Evolving New Market Opportunities with Regenerative Agriculture Systems

Market opportunities for secondary crops, data products, and environmental markets

The Rockefeller Foundation

Smallholder Data Services

Terra Genesis

Grant Number: 2022 FOD 018
Grantee: Smallholder Data Services
AUGUST 2023

Foreword

Smallholder Data Services (SDS), supported by a grant from The Rockefeller Foundation, is working to ensure that smallholders who are directly involved in defining, implementing, verifying and scaling regenerative agriculture have a stakeholder voice as each of these aspects are being shaped at a global level.

In support of this goal, SDS and one of its founding partners, Terra Genesis, are generating a series of reports, recommendations, best practices and guidelines that draw from early-stage regenerative farming by smallholders in various parts of the world.

This report explores the following market opportunities for smallholder farmers: secondary crops, data products, and environmental markets.

In the course of undertaking this Rockefeller Foundation-supported initiative, SDS has also been drawing on an additional partner, the Smallholder Farmers Alliance in Haiti.

SENIOR EDITORS

Tim Tensen
Chief of Operations,
Terra Genesis

Hugh Locke
President and Co-founder,
Smallholder Data Services
President and Co-founder,
Smallholder Farmers Alliance

LEAD AUTHOR

Dennis Posthumus
Design Associate,
Terra Genesis

EDITOR

Mari Stuart
Senior Associate,
Terra Genesis

Smallholder Data Services

Smallholder Data Services (SDS) is a consulting and research firm exploring how big data and technology innovations are enabling a revolution in both sustainable supply chains and regenerative agriculture. We reimagine data as a new sustainability product that financially rewards farmers and others involved in sustainable production, including small-holders in the global south. We focus on how the combination of data products and emerging technology unlock solutions for those concerned with the environmental and social impact of the products and services they market and purchase.

More at
smallholderdataservices.com

Terra Genesis

Terra Genesis is an international regenerative design firm that convenes brands, farmers, developers, communities, investors, and NGOs to work at the intersection of agriculture, ecology and economy. Our work is to evolve the role of agriculture and business as drivers of social and ecological health. We work from the ground up to evolve stakeholder capacity and capability and to identify solutions, create processes and curate interventions for systemic regeneration.

More at
terra-genesis.com

smallholder farmers alliance

The Smallholder Farmers Alliance (SFA) is social business non-profit working to feed and reforest a renewed Haiti using a new agroforestry model in which smallholders plant trees to earn credits they exchange for seed, tools, training and other agricultural and community services. The SFA's 6,000 farmer members use organic methodologies, and are now in the process of transitioning to become regenerative.

More at
http://www.haitifarmers.org/

GLOSSARY

COP15
Refers to the 15th meeting of the Conference of the Parties to the Convention on Biological Diversity (CBD). The Convention on Biological Diversity is an international treaty aimed at conserving biological diversity, promoting sustainable use of its components, and ensuring fair and equitable sharing of benefits arising from genetic resources.

DAO
A decentralized autonomous organization (DAO) is an emerging form of legal structure that has no central governing body and whose members share a common goal to act in the best interest of the entity. Popularized through cryptocurrency enthusiasts and blockchain technology, DAOs are used to make decisions in a bottom-up management approach.

ESG
Stands for Environmental, Social, and Governance, and it refers to a framework that is used to evaluate and measure the sustainability and ethical impact of an investment in a company or business. ESG criteria are used by investors, analysts, and organizations to assess how well a company aligns with environmental, social, and governance considerations.

GDPR
The General Data Protection Regulation is a comprehensive data protection and privacy regulation that was implemented by the European Union (EU) in May 2018. GDPR replaced the previous EU Data Protection Directive and introduced significant changes and enhancements to data protection and privacy rules within the EU and the European Economic Area (EEA).

GHG
Greenhouse gasses (GHGs) are gasses in the Earth's atmosphere that have the ability to trap heat, leading to the greenhouse effect. This effect is essential for maintaining a habitable temperature on Earth because it keeps the planet warm enough to support life.

However, an excess of these gasses in the atmosphere, primarily due to human activities, can intensify the greenhouse effect and contribute to global warming and climate change. The main gasses in question are carbon dioxide, methane, nitrous oxide, water vapor, ozone, and fluorinated gasses.

GIS
Geographic Information System. GIS is a technology that allows users to capture, analyze, interpret, visualize, and present data related to specific geographic locations on the Earth's surface. GIS combines hardware, software, data, and expertise to provide a wide range of capabilities for understanding and working with geographic information.

IoT
The Internet of Things refers to the network of physical objects or "things" that are embedded with sensors, software, and other technologies to connect and exchange data with other devices and systems over the internet. These "things" can be everyday objects such as household appliances, vehicles, industrial machines, wearable devices, and even entire smart cities infrastructure. In the context of agriculture these can be sensors, farming machines, drones, and other "things" that are used to support the farming process and are connected to a shared network.

GLOSSARY

MRV
Monitoring, Reporting, and Verification. MRV stands for Monitoring, Reporting, and Verification. It is a framework used in various contexts to track and assess progress, compliance, or performance in relation to specific goals, targets, or requirements. MRV is commonly used in the fields of environmental management, climate change mitigation, and international agreements.

PES
Payments for Ecosystem Services is a conservation and environmental policy approach that involves compensating individuals or communities for the positive externalities or services their ecosystems provide to society. These services can include clean water provision, carbon sequestration, biodiversity conservation, and more. PES programs are designed to incentivize landowners and communities to adopt practices or protect natural resources that benefit the environment and society as a whole.

PGS
A Participatory Guarantee System (PGS) is a quality assurance and certification system often used in organic and ecological agriculture. Unlike conventional third-party certification systems, PGS relies on the active participation of farmers, producers, and consumers in the certification process. PGS is often used for small-scale, local, and community-based organic farming initiatives.

REDD+
Reducing Emissions from Deforestation and forest degradation in Developing countries, and the role of conservation, sustainable management of forests, and enhancement of forest carbon stocks in developing countries. REDD+ is a voluntary climate change mitigation framework developed by the United Nations Framework Convention on Climate Change (UNFCCC). REDD+ is essentially a vehicle to encourage developing countries to reduce emissions and enhance removals of greenhouse gasses through a variety of forest management options, and to provide technical and financial support for these efforts

ReFi
Regenerative Finance in a broad sense is part of a movement toward more responsible and sustainable finance practices. In recent times regenerative finance and particularly ReFi, points toward blockchain and crypto based financial instruments aimed toward addressing pressing global (environmental) challenges, including climate change, biodiversity loss, and social inequality. It encourages a shift in the financial sector's priorities from short-term profit maximization to long-term resilience, regeneration, and positive impact on people and the planet.

ROV
Regenerative Outcome Verification is a proprietary ecosystems monitoring and outcome verification methodology developed by Terra Genesis. The methodology is tailored specifically to a given landscape context it and is aimed at monitoring the appropriate ecosystem indicators with the goal of tracking and verfiying regenerative outcomes.

VBC
Voluntary Biodiversity Credits, also known as biodiversity offsets or conservation credits, are a market-based approach to biodiversity conservation. They are designed to compensate for the negative environmental impacts of development projects by generating and selling credits that represent conservation or restoration efforts elsewhere. These credits can be purchased by developers, businesses, or government agencies to offset the ecological harm caused by their activities.

Executive Summary

This report explores the following market opportunities for smallholder farmers:

- Secondary Crops
- Data Products
- Environmental Markets

Secondary Crops

The preceding reports in the Rockefeller Foundation-supported project "Regenerative Agriculture Data Pilot" have underscored that diversification of agricultural production systems is one of the main premises of regenerative agriculture. This diversification creates more complexity in agricultural production systems — a complexity that poses new challenges and creates new opportunities. Challenges revolve around gaps in knowledge, experience, and management. Opportunities revolve around ecosystem resilience, as well as income diversification and increased economic and financial resilience.

Managing complexity has to be a multi-stakeholder endeavor, and not fall solely on a single farmer. This is why we have stressed the social and organizational dimensions of scaling regenerative agriculture: to be successful, it needs to be a collaborative process, with all actors of the supply system playing a role to enable a successful transition.

'Secondary crops' here refers to any crop other than a primary commodity crop in a farm system. In other words, it can refer to agricultural crops that usually aren't included on lists of the world's top agricultural commodities; or it can refer to crops that do count as major commodities (e.g. cacao, coffee, cassava) but that are grown as a companion crop for other crops that the farmer in question considers equally or more significant.

While transitioning to secondary crops leads to more financial risk in the short term, and more complexity in farm management, in the long term it results in greater income diversification, and more productivity and profit, for farmers. The ecological and economic resilience that secondary crops afford is a condition for successful scaling.

Data Products

As the boundaries of digitization are pushed throughout all sectors of human activity, agriculture too has seen huge strides in the application of data collection and analysis to inform decision making. One application of this is "smart" or "precision agriculture," typically used in industrial agriculture, where real-time monitoring of land-based variables informs management decisions and a higher degree of effectiveness

handling agricultural inputs. The implications of high-resolution real-time monitoring of farm variables are potentially far-reaching as it leads to more insight and can create more transparency, both of which are factors that inform scaling. Some core themes are data collection, data stewardship, and data derived products.

The various products offered on the environmental market, such as ecosystem services credits, are also heavily dependent on data products. For instance, carbon credit formation is tied to a complex system of monitoring land-based data and verification methodologies. Building on that example, data also plays a pivotal role in the verification of whether regeneration is taking place in agricultural systems.

In all these instances, specific data products are being developed to support the overall evolution of agritech. These innovations hold much potential and opportunity for farmers and developers. For these innovations to work and live up to their potential in terms of scaling regenerative agriculture, they must be accessible to, and benefit, smallholder farmers as well.

A great opportunity to catalyze the development of regenerative agriculture from a multistakeholder point of view is to facilitate the development of open-source and democratized MRV systems, so that farmers have autonomy and agency in the process while attracting partnerships and gaining access to platforms that incentivize regenerative land stewardship.

Environmental Markets

Recent decades have seen the development of various financial products and instruments that relate to quantifying ecosystem change and trading them through voluntary and compliance based marketplaces. Some examples of these instruments are carbon credits, more recently biodiversity credits, as well as payments for ecosystem services programs.

In addition, recent years have seen the rapid emergence of crypto and blockchain technology, which gave birth to the highly innovative ReFi (Regenerative Finance) space as well as the proliferation of DAOs (Decentralized Autonomous Organizations). These blockchain based instruments can be complementary to existing instruments and governance structures in the environmental marketplace, adding a layer of trust and operability.

The potential for financial gain can be an incentive for farmers to engage in regenerative agriculture or employ practices conducive to regeneration. The main advantage, as in the case of data products, is the supplementation of farm income through the sale of ecosystem service credits or receiving payments under PES programs. There are disadvantages, however: participation can be cumbersome, compensation is often low for smallholders, and some verification methods have recently come under severe scrutiny and consequently have suffered a credibility loss.

Particularly the role of carbon credits has come under heavy scrutiny. A recent report by Boston Consulting Group and OP2B mentions, based on a survey done with farmers in the USA, that payments from some kind of environmental market credit or program was the least significant incentive to engage in regenerative agriculture. The top incentives were reduction of costs from agrichemicals, improving soil health, and protecting the environment. (BCG & OP2B, 2023) On a similar note companies have reported that they are increasingly steering away from carbon credits as well.

Introduction

Regenerative agriculture is an intervention that draws on both traditional and innovative knowledge to address questions of food and fiber production within the context of the stewardship of landscapes at large. The project this report is a part of, The Regenerative Agriculture Data Pilot, has analyzed the role of secondary crops in scaling regenerative agriculture specifically among smallholder farmers, and the enabling environments that would best support such scaling. While assessing four broad geographical regions, our analysis has been informed by insights gained from two regenerative agriculture projects in particular: the Haiti Regenerative Cotton project with Smallholder Farmers' Alliance, and the Thai Regenerative Rubber project in Thailand.

This report focuses on the key mechanisms that make regenerative agriculture economically and financially viable and allow for it to scale, specifically for smallholder farmers. It discusses key opportunities to increase the vitality, viability, and evolutionary potential of regenerative agriculture as a mainstream mode of production, namely: secondary crops, data products, and environmental markets.

The challenge of scaling regenerative agriculture lies partly in developing the financial viability of farming systems as part of the process of ecological and economic diversification. Transitioning to regenerative agriculture requires significant investment, whether through building soil, building farmer capacity, establishing resilient farm infrastructure, or diversifying cropping systems through the integration of perennials.

In addition to the financial risks incurred from the transition, there may be a period of time before the regenerative systems begin producing secondary crops and yielding profits from produce diversification. Provisioning for these kinds of initial funding gaps is critical for the regenerative transition to be a realistic option. It is therefore necessary to explore what the scaling model and the regenerative farming business model could look like, and how financial imperatives for the development of regenerative agriculture can be met by diversifying farm enterprises and developing sources of revenue through the mechanisms explored in this report.

MARKET OPPORTUNITIES FOR SECONDARY CROPS

Biological diversity is one of the hallmarks of a healthy and resilient ecosystem. When left alone, natural ecosystems inherently evolve to include a large variety of species — of both flora and fauna — interconnected and ever-progressing toward a climax state of dynamic equilibrium. The advent of agriculture, however, has seen the gradual decrease of complexity in farming ecosystems, including the destruction of native ecosystems for the sake of increased (perceived) efficiency and effectiveness.

> **" ... today's agriculture generally aims to produce large quantities of food, against the lowest economic costs, in the short term. These short-term goals often lead to conflict with the conservation and management of biodiversity and other long-term ecosystem services"**
>
> (ERISMAN ET AL. 2016)

Although industrial agriculture has long been seen as a core enabling factor for the growth of global wealth and prosperity in modern times, it has done that at a huge externalized cost, a cost that has led to the wholesale degeneration of otherwise healthy ecosystems. The paradigm and mindset that underlie the development and proliferation of industrial agriculture is untenable, due to its proclivity to extract and deplete ecosystems to total exhaustion or worse. It is a food production system that is heavily dependent on agro-chemicals and other external inputs; it is polluting, extractive, and inequitable to those that work the hardest to enable the system, particularly the smallholder farmers that are directly involved in agricultural production. This mode of farming could be said to have been a logical developmental step in the larger scope of food production and human-landscape interaction, flowing out of 19th and 20th-century mechanical, chemical, and productive industrialization. It is becoming increasingly clear that a momentous shift is taking place, a paradigm shift away from fragmented systems that deteriorate and degenerate the environment, toward one that integrates life on all levels, to the benefit of the whole.

From an ecological point of view, the regeneration of these production ecosystems requires a reintroduction of species richness and biological complexity. With that complexity, many ecosystem services and functions can be re-established, such that farm landscapes begin to move towards

greater health and resilience again. Examples of such diversity-increasing strategies include re-introducing keystone endemic species to perform key ecosystem services such as providing habitat for other flora and fauna, as well as bringing in support species that fix nitrogen, support species that accumulate minerals from the soil and make them biologically available, and using species that attract beneficial insects and microorganisms to mitigate pests and disease. (Kaushal et al., 2021), (Augere-Granier, 2020) As an aside it is interesting to note that there are compounding effects between ecological and economic diversification as well, where plant species used for diversification of the system such as nitrogen fixers or biomass accumulators lead to higher yields (Coulibaly, et al., 2017) and higher nutritional value of the main crops.

Species diversification can also be used to introduce crops that are of economic interest. These crops fall roughly into three categories, based on the kinds of market opportunities they create for smallholder farmers: primary commodity crops, secondary crops for local or export markets, and crops for food security and subsistence.

Commodity Crops

Although in many cases the smallholder farmers in question are already farming some kind of a commercial crop, for those that are not, considering the introduction of a commercial crop can lead to a first step in increasing the financial viability of a farm.

Commodity crops that are in high demand and have a global export market, such as coffee and cacao, have the potential to make a positive contribution to the livelihoods of smallholder farmers in several ways — particularly if they are of verifiable regenerative agricultural provenance. First and foremost, these crops provide a reliable source of income due to their demand in global markets. By growing and selling these crops, farmers can secure stable revenue streams, which can mitigate the economic risks they face. Moreover, these crops often have a high value per unit of land, allowing farmers to maximize their yield and income from limited resources. (Duffy et al., 2021)

The introduction of a high-value commodity crop can significantly support the financial transition necessary in the development of a regenerative farming system. There are impediments to successfully developing commodity crop

income, including difficulty accessing the right marketplaces. (Waarts et al., 2021) The development of a regenerative agricultural system that centers on commodity crops should always be taken as a multi-faceted approach to development of production systems. Of key importance are developing the right commercial partnerships and offtaker relationships, which goes hand in hand with organizing farmers and developing shared essential capacities and capabilities to manage regenerative agricultural systems at scale, as well as the necessary infrastructure to accommodate market access.

Secondary Crops for Markets

The introduction of secondary crops for commercial purposes is of pivotal importance when considering the diversification of species in a regenerative farming system. The commercial opportunities are ample, and depend on the context. Generally, studies observe that multi-commodity production systems have a significant correlation to increased farmer welfare as compared to single-commodity systems, making a strong economic case for ecological and economic diversification. (Manda et al., 2021).

Because a percentage of the main crop will have to make way for diversification, yields per area tend to go down. In practice — especially in the first few years — this leads to a decrease in revenue from that primary crop. It is therefore critical that other avenues for farmer income are identified. One logical avenue is diversification into other marketable crops. Depending on the context, these can be crops that target export markets, domestic commodity markets, or local marketplaces. In addition, crops can be selected depending on their time to yield, ranging from annuals and short-lived perennials to medium and long-term perennials.

Of pivotal importance is the development of offtaker relationships within the context of growing secondary crops for commercial purposes. Commercial diversification is therefore not simply a question of adding more crops to a production system. The secondary market crops need to make sense — from a spatial perspective, an ecological perspective, a management perspective, and crucially from a market perspective. As stated in previous reports, a concerted effort on the part of all stakeholders involved is required to mitigate the financial risks involved and ensure successful outcomes.

Secondary Crops and Food Security

A less obvious way to economize species diversification is through the development of crops for food security. Arable land is mostly committed to crops that can be monetized. However, depending on the context, the economics of self-reliance can make a lot of sense (Waldron et al., 2017) — especially when considered through the lens of multi-strata production systems, where commodity crops can co-exists with food security crops without necessarily compromising productive space. Although food security is only marginally treated in this report, its importance in viable and sustainable food production systems cannot be overstated. Moreover the question of food security and food sovereignty as an integral part of regenerative agriculture points toward the imperative for democratization, decolonization, and decommodification of the food system.

Establishing a degree of food security through regenerative agricultural systems is a vital part of evolving (food) sovereignty and a core component of economically thriving rural communities. In that sense, biological diversification leads not only to ecological resilience, but economic resilience as well. By having multiple crops aligned with different marketplaces and economic imperatives (subsistence, local, domestic, export), the farmer is never dependent on just one crop, as well as provision for their own and their communities' sustenance.

Value Addition

Technically, any activity that adds value to produce or a products can be characterized as value addition. In most cases, as a product moves up the value chain, its monetary value goes up as well - it's worth more. The value adding process might start with production and harvesting, then go through a first round of processing, then drying, then storage, then transport, then another secondary round of processing, with the final steps being the product brought to market. Each of the steps along the value chain adds value, and each of those steps represents an economic opportunity that is actualized by actors and stakeholders in the value chain. In most cases, smallholder farmers only partake in production and harvest. Because they do not engage with any of the value-adding steps, they receive the smallest amount of compensation within the value chain or value system. This in almost all cases results in economically disadvantaged farmers.

If farmers had the means to engage with the process of value addition, they would be able to capture a much more significant part of the value creation and be financially better off. This does not mean they need to own the full vertical of value creation; simply engaging in the first steps of value addition can add a significant monetary value to the product. Farmer organization and collaboration is a key enabling condition for developing and scaling the capacity to add value, the outcomes are economically very

significant: “Scaling up value addition, especially aimed at smallholders, can help the rural economies of such primary producers by enabling a better market price. That can improve their economic gains in the long run and reduce rural poverty.” (Aiyer and Sharma, 2021)

One example of this is with coffee. The coffee cherry is the least valuable when freshly harvested. However, when the cherry is removed and the bean is dried, what is left is high-nutrient residue that can be composted and incorporated into the soil, and importantly the high-value coffee bean. Drying also allows for proper storage, which increases the quality and shelf stability of the final product. The right-fit or most effective value-adding process differs from one commodity to another, and needs to be determined on a case by case basis.

Value-adding of produce has the potential to significantly increase farmer income. What the value adding process looks like differs greatly from crop to crop. The point is that at each stage of processing there is an economic opportunity for smallholders to add value to their produce and get a higher price.

Developing infrastructure — including processing infrastructure, but also transport, storage, refrigeration, and so on — is a key prerequisite for scaling smallholder-centered regenerative agriculture. To accomplish that, farmers need to be organized and collaborate amongst themselves to build their collective capacity for volume aggregation, quality control, and value adding for goods. (For further discussion on this, see the project Final Report.)

Lastly, value addition is recognized by development agencies as a key piece for making smallholder farmer operations viable and scalable. To that end value addition initiatives are eligible for various forms of private and public funding. Within this context value addition is a necessary piece for the economic development of smallholder farming and scaling of regenerative agriculture as well as an instrument to unlock funding as part of a comprehensive transition finance stack. ■

KEY INSIGHTS

Secondary crops hold potential in creating significant financial gains and, over time, financial resilience for smallholder farmers. At the same time, there are various practical considerations related to the economics of secondary crops, particularly when it comes to bringing secondary crops to market. Secondary crops are not guaranteed to succeed on their own; several components need to be in place to increase the likelihood that farmers are set up for success.

- **Crop selection and development is contextual**
  - Ecological suitability
  - Management capability
  - Produce-market fit
  - Off-taker relationships
- **Value chain approach to identify economic opportunities**
  - Infrastructure and (value adding) facilities
  - Aggregation of volume
  - Quality control
  - Value adding partnerships
- **Comprehensive financial strategy for transition and long term viability**
  - Equitable farmer - offtaker relationship
  - Forward contracting
  - Longer term price commitments vs short term spot prices
  - Active stakeholder engagement committed to de-risking farmers
  - Farmer access to equitable 'transition' financing
  - Premiums for regenerative produce
  - Government support and incentives (subsidies, payments for ecosystem services)
  - Environmental market opportunities (carbon credits, biodiversity credits)
- **Other enabling factors and environments (see Report 4)**

The Power of Data

The place where agriculture and technology meet has been an exciting and innovative space for the past two decades or so. Strides have been made in remote sensing, access to satellite imaging, geographical information systems (GIS), in-field sensors, connectivity through the Internet of Things (IoT), extended reality, blockchain technology, and data processing and analytics.

At the heart of these innovations lies the power of data and the development of data products. Commitments to fund and further innovate in the agritech and environmental space will further propel the field forward, with many interesting implications for the development and scaling of regenerative agriculture.

The collection and analysis of data regarding ecological and climate impacts and production outcomes has for instance become increasingly crucial for the development of data products such as ecosystem services derived financial instruments. In addition this data is also becoming centrally important for informed decision-making about farms and landscapes. The methodology and process used to collect this data is captured in what is called an MRV framework, a monitoring, reporting, and verification framework.

Although there are variations on MRV, in essence it represents what is becoming an industry standard for approaching data collection in farming. MRV frameworks lie at the heart of substantiating claims needed for the creation of ecosystem services credits, payments for ecosystem services programs, and any instrument, mechanism, or product that is based on the measurement of outcomes from (productive) ecosystems: MRV lies at the core of creating trust in environmental products and markets: "Monitoring, reporting and verification (MRV) frameworks are increasingly seen as [an emissions reduction] 'market shaper.'" (Mercer, 2023)

Measuring Regeneration

Through systematic monitoring and measurement of outcomes, data can capture the positive impacts of regenerative approaches on ecological systems. Particularly in the transition toward regenerative agriculture, data plays a pivotal role in measuring ecological improvements such as soil health, hydrology, water quality, watershed health, carbon sequestration, greenhouse gas (GHG) emissions accounting and reduction, as well as farmer and community well-being.

Data collection can help demonstrate the viability of regenerative practices, improving agricultural techniques, empowering farmers and stakeholders to make informed decisions and refine their regenerative practices, and creating financial incentives for regenerative transition. These might include offsetting and importantly insetting opportunities for the public and private sector. (McDonald et al., 2021) Moreover, data turns facts into knowledge and insights, facilitating effective communication with stakeholders, which creates greater buy-in and traction.

An example of an industry initiative towards a comprehensive framework for regenerative data is the Textile Exchange Regenerative Agriculture Outcome Framework, which provides guidelines for the textile industry to develop outcome-based methods for assessing the holistic impacts of regenerative agriculture. The framework provides a flexible, context-adaptable way to assess regenerative impacts, laying out the key indicators while also allowing for context-specificity and regional variation.

Data as a Product: Monetizing Regenerative Outcomes

As mentioned, farmers benefit from reliable monitoring systems on their farms, for instance helping them to make more informed management decisions. Data that measures regeneration holds, increasingly, potential as a valuable product that can be monetized for farmers.

The data on regenerative outcomes can be developed as a data product and function as a source of revenue if the platform is designed in a farmer-centered way. An example is using data collected on-farm to help inform a verification system that measures regenerative outcomes. This data can then be purchased by corporations seeking to demonstrate their commitment to sourcing from regenerative agricultural systems.

The transparency and credibility that data provides enable companies to showcase their sustainability efforts, trace their supply chain, and meet consumer demands for ethically and environmentally responsible products. This creates economic incentives for farmers to adopt regenerative practices and receive financial compensation for their efforts in building and maintaining sustainable agricultural systems.

One example of such a system is the Ethos™ Regenerative Outcome Verification™ system, developed by Terra Genesis, where on-farm data collection allows farmers to access data-driven market actors and marketplaces, including ecosystem service credit markets and companies seeking insetting opportunities.

While the potential for agricultural data as a product is significant, several challenges must be addressed.

Developing robust monitoring, reporting, and verification systems is crucial to ensure the accuracy and reliability of the data collected. Selecting appropriate metrics and indicators that capture the complexity and nuances of regenerative agriculture is another challenge, as it requires balancing scientific rigor with practicality. Additionally, building the capacity and infrastructure necessary to collect, analyze, and interpret the data demands investments in technology, training, and data management. However, pioneering work is underway to overcome these challenges, offering promising solutions that enhance farmers' ability to receive rightful compensation for their contributions to regenerative agriculture.

Democratization of Farm Data and Collection Tools

As we witness a major shift in how the impacts of agricultural systems are measured, one looming question is what implications the emerging agricultural data economy has for smallholder farmers. As mobile technology use increases and improves, even in rural areas, many smallholder farmers have new opportunities to participate in the data economy. At the same time, there are concerns that need to be addressed regarding equitable access to data platforms, farmer digital literacy, the management of farmer data privacy, and how data payments are structured.

Access to technology

Smartphone ownership among rural populations is growing in many areas. Even so, cellular networks have limited reach in many rural areas. Equitable access to digital data collection technologies should be ensured, as well as generally access to the tools, platforms, and technologies that enable participation in the agricultural data economy.

Use of data

As the Feed the Future report notes, "Given smallholder farmers' uneven ownership of digital technology, limitations in internet connectivity, and varying rates of literacy, farmers' direct use of their own data has been limited. More recent innovations, however, are leading farmers to interact more with their own data." (USAID, 2018) At the very least, data collection platforms should make it easy for farmers to access and view their own data in ways that help them make informed management decisions. Examples of applications and services that benefit smallholder farmers include educational tools and videos about nutrition and farming practices associated with the data collection platform; weather forecast information, crop calendars, and alert systems; and smartcards that can double as IDs in countries where smallholders, especially women, may not have other official IDs.

When it comes to scaling regenerative agriculture among smallholder farmers, digital educational platforms and applications are as of yet an underutilized strategy. Many agri-chemical and agricultural technology companies have developed tools that allow farmers to input their data and generate, as a result, recommendations about chemical fertilizers and other inputs. (ibid.) How can service providers and project developers focused on regenerative agriculture utilize similar channels to educate farmers about regenerative management practices and their benefits?

Privacy

Various kinds of service providers collect data from smallholders: research entities, government or NGO extension services, project management or technical assistance providers, and commercial service providers. (ibid.) As they capture and store data regarding farmers' bio-data, the GPS of their plots, and the crops they grow, concerns around farmer privacy must be carefully considered and addressed.

To make data sharing equitable and to protect farmers' privacy, farmers would ideally have the opportunity to control who uses their data and how. The strongest security platforms also anonymize data and place other protective measures around farmers' personal data, the GPS coordinates of their plots, and so on.

Equitable data collection and payment structures

While it should be a minimum requirement that farmers can access and use their own data, manage privacy settings, and have a say in who gets to use their data, there are further considerations to ensure that data collection systems are structured in equitable ways, this is currently not the case: "according to FAO-supported research on farmer's rights to data, information, and knowledge, information access is mainly held by large-scale farmers and service providers, and the data generated by smallholder farmers is generally gathered by stakeholders who control satellite imagery. Also, data management is not always consensual, and in most cases, it is not regulated by any digital framework such as the General Data Protection Regulation (GDPR)." (Monteiro, 2017)

Moreover, the process should also integrate a consideration of how the data is collected, by whom, and how farmers experience this process. One major concern is that data collection, if performed by farmers, may prove overly laborious and overwhelming, adding to the farmers' already intensive workload.

For regenerative agriculture data markets to be truly regenerative, they need to consider these questions of equitability, investment, cost, benefit, and democratization, and design systems that ensure the inclusion of farmers' voices and participation.

Regemerative Outcome Verification

The Ethos™ Regenerative Outcome Verification™ system developed by Terra Genesis is designed to address these considerations. The data collection process is based on Participatory Guarantee Systems, reliable field technologies, remote sensing, and relationships with smallholder communities in highly varied contexts. The Ethos™ system also considers the well-being of a whole system — looking at ecological, social, and economic indicators. The holistic approach includes bringing the farmers/producers to the table as stakeholders, and giving them a voice in defining what regeneration means in their place, identifying appropriate indicators, and involving them in the data collection. Data is collected across a wide and robust set of indicators and data types, and makes that data available for all stakeholders to see.

These data are collected on a peer-to-peer basis, allowing smallholders to serve as data collectors whilst simultaneously enriching the social bonds and knowledge exchange between farmers. This allows the system to scale much more rapidly — as the bottleneck of external certification bodies is eliminated. The Ethos™ system strives to be transparent, inclusive, equitable, democratizing, and of benefit to all stakeholders; with data as income source for farmers that are producing regeneratively, and that same data as assurance for the offtakers that what they are sourcing was produced regeneratively.

The Ethos™ platform is being piloted at the Haiti Regenerative Cotton project with Smallholder Farmers Alliance and the Regenerative Rubber Agroforestry project in Thailand in collaboration with a number of farmer cooperatives.

KEY INSIGHTS

Data products in agriculture is a new and rapidly innovative field that holds much promise for the development of regenerative agriculture and smallholder farmers.

Uses of data and data products in regenerative agriculture:

- Data informs better decision making on a farm, enterprise, landscape, and policy level
- Data and data products are potential sources of income for farmers
- Farm data enables hyper-transparency through real-time, automated data collection and analysis, with potential benefits or smallholders in terms of improved access to services and markets
- Data enables farmers to more easily access private and public offsetting and insetting opportunities (Kos and Kloppenburg, 2019)

Important criteria for the development of data products as market opportunities for smallholder farmers:

- Democratization and open sourcing of data collection tools and verification methodologies (e.g. MRV, PGS, ROV)
- Lowering the threshold to engage with key technologies through access to digital tools and platforms as well as developing digital literacy
- Safeguard the right to data access and use for smallholders, as well as ensuring privacy and security
- More studies assessing the impact of data use and data products on smallholder farmers, and financing to develop appropriate systems are needed

Data collection, verification, and data products that can be derived from the whole value systems built around data opens up a whole new world of (financial) opportunities for smallholder farmers. The sector needs substantial public and private funding for innovation, development, as well as education and developing farmer digital literacy. The democratization of data collection tools and verification methodologies presents a currently vastly underdeveloped opportunity to scale regenerative agriculture among smallholder farmers.

Environmental Market

The environmental market is an umbrella term that is used to describe various financial instruments and market mechanisms that operate to facilitate economic transactions based on and derived from ecosystem services. One of the underlying aims of the environmental market is to bring about positive environmental change by developing systems that attribute (monetary) value to ecosystem services.

Ecosystem services credits can be used by businesses and governments to meet environmental goals. For example, a business can use carbon credits to offset its greenhouse gas emissions, or a government can create and market biodiversity credits by protecting a threatened species. The most common categories of ecosystem services related to the environmental market are: carbon, water, air, biodiversity, and habitat.

Due to the pertinence of the issues surrounding the climate crisis, environmental degradation, and the detrimental effects on the environment incurred by business as usual, the environmental market has grown rapidly in recent decades, and continues to grow, despite recent setbacks experienced in the carbon credit space. The setbacks point toward real concerns that have to do with the (lack of) integrity that exists within the environmental marketplace. There is great potential in making ecosystem services "investable," however, these services must be developed in a way that makes sense, is appropriate in the given context, with integrity, transparency, verifiability, and with all relevant stakeholders being treated in an equitable manner.

Some important instruments, mechanisms, and programs that currently operate in the environmental market are:

- Payments for ecosystem services (PES) programs
- Carbon offsets and credits
- Biodiversity offsets and credits
- Blockchain based ReFi (Regenerative Finance) solutions
- Land use, land-use change, and forestry offsets (LULUCF)
- REDD+
- Renewable Energy Credits (RECs)
- Water Quality Trading
- Habitat Mitigation Banking
- Wetland Mitigation Credits
- Eco-labels and Certifications
- Air Quality Credits
- Emission Reduction Offset Programs

For the sake of succinctness this report will primarily focus on payments for ecosystem services, carbon credits, and biodiversity credits, as the most promising instruments within the environmental market at the moment, in relation to developing and scaling regenerative agriculture.

In addition, a concluding section will address the potential of blockchain technology, the ReFi space, and how it might grow to play a significant role in the development and democratization of the environmental marketplace. ■

Payments for Ecosystem Services

Payment for ecosystem services (PES) is a market-based approach to encourage the conservation, restoration, or regeneration of natural resources and ecosystem services. PES are incentives offered to farmers or landowners in exchange for good land management that provides ecosystem services such as watershed protection, purification of air and water, habitat, biodiversity conservation, or carbon storage in forests. In short, in a PES scheme, a buyer directly pays a seller for providing or stewarding an ecosystem service.

There are many different types of PES schemes – some voluntary, others compliance based. Examples of PES platforms and marketplaces include Ecosystem Services Market Consortium, Ecosystem Marketplace, and IIED, active in many countries in Asia and Latin America. Many PES projects are also funded through the UN's REDD+ program.

In theory, PES is a promising approach to conservation or even regeneration: PES schemes can help to conserve biodiversity, protect water quality, mitigate climate change, and improve rural livelihoods and reduce poverty. In practice, however, it is not always straightforward. PES schemes can be difficult to design and implement, and they can be expensive.

They can also be vulnerable to corruption. An analysis by Mongabay revealed that there are very few rigorously designed

studies to assess the success of PES projects. The most rigorous of these studies "showed very modest reductions in deforestation, generally of just a few percentage points. Meanwhile, the majority of the available evidence suggests that payments were often too low to cover the opportunity costs of agricultural development or other profitable activities that the land could have been used for." (Gaworecki, 2017) PES is therefore currently not a strong incentive for farmers, and monetization for smallholders is often low for the effort.

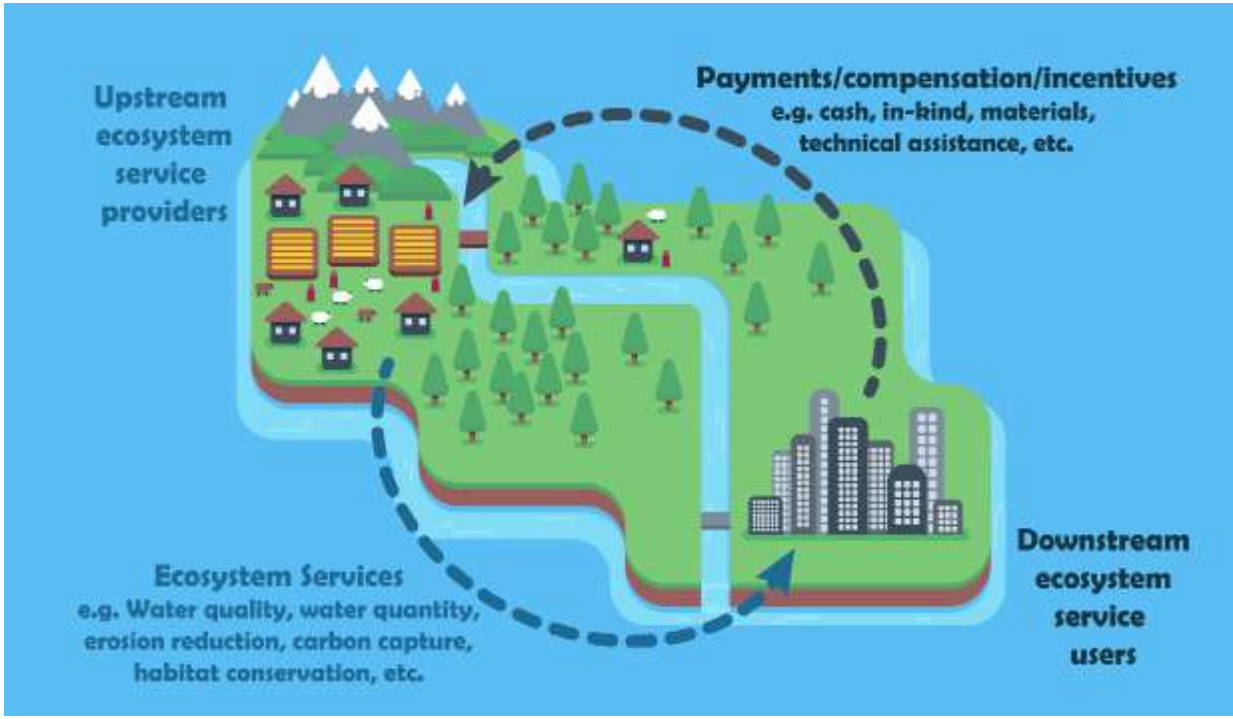
Another kind of danger in PES programs is having a fragmented approach to the development of ecosystem services, which could lead to developments such as carbon sequestration with inappropriate species or with disregard for biodiversity and endemic flora and fauna. It is important to carefully consider the specific needs of the ecosystem and the community before implementing a PES scheme. In fact, the strongest PES projects are ones that have been tailored to a specific place and context, and highlight the importance of always working with the local communities and with intimate knowledge of the local ecosystem. It is a fact that governance structures, land tenure systems, and ecosystems vary widely from place to place.

Despite the challenges, PES projects have the potential to make a significant contribution to the conservation and even regeneration of productive landscapes. What is required is context-specific approaches, better digital infrastructure,

more rigorous industry standards, trustworthy verification systems, and building capacities in farmers. Lastly, as Mike Gaworecki writes, programs have to be designed in an equitable manner:

> "the very design of a PES program has to consider equitability from beginning to end: in terms of access to the PES scheme, such that everyone has the opportunity to enroll their land if they want to; in terms of decision-making, such that everybody is able to participate and everyone perceives the decision-making process as fair; and in terms of the distribution of outcomes, such that the financial and environmental benefits are distributed across participants in an impartial manner, and this distribution is perceived to be fair."

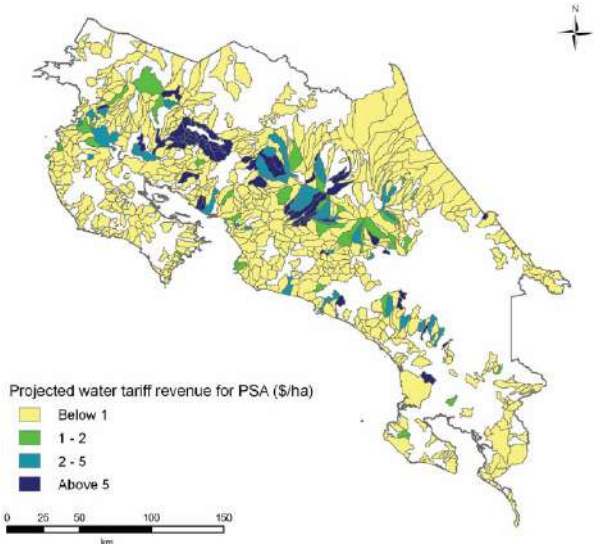
(GAWORECKI, 2017)



By Bosco Lliso - Own work, CC BY-SA 4.0

Success Story: Watershed Protection Costa Rica

In the early 1990s, Costa Rica began a PES program to protect watersheds that supply drinking water to major cities. The program, known as the Watershed Protection Fund, pays landowners to keep their land forested and to adopt sustainable agricultural practices. The program has been very successful, and it has helped to reduce deforestation and improve water quality. (Zhang and Pagiola, 2011)

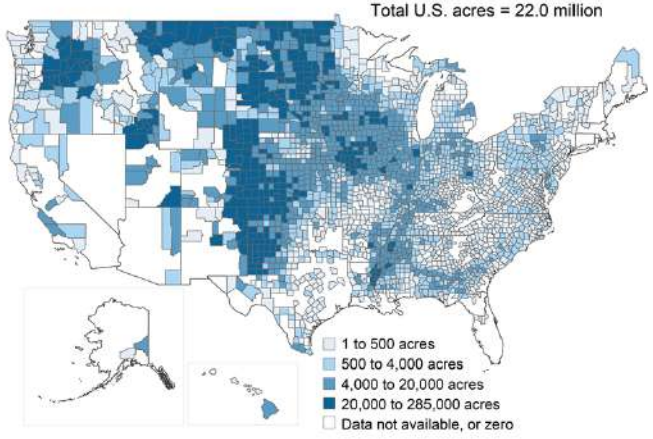


Success Story: Biodiversity Conservation in the United States

In the early 2000s, the United States began a PES program to protect endangered species and their habitats. The program, known as the Conservation Reserve Program, pays farmers to convert cropland to grassland or to plant trees. The program has been very successful, and it has helped to protect a wide variety of endangered species. (Lichtenberg, 2019) The United States' Conservation Reserve Program is the world's largest and longest-running PES initiative.

The program allocates approximately $1.8 billion annually through 766,000 contracts with farmers and landowners. In exchange for these payments, these individuals agree to essentially rent a total of 34,700,000 acres (140,000 km2) of what is classified as environmentally-sensitive land. Their commitment involves planting long-term, resource-conserving covers aimed at improving water quality, preventing soil erosion, and enhancing habitats for waterfowl and wildlife. This program has been in existence in various forms since the aftermath of the American Dust Bowl, when the federal government started compensating farmers for refraining from cultivating poor-quality, erodible land.

Conservation Reserve Program total enrolled acres by county, 2022



Note: Total acres include continuing and newly enrolled acres as of September 30, 2022.
Source: USDA, Economic Research Service using data from USDA, Farm Service Agency.

Ecosystem Services Credits: Carbon and Biodiversity

Carbon credits and other ecosystem services derived credits are in a way analogous to what are called "derivatives" in conventional financial markets. They are financial instruments derived from real-world commodities or in this case ecosystem services, to allow for a higher degree of interaction between public/private entities and the environment — for the purposes of mitigation, conservation, restoration and regeneration.

For practical purposes, this report touches mainly on the market opportunities surrounding carbon and biodiversity credits. Hydrology or water credits, as well as habitat and land use credits, are all credit categories that are seeing advances similar to carbon and biodiversity; however, their economic impact is currently too small to warrant separate treatment. Their potential is discussed at the end of this section in terms of the possibilities that exist for ecosystem service derivative financial instruments in general.

Carbon Credits

A carbon credit is a tradable certificate or instrument representing the right to emit one ton of carbon dioxide or the equivalent amount of another greenhouse gas. Carbon credits are used to offset greenhouse gas emissions, often by businesses and governments to meet emissions reduction targets.

Carbon markets can be either compliance markets or voluntary markets. Compliance markets are regulated by governments, and they are used to meet emissions reduction targets that have been set by law. Voluntary markets are not regulated by governments, and they are used by businesses and individuals to voluntarily reduce their greenhouse gas emissions.

A host of platforms for agriculture-focused carbon credits and offsets have sprung up over the last decade, riding on the excitement over the potential of agricultural lands to function as carbon sinks through soil carbon sequestration and "climate-smart" farming practices.

Examples of carbon farming practices include intensively managed grazing, perennial agriculture, different types of agroforestry, minimal tilling or no-till, and/or building soil through cover crops, crop rotations, and compost application. However, rather than any one farming practice, carbon farming is defined by intentional design for desirable ecological, social, and climate outcomes.

While this space holds much promise, in practice there are a few challenges that make it less attractive for farmers to participate, or buyers to purchase the credits:

- **Challenging for many farmers to access:** Receiving carbon payments requires that farmers qualify for participation in a given platform, comply with a specific farming practice scheme, and either arrange for monitoring and auditing or do it themselves. Many farmers, even in the Global North, find the process of enrolling in these platforms too laborious and daunting. The per-acre payments tend to be so modest that they only make sense for the very largest farms, unless smaller-scale farmers coordinate amongst themselves to aggregate their lands. Lastly, most of the active ag-focused carbon payments platforms are active in North America and Europe; participation is rarely realistic for smallholder farmers in the Global South, unless a highly capable NGO or other organization is involved to facilitate the process. One exception to this, a document exploring carbon payments specifically with smallholder farmers in mind, is the "Haiti Carbon Project Handbook," linked in the Bibliography.

- Lack of a global carbon market: There is currently no global carbon market. This means that there is no single price for carbon credits, and the price of carbon credits can vary significantly from one country to another. This can make it difficult for businesses to plan their investments in low-carbon technologies

- Risk of fraud and corruption in the carbon market: There is a risk of fraud and corruption in the carbon market. Carbon credits are a valuable commodity, and there is a temptation for some people to try to cheat the system. This can undermine the integrity of the carbon market and make it difficult for businesses to trust the system. For example, VERRA, one of the major carbon credit platforms, came under scrutiny in 2023 for grossly overstating the emissions reductions associated with its "avoided deforestation" credits (Padin-Dujon, 2023.

- Challenges for the offsetters: On the industry/company side, with the inapplicability of carbon stocks to company GHG reduction goals (with the exception of Land-Based Targets under Science-Based Targets), and increasing scrutiny around the additionality requirements of carbon farming practices, using ag-based carbon offsets towards company climate goals is increasingly challenging.

- "Carbon tunnel vision": There is a danger associated with a near-exclusive focus on greenhouse gasses (GHG) and carbon as the singular metric of climate responsibility and environmental action. There are so many other considerations to climate resilience and ecosystem health that are in danger of being omitted: biodiversity, water, air quality, social and economic metrics of well-being, to name a few. ■

Although the carbon credit markets gained much traction in the past years and were looking to set a strong precedent for the ecosystem services credit markets, growing friction experienced by its users both on the farming as well as the corporate side have laid bare many of its shortcomings. Particularly the recent VERRA debacle has exposed outright faulty aspects of the carbon credit creation and verification process that has made many companies steer away from its use, the Wall Street Journal reported that: "Around half of respondents say they aren't buying credits because of a complex web of standards, varying definitions of carbon credit quality or a lack of market transparency. Around 40% cite the risk of reputational damage, including legal action." (WSJ, 2023)

Interestingly the skepticism around offsetting through carbon credits has pushed companies more toward acting on their insetting opportunities, playing an active role in their existing supply chains to find opportunities for emissions reduction and collaborations with supply chain partners to adapt better practices.

Despite the fact that carbon credits have for the moment fallen out of fashion, they could still play a significant role as part of a comprehensive and integrated approach to regeneration. The industry needs to address the issues that have come to the fore, and (re-)develop a strong foundation for its application.

The use of carbon credits is likely to make the most sense as part of a larger bundle of complementary financial instruments and mechanisms sourced from the environmental market, both for companies seeking to amend their impact, as well as farmers seeking compensation for stewarding ecosystem services.

Biodiversity Credits

The Biodiversity COP15 Montreal Agreement has been hailed as a landmark global deal for nature and people by the European Union. Signed by 196 nations in December 2022, the agreement is a joint effort to "take urgent action to halt and reverse biodiversity loss" and protect 30 percent of land and sea area by 2030. Importantly, the agreement is seen as a catalyst for the creation and allocation of financing toward that aim, estimated to exceed $700 billion annually, in part by investment in the creation and further development of biodiversity credits.

> **"With a new international framework combined with the global trend of making ESG standards mandatory for businesses, global investments in biodiversity are expected to grow rapidly, particularly in the private sector. One such innovative financial mechanism being developed and promoted by international conservationist groups is biodiversity credits."**
>
> (RADJABOV, 2023)

Biodiversity credits are not new. However, recent years have seen a marked increase of development of the field. Frontrunners have mostly been governments: "The government, contrary to received wisdom, plays a key role not just in enforcing mandatory policies but also in determining the supply and demand of biodiversity units, supervising the transaction or granting legitimacy to the compensation site." (Koh et al. 2019)

What currently characterizes the realm of biodiversity credits is that it is highly localized to specific geographies, and standards and methodologies for credit creation are still highly proprietary and diverse — there is no strict consensus. Various governments, like the UK, have started to develop systems and experiment with them at a regulatory level. Other projects have been set up as private-public partnerships like in the High Andes of Colombia as voluntary credit systems.

Offsets versus Credits

Biodiversity offsets are measures taken to compensate for the negative impact of development or human activities on biodiversity. The primary purpose of biodiversity offsets is to mitigate environmental damage by ensuring that there is no overall loss of biodiversity. Biodiversity credits, on the other hand, are a market-based mechanism used to quantify and trade the positive biodiversity outcomes achieved by conservation, restoration, or regeneration efforts. Biodiversity credits provide a way to monetize and incentivize conservation actions. They allow organizations or individuals to purchase credits to compensate for their own biodiversity impacts or to invest in conservation projects that generate credits.

So where biodiversity offsets are a compliance instrument designed to compensate for adverse environmental impacts from project development, biodiversity credits are mostly seen as voluntary market instruments and can be used to finance stronger biodiversity outcomes. This opens the demand beyond the traditional market segment of mining companies and developers to any of the companies that have set biodiversity goals, or have committed to Nature Positive 2030 and similar frameworks.

Concerns

- **Commodification of nature**: Commodification does not adequately capture the intrinsic value of biodiversity and could lead to the perception that nature can be traded like any other economic good. This re-affirms the transactional mindset of extractive agriculture and land management
- **Challenging for smallholder farmers to access:** The frameworks for the development of biodiversity credits are even less developed than those of carbon credits. Each ecosystem, bioregion, ecoregion, landscape, needs to engage with its own process to create these credits, both capacity and capability might be difficult for smallholders to access
- **Inequitable outcomes:** Concerns have been raised that credit formation and participation in the marketplace is only accessible to wealthy institutions that have the means to participate and capitalize on it
- **Lack of a biodiversity marketplace:** There are currently very few platforms where biodiversity credits are offered and traded, let alone a global marketplace with streamlined operability

- **Valuation and low commodification:** How biodiversity credits are valued remains an open question: "Like payments for ecosystem services, the price of a biodiversity credit is most commonly based on the cost of management measures rather than the 'value' of biodiversity; which corresponds to a low degree of commodification." (Koh et al. 2019)

- **Fragmented approach / not context specific:** Although an approach that emphasizes biodiversity, contrary to just carbon, is a more integral approach to tackling issues of environmental concern, there are many similar concerns about fragmentation. The development of diversity must make sense within the ecological, social, and economic layers of a given ecosystem. Anything short of that will likely be unsustainable and unviable.

- **Measuring biodiversity is complex:** Biodiversity credit markets often lack standardized methodologies for measuring biodiversity gains or losses. Developing valuation methods for biodiversity and establishing exchange rules is technically difficult. (Walker et al., 2009) This can lead to inconsistent and unreliable assessments, making it challenging to ensure that credits genuinely represent biodiversity improvements.

- **Unpredictable Outcomes:** The effectiveness of biodiversity credit programs can vary, and there's a risk that they may not consistently deliver the intended biodiversity benefits. Market fluctuations and changing environmental conditions can affect outcomes.

- **Loss of Local Control:** In some cases, local communities and indigenous groups who have been the stewards of biodiversity may lose control over conservation decisions if biodiversity credit projects are driven by external entities.

- **Encouraging Land Conversion:** In some cases, biodiversity credits might indirectly incentivize land conversion, as entities may believe they can compensate for habitat destruction by investing in conservation elsewhere. The risks of creating a "license-to-trash" and "biodiversity leakage" are often problematic to account for (Pilgrim and Bennun, 2014)

- **Regulatory Challenges:** Implementing effective regulations and oversight for biodiversity credit programs can be complex, and if not properly managed, can lead to loopholes or perverse incentives.

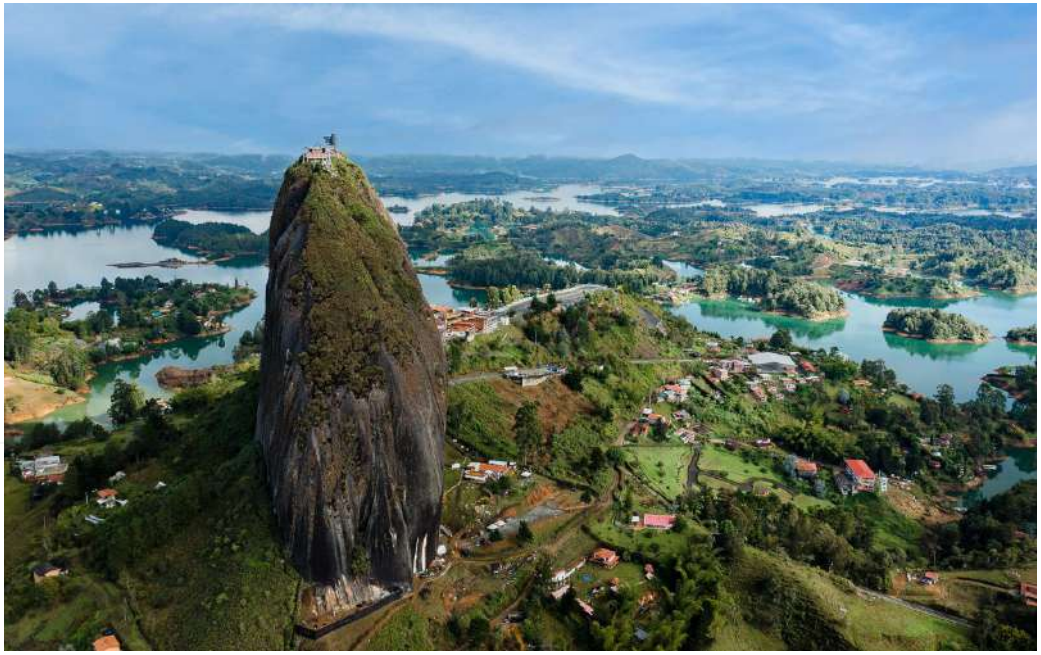
- **Integrity of the Marketplace:** There is criticism that touches on the question to what extent the integrity needed to regenerate (productive) ecosystems can derive from or be incentivized by financial instruments and mechanisms that are inherently transactional in nature and unable to capture the true value of ecosystems. Recent setbacks in the ecosystem services marketplaces attest to a degree of co-option and perversion of these spaces by opportunistic and predatory forces.

It's important to note that proponents of biodiversity credits argue that when designed and implemented well, they can provide a valuable tool for financing conservation efforts and incentivizing sustainable practices. However, addressing the above concerns and challenges is crucial for ensuring that biodiversity credits contribute meaningfully to biodiversity conservation without unintended negative consequences. ■

SUCCESS STORY: BIODIVERSITY CREDITS IN COLOMBIA

In May 2022, a new biodiversity credits product was launched in Colombia. The product was created by ClimateTrade, a blockchain-based climate marketplace, and Terrasos, a Latin American biodiversity conservation and habitat banking organization. The first project to issue these "voluntary biodiversity credits" (VBCs) is the Bosque de Niebla-El Globo Habitat Bank (also called the Spectacled Bear Habitat Bank) which is dedicated to the conservation of remaining native species in the High Andes.

The Bosque de Niebla is a cloud forest that is home to a number of threatened species, including the spectacled bear, the yellow-eared parrot and the black-and-chestnut eagle. Each VBC from the project — priced at $30 — corresponds to 30 years of conservation and/or restoration of 10 square meters of the Bosque de Niebla forest. According to ClimateTrade, purchasing VBCs "is a way [for companies] to give back to nature and ensure positive impacts" by aligning their operations with biodiversity and ecosystem conservation. The example itself is a proof of concept and shows how innovations around biodiversity credits, blockchain, and nature conservation or restoration might work. The success of the project depends a lot on its ability to address the concerns expressed above. (World Economic Forum, 2022)



El Peñol of Guatape in Colombia Source: weseektravel.com

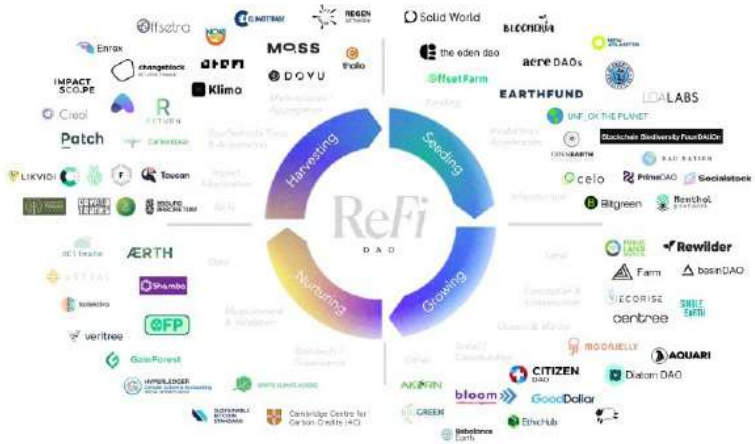
Regenerative Finance

Although regenerative finance as a paradigm and movement have been around for a while, blockchain technology and the web3 space opened up new avenues for innovation. ReFi as such is a new financial paradigm that seeks to align financial incentives with the regeneration of natural and social systems. ReFi uses blockchain and other web3 technologies to create new financial products and services that support regenerative development.

Some of the key features of ReFi include:

- **Decentralization:** ReFi is built on decentralized networks, such as blockchain, which eliminates the need for intermediaries and creates a more transparent and equitable financial system.
- **Tokenization:** ReFi uses tokens to represent assets, such as carbon credits, water rights, and land, which makes it easier to trade and invest in these assets.
- **Smart contracts:** ReFi uses smart contracts to automate financial transactions, which reduces costs and eliminates human error.
- **Community governance**: ReFi projects are often governed by a community of stakeholders, which ensures that the projects are aligned with the needs of the community.

ReFi is still in its early stages, but it has the potential to revolutionize the financial system and create more democratic, equitable, and sustainable solutions to pressing environmental issues.



Some of the potential applications of ReFi include:

- **Investing in regenerative projects:** ReFi can be used to invest in projects that are focused on regenerating natural and social systems, such as renewable energy projects, regenerative agriculture projects, and social impact projects
- **Financing climate adaptation and mitigation**: ReFi can be used to finance climate adaptation and mitigation projects, for instance by adding a lyer of operability to existing ecosystem services payment programs or credit creation
- **Insurance**: ReFi can be used to create new types of insurance products that are tailored to the needs of regenerative (agricultural) enterprises and communities
- **Microfinance:** ReFi can be used to provide microfinance loans to small businesses and entrepreneurs in developing countries, helping them to invest in sustainable practices

ReFi for Transition Financing

ReFi could benefit farmers working to transition to regenerative agriculture in a number of ways:

- **Access to capital:** ReFi could provide farmers with access to capital to finance the transition to regenerative agriculture. This could be in the form of loans, grants, or investments
- **Risk sharing:** ReFi could help to share the risk of transitioning to regenerative agriculture. This could be done through insurance products or through community-based projects
- **Market access:** ReFi could facilitate farmers' access to markets for their regeneratively produced goods. This could be done by creating new market platforms or by connecting farmers with buyers who are willing to pay a premium for regeneratively produced goods
- **Networking:** ReFi could help farmers to network with other farmers who are transitioning to regenerative agriculture. This could be done through online forums, community events, or peer-to-peer lending platforms

Some innovative projects that are well underway are:

- **The Carbon Underground:** This project is using ReFi to finance the transition of farms to regenerative agriculture. The project is issuing carbon credits to farmers who adopt regenerative practices, and these credits can be sold to businesses and individuals who are looking to offset their carbon emissions
- **Regen Network:** Pioneer of a series of ReFi innovations, with a focus on the creation of a marketplace that allows for buying and selling of ecocredits, as well as pioneering work around ecocredits standards that focusses on methodologies and (permissionless) credit classes
- **The Soil Carbon Collective:** This project is using ReFi to fund the restoration of soil carbon. The project is issuing tokens that represent ownership of soil carbon, and these tokens can be traded on a blockchain-based platform

Concerns

Some of the high level concerns that need to be addressed in the ReFi space, mainly as it relates to smallholder farmers and regenerative agriculture are:

- **Early stage**: ReFi is still in its early stages, so there is a risk that the innovations it brings forth may not be widely adopted. This could make it risky for farmers to partake in ReFi products and services.
- **Complexity:** ReFi can be complex, so farmers need to learn about how it works in order to take advantage of it. This could be a barrier for some farmers.
- **Regulation:** ReFi is bringing forth new financial products, so it is not yet clear how it will be regulated. This could be a barrier for some farmers, as they may be hesitant to use unregulated financial products.
- **Volatility:** The development of ReFi is strongly connected to the volatility of the crypto markets. Because of this high volatility there is a lot of risk involved, not excluding financial consequences for the viability of innovative ReFi products, and services

It is important to realize that the value proposition of ReFi is not the innovation of products and services, instead it represents a paradigm shift in the financial world particularly within the context of environmental / nature markets. As such ReFi has the potential to fast track the development of connecting smallholder farmers around the world with market places, possibly a key to supporting the regenerative transition. We are in the early days, and the space needs to evolve in order for that vision to become real. The importance of Web3 and the role it could potentially play in that transition is also becoming increasingly apparent. ■

KEY INSIGHTS

- Payments for ecosystem services can be a highly effective tool to create additional income for smallholder farmers, they are however heavily dependent on government or third-party intervention, and they must be designed and operated with an integrated approach

- Access to financial rewards of carbon and similar credits can be cumbersome and often amounts to very little compensation for individual smallholders. However, ecosystem services credits could make sense at scale, and require smallholder farmer organization

- PES and Ecosystem Services Credits need to be explored in unison as part of a comprehensive finance stack to support regenerative agriculture projects/landscapes at scale

- Companies are shifting from offsetting to insetting opportunities. Both realms offer opportunities for smallholders and scaling. What is required to attract insetting opportunities (emissions reduction within existing supply systems) is farmers' organization and the development of MRV / PGS systems that facilitate corporate engagement. This requires a degree of capacity building and would be greatly catalyzed by access to open source digital tools

- Biodiversity credits and "nature positive" hold much promise. But the continued development of ecosystem service credit markets must learn from the mistakes of carbon credit markets and emphasize equitability, strong governance, transparency, inclusivity, and integrity, while creating interesting investable opportunities for public and private institutions to help them meet their sustainability goals

- Ecosystem services based financial instruments can see a higher degree of commodification and monetization through storytelling and conveying the right degree of scarcity and uniqueness of the credit in question, rather than following a generic trajectory of value creation that is based purely on expenditure of energy related to maintenance and management of that ecosystem

- ReFi, blockchain, and the Web3 space hold incredible potential for radical innovation in the environmental / nature markets. It is very early days still, and much work needs to be done developing stable and effective products and services, garnering trust and confidence from farmers, and other stakeholders, as well as making the platforms, products, and services accessible.

CONCLUSION

Developing and scaling regenerative agriculture requires the orchestration of many layers of complexity. Complexity is a hallmark of regeneration; complexity in ecosystems is expressed through biodiversity, and that diversity creates resilience.

Diversity and resilience in regenerative agriculture manifest and connect in different ways: a diversity of financial instruments and mechanisms, a diversity of stakeholders and marketplaces, diverse ecosystems of farmers, farms, and landscapes, a diversity of actors in the value/supply system, and diversity across governance structures that are best suited to the social and cultural diversity of place. As an integrated whole, regenerative agriculture can be seen as cultivation of biological diversity, navigating social diversity, and development of economic diversity.

The invisible structures that shape market opportunities related to developing and scaling regenerative agriculture are about inclusion, equitability, radical transparency, innovation, access to (digital) tools and markets, long-term vision and commitment, aspirational partnerships, coalition building, sharing risks and profits fairly and, ultimately, a paradigm shift, from being producers and consumers to becoming stewards of a landscape.

Stewardship implies responsibility and commitment, which in our fast-paced world is seen as a burden by most. As many know, however, it is through the burden of responsibility and commitment that growth and evolution takes place; by not only engaging with what is wanted and desired, but with what is necessary and needed. The polycrisis of our times in that sense is a call for humanity as a whole, a moment to find a common purpose and collaborate for the betterment of the planet, an opportunity to grow collectively and find alignment with the world we inhabit — as individuals, communities, corporations, nations, and as a species — and make it a place again where life in all its richness can thrive.

Concluding insights related to the intersection of developing market opportunities for smallholder farmers across secondary crops, data products, and the environmental market:

- Diversification in farm systems, increasing species biodiversity, and developing secondary crops is a precondition for regenerative agriculture. Of key importance is developing committed and aspirational stakeholder alliances — including key offtaker partnerships guided by long-term thinking, facilitating the right produce-market fit, and developing the right financing strategies.

- The intersection of data products, MRV systems, and participatory guarantee systems is key to scaling regenerative agriculture. Not only does it create new opportunities for income and revenue by creating better market access (data as a farm product, access to ecosystem services credit markets), it also paves the way for hyper transparency, better decision making, and democratization of access to data and markets. All of these are key components for scaling regenerative agriculture.

- The environmental market, including payments for ecosystem services and derivative instruments such as ecosystem services credits (carbon, biodiversity), as well as the whole array of financial instruments developed around offsetting and insetting, are pathways that are mutually complementary as part of an integrated financial strategy. Having the right finance stack in place ensures the financial viability for development and scaling, particularly during the transition period.

- The ReFi space represents a paradigm shift that holds the potential to radically catalyze regenerative development, it is crucially important that these innovations are developed with the smallholder farmers at its center.

BIBLIOGRAPHY

A

Aiyer, S., & Sharma, S. (2021, February). Reversing Rural Poverty with Value Addition in Agribusiness. Development Asia. [Link]

Augere-Granier, M.-L. (2020, June 25). Agroforestry in the European Union. Policycommons.net; European Parliamentary Research Service. [Link]

B

BCG & OP2B. (2023) Cultivating farmer prosperity: Investing in Regenerative Agriculture. [Link]

C

Coulibaly, J. Y., Chiputwa, B., Tebila Nakelse, & Godfrey Kundhlande. (2017). Adoption of agroforestry and the impact on household food security among farmers in Malawi. Agricultural Systems, 155, 52–69. https://doi.org/10.1016/j.agsy.2017.03.017

D

Duffy, C., Toth, G. G., Robert, McKeown, P. C., Syed Ajijur Rahman, Yekti Widyaningsih, Sunderland, T., & Spillane, C. (2021). Agroforestry contributions to smallholder farmer food security in Indonesia. Agroforestry Systems, 95(6), 1109–1124. https://doi.org/10.1007/s10457-021-00632-8

E

Erisman, J. W., N.J.M. van Eekeren, Jan de Wit, Koopmans, C., W.J.M. Cuijpers, N. Oerlemans, & Koks, B. J. (2016). Agriculture and biodiversity: a better balance benefits both. AIMS Agriculture and Food, 1(2), 157–174. https://doi.org/10.3934/agrfood.2016.2.157

G

Gaworecki, M., & Burivalova, Z. (2017). Cash for conservation: Do payments for ecosystem services work? Mongabay Environmental News. [Link]

H

Hawken, P. ed. (2017) Drawdown: *The Most Comprehensive Plan Ever Proposed to Reverse Global Warming*. Penguin.

K

Kaushal, R., Mandal, D., Pankaj Panwar, Rajkumar, Kumar, P., Tomar, S., & Mehta, H. (2021). Soil and water conservation benefits of agroforestry. Elsevier EBooks, 259–275. https://doi.org/10.1016/b978-0-12-822931-6.00020-4

Koh, N.S., Hahn, T. P., & Boonstra, W. J. (2019). How much of a market is involved in a biodiversity offset? A typology of biodiversity offset policies. Journal of Environmental Management, 232, 679–691. https://doi.org/10.1016/j.jenvman.2018.11.080

Kos, D., & Kloppenburg, S. (2019, December). Digital technologies, hyper-transparency and smallholder farmer inclusion in global value chains. ResearchGate; Elsevier BV. [Link]

Lichtenberg, E. (2019). Conservation and the Environment in US Farm Legislation. EuroChoices, 18(1), 49–55. https://doi.org/10.1111/1746-692x.12214

Locke, H. and Georges, T. (2022). The Haiti Carbon Handbook. Smallholder Farmers Alliance and Down to Earth Carbon. [Link]

M

Mcdonald, H., Frelih-Larsen, A., Lóránt, A., Duin, L., Andersen, S., Costa, G., & Bradley, H. (2021). Carbon farming Making agriculture fit for 2030. Study for the committee on Environment, Public Health and Food Safety (ENVI), Policy Department for Economic, Scientific and Quality of Life Policies, European Parliament, Luxembourg. [Link]

Mercer, L. (2023, March 31). The key to scaling up greenhouse gas removals? Robust monitoring, reporting and verification (MRV). Grantham Research Institute on Climate Change and the Environment. [Link]

P

Padin-Dujon, A. (2023, January 26). The Verra scandal explained: Why "avoided deforestation" credits are hazardous. LSE International Development. [Link]

U

USAID (2018) DIGITAL FARMER PROFILES: Reimagining Smallholder Agriculture. U.S. Agency for International Development. [Link]

W

Waarts, Y.R., Janssen, V., Richmond Aryeetey, D.D. Onduru, Dwi Heriyanto, S. Tin Aprillya, Anny Estelle N'Guessan, L. Courbois, Bakker, D., & Ingram, V. (2021). Multiple pathways towards achieving a living income for different types of smallholder tree-crop commodity farmers. Food Security, 13(6), 1467–1496. https://doi.org/10.1007/s12571-021-01220-5

Waldron, A., Garrity, D., Malhi, Y., & Seddon, N. (2017, August). Agroforestry Can Enhance Food Security While Meeting Other Sustainable Development Goals. ResearchGate; SAGE. [Link]

Wall Street Journal. (2023, January 17). Many Companies Are Shying Away From Carbon Credits. WSJ; The Wall Street Journal. [Link]

World Economic Forum. (2022). Biodiversity Credits: Unlocking Financial Markets for Nature-Positive Outcomes. [Link]

Zhang, W., & Stefano Pagiola. (2011). Assessing the potential for synergies in the implementation of payments for environmental services programmes: an empirical analysis of Costa Rica. Environmental Conservation, 38(4), 406–416. https://doi.org/10.1017/s0376892911000555