

Financing sustainable agriculture and mitigation: Smallholders and the Inari system of finance

Working Paper No. 52

CGIAR Research Program on Climate Change,
Agriculture and Food Security (CCAFS)

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RESEARCH PROGRAM ON
**Climate Change,
Agriculture and
Food Security**



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Correct citation:

Alforte A, Matias D, Munden L, Perron J. 2013. Financing Sustainable Agriculture and Mitigation. CCAFS Working Paper no. 52. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen, Denmark. Available from: www.ccafs.cgiar.org

Titles in this Working Paper series aim to disseminate interim climate change, agriculture and food security research and practices and stimulate feedback from the scientific community.

This document is published by the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), which is a strategic partnership of the CGIAR and the Earth System Science Partnership (ESSP). CCAFS is supported by the CGIAR Fund, the Danish International Development Agency (DANIDA), the Australian Government Overseas Aid Program (AusAid), Irish Aid, Environment Canada, Ministry of Foreign Affairs for the Netherlands, Swiss Agency for Development and Cooperation (SDC), Instituto de Investigação Científica Tropical (IICT), UK Aid, and the European Union (EU). The Program is carried out with technical support from the International Fund for Agricultural Development (IFAD).

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Abstract

Key messages:

- Smallholder farmers and forestry producers have a crucial role to play in food security, sustainable land use and emissions reductions initiatives.
- Producers and investors alike require appropriate incentive structures to facilitate participation in sustainable land use initiatives.
- A networked financing approach—Inari—may provide an innovative response to financing sustainable land use via intelligent diversification and addressing the finance needs of smallholders.
- Diversification requires the development of a more holistic risk model for investment in smallholder agriculture and forestry, which will be tested in a number of developing countries in 2013 and 2014.

Keywords

Sustainability; IFAD; Climate change; Climate financing; UN; FAO; Land use; Products; Finance; Small farms.

About the authors

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Acknowledgements

This article was researched and written with support from the CGIAR Research Program on Climate Change, Agriculture, and Food Security (CCAFS), funding from the European Union (EU), and technical support from the International Fund for Agricultural Development (IFAD).

The Munden Project donated time and effort to research and writing this report. The Munden Project aims to design and show how to implement sustainable, responsible practices at scale.

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Introduction

Stepping out of the shadows: how smallholders came to our attention and why we think they're important

Climate change is already a reality. Even if we immediately stopped emitting greenhouse gases, agriculture and forestry are sectors that depend on a stable climate to pull resources from the land, and these stable patterns are already going to be interrupted. This means that those sectors will inevitably have to adjust.

For better or worse, our ability to mitigate climate change will largely depend on money. To alter their practices, producers will need favourable incentives that include realistic means for improving their livelihoods or increasing food security. The investors financing producers' shifts in practices likewise will need incentives, which often mean a realistic chance of earning income. Therefore, one of the most critical factors in promoting sustainable land use at scale is the provision of appropriate and attractive incentive structures to facilitate both producer and investor participation.

For several years, the Munden Project has been engaged in an in-depth examination of how to do this. This effort has resulted in an investment scheme that will combine different kinds of credit extended to sustainable practices in agriculture, forestry and agroforestry. Called 'Inari',¹ the scheme is a networked financing approach that aims to better catalyse private sector investment in sustainable land use.

Initially, we never even considered the possibility of financing the millions of smallholder agriculture and forestry producers who comprise an estimated 85% of farms worldwide.² Regrettably, we never reviewed expert opinions stating that these producers represent a ripe opportunity for investment in, and promotion of, sustainable land use practices.³

And we certainly never understood that smallholders – particularly those in the developing world – often lack sufficient access to the upfront capital resources and credit delivery systems necessary to adopt more sustainable practices, as well as the long-range finance needed to maintain them.⁴

Not charity: Smallholders hold our future in their hands

When we reviewed information produced by the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), the pattern that emerged left us convinced that smallholders not only could be included in Inari, but they collectively form a vital piece of the sustainability finance puzzle Inari seeks to solve.

Among experts, there are many specific definitions of a “smallholder,” but they generally converge around the concept of people “operating a small area of land (compared to the national average) that uses no, or limited, hired labour.”⁵ The term encompasses a diverse range of stakeholders cultivating land parcels of varying sizes⁶ with a wide variety of land use practices, each with varying needs and incentive structures.

Consequently, we aggregate “smallholders” here by drawing on their commonalities of relatively small acreage of managed land, a size constraint largely caused by reliance on family in lieu of hired labour or mechanization and a lack of surplus capital.⁷

And there we find the answer to our question: unlike other land-use operators, historically a smallholder could only be so big – not because of the size of land available, but instead because of the labour available to exploit it. Land constraints exist in many countries now, so it is also often difficult for smallholders to acquire additional land, especially if it needs to be purchased.

With that said, the physical footprint of any one smallholder should not mislead us into thinking that the impact and importance of all smallholders globally is anything but large.

Take environmental impact as an example.⁸ The vast majority of agricultural emissions (74%) are attributable to regions where smallholder farmers are most prevalent,⁹ predominantly in the developing world.

Smallholders also stand out in their aggregate importance to the food system. Smallholders are responsible for an estimated 80% of food production in the developing world, most notably in Southeast Asia and Sub-Saharan Africa.¹⁰ Agriculture is a primary driving force of livelihoods in much of the developing world,¹¹ with three-quarters of the world’s rural poor relying on agriculture for their livelihoods. Therefore, the sustainability of land-use practices has a direct bearing on food security, livelihoods and economic security, as well as a connection with poverty reduction efforts.¹²

Yet, significant new investments are needed to meet projected increases worldwide in agricultural demand in coming decades, and to improve food security for millions across the globe.¹³ The Food and Agriculture Organization of the United Nations (FAO) has estimated need in the range of \$9.2 trillion by 2050.¹⁴ To meet the increased demand without increasing impacts on the environment—including climate—smallholders will need to play a vital role in the promotion and adoption of more sustainable land use practices.

Furthermore, with the growing spectre of climate change, 56% of crops in Sub-Saharan Africa and 21% of crops in Asia are anticipated to be adversely affected by mid-century.¹⁵ Moreover, the United Nations Development Programme’s (UNDP) 2013 Human Development Report warns that climate change stands to “halt, or even reverse” the last two decades of poverty reduction gains.¹⁶ Therefore, assuming that development of low-emissions smallholder agriculture can contribute to climate change mitigation, significant consideration and investments must also be channelled toward reducing greenhouse gas emissions contributing to climate change, as well as better understanding and learning how to prepare for and adapt to the effects.

Smallholder barriers to finance for sustainable land use

Establishing sustainable land use practices takes time and needs environmental and financial support in the initial months or years to take root. For example, a multi-crop system of durian, pepper, coffee, green bean, and betel nut needs at least three years before one of its crops became productive.¹⁷ If cash expenses were required, these costs would not be recovered until the system is organized and productive-enough to also sell products. This delay in productivity and returns is one of the most significant barriers that smallholders face in adopting improved sustainable, low-emissions land-use practices.

Smallholder producers face significant barriers to capital access and effective credit delivery systems



Photo: The Munden Project

Smallholders in Claveria in the Misamis Oriental Province of the southern Philippines experience challenges in accessing capital for sustainable land use practices. Producers in this region, like many producers in emerging markets, face prohibitively high interest rates – ranging from 15-20% per month – for capital finance. Such examples highlight the clear need for improved modes of capital access for smallholder producers.

The challenge is therefore to provide sufficient up-front capital resources to transition to such practices, and the necessary information, technology, and material or human resources to enact them.¹⁸ Lack of, or low access to, affordable credit delivery systems and options exacerbates this problem and is associated with low productivity and unsustainable land use practices.¹⁹

Smallholders also face natural, governance, market and informational challenges in the adoption of more sustainable land use practices, as discussed in the example in the text box below. Without appropriate financial incentives in place, and clear steps toward surmounting these barriers, smallholders are unlikely to view such practices as viable, much less desirable.

Barriers to smallholder engagement in sustainable land use practices

- **A lack of access to upfront capital and affordable and effective credit delivery systems**
- **Weak land tenure or property rights**
- **High finance interest rates**
- **Short-term loan maturities**
- **Inflexible loan repayment schedules**
- **A lack of access to sufficient technical resources or expertise, or to extension services**
- **Lack of sufficient labour capacity**
- **Price volatility in the sale of goods**
- **Barriers to market access or insufficient transport systems**

Yet by virtue of smallholders' limited scale of operation and the perceived absence of a sufficient business case to warrant investment, international finance for sustainable land use practices has been largely absent in the smallholder sector. This has resulted in ineffective credit delivery to smallholders and shortcomings in risk management have led to high interest rates, short maturities, and inflexible payment schedules.

Proposed solution: Inari design concept

Inari is a networked financing approach designed to catalyse capital investment in sustainable land-use practices among smallholders and others by driving down the risk commonly associated with these investments. Targeting agriculture and agricultural commodities has the potential to attract private-sector involvement at scale for climate change adaptation and mitigation, while also generating important “non-carbon benefits” such as poverty alleviation and improved biodiversity management.

Inari’s purpose is to drive a number of public benefits under the banner of sustainability: improved environmental integrity, enhanced food security, and improved rural livelihoods. It does so by using a networked portfolio approach to aggregate producer initiatives. The differing size, location and production cycles of the borrowers can be used to reduce the risk from any single project, as well as smooth the overall cash flows of the portfolio.

Inari’s Innovative Design

Portfolio Approach

The differing size, location and crop cycles of the various borrowers can be used to reduce the risk from any single project as well as smooth the overall cash flows of the portfolio.

True Sustainability

Sustainability is a major factor in selecting obligors. Inari will specifically target borrowers that either currently employ, or have a clear path to the establishment of sustainability practices (general financial concepts, like asset-backed securities, are indifferent to this consideration).

Investment, Not Speculation

Inari’s securities are tailored for investment, not speculation. This differs from proposals for land-based carbon markets, which rely on the existence of purely speculative markets to generate liquidity.

Credit Markets

Inari targets a large pool of existing capital instead of relying on the creation of a new and different asset class (such as carbon or PES). This is important, insofar as size of credit markets matches the enormous scale of the finance required for sustainable land use.

Global Scope

Inari’s focus is on sustainability and is not restricted to either the developed or developing world. Sustainable land use is a universal issue, and this global perspective enables us to look at more options in constructing a portfolio of projects.

Technology

From enabling frameworks to the significant parallel communications required for network participants to the algorithms needed to generate low-risk securities, Inari leverages technology in a very new and different way.

Inari would invest in sustainable land-use practices in agriculture, agroforestry, and forestry, as well as the infrastructure that transforms the outputs of those activities into market-ready products. Thus, Inari's investment activities will have much greater breadth than usual financial investments. Table 1 highlights examples of sustainable practices Inari might seek to finance.

Table 1: Potential techniques and practices for improved sustainable land use²⁰

Adapted livestock and pasture management	Integrated pest management ²¹
Afforestation and reforestation (A/R)	Integrated plant nutrient management ²²
Agro biodiversity ²³	Intercropping ^{24,25}
Agroforestry (e.g., multi-story, timber-based)	No-till farming ²⁶
Bioenergy production and use	Organic farming ^{27,28,29}
Composting ³⁰	Permaculture ³¹
Conservation agriculture	Reduced deforestation and forest degradation
Crop rotation	Silvo-pastoral systems
Cropping practices e.g., altered planting times	Soil conservation
Cover cropping	Sustainable land management practices ³²
Diversification of crops, practices, & farm activities ^{33,34}	Use of weather, seasonal, and climate information
Drought-resistant crops ³⁵	Water conservation, management, harvesting ^{36,37}

As standalone prospects, each of these investments might seem too risky. This underpins the rationale for a networked financing approach: the aggregated cash flows of these operations might represent a significantly underappreciated investment opportunity. From a private finance perspective, the inherent diversity of the practices might create a compelling way to reduce risk – and from a public perspective, there is considerable benefit in the effect diverse practices will have in mitigating and adapting to climate change.

This concept has a direct bearing on smallholders. First, they are almost universally too small to justify the costs of due diligence that are inherent in any investment process. In our estimation, this is true even if they are bundled at a regional level. Second, the specific risks associated with how smallholders generate products – and perhaps more importantly, how they turn those products into revenue – make them a very difficult investment to justify.

Finance in the field: Connecting Inari with smallholder practices

To translate this potential into reality, we are targeting and visiting potential sites to better understand the specific production and market risks associated with Inari's initial set of loans. The Munden Project has conducted field visits to sites in the Philippines and Vietnam to examine this problem more closely.

The Philippines

In late 2012, we observed field trials of multi-story agroforestry systems in Claveria, Misamis Oriental province in the southern Philippines. This region is a rural upland with extremely high soil erosion rates. This erosion is problematic both for farmers in the immediate area and inhabitants of the lowlands that receive the impacts of such erosion.³⁸

To combat erosion, farmers are beginning to turn to agroforestry. Field trials are underway to examine techniques to achieve optimal intercropping of a rubber species that produces both latex and timber with coffee, cacao, banana and snake fruit or with cassava, rambutan, and lansones. The rubber timber trees store carbon and therefore also provide a climate change mitigation benefit.

Control plots of open areas planted with stand-alone trees had drier soil, smaller banana trees, and fewer cacao fruits compared to the agroforestry system, where the crops were grown together with the rubber tree clone. The bigger trees and increased abundance of fruits in

Multi-story agroforestry in the Philippines



Intercropping with banana and snake fruit



Photos: The Munden Project

the agroforestry plots will potentially translate to better economic returns, and farmers in Claveria are therefore eager to adopt the rubber timber-latex clone. Trials showed that the rubber timber-latex system was more financially sound than plots with other timber species, as harvest times were four years for rubber trees vs. ten to fifteen years for hardwoods.

Interviews with farmers revealed that poor access to finance was a major obstacle to implementing these systems. Farmers expressed interest in applying these practices at a much larger scale, but they lacked financial means to do so. Some smallholders (defined as having farms smaller than 2.5 hectares in this community) were obliged to work as daily laborers in bigger (and unsustainably managed) plantations because they lacked capital to develop their farms.

Where credit was available, it was inordinately expensive. Farmers said that current loan systems in the area had high interest rates. For example, a cooperative that lent Philippine Peso (Php) 100,000 (USD 2,249) charged 16% per month for yearly payment). Further, the national agricultural bank (Landbank) only allowed longer-term payments for Php 500,000 (USD 12,243) loans, which farmers considered too large a sum to borrow. Some farmers also reported that they sometimes acquired seeds on credit with a *monthly* interest rate of 18%.

The reason for these high interest rates became apparent shortly after these field visits were conducted. Claveria was devastated by a powerful typhoon in December of 2012,³⁹ with dramatic effects on all forms of agricultural production. If an investor had placed an all-or-nothing bet on the region, then the investor would have been lost (financially speaking, at least). And indeed, most providers of credit in Claveria are regional, which means they lack diversification.

Inari's networked finance approach would limit these losses by spreading investments across a wide range of countries. In so doing, the approach also reduces the interest rates charged to producers. By only financing sustainable practices, a competitive advantage is created for sustainable land use relative to conventional approaches.

Vietnam

The Northwest Vietnamese uplands are a top priority for sustainable agricultural practices (locally known as conservation farming), due to 10.2 million-hectare size of the agro-ecological zone, its eroded soils, and the relatively low forest cover of nine percent.⁴⁰

Crop diversification in Viễn Sơn commune in the Van Yen district of Yen Bai city, in Vietnam



Photo: The Munden Project

The Northwest uplands of Vietnam remain predominated by monoculture production of maize and rice. Efforts at better incorporating sustainable practices such as the diversification of crop portfolios, is likely to result in improved biodiversity and livelihood outcomes.

The Munden Project visited the Viễn Sơn commune in the Van Yen district of Yen Bai city, which practices a century-old tradition of growing organic cinnamon (*Cinnamomum cassia*) on over 2,000 hectares of land. This commune is known for its high-quality cinnamon, with leaves yielding 50% cinnamon oil compared to only 20% in other communes. In addition to oil, Viễn Sơn's cinnamon trees produce spices from its bark and furniture from its timber. One cubic meter of cinnamon wood fetches a price of 1,000,000 Vietnamese Dong (VND) or 48 USD. One liter of cinnamon oil sells for 600,000 VND (29 USD), while cinnamon bark is bought at an average price of 200,000 VND (10 USD) per kilogram. Most products are exported to Taiwan, USA, and India.

A two-hundred hectare area of land formerly used for slash-and-burn agriculture is now in the pipeline for reforestation, and the commune proposes planting cinnamon trees as part of the restoration. For them, cinnamon is easy to plant, pest-free due to its spicy taste and aroma, and is productive from the crown to the trunk. Cinnamon guarantees steady harvest over its economic lifecycle of 15 years, it has a long and has an established market, which explains why research demonstrates that cinnamon production tends to be correlated with higher incomes in the area.⁴¹

The challenge for producers in Viễn Sơn is getting the chance to earn those higher incomes. Established financing practices in the area require that most operating loans be repaid within one year, whereas establishing a cinnamon seedling for planting alone takes almost that long. Consequently, longer-maturity credit (loans that are paid back over longer time periods) is needed. **This is exactly the type of credit Inari seeks to provide.**

Agro ecology in Viễn Sơn, Vietnam



Photo: The Munden Project

Viễn Sơn region in NW Vietnam is a prime location for agro-ecological techniques and improved land use and conservation practices. The region has suffered from heavy deforestation, lowered soil productivity, and consequent lowered agricultural yields. A two-hundred hectare of land, which was formerly used for slash-and-burn agriculture, is now in the pipeline for reforestation using organic cinnamon.

Kenya and Brazil

Additional scoping is also underway in Kenya and Brazil, both of which reveal interesting challenges with implications for the Inari model.

It is estimated that 12.5 million hectares in Sub-Saharan Africa are planted with cowpea (*Vigna unguiculata*) by small-scale farmers.⁴² Mono-cropping cowpea is profitable; however, farmers still often plant cowpea in intercropping systems with maize, millet, sorghum and other cereals because they would like to maximize their harvests and farm income.

The Kenya National Dry Land Research Center in Katumani conducted a study to determine yields and profitability of cowpea monoculture and cowpea-maize intercrop.⁴³ They found that the cowpea intercrop treatment improved maize yield, but reduced cowpea yield. Despite this, economic returns were higher in the cowpea intercrop system compared to the cowpea mono crop. The costs of establishing and maintaining a cowpea intercrop system are higher than its mono crop counterpart, and it appears the timing of the returns on that investment can be quite variable.

A similarly interesting case study exists in Brazil, which is set to overtake the United States as the world's top producer of soybeans.⁴⁴ Brazil's massive increase in soybean yields has been

made possible with the use of non-renewable resources such as fertilizers, pesticides and hybrid seeds and has contributed to adverse environmental impacts through clearing of the Brazilian *cerrado* and forests in the southern Amazon.

A study by the State University of Campinas indicates that it is more profitable to process the soybean in Brazil and sell finished products in the international market than export raw soybeans. Moreover, researchers observed that “actual soybean prices are subsidized by the non-payment of negative externalities” and explained that if negative externalities of soybean production were considered, soybean would give a *negative* return to Brazil. Indeed, nutrients exported with the Brazilian soybean cannot be recycled back to the area where the soybean was produced, resulting in broken nitrogen and phosphorous cycles and losses of these nutrients to the soils.⁴⁵

In addition, agricultural production of Brazilian soybeans utilizes more resources than any other stage in its value chain. Improvement in the management of this stage – which will result in the overall improvement of the soybean supply chain⁴⁶ – requires more sustainable agricultural practices (such as no-till planting). However, investors – and more importantly, producers – fear that the adoption of these more sustainable practices will result in more year-to-year variance in yields.

Whether in Brazil or Kenya, the problem is not unique: many sustainable practices generate “lumpy” or uneven cash flows. For such systems, Inari is designed to allow payments on a variable schedule. Due to diversification in the Inari system, the “lumps” will be occur at different times depending on the location and practice, and if sufficiently numerous and diverse, can be blended into a single, smooth payment stream.

From farm to finance: Quantifying risks for smallholder operations

Opportunities to apply Inari in places like the Philippines, Vietnam, Kenya and Brazil are only possible if the system has a sensible assessment of risk. There must be a quantitative basis upon which to ensure that the aggregation of Inari producer loans is, indeed, reducing risk via true diversification.

This section describes the general framework for assessing risks and that we will be testing and refining in 2013 and 2014.

Production risks

Production risks encompass all factors that are important in getting a crop out of the ground. These are mostly natural or environmental indicators, which can be difficult to predict but must contribute to any assessment of a production system’s viability. There are two concepts in this area:

Physical factors

- Climatic and meteorological conditions, such as number and type of seasons, amount of rainfall and sunlight in a given period, temperature, wind, and relative humidity

- Physical and chemical soil characteristics (topography and pH, depth, nutrients, water holding capacity, etc.)

Biological factors

- The crop: its lifecycle and requirements
- Pests and diseases affecting both crop and soil.

Crop-related biological factors (nutrients needs, water needs, etc.) are stable over the producer's timeframe; however, the introduction of new varieties of crops and physical factors such as soil erosion and climate change can change quickly.

Non-production risks

Non-production risks are unnatural or non-environmental factors that indirectly affect how that production translates into the final outcome of all saleable goods: namely, cash. Non-production risks can be broken into four concepts: market, infrastructure, socio-political and financial.

Market risks

The central component of market risk is price. Some of the key elements that affect prices include:

- Quantity of supply – Excess supply leads to depressed prices; conversely, scarcity of supply causes prices to rise.
- Type and quality of the products – Different product qualities command different prices, especially on international markets with existing standards. In addition, some products command a premium, such as organic, certified products. Moving up the supply chain by selling processed, instead of raw, products may also result in higher prices.
- Access to market – Farmers cannot always sell their products directly to end-users; they must resort to middlemen that take a portion of the profits. A greater degree of dependence upon these middlemen leads to a less optimistic risk assessment, particularly in situations where there are a) few of these middlemen or b) farmers are captive to a single middleman for crucial market access. Such scenarios usually limit access to market, making it difficult for the farmer to get a competitive price for his product.
- Access to market information – Farmers may not have access to up-to-date market information. Middlemen and others can, for instance, take advantage of such lack of information and not offer the current market prices to farmers.
- Exchange rates – When market prices are denominated in a strong currency (like the US dollar), but farmers are still paid in local currency, changes in the exchange rate directly affect their revenues. Inari will address this directly by favoring farmers that sell locally or regionally, and outside of commodities markets.

To a lesser extent, market risks also reflect the *structure* of the market: farmers may be facing a monopsony situation where there is only one buyer. Farmers have little recourse if, for example, the only buyer decides to lower the prices, or even not pay at all.

Inari would prefer to see competitive markets where producers can negotiate for higher prices – although this may not be possible in all regions or for all products.

Infrastructure risks

Infrastructure risks comprise two main components: storage and transportation.

- Storage – The storage capacity available to farmers affects their revenues, as it can allow farmers to wait and choose the moment when prices are higher to sell their products. It also affects the percentage of production that is lost after harvest.
- Transportation – Poor transportation infrastructure, such as roads, increases losses produce will deteriorate. In addition, farmers may be forced to rely on intermediaries if travel times are too long.

Socio-political risks

Sociological risk factors include the: number of working hours, ratio of men and women working in agriculture, average age of working people, access to education including extension services, and health care. The “attractiveness” of farm jobs must also be considered. For example, younger generations in Claveria, Philippines are interested in moving to the city in search of better living conditions more so than becoming farmers.

Political risk factors include: the level of corruption, efficiency of the bureaucracy, land tenure situation, government agricultural policies including lending policies of state-controlled banks and financial institutions, farmer access to organized groups such as cooperatives, and risk of political instability, violence or war.

Government policies determine the amount of taxes each farmer should pay and often support loan opportunities from both government and non-governmental institutions. Farmers in Claveria, Mindanao lamented that the national agricultural bank only takes commercial land (with building structures) as collateral, meaning agricultural land is not eligible.

The presence of cooperatives may address the lack of access to government loans through micro-credit schemes, although micro-finance institutions have their shortcomings. Unlike banks, the amount of money cooperatives can lend is limited however, and interest rates are not necessarily lower. In addition, not all governments have regulatory laws for cooperatives, which may lead to opaque management practices – another source of risk.

Financial risks

As discussed above, producers’ lack of access to adequate sources of capital is a major impediment in agriculture. Capital is necessary from the start – for expenses (like machinery or even land purchase) required to start a farming practice, to cover some operational costs (like salaries, inputs or equipment rental) until the production can be sold, and to adopt more sustainable or productive farming practices.

In fact, capital is often just not available to farmers. And when capital is available in the form of loans, it comes with excruciatingly high interest rates and short, non-flexible repayment periods that may lead to a default. For example, the aforementioned farmers in Claveria referred to the so-called “5/6 rule:” when a farmer borrows five in the morning, she or he must pay back six in the evening.

Next steps

The next phase of work on Inari relies upon a collaboration that fuses private, public and non-governmental expertise from several leading organizations in agriculture, agroforestry and forestry research, finance, and governance. This research partnership includes:

- The Center for International Forestry Research (CIFOR)
- World Agroforestry Center (ICRAF)
- The Munden Project
- The Ateneo School of Government
- The CGIAR Research Program on Climate Change, Agriculture and Food Security

The project aims to pilot a mechanism for the provision of credit for sustainable agriculture practices that also reduce impacts on the climate. Credit would be designed to have comparatively low interest rates, longer maturities and context-specific, flexible repayment schedules across a range of landscapes and contexts. As a prerequisite to this, work is underway to develop a risk model, as outlined in the previous sections.

Site visits, field trials and interviews have been conducted in the Philippines and Vietnam, and additional work will take place in 2013 in Benin, Cameroon, Indonesia, and Peru. We anticipate updating these results in the first quarter of 2014 and implementing Inari by the end of 2014.

Conclusion

Smallholder agriculture and forestry in the developing world are important to support food security of the rural poor and reduce environmental impacts, including climate change. Yet smallholder farmers' access to and use of credit is a huge barrier to meeting these goals. The Philippines, Vietnam, Kenya and Brazil cases demonstrate that to best match their own variable and long-term yields, farmers would benefit from upfront finance that they can pay back in a flexible way over longer time periods.

International private investment may be able to help overcome this barrier. The Munden Project is therefore exploring two innovations:

- Better managing risk through a portfolio diversified across a range of landscapes and contexts; and
- Designing credit that better meets the needs of smallholders by providing low interest rates, longer maturities and context-specific, flexible repayment schedules.

Developing new mechanisms for international investment in sustainable agricultural and forestry practices among smallholders can provide much needed incentives for both investors and farmers to shift their practices. We are currently working hard to mobilize both international public and private investment in this direction and creating tools that will enable investors to better assess their options. These shifts in practices are urgently needed. Without them smallholder farmers – and the rest of us – face a much more uncertain world.

Endnotes

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