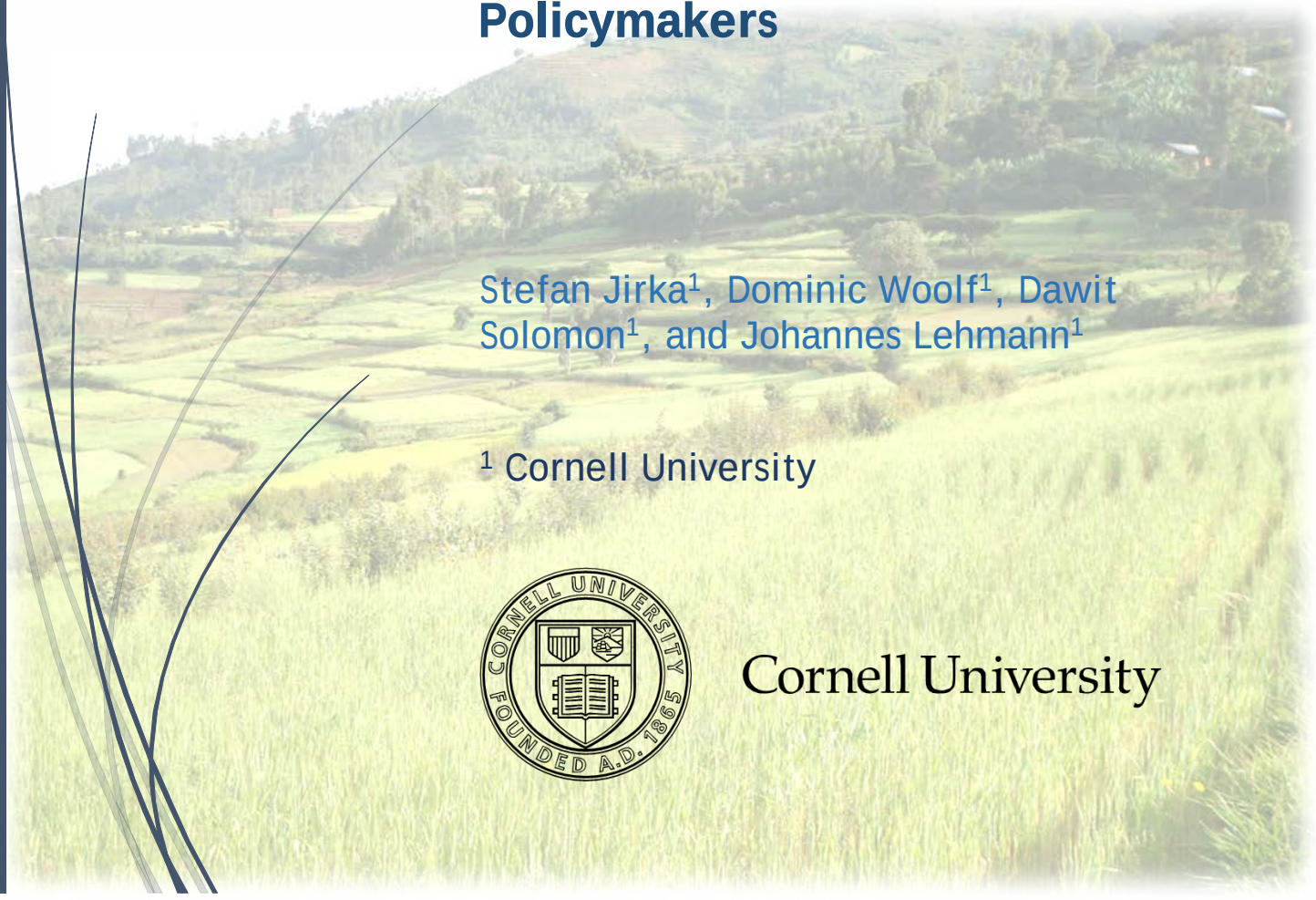
November 2015

Climate finance and carbon markets for Ethiopia's Productive Safety Net Programme (PSNP)

Executive Summary for Policymakers



Stefan Jirka[1], Dominic Woolf[1], Dawit Solomon[1], and Johannes Lehmann[1]

[1] Cornell University

Cornell University

Climate finance and carbon markets for Ethiopia's Productive Safety Net Programme (PSNP):
Executive Summary for Policymakers

This report was prepared on behalf of The World Bank by:

Stefan Jirka[1], Dominic Woolf[1]*, Dawit Solomon[1], and Johannes Lehmann[1]

[1]Cornell University, USA
* Corresponding author

November 2015

Please cite this work as follows:

Jirka, S., D. Woolf, D. Solomon, J. Lehmann. 2015. "Climate finance and carbon markets for Ethiopia's Productive Safety Net Programme (PSNP): Executive Summary for Policymakers." A World Bank Climate Smart Initiative (CSI) Report. Cornell University.

The PSNP is implemented by the Government of Ethiopia with support from the following development partners: Canadian International Development Agency, Irish Aid, European Commission, Royal Netherlands Embassy, Swedish International Development Cooperation Agency, UK Department for International Development, United States Agency for International Development, World Food Program and World Bank

Ethiopia's Productive Safety Net Programme (PSNP) Climate-Smart Initiative: Accessing climate finance to promote socially and environmentally sustainable public works social safety net programs

Stefan Jirka[1], Dominic Woolf[1]*, Dawit Solomon[1], Johannes Lehmann[1]
[1]Cornell University, USA
* Corresponding author. Please send enquiries to d.woolf@cornell.edu.

Ethiopia's Productive Safety Net Programme (PSNP) is recognized as a model public works safety net program, which provides food and cash payments to households suffering from food insecurity in return for labor that builds public infrastructure. In addition to the target benefits of food security and infrastructure development, PSNP's participatory watershed management interventions, while not their primary objective, are already delivering climate-change mitigation benefits by sequestering carbon in soils and biomass and reducing emissions of greenhouse gases (GHGs) from the agricultural, forestry and other land use (AFOLU) sector. New opportunities for support from dedicated climate finance channels could be opened up by quantifying the climate change mitigation benefits (a.k.a. carbon benefits) generated by PSNP activities.

Global climate change is well underway and policies must be enacted to reduce anthropogenic GHG emissions through cost-effective mechanisms such as land restoration.

It is now clear that the Earth's climate is warming, and that it is doing so in response to changes to the atmosphere resulting from human activities. A target rise in global average surface temperature of no more than 2° C has been widely advocated as required to maintain the Earth system within safe limits. However, at current global emission rates, the world will have exceeded its total budget to keep warming below 2°C within 25 years. Meeting targets to limit warming within this safety margin will require a concerted and protracted global effort, and will require developing countries to adopt policies like Ethiopia's ambitious and forward-looking Climate-Resilient Green Economy (CRGE) strategy. Sequestering carbon in soils and trees is likely to be an essential element of any mitigation scenario that achieves safe climate stabilization, making land restoration works such as those conducted by Ethiopia's Productive Safety Net Programme (PSNP) a key part of an overall climate-change mitigation strategy.

Ethiopia's PSNP can dually provide food security to millions of beneficiaries while contributing to global climate change mitigation.

Along with the looming challenge of global climate change, countries must also address poverty and malnutrition endemic to the developing world. One response mechanism is social safety net programs—developed to provide poor, vulnerable and marginalized members of society with cash or in-kind transfers to reduce negative impacts from economic, environmental or governance shocks and chronic stresses. Public works safety net programs, in particular, are designed with the dual objectives of providing temporary employment and building and maintaining vital public assets.

Ethiopia's PSNP—heralded as a model public works safety net program since its inception in 2005—has deployed sustainable land management interventions that cover hundreds of thousands of hectares. Data

Figure 1: A highly degraded landscape (foreground) and a reforested area enclosure (background) showing significant gains in biomass at PSNP-CSI site in Alaba Special Woreda, SNNPR, Ethiopia.

from PSNP's Climate-Smart Initiative (CSI) demonstrate that Ethiopia's PSNP interventions harbor the potential for the program to have a meaningful impact on climate-change mitigation by sequestering carbon in soils and biomass and reducing emissions of greenhouse gases from the agricultural, forestry and other land use (AFOLU) sector (see Box 1 and Figure 1).

Market-based mechanisms to reduce GHGs comprise carbon taxes and carbon offset markets. The latter incentivize investments in technologies, projects and practices that reduce GHGs by creating demand for carbon offset credits.

Economies across the globe are taking steps to mitigate rising atmospheric GHG levels. Instruments that put a price on GHGs in order to incentivize decarbonization are termed market-based mechanisms and fall into two categories: carbon taxation, and cap-and-trade systems. At present, there over 60 carbon-pricing schemes (carbon taxes and cap-and-trade systems combined) valued at about US$30 billion that are implemented or planned within regulations capping GHG emissions at the subnational, national or international levels.

Cap-and-trade systems are a type of market mechanism that place a limit (cap) on annual emissions by sector or jurisdiction and then allow emitters to buy and sell (trade) excess emissions amongst regulated entities. Carbon markets (aka carbon offset programs) enable GHG-emitting entities—whether governments, companies or other institutions—to offset their carbon footprint by investing in external projects or activities that reduce GHGs or sequester carbon. Carbon markets can be utilized either for compliance with cap-and-trade regulations or on a voluntary basis. The unit of transaction utilized by the majority of carbon markets is one tonne of carbon dioxide-equivalent (tCO2e), which is used to quantify the tCO2e that a given project would reduce.

At present, the only compliance market relevant to Ethiopia's PSNP is the UNFCCC Kyoto Protocol's Clean Development Mechanism (CDM). But, even this market is in a downturn, given uncertainties in international climate change negotiations. Voluntary carbon markets, while considerably smaller in volume of offsets transacted, continue to see demand especially for offsets created from AFOLU sector projects.

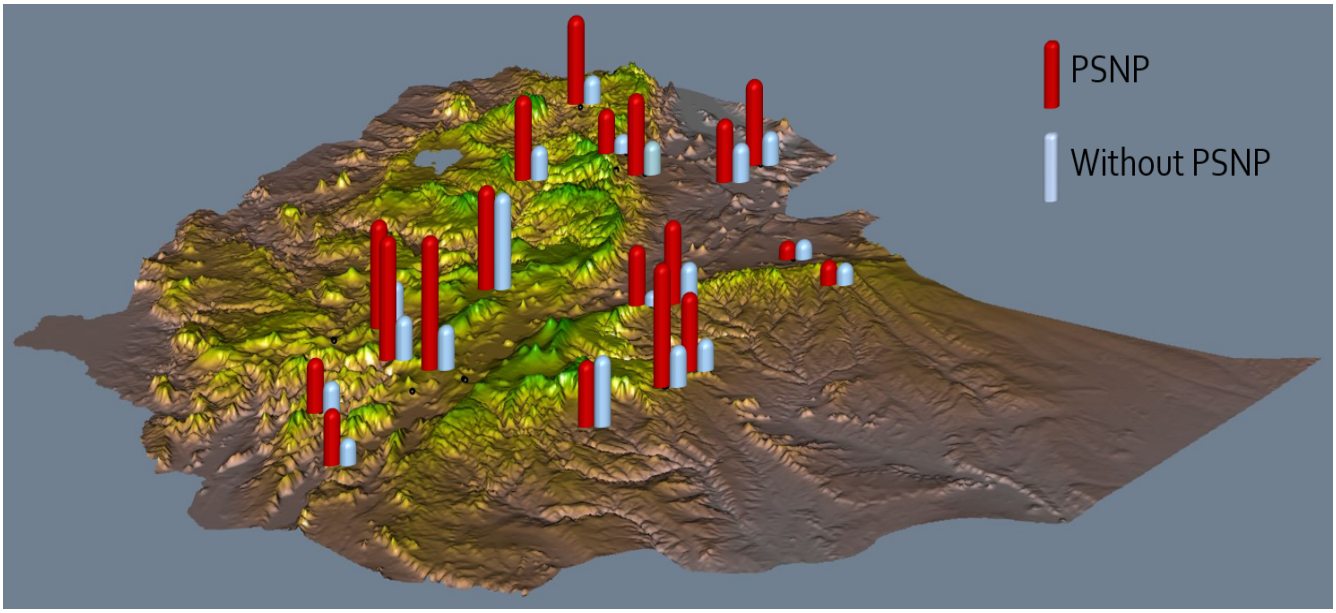


Figure 2: Topographic map of Ethiopia, depicting soil organic carbon (SOC) stocks at PSNP-CSI sites under project (red bars) and business-as-usual (light blue bars) scenarios. Note that up to three times more SOC is stored under project scenarios (Solomon et al., 2015).

Ethiopia's PSNP land-restoration works are strong candidates for carbon projects. However, several key characteristics of AFOLU carbon project development must be considered during planning and implementation phases.

For Ethiopia's PSNP, there are several important considerations that must be taken into account when considering development of carbon projects for carbon offset programs in the AFOLU sector:

1. Carbon standards provide the guidelines, specifications and requirements that must be met to ensure consistency amongst projects that are accepted under a carbon market. Standards are developed by, and are part-and-parcel of carbon markets. For Ethiopia's PSNP, an analysis of the most suitable carbon market would include trends in terms of prices and volume of carbon credits transacted, methodologies suited to PSNP public works activities, and ease of project development, among others.

2. For carbon markets to operate, GHG sources, sinks and reservoirs (SSRs) must be quantified. To this end, scientifically-based GHG accounting methodologies (or protocols) are developed. These methodologies document the steps to quantify carbon benefits of a given emissions reduction activity or project. For AFOLU sector projects, numerous forest-based and, to a lesser extent, agriculture-based methodologies have been published[2] and are available for use by Ethiopia's PSNP project developers.

3. The use of geospatial techniques to delineate the geographic boundary of areas where activities are to be implemented is a requisite for all GHG accounting methodologies in the AFOLU sector. Ethiopia's PSNP implementation entails suites of activities distributed across thousands of geographically unconnected locations across the country. The leading carbon offset programs contain mechanisms to group (or bundle) projects so that they fall within the overall project boundary, which, in turn, dictates which SSRs must be quantified in order to calculate the net carbon benefit of a project.

4. In some cases, the carbon project may induce additional unintended effects outside the project boundary that can increase GHG emissions elsewhere. These effects are known as leakage and are of particular concern in AFOLU projects where project interventions may displace current land use activities. All carbon offset programs recognize the importance of identifying and mitigating leakage effects prior to project implementation. One type of leakage of particular relevance to Ethiopia's PSNP is the potential for livestock to be displaced by area enclosures. This leakage potential, along with others, must be identified and mitigation activities must be designed and

Box 1. Carbon benefits of climate smart interventions in Ethiopia's PSNP CSI consortium partners at Cornell University projected the mitigation potential of PSNP interventions as compared to the business-as-usual scenarios using field measurements and modeling techniques at 28 sites within six Ethiopian regions. Using IPCC Tiers 1 and 2 methodologies[1], the mean carbon benefit across all PSNP's CSI sites was estimated at 5.7 tCO2e ha^{-1} yr^{-1}.

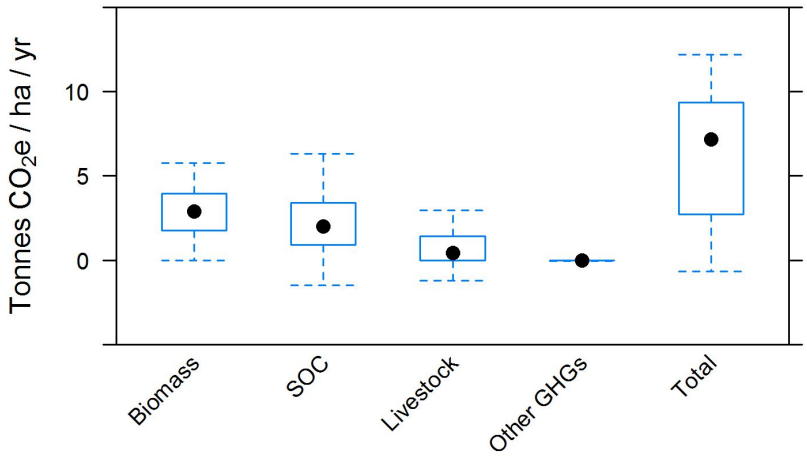


Figure 3: Summary of IPCC Tier 1 assessment carbon benefits by GHG flux category aggregated over 28 modeled sites. Black dots indicate median values, and boxes show interquartile range. SOC is soil organic carbon. Reproduced from Woolf et al. (2015)[1].

Biomass and SOC accumulation were the largest sinks of GHG fluxes contributing to the overall carbon benefit (i.e., the difference between PSNP interventions and business-as-usual scenarios), contributing on average 2.3 and 2.2 tCO2e ha^{-1} yr^{-1}, respectively, followed by reduced emissions of methane from livestock management at 1.3 tCO2e ha^{-1} yr^{-1}. Contributions from other GHG fluxes (primarily attributable to fertilizer management) were negligible due to the low impact of PSNP on inorganic fertilizer use in Ethiopia. Variability between PSNP sites was substantial (standard deviation 6.1 tCO2e ha^{-1} yr^{-1}) underscoring large differences across the landscape in potential carbon benefits. Nonetheless, at some sites the net carbon benefit exceeded 10 tCO2e ha^{-1} yr^{-1}. When considering that Ethiopia's PSNP interventions cover hundreds of thousands of hectares, the potential for PSNP to have a meaningful impact on climate change mitigation is compelling. Further details on the content of this box can be found in Woolf et al. (2015)[1].

implemented. There is also some evidence that participants in PSNP activities may consequently invest less effort in land improvements to their own farms, due to the diversion of labor into PSNP. Such possible forms of leakage should also be addressed.

5. Net GHG emissions over time are commonly estimated in what are known as scenarios. These scenarios are measured relative to the initial state of the system at time zero. In order to quantify changes in GHG emissions resulting from a carbon project, it is necessary to estimate what the emissions would be in the absence of project implementation. This is known alternately as the baseline or business-as-usual (BAU) scenario. Activities that are designed and implemented under a carbon project, are then evaluated in relation to BAU, with the net carbon benefits generated under the project scenario defined as the incremental difference between total emissions in the project and BAU scenarios. For Ethiopia's PSNP, identifying the business-as-usual scenario may be a complex task. Ethiopia is defined by highly variable agro-ecological zones and cultural and socio-economic circumstances. Scenario identification should focus in on those PSNP sites that share similar biophysical and socio-economic attributes, enabling them to be grouped under the auspices of a single project, or on specific interventions within PSNP that are designed specifically as carbon finance projects.

6. A key requirement of all carbon markets is that the GHG project would not have advanced without revenues generated from sales of carbon credits. This

Figure 4: Climate smart land use interventions including terraces, soil bunds planted with multi-purpose perennial legumes, cut-and-carry forage systems, and multi-story agroforestry systems at PSNP-CSI watershed in Damot Gale Woreda, SNNPR, Ethiopia.

requirement that project implementation is dependent on carbon finance is known as additionality. The steps to demonstrate additionality build on those used to identify the BAU scenario.

Carbon market trends in the AFOLU sector reflect volatility related to uncertainties in international commitments to combat climate change.

Carbon markets support a wide range of GHG emissions reduction projects, only some of which are in the AFOLU sector. In the CDM, AFOLU projects only make up a tiny fraction (approximately 1%) of the market share of traded emissions reductions for reasons related to complexity, financial constraints, and risk. While voluntary carbon markets only trade a small fraction of the volume of the CDM and other compliance markets they are nonetheless important because they serve as testing grounds for new methodologies, tools, and technologies and they have a high representation of methodologies for the AFOLU sector and serve as important sources of finance for sustainable land management.

Whereas the CDM has been in a slump since supply of carbon credits outstripped demand beginning in late 2011, the trend in voluntary markets has been more even-keeled. There was a slight downward trend in terms of volume of traded GHG reductions in 2013 (the last year for which data is available) over previous years but the price still hovered around US$5/tonne of CO2e —a full order of magnitude higher than that of the CDM.

Notwithstanding these historical data, the political and technical landscape that underpins carbon markets and their success is highly dynamic and, as a result, future projections are difficult to make. As seen in the global economic recession from which certain regions are still emerging, carbon markets are tightly enmeshed with the prosperity of both public and private sector actors. A new binding treaty emerging from COP-21 in Paris that caps emissions and/or sets a price on carbon would send a clear message that a robust carbon market can be anticipated. As such, PSNP 4 managers should be cognizant of developments with respect to the UNFCCC process.

AFOLU carbon projects generate many additional social and environmental co-benefits that can be quantified and marketed.

Carbon markets solely transact in volumes of GHG reductions i.e., carbon credits. Yet, there are many additional social and environmental aspects that a project can deliver to the community and region where it is implemented. This is especially true for AFOLU projects which often operate in a community-based context in developing countries.

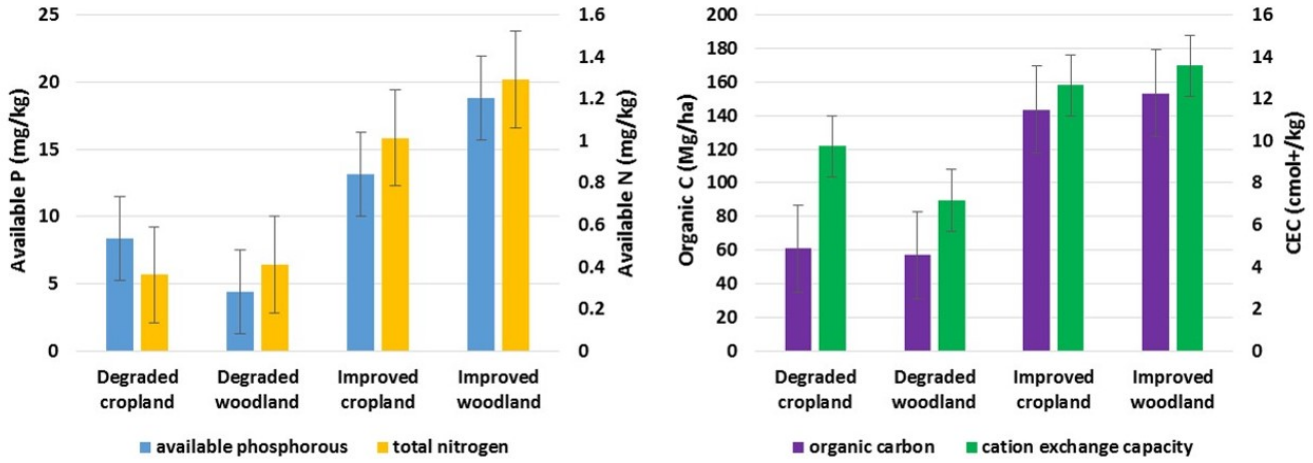


Figure 5: Soil available phosphorous and total nitrogen (left graph) and soil organic carbon and cation exchange capacity (right graph) to 1m depth in degraded vs. improved cropland and woodland at 12 PSNP-CSI sites.[3]

Market analyses show that "gourmet" carbon projects with stacked benefits receive a price premium in voluntary carbon markets. Ethiopia's PSNP is well-placed to take advantage of market interest in carbon projects delivering co-benefits. For example, data from PSNP-CSI support the conclusion that Ethiopia's PSNP public works interventions provide key ecosystem services and benefits including soil fertility and productivity (see Figure 5)[3] in addition to climate-regulating benefits. PSNP 4 project developers should review requirements of the various programs that have developed methodologies[4] to quantify carbon project co-benefits to assess options for marketing the many social and environmental benefits that PSNP brings to communities across Ethiopia.

Recent advances in carbon markets may allow for PSNP 4 activities to be developed into carbon projects across scales that match the ambitious national scope of PSNP.

The ambitious national scale of PSNP has already demonstrated widespread benefits for communities and the environment, not least of which is climate change mitigation. But this very breadth represents a hurdle in accessing AFOLU carbon markets which, to date, have focused on project-based activities at scales many times smaller than PSNP. Recent advances in carbon markets, however, may allow for PSNP activities to be developed into carbon projects across much larger areas within Ethiopia.

First, carbon markets have moved to allow grouping of diverse activities under the umbrella of one project with the aim of lowering the administrative and financial burden involved in developing carbon projects, particularly for small-scale projects in the developing world. Both the CDM and the leading voluntary carbon offset program, Verified Carbon Standard (VCS), have developed such bundling mechanisms. Under PSNP 4, a grouped project could encompass a mosaic of SLM activities within an extensive project boundary. GHG benefits could be quantified for PSNP practices and project activity instances could be added by watersheds or kebeles, as resources are made available.

Second, standardized methods have been developed with the goal of streamlining the process of demonstrating additionality and/or identifying the BAU scenario. These methods are a newer, potentially more attractive approach for PSNP. Using standardized methods, entire landscapes measuring millions of hectares at the scale of the regional state in Ethiopia are theoretically targets for development of carbon projects.

Additionality – the requirement that a carbon project would not be feasible without the assistance of climate finance – has important implications for the Ethiopian PSNP context.

Additionality is the central tenet of carbon markets: without it carbon offset projects can neither quantify their climate change mitigation impacts, nor attribute these impacts to the availability of climate finance. Climate finance is only applicable to activities that are demonstrably additional. Additionality is therefore rigorously reviewed during project validation, and PSNP must carefully analyze the options to demonstrate addi-

tionality of any of its activities that seek climate finance.

Additionality cannot be demonstrated for PSNP projects that a) have already been implemented, or b) would occur in an ongoing PSNP program of work without carbon finance. However, additionality may be demonstrated for (in order of decreasing viability) i) an expansion of PSNP, ii) improvements in implementation of existing or planned PSNP, and iii) securing the continuation of PSNP activities when sites are returned to community management after PSNP ends. All three of these scenarios must demonstrate that they are not possible without carbon finance.

The third of these options would need to be considered on a site-by-site basis, with local conditions that create a threat to the already established project being demonstrated, while also making a credible case that carbon finance would remove that threat. However, such a case could be hard to establish for the national PSNP program as a whole, making this an option most likely restricted to local community carbon projects.

The second of these options, although feasible in principal, may be constrained by the fact that not all carbon benefits of the PSNP carbon project sites would be marketable, but only the additional carbon benefits accrued directly as a result of carbon finance. This would lead to lower carbon benefits per hectare being marketable, but without any associated reduction in development or MRV costs per hectare, thus lowering the return to investment ratio achievable.

The most promising approach to achieving additionality for PSNP to receive carbon finance would be to extend the PSNP program beyond what would otherwise be achievable, and to do so using targeted landscape-scale projects that minimize carbon project development and MRV costs. This approach could be further streamlined by use of jurisdictional standardized methods.

Direct climate finance continues to be by far the largest source of finance for mitigation activities.

Whereas significant research and discussion has been focused on the potential for carbon markets to spawn investments in climate change mitigation and adaptation activities in developing countries, an analysis of carbon finance trends shows that this has yet to crystallize. Not carbon markets, but bi- and multi-lateral funding agencies continue to be by far the largest source of finance for mitigation (and adaptation) activities.

An emerging multi-laterally funded carbon-finance instrument with potential to support PSNP 4 is the Green Climate Fund (GCF). The six investment criteria used by GCF are all highly compatible with PSNP. While GCF represents perhaps the best near-term opportunity for financing additional implementation of climate smart interventions through PSNP, there are other established funds[5] that may support PSNP or elements thereof. These include bilateral funds linked to the international development arms of industrialized nations, and multilateral funds operated under the purview of United Nations or World Bank agencies.

Conclusions and recommendations

Ethiopia's PSNP is a model public works safety net program that creates multiple social, economic, and environmental benefits through climate-smart interventions. Using a combination of geospatial techniques, field-based analytical methods and modeling, the climate-change mitigation benefits of the program were quantified on a subset of PSNP sites through the CSI. These carbon benefits can be used by PSNP administrators to pursue climate finance opportunities—whether from bi- and multilateral donor institutions seeking to support climate smart sustainable development priorities or public/private sector entities looking to purchase carbon credits through compliance or voluntary carbon markets. Indeed, data generated by CSI has already been used to secure support for PSNP 4 from bilateral donors. Looking forward, there are several important messages regarding the potential for climate finance to support Ethiopia's PSNP:

1. Carbon offset markets are not currently in a state to allow for ambitious proposals (although note that non-market mechanisms of climate finance are in a more robust state).

2. Nonetheless, there are encouraging signs within the ongoing UNFCCC climate negotiations that i) binding international commitments to reduce GHG emissions will be reached at COP-21 in Paris at the end of 2015, and ii) that carbon offset markets will likely be one of the mechanisms made available for countries to meet their reduction obligations.

3. If carbon markets do indeed grow substantially in the near future—as they must if climate change is to be kept within safe limits—then Ethiopia should act now to insure that it is well-positioned to take advantage of market opportunities as they arise. It is, therefore, recommended that a carbon market project be developed for Ethiopia's PSNP. Using a grouped projects (VCS) or Programme of Activities (CDM) approach, such a project could encompass a mosaic of sustainable watershed management activities within an extensive project boundary; for example, covering up to four woredas across the PSNP regions and totaling thousands to tens of thousands of hectares. Such a project could have a market value of US$ 15 – 20 million over 20 – 30 years making it an ambitious and worthwhile initiative.

4. Site selection for carbon projects is critical. The highest carbon sequestration potential per hectare is in the wetter and more fertile regions, whereas food security issues are more pervasive in the drier regions. The low hanging fruit will be to develop projects that generate the highest benefit to cost ratio in terms of carbon sequestration potential per unit area. However, the drier regions also stand to benefit greatly from the food security and ecosystem rehabilitation improvements that carbon projects offer. Therefore, there are strong rationales for initiating and incubating pilot projects in both more humid and in dryer regions, to build the in-country capacity for carbon finance across varying agroecological zones that will be key to contributing to Ethiopia's overall climate-smart development goals.

5. Carbon projects developed in the near future must be sized to be compatible with the current volumes of transactions in carbon markets. It is not realistic to attempt to finance a project on the scale of the whole of PSNP through carbon markets at the present time.

6. To ensure compliance with the additionality requirement of climate finance, any carbon project seeking climate finance should be a demonstrably new project that was not already planned or financed by PSNP.

7. Project costs have historically often been comparable to, or sometimes greater than, the funds accessed through climate finance. Therefore keeping project costs as low as possible, while maintaining the rigor demanded of climate finance mechanisms, must be a high priority.

8. To lay the foundation for larger jurisdictional carbon projects, Ethiopia's PSNP should pursue development of standardized methods in VCS or other relevant markets to quantify carbon benefits across much larger land areas more applicable to the scope of PSNP. These jurisdictional approaches should best be based on agroecological and livelihood zones to facilitate GHG accounting across reasonably homogeneous climatic, ecological, and socio-cultural regions; for example, the dry highlands of Tigray and Amhara, and the relatively wetter highlands of Oromia and SNNPR. The semi-arid and arid lowland regions of Ethiopia, although they are chronically vulnerable and their resilience to climate change can benefit from improved land management and rehabilitation, they are more challenging environments to establish carbon projects in the near future. Further research should be undertaken to establish the best climate smart practices with proven carbon benefits that are socio-economically viable at scale in these regions.

9. The Oromia Forested Landscape Program (OFLP) is a REDD+ pilot project that is breaking new ground to develop jurisdictional approaches that will be relevant primarily to large-scale forest ecosystems. Although some PSNP activities (i.e., area enclosures focused on forest regeneration within Oromia) could benefit from OFLP's outputs, there are strong rationales to pursue additional climate finance avenues within the wider PSNP context:

   (a) For PSNP's diverse suite of climate smart land management practices on agricultural lands (including cropland improvements, agroforestry and sustainable forage production), Oromia is too large a scale, given the current complexities of developing GHG accounting methodologies for smallholder agricultural systems.

   (b) OFLP is a much-needed effort, but will take several years to establish the required methodologies before GHG-reducing activities can commence and finance begin to flow. But, PSNP and the government of Ethiopia (GoE) can benefit from gaining experience now by developing smaller scale project(s) using established methodologies and market channels in addition to developing standardized methods specifically tailored to PSNP's diverse suite of climate smart land management practices.

   (c) The unique aspect of PSNP is that it opens a novel opportunity for food-security interventions to be a vehicle for climate change mitigation. The clear opportunity to access new funding from carbon markets and multi- or bi-lateral sources is compelling, not only for PSNP but other safety nets and food security programs in Sub-Saharan Africa and beyond. In this regard, PSNP could be a trailblazer by providing valuable lessons to facilitate future scaling-up of land-based climate change mitigation efforts that are coupled with food security interventions. It could also provide an opportunity to enhance the long-term endurance and sustainability of such systems beyond the life time of the food security program.

10. A proposal should be developed and submitted to the development partners to support creation of a task team within the CRGE unit under the umbrella of the Ministry of Agriculture for climate finance of PSNP.

11. Notwithstanding the potential of carbon offset programs to support PSNP, direct income from bi- and multilateral donors in the form of grants and loans remains the mainstay of climate finance opportunities at present.

12. The GCF is an attractive emerging multilateral climate fund for Ethiopia's PSNP public works based on its fit with GCF's six top-level investment criteria, not least of which is a project's climate change mitigation and adaptation potential. To avoid jeopardizing or conflicting with potential submissions to GCF from the GoE for a larger multi-sectoral proposal, there should be communication between PSNP administrators and the GoE when preparing proposals for submission to GCF.

13. The potential for demonstrated mitigation benefits of Ethiopia's PSNP to be used in support of negotiations for development funding should not be overlooked. This is known as results-based finance and is increasingly used by international donors to justify expenditures. For example, the UK Department for International Development (DfID) has already used results on PSNP's net carbon benefits generated by the Cornell CSI group to support the business case for release of funds from the UK International Climate Fund (ICF) to further support Ethiopia's PSNP.

Further details about all aspects of this document can be found in:

- Jirka, S., Woolf, D., Solomon, D., & Lehmann, J.(2015). "Climate Finance for Ethiopia's Productive Safety Net Programme (PSNP): Comprehensive report on accessing climate finance and carbon markets to promote socially and environmentally sustainable public works social safety net programs." A World Bank Climate Smart Initiative (CSI) Report. Cornell University. https://ecommons.cornell.edu/handle/1813/41298
- Jirka, S., Woolf, D., Solomon, D., & Lehmann, J. (2015). "Guide to Developing Agriculture, Forestry and Other Land-Use (AFOLU) Carbon Market Projects under Ethiopia's Productive Safety Net Programme (PSNP)." A World Bank Climate Smart Initiative (CSI) Report. Cornell University. https://ecommons.cornell.edu/handle/1813/41297
- Solomon, D., Woolf, D., Jirka, S., De'Gloria, S., Belay, B., Ambaw, G., Getahun, K., Ahmed, M., Ahmed, Z., and Lehmann, L. (2015). "Ethiopia's Productive Safety Net Program (PSNP): Soil carbon and fertility impact assessment". A World Bank Climate Smart Initiative (CSI) Report. Cornell University. https://ecommons.cornell.edu/handle/1813/41301
- Solomon, D., Woolf, D., Jirka, S., De'Gloria, S., Belay, B., Ambaw, G., Getahun, K., Ahmed, M., Ahmed, Z., and Lehmann, L. (2015). "Ethiopia's Productive Safety Net Program (PSNP) national baseline database (NBD): Georeferenced site, management, topography, climate, soil carbon, soil fertility indicators, yield and low-cost soil mid-infrared (MIR) analysis results". A World Bank Climate Smart Initiative (CSI) Report. Cornell University. https://ecommons.cornell.edu/handle/1813/41299
- Woolf, D., Jirka, S., Milne, E., Easter, M., DeGloria, S., Solomon, D., & Lehmann, J. (2015). "Climate Change Mitigation Potential of Ethiopia's Productive Safety-Net Program (PSNP)". A World Bank Climate Smart Initiative (CSI) Report. Cornell University. https://ecommons.cornell.edu/handle/1813/41296

Notes

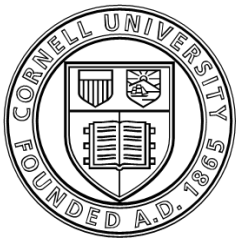
[1]For details, see Woolf, D., Jirka, S., Milne, E., Easter, M., DeGloria, S., Solomon, D., & Lehmann, J. 2015. "Climate Change Mitigation Potential of Ethiopia's Productive Safety-Net Program (PSNP)". A World Bank Climate Smart Initiative (CSI) Report. Cornell University.

[2]For a complete listing of published AFOLU methodologies relevant to PSNP, see Appendix 1 in Jirka, S., Woolf, D., Solomon, D., & Lehmann, J. 2015. "Ethiopia's Productive Safety Net Programme (PSNP) Climate-Smart Initiative: Accessing climate finance to promote socially and environmentally sustainable public works social safety net programs". A World Bank Climate Smart Initiative (CSI) Report. Cornell University.

[3]For details, see Solomon, D., Woolf, D., Jirka, S., De'Gloria, S., Belay, B., Ambaw, G., Getahun, K., Ahmed, M., Ahmed, Z., and Lehmann, L. 2015. "Ethiopia's Productive Safety Net Program (PSNP): Soil carbon and fertility impact assessment". A World Bank Climate Smart Initiative (CSI) Report. Cornell University.

[4]For details, see Section 6 in Jirka, S., Woolf, D., Solomon, D., & Lehmann, J. 2015. "Ethiopia's Productive Safety Net Programme (PSNP) Climate-Smart Initiative: Accessing climate finance to promote socially and environmentally sustainable public works social safety net programs". A World Bank Climate Smart Initiative (CSI) Report. Cornell University.

[5]See Section 9.3 in Jirka, S., Woolf, D., Solomon, D., & Lehmann, J. 2015 "Ethiopia's Productive Safety Net Programme (PSNP) Climate-Smart Initiative: Accessing climate finance to promote socially and environmentally sustainable public works social safety net programs". A World Bank Climate Smart Initiative (CSI) Report. Cornell University.



Cornell University

School of Integrative Plant Science
Soil and Crop Sciences Section
Bradfield Hall
Cornell University
Ithaca, NY 14853 USA

Please address questions and comments to:

Dominic Woolf: d.woolf@cornell.edu
Dawit Solomon: ds278@cornell.edu
Johannes Lehmann: cl273@cornell.edu
Stefan Jirka: sj42@cornell.edu