Methods for Measurement of Regenerative Agriculture in Practice

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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 will be generating, over the course of the next year, a series of reports, recommendations, best practices and guidelines that draw from early-stage regenerative farming by smallholders in various parts of the world.

For this first set of reports, SDS has turned to one of its founding partners, Terra Genesis International, to take the lead in addressing the definition, measurement, and strategies for scaling regenerative agriculture as implemented by smallholders.

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

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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 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

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/

Introduction

Regenerative Agriculture has great variability in the way it is defined, designed, and practiced. We can only assume, then, that effective monitoring, reporting, and verification (MRV) will contextualize the way the agricultural system being examined is evolving: i.e. where it has been, where it is currently, and where it is likely to go in the future. The result of successful MRV efforts is the ability to identify the presence — or absence — of regeneration in a system.

We can look at indicators — variables that can be quantified or qualified to indicate the state or change in state of something — to gain clarity around a system's re/degeneration.

It is crucial to note that this should not oversimplify the monitoring and verification process. Regenerative agriculture does not result in products that are in and of themselves indicators of the regeneration they derived from. They don't have an empirical mark of their regeneration (that we have identified so far) in the way that other quality markers, such as grade of rubber or cotton do. Higher-grade materials can be differentiated in the marketplace because those higher grades have standards set by standards bodies that can be empirically measured on the actual product. Those grades of material result from management decisions such as when to plant, when to harvest, how to handle the material, etc. Regenerative indicators are far less cooperative, standardized, or straightforward. Therefore, we need a way to measure something that is incredibly recalcitrant.

A fantastic example is the climate. The term 'climate' only came to be used in reference to a pattern of atmospheric conditions in the 1600s. The idea of climates changing was not formalized until the 1950s. We did not have proof that this happens until computer modeling. We need very powerful computers to "see" the climate. Regeneration is similar; it is difficult to see without the appropriate instruments. We are working collectively to figure out what those instruments are. This report outlines steps towards the development of robust monitoring and verification systems that may support this process.

You can't measure that *something* is regenerative, but rather that the process it was a part of supported regeneration itself. Regeneration is difficult to "see" in a place, and it is still not completely clear how to accomplish that. Yet, demand for monitoring and verification of regeneration within agricultural production systems still exists. This demand is often driven by a desire to "see" what can be more easily measured: the individual environmental and social impacts within a system. While any particular impact — such as increased water health — may only portray a fragment of the system, taken in aggregate they give data-based insights to "see" the greater system. This "seeing" may not be clear at first; data points alone may not make sense until contextualized with others, just as a doctor is not able to see the health of your body via one test alone.

Importantly, data collection in and of itself is not the desired outcome of this process. Generating a robust data set is not the reason regenerative agricultural systems should be designed in the first place; they are not designed for the sake of data. Rather, data collection is a tool to support the intended goal, which is deep regeneration within a place. Data insights around impacts can inform management decisions and provide credibility to public-facing claims regarding the effect that a production system has on the place it is a part of. Therefore, effective monitoring and verification are recognized as crucial to credible claims arising from brands' regenerative agriculture investments. In this report, we cover common methods of measurement, paradigms of data collection, and the value that MRV can provide to involved stakeholders.

Technical Design and Methodology

The design of monitoring systems is multifaceted. As described above, we can look at indicators — variables that can be quantified or qualified to indicate the state or change in state of something — to gain clarity around a system's status.

What these indicators are, as well as how they are measured, is unique to the context of the project they are a part of. The process of determining these considers the following:

MONITORING PRACTICES AND OUTCOMES

When selecting indicators of regeneration, both practices and outcomes can be monitored. **Practice-based** monitoring measures and verifies that agricultural inputs, processes, and practices are being used as intended. **Outcome-based** monitoring measures and verifies the changes in environmental, social, and/or economic conditions resulting from improved practices. Both require a sufficiently accurate baseline of information to make accurate claims about changes resulting from improved practices. These two approaches are further explored here.

PRACTICE-BASED MONITORING

Monitoring practices focuses on the management decisions within a project, including how cropping systems are stewarded, how relationships are formed, how markets are designed, and how humans and animals within the system are treated.

Most current agricultural certifications, such as Fair Trade and USDA Organic, are practice-based. Businesses often adopt internal control systems to mitigate risk and increase efficiencies. These compliance-based processes monitor that a specific set of practices are implemented in accordance with the standards of the certification or protocol. Practice-based monitoring, looks at what practices did or did not take place within a particular program. This approach generally relies on farmer self-reporting, often with supporting input documentation and brief or periodic third-party audits. In many instances, practice-based monitoring can be easier, lower cost, and requires simpler technology than outcome-based monitoring. The practices being measured are assumed to be a proxy for a set of desired outcomes. Often, practice-based monitoring systems look towards indicators that have reliably supported regeneration — such as ecological health or social wellbeing — in other contexts. For example, if regeneration is defined by an increase in soil health (outcome), the practices that may be monitored could include maintaining soil cover, reducing tillage, reducing chemical inputs, diversifying crops grown, and perennializing the cropping system.

OUTCOME-BASED MONITORING

Several emerging monitoring methods are outcome-based. This approach directly measures outcomes to ensure that intended impacts are achieved. In the soil-health example above, instead of monitoring the practices that intend to support soil health, measurements could be taken to provide evidence of that outcome itself, such as an increase in earthworms, water holding capacity, and soil texture.

Because of this directness, outcome-based verification can enable greater precision and confidence in the desired social, environmental, or economic impacts, and can enable producers to select practices based on their own context and needs as long as the intended outcomes are realized. This creates the opportunity to reduce unproductive bureaucracy and practices potentially not suitable within a given context.

Depending on the degree to which outcomes are quantified, they may require more financial resources and technical capabilities. As the industry develops, outcome-based methods may become more prevalent, advanced, and affordable due to scale and technological advances. It is also likely that as consumer awareness continues to increase, demand will grow for evidence that regenerative agriculture is indeed supporting consumer values of environmental health and social wellbeing. In order for brands to make disclosures related to their sourcing impact, outcome-based monitoring is crucial.

BALANCING ACCURACY, FEASIBILITY, AND CREDIBILITY OF INDICATORS AND METHODOLOGY

When choosing indicators and the methodology for assessing them, three factors of accuracy, feasibility, and credibility should be considered.

ACCURACY

By "accuracy" we mean that there needs to be reasonable agreement between estimates generated by the accounting methodology and the "true" values found through field research (Wells et al. 2017). In other words, indicators and methods should be selected so that findings are likely to reflect realities on the ground. In terms of accuracy overall, several studies point out that — especially in research on ecosystem services and natural resource management — there will always be inherent imprecision given the complexities that exist across multiple scales in landscape-related research (see e.g. Vorstius & Spray, 2015). Furthermore, several field-based studies argue that, in environmental monitoring, the assumption that more technologically complex methodologies necessarily lead to more accurate results is a relatively common misconception (see e.g. Caughland & Oakly, 2001). Often, what matters most in terms of achieving accuracy is less about methodological complexity in itself, and more about achieving higher data resolution, such as higher quality aerial photography or more data collected on the ground (Ibid.). See the sub-section titled "Credibility" under the "Farmer Survey" section for more on this point of data quantity leading to data credibility.

FEASIBILITY

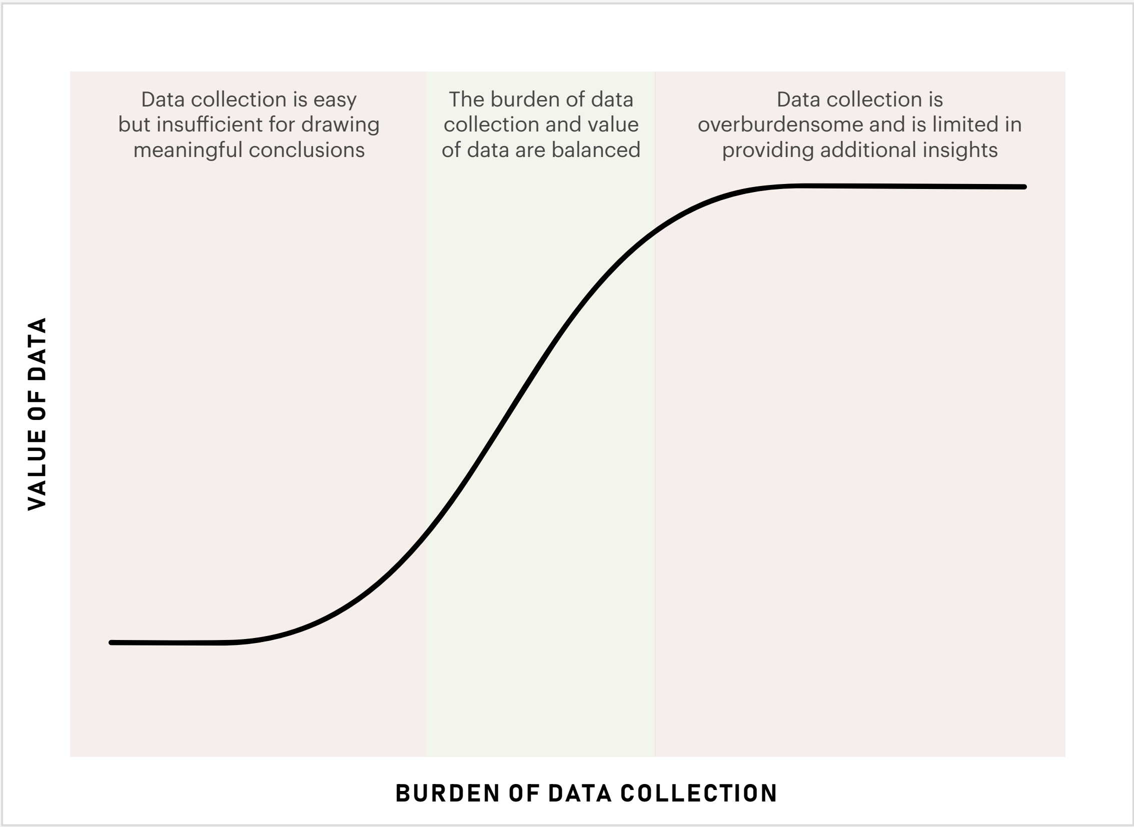
The selected methodologies need to be understandable, accessible, and doable for those collecting the data on the ground, including smallholder community members. They also need to be time and cost-effective for all parties. The basic methodology framework needs to consist of methods that are simple enough to be operational from the ground up, while thorough enough to enable defensible claims around insights (ie impacts) to be made. The methodologies must also be expandable and evolve to meet the needs of the initiative as more cooperatives join, avoiding structural bottlenecks. Within this criteria, it is useful to find balance between brevity and depth of foci. As projects look to scale, feasible (read: repeatable) methodologies will be most helpful. Building capacity and capability, as well as beneficial relationships with partners, are all desirable pathways to follow.

LESSONS LEARNED ON THE GROUND: THAILAND

When developing the farmer survey for the Thailand rubber origin, we had to ask ourselves, "Where is the happy medium for the length of the survey?" Initially the survey took 2 hours to complete, and that was too overwhelming for the producers. Thus, it needed to be downsized. To do this, we narrowed it down to key indicators that the community felt were most relevant to their agroecological and social systems. As a result, the survey was shorter and more enjoyable for the data collectors. Doing the survey as you move through the farm is pleasant, and farmers have an interest and pride in showing what they have accomplished.

CREDIBILITY

For the accounting to be effective, the selected methodologies need to have perceived value and credibility in the eyes of all involved parties. This necessitates a balance between the previous criteria, which — if done well — should support the building of trust and transparency between the producer community, buyers, and industry experts. This criterion points to the level of trust that the selected methodologies need to be able to facilitate.



The relationship between the intensity of data collection (burden) and the value of data is non-linear. The exploration of processes to increase value of data (credibility, accuracy) whilst maintaining low levels of burden (feasibility) is a central focus.

STRATEGICALLY IDENTIFYING INDICATORS

In the process of engaging with community stakeholders, nodal indicators start to arise. An indicator can be "nodal" in the sense that a small expenditure of effort to monitor it can have ripple effects across the ability to better understand the whole system. Producers on the ground and local researchers are stakeholders who are most intimately involved within these systems. Through their experience, they may be best positioned to identify a single indicator that can provide multiple insights at once. Using multiple nodal indicators can thus give holistic insights into the state of a system.

LESSONS LEARNED ON THE GROUND: THAILAND

A process was employed to learn from the producers about their relationship with their system and what indicators they look to to understand whether regeneration is actively taking place. These Thai producers spoke about the significance of mushrooms and how their presence (and their increased prevalence) can tell one a lot about their systems. Rather than the single indicator providing a single insight, the presence of mushrooms informs the producers about soil health, water holding capacity, decomposition rates, bio-chemical health, and ecosystem-wide wellbeing. Further, an abundance and diversity of mushrooms supports the social aspects of the community, including access to medicines and food. Importantly, the presence of mushrooms can be cross-verified with geotagged photos and automated (or human-powered) systems for verifying mushroom genus and species. Thus, monitoring the species diversity and abundance of mushrooms has given this community a multitude of insights.

SCOPE OF MONITORING

When monitoring regeneration within a project, multiple levels can be assessed. This approach not only qualifies regeneration within each farm engaged in a project, but also how that collective change has impacts on the social experience of the community at large and the ecological regeneration of the landscape more broadly.

DYNAMIC VS STATIC INDICATORS

As described above, industry standards and the perspectives of on-the-ground stakeholders can both inform which foci and monitoring methods are preferable for a particular project. Due to their nature, these standards and perspectives are likely to change over time. While this can ensure that data is highly relevant to a project as it evolves, using this data to track changes over time can be nearly impossible if indicators and their monitoring methods vary from year to year.

VARIABILITY VS CONSISTENCY

What may vary over time are the indicators that are identified as most important and relevant within a particular project. What remains consistent is the value of drawing upon stakeholders and place to identify which indicators are appropriate.

Forms of Measurement

Measurement of indicators can take place via multiple collection points, including remote sensors, on-the-ground producers, and industry experts.

REMOTE SENSING

According to the USGS, remote sensing is the process of detecting and monitoring the physical characteristics of an area by measuring its reflected and emitted radiation at a distance (typically from satellite or aircraft). Special sensors collect remotely sensed images and data, which help researchers monitor or view conditions about the Earth. Put another way, remote sensing generates visual evidence of the status of landscapes and can be used to understand the history of a place in comparison to its current state. These data — depending on their resolution — can demonstrate changes on Earth's surface over time relating to deforestation, land cover, hydrology, ecosystem connectivity, among others. Researchers are exploring the potential of remote sensing to assess forest and biomass density to draw conclusions of living carbon, but the science is as of yet inconclusive — better satellites and new algorithms are needed. Remote sensing data is often most valuable when used in concert with ground-truthed data, or data that has already been collected on the ground. When working in concert with ground-truthed data, remote sensing can provide data for insights that may otherwise be difficult to obtain through manual surveys.The remote sensing industry was founded by governmental institutions during the 1960's space race, many of whom have since open-sourced the majority of these data (e.g. the data provided by the Sentinelle, Landsat satellites). Today, there are numerous for-profit remote sensing entities offering increasing image resolution and frequency of data collection (Planet Labs, Pachama, Ceres Global, etc.). The primary limitations of remote sensing technologies are the resolution of the data, the spectral bands that are collected, and the frequency of data collection.

FARMER SURVEY

Farmer surveys are heavily utilized in the data collection process within the regenerative agriculture pilots. As such, we elaborate here on the methodologies, credibility, and opportunities of this approach.

METHODOLOGY

Using the considerations outlined in the section on Technical Design and Methodology, producers are engaged to co-create surveys that incorporate indicators and measurement methodologies suitable for their landscape, ecology, culture, and personal interests. The surveys are deployed either via mobile application or paper survey, and information is collected via data collectors who work with the farmers and are often farmers themselves. Data is used to generate a baseline measurement of the system, which can be used to compare to historic data from satellite imagery or to future data collected with the same survey in future years.

Image: CABI

VARIABILITY VS CONSISTENCY

What may vary over time are the methods used to collect data via farmer survey. What remains consistent is the value of drawing upon stakeholders and industry advancements to identify which methods are appropriate.

LESSONS LEARNED ON THE GROUND: ECUADOR

This project has identified the importance of turning to the community to determine appropriate monitoring methodologies by asking producers and local agronomists, “What would be the best way to measure ___?” From this inquiry, it has been valuable to incorporate the feedback and further co-design the process with the community. This approach is valuable in order to increase community buy-in for the survey once it is deployed. This process enables the survey to provide value to the community itself and can support more accurate data collected — assuming that if producers care about the survey, they will answer the questions more thoughtfully.

OPPORTUNITY

There are strong arguments for the active use of citizen science (read: farmer survey) approaches when monitoring larger scale environmental changes over time, as data granularity remains detailed and cost-effective compared to third party led approaches (Billaud et al. 2021). This level of granularity should ensure robust data collection alongside the building of relationship between the producer communities and buyers.

In addition to farmer monitoring, farmer-to-farmer verification is largely inspired by the Participatory Guarantee System (PGS) model. PGSs are ''locally focused quality assurance systems that certify producers based on the active participation of stakeholders and are built on a foundation of trust, social networks, and knowledge exchange" (source). In a PGS, farmers, customers, and potentially other stakeholders work together to develop the standards and guarantee protocols for their production systems. PGS systems are common in emerging organic markets and are widely used in communities, including those we are engaging in Thailand. The PGS — as inspiration for general peer review and verification framework — engages the farmer as an expert. It provides a structure for farmers to be active participants in the data collection and verification process, increasing their input and involvement in farm monitoring. Importantly, this process not only facilitates data collection but also knowledge sharing and grassroots farmer capacity building. As farmers visit and review other farms, they observe different farming practices and learn from those farmers how their management styles have contributed to various outcomes. This process integrates capacity building with data collection processes. Through peer review and verification, this approach aims to engage farmers as experts and to foster knowledge sharing within producer communities.

CREDIBILITY

A perceived challenge of survey-based data collection is collecting data that is accurate and credible via stakeholder assessment. It can be reasoned that producers — who have no formal training in ecological monitoring — are likely to make mistakes. Yet, significant research around the validity of citizen science and community science debunks this concern. Numerous studies have found that citizen scientists can collect data of comparable quality to professional scientists (see, e.g. Balazs and Morello-Frosch, 2013 and Steinke, Etten, and Zelan, 2017). Further, this monitoring method enables significant quantities of data to be collected, which as the Wisdom of the Crowds principle identifies, increases the accuracy of data collected. Writings on this approach argue that a distributed methodology is recommended where the producer communities are reporting most of the stat. Such an approach is likely to support the building of a strong sense of equity, credibility, and transparency, especially within the producer communities (Wells et. al, 2017).

3RD PARTY RESEARCH

Research conducted by a third party can provide additional richness to collected data. Firstly, engaging research professions can validate farmer-survey methodologies as well as ground-truth the collected survey data. When surveys may struggle to gain in-depth metrics of a certain indicator, researchers can add robustness to the data by collecting information that may be difficult to obtain otherwise. Further, the credibility that third-party researchers hold can increase buy-in from additional industry stakeholders. This layer of data collection (and the publication of findings) can amplify awareness about regenerative systems development in other countries, communities, and contexts to increase rate of adoption. This is likely to build momentum for regenerative practices and outcomes, and can establish a baseline of understanding for future research to build off of.

Paradigms of Data Collection

Underlying the functional design considerations iterated above is the paradigm within which data collection takes place. An extractive paradigm of data collection is one that designs for one party or stakeholder to benefit more than others involved. It extracts from communities and ecosystems to generate data insights. If asked, “what does extractive data collection look like?”, one might describe scenarios in which data was collected forcefully, without reciprocity, or in a manipulative manner. It is important to consider that extraction is not always so explicit. Undermining cultures, taking advantage of social power differences, or ignoring the unique context of an ecosystem or community all are representative of an extractive approach to data collection.

If an extractive paradigm sits at one end of the spectrum, what does the other end — a regenerative paradigm — look like? Put another way, how can the process of data collection, and the design of that process, uplift life and wellbeing in all parts of the system it is involved in?

A regenerative paradigm of data collection should align with the following principles:

- Builds a community's power and capacity within the global network they are a part of
- Develops social cohesion amongst community members
- Supports community learning and agency
- Contributes to community's ability to achieve locally-relevant goals
- Honors the wisdom of community members, even as / especially when they are sourced from a different culture or worldview than those with more power in the project
- Enables a community and the place they are a part of to evolve over time
- Focuses on communities of people, land stewards, and smallholders and key informants
- Smallholder data collectors as owners of the data, rather than individuals from whom data is extracted

VARIABILITY VS CONSISTENCY

What may vary over time are the monitoring tools, verification methodologies, demand for data collection, etc. What remains consistent is that producers should maintain power and overship over their data and be compensated for their licensing of it to other users. Data collection can quickly become extractive, and all MRV systems should be designed to uphold the principles outlined here.

What Monitoring, Reporting, and Verification can Enable

CLAIMS GENERATION

Investors in a cropping system — whether they be buyers, project developers, farmers, or third parties — may want to be able to communicate about the impacts of their work. Currently, brands that purchase from agricultural systems are being pressured by their industry to minimize their impact. Oftentimes, claims around impact reduction — whether a change in biodiversity or carbon footprint — can be viewed skeptically if there is no data to back the statement. Monitoring and verification can yield data insights that provide credibility to these statements.

DATA AS AN ECONOMIC DRIVER

If a monitoring and verification system is designed to support data sovereignty, farmers own the data they collect and can receive compensation for licensing its use to other parties, such as those who buy their crop. This provides an additional stream of income to producers. The data can be sold more than once and be related to each product grown in the surveyed system. As a result, when farmers diversify their production systems, the data associated with each crop can provide economic value.

INFORMED INVESTMENT AND MANAGEMENT

Data insights can be accessed by multiple stakeholders to inform the way they invest in or manage the production systems and overall program. For example, if a farmer cooperative sees that many producers within their network have not adopted a particular practice, they can evaluate the usefulness or relevance of that practice and consider if additional supporting instruments — such as technical assistance — may be necessary to support adoption. Further, if producers and buyers are consistently not seeing the outcomes they intended to generate, they can make an informed decision to adjust management practices or programmatic design.

COMMUNITY COHESION

The pilot projects have demonstrated the value of engaging communities in the data collection process. Designing data collection through farmer surveys enables a participatory, peer-to-peer process in which producers can learn from one another and apply those lessons learned to the work they are doing in their landscapes. Collectively, this can enable whole communities to achieve desired outcomes, rather than outcomes being on a farm-by-farm basis alone.

LESSONS LEARNED ON THE GROUND: THAILAND

In Thailand, the project was designed around principles of Wanakaset, or community-level self-reliance. We have seen a strong correlation between the diversification of the production systems and the community's ability to work towards this principle. When producers are asked, "Where did regeneration happen and where did it fail?" they can reflect not only on the results of their individual farm but on the changes that they see across their whole community.