

## OBJECTIVE

The Climate Investment Funds (CIF) has a mandate to accelerate climate action. Where it invests directly in projects, it seeks also to measure, evaluate, and refine the delivery of impacts. This is particularly valuable in scenarios where real time assessments and course-corrections stand to significantly enhance the targeting and maximization of impacts. To this end, CIF has partnered with the World Bank Group's Development Impact Evaluation Group (DIME) to carry out an in-depth impact evaluation of the African Development Bank's (AfDB) Gazetted Forests Participatory Management Project for REDD+ in Burkina Faso. The evaluation seeks to gauge the effectiveness of various key aspects of the project's design and delivery.

The project focusses on 12 gazetted forests and is supported by CIF's Forest Investment Program (FIP), a funding window set up to provide and mobilize financing to address drivers of deforestation and forest degradation. Forests cover a third of the Earth's terra firma and are essential on many fronts—sometimes for livelihoods and jobs, and always as habitats for animals, for soil and water conservation, and for carbon capture and storage. The FIP works to support lower-income countries to institute woodland management practices that address these aspects in tandem, creating win-win strategies for human development and for climate action. Within this frame, the evaluation in Burkina Faso assesses the utilization of Payment for Environmental Services (PES) as timely cash transfers to support: reforestation and improved food security; the utilization of remote sensing techniques for tree cover mapping; and the utilization of georeferencing techniques for rigorous tracking of the survival rates of trees.

Burkina Faso is a lower-income, landlocked country with significant risk of forest cover loss: between 2001 and 2009 the country lost 131ha of forest cover, representing a 99% decrease in cover since 2000, equivalent to 25.0kt of CO<sub>2</sub> emissions<sup>1</sup>. 28% of this loss was due to deforestation<sup>2</sup>. While the related vegetation may hold less carbon than a similarly sized tropical forest, below ground carbon stocks are an important part of the ecological balance—wooded savannahs hold an average of 74 tons of soil organic carbon per hectare. However, forest-related activities are also an important



## QUICK FACTS

### DATE

September 2020

### COUNTRY

Burkina Faso

### PROJECT

Gazetted Forests Participatory Management Project for REDD+

### CIF FUNDING

USD 11.5 million from FIP

### MDB

African Development Bank

### PRODUCT TYPE

Development Impact Evaluation (DIME)

contributor to poverty reduction and economic security, with forest products representing 22 percent of rural household

1 [www.GlobalForestWatch.org](http://www.GlobalForestWatch.org), Burkina Faso Dashboard, 2020

2 Ibid.

incomes<sup>3</sup>, particularly in months with droughts or low harvests. At the national level, the forest sector contributes to GDP via fees, taxes, and permits for the use of timber and other forest products, mostly in the form of wood fuels<sup>4</sup>. The need for forest protection and livelihood generation therefore often compete, and projects such as this are important for testing and realizing the aligning of incentives. With this in mind, the evaluation seeks to understand if and how payments for environmental services (PES) and participatory forest management approaches affect both forest conservation and the generation of supplementary incomes.

## INTENDED USES AND USERS

The intended audience for this evaluation is forest policymakers and practitioners who design, implement or monitor afforestation programs, including those who utilize community PES schemes. This is particularly important in dryland, arid-climatic countries like Burkina Faso, where the sole rainy season is getting shorter and more irregular, resulting in poor, agriculture-dependent communities experiencing heightened food insecurity between harvests.

## PROJECT OVERVIEW

The Gazetted Forests Participatory Management Project for REDD+ is a USD 11.5 million project implemented by the African Development Bank (AfDB) and the World Bank (WB), with twin objectives: improving the carbon sequestration capacity of gazetted forests and reducing poverty in rural areas. The evaluation focused on two activity streams within the project, selected based on learning interests and priorities of the government, and based on design elements that allowed for the integration of rigorous impact evaluation methodologies.

**Evaluation component 1** focused on **Payments for Environmental Services (PES)** that were utilized to increase forest cover. Here, communities near selected forests were invited to participate in afforestation campaigns, wherein they plant new trees and are offered a monetary reward conditional on the survival of those trees. The approach works multi-fold. On the forest-protection side, the monetary incentives ensure the planting and protection of new seedlings. On the social protection side, well-structured PES schemes contribute to increased rural incomes that aid poverty reduction and food security. On the policy side, the evaluation's lessons help inform climate vulnerable countries looking for ways to maximize the impacts of Nationally Determined Contributions (NDCs), particularly in the face of significant resource scarcity.

Additionally, the evaluation broke new ground on precisely and cost effectively mapping dry forest cover, testing the use

of satellite and drone imagery and remote sensing techniques. It also tested innovative methods for precision monitoring of tree survival rates during afforestation campaigns using GIS techniques. The goal was to devise and replicate an accurate measurement of afforestation and tree survival rate outcomes.

**Evaluation component 2** focused on a '**cascade training scheme**' where in stage 1, government officials trained a limited number of farmers (termed 'contact farmers') on new agricultural conservation techniques; in stage 2 these contact farmers then passed on learned information to their community members, or 'peer farmers', with the expectation of stage 3: adoption of these techniques by the peer farmers. The DIME evaluation tests if providing financial incentives to participants helped enhance adoption, and compares the effectiveness of two different types of compensation schemes: one where only the peer farmers are offered compensation, conditional on adoption of conservation methods; and the other where compensation is split between the peer farmer and the contact farmer. The hypotheses tested are:

- (i) that the provision of financial incentives results in a better exchange of information (stage 2), and higher adoption rates of conservation technologies (stage 3); and
- (ii) that the allocation of financial stakes (only to peer farmers in one case, or to both peer and contact farmers in the other case) does not affect the magnitude of knowledge transfer or the rate of adoption of conservation techniques.

The second hypothesis is built on the rationale that if participants are able to bargain, the initial allocation of financial incentives will not affect end outcomes as these can be redistributed via negotiations. The evaluation, conducted via randomized control trials, will also assess project effectiveness in areas of agricultural production, food security and wealth.

## CAN PES REDUCE FOOD INSECURITY?

Within this frame, the ongoing evaluation tests if and how PES participation effects households' food security by uncovering the linkages between conservation incentives and food security outcomes. PES programs, like Conditional Cash Transfer (CCT) programs, are often justified by their potential contribution to social protection. Communities in the drylands of Burkina Faso, for example, rely primarily on rainfed agriculture for their food, with only one rainy season per year. This means that for a large part of the calendar year, families face food shortages. The impact evaluation shows that well timed cash transfers can provide timely and needed income when food insecurity is reaching its peak, just prior to the harvest season. Evidence from the impact evaluation indicates that there is a statistically significant link between environmental conservation incentives and improved food security outcomes.

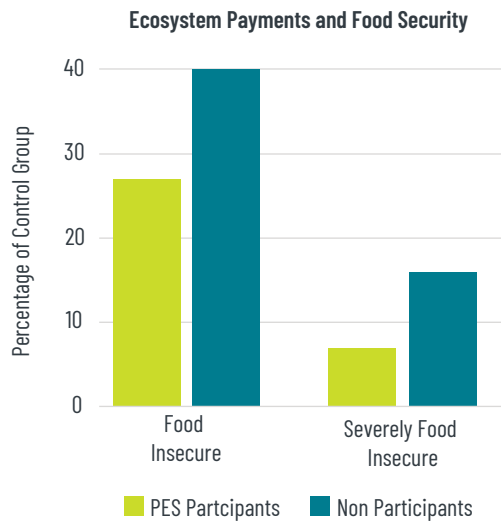
**FINDINGS:** According to the Household Food Insecurity Experience Scale (FIES), participants of the PES schemes experienced significantly less food insecurity than non-

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3 *Poverty Reduction through Commercial Forestry: What Evidence? What Prospects?* Background Paper for TFD's Dialogue on Poverty Reduction through Commercial Forestry 19-21 June 2006 Richards Bay, South Africa

4 [Burkina Faso CIF Investment Plan](#), 2012, Page 10

Figure 1.  
FOOD INSECURITY EXPERIENCE SCALES, PES VS. CONTROL GROUPS



participants, shielding farmers against food insecurity at a time when they were most vulnerable to it – aiding social protection during hungry months. 6 months after receipt of PES, households reported an increase in food consumption expenditures of about 12%, a reduction in moderate food insecurity by 35% and reduction in severe food insecurity by 60% in comparison to the control group. That the receipt of this income coincided with the pre-harvest period, when farmers have little food stocks remaining from the previous season, aids efforts for social protection at vulnerable periods.

### WHAT ARE THE INCOME EFFECTS OF PES IN THE LONGER TERM?

The dependence on unpredictable rainfed production practices and the related prevalence of food insecurity in Burkina Faso results in negative coping strategies among rural farmers. Reduced investment capacities for future agricultural production and constrained capacity for post-harvest welfare therefore lead to vicious poverty cycles. The evaluation looked also at PES's effects on overall consumption and investment choices, and their impacts on longer-term income and welfare security.

**FINDINGS:** PES participants were seen to invest in agriculture inputs, cultivating larger land areas, investing more in improved seeds and pesticides, and having higher agricultural outputs than their peers.

In addition, while agricultural production was the main economic activity for 90 percent of participants, PES receipts were seen to influence livelihood diversification, with respondents showing a seven percent point increase in the likelihood of having a second occupation, particularly livestock production. Four percent of recipients had also saved a share of the payments up until the time of the endline survey.

### WHAT IS THE BEST WAY TO STRUCTURE PES CONTRACTS?

PES are becoming increasingly popular in forest conservation programs, but relatively little is known about the conditions of their effectiveness. Pricing and incentives matter. The theory of change behind the use of PES is that the provision of environmental services generates positive externalities for which participants need be compensated so to as to generate socially desirable levels of outcomes. Given that these arrangements are delivered collectively to communities or groups, rather than to individuals, collective action failure presents a threat to the effectiveness of the monetary incentives. The DIME evaluation aims to test the extent to which alternative contract designs could mitigate such losses.

The project designed and implemented two types of PES contracts, utilizing the evaluation to compare efficacy of: (1) a linear payment structure, and (2) a threshold-based payment structure. Groups of five community members were enrolled in one of the two PES contracts, all with the same end objective: maintaining saplings planted at the beginning of the reforestation season.

The linear payment contract paid the group about USD 0.62 per tree surviving at the end of a designated time frame, with each member of the group receiving one fifth of the total income. The threshold payment contract paid the group a predetermined amount based on the number of trees living at the end of the designated time frame, with each member of the group receiving one fifth of the payment (about USD 240 for 400 or more trees, USD 185 for 300 to 399 trees, USD 130 for 200 to 299 trees, or USD 80 for a 100 to 199 trees, and USD 25 for less than a 100 trees). The two schemes were arranged such that they are pay-off equivalent, with the payment at the mid-point of each threshold value being equal in both schemes. I.e., if groups in both payment schemes behaved in the same way, the payoffs would on average be equal. Overall, some 33,000 trees were planted and are being maintained under these contract arrangements.



A theoretical model predicted that the threshold payments would outperform linear payments by addressing efficiency losses that could arise from asking a collective of individuals to care for an environmental resource that is not owned by any one member of the collective. As such, threshold payments were seen to have the potential to shift the nature of conservation from a possible collective action failure to a more cooperative effort—i.e., from a social dilemma scenario to a coordination game, with the latter predicted to be more conducive to public goods provision. The findings of this study, however, seem to point in a different direction, raising new questions, and therefore new possibilities, on how best to distribute incentives and information.

**FINDINGS:** Contrary to expectation, linear payments appear to outperform threshold payments both in terms of the absolute number and of the quality of surviving trees. While threshold payment schemes did in fact perform better on indicators for cooperation (number of maintenance meetings planned, trust in fellow group members, and the extent to which group members contributed equally to maintenance activities), this did not coincide with participants monitoring tree survival rates more often than those in the linear scheme, implying that participants may not have been influenced by the threshold payments to work toward crossing above or not falling below threshold markers. This supported by a finding that, in the threshold payment model, the evaluation did not observe a “bunching” of tree-counts around threshold values due to participants aiming for a just-over-the-threshold number of trees. Lab experiments conducted to explore why threshold payments did not outperform linear payments found that the former may indeed be an effective incentive instrument, but that uncertainty about tree-counts (i.e., inability to effectively track the number of trees alive at a given time) may have diminished the power of the threshold incentive.

## **ADDITIONAL AREAS OF RESEARCH: EFFECTIVE METHODS TO MEASURE TREE COVER AND SURVIVAL RATES**

Precise data gathering is not only necessary but also possible. Monitoring REDD+ progress as well as the real impacts of forest conservation policies will likely require governments to develop greater capacity to measure and monitor forest cover, including tracking changes resulting from conservation and reforestation programs. The inability to precisely measure outcomes often curtails opportunities to monitor and learn effectively from development interventions. In Burkina Faso, and many other countries implementing largescale afforestation programs in the drylands, there has often not been a system in place to track tree cover loss within forests, or to accurately record, geolocate, and track the survival rate of the trees planted during afforestation campaigns so as to learn about the conditions that are conducive to their sustainability.

To begin to address this issue, the project utilized images from the European Space Agency’s (ESA) fleet of Sentinel satellites to map tree cover in select Burkina Faso gazetted forests. The sentinel images provide sufficiently high-resolution imagery

for Earth-observation purposes. These satellites help monitor variability in land surface conditions over large areas every 10 days. The Sentinel satellites support the ESA Copernicus environmental studies program, which includes the monitoring of vegetation, soil, water, and coastal areas. These images, and related processing technology, are available at little-to-no cost. This means that Burkina Faso can precisely map forest cover using extremely cost-effective and easy-to-use methods. The project also undertook a pilot initiative to test the use of drones in precise forest mapping. This showed significant improvements in image precision when establishing ground truth data.

On-the-ground mapping of specific locations where trees have been planted in an afforestation program can also be done at low cost. With minimal training, local teams have been able to use the ESRI Survey123 tool to geo-reference the 33,000 trees planted in various forest locations under the PES contracts. Nine months later, the ESRI Collector tool was used to locate those same trees and record survival status, for a precise measurement of tree survival rates. To streamline monitoring of these trees, a virtual forest corridor was created, which allowed teams to verify tree survival rates within a narrow band.

**FINDINGS:** Tree survival rates can be better monitored using low-cost technologies to achieve landscape restoration objectives. Geospatial technologies were used in this project to track the precise survival rates of reforested trees the following season. It emerged that the survival rate of reforested trees is between 30 to 37 percent. By establishing what could be baseline survival rates, this innovative low-cost scheme presents important landscape restoration opportunities that could guide and prioritize both national and international forest conservation policies. Establishing accurate baseline reforestation survival rates provides the ability to measure and quantify forest conservation methods in a way that was not previously possible.

## **INFORMING PROJECT DESIGN AND EXECUTION**

Both the project and the impact evaluation are still ongoing, and final results have yet to be determined. Key take-aways and course correction options, however, are already available.

### **Understanding the Incentives within PES Contract Designs: feedback on survival rates may help improve the performance of threshold schemes.**

Linear payments schemes’ outperforming thresholds payments could have resulted from several factors: (1) insufficient information about the necessary actions or the format of the threshold payment schemes, or weakness in the understanding of the assured conditionality of payments; (2) communities’ inability to track the number of trees within their purview—i.e., reaping the coordination benefits in threshold schemes may be more difficult when there is uncertainty regarding the probability of accidentally crossing a lower threshold, which then lowers the expected marginal benefits to the invested effort. In fact, the laboratory evidence suggests that the threshold payments may in fact have outperformed



liner payments had participants been provided regular updates on survival rates, calling for considerations of feed-back mechanisms in subsequent or similar interventions.

**Scaling-up and Replication.** PES contract approaches could be expanded to the remaining forests in Burkina Faso. Given the availability of high-frequency and low-cost satellite images, forest mapping could also be scaled and replicated—in fact, remote sensing analyses of Sentinel-2 images are already fully incorporated into the routine measured, reported and verified (MRV) REDD+ forest monitoring by the project team. As this initiative forms part of REDD+ readiness project, the tools and lessons developed are intended to inform the efficient planning of the REDD+ implementation phase.

The tree planting and survival rate tracking approach is innovative and should be tested in several other contexts to improve the ways in which afforestation activities are implemented, with a goal to enhance results. This is becoming increasingly important as most dryland countries' NDCs involve ambitious forest landscape restoration plans.

## WHAT'S NEXT?

The findings on PES's effects on food security have been published as a World Bank Working paper, titled [Reducing Hunger with Payments for Environmental Services \(PES\): Experimental Evidence from Burkina Faso](#), and the document has been accepted for publication in the American Journal of Agricultural Economics, the lead journal in the field. Findings on the effects of linear and threshold payment contract designs on tree survival rates are being prepared for submission to the World Bank Working Paper series this fall, titled *Incentivizing Conservation in de facto Community-owned Forests*. The evaluation is ongoing: endline data has been collected and is being analyzed, with findings expected to be finalized at the end of 2020, with the full array of lessons shared in 2021-22. The evaluation team is also slated to present findings to the Burkina Faso country office in Burkina Faso in the near term.