Cost-Benefit Analysis of the Payments for Ecosystem Services (PES) in Burkina Faso

Anders Shropshire
Jiayu Liu
Jingyi Tong
Lauri Luosta
Will Henkes
Yixuan Cheng

University of Wisconsin-Madison

Consideration to Standing

The World Bank Group; the Burkina Faso Government; African Development Bank; Climate Investment Fund, and Burkinabé. We will evaluate whether to grant standing to international actors and conduct the analysis accordingly.

Problem Statement

Food insecurity is a problem for Burkina Faso, which has a long lean period and a large portion of its population subsisting off of a single yearly harvest; a recent estimate found that 686,000 of the country's residents required urgent food assistance from June to August in 2019 (USAID, 2019). Burkina Faso also faces the problem of desertification. The combination of a semi-arid climate, reliance on low input farming, and deforestation has lowered the productivity of the land, an issue that will only increase as climate change intensifies. Currently, one-third of the land in Burkina Faso is degraded, and the nation is expected to lose 360,000 more hectares of productive land each year (UN FOA, n.d.). The loss of Burkina Faso's forests and the degradation of its soil further contributes to climate change. While Burkina Faso's dry climate does not offer the same potential for carbon sequestration as more humid areas, it is representative of an ecosystem (semi-arid forests) that covers roughly 43% of Africa and over 500 million hectares worldwide (Investment Plan for Burkina Faso, 2012). As semi-arid forests cover such a large portion of the globe, restoring and maintaining them is an important factor in climate mitigation. A PES program that can be successfully implemented in Burkina Faso could serve as a blueprint for other countries that contain this ecosystem.

In PES, residents are paid to conserve or restore natural resources. Ideally, PES would mitigate both the environmental problem in question through the actions of the residents and improve the living standards of the population via the payments received for these actions. In the

case of Burkina Faso, the government has partnered with the African Development Bank and the World Bank to implement a PES program that rewards residents for reforesting the nation's vulnerable gazetted forests. The program began in 2017, when 33,500 trees were planted at 62 reforestation sites at 11 of the nations 77 gazetted forests. Volunteers were assigned to maintain the trees in a given area of land, and received payments proportionate to the number that survived to the programs verification period. Roughly 90% of the participants were farmers, the average of whom had made $30 in the month preceding the survey and was supporting a family of 12 (Adjognon et al. 2019). In order to best provide food security, these payments were delivered during the lean season. Implementation was handled by a project team from Burkina Faso's Forest Improvement Plan (FIP) (Investment Plan for Burkina Faso, 2012.) and by local Forest Management Committees (Comite de Gestion Forestiere, or CGFs). The CGF's, each of which handles a single gazetted forest, identified community members who were interested in and able to participate in the program. Independent monitors were responsible for assessing the survival rate of the trees.

There are a number of other factors that need to be considered when measuring the impact of PES. For example, some landowners would engage in reforestation regardless of the payments. How does one estimate the number of these landowners to avoid falsely contributing their contributions to the program? If the PES lowers the timber supply from participating villagers, will other villagers simply increase their timber production to satisfy demand (Jayachandran et al. 2017)? More than 80% of Burkina Faso's energy needs are addressed by firewood, making the latter question a serious concern (Livelihoods Fund, n.d). The literature on PES is sparse (Samii et al. 2014), and many of the studies that have been conducted are set in countries with different cultures, ecosystems, and income levels than Burkina Faso.

Plan for Completion

There are a number of costs and benefits that need to be accounted for to properly assess PES's effectiveness, including but not limited to the carbon sequestered through the reforestation program, the health benefits of increased food security, the implementation cost, such as the cash prizes handed out and pay for administrators, and the opportunity costs.

Monetize Costs

Among the implementation costs, we first determine the compensation from the government. According to Adjognoon et al, each participant group (five people a group) would receive a financial compensation of $0.70 for every tree still alive at verification a year later, and every member in the group would receive an equal share of the total amount (2019) In addition, implementation costs also include transportation costs, monitoring surveillance, administrative costs, mapping costs, et al. We will track all these data either from the client or from CIF online.

As for opportunity costs, we come up with two kinds: the land value given no afforestation which can be measured by the cost of people who rely on forest or non-forest land as their source of income or well-being, and the harms on social capital.

FIP's afforestation campaign suggests the conservation of existing forests and a decrease of non-forest resources in Burkina Faso. Despite its positive impact on climate change mitigation, FIP might affect those who rely on forest and timber resources as a major source of income. Therefore, we should consider the prohibition of lumbering and its associated socioeconomic effects as a cost of the project. This cost can be measured by the income of those workers. In addition, one study showed that in Burkina Faso and Ghana, the poorest households depend more on the non-forest environment than on forest economically (Pouliot, Treue, Obiri, & Ouedraogo, 2012). The compensation paid to the community members in Burkina Faso should

be high enough to cover the cost of losing non-forest environment and conserving. This cost can be measured by the market price of the land. The Balance Carbon Tool may also help to calculate the land value.

Another part of the opportunity costs we need to consider is the harms on social capital. The financial incentives for conservation are controversial and a core concern is that paying for actions previously offered freely may reduce community-level social capital or crowd out general prosocial behaviors. Alix-Garcia et al. did an empirical study on the PES in Brazil and provided evidence that conservation incentives can support social institutions, attitudes, and values while rewarding environmental stewardship (2018). However, causal estimates of social capital impacts can only be studied country by country because they must include both in-person surveys in remote areas and detailed understanding of and information on program selection criteria (Alix-Garcia et al., 2018). Thus, we need to measure if the PES in Burkina Faso reduced the social capital. If it did not reduce but increase the social capital like the case in Brazil, we then should count it into the benefits.

Monetize Benefits

Besides the benefits of direct cash transfer, there are two primary areas in which this program expects to produce net social benefits. It is reducing atmospheric CO_2 content through rising rate of tree cover, and improving local health by reducing food insecurity and susceptibility to disease by supplementing the income of poor-farmers.

The participants can directly receive the benefits from government compensation which has been calculated in the implementation cost part. The participants can mainly be divided into two parts: the unemployed and the workers who engaged in other vocations. Only when the payment is larger than the previous income of these workers, the social surplus would be

positive. The empirical study shows that agricultural productivity was unaffected, which suggests on farm labor was not displaced by PES work. Due to the scarce productive land in targeted regions, there was surplus labor that could be employed by PES programs (Adjognon, Kondylis & Loeser, 2019).

There are several items which will be necessary to quantify the social benefits of reduced GHG. Firstly, we will need an estimate for the increased number of trees that the program will create annually. This will be translated into an estimate of how much carbon can be removed from the atmosphere from these trees, which can be estimated with knowledge of the type of trees to be planted and their respective carbon-scrubbing abilities. We will need to set a time horizon for which these benefits considered, for example an arbitrary period of 15, 30, or 50 years, or for the lifetime cycle of the trees. We will need to consider if one year worth of trees will be evaluated, or whether the cumulative number of trees planted will be considered. Ultimately, this process needs to attain an estimate of how much CO_2, and other relevant gases, will be removed as a result of this program.

Next, these reductions will need to be translated into a monetary value. Internationally, there are dozens of examples of states and other bodies setting a price on carbon or providing estimates for that price (Kossoy, 2015). However, these estimates range from just several US dollars per ton of gas to over $150 per ton. A significant portion of state-pricing schemes price carbon below US$10, an estimate many experts consider too low compared to the costs of a changing climate. Our group will need to review the literature and identify the appropriate price of carbon for this project. According to the US EPA, the ‘social cost of carbon’ must consider many factors including, “changes in net agricultural productivity, human health, property damages from increased flood risk, and changes in energy system costs, such as reduced costs

for heating and increased costs for air conditioning." These factors, and others relevant to Burkina Faso, will be considered as we review the literature. Further, the costs will need to be discounted over the relevant time frame we select, and attention will be necessary to the discount rate we select for these reductions.

Previous research has identified that this compensation improves health outcomes by increasing food budgets. Empirical evidence found that food insecurity was reduced by 35%, and severe food insecurity fell by 60% within one year in Burkina Faso (Adjognon, Kondylis & Loeser, 2019). Food insecurity and malnutrition have many negative impacts to individuals and community including inhibiting learning, increasing susceptibility to illness and disease, and premature death. Therefore, reducing food insecurity and malnutrition can result in social benefits through improved human health and. Given the requirement from our client, if we are aimed at the benefits for one year from the starting date, we can directly use the result of increased food consumption (12% higher expenditure) in their paper (Adjognoon, Soest & Guthoff, 2019).

In addition to the health benefits caused by higher food consumption, another benefit we considered is the reduction in vector-borne disease (e.g. malaria) caused by afforestation. We are exploring the literature on this field but the evidence is limited in the context of West Africa.

Bibliography

USAID. (2019). Food Assistance Fact Sheet - Burkina Faso. Retrieved from https://www.usaid.gov/burkina-faso/food-assistance

Food and Agricultural Organization of the United Nations. (n.d.). Action Against Desertification. Retrieved from http://www.fao.org/in-action/action-against-desertification/countries/africa/burkina-faso/en/

Livlihoods Fund. (n.d.). Burkina Faso: Fighting Desertification & Increasing Food Security With 30,000 Families. Retrieved from http://www.livelihoods.eu/projects/tiipaalga/

Kossoy, Alexandre. (2015). *State and trends of carbon pricing 2015*. World Bank Publications, 2015.

Pouliot, M., Treue, T., Obiri, B. D., & Ouedraogo, B. (2012). Deforestation and the Limited Contribution of Forests to Rural Livelihoods in West Africa: Evidence from Burkina Faso and Ghana. *Ambio*, *41*(7), 738–750. https://doi.org/10.1007/s13280-012-0292-3

Investment Plan for Burkina Faso, 2012. https://www.climateinvestmentfunds.org/country/burkina-faso

Adjognon, G. S., van Soest, D., & Guthoff, J. Payments for Ecosystem Services (PES) and Food Security: Experimental Evidence from Burkina-Faso.

Jayachandran, S., Laat, J. d., Lambin, E. F., Stanton, C. Y., Audy, R., & Thomas, N. E. (2017). Cash for Carbon: A Randomized Trial of Payments for Ecosystem Services to Reduce Deforestation. *Science*, 6348(357), 267-273. https://science.sciencemag.org/content/357/6348/267

Samii, C., Lisiecki, M., Kulkarni, P., Paler, L., Chavis, L., Snilstveit, B., & Vojtkova, M. (2014) Effects of Payment for Environmental Services (PES) on Deforestation and Poverty in Low

and Middle Income Countries. *Campbell Systematic Reviews*, 10(1), 1-95. https://onlinelibrary.wiley.com/doi/abs/10.4073/csr.2014.11

Alix-Garcia, J. M., Sims, K. R. E., Orozco-Olvera, V. H., Costica, L. E., Medina, J. D. F., & Monroy, S. R. (2018). Payments for environmental services supported social capital while increasing land management. *Proceedings of the National Academy of Sciences*, 115(27), 7016-7021. https://www.pnas.org/content/115/27/7016

Adjognoon, G. S., Rivera-Ballesteros, A., & van Soest, D. (2019). Satellite-based Tree Cover Mapping for Forest Conservation In the Drylands of Sub Saharan Africa (SSA): Application to Burkina Faso Gazetted Forests. *Development Engineering*. https://linkinghub.elsevier.com/retrieve/pii/S2352728517300891