monitoring compliance

Checking that certified growers are complying with standards requires not only capacity and budget, but also clear allocation of responsibilities. ISPO in Indonesia is mandated centrally, with roles and responsibilities not necessarily cascaded effectively to lower tiers of administration, especially as ISPO comes on top of other administrative policies (Biru et al., 2023).

> *"Vertical governance: There was a vertical disconnection between the national and sub-national policies as the policy-making authorities at the regional level did not produce any regulation supporting the national ISPO policy.*
>
> *Regional and local-level governments also experienced uncertainty in following up on ISPO's regulations due to the many existing regulations and policies that are still in effect and have the potential to conflict and even collide with other regulations." (Putri et al., 2022, p.14 & p.17)*

Conclusions on certification

The record on certification is mixed. This is unsurprising when considering just how many different certifications exist, for different products, organised by very different actors, and implemented in many different settings.

Key take-aways include that:

- certification can be costly for smallholders, often as much in documenting their adherence to the standards set as in actually implementing them;
- environmental standards are usually one of a set of criteria being certified, and may come second to other requirements such as those of decent labour;
- while certification may result in a premium price being paid, or access to a market with premium prices, price increases may be marginal.

Ultimately, it takes time and effort to reach a point where smallholders both understand and align with the standards. Indeed, certification schemes are usually designed by agencies other than farmers, reflecting the concerns of consumers and other actors in the supply chain, rather than the farmers themselves. If farmers do not align with the standards, it would be wrong to attribute that to lack of awareness or understanding — it is just as likely to arise from the interests of farmers being different from those of other actors.

iii. Raising returns to environmentally sustainable production

Nature of interventions raising returns to sustainable production

Central to considerations about levels of incentives is whether production systems, current or improved, yield an adequate return and a living income for farmers (Duchelle et al., 2017).

Agroforestry, combining trees with crops and sometimes also with livestock, is a prominent case of a system devised for sustainability and better returns to farmers. Much effort has gone into researching agroforestry.

Effectiveness of raising returns

To set the context, a review of the returns to smallholder production of cocoa, coffee and tea concluded that farmers could not make a living from these commodities. To escape poverty, they needed to either give up farming or diversify their incomes (Waarts et al., 2019).[20] Given that stark assessment it should not be surprising that systems to grow crops sustainably may not offer attractive returns to farmers.

In the Sumatran peatlands, villagers were told that they could no longer burn to clear land and were offered social forestry and paludiculture (agriculture and forestry in very wet, boggy conditions) to restore peatlands. But neither of these options offered the returns that commercial crops of areca nuts and oil palm could. It did not help in this case that villagers distrusted the government, as the latter's offer of land rights was not seen as credible by the former (Merten et al., 2021).

In Ghana, *taungya* was used to establish forest plantations: farmers were offered use of the land being forested to plant annual crops in among the growing seedlings, until the trees grew enough to shade out the crops. In return, farmers were expected to protect the young trees. To raise the incentive to farmers, a modified *taungya* was offered, one that gave the farmers a share of the trees:

> *"A modified version of the taunga system was introduced in 2002. The main difference with the old system is that farmers not only receive 100% of the crop proceeds, but also a 40% share in the timber benefits in return for their contribution to tree planting, maintenance and protection against fire and illegal felling. Institutions were also put in place to give them a say in the management of the scheme." (Ros-Tonen et al., 2013, p.58)*

[20] The authors drew on studies of what a decent living income would be for a smallholder family growing specific commodities in particular countries. For example, in 2018, living income "in rural cocoa growing areas of Ghana … is GHS 1,464 ($329) per month for a family of five people. This is the net monthly income required for a decent standard of living for a typical family of two adults and three children. The estimate is based on actual costs of living at a basic standard of decency, and indicates the amount of profit from all sources of household income (i.e. minus business expenses) that would be necessary to cover living expenses for the family." (Smith and Sarpong, 2018)

Although promising, it seemed that farmers had to wait too long for timber benefits and many of them saw this system as a stop-gap measure at best.

Experiences of agroforestry have been mixed. In West Java, for example, farmers used swidden to clear forest and cultivate crops (Rahman et al., 2017). Agroforestry would generate more income, especially from teak, but it had higher up-front costs and farmers were unsure of the technology:

> *"This is particularly true for swidden farmers as their cultivation practices are largely subsistence-oriented and yield insufficient capital to invest in agroforestry, i.e. it requires about half of their annual household income to invest in agroforestry. Lack of technical assistance is another major constraint as government programs to promote agroforestry do not exist in the study site. There is no agroforestry extension, no technical or market information, no price guarantees and no supply of high-quality seedlings." (Rahman et al., 2017, p.192)*

Similarly, trials showed that agroforestry could combine with oil palm in Jambi, Indonesia, a peatland area — but the outcomes of action research in this case had yet to be reported (Sundawati et al., 2020).

Agroforestry adoption can enhance land rights, as experience from Laos showed. In Laos, people operating swidden had less secure land rights than those who had trees planted in agroforestry. Villagers were keen to take up agroforestry because it gave them land rights, but only some farmers could make the change: these farmers accumulated land while those less able lost out. Those households which had cleared forest for private fields found that agroforestry could legitimise their claims to land (van der Meer Simo et al., 2020).

The government of Kenya obliges farmers to have 10% of their land under trees. In Western Kenya, Owuor (2017) found that farmers taking up agroforestry had title deeds, already had 10% of their land under trees, and were typically younger than average. Agroforestry paid off: farmers achieved higher gross margins than they could with most other cultivation systems.

Driven by high economic benefits, smallholder fruit-tree cultivation recently expanded in several provinces in northwest Vietnam. Do et al. (2020) reported some success in combining the fruit trees with field crops:

> *"After seven years, longan (Dimocarpus longan Lour.)-maize-forage grass and son tra (Docynia indica (Wall.) Decne)-forage grass systems had generated 2.4- and 3.5-fold higher average annual income than sole maize and sole son tra, respectively. Sole longan gave no net profit, due to high investment costs.*
>
> *All farmers reported ecological benefits of the agroforestry systems in terms of reduced erosion, weed control, enhanced soil moisture and fertility, and greater resilience to extreme weather conditions (drought, snow, and frost) compared with sole-crop cultivation." (Do et al., 2020, p.1 & p.13)*

In Alta Verapaz, Guatemala, agroforestry has been promoted, combining primary or secondary forest as shade for cardamom or cocoa. Farmers were supported by the Fundalachuá NGO, which provided a start-up package based on micro-credits with low interest rates for a one-hectare cocoa plantation, free timber tree seedlings and free high-yielding cocoa seedlings. This was effective in encouraging agroforestry with good returns to farmers. The farmers also benefitted from a government payment of US$270 for each hectare of protected forest, plus an incentive of around US$250 per hectare for afforestation over six years (Nicli et al., 2019).

In the Tapajós region, Pará state, Brazil, two experimental agroforestry systems were developed. Based around highly productive fruit trees with good market prices — acerola trees (Malpighia glabra), açai palm trees (*Euterpe oleracea*) and Beira-rio orange trees (Citrus sp.) — the systems generated higher net present values per hectare than the slash-and-burn farming practised by most settlers. That said, to adopt these systems, smallholders would need technical knowledge and credit to cover the initial costs of planting, while cheaper and faster access to markets would also help (Tremblay et al., 2015).

In another part of Pará, Tomé-Açu, smallholders practised diversified farming, including agroforestry. Agroforestry made a major contribution to the incomes of those practising it:

> *"In our sample, AFS [agroforestry farming systems] income was estimated at 30 ± 42 % of on-farm income. Additionally, almost one-third (32%) of food produced on-farm came from AFS. The vast majority (72 %) of households stated that AFS have fully or partially contributed to achieving their life aspirations (subjective well-being)." (Braga et al., 2024, p.7)*

Considerations for policy and decision-makers

Experiences may be mixed, but farming systems that are environmentally sustainable with higher returns for farmers can be devised. Such systems will not, however, be blueprints: they will usually need to be tailored to local circumstances. Such adaptation to context can be supported by participatory agricultural research and farmer field schools.

Key considerations for farmers taking up these systems concern initial costs, and the technical knowledge and skill needed to establish and operate them. In Vietnam, for example, farmers needed technical assistance and credit to take up agroforestry:

> *"…all farmer groups mentioned training in agroforestry techniques, support in obtaining seedlings and fertilisers, and financial support or access to low-interest loans/credits as important incentives for implementing agroforestry." (Do et al., 2020, p.14)*

In Indonesia, efforts to get smallholders to replant higher-yielding varieties of oil palm ran into cost barriers, with a public grant covering only half of the cost. By 2020, a public programme to assist farmers to replant had made slow progress, with only 94k ha replanted against an annual

target of 180k ha (Tropical Forest Alliance, 2021b). Further obstacles in this case included the legality of smallholders' land tenure (Tropical Forest Alliance, 2021b).

Conclusions on raising returns

Improved production systems in former forests are possible and can both conserve resources and raise returns to farmers. When returns rise there may be less incentive to convert forest to fields and grazing, although this will not always be the case. On the contrary, if returns per managed hectare rise, there is more incentive to convert forest to the managed use than before, not less. Nevertheless, improved farming systems change the motivation for forest clearance from simple necessity to one of profit.

While improved systems with higher returns have been developed in many settings, in others they have not, which is to be expected given the great variety of circumstances and contexts that apply. Given that improved systems have been devised, it is likely that further research — including action research with farmers — can devise yet more and better systems.

iv. Improved supply chains linking large companies to small farmers

Nature of interventions improving supply chains

Another way to stimulate sustainable farming is to link farmers growing crops for market more closely with key actors in the supply chain, including processors, exporters, and sometimes supermarkets in distant HICs. Gains are possible for all parties. Farmers, usually smallholders, potentially access know-how, inputs and credit and may then be able to sell into premium markets. Agribusiness firms targeting export markets in HICs, and perhaps also some domestic middle- and high-income households, are assured a supply of quality produce that can be traced back to its origin. In some cases, those of interest here, the key supply chain operators are also concerned that produce comes from sustainable farming, and above all, from farms that have not deforested the local landscape. Some examples show how this has been done.

Effectiveness of improved supply chains

In Ethiopia, Nestlé have worked with coffee farms and coffee processing plants to make growing and processing more environmentally sustainable and to raise the quality of coffee beans (TechnoServe, 2023). The company claims good results for farmers:

> *"Farmers who adopted most of the farming practices in Kenya increased their coffee incomes by 250%, and farmers in Ethiopia who partially rejuvenated their farms saw an increase of up to 60% in their coffee incomes (if farmers fully rejuvenated their farms, they could expect a 2.5-fold increase in their production).*
>
> *In total, farm-level interventions have helped participating farmers earn an additional $7.1 million per year, representing an ROI of more than 4:1 on the initial investment." (TechnoServe, 2023, p.9)*

These improvements probably reflect that small-scale coffee growing and local processing were less than optimal owing to combinations of lack of technical know-how, inputs, and finance.

In Indonesia, five initiatives[21] were reported that link companies processing palm oil with farmers to increase yields through the provision of technical assistance and finance. These probably led to higher incomes for farmers (Johnston et al., 2018).

Other reports discuss promising initiatives, but the outcomes are not yet known or reported. For example, the Smallholder Acceleration and REDD+ Programme (SHARP) was an industry-led intervention working to engage smallholders and supply chain actors in dialogue to support a shift towards sustainable agricultural practices (potentially leasing to certification standards) (Proforest, 2019). The programme aimed to reduce transaction costs and facilitate know-how and finance to smallholders, although outcomes have not yet been reported:

> *"Aggregation of smallholder land managers to achieve required scale for commercial investment is a missing piece of the jigsaw to bring commercial investment to sustainable smallholder production. Often grant/philanthropic capital remains critical to unlock impact investment and then access to commercial capital. Expectations of commercial investors on return-risk balance and duration of investments not well aligned with needs and there are few off-takers willing/able to pay for long term resilience of sustainable livelihoods in sustainable landscapes." (Proforest, 2019, p.4)*

SNV, an international NGO specialising in supply chains, traced the source of coffee in Vietnam using satellite imagery to identify deforestation promptly. They also mapped and used drones to identify land use (SNV Netherlands, 2021). SNV aimed to support closer relations between growers and buyers, which in turn should make for better returns. In comparison to certification:

> *"Traceability systems are easier to implement when supported by a contract between processors and producers, which is very rarely the case in Viet Nam's coffee sector. So, in the absence of this we support the coffee companies to develop better relationships and loyalty with farmers a core motivation for them both, any way including through provision of training and extension services.*
>
> *This benefits farmers and companies alike and are more impactful for farmer livelihoods than the low, or non-existent, premia from certification." (SNV Netherlands, 2021, p. 4)*

Technoserve, another international NGO specialised in supply chains, worked to connect coffee cooperatives in South West Ethiopia with (high-end) coffee companies in HICs, to allow the cooperatives to break into speciality coffee markets by enabling better processing. Incomes could be more than doubled if all coffee could make the grade (Schuit et al., 2021). The environment benefitted as well:

[21] Three companies: Golden Agri Resources (GAR), Wilmar, 4.3 Cargill; one producer cooperative: Asian Agri; and Indonesian producers' cooperatives in general.

> *"The increases in income via specialty coffee production, reported in the study, were achieved without increasing land use or the application of environmentally costly inputs. Moreover, analysis of satellite data shows that a large proportion of the coffee farms surveyed retain a level of forest cover and quality approaching primary (undisturbed) forest, and that the coffee production area at Yayu has not experienced any significant deforestation (since 2000)." (Schuit et al., 2021)*

F3 Life serves businesses wanting to invest in planting trees. The typical model involves a company that makes high-end products for high-income customers who are prepared to pay for environmental consciousness. The company can then pay premia to growers in the global south who plant trees or practice agroforestry (Faruqi et al., 2022). The model, however, faces challenges in uncertain land tenure, high transaction costs and illiquidity:

> *"High transaction costs: Information on restoration businesses can be hard to find. Although visible avenues exist for technology or clean energy businesses to pitch ideas and raise capital, the same cannot be said for the restoration industry. Furthermore, restoration businesses are typically smaller and seek sums of capital under $10 million. These characteristics can result in high transaction costs for investors.*
>
> *Low liquidity: To date, no publicly traded companies are focused on restoring degraded land. As with investing in any private company, liquidity — the degree to which an asset can be quickly bought or sold — is low." (Faruqi et al., 2022, p.15)*

Considerations for policy and decision-makers

A key point in improving supply chain functioning is transaction costs,[22] the costs of doing business. These costs include the considerable time and effort to exchange information between (large) firms and (small-scale) farmers:

> *"A major barrier to progress can be a lack of trained and competent practitioners, both to support engagement with smallholders and to work with them to implement better practices. Developing a critical mass of practitioners is an area of need for new public-private investment through landscape-level programmes." (Proforest, 2016, p.3)*

Costs depend on the firm's experience of working with smallholders; whether the smallholders are (well) organised in groups, associations or cooperatives; the amount of technical assistance farmers may need to meet company standards; and monitoring of compliance with standards — a cost that may be outsourced to a third-party audit (Proforest, 2016).

> *"Based on examples in palm oil, sugar cane, coffee, cocoa and non-timber forest product supply chains, the costs of engagement per smallholder have been estimated in the following ranges: Pilot project US$250-1000; Engagement at scale US$100-300; and, Engagement on a single or limited issues US$75-250." (Proforest, 2016, p.4)*

[22] Transaction costs are largely those of information acquisition: of gathering information prior to making a deal; of negotiating the deal; and of monitoring compliance with the agreed deal.

It is not just the cost of engagement between firms and farmers, however, but also the time necessary to reach agreements and to convey information and know-how. The time required is easily underestimated, with the danger that policies and political priorities which affect the agreements change during the process, or that a party simply loses interest:

> *"The timescales needed for interventions to deliver positive sustainability outcomes in production landscapes are at odds with policy-making processes and timescales of the political cycle. Designing and implementing policy changes for widespread reform is a slow process, and reliant on the existence of ongoing political support. Yet with a single change in national or sub-national government and associated political priorities, existing policies, operational programmes or multi-stakeholder platforms building formal action plans can be neglected, revoked or rapidly disbanded." (United Nations Development Programme et al., 2020, p.36)23*

Conclusions on improved supply chains

Most initiatives to improve supply chain functioning sound promising, but the outcomes are either only partly known, not yet known, or have not been documented. While it would be good to know the results of the initiatives seen in the literature, the fact that plenty of these initiatives exist and have been documented is potentially good news. If indeed there is a plethora of initiatives, it is likely that some will prove successful and scalable. For policymakers, the point is then to detect and learn from successes, and subsequently work with farms and firms to scale out successes.

Overall conclusions on economic incentives

Incentives can work to conserve the environment and raise returns to farmers in and around tropical forests — but all forms of incentives have requirements in their design, time, and cost to implement if they are to function as intended.

Payments for Ecosystem Services require three demanding conditions to be met.

- One, land users must understand the contract, sometimes to allay fears that users are signing their land away. It takes much time and trouble to explain and discuss the contract with many small-scale land users dispersed across large areas. When land users do not understand the scheme, their commitment to its provisions will be low.
- Two, payments must be high enough to compensate users for any actual or future potential loss of use of forest. The size of payment necessary varies, with larger payments typically required in sites where clearing the forest allows land users to grow crops or graze livestock profitably.
- Three, land users must have access to technical knowledge and the means (inputs, credit) to adjust their farming systems to the requirements of the scheme.

[23] United Nations Development Programme et al. (2020) gives more than half a dozen examples across the global south.

Certification requires that farmers are made aware of the schemes and that time and effort is spent negotiating their inclusion. Certification can be costly to smallholders, however, and the rewards to farmers may not compensate for the costs.

Improved production systems in former forest are possible but the effectiveness of such improved systems, when they exist, varies by context. This implies that further research, both formal and less formal, will very probably pay off.

From the number of documented instances, attempts to **improve supply chain functioning** are many — with the likelihood that some will succeed. This sets a policy agenda of detecting success and working with farms and firms to scale them out.

Overall, the evidence shows that there are no blueprints which provide ideal incentives to land users.[24] Policymakers should be wary of those suggesting that any particular idea will always be effective without considerable tailoring to context. Policymakers should also not underestimate the time and costs needed to set up PES and certification. For improved production, research is indicated — agricultural investment has been evaluated to have very high returns.[25] For better supply chains, monitoring initiatives to learn which are succeeding and how will generate lessons for effective public action to scale out innovations to benefit both farms and firms in the supply chains.

4.3.3 Market creation

Characteristics of interventions using markets

Market-based interventions work by creating a mechanism whereby goods not traditionally monetised and priced into economic decisions (such as biodiversity, forests or carbon), are given a monetary value by creating a market for them. This can allow natural assets such as forests to be more accurately and consistently accounted for across the global economy.

Only four studies were identified that described interventions where markets were created to incentivise smallholders to reduce deforestation and transition to more sustainable agricultural practices. These studies included a review of 18 PES projects across the global south, including market creation (Cross et al., 2015); a brief on carbon finance for smallholder agroforestry projects (CASA, 2022); a review of REDD+ interventions across the global south (Duchelle et al., 2017); and an evaluation of reforestation in Panama (Holmes et al., 2017).

[24] The urge to blueprint is strong in public administration: blueprints cut costs and simplify administration. Business is different: the private sector is fragmented into dozens and hundreds of firms: that fragmentation leads to competition and innovation (not each and every firm, but the system does not depend on all firms succeeding: it is enough that some do). Good business is about tailoring the business to context, not about blueprints. If we need to avoid blueprints, we need to work with private actors – both for-profit businesses and not-for-profit charities.

[25] See, for example, Alston et al., 2009; Fuglie and Rada, 2011.

The four studies identified all used some form of carbon trading as part of their approach. There are two types of carbon markets:

- **Voluntary carbon markets** are decentralised markets that allow parties to buy and sell carbon credits through a retail trader or broker to offset some or all of their unavoidable emissions.
- **Compliance carbon markets** are regulated at the national, regional or international level and are mandatory, establishing a carbon price by law or regulation, and often aimed at high-emitting sectors such as steel or aviation.

Only one intervention identified used compliance carbon markets: the others used voluntary carbon markets. The flexibility of voluntary carbon markets allows them to offer a range of project types applicable to a wider range of actors, which is why they are often favoured by forest projects. This has been reflected in the rapid growth in such markets in recent times.

> *"Voluntary carbon markets have grown rapidly in the last two years, reaching approximately $2 billion in 2021. They are expected to grow 10x by 2030, with increasing demand for "carbon removal" credits generated by agriculture and forestry, in particular from agri-food corporations seeking to mitigate emissions within their own value chain to meet commitments under the Science-Based Targets initiative (SBTi). This is making the generation of carbon credits from smallholders an increasingly realistic prospect." (CASA, 2022, p.8)*

Most examples use the United Nations' Reducing Emissions from Deforestation and Forest Degradation (REDD+) framework, formalised as part of the Paris Agreement in 2015 to protect the world's forests (UNFCCC, 2023).[26] The framework offers a mechanism whereby developing countries can receive results-based payments for emissions reductions when they reduce deforestation and forest degradation, by using international climate finance.

> *"Activities eligible under REDD+ include reducing emission from deforestation and forest degradation as well as conservation of forest carbon stocks, sustainable forest management of forests, and enhancement of forest carbon stocks." (Holmes et al., 2017, p.1182)*

In this way, a created market — the carbon market — can become a source of funds for smallholders to access through a REDD+ project. Smallholders participating in these projects can benefit from this funding in return for carrying out project activities that reduce deforestation such as Payments for Ecosystem Services (PES — see section 4.3b above), agroforestry,

[26] Although the inclusion of REDD+ in article 5 of the 2015 Paris Agreement formalised it as a way for countries to implement forest protection plans under the framework, REDD+ had been in development since at least the early 2000s. Originally referred to as reducing emissions from deforestation in developing countries (REDD), the idea was first discussed at COP 11 in Montreal, in 2005. Expanded to REDD+ at COP 13 in Bali in 2007, the UN-REDD programme was established in 2008 to help countries build capacity ('readiness') to meet UNFCCC requirements to receive results-based payments. However, it was not until COP 19 in Warsaw in 2013 that the methodological and financial guidance for the implementation of REDD+ projects was agreed, known as the REDD+ rulebook. See link for more details.

reforestation, and income diversification, for example by switching to the production of non-timber forest products or engaging in alternative livelihoods.

We also found examples of using carbon markets to fund agroforestry interventions. Agroforestry-generated carbon credits are particularly valuable as they generate carbon emissions *removals*, rather than emissions *avoidance*. Agroforestry projects therefore represent a neat solution for farmers (who need access to finance), funders (who need projects to fund), and forests (which benefit from sustainable agroforestry practices).

> *"There is an opportunity for carbon finance for smallholder agroforestry to address part of the vast smallholder farmer climate adaptation gap by funding the physical adaptation of farms to climate change and the diversification of smallholder incomes." (CASA, 2022, p.8)*

A summary report on experience from 28 SHARP (Smallholder Acceleration and REDD+ Programme) projects includes two case studies of PES projects accessing voluntary carbon markets: the Noel Kempff Mercado Climate Action Project (NK-CAP) in Bolivia and Trees for Global Benefits (TFGB) in Uganda (Proforest, 2019). These interventions were some of the longest-running carbon market-funded projects in our sample. Differences in project designs have led to quite different outcomes in both cases (Box 4).

Box 4: Different experiences in long-running conservation projects (SHARP, 2015)

In Bolivia, the Noel Kempff Mercado Climate Action Project (NK-CAP) began in 1997, designed to regenerate almost 650,000 ha of national park which had been degraded by logging. A Bolivian project partner ran the project with up-front funds from The Nature Conservancy and three corporate donors.

The project acquired the logging rights on the land: cessation of logging in the area would enable the park to become a carbon sink and provide verified emission reduction (VER) credits for the 30 years of the project. Seven Indigenous communities received livelihood support — as opposed to direct payments — while development programmes were put in place to provide income-generating activities and capacity building.

The total cost of NK-CAP was $11.5 million, with a significant portion of the cost going towards retiring logging. In the 1997-2005 verification period, 763 ha were saved from deforestation and a further 468 ha of timber slated for harvest were protected from degradation. Using estimates from 2009, the project had achieved some 5.8 million tonnes of avoided CO_2 equivalent emissions.

Following elections in 2006, the new government disagreed with the project's use of commercial VERs. Monitoring and verification at the site ended, so not much is known of results after that. The project did manage to achieve some considerable conservation gains, but the livelihoods effects on communities were more complex and diffuse, making it hard to say whether they were positive or negative.

With concerns over the measurability and viability of the actual carbon emission reductions generated by the project, NK-CAP lost its corporate backers in 2012. Having been set up to run to 2026 and being

hailed as one of the first and most ambitious projects of its kind, the NK-CAP project ended prematurely in 2016.

In Uganda the Trees for Global Benefits (TFGB) project, started in 2003, is one of the oldest carbon finance projects in the country. Implemented by a Ugandan environmental NGO, ECOTRUST, the project entered into long-term contracts with smallholder farmers to plant a variety of Indigenous trees on their private farmland. TFGB combines carbon reduction and sequestration with livelihoods improvements through small-scale agroforestry and PES, linking farmers with international climate finance via the Plan Vivo certification — a certification that specialises in climate and ecosystem services provided by local communities.

The carbon credits in TFGB were sold up front, and these up-front payments were then distributed to participants in instalments over the first decade of the contract (contracts are for 25 years). In contrast to the NK-CAP project, TFGB was set up at low cost ($50,000) using donor funds.

According to the SHARP case study, it has benefitted from having strong local coordination. Each smallholder works with a volunteer coordinator to submit their application to participate, and the coordinator becomes the project's point of contact for the smallholder. Starting from 33 farmers, the project now involves over 2,500 households, across over 3,000 ha. In its 2023 annual review, the project reported selling over 574,183 tCO2e; an increase of over 80,000 tCO2e on the previous year. This was the highest volume of credits sold under the project since its start.

Most monitoring and evaluation of the project focuses on trees planted and area under conservation. However, the annual report also collects data on environmental co-benefits in terms of biodiversity improvements (where 79% of trees planted in 2023 were Indigenous rather than naturalised species) and some data on socio-economic impact in terms of livelihoods, jobs, tenure and social capital. The latest report found that per capita income as a result of PVC sales was $595 (up from $550 in 2022) and that the number of full-time employees hired by the project had increased by 7 to 32. The number of VSLAs supported by TFGB also increased from 30 to 33. However, the area under communal ownership, the number of community groups supported, and the number of communal ownership titles remained static.

2023 marked the 20-year anniversary of the project and the second year in a row that the project had generated in excess of one million emissions reductions units. Nonetheless, the project has been criticised for lack of transparency and communication between ECOTRUST and participant farmers, some of whom reported that they did not understand the model they were engaging with. Concerns have been raised over food security for participant farmers who have diverted land for food crops to conservation.

Sources: Kamukama and Kamukama, 2022; Rambert and Sardonis, 2023; SHARP, 2015; Ecotrust, 2024 & 2023

Effectiveness of market-based interventions

To maximise the likelihood of effective, long-term smallholder participation, interventions should focus on the smallholder's business model, not the carbon business model. Particularly where rural and Indigenous communities are concerned, participation in a project is not likely to be

motivated by the potential to farm carbon but rather by co-benefits derived from the project. These can be livelihoods, incomes or even biodiversity (Holmes et al., 2017).

CASA (2022) finds that alignment with existing business models, up-front payments to farmers, covering set-up costs (at least in part), and training and support (made available by the project partner) are important elements that influence a project's effectiveness. Programme designers need to consider that the economic benefit from carbon credits is likely to be small relative to the smallholder's normal income stream, therefore for the farmer, carbon revenue is not a key motivator (CASA, 2022).

In Panama, it was found that receiving inputs — seedlings to establish a plot of trees — motivated farmers to participate in a REDD+ project (67%) more than receiving monetary compensation from carbon payments for managing the plantation (8%) (Holmes et al., 2017). Agroforestry interventions that have an element of choice were likely to be more effective in maximising participant welfare. In this Panamanian case, choice also had nature co-benefits:

> *"When free to design a reforestation system, local people may select an array of species that provide livelihood benefits. In this study, participants chose species valued for their wood, fruits, medicines, and cultural values. The multi-strata agro-forestry system that participants designed had high native tree diversity and is thus likely to support native biodiversity." (Holmes et al., 2017, p.1193)*

That said, programme designers do need to consider the wider market and value chain that smallholders operate in. To maximise viability, CASA (2022) found that smallholder agroforestry programmes must consider the potential to scale up, aggregating smallholders working in the same commodity to provide a combined (and potentially more attractive to the investor) offer. Carbon sequestration potential varies between commodities: business cases must recognise this in proposed models.

In Ghana, for example, a small number of buying companies are licensed by the government board (COCOBOD) to purchase cocoa from smallholder farmers; aggregation is already a factor of the market there. This allows business cases to be considered over a much wider combined intervention area, with potentially shorter payback periods. Agribusinesses working in high-value export commodity chains, for instance, may be able to work on the basis that there are opportunities at the higher end of the carbon credit price range, while those working in staple crops will function at the lower end. Here, the proximity of the agribusiness to the farmer is key:

> *"…inclusive agribusinesses, which already provide farmer support as core to their business operations, can set their sights on more complex agroforestry transformations, while those with looser links to farmers should focus on simpler interventions that pay back at scale…" (CASA, 2022, p.35)*

Effective projects using carbon market finance need to balance incentives and disincentives carefully — both costs and benefits for the parties involved, as well as incentives and disincentives to conserve forest. In many projects, participants receive up-front payments from the beginning

of their participation in the project, which facilitates engagement in the project and transition to adopting more sustainable land use practices. Projects that generate benefits on a regular basis, or that are less disruptive of local livelihoods, are found to be more inclusive than those that involve a large payout after a longer waiting period, such as planting timber trees, which take several years to mature (Holmes et al., 2017).

Most projects try to use incentives, or a mixture of incentives and disincentives, to encourage forest users to adopt sustainable practices. In a global study of REDD+ interventions, it was found that while disincentives (e.g., forest patrols and fines) were associated with less forest clearing, households subjected only to disincentives reported negative impacts on well-being. There was also a reported decrease in tenure security over time for households exposed to disincentives alone. Projects using disincentives alone to reduce forest clearance risk harming household well-being (Duchelle et al., 2017).

Support strategies need to be put in place to help smallholders participate over the long term. From a study of REDD+ interventions in Panama, early failures in REDD+ projects, notably crop losses and tree mortality within the first years, discouraged participation in the project. Forest users who had experienced tree mortality were obliged to replant dead trees under the terms of the project agreement, but after two years had only done so in 60% of cases (Holmes et al., 2017). A suggestion here is to include a carbon buffer in the project design to account for losses during a project, particularly in the early years:

> *"At the design level, our results provide key insights to the design of a ''carbon buffer,'' i.e., the setting aside of a certain amount of carbon offsets to be used to replace unexpected carbon losses or in case of reversals in emissions reductions." (Holmes et al., 2017, p.1192)*

A study of agroforestry projects in Africa found that the success of these projects depended on the involvement of a not-for-profit as an 'anchor partner' working with smallholders (e.g., providing technical assistance) and investors (e.g., providing confidence). Agroforestry projects should consider who is the correct anchor partner for them to work with, while also developing opportunities to grow beyond this model. Increasingly, working with agribusinesses in the smallholders' own value chain to provide both the investment and technical assistance is being seen as an opportunity to bypass this model.

Only one intervention identified involved a compliance carbon market. As a lack of data prevents analysis and synthesis in this area, we have instead included a case study of a compliance carbon market intervention drawn from the literature.

Box 5: Humbo Community-Managed Natural Regeneration Project, Ethiopia

The Humbo Community-Managed Natural Regeneration Project in southern Ethiopia is a community-managed forestry project to regenerate a deforested region prone to soil erosion, flooding and

landslides. In addition to restoring this once forested area, the project aimed to improve livelihoods by making farmers more resilient to climate change.

One challenge faced was land tenure: based on public ownership of land, with usufruct rights (e.g., to cultivate and profit from the land) given to land users (e.g., smallholder farmers). An early project activity therefore focused on community empowerment and the transfer of legal land titles. Each project area — seven in total — is managed by a village cooperative whose members have drawn up a list of bylaws by consensus which restrict ecologically damaging uses and encourage the use of farmer-managed natural regeneration (FMNR) for forest restoration.

The project set a number of precedents: it was the first compliance carbon project in Ethiopia and the first forestry Clean Development Mechanism (CDM) project in Africa, registered under the UNFCCC. After two years of consultation, using the IPCC's Land Use, Land Use Change and Forestry (LULUCF) carbon trading values, an Emissions Reduction Purchase Agreement (ERPA) was signed in 2009 by the project developers on behalf of the communities. Establishing a carbon baseline for the 2,728 ha of degraded forest allowed the project to disburse funds to the seven communities based on the amount of emissions reduced relative to the baseline over the lifetime of the project.

Since this was the first project of its kind, a significant amount of time and effort was spent on engagement, outreach and collaboration with initially sceptical communities. CDM compliance and registration processes were also time-consuming, complex and costly. Complex land tenure, fragmented sites, and high set-up costs limited the project area eventually developed, reducing the area originally planned for reforestation.

While the project broke new ground, it provides several lessons:

1. Compliance carbon market projects bring with them added layers of complexity and bureaucracy. In global south contexts, a more flexible compliance regime — such as in voluntary markets — may be more appropriate.

2. New project types require added time to be spent on planning, outreach and consultation.

3. Ownership of emissions reductions credits is more complicated when ownership is public.

4. Considerable time needs to be set aside for community engagement, awareness raising and mutual understanding to ensure not only that participants understand the project, but also that the project design provides sufficient incentives to encourage their ongoing participation (Cross and McGhee, 2015).

Considerations for policy and decision-makers

Tenure and rights

To generate verified emissions reductions in the long term, smallholders need to be able to demonstrate tenure security in REDD+ projects or have clear local rights to forests in agroforestry. Differences in landholding between REDD+ project participants and non-participants in one study was one of several factors affecting participation (Duchelle et al., 2017).

Insecurity and ambiguity of tenure raise risks over the ownership of credits generated by the project in the short term, as well as longer-term risks over the valuable trees and crops planted on the land by the agroforestry project. In Ghana, for example, the government by default owns all naturally occurring trees (CASA, 2022), although local norms would see the forest as a collective resource. In Ethiopia, national land laws and local tenure norms are not always the same: forests and grazing lands are usually seen as a community resource, whatever the government may decree them to be (Cross and McGhee, 2015). This presents issues for the generation and ownership of carbon credits in agroforestry projects.

Equity

Forest carbon projects can deepen existing inequalities. Participation in conservation-development initiatives such as REDD+ and agroforestry projects has sometimes been biased to households already rich in land, income and assets; to households with higher levels of education; and to households which have existing assets to invest — all of which find it easier to engage with projects (Holmes et al., 2017).

Where such projects involve disincentives, such as fines or forest patrols, this can have a disproportionately negative impact on some of the poorest people who rely on forest clearing and bush burning, as well as forest access more generally, for their livelihoods (Duchelle et al., 2017). Project designers need to consider how to address this potential bias and reduce barriers to participation for poorer farmers.

Time and cost

Agroforestry projects are long-term, raising several issues for policymakers and funders. Foremost is the risk that projects are terminated, or project participants quit the project before the end of the project period — with the result that projects do not manage to meet their goals, as demonstrated in Bolivia (NK-CAP project, Box 4).

A related risk is reversal — when assumed carbon gains (often requiring carbon project activities to be maintained over several decades) are lost, or reversed, when project participants move on or no longer maintain the project, or when land changes hands (CASA, 2022). For both farmers and investors, carbon payback periods running into the long term can deter smallholder participation. CASA (2022) describes how market conditions affect the financial viability of smallholder agroforestry projects in the coffee sector in Ghana and Tanzania, finding that Ghana agroforestry interventions are much more financially viable due to the ability to aggregate up, while in Tanzania low cooperative capacity and insecurity of tenure make long-term investment less attractive.

The small size and fragmented nature of smallholdings, and the capacity needs faced by farmers as part of agroforestry interventions, often mean that such interventions come at a high cost. This is especially the case when developing a smallholder base for a high-value product where support

needs are high, for instance the nascent market for smallholder vanilla production in Tanzania (CASA, 2022).

Conclusions on market creation

Engaging with markets, and particularly the voluntary carbon market, as a source of funding for projects that aim to reduce deforestation presents an attractive option for closing a smallholder climate finance gap that is already huge and growing.[27] How effectively projects can engage with markets, however, varies greatly across project approaches, market type and value chain. A key conclusion from the evidence is the importance of tailoring the approach to the market and to the farmer: where these are not aligned, or where objectives are in opposition, interventions are most likely to fail.

Some insights include:

- **Understand the buyers …:** working with markets can be complicated, and understanding the conditions within which they operate is key to being able to make use of them. Projects not well aligned with the demands of the market they are trying to access will find it hard to be effective. Compliance carbon markets may not be flexible enough, and technical requirements may be discouraging, for projects being implemented in the global south. On the other hand, there are real opportunities for smallholders to access finance from agribusinesses looking to use insets to meet their environmental obligations. Projects can incorporate this consideration in their design.

- **… and the sellers:** projects need to be aligned to smallholder needs and activities. Agroforestry projects for vanilla, with high carbon removal potential, may be viable at a smaller project scale than coffee or cocoa. Coffee and cocoa smallholders, however, can aggregate their produce over a larger project intervention area, making it more viable to sell on the international market at a larger scale. Developing a strong business case based on the smallholder and the value chain they operate in is key.

- **Tenure and rights:** markets require secure property rights to function, and this is also true for smallholder forest projects looking to attract funding from carbon markets. The long duration of forest projects means that secure tenure — whether formal freehold or some customary collective tenure — is even more important, not only to be able to access carbon payments in the first place but also to ensure that the project area remains with the smallholder and is not subject to land grabbing or eviction.

- **Support and assistance:** the provision of support to smallholders in the form of an anchor partner — normally an NGO or civil society organisation — to help them navigate the complexities of accessing funding through markets is almost always essential. During the

[27] According to research by ISF Advisors, farmers in developing countries face a formal financing gap of $106 billion (ISF Advisors, 2022, link). Meanwhile, a 2022 report from Climate Policy Initiative finds that climate finance for smallholder farmers fell by 44% between 2017/18 and 2019/20 (CPI, 2023, link).

project, technical assistance will be needed to move towards a new business model and to comply with market demands. Projects should also build in early incentives to meet immediate smallholder needs as well as long-term payoffs.

4.3.4 Technology and know-how

Characteristics of interventions improving technology and know-how

Some 39 studies included a focus on technology and know-how. Only six of these studies focused on increasing technology and know-how independently of other interventions; the majority used technology and know-how as an enabler for broader interventions, including PES, certification schemes, and regulations.

Three key approaches for increasing access to technology and know-how were identified, although the depth of findings across them is quite varied. They include:

- **Public investment in research** to develop more effective technologies and practices for forest management and production of forest-risk commodities, for example research on improved crop varieties and techniques for reforestation of degraded areas, developing public data inventories, and experimental field sites;

- **Agricultural extension** to disseminate and increase the uptake of new technologies and techniques, including technical assistance and advisory services, farmer field schools, and input support;

- **Farmer training** to develop smallholder farmers' skills and capacity to apply new technologies and techniques effectively, including tailored training programmes and qualification schemes.

Agricultural extension can include farmer training but is typically a broader approach that includes input support and market development. It also intersects with investments in research as the objectives of agricultural extension are linked to disseminating knowledge and establishing platforms for knowledge exchange, often overseen by research institutions and government agencies. Findings on agricultural extension largely focused on three areas:

1. **On-farm practices**, including advisory services to increase awareness of climate-smart and sustainable agricultural practices;

2. **Supply chains, business, and market development**, including advisory services, market support or network development to increase access to inputs and engagement with buyers and customers;

3. **Planning, monitoring, and traceability systems**, including activities focused on developing knowledge platforms and multi-stakeholder partnerships to disseminate new technology and skills.

Several studies focused on increasing awareness of best management practices (BMPs) linked to regulation and certification compliance. This approach often targets smallholders directly through farmer field schools, demonstration sites, and train-the-trainer approaches using agricultural extension officers. We also found examples of interventions working to increase the capacity of farmer cooperatives, local NGOs, or local government agencies to provide longer-term advisory services to smallholders.

Advisory support can help to raise awareness on the eligibility criteria and application process for credit and grants; to connect smallholders to investors and business opportunities; and to improve business models and marketing. Some interventions targeted smallholders directly, while others found it more economical to work through farmer cooperatives or local NGOs. In Vietnam, for example, one of SNV's core approaches in coffee is inclusive value chain development, which involves strengthening cooperatives and SMEs so they are better organised to access markets, services, credit and training (Macfarland, 2023).

Agricultural extension services can also improve local government capacity to implement landscape and jurisdictional approaches. This includes advisory services and the development of new technologies to improve the planning and monitoring capacity of local agencies. For example, the Sustainable Management of Peatland Ecosystems in Indonesia (SMPEI) project, implemented by IFAD, pioneered the application of landscape-level approaches in national regulatory and planning frameworks by supporting the government to establish innovative policies for integrated peatland management and restoration, as well as sub-regulations and technical guidelines to mainstream implementation at the provincial and district or city level (Global Environment Facility and International Fund for Agricultural Development, 2022).

Additionally, in Vietnam SNV has trained provincial officers from the Forest Protection Department (FPD) on utilising Terra-I, an automated software based on drone and satellite imagery, for real-time forest monitoring, enabling public agencies to respond to land use change without waiting years for publication of official government maps and databases (SNV Netherlands, 2021).

While the public sector has traditionally been responsible for implementing and coordinating agricultural extension, implementation has increasingly involved the private sector and civil society. Development of agriculture is increasingly market-led: active participation of the private sector in the implementation and financing of agricultural extension is encouraged and even expected by project proponents (Macfarland, 2023; Tropical Forest Alliance et al., 2023a). In some cases, this responded to limited government capacity. For example, an innovative 'public-private-community' partnerships model was developed by the Forest Development Authority (FDA), the Dutch Sustainable Trade Initiative (IDH), and palm oil developer Golden Veroleum Liberia (GVL) to address the Liberian government's limited capacity to provide extension services and finance to farmers. Through this model, GVL alleviated gaps in government capacity by providing extension to farmers, purchasing offtakes, and co-financing plantation development via loans. (United Nations Development Programme et al., 2020).

Private sector actors are particularly involved where extension activities are linked to certification or PES schemes. Several initiatives used the Responsible Sourcing from Smallholders (RSS) framework developed by the Smallholder Acceleration and REDD+ Programme (SHARP) partnership, which provided supply chain companies with a toolkit on smallholder capacity building to support certification compliance (SNV Netherlands, 2016).

Private sector involvement can include delivering extension directly, as well as private sector training to government extension officers, and private sector data collection. The Nespresso AAA Sustainable Quality Program, for example, trained 70 government extension workers in Ethiopia and Kenya and provided data on soil health for government institutions to use in planning and making recommendations for input use (TechnoServe, 2023).

The increased involvement of the private sector is also attributed to the nature of jurisdictional and landscape approaches, which require responsibilities to be shared between companies, producers, civil society and local governments (Tropical Forest Alliance et al., 2023a). Private sector signatories to jurisdictional approaches are often involved in funding or developing monitoring and traceability systems (Tropical Forest Alliance, 2021b). For example, in Mexico, companies financed the development of High Conservation Value (HCV) and High Carbon Stock (HCS) probability maps to identify areas that may need protection. In Indonesia, Unilever supported training for the government's forest management unit to review data from Radar Alerts for Detecting Deforestation, a system developed by the World Resources Institute and Global Forest Watch (Tropical Forest Alliance et al., 2023b).

Effectiveness of research

Although only a few studies focused on ***public investments in research***, research that seeks to address the socio-economic factors leading to deforestation is likely to have greater relevance and impact than research focused on generating new knowledge and scientific results alone. Public investment in research is also more likely to be relevant when carried out in the field, particularly when research design is tailored to specific contexts and impact pathways.

In Brazil, for example, Tremblay et al. (2015) evaluated the short- and medium-term profitability of two experimental agroforestry systems compared to traditional slash-and-burn, as well as the Brazilian Bragantino system, a short-cycle crop system developed in the early 2000s by Brazil's public research agency, EMBRAPA. The system has similar environmental benefits to agroforestry and was designed to facilitate soil recovery after degradation, encompassing no-till systems, crop rotation and intercropping to restore soil quality. While both systems were profitable alternatives to slash-and-burn, costs of agroforestry were a major barrier to households adopting the practice. The material costs for the Bragantino system were significantly lower because farmers had developed techniques to maintain, harvest and transport crops. The study concluded that the Bragantino system could provide a better option for farmers who want to adopt more sustainable practices but cannot afford the initial costs of agroforestry (Tremblay et al., 2015).

Conversely, in Indonesia, innovative cacao varieties promoted through the National Cacao Movement (GERNAS), a government-led approach to intensify cacao growing, were less successful. Despite high awareness among growers of the new varieties and techniques, promoted since 2007, by 2020 only 27% of 289 surveyed fields used the technology (Kelley, 2020). Farmers cited additional labour as the primary reason for slow uptake. While the varieties were theoretically pest- and pathogen-resistant, yields failed to substantially increase, with 92% of households getting yields of half or below half of the levels seen at peak production. Instead of raising yields and household income in cacao, producers moved away from cacao, selling or fallowing fields and planting alternative commodities, including in newly cleared forest. Although before 2000 cacao was a primary driver of tree clearance, lands cleared for other commodity investments in the four surveyed villages since 2000 exceeded all remaining land in cacao by 369% (Kelley, 2020). While research to develop innovative varieties has been cited as a pathway to increased agricultural productivity and, in turn, farmer income, farmers reported that new varieties on their own would not increase cacao production, highlighting a need for more focus on supply chains:

> *"If we're only given this advice, these grafts, cacao production in Indonesia will continue to go down…Indonesia doesn't have any more companies producing cacao. That's proof it's a bad investment. The expenses don't match the costs." (Kelley, 2020, p.11)*

The study of the Amazon Fund by Correa et al. (2019), which includes research, similarly identified the absence of a clear strategy that could maximise the Fund's results on deforestation reduction. The Fund committed $40.7 million to scientific and technological development between 2008 and 2017, including $8.5 million allocated to federal governments for research into native seedlings and techniques for reforestation of degraded areas, and development of demonstration units (pilots) to disseminate knowledge (Correa et al., 2019). Research had the lowest implementation rate; it was often unclear how funding distributions (across research and other projects) coincided at ground level to support reduced deforestation (Correa et al., 2019).

If research is to achieve impact, result have to be taken up by farmers, agribusinesses or policymakers. Research projects that include components for engaging with and communicating results to key stakeholders, including policy briefs, farmer training, and dissemination workshops, are more likely to encourage the adoption of sustainable practices. Increasing smallholder farmers' awareness of, and capacity to implement, sustainable agriculture is the first step to better practice. Research should be combined with agricultural extension and farmer training.

Effectiveness of agricultural extension

Several studies report improved farmer income and well-being from adoption of new agricultural practices. Bravo-Ureta et al. (2011), for example, explore the outcomes of technology and technical assistance packages provided by the Manejo de Recursos Naturales en Cuencas Prioritarias (MARENA) programme in Honduras, designed to encourage more sustainable agricultural practices, to boost productivity, and to raise rural incomes. Technical assistance

focused on sustainable production technologies, market access, and microfinance. A study of comparator groups found that MARENA had contributed significantly to the economic well-being of beneficiaries: over four years of implementation, the contribution of MARENA to the average annual value of agricultural production per beneficiary ranged from US$263 to US$331 (Bravo-Ureta et al., 2011).

Cavatassi et al. (2018) explore the outcomes of the Community-based Forestry Development Project in Southern States (DECOFOS) project in Mexico, which provided technical and financial support to start-up micro-entrepreneurial projects and small businesses working in sustainable timber production and non-timber forest products. Outcomes included improved food security and food diversity, increased household incomes, and improved climate resilience as project beneficiaries were less affected by and better able to recover from drought and other climatic shocks (Cavatassi et al., 2018).

Agricultural extension linked with certification or PES schemes has also improved farmer welfare and the adoption of sustainable agricultural practices. The Mars Partnership for African Cocoa Communities of Tomorrow (iMPACT), run in collaboration with the Rainforest Alliance, for example, certified 10,000 farmers in 40 communities in Ghana and Côte d'Ivoire (Astrid Fenger et al., 2017). Certified farmers received considerably more external support for cocoa production from the government and partner organisations than conventional farmers, including shade tree seedlings, farmer training, fertiliser and personal protective equipment. Farmer field schools supported by the Rainforest Alliance enabled farmers to learn Good Agricultural Practices (GAP) and farming as a business, resulting in improved record keeping and planning. An impact assessment found that non-certified farmers in the area had seen reduced cocoa production and lower incomes, while certified farmers cited an increase in cocoa production, higher incomes and higher savings (Astrid Fenger et al., 2017). The programme also helped reforestation, with certified farmers increasing shade trees on their farms, whereas the non-certified farmers saw no change or a decrease. Certified farmers reported improved soil fertility and water quality, while conventional farmers indicated the contrary. The most significant inputs of the certification programme were not the premium prices paid to farmers, but rather the information and knowledge about the certification of goods, the cocoa sector and project planning through training and technical assistance, and access to credit and farm inputs (Astrid Fenger et al., 2017).

The sustainability of results across studies varied, however, and most were project-specific. The Ghana and Côte d'Ivoire programme just reviewed, for example, increased farmer incomes but depended on ongoing farmer-capacity-building institutions such as the Agro-Eco Louis Bolk Institute (AELBI) and externally-funded projects like iMPACT (Astrid Fenger et al., 2017). A weakness of certification projects is their need for continuing support.

Although agricultural extension can enable adoption of practices to reduce deforestation, only three studies measured a *reduction* in deforestation — all of which were linked to PES or certification schemes. Most studies on technology and know-how measured improvements in reforestation through agroforestry, although the objectives and scale of agroforestry

interventions varied. For example, in Ghana, several national tree planting schemes have been implemented, but have struggled to reach the targets set by the Forestry Commission owing to farmers planting too few trees (Osei et al., 2019). In Cameroon, reforestation has been aggregated through rural resource centres, with over 52,500 fertiliser trees to improve soil fertility of degraded land and 122,500 Indigenous fruit and nut trees planted to generate additional income in a single year (Asaah et al., 2012).

Studies focused solely on on-farm practices such as agroforestry and sustainable intensification in high deforestation areas often implicitly assume that improved practices will reduce deforestation, but evidence is limited, as many of these programmes do not consistently measure tangible impacts on deforestation. For example, Ngoma et al. (2021) evaluated the links, processes and drivers of climate-smart agriculture (CSA), cropland expansion and deforestation in Zambia and found that CSA did not stop cropland expansion into forests:

> *"The pathways through which CSA can reduce deforestation are neither obvious, nor are they well understood. The hypothesis around CSA and deforestation is that since CSA improves yield, smallholder farmers deploying such practices are less likely to expand cropland because they are able to produce more per given unit of land. However, our results do not support this hypothesis…Adopting CSA had no statistically significant effect on cropland expansion in our national sample, indicating that CSA alone might not avert expansion-led deforestation." (Ngoma et al., 2021, p.v)*

This study concluded that technical intensification alone, including CSA, would probably not lead to deforestation: technology and know-how needed to be coupled with improved resource governance and better land use planning (Ngoma et al., 2021).

Effectiveness of farmer training

We identified farmer training programmes implemented by governments, cooperatives, NGOs, and increasingly by private sector actors. Training extends beyond demonstration sites and includes training on both agricultural practices and agribusiness development, including access to capital (see section 4.3.e below). In Vietnam, for example, training provided by SNV through the Café-REDD initiative helped smallholder farmers to develop the skills needed to access financial services (McFarland, 2024).

Training that targets both farmers and downstream supply chain actors has helped increase farmer welfare. For example, the Nespresso AAA Sustainable Quality Program in Ethiopia and Kenya includes a two-year intensive training programme that guides farmers on regenerative agricultural practices to raise the quality and size of coffee harvests, as well as training for wet mill employees to ensure that quality is maintained during processing (e.g., on fermentation, drying and storage) (TechnoServe, 2023). More than 46,000 households and 288 wet mills participated in the training; the programme claimed more than a 4:1 return on investment, with additional incomes of participating farmers totalling $7.1 million per year (TechnoServe, 2023).

Degli Innocenti and Oosterveer (2020) explore how different actor relationships affect knowledge transfers in sustainable palm oil production, with a focus on enablers and barriers to social learning within RSPO-certified value chains in Indonesia and Thailand. Training delivered to smallholder farmers by GIZ extension officers in Thailand was accessible, with 95% of surveyed smallholders stating that the information provided was easy to understand, compared to only 8% of scheme farmers reporting the same in relation to knowledge shared by plantation staff (Degli Innocenti and Oosterveer, 2020). The externally organised training for independent farmers was broad, while scheme farmers had a narrower set of instructions from the plantation company. Scheme farmers rarely received training on maintaining the oil palms and knew little of RSPO criteria — only 61% of scheme farmers surveyed were aware of their RSPO certification status compared to 92% of independent smallholders in Indonesia and 98% in Thailand (Degli Innocenti and Oosterveer, 2020). While this enables learning by interaction, it holds low potential for empowering farmers to learn by decision-making. Instruction-based learning created limited incentive to improve performance (Degli Innocenti and Oosterveer, 2020).

In-depth training may have limited reach unless there are sufficient networks to sustain knowledge exchange. Bravo-Ureta et al. (2011), for example, found no spillover effects from training provided under the MARENA programme in Honduras (see above), possibly because the skills required to implement farming practices supported by MARENA may be too complex to share in casual exchanges between beneficiaries and non-participants (Bravo-Ureta et al., 2011). Effective programmes, like the series of agroforestry projects implemented in Cameroon (Box 6 below) often adopt a train-the-trainer model, enabling longer-term knowledge exchange (Asaah et al., 2012).

Considerations for policy and decision-makers

A key factor in the adoption of sustainable agricultural practices is farmers' own perception of having the capacities and knowledge to establish and maintain such systems (Tremblay et al., 2015). However, even for low-tech practices, demonstration sites and field schools are often not enough to lead to widespread adoption (Degli Innocenti and Oosterveer, 2020), particularly for BMPs linked with certification and climate-smart agriculture, which involve multiple components. This type of learning may involve more substantial farmer training or can be developed through extension to build networks to provide longer-term technical assistance and knowledge support (see Box 6 below).

Box 6: Creating extension networks in Cameroon

In Cameroon, agroforestry projects have been implemented by the World Agroforestry Centre through its Agroforestry Tree Domestication projects, funded by the International Fund for Agricultural Development (IFAD), the United States Department of Agriculture (USDA), and the government. To promote tree domestication, IFAD researchers trained NGO trainers, who disseminated knowledge via rural research centres (RRCs). Expansion to new villages was often via farmer-to-farmer visits. The programme worked with 17 relay organisations, including local NGOs, community-based organisations and well-established farmer groups, which supervised more than 200 farmer groups or associations.

The relay organisations served as 'diffusion hubs' for new technologies, skills and knowledge, in collaboration with national and international research institutes. They are also becoming financially independent as viable commercial nurseries and organisation-strengthening enterprises.

Technology and know-how continued to be disseminated via farmer-to-farmer exchange with positive results. In 2008, seven RRCs produced over 52,500 fertiliser trees to improve soil fertility of degraded land, and over 122,500 Indigenous fruit and nut trees were planted to generate additional income. These improved fallows were well accepted in most project communities, with farmers reporting their crop yields to double or triple. While the project focused on an original set of priority species, once farmers understood the techniques of vegetative propagation, they started to apply them to a wider range of crops, including cocoa, avocados, mangoes and apples (Asaah et al., 2012).

Awareness raising on its own, however, often has limited impact (Cavatassi et al., 2018). Multiple studies found that farmers do not have the capital to purchase inputs required for implementing techniques such as agroforestry; therefore, in addition to disseminating knowledge, several agricultural extension interventions also provide technical inputs through either direct cash payments or government subsidies (Simonet et al., 2019). While this approach can concentrate benefits in a targeted location, it requires continuous input support, which means that results are often not sustainable in the long term. In Vietnam, for example, the costs of adopting sustainable coffee production practices were generally shared with, or fully subsidised by, an SNV project (see section 4.3.a on access to capital). The project's own risk assessment flagged that further uptake may be limited as non-beneficiary farmers will be unable to afford the necessary investment (McFarland, 2024).

Recent studies also explore using carbon finance to subsidise inputs, but such programmes are still in development and have not yet reported outcomes (CASA, 2022). Sustainability may be better achieved by linking agricultural extension with long-term access to finance through market development. In Cameroon, for example (see Box 6 above), in addition to on-farm practices (agroforestry) the project promoted entrepreneurism and development of value-adding and processing technologies for new tree crop products, including the marketing of agricultural and tree products, microfinance and small post-harvest machinery (Asaah et al., 2012).

Working with cooperatives can also help to connect smallholder farmers with inputs to apply new knowledge and information, as well as markets to sell their products. Successful interventions that have worked through cooperatives and/or worked to improve the technical capacity of cooperatives were able to build enabling conditions for sustained uptake of technology and know-how. Working with cooperatives can support knowledge dissemination beyond the project site and duration and engage buyers to support the development of markets for agroforestry products.

Box 7: Examples of farmer cooperatives in Vietnam and Guatemala

In **Vietnam**, local farmers typically sell to intermediaries and small-scale traders who pay low prices for their products, resulting in low incomes for smallholder farmer households. The Yen Duong

Cooperative, established in June 2018 by the Vietnam Farmers' Union with support from the Forest and Farm Facility hosted by the FAO, is helping to change this. Membership gradually increased, from seven members in 2018 to 45 official members and 230 associated farming households (non-members engaged in the activities of the cooperative) in 2021. Women account for 80% of the total members. The cooperative provides marketing support for all products produced by its members and production groups, manages irrigation systems, and supports the collection of forest and farm products. The cooperative, together with the Vietnam Farmers' Union, has also organised training courses, visits and exchanges to enhance the skills and knowledge of its members, including training on using information technology and smartphones in production management, supervision and market access (Asian Farmers' Association for Sustainable Rural Development, 2022).

In **Guatemala**, the NGO Fundalachuá has worked to increase knowledge and transfer skills on cocoa cultivation and offer micro-credits to farmers by creating farmer cooperatives. The cooperatives engage cocoa producers within and outside the community in micro-enterprises and marketing to generate a higher and homogenous quality of cocoa beans and earn more income. This has improved smallholders' business and administration skills and network abilities, increasing their competitiveness on the international market and their compliance with quality requirements (Nicli et al., 2019).

Agricultural extension is increasingly linked with certification or PES schemes to support access to inputs and technical assistance. Astrid Fenger et al. (2017), for example, found that extension services were often the first step of certification implementation: standard bodies advise farmers on how to implement sustainable farming practices and establish protocols for adhering to environmental and social standards, while certification and accreditation bodies implement auditing and third-party verification of farmers' standard compliance. Osei et al. (2019) explore an ongoing community-based agroforestry and PES programme enabled by agricultural extension services. The programme, established in 1998, is implemented by the Wassa Amenfi Traditional Council (WATC), a neighbouring timber-processing company named Samartex Timber and Plywood Company Ltd (SAX), and the Ghana Forestry Commission. The WATC, which oversees communal lands in the district, released land for the project, the Forestry Commission provided technical assistance, and SAX provided free seedlings of Indigenous tree species to the farmers. SAX is motivated to support the community, which is developing an Indigenous species resource base for their factory; and the success of the project can be used to demonstrate the value of tree planting to other communities in the area. The WATC was entitled to one-third of the harvest proceeds, with the remaining two-thirds going directly to the farmer (Osei et al., 2019).

Conclusions on technology and know-how

Technology and know-how, including research, knowledge and training, is central to reducing forest clearance and promoting sustainable agriculture. Commonly, a network of actors are involved in extension: knowledge platforms and multi-stakeholder partnerships to connect with the private sector, as well as initiatives to build the capacity of local government to disseminate knowledge and new technology — all can enhance knowledge transfer.

Most reports of outcomes concern adoption of sustainable practices. Reports on farmer training tend to be limited to stating numbers of farmers trained. Given that technology and know-how is usually delivered with other measures, the improvements seen in farmer welfare are not solely due to technical knowledge.

Ensuring that improved agricultural practices lead to reduced deforestation requires cross-sectoral planning and policymaking and targeting buyers.

If research results are to achieve impact, they need to be adopted and used by farmers (and sometimes agribusinesses). Research projects that include components for communicating results to key stakeholders — through, for example, policy briefs, farmer training, and dissemination workshops — are more likely to encourage smallholders to adopt more sustainable practices. Research should be combined with agricultural extension and farmer training.

4.3.5 Access to capital

Characteristics of interventions supporting access to capital

We found 20 studies that include access to capital as a means to support smallholder farmers' transition to sustainable agricultural practices. Sixteen of these studies discuss access to capital combined with other policies and interventions: access to capital is rarely a stand-alone feature of the interventions reviewed.

The types of capital most identified in the literature include:

- Credit and loans from banks and other formal financial agencies;
- Subsidised or preferential credit;
- International climate finance (donor grants);
- Microfinance schemes, including village savings and loan associations (VSLAs).[28]

Access to capital, including loans, enables smallholder farmers to invest in productivity-enhancing technologies and practices that are more sustainable and reduce the need to expand farming into forest areas. This includes purchasing improved seeds and fertilisers, investing in more efficient irrigation systems, and implementing soil conservation — typically practices which require initial investments that are difficult for smallholder farmers to make without access to credit. This can benefit smallholder farmers, through higher and more consistent income stability, reduced

[28] While studies also referenced how access to carbon finance could potentially enable smallholder farmers to transition to more sustainable agricultural practices, no specific interventions were identified and discussed in the literature. CASA (2022), for example, notes the novelty of carbon finance and the complexity of partnering with smallholder farmers.

poverty, and enhanced food security. It can also help to promote gender equality in rural areas, especially through VSLAs that often focus on benefitting women farmers.

In practice, however, smallholder farmers face multiple barriers to accessing finance, including perceived high risk, limited collateral, and high transaction costs. Bronkhorst et al. (2017), for example, highlight a lack of financial and other data available for lenders to make informed decisions on the creditworthiness of smallholders. Financial institutions view smallholder farmers as high-risk borrowers due to the unpredictable nature of agriculture. Tropical Forest Alliance and Preferred by Nature (2024), for example, recognise that "agriculture is a relatively 'risky' sector, with production often unpredictable [sic] — an issue which will be intensified by climate change". Puspitaloka et al. (2023) similarly recognise that agriculture and forestry land use projects are often seen as risky due to challenging local conditions, including complex land tenure and governance issues.

In many places, inadequate financial infrastructure in rural areas also continues to limit access to formal finance, as does limited financial literacy among rural people. Smallholders may lack the knowledge or skills needed to access and manage loans and other financial products: McFarland (2024) reports this on access to climate-smart agriculture in Vietnam's coffee landscapes, as well as SNV Netherlands (2023) on Café-REDD, also in Vietnam.

Access to finance is even harder for marginalised groups:

> *"Groups facing equality and inclusion challenges, such as women, ethnic minorities, and businesses owned by them, face even higher barriers to access finance. In Vietnam's case, these are neither regulatory nor is their [sic] evidence of discrimination on behalf of the lenders. Instead, it is due to overlapping characteristics of these more marginalized and vulnerable groups – intersectionality – that combine to make access to finance even harder." (McFarland, 2024, p.13)*

Smallholder farmers often face limited access to capital, which leaves them with limited reserves and fewer options for adapting farming systems and adopting more sustainable approaches to agriculture and forest management. In Indonesia, for example, Johnston et al. (2018) found that smallholder oil palm yields were often 45% less than those of plantation companies, linked to a lack of credit and investment capital for replanting aged, low-yielding palms. This had environmental impacts as farmers were often forced to expand into neighbouring forests (Johnston et al., 2018). In Vietnam, McFarland (2024) highlighted a lack of capital as one of the biggest challenges in raising production standards in coffee farming, noting that smallholders often seek informal finance at high cost with little transparency on rates or terms.

Interest rates can also be prohibitively high and repayment terms too restrictive. The seasonal nature of agriculture and limited market access can make it difficult for smallholder farmers to generate consistent income to meet regular loan repayments. Morris (in Tropical Forest Alliance and Preferred by Nature, 2024) explored financing for smallholder farmers in Peru, where smallholders on farms of fewer than 5 ha make up 70% of Peru's agricultural sector:

> *"From the farmers' perspective, high interest rates are a major problem. In the Peruvian Amazon, interest rates are regularly over 20%, with short repayment periods. This makes naturally risk-adverse farmers tentative about taking loans for sustainable agriculture. Indeed, as our studies show it is likely that under current terms they would struggle to repay their loans due to short-term decline in profits in the transition to sustainability." (Tropical Forest Alliance and Preferred by Nature, 2024)*

As a result:

> *"Farmers (are) trapped in a cycle of deforestation. They are cutting further into the forest to support their livelihoods and families, while being keenly aware this damages the important services provided by the forest – including consistent rainfall, soil stabilisation, and shade from the sun – that they rely on." (Tropical Forest Alliance and Preferred by Nature, 2024)*

Despite the problem being clear, increasing access to capital for smallholders is not straightforward. Access often depends on a range of factors, including local institutions, market conditions and regulations. SNV Netherlands (2023), for example, highlighted the importance of governments and international organisations in creating supportive policies for enhancing access to capital. Tropical Forest Alliance and Preferred by Nature (2024) also recognised that access to capital often needs to be provided alongside technical assistance to ensure that farmers have the technical knowledge to best use the finance provided. Financial products should be tailored to the specific needs and contexts of smallholder farmers to ensure that they support sustainable agriculture.

Effectiveness of interventions supporting access to capital

Innovative financing models, including microfinance schemes, public-private partnerships and impact investments, are becoming increasingly commonplace in LMICs and can help to overcome traditional barriers to finance, while at the same time promoting sustainable agricultural practices and climate resilience. Chakrabarti (2015) links this to growing recognition of the need for smallholder farmers to be part of the:

> *"global solution to climate change, including through incentives that help engage them in the solution and encourage the behavioural change necessary to bring about more sustainable and environmentally sound improvements in agriculture".*

The following example from Cameroon demonstrates how microfinance can contribute to climate and sustainability objectives.

Box 8: Accessing small-scale loans in Cameroon

In Cameroon, a "multi-functional agriculture philosophy", as indicated in 2008 by the International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD), was adopted. It sought to empower smallholder farmers to help themselves climb out of poverty, malnutrition and hunger, while at the same time creating more sustainable agricultural systems (Asaah

et al., 2012). This project, funded by the USDA and implemented by the World Agroforestry Centre, integrated agriculture, agroforestry, product marketing, microfinance and small post-harvest machinery through a self-help package for smallholder farmers centred around capacity building, communication and community development (Asaah et al., 2012). It took the following steps:

1. Restoration of soil fertility using nitrogen-fixing trees and shrubs in improved fallows to rehabilitate degraded land;
2. Tree domestication, developing new tree crops to replace lost resources and to enrich and diversify farmland;
3. Promoting entrepreneurship and developing value-adding and processing technologies for new tree crop products, expanding trade and increasing off-farm employment opportunities.

While the project's philosophy was to provide knowledge rather than money, smallholders were helped to access small-scale loans through a local microfinance provider, First Investment for Financial Assistance (FIFFA), to buy inputs such as seeds, fertilisers and hired labour (Asaah et al., 2012). A first phase provided US$78,000 to over 900 farmers in 82 communities, 70% of whom were women. By the end of 2009, US$246,000 had been supplied to 1,239 farmers (359 men and 642 women), with rural resource centres engaged to explain to farmers how to manage and pay back loans. Loan repayments were also incentivised: farmers that paid back their loans on time were able to access larger loans in subsequent years (Asaah et al., 2012).

Reported results from the project included improved soil fertility, with improved fallows becoming a well-accepted technology, and farmers reporting a doubling or tripling of crop yields, alongside protected forests and improved food security (Asaah et al., 2012). A secondary benefit was children being released from farm work to attend school, as loans enabled hire of casual labour (Asaah et al., 2012).

Income generation was also improved through tree nurseries growing Indigenous fruit.

In Brazil, the Global Innovation Lab for Climate Finance (the Lab) is working to "bridge the climate finance gap by identifying and developing financial instruments that have the potential to mobilise financing for climate and sustainable development projects" (Chiriac and Byrd, 2021). Projects supported by the Lab include:

- The Responsible Commodities Facility, which provides credit to encourage responsible soy production on previously cleared lands and abandoned pastures to meet growing international demand for zero-deforestation supply chains;

- The Consensus Impact Fund (CX Impact Fund), which works to redirect Pronaf, a Brazilian federal subsidised credit for smallholders, to sustainable production systems and forest-based activities that prevent deforestation (Chiriac and Byrd, 2021). Alves and Byrd (in Chiriac and Byrd, 2021) described the CX Impact Fund as a mechanism for "greening" an existing subsidised credit line.

These interventions in Brazil simplified access to capital for smallholders, provided they adopted sustainable practices. At the same time, access to capital helped smallholders to build their credit history and financial capacity, making them more likely to be able to access future credit (Chiriac and Byrd, 2021).

Keeping the spotlight on Brazil, Carauta et al. (2018) explored whether preferential credit systems could speed up the adoption of low-carbon agricultural systems in Mato Grosso state. The Federal Government's Strategy for Low-Carbon Agriculture (the ABC Plan, now the ABC+ Plan) supported the adoption of integrated crop-livestock-forestry systems by providing preferential loans to their adopters. Preferential loans (subsidised credit at 5% compared to the Brazilian Central Bank rate of around 12% in 2015) were offered to farmers for implementing one or several of the following agricultural practices: integrated systems of crops, livestock and forestry; restoration of degraded pastures; no-tillage farming; biological nitrogen fixation; treatment of animal waste; and commercial forestry plantations.

The study by Carauta et al. (2018) of 844 farms between 2010 and 2013 applied a microsimulation model to test the effect of different supply-side incentives. While this is a theoretical paper with no reported outcomes, the model found that ABC credit contributed to the adoption of integrated systems in Mato Grosso (Carauta et al., 2018). The findings of this study "highlight the importance of understanding farmer adoption decisions and responses to changes in financing conditions, especially in situations with high rates of interest and inflation" (Carauta et al., 2018).

The Café-REDD project in Vietnam's coffee sector takes an integrated approach to reduce the pressures on forests by supporting sustainable agricultural development and local job creation and livelihoods (see Box 9 below).

Box 9: Increasing access to finance in the coffee sector in Vietnam[29]

In Vietnam, government-managed investment funds and grants provide an important source of finance for early-stage enterprises. Facilitating access to these financing mechanisms was therefore identified by the Coffee Agroforestry and Forest Enhancement for REDD+ (Café-REDD) project team as a way to reduce deforestation and forest degradation by addressing the conversion of forest to agriculture in the Lang Biang conservation area. The project, running between 2018 and 2024, was funded by the German Ministry for the Environment, Nature Conservation, Nuclear Safety, and Consumer Protection (BMUV) with a budget of approximately EUR 2.8 million (SNV, 2024).

The Café-REDD team focused on five key activities to increase access to finance:

1. Developing an integrated climate-smart 'landscape investment plan' for the district;
2. Helping the district to establish a new livelihood and forest protection fund;
3. Delivering a business 'incubator', to provide grants and training for enterprises in the coffee and inter-crop value chains;

[29] information in Box 9 is based on findings from SNV Netherlands (2023) and McFarland (2024).

4. Working with banks to provide financial products to meet the needs of farmers, especially women;
5. Supporting access to finance by cooperatives and farmer groups.

Activities supported different stakeholders and targeted access to different types of finance, including public programmes, philanthropic or donor grants, and commercial finance.

This work helped develop the financial literacy of smallholders and helped farmers and business owners to identify loan opportunities and existing public grants. The team also partnered with two banks, Agribank and Lienvietpostbank (LPBank), to score 375 farmers using a credit scorecard developed collaboratively with the banks to assess the creditworthiness of smallholders participating in the project.

The underlying assumption of the project was that improved access to finance for smallholders would enable improved farming practices, leading to less need to clear land for unproductive farming methods. Since its inception in 2018, the project helped over 3,355 farmers, leading to enhanced coffee quality, diversified income streams, and heightened resilience to climate challenges.

The project also learned lessons. Engagement with banks, for example, came too late, with project stakeholders identifying a need for more formal partnerships with banks to resolve some of the finance gaps in the landscape. The costs of adopting these approaches were also generally shared with, or fully subsidised by, the project itself, but this raised questions on the sustainability of the project's approach.

Considerations for policy and decision-makers

While there is no doubt that access to capital can enable sustainable agriculture and prevent deforestation, its importance and impacts are nuanced. Consensus across the literature is that interventions to access capital should be combined with other supportive measures, such as technology and know-how and market access, to maximise effectiveness.

Several studies examined access to capital alongside other intervention types, especially technology and know-how, followed by economic incentives and regulation and, to a lesser extent, creation of markets. There are clear links, for example, between having technical knowledge on sustainability standards and having access to the capital required to transform this knowledge into practice. Tropical Forest Alliance and Preferred by Nature (2024), for example, focusing on financing smallholders in Peru, found that access to capital needed to be supported by technical assistance.

> *"It is not enough for a farmer to receive a cash injection to ensure sustainable production; they must also be given the support they need to implement new farming techniques." (Tropical Forest Alliance and Preferred by Nature, 2024)*

Degli Innocenti and Oosterveer (2020), conversely, found that initiatives focused solely on knowledge transfer have been repeatedly unsuccessful in changing smallholder practice.

Examples of interventions that combine access to capital with other supportive measures include the following:

- Musim Mas, an innovative financing scheme for palm oil development for smallholders in Indonesia, helped farmers access finance alongside corresponding education and training to ensure Good Agricultural Practices (GAP), thereby increasing palm oil yields and ultimately promoting palm oil farmers' livelihoods (Bronkhorst et al., 2017).

- The agroforestry project in Cameroon mentioned above provided a blend of interventions to support smallholder farmers, combining access to microfinance with capacity building, communication and community development (Asaah et al., 2012).

- An IFAD-supported forestry development project in Mexico combined farmer training with financial and technical support (Cavatassi et al., 2018) (Box 10).

Box 10: Combining farmer training with financial and technical assistance in Mexico

The IFAD-supported Community-based Forestry Development Project in Southern States (DECOFOS) in Mexico combined farmer training with financial and technical support to micro-entrepreneurial projects to ensure an integrated approach to forest management, with positive results.

Intervention: training was designed to improve the organisational, planning and managerial capacities of local communities. Some 294 training courses and workshops were delivered, with a focus on "(i) climate change effects and the adoption of good agricultural/environmental practices to adapt and mitigate these effects; (ii) the formulation of local development plans, participative environmental assessments, and business plans".

Training was augmented through provision of financial and technical support for forest projects and businesses and for adaptation of agroforestry and good environmental practices for climate change mitigation and adaptation.

Results: the main outcomes were forest protection and reduced vulnerability to climate change. Reforestation and agroforestry were successful: the normalised difference vegetation index (NDVI) significantly increased in project areas, compared to control areas, indicating increasing green mass.

Among the treated group, resilience increased, with project beneficiaries better positioned to recover from shocks.

Household incomes and assets rose: project beneficiaries were able to make investments in diversifying their livelihoods.

Source: Cavatassi et al., 2018

Conclusions on access to capital

Limited access to capital restricts the ability of smallholders to switch to more sustainable agriculture. While efforts are being made to address barriers through more innovative finance models, a systematic approach to increasing access to capital for smallholders remains to be defined. In Vietnam, for example, McFarland (2024) identified a lack of national-level discourse and the absence of a long-term policy framework to support or drive innovation in rural finance. Tropical Forest Alliance and Preferred by Nature (2024) similarly identified the absence of specific green credit products designed to support the shift to more sustainable production, as opposed to general lending, and made the case for green finance to be made available for smallholders in Peru.

Financial interventions should, however, be carefully designed and implemented alongside other supportive measures to ensure they benefit the environmental while improving farmers' livelihoods. McFarland (2024), for example, argued that single interventions are not enough to solve financial inclusion: a combination of activities and interventions is needed to more systematically improve access to capital. Appropriate safeguards should also be in place to ensure that access to capital supports sustainable practices and does not inadvertently lead to more deforestation. This might mean improved monitoring of the environmental impacts of increased access to capital among smallholders in different contexts and locations.

4.3.6 Rights and empowerment

Characteristics of interventions focused on rights and empowerment

We found 15 studies that incorporated rights and empowerment into their analysis, although only two were exclusively focused on rights and empowerment. The other 13 studies looked at how interventions that include rights and empowerment can help stop trees from being cut down and help smallholder farmers farm sustainably.

Rights and empowerment focused on:

- **Land tenure:** helping smallholders secure land rights by providing formal land titles or certificates, recognising customary rights, and registering land;
- **Community empowerment**, including forest management: helping local communities to come together to manage forest and agricultural resources sustainably, for example through community forest management (CFM) or by forming cooperatives;
- **Indigenous rights:** acknowledging Indigenous land claims, respecting traditional knowledge and practices, and ensuring Indigenous participation in decision-making;
- **Women's empowerment and gender equality:** ensuring equal land rights for women and their equal participation in decision-making to encourage more sustainable outcomes.

Rights and empowerment actions were coupled, most often, to economic incentives (nine studies); followed by coupling to regulation and access (six studies); and technology and know-

how (six studies). Rights were coupled less often to market creation and access to capital (two studies each).

Effectiveness of rights and empowerment interventions

When farmers have clear ownership or long-term land use rights, they are more likely to implement practices that benefit both their livelihoods and the environment. By gaining land rights, farmers and communities have greater incentives to invest in sustainable production. In Thailand, Charoenratana et al. (2021) described the Mae Chaem Model Project, which aimed to return 98,077 acres of forest to the government and allocate additional land and land rights to villagers. Increased land tenure allowed farmers to engage in what the authors call 'food sovereignty' strategies and mixed farming. The authors suggest that these strategies were better for farmer livelihoods and forests than chemical- and credit-intensive monocropping of maize, which contributed to deforestation.

The effectiveness of (any) interventions is undermined when they fail to consider how they might impact on rights to land, which can harm welfare. Duchelle et al. (2017) found that in Brazil, where forest projects had used disincentives to deforest (such as surveillance and forest patrols), which were indeed correlated with fewer hectares of forest cleared, the approach also led to decreased tenure security and harmed household well-being.

When communities are given more power through cooperatives or CFM, they can choose the crops and production methods that work best for their needs and conditions. They can also use farming methods that are in line with traditional knowledge and resist outside pressures for unsustainable land use.

In Uganda, Mawa et al. (2021) described a range of community-based land management systems with varying degrees of government collaboration and community ownership. Smallholders who participated in CFM through a Communal Land Association (CLA) had significantly higher average livelihood capital than others: a livelihood capital indicator value of 0.60 for CLA members compared to 0.51 for non-members. Members had greater access to forest resources and land for farming, higher incomes and greater household financial capital (in access to credit), and greater social capital (e.g., in a position of leadership and with a higher level of trust in the community), and were more likely to live above the poverty line. Other positive impacts, although not statistically significant, arose in human capital (number of adults within a household and ratio of dependants to working population) and physical capital (assets and housing type). The greatest difference was found in higher levels of natural capital, mainly due to increased access to on-farm trees for CLA members compared to non-members.

In Ghana, Osei et al. (2019) described a community-based reforestation project that started in 1998 involving the Ghana Forestry Commission, local government, a timber-processing company, and local smallholders. Sustainable provision of materials through the community-based reforestation project incentivised farmers, particularly younger farmers, to increase tree planting and conserve threatened tree species.

A review of 50 collective forest enterprises in 24 countries across the global south (Macqueen et al., 2020) demonstrated that such enterprises can be effective and can realise a diverse set of goals (Box 11). Under what conditions and circumstances collective enterprise works well is, however, less clear. What is clear is that collective enterprise has promise, especially when multiple and diverse goals are sought — as applies when the aims include conserving the environment and improving livelihoods with social equity. Collective enterprise deserves equal consideration with private enterprise.

Box 11: Collective forest enterprises: promises and pitfalls

The Forest Connect Alliance — "more than 1000 individuals from more than 90 countries dedicated to sharing best practice in support of locally controlled forest businesses" — documented and reviewed 50 cases of collective forest enterprises in 24 countries (Macqueen et al., 2020).

The Alliance argued that enterprises in forests should aim to satisfy several objectives, beyond the simple one of operating a business for profit; the additional objectives including conservation of ecosystems, social equity and democratic governance. The 50 cases selected showed how these enterprises contributed to broader values than profit. Those values clustered around six goals: sustained environmental and cultural heritage; material health and well-being; affirmative social relationships; justice and security; personal and reproductive fulfilment (including women's rights); and cognitive identity and purpose.

The 50 cases were selected from known successes: the aim of the evaluation being to show that it is possible to run enterprises which serve a broad range of human values.

While the cases shown are inspiring, we do not have a detailed examination of what allows them to function — and we do not have the counterfactual of how many such enterprises were started but failed to reach their objectives — enterprises which would have been abandoned and very probably lost to the sight of evaluators. [Survivor bias is likely with case studies.]

Additionally, the analysis does not address the questions that confront any enterprise, scheme or project with diverse and multiple objectives: Do the activities involve trade-offs, in that effective ways to reach one objective may preclude reaching another? How can the enterprise be effectively and practically managed to reach diverse goals?

Macqueen et al. (2020) admit that running collective enterprise is not straightforward:

> *"The transaction costs of organization of multiple smallholder producers into viable business models is one key challenge. As noted by Ostrom (2010), such organizations are plagued by 'complex linkages among variables at multiple levels that together affect individual reputations, trust, and reciprocity as these, in turn, affect levels of cooperation and joint benefits'. Collective action is costly and by no means is working as a group attractive to all…" (Macqueen et al., 2020)*

Overall, it is difficult to judge the potential of collective enterprise in the forest — as applies with collective enterprises anywhere. Some will no doubt succeed, but just as likely some will not.

But that is equally true of private enterprise: indeed, private enterprise has become so central to market economies in part because the market disciplines firms — if they do not work well, they fail to turn a profit and go out of business. In any economy, the current private sector comprises the firms that have survived.

Nonetheless, at least one message emerges from this review — which is that policymakers should be as alert to the circumstances and potential of collective enterprise as they are to those of private enterprise; and that when considering policies, institutions and public support for economic activity, the particularities of collective enterprises should be taken into account just as those of private firms are.

Free Prior Informed Consent (FPIC) processes were important in interventions that seek to incorporate Indigenous communities. FPIC empowered Indigenous people and local communities to make informed decisions about projects that might affect their lands and resources. This collective approach could result in coordinated land use planning at the community level, shared resource management, and stronger resistance to external pressures for deforestation or unsustainable practices. Proforest (2024) explored the role of FPIC for the member countries of the Africa Sustainable Commodities Initiative (ASCI). In Edo state in Nigeria, for example, FPIC was used for local communities and Indigenous people during land allocation for an oil palm programme that mandated private companies to allocate 25% of their landholding to restore degraded forest areas. In Indonesia, historic exclusion of Indigenous groups has led to forest clearing for large-scale oil palm plantations, dispossessing native groups that once held customary rights over land allocated to private companies (Pacheco et al., 2017).

Gender equity is important. Interventions that help women to gain equal rights and decision-making power can result in more diverse crop choices, including growing food crops for household consumption, a greater emphasis on sustainable practices that ensure long-term food security, and increased investment in soil conservation and agroforestry. In Liberia, although women play a key role in oil palm production and represent 51% of the agricultural labour force, they continue to be under-represented in decision-making. Stakeholder and gender analysis by Conservation International Liberia and the United Nations Development Programme (UNDP) helped encourage greater female participation in the National Oil Palm Platform of Liberia (NOPPOL) and the Northwest Oil Palm Landscape Forum (NOPLF), as well as the National Interpretation of the RSPO. Inclusive measures, such as gender-separated meetings, accessible community centres, and more convenient meeting times, took more time, but helped strengthen the NOPLF and RSPO documents. By incorporating a gender angle, inclusion may have helped increase the sustainability of results (United Nations Development Programme et al., 2020).

Considerations for policy and decision-makers

Secure land rights are crucial for smallholder farmers to invest in long-term sustainable agricultural practices and forest conservation. However, assigning rights to land and the ability to manage resources on that land can introduce or deepen inequalities in the community, or

undermine forest initiatives where there are perverse incentives. In Lao PDR, van der Meer Simo et al. (2020) looked at the unintended consequences of *chap chong*, a type of customary land tenure. The study found that farmers who were accessing *chap chong* lands had more opportunities to diversify incomes and were more able to adopt agroforestry. However, *chap chong* also exacerbated inequality in the communities as land was unevenly distributed, and some households were more able to adopt diverse agricultural practices, leading to further wealth inequality.

An important aspect for community empowerment — and something that runs across the literature — is participatory decision-making. When stakeholders are empowered to participate in local and regional policymaking it can significantly influence their land use decisions.

Policymakers should consider how to encourage local participation, so that local communities can better advocate for policies that support sustainable land use, contribute local knowledge to land use planning, reflect local values, and help negotiate for better support and resources. In Vietnam, the Asian Farmers' Association for Sustainable Rural Development (2022) described the Yen Duong Cooperative, established in 2018 in Bac Kan province with seven members. By 2021, membership had grown to 45 official members and 230 associated farms. Formed on the values of self-help, self-responsibility, autonomy and democracy, the Yen Duong Cooperative incorporates various ethnic minorities, is women-led, and operates based on unanimous consent. This model meant that the cooperative has developed gradually, rather than exponentially, but the model has been critical to its success and stability.

Recognising and protecting the rights of Indigenous people is important for forest conservation: incorporating Indigenous expertise can lead to more effective conservation efforts. That said, legal, political and economic barriers can be significant. For example, although a landmark commitment by Indonesia's president to empower rural communities and Indigenous people's rights to land management was made in 2012, the Indonesian Ministry of Forestry was slow to implement the changes. Pacheco et al. (2017) showed the importance of legal action for Indigenous rights, but also that legal precedent often did not lead to immediate change as this depended on the action of government departments and constitutional courts. Indeed, in 2024 the bill had yet to be passed through parliament (Jong, 2024).

Where interventions find that uptake from women-led producers and businesses is low, gender may be just one of several inclusion challenges to be recognised and overcome. Often, exclusion may not be immediately apparent as it arises not from specific discriminatory laws or practices, but rather from to overlapping characteristics — intersectionality — that combine to make it more difficult for women and other groups to seek, or accept, support: even though paradoxically they are most in need of support. Incorporating specific activities to strengthen confidence and ability to participate in interventions may be necessary. In the Café-REDD project in Vietnam, for example, project developers incorporated targeted training to enhance the capacity and confidence of women to participate in different aspects of the project, as well as making female participation a specific project objective (McFarland, 2023).

Conclusions on rights and empowerment

Ensuring that smallholders, local communities, Indigenous people and women have a voice in policymaking and implementation related to land use and resource management is rightly seen as vital for encouraging sustainable agricultural practices and forest management.

As a cross-cutting issue that impacts the success of almost any approach to preventing deforestation and promoting sustainable agriculture among smallholders, rights and empowerment are addressed in quite different ways across the interventions reviewed. Actions on rights and empowerment, however, do not always lead to positive outcomes; empowering one party may disempower another.

One element common across the literature on rights and empowerment is the importance of participatory approaches. These can lead to more effective and locally adapted strategies for sustainable agriculture and forest conservation, but take time and resources to implement, are often difficult to navigate, and may face opposition from other social, political and economic forces.

4.4 Findings on scaling up

Our review found only a few examples of scaling up across the intervention types presented above. Most of the studies reviewed concerned initiatives running at sub-national scales, often at the third tier of administrative division, or below. While some of these initiatives were effective or promising (in conserving the environment, or raising farmer incomes) at a limited scale, there were no accounts of such initiatives being taken to substantially greater scale.

It is not that some initiatives will not scale up: the lack of documentation probably results from common biases in research; notably there are few rewards to researchers carrying out repeated observations through time. Scaling is all about change through time: studies at one moment cannot show scaling as a process — at best they can record that scaling has taken place, but without detailed study of how that came about. An associated bias is that tracking stories about processes is time-consuming and requires skill and knowledge not commonly taught in most social sciences.

This means we have only a couple of insights into scaling from our rapid evidence assessment: insights on certification and on replication across contexts.

Some of the certification schemes referenced across the studies we reviewed — Fairtrade, Rainforest Alliance, Forest Stewardship Council, for example — have gone to scale. As recently as the 1970s, certification of agricultural and forest products from the global south began in earnest. From very small-scale trials, involving growing and supplying to what were, at the time, some very small niche markets in the global north, certification has become common in global north supermarkets. Even when the produce on the shelf is not formally certified, labels reassure customers about (some) standards of production and trading the supermarket upholds.

A few of the papers recorded replications of innovations across several countries. Examples include the SHARP partnership, 2013 to 2019, which brought together a large oil palm production and processing corporation, Sime Darby, with three NGOs: Proforest, Solidaridad and Earthworm. They jointly developed a set of guidelines that could be used by any private enterprise wishing to show that it was sourcing from smallholders responsibly. The guidelines consider three sets of issues for sustainability: land rights and land conflict, deforestation and land conversion, and labour rights and working conditions; plus three issues for smallholder suppliers: better crop yields and food security, improved livelihoods and institutions, and better agricultural practices. Proforest developed templates and other materials that companies could download to create their own procedures to ensure responsible sourcing.

The guidelines have been applied in contexts as diverse as oil palm in Indonesia, sugar cane in the Philippines, and soybeans in Brazil (Proforest, 2021).

A second case is that of the Initiative for Sustainable Landscapes (ISLA) programme (2021-2025), which is taking place in Mato Grosso, Brazil; Grand Mbam, Cameroon; Cavally, Côte d'Ivoire; Dembel-Shalla sub-basin, Ethiopia; West Kalimantan, Indonesia; southwest Mau Forest, Kenya; and Central Highlands, Vietnam (Schouten et al., 2023).

ISLA operates at the landscape level by convening multi-stakeholder coalitions at multiple jurisdictional levels of government. These coalitions agree on and commit to sustainability targets for the jurisdiction in question through a Production-Protection-Inclusion Compact.

> *"Pilot projects are co-developed with the public and private sector to test innovative business models that can contribute to the compact's goals. Landscapes with a compact are linked with potential commodity buyers and (green) investors through the online platform SourceUp, but also through other linking activities (technical assistance, preparing investment plans, searching for investors, etc.). This should help in scaling-up sustainable business models and incentivize the landscapes to become self-sustaining." (Schouten et al., 2023)*

Both these examples of first steps towards scale concern, above all, processes: processes that the originators hope and believe can be applied to specifics of particular settings.

While what is described is promising, evidence of effectiveness is not yet available.

5. Conclusions

5.1 Summary

We found 122 studies with evidence of interventions targeting smallholder farmers to reduce tropical forest clearance and transition towards sustainable agricultural practices, covering a range of locations, crops/commodities and intervention types. In most cases, despite seeking to cluster findings by intervention type, a key finding is that the interventions set out in Table 1 above, and captured in the ToC, are rarely implemented alone. Instead, projects and programmes typically combine a range of complementary intervention types, making it more difficult to determine causal pathways and identify which specific interventions are leading to outcomes. If a scheme combines, for example, farmer training with capital grants with a price premium for sustainable production, attribution of impact to the (three) different components becomes difficult.

Further, the success of interventions often depends heavily on how well they are resourced and how carefully they are implemented. For example, a policy ban on clearing forest will only be effective if sufficient forest guards can be paid, and if they have the motivation, incentives, skills and equipment to do their job diligently. Absent those factors, a ban will have no effect.

An overarching theory of change (see Figure 1), including enablers and barriers, has been developed to help interpret this diverse landscape of interventions. While the enablers and barriers are broad, they often involve the presence (or absence) of governance, markets, finance and know-how. Future policy and programming targeted at smallholder farmers should be based on a good understanding of these enablers and barriers, which are context-specific, and the combinations of activities and interventions that can address them.

Mapping of reported outcomes against activities helps to identify correlations across the literature (see Figure 11 below). This shows a high incidence across three main outcome areas — forests protected, sustainable agricultural practices adopted, and higher and more stable farmer income — confirming that interventions captured in the study support primary outcomes sought by this study. Fewer results were, however, recorded for increased property rights and secure tenure, improved food security and nutrition, and reduced vulnerability to climate change.

The three primary outcomes highlighted above are most associated with three activities: skills and awareness training, incentives and standards introduced, and stakeholder engagement. Owing to the highly varied interventions reporting outcomes, however, it is not possible to draw robust conclusions on causal pathways and on effective combinations of activities.

Figure 11: Incidences of reported outcomes against reported activities

A fourth activity, Payments for Environmental Services, shows moderate correlation to key outcomes such as forests protected and improved farmer welfare. We found weak correlation, however, between sustainable agricultural practices and improved food security and nutrition; although this may arise because measuring changes to nutrition or food security can be difficult.

There are no blueprints for ideal incentives to land users: policymakers should not underestimate the time and costs needed to set up PES and certification. Long-term monitoring of initiatives to learn which are succeeding and how is needed to help identify and develop innovative approaches.

A key conclusion is the importance of carefully tailoring interventions to the context, above all to market conditions and to the farmer: when interventions do not align with context, or when objectives are in opposition, interventions are most likely to fail. In many cases, this may require a combination of tailored activities to address more systematically the barriers identified in the ToC and to make use of the enablers to maximise effectiveness. Carefully designing and implementing supportive measures alongside the primary intervention is therefore critical for policy and decision-makers. This should include stakeholder engagement and participatory approaches to ensure dialogue and buy-in across a diverse set of interest groups, not least the farmers themselves.

5.2 Key lessons learned and their implications

Four sets of lessons stand out from this review concerning: programming and process; programme content; fairness and equity; and learning from experience.

5.2.1 Programming and process

Most of the initiatives reviewed confront at least three challenges. One concerns the lack of knowledge of both natural and human systems in and around tropical forest: it is far from clear what the results will be from intervening in some part, or several parts, of these systems. Exacerbating this is the fact that the forests are often physically large, quite remote and difficult to access.

A second challenge is that forests, and the economies and societies within them, are diverse: the context and circumstances of the Amazon basin, the forests of southern Côte d'Ivoire and Ghana, and the jungles of Indonesia all differ markedly.

A third challenge arises from the numerous actors of very different social backgrounds found in and around tropical forest: Indigenous forest dwellers; longstanding immigrants to the forest who harvest forest produce (for example, rubber tappers); more recent immigrants seeking to clear forest to create (small) farms; and large-scale farmers and companies also interested in the forests for crops, livestock and mining (Box 12). Understanding their different interests and motivations is no mean task.

Box 12: Social difference and tropical forests

At least three groups make immediate use of the forests:

- Indigenous people who have long lived in the forest and made their livelihoods in it, with minimal clearance of forest. Similar are those who migrated to the forest several generations ago and who also practice livelihoods that minimally interfere with the forest (for example, rubber tappers, Brazil nut collectors);
- Recent (within a generation) migrants into the forest, most of them on low incomes with few assets, probably farmers lacking land, who clear forest to acquire more land to grow crops and graze livestock;
- Large-scale farmers and firms with capital seeking to convert forest to crops or livestock grazing, and sometimes to mine minerals for profit. These actors are often well connected and politically powerful (see, for example, Brazil's *bancada ruralista*, Box 1, a group of legislators who represent agribusiness interests), able to resist public controls on their activities, and sometimes able to make public agencies work on their behalf.

Social differences between these groups can be very large indeed: in incomes, customs, education, knowledge, etc. — moreover, they live dispersed across the landscape and may only occasionally come face to face with members of other groups.

Less directly, the general public across the world who need the ecosystem services the forests provide, some of which are global public goods, also have an interest in tropical forest.

Implications for practice

Effective programmes are **unlikely to be blueprints —** not only do programmes need to reflect local circumstances, but also, because not enough can reasonably be known before intervening, the initial plan will almost certainly need modification as the programme proceeds and early lessons become apparent. Programmes thus need to be designed as learning processes, with effective monitoring of progress, set within — and this is more challenging — management structures and processes that allow for learning and adaptation.

Programmes of this nature can involve considerable time and effort to design, to mobilise and to run through pilot phases. One requirement above all demands time and patience: convening the different actors.

Designing programmes that can accommodate the needs and wishes of the different groups requires some skill. It will take time: time to meet with representatives of different parties to understand their concerns, to discuss potential actions, and to assess what has been learned and understood — a process that probably involves several rounds of discussions. The time needed for effective and productive negotiation may be longer than fits with business and political cycles, where results are often expected in the short term.[30]

Professional facilitators exist. Such professionals are commonly used to intermediate in conflicts, or in commercial disputes that are about to be elevated to the courts. The differences between parties to the use of forests are comparable to those seen in conflicts and legal cases. Professional facilitators could very usefully deploy their skills when creating programmes that bridge across different parties, and where the non-monetary returns to the environment and financial returns to unsustainable land use may be in opposition.

Some of the time and trouble taken in intermediation can be trimmed by adopting **jurisdictional approaches**, where programmes are created that align with administrative units such as local or regional government. Although ideal units for environmental intervention may not align with administrative divisions, in practice the economies of only having to intermediate with one political division compensate for whatever is lost by not programming at the environmental unit.

[30] In this respect, FCDO may be fortunate in that the UK Foreign Secretary David Lammy appreciates this point, to judge from his speech to COP29 in Baku on 12 November 2024, link.

Considerations of lengthy design and pilot phases raise questions about **scaling such programmes out**. More than one route to scale can be seen. One is commercial, as may happen with certification: if a programme can be devised that is simply good business for all along the supply chain, from farmers through to supermarkets and consumers, then business leaders will scale the scheme because it generates earnings and profits.

Another path exists for interventions that generate public goods and services. If some (largely) successful intervention, probably a component of a wider programme, can be translated into a regular public programme with standard operating procedures — the kind of procedures that apply, for example, to road maintenance or rural health clinics — then if public policymakers can see that the intervention is effective and efficient, there is a good chance it will be adopted and funded. Examples of this were not common in the review, but Brazil's rural land register, which facilitates monitoring of environmental regulations, might be an example.

A third path to scale, and one that may well apply to many of the interventions reviewed, applies when the intervention generates largely public goods and services, but it cannot readily be run by standard public operating procedures. Scaling then requires the intervention to be taken up by a public agency that does not have to conform to normal bureaucratic practice: the agency might be an NGO or some semi-public quango or possibly even a firm whose owner has a social mission. Such agencies start local, but some find ways to operate at considerable scale: Bangladesh's BRAC and the USA's One Acre Fund would be examples of social enterprises driven by a mission, with successful and proven technical programmes, backed by some public subsidy — government grants, charitable donations, etc., which have scaled from district pilots to national level and beyond.

Such agencies are often led by committed and talented individuals and their close-knit teams. Identifying such people is the key to supporting and investing in them — a lesson that venture capitalists know well (Roe, 1985). Backing individuals on character assessment goes against the grain of most formal public administration (which is built on professional structures and procedures), but in these cases, it is critical: leadership matters (Korten, 1980).

Only a few examples of scaling up forest interventions were reviewed: most studies concerned initiatives running at sub-national scale, often at the third tier of administrative division, or an even smaller scale. While some of these initiatives were effective or promising (in conserving the environment, or raising farmer incomes) at limited scale, there were no accounts of such initiatives being taken to substantially greater scale. That does not mean that interventions do not and cannot scale up, only that accounts of scaling are so rarely documented and published. But we have two insights into scaling from this review: insights on certification and on replication across contexts.

Some **certification** schemes — Fairtrade, Rainforest Alliance, FSC, for example — have gone to scale. As recently as the 1970s, certification of agricultural and forest products from the global south began in earnest. From very small-scale trials, involving growing and supplying to what

were, at the time, some very small niche markets in the global north — few consumers in the 1970s were concerned about the conditions under which items in the supermarket were produced — certification has become common in global north supermarkets. Even when the produce on the shelf is not formally certified, labels reassure customers about (some) standards of production and trading that the supermarket upholds.

A few of the papers reviewed recorded **replications of innovations across several countries.** Examples include the SHARP partnership (2013-2019), which brought together a large oil palm production and processing corporation, Sime Darby, with three NGOs: Proforest, Solidaridad and Earthworm. They jointly developed a set of guidelines to be used by any private enterprise wishing to show that it was sourcing from smallholders responsibly. The guidelines consider three sets of issues for sustainability: land rights and land conflict, deforestation and land conversion, and labour rights and working conditions; plus three issues for smallholder suppliers: better crop yields and food security, improved livelihoods and institutions, and better agricultural practices. Proforest developed templates and other materials for companies to download to create their own procedures for responsible sourcing.

The guidelines have been applied in contexts as diverse as oil palm in Indonesia, sugar cane in the Philippines, and soybeans in Brazil (Proforest, 2021).

A second case is that of the Initiative for Sustainable Landscapes (ISLA) programme (2021-2025) taking place in Mato Grosso, Brazil; Grand Mbam, Cameroon; Cavally, Côte d'Ivoire; Dembel-Shalla sub-basin, Ethiopia; West Kalimantan, Indonesia; southwest Mau Forest, Kenya; and Central Highlands, Vietnam (Schouten et al., 2023).

ISLA operates at the landscape level by convening multi-stakeholder coalitions at multiple jurisdictional levels of government. These coalitions agree on and commit to sustainability targets for the jurisdiction in question through a Production-Protection-Inclusion Compact.

> *"Pilot projects are co-developed with the public and private sector to test innovative business models that can contribute to the compact's goals. Landscapes with a compact are linked with potential commodity buyers and (green) investors through the online platform SourceUp, but also through other linking activities (technical assistance, preparing investment plans, searching for investors, etc.). This should help in scaling-up sustainable business models and incentivize the landscapes to become self-sustaining." (Schouten et al., 2023)*

Both these examples of first steps towards scale concern, above all, processes: processes that the originators hope and believe can be applied to specifics of particular settings.

A third reflection concerns **private enterprise.** Considerable and diverse efforts are being made by some large commercial enterprises to meet society's expectations for decent and sustainable business. The number and diversity of these initiatives suggest that at least some of them will succeed. Business does not invest much in reviewing, evaluating and publishing their experiences:

some enterprises, but not all, treat their experience as a commercial secret. There is scope to keep track of promising private initiatives and to review them, to learn lessons. [This point applies equally in the fourth set of lessons, on learning.]

5.2.2 Programme content

Lessons about process are so important that they appear before lessons about the actual content of the programmes. On content, two considerations stand out from this review: some (simple) economic aspects; and changing behaviour.

Economics

Simple **economics** often greatly affect the success of interventions. Time and again, evidence confirms that forest users will only conserve forests and the environment if it is financially worth it to them. Whether users see the forests as worth conserving depends in large part on the difference in returns per hectare of crops and livestock on cleared forest versus returns to conserved forest, net of any payment made to land users to conserve forest and environment. [Economic motivations are strong drivers of behaviour, but not the only ones: forest users can and often do recognise ecological and cultural values of the forest.]

In financial terms, clearing tropical forest to plant crops — above all oil palm — or to graze livestock almost always trumps the returns to activities that conserve the forests such as hunting and gathering (rubber, Brazil nuts, etc.). The difference between returns to use of forests versus use of cleared forest has to be bridged by some form of payment, such as PES, if the forest is to be conserved. If PES payments per hectare are not large enough to rival or surpass those of the use of cleared forest, land users will not necessarily conserve the resource. To be specific, payments of under US$350 per hectare per year will usually be less attractive than the earnings from clearing the forest for crops and grazing (Wiggins et al., 2022).

In cleared or secondary forest, the issue may be less about preventing forest clearance, but rather about conserving biodiversity and providing ecosystem services that mimic those of the former forest through production systems such as agroforestry. Once again, the same calculus applies of comparing returns from conventional crop and livestock systems (that all too often exhibit low biodiversity, produce few other ecosystem services, degrade soils, overuse water and pollute air, soil and water) to returns from systems that are environmentally sustainable, net of payments made to farmers for environmentally sustainable farming. Any such payments are likely to come either from price premia that apply to certified produce, or from payments for capture of carbon. Payments seen so far have often been small: too small to encourage farmers to farm sustainably.

That said, returns to land uses are not fixed: technical advances can improve returns. This applies especially for agroforestry, where a combination of formal research and recuperation of Indigenous knowledge has led to the creation of production systems that not only generate the non-monetary values sought but also raise financial returns.

Implications for practice

Naïve evaluation can deceive. When some payment is made for ecosystem services but land users do not change their behaviour, one cannot conclude that payments are ineffective; leastways, not without considering whether the payment was large enough to compensate land users for forgoing the option of clearing forest.

It is not hard to calculate what a sufficient payment may be. Agricultural economists have been computing gross margins per hectare of crops (and similar measures for livestock) since the 1940s if not earlier. Similarly, appraisal of the non-monetary value of forests and their ecosystem services needs to be assessed — and taken seriously. We have 40 years or more of environmental and ecological economics which provide guides on how to estimate of the values of forest, biodiversity and, above all, the costs of greenhouse gases and the value of carbon (Box 13).

Box 13: How much is a tonne of carbon worth?

Different approaches yield very different values.

Some countries have applied carbon taxes, ranging from as little as US$2 per tCO2e (tonne of carbon dioxide equivalent) in Japan, to as much as US$167 per tCO2e in Uruguay. Other countries and regional blocs have applied cap-and-trade schemes. The EU Emissions Trading System (ETS) has seen the value of carbon traded rise with time, registering a price of just under €70 in November 2024 (https://carboncredits.com/carbon-prices-today/).

Another price for carbon comes from the political aspirations of the Paris COP15, where prices of US$45 to US$100 a tCO2e were recommended.

The social cost of carbon can be estimated to set a price. The US government uses a social cost of US$120 per tCO2e: Germany's Environment Agency has recommended a social price of US$215 per tCO2e.

A 2024 paper estimates the economic cost of CO_2 equivalent by looking at the damage to economies resulting from extreme weather over more than hundred years. The authors compute the harm to economies at a level of more than US$1,000 per tCO2e (Bilal and Känzig, 2024).

Main source: World Bank, 2023

Research into agricultural systems that are sustainable can, as with agricultural research in general, pay off handsomely. Research is routinely underfunded compared to the returns it can generate. When it comes to researching more sustainable farming systems, technical advances are likely to have to be tailored to local circumstances — at the level of the agroecological zone, the village, and often even to the farm itself. Participatory research that brings together formal researchers and extensionists with local farmers, such as through farmer field schools, will probably make most progress.

Behaviour change

Conserving the forest and environment is about changing the behaviour of land users directly, and the behaviour of consumers and the global public less directly.

Regarding land users, although it is convenient to consider the effects of drivers of behaviour change individually, it may well be that combinations of incentives act (far) more strongly to change (longstanding) behaviour than any single incentive. For example, rules and regulations may limit land use; financial payments can be made for sustainable practice; training and extension to endow land users with useful skills may be provided; and some empowerment that instils a sense of responsibility for the environment may be encouraged. Each of these alone might not be sufficient, but when several act simultaneously on land users they may indeed be sufficient.

Similar considerations may apply to consumers and their willingness to pay more for goods and services produced sustainably, and to pay taxes that can finance PES or payments for carbon capture. Awareness and education, governments setting rules (e.g., taxes on imports of produce from cleared forest), labelling on supermarket shelves that records certification — each alone may not be sufficient, but these may work in combination to change attitudes and behaviour.

Implications for practice

Learning about combined interventions is not straightforward. In social science, assessing combinations runs against the grain of conventional experiments (including randomised control trials) that typically assess the effects of a single factor; and lends itself better to other approaches, which could include those rooted in the complexities of context.

To have enough power to judge what combinations work, and perhaps the contributions of different elements, we need many more evaluations of observed models and practices that consider complex relational dynamics.

The evaluation gap in development practice is wide. There is no point in calling for policy to be based on evidence if investment in evidence runs at a fraction of the level it might and should.

5.2.3 Fairness and equity

The studies reviewed show that processes and outcomes can work against people on low incomes and people with little political power. Three points stand out.

One, the design of some programmes tends to (inadvertently) exclude those people on low incomes with few assets. They are often also disadvantaged in education and knowledge, and they are the most likely not to see how they might benefit from programmes — and indeed to misinterpret some interventions. They are the least likely to have the means to respond to

incentives, lacking land, labour and capital, and they are the least able to defer immediate returns in favour of future rewards.

Two, and perhaps more important, social differences among actors in forest zones are often wide and deep. Rights and entitlements — primarily to land, but sometimes also to public services — may be weakly defined in formal law, giving those with political connections, able to hire amoral lawyers, the chance to take over land that has customarily been used by others less powerful. The fears of the less powerful as to what may lie behind schemes such as PES and certification are not imaginary: some of them know from experience how well-meaning interventions may play out in practice — to their disadvantage.

Three, when diverse goals are pursued — including environmental conservation, livelihoods improvement and social equity — collective enterprises can be a way to meet the different objectives, in ways that private firms often find hard to emulate.

Implications for practice

When people have few assets, programmes should include components to support them — with capital grants and technical assistance. An alternative is social protection for those unable to participate, but that is second best to an attempt to endow the assetless with the assets by which they can participate.

The marginalisation and powerlessness of some forest actors may be more difficult to remedy, but it is possible to work to strengthen the rights to land of people with customary tenure — for example, by pressing for legal recognition of such rights, and helping people register their longstanding claims.[31] Similarly, work with grassroots groups can help to raise the voices of the marginalised and give them a say in decisions that affect them, decisions in which they are entitled to have a say.

Collective enterprise deserves equal consideration to that given to private enterprise — when setting economic policy, creating economic institutions and otherwise encouraging enterprise, collectives need to be considered, not just private firms.

Social differences and their implications are typically elements of systems that reveal themselves only after programmes begin, reinforcing the message about managing programmes through adaptive learning.

5.2.4 Learning from experience

The review shows that public and private initiatives are underway that potentially conserve tropical forests and enhance the livelihoods of those living in and around the forests. The number of publications describing plans and pilots suggests that such initiatives may be gathering pace —

[31] Registering rights is not without danger: handled badly, the rights of elites and of men are written down, while those of women and socially excluded groups are not, thus worsening inequality of rights.

to be expected given increasing awareness of the value of forests and their ecosystem services in a world facing biodiversity and climate emergencies.[32]

Implications for practice

The more initiatives that are underway, and the more diverse those initiatives are, the greater the promise that some will succeed and that valuable lessons can be harvested in the near future. Public agencies should search out and learn these lessons, investing in reviewing and assessing these initiatives. Action-focused programmes need to be accompanied by commensurate efforts to gather, manage and disseminate knowledge.

Advances in physical science and technology (remote sensing, use of drones, etc.) are making it easier to assess changes to forest cover at the local scale. Increasingly, it should be possible to monitor forest clearance within weeks or months of it taking place. Complementary advances in gathering economic and social data are necessary to enhance our understanding of how natural systems are changing in tandem with changes in human systems. There may be scope for crowdsourcing information from forest actors in sentinel sites to register events and trends in near real time. Pilot experiences in the drylands of Ethiopia and Kenya provide models of how this may be done (Chelanga et al., 2022).

[32] Because we could only review initiatives documented to set standards, other initiatives that have not been documented in this way were not considered. That there may be other, valuable initiatives underway only strengthens the point we make.

Annex 1. List of countries included in the study

The following countries have significant coverage of tropical forests and were included in this study.

Country or area	UN M49 code[33]	ISO-alpha3 code[34]	Other groupings
Madagascar	450	MDG	LDC
Mozambique	508	MOZ	LDC
South Sudan	728	SSD	LDC LLDC
Angola	24	AGO	LDC
Cameroon	120	CMR	
Central African Republic	140	CAF	LDC LLDC
Chad	148	TCD	LDC LLDC
Congo	178	COG	
Democratic Republic of the Congo	180	COD	LDC
Gabon	266	GAB	
Benin	204	BEN	LDC
Côte d'Ivoire	384	CIV	
Gambia	270	GMB	LDC
Ghana	288	GHA	
Guinea	324	GIN	LDC

[33] The UN M49, or the Standard Country or Area Code for Statistical Use (Series M, No. 49), is a standard for area codes used by the United Nations for statistical purposes, developed and maintained by the United Nations Statistics Division.

[34] ISO 3166-1 alpha-3 codes are three-letter country codes defined in ISO 3166-1, part of the ISO 3166 standard published by the International Organization for Standardization (ISO), to represent countries, dependent territories, and special areas of geographical interest.

Guinea-Bissau	624	GNB	LDC SIDS
Liberia	430	LBR	LDC
Nigeria	566	NGA	
Sierra Leone	694	SLE	LDC
Togo	768	TGO	LDC
Cuba	192	CUB	SIDS
Belize	84	BLZ	SIDS
Costa Rica	188	CRI	
El Salvador	222	SLV	
Guatemala	320	GTM	
Honduras	340	HND	
Mexico	484	MEX	
Nicaragua	558	NIC	
Panama	591	PAN	
Bolivia (Plurinational State of)	68	BOL	LLDC
Brazil	76	BRA	
Colombia	170	COL	
Ecuador	218	ECU	
Guyana	328	GUY	SIDS
Paraguay	600	PRY	LLDC

Peru	604	PER	
Suriname	740	SUR	SIDS
Venezuela (Bolivarian Republic of)	862	VEN	
Cambodia	116	KHM	LDC
Indonesia	360	IDN	
Lao People’s Democratic Republic	418	LAO	LDC LLDC
Malaysia	458	MYS	
Myanmar	104	MMR	LDC
Philippines	608	PHL	
Thailand	764	THA	
Vietnam	704	VNM	
Bangladesh	50	BGD	LDC
India	356	IND	
Sri Lanka	144	LKA	
Papua New Guinea	598	PNG	SIDS

Annex 2. Search terms and summary of steps taken to search each database

We created a bespoke set of search terms for each database, based on character limits and search functions. Our search and screening strategy for each database is set out below. Search terms were created in collaboration with FCDO and are detailed in the research protocol.

Scopus

Scopus has a high character limit and advanced search functions. This allowed the team to input long search strings, including synonyms, such as "green finance" and "climate funds" and "microfinance". This meant that studies with different wordings in their titles and abstracts would be captured using the same search string. The search string also included the names of all the countries with significant tropical forest coverage listed in Annex 1. The search term also included words relating to study methodologies (e.g., random control trial, quasi-experiment).

The team used iterative loops to home in on the most useful combination of search terms. Key search terms included "sustainable agriculture", "agroforestry" and "smallholder farmers". The team experimented with adding additional search terms in different combinations to see if the results became more relevant.

The team identified 319 studies on Scopus. Seven studies were removed as duplicates and a further 263 studies were excluded in the title and abstract screening, leaving 49 studies for quality appraisal. 20 studies were excluded in the quality appraisal stage, meaning that 29 studies from Scopus were included for data extraction.

Web of Science

Similar to Scopus, Web of Science has a high character limit and advanced search functions. The search string was inputted in layers, beginning with a selection of interventions (e.g., "PES", "carbon markets" and "certification"), and then the searcher added search term layers for sustainable agriculture, forest clearance, smallholder farmers, study design and countries included in the study.

The team identified 83 studies on Web of Science. 43 studies were duplicates from other databases, suggesting that the Web of Science database overlaps significantly. Of the 40 remaining studies, 36 were excluded at the title and abstract screening stage, leaving four studies for quality appraisal. Of those, three were excluded at the quality appraisal stage, meaning that one study was included for data extraction.

EBSCO

The search process on EBSCO followed a similar pattern to those on Scopus and Web of Science. The only challenge was that the filter for dates of publication had to be entered manually.

The team identified 13 studies on EBSCO. The small number of studies in comparison to other databases is due to more limited coverage, different search algorithms, different features, and covering slightly different content. One study was removed as a duplicate, and eight studies were excluded at the title and abstract screening stage, leaving four studies for quality appraisal. Two studies were excluded and two included for data extraction.

Google Scholar

Due to the constraints of Google Scholar in terms of character count and advanced search functions, the team took a slightly different approach for this database. We used a condensed search string to comply with the 256 character limit. The search string used was:

"smallholder farmer" AND ("forest degradation" OR deforestation) AND ("livelihood" OR "co-benefits") AND (microfinance OR programme OR training OR policy OR certification OR regulation) AND ("cattle OR maize OR soy OR palm OR cocoa OR coffee OR rubber)

After numerous pilot searches, we found that this combination of search terms produced the most relevant set of results. This search string included key words relating to smallholder farmers, forest clearance, farmer livelihoods, interventions that prevent forest clearance, and various forest-related commodities.

Filtered by the years 2010-2024, the team got 2030 hits on Google Scholar. This is a high volume of studies and, on Google Scholar, the further you get into the results, the less relevant they typically become. We therefore employed a limited search strategy and looked at the first 10% of results, i.e., 203 results.

From the 203 studies from Google Scholar, five were removed as duplicates. In the title and abstract screening 164 studies were excluded, leaving 34 studies for quality appraisal. Of those, 14 were excluded in the quality appraisal stage, leaving 20 studies which were included for data extraction.

	Identified in search	Included for quality appraisal	Included for data extraction	% included
Scopus	319	49	29	9%
Web of Science	83	4	1	1%
EBSCO	13	4	2	15%
Google Scholar	203	34	20	10%

Annex 3. List of backward citations

Excluding duplicates, a total of 81 backward citations were identified during data extraction. Given the limited time for this REA, we used purposeful sampling to further reduce the selected backward citations. We developed a grading system based on our inclusion criteria to prioritise widely cited studies, or studies that included innovative interventions not yet captured through data extraction. Some 29 studies received an 'A' rating and were brought through to quality appraisal. 24 studies, highlighted below, passed the quality appraisal process and were included in the data extraction.

Andersson, K. P. et al. (2018). 'Experimental Evidence on Payments for Forest Commons Conservation', *Nature Sustainability*, 1 (3), pp.128-135. https://ideas.repec.org//a/nat/natsus/v1y2018i3d10.1038_s41893-018-0034-z.html

Arriagada, R. A. et al. (2012). 'Do Payments for Environmental Services Affect Forest Cover? A Farm-Level Evaluation from Costa Rica', *Land Economics*, 88 (2), pp.382-399. https://www.jstor.org/stable/23272587

Börner, J. et al. (2017). 'The Effectiveness of Payments for Environmental Services', *World Development*, 96 (C), pp.359-374. https://ideas.repec.org//a/eee/wdevel/v96y2017icp359-374.html

Corbera, E. et al. (2020). 'Troubled Encounters: Payments for Ecosystem Services in Chiapas, Mexico', *Development and Change*, 51 (1), pp.167-195. https://doi.org/10.1111/dech.12540

Correa, J., van der Hoff, R. and Rajão, R. (2019). 'Amazon Fund 10 Years Later: Lessons from the World's Largest REDD+ Program', *Forests*, 10 (3), p. 272. https://doi.org/10.3390/f10030272

Costedoat, S. et al. (2015). 'How Effective Are Biodiversity Conservation Payments in Mexico?', *PloS One*, 10 (3), e0119881. https://doi.org/10.1371/journal.pone.0119881

Duchelle, A. et al. (2017). 'Balancing Carrots and Sticks in REDD+: Implications for Social Safeguards', *Ecology and Society*, 22 (1 September). https://doi.org/10.5751/ES-09334-220302

Garrett, R. D. et al. (2018). 'Intensification in Agriculture-Forest Frontiers: Land Use Responses to Development and Conservation Policies in Brazil', *Global Environmental Change*, 53 (1 November), pp.233-243. https://doi.org/10.1016/j.gloenvcha.2018.09.011

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Holmes, I., Kirby, K. R. and Potvin, C. (2017). 'Agroforestry within REDD+: Experiences of an Indigenous Emberá Community in Panama', *Agroforestry Systems*, 91 (6), pp.1181-1197. https://doi.org/10.1007/s10457-016-0003-3

Jayachandran, S. et al. (2017). 'Cash for Carbon: A Randomized Trial of Payments for Ecosystem Services to Reduce Deforestation', *Science*, 357 (6348), pp.267-273. https://doi.org/10.1126/science.aan0568

Jones, K. W. et al. (2017). 'Forest Conservation Incentives and Deforestation in the Ecuadorian Amazon', *Environmental Conservation*, 44 (1), pp.56-65. https://doi.org/10.1017/S0376892916000308

Kaczan, D. et al. (2017). 'Increasing the Impact of Collective Incentives in Payments for Ecosystem Services', *Journal of Environmental Economics and Management*, Special issue on environmental economics in developing countries, 86 (1 November), pp.48-67. https://doi.org/10.1016/j.jeem.2017.06.007

Kassie, G. W. (2017). 'Agroforestry and Farm Income Diversification: Synergy or Trade-off? The Case of Ethiopia', *Environmental Systems Research*, 6 (1), p.8. https://doi.org/10.1186/s40068-017-0085-6

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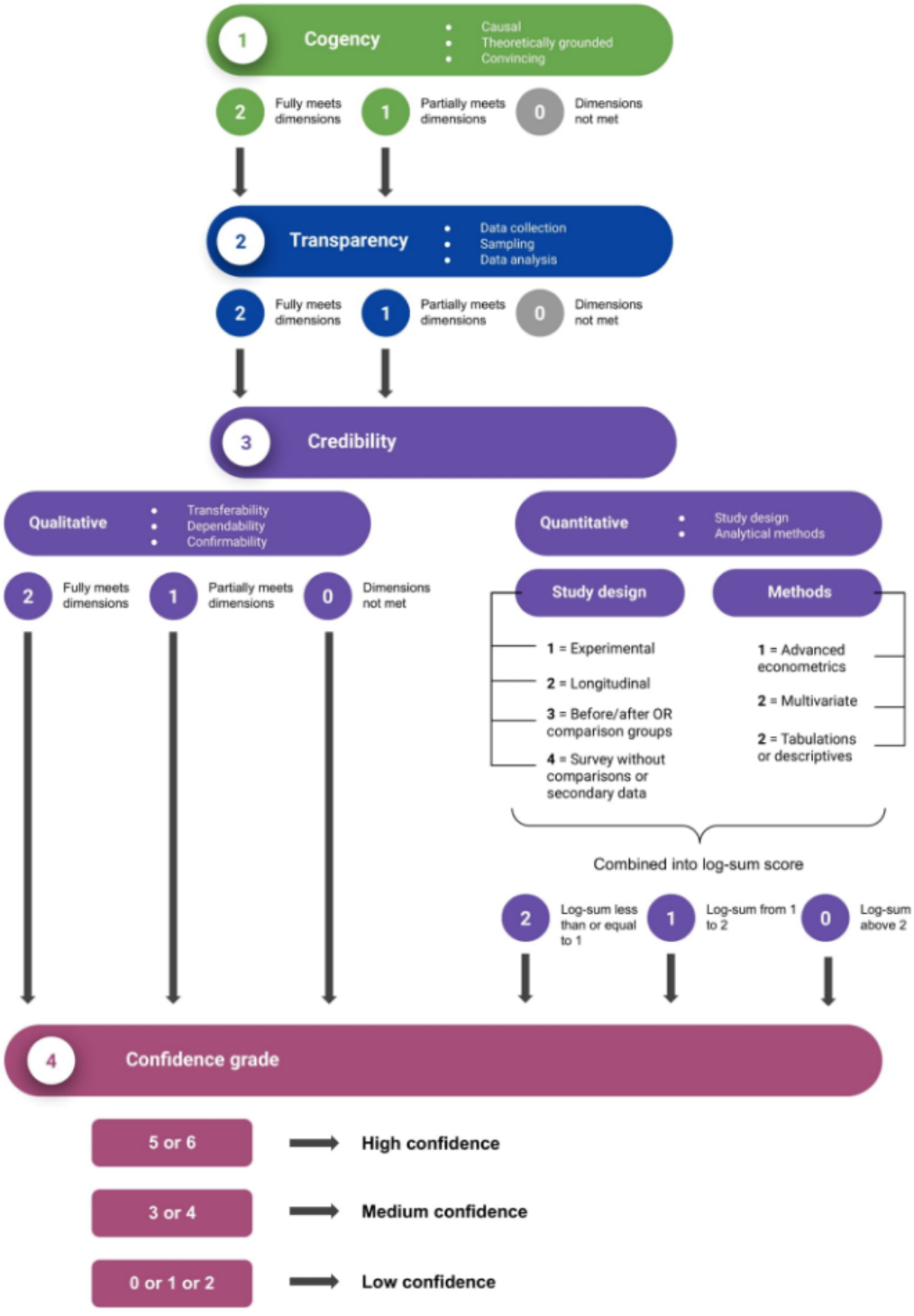
Annex 4. Quality appraisal tool



Annex 5. Data extraction form

FCDO smallholder farmers REA - data extraction form (final)

lekha@agulhas.co.uk Switch accounts

Not shared

* Indicates required question

Reviewer's initials: *

Your answer

Study number: *

Your answer

Source: *

- ◯ Peer-reviewed publication
- ◯ Working paper
- ◯ Technical report
- ◯ Policy brief
- ◯ Conference paper
- ◯ Other:

Location(s) of the study:

Your answer

Region(s) of study:

- [ ] Southern Africa
- [ ] East Africa
- [ ] West Africa
- [ ] Caribbean
- [ ] Central America
- [ ] South America
- [ ] South Asia
- [ ] Southeast Asia
- [ ] Pacific Islands

Description of the **economic** conditions:

Your answer

Description of the **political** conditions:

Your answer

Description of the **social** conditions:

Your answer

Description of the **environmental** conditions:

Your answer

Crops/commodities in the study:

- [ ] Beef/cattle
- [ ] Soy
- [ ] Palm
- [ ] Cocoa
- [ ] Rubber
- [ ] Coffee
- [ ] Maize
- [ ] Other:

Participants:

- [ ] Smallholder farmer
- [ ] Other farmer
- [ ] Forest dweller
- [ ] Other:

Name of intervention:

Your answer

Scale of intervention:

- [ ] Household
- [ ] Community
- [ ] District
- [ ] Region
- [ ] Country
- [ ] International

Funding partner(s):

- [ ] Government
- [ ] Development finance institution
- [ ] Climate fund
- [ ] International NGO
- [ ] Local NGO
- [ ] Multilateral organisation
- [ ] Not specified
- [ ] Other:

Implementing partner(s):

- [ ] Government
- [ ] International NGO
- [ ] Local NGO
- [ ] Multilateral organisation
- [ ] Business/company/corporation
- [ ] Community group
- [ ] Not specified
- [ ] Other: _____

Social groups targeted:

- [ ] Indigenous groups
- [ ] Women
- [ ] Youth
- [ ] Other: _____

Policy type of intervention:

- [ ] Regulation
- [ ] Economic incentives
- [ ] Creation of a market or quasi-market
- [ ] Technology and now-how
- [ ] Access to capital
- [ ] Rights to land

Description of intervention:

- [ ] Protected areas / land zoning
- [ ] Moratoria on land conversion
- [ ] Tenure laws that stipulate land use
- [ ] Pay farmers to conserve specified land uses
- [ ] Payments for Ecosystem Services (PES)
- [ ] Voluntary schemes that reflect social and consumer preference: industry roundtables
- [ ] Voluntary schemes that reflect social and consumer preference: certification
- [ ] Debt for nature swaps
- [ ] Land swaps
- [ ] Biodiversity offsets
- [ ] Carbon trading
- [ ] Public investment in agricultural research

- [ ] Agricultural extension (including farmer field schools)
- [ ] Farmer training
- [ ] Encourage Village Savings & Loans Associations (VSLA) / Savings & Credit Cooperatives (SACCO) and Credit Unions (CU)
- [ ] Lower transaction costs to allow formal financial providers to extend services to forest areas
- [ ] Public underwriting of lending to smallholders
- [ ] Access international climate funds and channel to smallholders
- [ ] Conferring rights to use forest to active farmers
- [ ] Indigenous and Community Conserved Areas (ICCA)
- [ ] Other: _____

Narrative description of the intervention:

Your answer

Enabler(s):

Your answer

Barrier(s):

Your answer

Activities completed:

- [ ] Stakeholder engagement
- [ ] Incentives and standards introduced
- [ ] Investments in infrastructure and/or technology
- [ ] Skills and awareness training
- [ ] Voluntary reputation schemes implemented
- [ ] Non-traditional finance disbursed
- [ ] Green finance disbursed
- [ ] Payment for environmental services programme implemented
- [ ] Private or voluntary carbon markets introduced

Describe the specific activities completed:

Your answer

Outcomes achieved:

- [ ] Forests protected
- [ ] Sustainable agriculture practices put in place
- [ ] Increased property rights/tenure
- [ ] Quality and variability of income improved (farmer welfare)
- [ ] Food security and nutrition improved (farmer welfare)
- [ ] Reduced vulnerability to climate change (farmer welfare)

Describe the specific outcomes in **forest clearance**:

Your answer

Describe the specific outcomes in **sustainable agriculture**:

Your answer

Describe the specific outcomes in **smallholder farmer welfare**:

Your answer

Farmer perception of the intervention(s):

Your answer

Obstacles to forest preservation:

Your answer

Obstacles to practising sustainable agriculture:

Your answer

Unintended harms of intervention(s):

Your answer

Review/evaluation results of the intervention(s):

Your answer

Other findings:

Your answer

Method(s) used in study:

- ◯ Qualitative
- ◯ Quantitative
- ◯ Mixed methods

Research design:

- ◯ Experimental (e.g. RTC)
- ◯ Quasi experiment
- ◯ Longitudinal (e.g. panel or with/without)
- ◯ Natural experiment involving comparison groups
- ◯ Basic survey without comparison group of secondary data

Analytical approach:

- ◯ Advanced econometric techniques (e.g. IV/PSM/DiD/2SLS)
- ◯ Multivariate analysis
- ◯ Descriptive/tabulations
- ◯ Narrative/thematic

Type of data:

- ◯ Primary
- ◯ Secondary
- ◯ Both primary and secondary

Sample size (number of years observed):

Your answer

Sample size (number of households/farmer observed) (specify unit)

Your answer

Submit

Clear form

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