AFOLU CARBON CALCULATOR ASSESSMENT

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LIST OF ACRONYMS

ACC	Agriculture, Forestry and Other Land Use Carbon Calculator
AFOLU	Agriculture, Forestry and Other Land Use
AR	Afforestation/Reforestation tool/activity
CARPE	Central Africa Regional Program for the Environment
CBNRM	Community-based natural resource management
(M)t CO_2e	(million) metric tons of carbon dioxide-equivalent emissions
DfID	United Kingdom Department for International Development
EPA	United States Environmental Protection Agency
ER	Emissions reduction
ERZ	Extractive Resource Zone
FAO	Food and Agriculture Organization of the United Nations
FM	Forest Management tool (ACC)
FP	Forest Protection tool (ACC)
GEF	Global Environment Facility
GHG	Greenhouse gas
IPCC	Intergovernmental Panel on Climate Change
PPR	Performance Plan and Report
RDMA	Regional Development Mission for Asia (USAID)
REDD+	Reduced Emissions from Deforestation and Forest Degradation, with sustainable management of forests, conservation of forest carbon stocks and enhancement of forest carbon stocks
USAID	United States Agency for International Development
UNFCCC	United Nations Framework Convention on Climate Change
VCS	Verified Carbon Standard
WB/WBG	World Bank/World Bank Group

I. EXECUTIVE SUMMARY

Agriculture, forestry and land use change contribute up to a quarter of global carbon emissions annually, and represent a significant source of greenhouse gas emissions. Consequently, reducing emissions from deforestation, forest degradation, agriculture and land use change is a critical component of climate change mitigation efforts. USAID Global Climate Change Program's Sustainable Landscapes (SL) pillar focuses on climate change mitigation activities aimed at reducing land-based emissions of greenhouse gases. One measure of the impact of Sustainable Landscapes Program funding is an estimate of GHG emissions reduced, sequestered or avoided as a result of USG assistance. To help missions calculate the emissions reductions associated with their activities, USAID supported the development of the AFOLU Carbon Calculator (ACC). The ACC is a series of user-friendly tools that use standardized methodology to provide *ex-ante* estimates of greenhouse gas (GHG) mitigation impacts of a variety of forestry and land use projects. The key characteristics of the Calculator are ease of use, broad applicability across the SL portfolio, transparent and replicable methodology, and availability for use by a public audience.

The purpose of this assessment is to examine the usage of the ACC for reporting GHG emissions reductions (ERs) across USAID's Sustainable Landscapes project portfolio, examine the data and methodology used by the ACC and the quality of reported data, and compare it with other GHG accounting tools for AFOLU projects. The assessment looks at the past performance and usage of the ACC, current status of version 2 of Calculator, and recommendations for future improvements to the ACC and reporting for USAID.

PAST PERFORMANCE

PAST USAGE AND USER FEEDBACK

The majority of registered users only use the Calculator a few times, while 15-20% of users actively use the Calculator for reporting, project design and other applications. Reporting of emissions reductions from SL activities increased from 2012 to 2015 from 23% to 59% of OUs receiving focused SL funds, and SL activities account for the majority of GHG ERs across indicator 4.8-7[1]. Excluding the Central Africa Regional Program for the Environment (CARPE) program, GHG ER estimates reported in the Performance Plan and Report (PPR) increased from under 11 million metric tons CO_2-equivalent (Mt CO_2e) to over 13 Mt CO_2e from 2012 to 2014 across the remaining SL funding portfolio.

A survey of registered users (30 respondents, estimated 20% sample of 'active users') indicates that the majority of survey respondents have limited use and experience with the ACC. About 15% of survey respondents reported using the ACC more than a few times a year for project planning, assessment of potential ERs and reporting to USAID. The majority of survey respondents find the ACC easy to use, with the exception of minor bugs or difficulties in generating results

[1] State/F Standard Indicator: "4.8-7 Greenhouse gas (GHG) emissions, estimated in metric tons of CO2e (tCO2e), reduced, sequestered, and/or avoided as a result of USG assistance"

from the different tools. The Forest Protection tool is the most widely used tool, while the newer tools like Grazing Management, Cropland Management and Fuelwood Degradation being used the least.

DATA QUALITY ASSESSMENT

A case study approach was used to evaluate data quality, using four case studies of SL regional programs or bilateral mission activities: Central Africa (CARPE), Peru, Southeast Asia (LEAF), Cambodia and Vietnam.

The CARPE program accounts for the largest share of GHG ERs, with 130 Mt CO_2e in 2012 and 110 Mt CO_2e in 2013, but the reporting for FY 2014 dropped to under 14 Mt CO_2e. The assessment looked at a subset of landscapes across the CARPE program from 2011-2014, and replicated calculations of ER estimates using archived data from version 1 (v1) of the ACC, in an effort to identify the cause(s) of the drop in reported ERs. Version 1 of the ACC was used from 2011 to 2013, and version 2 was used for 2014 onwards. The new version of the ACC featured updated datasets for forest cover, deforestation and carbon stocks from version 1.

Comparing the reconstructed ERs with the reported values resulted in a large discrepancy in the ER values for Forest Protection (FP). The factors that explained the large decline in ER estimates for FP activities include 1) relatively high default deforestation rates used in version 1 of the ACC[2], and 2) the decline in the total area included in the landscapes from 2013 to 2014, as a result of the transition from CARPE II to CARPE III. The decline in area was a result of a change in the program design, from large 'macro-zones' to more focused areas, or 'micro-zones,' within the larger landscapes. For the purposes of reporting, the number of hectares in micro-zones was significantly lower than in CARPE II.

For some landscapes, the default deforestation rate in v1 was over 10%/year. These rates dropped by 1-2 orders of magnitude in the new database for ACC version 2 (v2)[3], significantly lowering the ER estimate. However, the updates to v2 of the ACC resulted in increased estimates of ERs for Forest Management (FM) and Agroforestry activities, due to changes in the methodology and default data for these types of activities. The changes in ER estimates from FM and Agroforestry activities were smaller than those for FP. The CARPE case study indicates the impact of changing data sources, and for some types of activities, this influences the default calculation to a large extent. The project effectiveness ratings also have a secondary level of importance in influencing overall ER estimates.

In Peru, Cambodia and the Regional Development Mission for Asia (RDMA), the ACC estimates were compared to REDD+ projects developed using the Verified Carbon Standard (VCS) methodology, which has a more rigorous accounting methodology for project baseline emissions and for leakage and permanence assessment. Using default data in the ACC, the aggregation of variables to administrative units can either over or underestimate deforestation rates and carbon

[2] FACET Atlases produced by the OSFAC initiative were used as sources of data for deforestation rates

[3] Hansen *et al*. 2013 used for Global Forest Cover Change maps

stocks. However, when advanced data values[4] are used, ER estimates agree reasonably well over short time periods. Over 10 year or greater timelines, the ACC and VCS methodology estimates tend to diverge. The use of the effectiveness tool to account for permanence risk and leakage can also approximate the same results as a more robust VCS methodology, but the effectiveness rating oversimplifies too many aspects of land use change dynamics.

CURRENT STATUS

TOOL METHODOLOGIES

The tools in the ACC are largely based on IPCC 2006 guidelines estimating project emissions reductions and accepted data sources. The ACC v2 incorporates more robust and recent remote sensing data for estimating carbon stocks and deforestation rates, and is comparable to methodologies applied across a broad suite of tools in the sector. Tools like the Agroforestry tool that do not have widely developed and standardized methodologies have bespoke methods developed through expert consultation and extensive literature reviews by Winrock.

The ACC departs from standardized methodologies and approaches in its use of the effectiveness rating, which is largely based on unpublished or reviewed Winrock-developed approaches to account for the risk of non-permanence and emissions from projects or leakage. The effectiveness rating guides assign quantitative deductions to subjective factors that influence project impacts, but these may not suit every project's individual circumstances, and may be overridden by users. Consequently, the effectiveness approach compromises the consistency and transparency of emissions reduction estimates.

The ACC also does not explicitly consider the spatial boundaries of project activities, raising the risk of double-counting emissions reductions. Along with this, the ACC does not provide basic checks for the quality of data entered by users for simple errors in entry of project areas or advanced values of certain variables. Finally, the ACC does not provide estimates of uncertainty to users alongside the emissions reduction estimates, which is a critical aspect of GHG accounting and evaluation

COMPARISON OF TOOLS AND OTHER AGENCIES

While there are several recent and ongoing studies to compare GHG accounting tools and calculators like the ACC, the assessment focused on tools that are used by other agencies for evaluation of AFOLU project portfolios, and use similar methodologies and cover the same range of project activities. Two tools in particular, the EX-ACT tool and the Carbon Benefits Project (CBP) were compared to ACC v2. While the ACC is easier to use than both these tools (can be used without training), both of these tools follow the Intergovernmental Panel on Climate Change (IPCC) tiered approach for accounting for emissions from AFOLU projects, and can be used for a more robust and scaled approach to project ER estimation. The CBP tool allows users to use spatial boundaries of projects and GIS functionality to develop more advanced estimates of project emissions. The EX-ACT tool is a spreadsheet tool, which offers greater transparency in the

[4] Advanced data allow users to specify activity data and emissions factors specific to a project context, allowing for more site-specific estimates to be calculated

calculation of project emission estimates, at the cost of not being capable of offering advanced spatial analysis.

US Government agencies like the Environmental Protection Agency (EPA) use the Agriculture and Land Use (ALU) tool for national or regional GHG inventories. The ALU tool does not provide *ex-ante* estimates of land-based project emissions. Multilateral agencies like the World Bank and Global Environment Facility (GEF) follow methodologies like the IPCC 2006 guidelines, and have promoted the use of the EX-ACT and CBP tools for reporting on projects in the agriculture and sustainable land/forest management sectors. Bilateral agencies follow a variety of different approaches for project monitoring. The UK's Department for International Development (DfID) uses the 'Hectares' indicator, which uses a risk-based approach to classify forest areas, and estimate the area of avoided deforestation using the University of Maryland data for estimating forest cover loss. Other agencies like Norway and Australia rely on *ex-post* estimates of reduced deforestation in evaluating the performance of funded projects in the AFOLU sector.

RECOMMENDATIONS AND FUTURE DIRECTIONS

The ACC user interface can be substantially improved to allow searching of the project database by users, and easier collaboration or forums for users to share project estimation best practices and troubleshooting. The ACC should offer training or demonstration projects to illustrate how advanced features and variables affect project emissions estimates. The ACC should also provide beginning users basic quality assurance or checking procedures to ensure that estimates are realistic or consistent with project potential and past performance. The ACC could also provide more options to import and export data for use with other tools and reporting formats.

The ACC methodology can be improved by explicitly considering the spatial boundaries of project activities, and accounting completely for land use change within the overall project area. The effectiveness approach should be revised to account for components like non-permanence, leakage and project emissions, to ensure that estimates are comparable with other tools and methodologies. The methodology should also include an estimate of uncertainty, as this is increasingly recognized as a critical component of GHG accounting for land use projects.

II. INTRODUCTION

Agriculture, forestry and land use change are a major source of anthropogenic greenhouse gas emissions globally. According to the IPCC Fifth Assessment Report (IPCC, 2014), annual net GHG emissions from land use and land-use change activities between 2000-2010 accounted for approximately 4.3 – 5.5 billion metric tons of carbon dioxide equivalent (Gt CO_2e) per year, representing about 12 percent of global carbon emissions. Reducing deforestation, forest degradation and emissions from other land use changes represents a critical component of global climate change mitigation efforts. Over the past decade, a broad number of bilateral and multilateral funding efforts have supported climate change mitigation efforts in the AFOLU sector. The quantification of GHG emissions and benefits of climate change mitigation efforts in this sector present unique challenges in the measurement and verification of emissions reductions from project activities. Unlike other sectors, several processes determine the sources and sinks of GHGs, and the accurate quantification of baseline emissions can be challenging and costly. The IPCC Good Practice Guidance for Land Use, Land Use Change and Forestry[5] provides a systematic approach to GHG inventories for these activities, establishing a tiered approach to developing and improving estimates of emissions and removals of GHGs from activities in the AFOLU sector.

USAID Global Climate Change Program's Sustainable Landscapes (SL) pillar focuses on climate change mitigation activities aimed at reducing land-based emissions of greenhouse gases. A broad array of project activities are funded under Sustainable Landscapes, ranging from capacity-building and policy development support to the direct implementation of natural resource management, conservation of forests and biodiversity, or integrated low emissions development activities. Estimating project impacts across a diverse portfolio of activities that fall within the AFOLU sector is a key challenge, especially in providing a high level of consistency and accuracy in estimation techniques.

1. PROGRAM BACKGROUND

One of USAID's primary mitigation indicators is "4.8-7 Greenhouse gas (GHG) emissions, estimated in metric tons of CO2e (tCO2e), reduced, sequestered, and/or avoided as a result of USG assistance," disaggregated by the sustainable landscapes and clean energy pillars. The AFOLU Carbon Calculator (ACC) is a series of user-friendly tools that use standardized methodologies to provide *ex-ante* estimates of greenhouse gas (GHG) mitigation impacts of a variety of forestry and land use projects. Winrock International developed the Calculator under a cooperative agreement with the USAID Global Climate Change Initiative. USAID provides climate change-related assistance in over 50 developing countries, supporting a wide variety of activities under Sustainable Landscapes. In fiscal year 2015 (FY 15), 17 operating units (including bilateral and regional missions and Washington bureaus) received focused SL funding. In order to aggregate mission-level results across the Agency for reporting, USAID facilitated the development of a standardized methodology that is easy to use for non-specialists in GHG accounting, is broadly applicable to all types of SL activities, and provides robust and transparent estimates of GHG

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[5] IPCC, 2006

impacts of projects. The AFOLU Calculator covers all geographical areas where USAID works and currently covers 7 types of AFOLU activities.

The key characteristics of the Calculator are:

- Ease of use: Easy step by step interface, limited technical knowledge required, limited data entry required

- Broad applicability: Can be used for a diverse set of activities, in all areas where USAID has programs

- Transparent, replicable methodology: Clear, publically available information on data sources and information. To the degree appropriate, methods are consistent across geographic locations, ecosystem type and activity. Results of estimation analysis are archived and retrievable by authorized USAID staff

- Available for use by the broader public

2. METHODS AND SCOPE OF ASSESSMENT

The purpose of this assessment is to examine the usage of the ACC for reporting GHG emissions reductions across USAID's Sustainable Landscapes project portfolio, review the data and methodology used by the ACC and the quality of reported data, and compare the ACC with other GHG accounting tools for AFOLU projects. The assessment identifies current challenges for the implementation of the ACC for USAID reporting, and provides recommendations for improving the ACC and reporting across the AFOLU project portfolio.

The assessment is based on the following key questions:

- *Past performance*: How has the Calculator been applied for reporting GHG ERs for the USAID project portfolio globally? How robust and consistent are estimates across reporting years? How do users across the agency, implementing partners and users from a variety of skill levels find the Calculator meets reporting needs?

- *Current status*: Are the methodologies and data sources in the Calculator technically sound, transparent and robust? How does the Calculator compare with other similar tools for GHG accounting in the AFOLU sector? How do other bilateral and multilateral agencies with AFOLU mitigation project portfolios estimate and report GHG ERs?

- *Future development*: How can the ACC be improved for future use - design, methods and data sources be updated for future projects? What current developments in GHG accounting for AFOLU projects are important to consider?

3. ASSESSMENT METHODOLOGY & LIMITATIONS

To answer the key questions in this assessment, Integra used a combination of qualitative and quantitative methods. Qualitative methods include comprehensive testing of the Calculator's features, user surveys and interviews, and comparisons with other tools and agency approaches. Quantitative methods include measurements of tool usage, simulated user testing, and technical analyses of estimates of ERs made by the Calculator.

PAST PERFORMANCE

Past performance of the Calculator was assessed by looking at adoption and use across USAID for generating ER estimates and reporting, the quality of reported ER estimates made using the Calculator, and user feedback on the Calculator.

USAGE ANALYSIS

The registered user database as of December 2015 was analyzed by frequency of user logins, number of project activities and activity types, and user organizational affiliations. The analysis was used to select participants for the user survey. Active users, defined as those that used ACC more than once during the year, were primarily selected to receive the user survey. Users from Winrock International's Ecosystem Services team and Applied Geosolutions were excluded from the user survey, as the developers of the tool.

USER SURVEY

The user feedback survey was designed to provide quantitative measures of frequency of use of the Calculator and specific tools, and provide qualitative feedback from users on the ease of use, clarity and adequacy of tools for user needs. Users were asked to provide feedback on the adequacy and relevance of the effectiveness guide and advanced values features of the Calculator. Other information gathered in the survey included demographic information about users, professional experience and education, geographic areas of work, and information about other tools used for GHG emissions estimations. Users were asked to provide additional details and feedback in addition to questions on the survey. The full survey questionnaire and results are attached in Annex B.

DATA QUALITY

The reporting data and calculations made using the AFOLU Calculator were examined using a case study approach. The assessment reviewed the calculations made by the USAID OUs and implementing partners, data entered in the ACC database and archives, and the ERs reported in the PPR across reporting years. Four case studies were used, representing major programs and activities across the SL funding portfolio, and a major proportion of the emissions reductions estimates reported over the past five years. The four case studies were Central Africa Regional Program for the Environment (CARPE, Central Africa), Lowering Emissions in Asian Forests (LEAF, Southeast Asia), Sustaining Forests and Biodiversity (SFB, Cambodia), and the Parque Nacional Cordillera Azul (PNCAZ, Peru). For each case study, GHG ERs reported to USAID made using versions 1 and 2 of the Calculator were analyzed for the accuracy, replicability and comparability with other, more rigorous methods used for carbon credits. Accuracy and replicability were assessed by comparing reported ER estimates to calculations made by Integra using version 2 of the Calculator. For reported ERs before 2014 archived data from version 1 of the Calculator were used to make estimates using version 2 of the Calculator for comparison. In the case of REDD+ project activities like the Peru PNCAZ project and Vietnam Lam Dong Province REDD+, ER estimates from the Calculator were compared to Verified Carbon Standard (VCS) and other methodologies for REDD+ and carbon market projects. Project reports from USAID and implementing partners were used as a source of additional information to replicate and compare estimates of ER benefits from projects.

CURRENT STATUS

The current design, functionality, ease of use and comparison of the Calculator to other tools and funding agency methods for evaluating AFOLU projects were assessed as part of the current status of the Calculator.

USABILITY TESTING

The usability testing approach used a pre-defined workflow for basic and advanced types of users to use the different tools, resources and features of the Calculator and generate estimates of ER benefits of project activities and reports. The usability testing approach provided qualitative feedback on the ease of use, requirements for user knowledge/skill, customizability to specific contexts, and bugs/errors encountered by users.

METHODOLOGY REVIEW

The methodology used for each of the tools within the Calculator was compared to IPCC guidelines for accounting for GHG emissions and emissions reductions in the AFOLU sector, for each of the relevant types of projects. The data sources used by each tool were also evaluated for the quality, consistency with established methodology/guidance documents for GHG accounting and comparability with other data sources. The effectiveness guide methodology was also evaluated by comparison with other methodologies, and IPCC good practice guidance for estimating ER from projects.

COMPARISON OF OTHER AGENCIES AND TOOLS

The Calculator was compared to other similar tools and calculators that estimate GHG emissions reductions for AFOLU projects. Review studies of tools and calculators and consultations with technical experts at World Bank, GEF, and academic institutions were used to select tools that were most similar in terms of methodology and applications to the Calculator. The tools selected for comparison were Ex-Ante Carbon Tool (EX-ACT), Carbon Benefits Project (CBP), the Agriculture and Land Use (ALU) tool, and the Cool Farm Tool. Literature reviews, working papers and interviews with tool developers were used to draw qualitative comparisons between the Calculator and other tools, and key differences in methodology and data sources used were described.

Integra also conducted interviews with other bilateral and multilateral agencies and donors with project portfolios in agriculture, forestry and land use change. Project evaluation reports and reports on methodologies were used as secondary sources of information on tools and methods used by other agencies. The World Bank, GEF, DFID, and Norway and Australian government funding agency methods were compared to the USAID GCC indicators for AFOLU projects.

RECOMMENDATIONS/FUTURE DIRECTIONS

Based on the analysis of past usage and performance of the AFOLU Calculator, and the review of usability and comparison with current tools and methods, recommendations are provided in the final section of this assessment. The recommendations are focused USAID GCC monitoring and evaluation needs, with emphasis on the technical features and design of the Calculator and current developments in tools and methodologies for GHG accounting.

Design: Recommendations based on user testing, web analytics and surveys/feedback. Recommendations will focus on increasing the use and usability of the Calculator for USAID reporting.

Technical features: Based on new developments in data and GHG accounting methodology, recommendations will be made for updating the Calculator's technical features. Software and website access issues will also be highlighted and necessary changes recommended

Future needs: These recommendations will focus on the evolution of USAID's GCC mitigation project portfolio, and the addition of ecosystem types (such as dry forests and savannah woodlands), a broader array of land use management, improved agriculture and NRM activities, and indicators used to estimate GHG mitigation impacts of USAID projects. Recommendations will focus on the gaps identified in the current version of the Calculator, and activities/projects that are planned for future reporting on GHG ERs

III. PAST PERFORMANCE

1. CALCULATOR USAGE

Out of the registered 953 users (as of February 2016), the majority have only used the Calculator once or a few times. The analysis of the user database revealed that approximately 40% of total registered users had logged in to the Calculator during 2015, and less than 15% of registered users had used the site more than once. This corresponds with Google Analytics measurements of visits during the period of the assessment (Nov 2015 – Feb 2016) – 69% of visitors to the website left without logging in or interacting with the website (metric: bounce rate). During the assessment period, there were 150 unique visitors to the site who logged in to the website multiple times, visiting more than one page. In the user survey, 20% of respondents reported using the Calculator regularly for reporting and analysis of projects. The level of usage of the AFOLU Calculator has increased, especially after the release of version 2 of the Calculator, in terms of number of user registrations and project activities added to the database between 2012 and 2015.

In the user survey, over 50% of survey respondents reported using the Calculator for purposes other than reporting to USAID, including project planning, demonstration, or training for local land resource management and other purposes. Within USAID, the proportion of OUs receiving focused SL funding which report GHG ERs has increased from 23% in FY12 to 59% in FY14 (Table 1). However, while there has been in increase in the number of OUs reporting GHG numbers, the use of Calculator for reporting remains limited. From 2012-2015, only 6 countries submitted reports using the Calculator's official reporting feature, representing less than 25% of total GHG emissions reductions reported in the PPR. A number of OUs and implementing partners use the Calculator to generate estimates of GHG ERs for project activities, but it was not possible to estimate how many of the implementing partners or OUs are reporting Calculator-generated estimates without using the reporting feature.

Sustainable Landscapes Reporting Summary	2012	2013	2014
OUs with focused SL funding	26	23	22
OUs with direct SL funding that reported SL GHGs	6	9	13
Percent of OUs with direct SL funding that report on SL GHGs	23%	33%	59%
SL GHGs from OUs with direct SL funding	140,669,989	123,973,274	27,317,416
OUs without direct SL funding that reported SL GHGs	1	3	2
SL GHGs from missions without direct SL funding	115,954	1,877,686	1,607,104
Percent of SL GHGs from OUs with direct SL funding	100%	99%	94%
Total OUs reporting on SL GHGs	7	12	15
SL direct without CARPE	10,785,943	13,973,274	13,097,956
Total SL GHGs reported	140,785,943	125,850,960	28,924,520

Table 1. Summary of USAID Sustainable Landscapes Reporting of GHG emissions reductions from FY 2012 - 2014

The Forest Protection tool is the most used tool within the Calculator, with over 1400 project activity entries in the database. Forest Management, Agroforestry and Afforestation/Reforestation are the next most used tools, with approximately 500 activities created using each of the tools. Cropland management and Grazing Management tools were the next most used tools, with 100-200 activities, and Forest Degradation by Fuelwood was the least used tool, with fewer than 100 activities entered. In the user survey, most respondents reported using the Forest Protection, Forest Management and Agroforestry tools, and very few users used the Cropland Management, Grazing Management or Fuelwood tools. Very few users (under 15%) reported using the policy tool, but several users reported using Forest Protection and other tools for demonstration of scenarios of GHG ER benefits from projects.

The geographic distribution of users is largely skewed towards the United States, representing over 30% of sessions (metric: visitor IP addresses). Overall, there were visitors from 48 countries using the Calculator, including Mexico, Colombia, Brazil, Peru, Democratic Republic of Congo, Indonesia and other USAID priority countries. We note that Integra's use of the Calculator website for the assessment also influences the site's usage metrics, possibly skewing usage levels higher than usual, especially for US-based users.

The majority of users find the Calculator an accessible, easy to use set of tools to calculate the carbon benefits of a variety of project activities in the AFOLU sector. The ACC has been used by several major projects funded through the Sustainable Landscapes pillar of GCC. However, the majority of users test out the tools and features of the Calculator, but do not use the advanced functionality, collaborative features and reporting functions that the ACC was designed to provide. Within USAID, wider use of the Calculator for the estimation and reporting of emissions reduction benefits has not occurred. The primary barriers to wider adoption of the Calculator for analysis and reporting of GHG ERs are the lack of user training and guidance, QA/QC procedures to ensure the Calculator is being used correctly, and the lack of customizability of some tools to project-specific circumstances to ensure accurate reporting.

2. DATA QUALITY OF ESTIMATES

2.1 CARPE (2011-2015)

Central Africa Regional Program for the Environment (CARPE) program spans 12 different landscapes in Central Africa over nearly a decade, and includes a variety of project activity types. For this assessment, only a subset of landscapes was used to evaluate the quality of data. The four landscapes selected represent a sampling of the different regions, project activity types, and years of activity in CARPE. The CARPE program is currently in its third phase (2012-2016), and the selected landscapes include those that were in CARPE II as well as landscapes that are currently active in CARPE III. For project activities between 2011-2013, estimation and reporting of emissions reductions was done with version 1 of the Calculator, and 2014-2015 reporting was done with version 2.

The following landscapes (LS) were selected, based on project activities, size of landscape, location and reporting years:

- Landscape 3 (Lope-Chaillu-Louesse, 'LCL'): CARPE II landscape under 1 million hectares (ha) with Forest Protection and Forest Management community based natural resource management (CBNRM) and extractive resource zones (ERZ).

- Landscape 4 (Dja-Minkebe-Odzala, 'Tridom'): CARPE II landscape around 12 million ha, across several countries, with Forest Protection and Forest Management activities.

- Landscape 8 (Salonga): CARPE II and III landscape around 4.7 million ha, with the largest reported emissions reductions over the 2009-2012 period. Activities include Forest Protection, and a variety of Forest Management projects.

- Landscape 12 (Virunga): CARPE II and III landscape under 1 million ha, with Forest Protection and Agroforestry activities.

In order to validate the calculations of ERs for the different landscapes, it is necessary to distinguish between the effect of the different versions of the Calculator from changes in the activities and other project design factors in these landscapes. Since version 1 of the Calculator is no longer available, estimates from version 1 were validated using the newer version of the Calculator, with data for emissions factors and activity data matched with calculations in archived project reports. Differences between the original reported ER estimates (Calculator v.1) and the new calculation in version 2 reflect differences in the Calculator's methodology. A second calculation was then made with version 2 of the Calculator using the current default values for emissions factors and other variables. Differences between the original ER estimate and the second calculation reflect differences in the emissions factors, carbon stocks, deforestation rates and other activity data.

These two calculations are referred to as Scenario 1 and Scenario 2, summarized below:

- **Scenario 1:** All variable values listed in the archive were used to re-create the calculated ER estimate for the activity, using version 2 of the AFOLU Calculator such as carbon stocks, deforestation rates, fire incidence etc. If the archive data were missing variables that exist in the new Calculator, default values were used. The effectiveness rating was also matched at 25% for all activities.

- **Scenario 2:** The estimate of ERs was made for each activity using the current default values in the new AFOLU Calculator, and the same 25% effectiveness rating for all activities.

For the two landscapes that continued during CARPE III, the reported ER values for all available reporting years were compared, to see how ER estimates have been calculated by different users across years.

Table 2. Comparison of GHG Emission Reductions estimates in four CARPE landscapes. Reported estimates for 2011 are compared with estimates that were recalculated using the AFOLU Calculator v2. *Scenario 1 uses archived values for variables from v1 of the Calculator, and Scenario 2 uses the v2 default values*

Location	Area (ha)	2011 Reported ER (tons CO2e)	Scenario 1 (tons CO2e)	Scenario 2 (tons CO2e)
LS 3: LCL	970,697	11,740,459	11,119,552	356,996
LS 4: Tridom	11,749,738	35,280,266	31,641,582	2,614,666
LS 8: Salonga	4,699,000	43,248,500	34,087,723	6,499,985
LS 12: Virunga	807,402	1,177,460	1,257,878	1,180,197

CARPE RESULTS

For all the landscapes in reporting year 2011 (CARPE II), Calculator version 2 ER estimates were lower than reported using ACC version 1. Scenario 2 estimates were lower than Scenario 1, with larger differences (>90%) in Scenario 2 estimates for landscapes 3, 4 and 8. In Landscape 12, the 2011 estimate of ERs for the landscape does not change significantly in ACC v2 calculations. Table 2 summarizes the reported ERs for these landscapes, and Scenario 1 and 2 calculations.

The changes in estimates of ERs also depend on the type of activity. For Forest Protection (FP) activities, Scenario 1 estimates were mostly within 15% of the original reported ER for project activities, while under Scenario 2, the ER estimates were >90% smaller. For Forest Management (ERZ) activities, both Scenario 1 and 2 estimates were smaller than the 2011 reported ER estimates, with a consistent 72% reduction for Scenario 1. The only exception was the West Waka Concession ERZ activity, where the Scenario 1 and 2 estimates were several times larger than the 2011 Report.

For Forest Management (CBNRM) activities, Scenario 1 and 2 estimates were 2 to 6 times larger than the 2011 reported ER estimates, with the exception of one Community Forestry activity in Landscape 4 (Cameroon) where the Scenario 1 and 2 estimates were lower than the 2011 report. For Agroforestry activities, the 2011 reported values are very low in comparison to the new version of the AFOLU Calculator, with the estimates increasing one or two orders of magnitude in the Scenario 1 and 2 estimates. The listing of activities by Landscape and Activity Type are attached in Annex III.

The ER estimates produced by the AFOLU Calculator are most strongly influenced by the values for deforestation rate, fire incidence, and logging, and secondarily by the values for carbon stocks and effectiveness of project activities. This is particularly evident in the comparison between the Scenario 1 and 2 calculations for these four landscapes, which differ by orders of magnitude in some cases, while there is relatively close agreement between estimates in others. Several of the Forest Protection activities analyzed here had deforestation rates >10% (LS 3, 4 and 8), and when default rates in the new version of the Calculator were used, these estimates dropped by orders of magnitude. For example, Birougou NP (LS 3), Lope NP (LS 3), Waka NP (LS 3), Ivindo NP (LS 4), Odzala Kokua NP (LS 4) all drop from millions of tons CO2e to tens of thousands, because the default deforestation rates drop from 12.5% to approximately 0.5%.

It is beyond the scope of this assessment to validate the accuracy of the deforestation rates that were used for the 2011 calculations, but it seems likely that the assumption of deforestation rates over 1% across large landscapes warrants a careful validation at the time of calculation and reporting, as the majority of ERs across the program are reported in project areas with these high rates of baseline deforestation. It is also noteworthy that for Landscape 12, there is relatively close agreement between the archive 2011 reported ER estimate and Scenario 2 (default new calculator) values, and the similarity of deforestation rates largely accounts for the agreement in values.

For Forest Management (FM) activities, there was little agreement between the reported 2011 ER estimates and the calculations made using ACC v2. For ERZ activities, the archive values are higher than both Scenario 1 and 2 calculations, possibly because of the assumption of a 'stop logging' measure instead of reduced impact logging. Stop logging results in far greater emissions reduction estimates, and it would be important to validate the exact management practice to avoid overestimation. For community-based natural resource management (CBNRM) activities, the archive ER estimates are consistently lower than the Scenario 1 and 2 estimates with the new Calculator, with default values producing the highest estimates of ERs.

It is noteworthy that for all FM activities, the difference between these estimates is far smaller than the difference in FP activities. The difference in estimates also highlights the importance of proper documentation of all inputs, metadata, and background data values in the Calculator to ensure interannual comparability and replicability of these estimates. The archived data from ACC version 1 cannot be searched or sorted using the web interface, and it is difficult to identify the specific activities and estimates that are used for reporting ER estimates to USAID.

For Agroforestry activities, there was once again poor agreement between the archive 2011 ER estimates and the new Calculator estimates. In all cases, the archive values are one or two orders of magnitude smaller than Scenario 1 and 2. It was noted that the Agroforestry tool in the Calculator has been revised significantly in the new version of the Calculator, along with the associated default values, and this is most likely the cause of the large difference in estimates once again.

For Landscape 8 and Landscape 12, reporting of ER estimates continued during CARPE III, although the size of these landscapes and specific activities have changed significantly. The reported ER estimates for 2011-2015 were also collected for the data quality assessment. For reporting years 2012 and 2013, ACC version 2 was not available for calculating ER estimates. In the case of Landscape 8 (Salonga NP), Forest Protection activities decreased in area from 3.65 million ha to 3.33 million ha from 2011 to 2014, but reported ER estimates went from 43 Mt CO_2e in 2011 to 2.38 Mt CO_2e. Using the validation analysis (Scenario 2) described above, the reported ER for Salonga NP in 2011 was 3.26 Mt CO_2e, which is more proportional to the 2014 estimate. In 2015, the ER estimate for Salonga NP decreased to 261,924 t CO_2e, and the biggest change was in the effectiveness rating for the activity, which was reduced from 70% to less than 10%. It is not clear why the effectiveness rating was changed, as the ACC v2 does not record responses to the interactive guide to determine project effectiveness. For Landscape 12 (Virunga NP), the area of activity decreased from 788,000 ha in 2011 to 157,125 ha in 2014, and there was a corresponding decrease from 1.1 Mt CO_2e in 2011 to 172,423 t CO_2e in 2014. In this case, the decline in ER estimate is proportional to the reduction in area, unlike Salonga NP in Landscape 8.

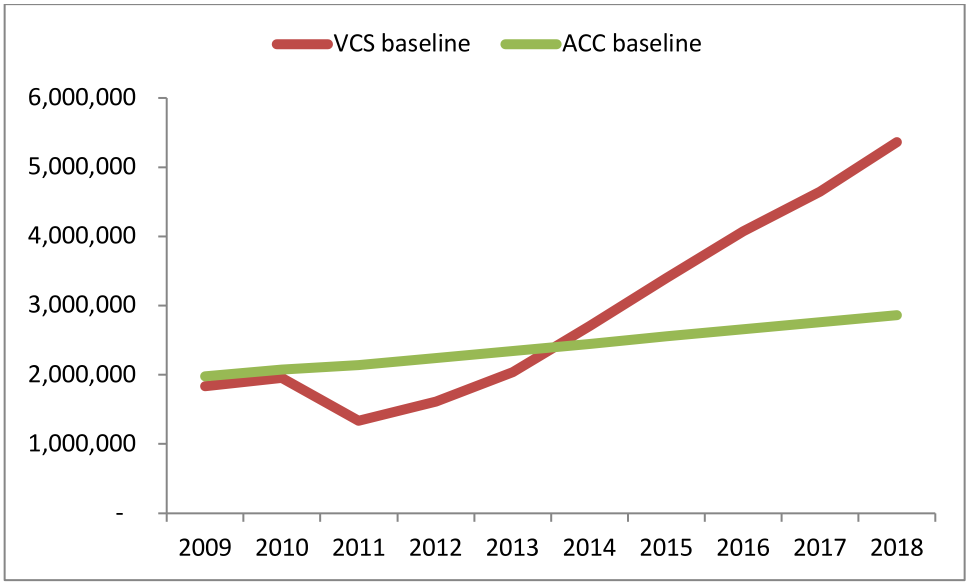
2.2 PERU: PARQUE NACIONAL CORDILLERA AZUL (PNCAZ) PROJECT

The PNCAZ project was designed to protect 1.35 million hectares in the tropical Andean region of Peru, a tropical montane forest ecosystem with high biodiversity and ecosystem service importance. The project was designed to protect buffer regions around the national park (PNCAZ), which were subject to high rates of deforestation due to illegal logging, road construction, mining concessions, agriculture and ranching encroachment, poaching and other threats. USAID began providing support to a consortium of partners working to improve law enforcement and protection of the Park, and to work with populations in the buffer zone areas to increase alternative livelihood sources and benefits from participating in conservation of forests and biodiversity. USAID also supported the development of a Reducing Emissions from Deforestation and Forest Degradation (REDD) project for PNCAZ for 2009-2018. The project was developed using the Verified Carbon Standard (VCS) Methodology, and was validated and verified under the VCS and the Climate, Community and Biodiversity Alliance (CCBA) Standards.

For the ACC assessment, the VCS-certified emissions reduction calculations were compared to the ACC estimates of ERs for the PNCAZ REDD project. The VCS methodology is a more rigorous approach for estimating a baseline and project scenario, because it requires estimation of actual deforestation rates for the project area, and accounts for leakage and permanence issues. The VCS methodology represents greater accuracy and explicit accounting for the effectiveness, indirect emissions, and risks in the project, and is a higher level of accounting than the ACC methodology.

RESULTS

The reported value of the Sustainable Landscapes indicator 4.8-7 for 2012 was 1,799,986 t CO_2e, whereas the VCS methodology produced a net ER estimate of 876,887 t CO_2e. ACC version 1 was also used to calculate the estimated ER benefits of the project in 2011-12, and the baseline calculated benefit was 4,679,589 t CO_2e. Figure 1 shows the comparison of the VCS baseline emissions reduction estimates vs. the ACC v2 estimates of emissions reductions. The ACC v1 estimate is almost double the estimate from ACC v2 or VCS. The ACC v2 estimate is within 10% of the VCS baseline scenario for the initial years, but the two estimates diverge increasingly over the 10-year project period. The ACC baseline estimate uses a single deforestation rate and a linear increase in the sequestration of carbon, while the VCS methodology has a dynamic baseline scenario and estimates higher sequestration within the project area. Since the ACC method uses average values for subnational units, the estimates for specific project areas lack the accuracy of a carbon finance project methodology. This is especially apparent for the ACC v1 estimate, where the deforestation rate is higher than the ACC v2 or the VCS defaults. It is also not possible to establish dynamic baselines for projects over multiple years using the ACC.



There are also significant differences between the net emissions reductions estimated using the VCS methodology and ACC v2. The VCS methodology provides verified estimates of project-related emissions, leakage, and the risk of non-permanence over the long term of the project. The ACC methods account for all these sources of emissions using the effectiveness tool, which results in close agreement in estimates in some years and large differences in others.

Year	VCS net ERs (tCO2e)	ACC effective ERs (tCO2e)
2009	997,497	989,583
2010	1,066,047	1,392,105
2011	726,995	1,605,414
2012	876,887	1,884,690
2013	1,109,247	1,971,318
2014	1,473,343	2,057,945
2015	1,846,955	2,144,572
2016	2,215,939	2,231,199
2017	2,524,164	2,317,826
2018	2,915,610	2,404,453

Table 3. Comparison of Verified Carbon Standard (VCS) and AFOLU Calculator v2 estimates of GHG emissions reductions for the Peru PNCAZ REDD+ project

2.3 CAMBODIA SUSTAINING FORESTS AND BIODIVERSITY (SFB)

The Supporting Forests and Biodiversity (SFB) project in Cambodia was designed to reduce deforestation and improve sustainable forest livelihoods in Mondulkiri province in the Eastern Plains Landscape (EPL), the Prey Lang Landscape (PLL) in the provinces of Kampong Thom, Preah Vihear, Steung Treng, and Kratie. The overarching goal of the SFB project is to improve conservation and governance of these two landscapes, which have the most extensive forest cover in the country, to mitigate climate change and conserve biodiversity. The objectives include:

- Effectiveness of government and other natural resource managers at national and sub-national levels to sustainably manage forests and conserve biodiversity enhanced.
- Constructive dialogue on forest management and economic development at the national and sub-national levels improved.
- Equitable benefits from the sustainable management of forests increased.

SFB includes the Seima REDD+ project in EPL, which was prepared and validated under the Verified Carbon Standard. Other project activities that have ER estimates include a variety of Forest Protection activities, like the Mondulkiri Protected Forest and Phnom Prich Wildlife Sanctuary in EPL, and Community Forests (CFs) where SFB works in PLL and EPL.

For the data quality assessment, the Seima REDD+ project ER estimates for 2013-2015 were compared with the Calculator estimates of ERs. Winrock used a VCS estimate of emissions benefits instead of using the Calculator to report ER estimates for the project. The Seima REDD+ project, Mondulkiri PA, and Phnom Prich Wildlife Sanctuary are compared in the assessment, as they represent similar types of activities across different landscapes.

RESULTS

The VCS calculation of ER benefits from the Seima REDD+ project for 2013-2015 is 9.35 Mt CO_2e, while ACC v2 estimates ER benefits as 3.98 Mt CO_2e using default values, or 10.76 Mt CO_2e using the advanced values from the VCS reporting. VCS estimates range from 1.77 Mt CO_2e in 2015 to 4.52 Mt CO_2e in 2013, while the ACC v2 estimates do not vary much from year to year.

In comparison to the Seima project, the Mondulkiri PA and Phnom Prich Sanctuary activities have ER estimates around 50,000 to 150,000 t CO_2e, even though the projects have similar areas. The most significant difference between the reporting of ER for these projects is the difference in deforestation rates, with the Seima project using a baseline deforestation rate of 4%, while Mondulkiri and Phnom Prich have deforestation rates of <1%. Since deforestation rates are estimated based on subnational units much larger than the project size, the result is a much lower ER estimate. By combining the VCS estimate with ACC default estimates of ERs, there may very significant underreporting of ER estimates for certain types of activities in the SFB project.

2.4 LOWERING EMISSIONS IN ASIAN FORESTS (LEAF)

USAID/RDMA created the Asia Regional Sustainable Landscapes Program in 2010, to address deforestation and forest degradation in Southeast Asia and develop the potential for the forestry and land use sector to participate in REDD+ through a variety of activities and partnerships.

The LEAF program is a 5 year cooperative agreement awarded to Winrock International and a consortium of partners with four major objectives:

- Replicate and scale up innovation through regional platforms and partnerships;
- Establish policy and market incentives for greenhouse gas reductions;
- Build and institutionalize technical capacity for economic valuation of forest ecosystem services and monitoring changes in forest carbon stocks; and
- Demonstrate innovation in sustainable land management.

LEAF activities are focused primarily in the four Lower Mekong countries (Cambodia, Lao PDR, Thailand and Vietnam) as well as Malaysia and PNG. The program's targets included the reduction of GHG emissions from the AFOLU sector by 15 Mt CO_2e, and improved land use management in 1 million ha of land within the sector. Winrock, the lead implementer, developed its own estimates of the ERs for the LEAF program based on field assessments, remote sensing analysis of forest carbon stocks, and deforestation, fire, and degradation emission factors instead of using the ACC to estimate and report ERs. The assessment compared the estimates of ERs independently developed by the LEAF program to the ACC estimates for a subset of project activities.

The following projects were used for the comparison:

1. Vietnam, Lam Dong Province REDD+ Action Plan: The LEAF program has been building capacity for implementing a REDD+ jurisdictional strategy in Lam Dong Province, in the Central Highlands of Vietnam. The forests in this region are threatened by agricultural expansion, logging and infrastructure. The PRAP has a target of reducing emissions from the AFOLU sector by 27% by 2020 through forest protection and low emissions development strategies. The program has also collected data on forest carbon stocks, forest cover loss and emission factors for different land cover types over the 1990-2010 period, as part of the REDD+ reference level development.

2. Vietnam, Nghe An Province: The Nghe An province in north central Vietnam has high forest cover, but with relatively high rates of forest degradation. Forest degradation is driven by commercial and domestic logging and timber demand, and domestic fuelwood demand. The forests are also threatened by shifting cultivation and extraction of NTFPs. LEAF has been supporting 1. Sustainable Forest Management planning with the Con Cuong State Forest Company (SFC); 2. Forest and land use planning with the Con Cuong Forest Management Board (FMB); and 3. Community based forest management with communities living adjacent to the SFC and FMB through the development of community forestry management guidelines. Efforts are focused on both forest conservation and improved forest management.

3. Thailand, Maesa-Kogma Man An Biosphere Reserve: USAID LEAF has supported the development of a management plan for the Mase-Kogma Man and Biosphere Reserve (MSKM MAB) in Chiang Mai Province, Thailand. This was completed and approved in 2014. Under this plan, USAID LEAF has further supported activities to conserve forest and water resources in the Reserve. This included 1)The establishment of a pilot Payment for Ecosystem Services (PES) scheme in the Mae Sa watershed; 2) Forest restoration activities; 3) Marking and mapping community forest boundaries; 4) Community fire management planning and provision of equipment (occurred very early on in the life of the project); and 5) Community education and awareness on the Reserve. The USAID LEAF contribution analysis for MSKM maps out USAID LEAF's support. The estimation of emission reductions only reports avoided fire emissions.

4. Malaysia, Selangor Peat Forest: USAID LEAF has supported the Global Environment Centre (GEC) to develop a management plan for the North Selangor Peat Swamp Forest. USAID LEAF provided much of the analysis for the estimation of historical emissions. The Management Plan is for 2014-2023 and sets out a range for peat land management, cooperative fire management, buffer zone management, boundary demarcation, and

management activities in each of the zones demarcated under the plan. A critical issue is the control of fire and re-wetting the peatland soils.

5. Lao PDR, Houaphan REDD+ Strategy: The USAID LEAF project has been supporting the development of a management plan for the Nam Xam National Protected Area (NPA) (70,000 ha) in Houaphan Province. USAID LEAF has been working with communities and Nam Xam NPA staff on a participatory process to develop a management plan and implement actions to reduce pressure on the forest resources of the NPA. Community led actions have included: 1) Participatory Land Using Planning (PLUP) and livestock health and management training for targeted communities in Xam Tai and Viengxay Districts; 2) Village patrolling of the NPA; and 3) village awareness raising on regulations governing the management and use of NPA forest resources.

RESULTS

For the Lam Dong PRAP, the ACC v2 emission reduction estimates for the overall region is 2.9 Mt CO_2e, while the LEAF analysis yields an estimate of 1.06 Mt CO_2e. Subsequent reanalysis by Winrock of the Lam Dong PRAP yields an estimate of 1.28 Mt CO_2e for FY 2015. Winrock analysis of these estimates showed that the deforestation rate is 1.3%, compared to the ACC database value of 0.77%, and forest carbon stocks were 56.7 tons C/ha, versus the ACC database 149 tons C/ha. Consequently, the LEAF analysis is lower than the default ACC calculation. For 2015 reporting, the ACC v2 ER estimate includes fire and illegal logging, and is higher than the LEAF analysis. Winrock uses an effectiveness rating of 27%, which is the target emissions reduction rate for the sector, although this does not agree with the application of the effectiveness rating in other activities, even within the LEAF program.

For Nghe Anh activities, the estimated ERs from Forest Protection were calculated using ACC v2, and the ER estimate was approximately 11,000 t CO_2e in 2014. Winrock's analysis and explanation of the relatively low ERs for this activity state that low project effectiveness and limited area of the pilot project activities reduce the ER estimates. However, at 60% effectiveness, the project has a higher rating that several other LEAF project activities with lower effectiveness ratings (like Lam Dong PRAP, with over 1 Mt CO_2e reported). The ACC calculations do not include an estimate of illegal logging, and the estimate is based only on reducing deforestation in the province.

For Thailand MSKM-MAB, the reported ER estimates do not include deforestation or forest degradation. Since the area is a biosphere reserve, there is very low deforestation, and the LEAF program was unable to accurately determine forest degradation activity. Community-based fire prevention activities is estimated to provide over 240,000 t CO_2e emissions reductions, but at the present effectiveness rating, the estimate is 38,981 t CO_2e.

The Selangor Peat Forest project activity has an estimated 1.7 Mt CO_2e emissions reductions for FY 2015, using the ACC calculations and including fire prevention in the estimate. The LEAF program analysis estimated a slightly higher ER estimate, at 2 Mt CO_2e, using a higher deforestation rate than the ACC database value. The majority of the ER estimate for peat forest relies on preventing drainage and rewetting of peat forests, and reducing fire, rather than deforestation activity. The project effectiveness rating varies between the LEAF project reporting

(>90%), and the ACC estimate (60%). In both cases, the use of the effectiveness rating varies from project to project within LEAF.

The Nam Xam NPA has an estimated 88,000 t CO_2e of emissions reductions, based on the analysis of the regional REDD+ reference level for the Houaphan region. The ACC v2 estimate of ERs for Nam Xam NPA is 325 to 360,000 t CO_2e (there is a range of estimates for different activities included). LEAF analysis of regional emission baselines indicates that the deforestation rate in the ACC database (0.87% yr^{-1}) is higher than estimates for Nam Xam NPA (0.2% yr^{-1}), but fire and degradation emissions may contribute a relatively greater amount to emissions for the project area. These emission factors are still being assessed by LEAF and the US Forest Service (USFS) for Houaphan REDD+ region. The overall REDD+ strategy includes over 157,000 hectares, and the LEAF program estimates 717,000 t CO_2e in ERs from the region, but these estimates are not based on ACC v2 calculations, and could not be analyzed here.

A summary of the 5 LEAF project interventions and ER estimates are summarized in Table 4 below:

Table 4. Comparison of LEAF project emissions reduction estimates with AFOLU Calculator v2 esimates

Location	Area	LEAF estimate	ACC v2 estimate	% difference (ACC-LEAF)
Vietnam, Lam Dong	598,192	1,060,037	1,203,803	12%
Vietnam, Nge Anh	8,500	--	10,314	
Thailand, Maesa Kogma (MKSM)	50,000	38,981	308,051	87%
PNG, Madang	158,300	439,815	688,012	36%
Lao PDR, Houaphan	70,000	805,791	325,914	-147%
Malaysia, Selangor	73,133	2,018,470	1,706,884	-18%
Lao PDR, Attapeu	21,050	33,187	82,232	60%

ACC default estimates tend to be greater than the estimates based on advanced values generated by research and analysis by the LEAF program, except for cases like the Laos Houaphan REDD+ region and Malaysia peat forest projects. The primary cause of differences between the estimates are in the activity data and emission factors in the ACC database defaults for subnational units. Secondarily, the use of the effectiveness rating is not clearly linked to data or evidence from the field on the implementation of specific protection or management activities, and consequently there can be a wide range of variation in estimates.

IV. CURRENT STATUS

1. METHODOLOGY REVIEW

The overall objective of the Calculator is to provide sound and transparent GHG emissions estimates from several types of project activities in the AFOLU sector. The Calculator follows IPCC methodology for several activities, and Winrock-developed carbon accounting methods for others. It also uses an effectiveness tool to pro-rate the potential emissions reduction estimates based on a number of factors, and the effectiveness approach was developed by Winrock based on past project performance and verifications. There are three fundamental components: projects, activities and groups. A project contains a number of activities of different types, each of which contributes to the overall emissions reduction estimate for the project.

Users must enter a project name, at least one activity, the area of the activity, and the administrative units where the project is located. The ACC has 7 different tools: Forest Protection, Forest Management, Grazing, Afforestation/Reforestation, Agroforestry, Cropland Management and Forest Degradation by Fuelwood. Users choose the appropriate tool, enter basic information about the types of interventions being implemented, the effectiveness of the activity (where it applies), and the tools generate an estimate of ERs from the activity for the project period. Users may also form groups to share project data, but each project can only be edited by the user who starts a project.

Each of the tools is reviewed in the following section, and the methodology and data used are reviewed. In the final section, general comments about the ACC and the effectiveness approach are discussed.

FOREST PROTECTION TOOL

The Forest Protection (FP) tool uses the IPCC method of activity data multiplied by emission factors. The calculator estimates the ER benefits as the sum of reducing deforestation, fire, and illegal logging, and subtracts community off-take and forestry activities from the total benefits. The ER estimate is also linearly scaled according to the project effectiveness (0-100%), based on a decision tree that makes additions/subtractions to the effectiveness based on criteria such as enforcement of protections, community engagement and proximity to roads. Forest types include the default forest for the location, mangroves, and peat forest. The Calculator defaults to estimating ERs from reducing deforestation, while for fire, illegal logging, and community forestry, users must input their own advanced values to generate an estimate of ERs from these components.

A majority of the data sets in the FP tool were remotely sensed. This includes forest cover and deforestation. The remainder of the data utilized IPCC values, Food and Agriculture Organization (FAO) datasets, or other datasets and equations. The datasets include:

- *Deforestation:* Hansen *et al.* (2013), using a 15% tree canopy cover

- *Carbon stock:* area weighted average of carbon within forested cells from Hansen, 2013. This was also qualified by Saatchi, Houghton and others.

- *Belowground biomass:* Ruesch, A. and H.K. Gibbs, 2008 and calculated from Mokany et al., 2006.

- *Fire:* Tansey, 2008.

The Forest Protection tool follows IPCC guidelines and methodologies used by similar tools and, as discussed in the data quality case studies, the tool produces comparable estimates to other GHG tools or methodologies currently available. The tool defaults to estimating ER benefits over a 30-year horizon, which was a feature requested by USAID during the design of ACC v2, and the user cannot select the start/end years of the activity, or customize the calculation report.

The tool makes it easy to calculate the emissions reductions without having to enter data on activity data or emission factors, but there is no checking of consistency or quality of data entered by the user. Users can enter unrealistic values for area, carbon stocks or any of the other variables, and the tool does not flag calculations that may be unrealistic.

The tool also does not explicitly account for the spatial boundaries of the activity, and assumes that users are not applying calculations for multiple activities (like fire and deforestation) to the same area within an administrative unit to prevent the double counting of ER calculations. However, this assumption is not made clear to users while entering data, and since the boundaries of activity areas are not represented, there is a substantial risk of incorrect usage of the tool. The FP tool does not provide an estimate of uncertainty, although Winrock describes a method to calculate it for specific data values. In comparison, other similar tools provide uncertainty estimates. Including uncertainty in carbon stocks and activity data is key to improving carbon accounting practices.

The datasets used in the FP tool are mostly consistent with other methodologies and GHG calculators. Data for deforestation, carbon stocks, fire and other default values are aggregated to the subnational unit, and specific project locations may have very different values for these variables. Most of datasets are peer-reviewed, but some are not – this is an issue that is not unique to ACC, but is noted for future revisions of the database or methods. The FP tool also does not provide any default data for illegal logging or community forestry, and users are not provided any guidance on estimating these inputs. In many project contexts, the components of degradation may be larger than deforestation, and may be influential in determining the project benefits.

The Calculator version 2 uses Hansen *et al*. (2013) data for tree cover as a proxy for forest cover, which means that deforestation rates are calculated using tree canopy change, not forest cover change. While a number of other carbon calculators also use tree cover as a proxy for forest cover, the consequent uncertainty from this assumption results in errors in estimating forest carbon stock changes. As the Calculator is developed in the future, forest cover change estimates should be improved with improved remote sensing datasets. As the CARPE data quality case study demonstrates, minor changes in forest cover and carbon stock changes result in large changes in ER estimates, especially when applied to large project areas.

FOREST MANAGEMENT ACTIVITY TOOL

The FM tool focuses on uneven-aged management (reduced-impact logging or stopping logging), and even-aged management (extended rotation logging or stopping logging). The tool is based on the IPCC approach, and includes a method described in Pearson *et al*. (2014) for uneven-aged logging. Even-aged logging methodology is based on Richards (1959) and Pienaar & Turnbull (1973).

Data sources for timber volume and logging rotation length are based on FAO data, reduced-impact logging (RIL) values are informed by Pearson (2014) and others; growth rate, biomass and extraction factors are based on IPCC factors.

The approach of the FM tool is consistent with IPCC guidance and currently accepted and peer reviewed methods based on empirical data on logging emissions accounting. As with the forest protection tool, this method does not account for uncertainty in the estimation of aboveground and belowground biomass, both of which are described as being of 'high' uncertainty in the ACC documentation.

GRAZING MANAGEMENT ACTIVITY TOOL

The Grazing tool was one of the newer tools introduced in version 2 of the Calculator. The tool estimates the emissions reduction benefits of specific grazing management best practices that provide carbon benefits. The tool calculates ER benefits as the sum of soil carbon sequestration, reduction in livestock enteric fermentation emissions, and carbon accumulation from rewetting of organic soils. The methodology follows IPCC 2006 guidelines, and uses IPCC factors for estimating livestock management emissions with and without improvements. Soil values are from IPCC factors. Soil carbon values come from the FAO World Harmonized soils database[6], as used in IPCC guidelines.

The Grazing tool uses a similar approach to other carbon calculators that are geared toward agriculture and grazing practices, but with some limitations. The number of types of livestock that can be included in a grazing system is limited to two. Tools such as EX-ACT, allow for a wider set of grazing practice interventions to be included in a project estimate of emissions reduction benefits. As with other tools, there is no estimate of uncertainty included in the tool.

[6] HWSD, 2011; accessible at: http://www.fao.org/soils-portal/soil-survey/soil-maps-and-databases/harmonized-world-soil-database-v12/en/

AFFORESTATION/REFORESTATION ACTIVITY TOOL

The Afforestation/Reforestation (AR) tool focuses on sequestering carbon through planting in non-forested areas. GHG emissions benefits are calculated for tropical native trees, mangroves, and plantation forests based on biomass accumulation. The methodology follows IPCC understanding of AR and utilizes the Chapman-Richards growth equation[7] and utilizes IPCC/FAO climate zones. In the tropics, aboveground biomass (AGB) was calculated as a function of age in secondary forests in dry forest, moist forest, and rain forest categories. Belowground biomass (BGB) was calculated in the same manner as the FP tool. Plantation forest data was extracted from the FAO Global Forest Assessment (2005).

The AR tool uses IPCC standardized methodology and is similar to other tools in the methodology used. The estimates of carbon sequestration in biomass do not use remote sensing data similar to the FP tool, which may result in a mismatch between carbon accumulation rates in different land use types, and the uncertainty in this analysis is not addressed, as with other tools.

AGROFORESTRY ACTIVITY TOOL

The Agroforestry tool is designed to account for carbon sequestration for trees on agricultural land and grazing land. The tool calculates ER estimates for a variety of different agroforestry systems (AFS), including multi-strata (home gardens and shaded perennials), tree intercropping (alley cropping and multipurpose trees on agricultural land), silvopastoral systems (planting trees on grazing land and tree fodder systems), protective tree plantings, and agroforestry woodlots. The data driving the agroforestry tool is mostly from expert sources and an extensive literature survey. The exact sources are not documented in the Winrock literature. The exception was data for Latin America where there was sufficient data to utilize standardized growth curves for trees based on the Chapman-Richards equation.

It should be noted that user-inputted advanced options are limited to AFS type, age and carbon accumulation rate. As there is no IPCC guideline for estimating emissions reductions for these types of systems, the ACC has a unique approach to estimation with this tool, and the estimates of carbon benefits or the uncertainties associated with these systems is still an area of active research[8].

CROPLAND ACTIVITY TOOL

The Cropland management tool estimates emissions reductions from a subset of agricultural practices, such as tillage, fertilizer, and rice management. The methods and data follow IPCC guidelines for rice emissions, with a preset number of options relating to type of irrigation, improved varieties, nutrient inputs and straw management. The data for rice are from IPCC the FAO Harmonized Soils dataset. Fertilizer data is from IPCC 2006 Tier 1 factors. %N is derived

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[7] Richards, 1959; Pienaar and Turnbull, 1973

[8] Nair, 1989; Nair, 2012

from extension service information and fertilizer production emission factors are derived from Clean Development Mechanism (CDM) methodology[9].

In comparison with tools like EX-ACT and others that are more geared towards estimating emissions from agricultural practices, the AFOLU tool has a limited number of interventions and cannot be configured to account for scaling of practices across a cultivation area. The tool also does not account for indirect emissions related to agriculture, such as infrastructure and transportation, which other tools can estimate, so the cropland tool only provides a subset of the functionality of other tools for estimating the impact of agricultural sector projects.

EFFECTIVENESS APPROACH

The effectiveness approach is a key feature of the ACC, and is used as a simplified approach to accounting for the initialization phase of projects, and the risks and factors that reduce the actual emissions reduction benefits of projects. The approach for accounting for the initialization/capitalization phase is straightforward, and is a linear scaling of the maximum ER benefits over the startup phase.

The assessment of overall project effectiveness varies according to activity type. Generally speaking, the effectiveness of the project is scaled from 0 to 100%, based on the design of the project. Effectiveness factors such as enforcement of forest protections, local community capacity building, and others contribute to deductions made from a maximum project effectiveness of 100%, and a linear scaling down of ER estimates is made.

For the Forest Protection tool, the effectiveness tool partially addresses the risk of non-permanence and leakage of emissions outside project boundaries by assessing some of the factors that contribute to these sources of carbon emissions in forest projects. However, the effectiveness approach is not equivalent to a standardized methodology for addressing these aspects of a project, and it is likely that user responses to subjective categories will result in inconsistent project effectiveness ratings. As implemented in version 2 of the Calculator, the effectiveness approach guides users through a series of questions relating to the project design and makes deductions according to the user input. However, user responses to the questions are not recorded, so users cannot refine the effectiveness rating based on specific factors that may change within the project. Users can also override the project effectiveness rating assigned through the guide, which makes this subjective and inconsistent for the sake of comparison of projects across a portfolio.

Documentation for the effectiveness tool states that the data source for the effectiveness approach is Winrock research on USAID projects, several of which are implemented by Winrock (such as LEAF). Without a peer-reviewed or standardized approach such as a carbon accounting standard like VCS, this approach to project effectiveness is subjective and may not suit all project circumstances. Consequently, the effectiveness approach results in a “black box” solution to addressing the effective emissions reductions from AFOLU and land use change projects. This also

[9] UNFCCC, 2015. Clean Development Methodology Booklet, Seventh Edition. Methodology III A. ver 2

sets the Calculator apart from other similar tools and may result in estimates that cannot be replicated or validated easily.

UNCERTAINTY ESTIMATION

As with the other tools, results calculated by the ACC are not accompanied by uncertainty measurements. Some of the other calculators reviewed during the assessment do provide uncertainty measurements. While the ACC could be developed to include uncertainty measurements, it could also be developed to include additional methods of providing comparative and contextual information. For example, the tool could compare results to empirical results from towers/eddy covariance measures, other field measurements, or Net Ecosystem Exchange.

CONCLUSIONS

The AFOLU Calculator is a user-friendly tool that allows users to generate estimates of GHG ERs for a wide variety of land use, forestry, agriculture and pastoral projects. However, the Calculator's methodologies and approach to some aspects of GHG accounting for projects raises possibilities for inaccurate and inconsistent estimates. The overall methodology for spatial definition of project boundaries is substantially different from that used in other calculators – the interface requires the user to enter the hectares of the project and then to specify the administrative units in which the project occurs. The Calculator does not explicitly consider the spatial boundaries of the project, which allows for the possibility of emissions reductions from multiple activities to be double-counted. The use of data scaled to subnational units may also not represent small project areas accurately. A number of other tools deal with the spatial boundaries and location-specific data for projects more accurately, and the AFOLU Calculator should be developed to improve this particular aspect of its overall methodology.

2. AFOLU CALCULATOR USABILITY TESTING

In the user survey, the majority of respondents found the tool easy to use, despite the majority of users not having received formal training by Winrock or USAID. Most respondents reported utilizing the documentation in the user manuals and the video tutorial.

While respondents find the tools easy to use, almost half found the clarity and adequacy of the data and methods to be lacking. Specifically, for certain kinds of activities, such as fire management in woodland or savannah landscapes, the tool's design does not facilitate an accurate accounting for baseline and project scenarios. The limited use of some of the newer tools like forest degradation by fuelwood extraction and cropland/grazing management may also be due to the lack of relevance of the tools for real project activities. The majority of users also do not use advanced inputs to improve estimates of emissions reductions or examine the sensitivity of estimates to the variables in the calculation.

In the usability testing, test users were able to complete the task of entering a project with 12 different activities using the 7 different tools in ACC, and generate estimates of emissions reductions. The ACC site is designed so that only registered users can access the tools in the Calculator, but all visitors to the site are able to use the 'Create a Plan' feature of the site, which allows users to estimate baseline scenarios of emissions from deforestation or other land use changes, and the benefits of planned project activities. However, there appears to be no way to link these scenarios to actual project activities entered in the database, or geographic location of these scenarios, so the usefulness of this feature is limited.

Once registered, users have access to a dashboard, providing useful summary information about projects, groups, reports and a policy tool. The general design of the ACC website features a panel on the left explaining the options available on each page and a tour of the features/actions on each page. However, new users or visitors to the ACC site cannot preview model projects or get an orientation to how activities, projects, or groups are linked to one another, or any background or introduction to land use projects or types of activities. While these features are explained in the user manual, the design of the site assumes that new users understand the basic structure of projects and activities, and how emissions reduction estimates are calculated.

Some respondents in the user survey also identified the lack of contextual support in the website design as an issue with the overall design and clarity of ACC. Users are also not able to sort or group projects or activities easily within the site, or search through the database to view projects, activities or summaries. This limits the usefulness of the ACC to several types of users, particularly USAID program leads or M&E specialists who might want to sort test projects or activities from reporting activities, or different project reporting scenarios or models.

GROUPING PROJECTS

The 'groups' feature is poorly designed, as it is not easy for users to join or leave groups, or collaborate with other users who might be working on project implementation or reporting collaboratively. Users must request permission to join groups, but there is no email notification either to group owners or to users when group memberships are requested or approved. Once users receive group membership, they must navigate to 'shared projects' to find projects belonging to the group, and these cannot be sorted or viewed by group, or any other selection criteria. Since it is possible for any user to view any project or activity within the database (if they have the URL for a project), it is not clear why the groups feature was designed this way.

CREATING PROJECTS/ACTIVITIES

The user interface for creating projects is mostly intuitive, although there is no contextual guidance for what constitutes the activity boundary. The site allows users to click on an interactive map to create a parcel representing the activity area, or upload shapefiles representing the area. However, these location data are not stored within the database, and effectively only serve to select the subnational units that the project activity boundaries fall within. Users can select the subnational units from a dropdown menu which is below the parcel selection map, although it is difficult to scroll through the list due to its length and placement at the bottom of the page.

CALCULATION OF AN ER ESTIMATE: EFFECTIVENESS ASSESSMENT

Depending on the type of activity, users are guided through a series of questions to rate the effectiveness of the project's implementation. The effectiveness guide was developed based on Winrock's research of project activity scenarios, and makes deductions or additions to the project's effectiveness, which are applied to the overall calculation of potential emissions reduction benefits of the project activity. This approach was designed for non-specialist users to accurately calculate emissions reductions, but there may be situations where not all questions may apply to every possible project activity, or the user may not have sufficient information to answer all the questions. The user's answers are not recorded in the activity, and while the user is allowed to override the effectiveness guide rating, there is no way to revisit the project effectiveness answers entered by the user to make modifications – the only way is to run through the effectiveness guide again, and assign a new effectiveness. This implementation can seem arbitrary, and is not explained to the user. Furthermore, there is no way to determine whether the effectiveness ratings are being consistently applied across different projects, or different activity types, giving rise to uncertainties in the precision of ER estimates across a whole portfolio of projects.

CALCULATION OF AN ER ESTIMATE: ADVANCED VALUES

Users may also enter advanced values for variables such as carbon stocks, deforestation rates, fire incidence and other variables, although it should be noted that several users have reported difficulties/bugs in changing default values, and the issue may pertain to the browser/OS being used. Users have also reported difficulties or bugs in deleting project activities or entire projects.

QUALITY ASSURANCE

The greatest shortcoming of the calculation of ER estimates is the lack of any QA/QC procedure. The ACC does not appear to perform even the most basic checks on whether the area of activity is realistic, or exceeds the size of the subnational unit. Similarly, the values of variables such as carbon stocks or deforestation rates may be modified by orders of magnitude, and the calculator will produce a number accordingly. The lack of error/consistency checking by the ACC creates the possibility of unrealistic ER estimates being produced, which would require expert checking to ensure quality. The ACC could use simple metrics like tons CO2e per area of activity to ensure that the calculation being made falls within a range, or flags problematic values.

REPORTING

The user has the ability to generate a report after entering and saving at least one activity for a project. The report provides estimates of annual ER in tons CO2e for a 30 year period, with the project effectiveness and all other variable values listed in the project report. In the user survey, the majority of users responded that they use the reports feature for reporting to USAID, but the survey did not measure whether reports are directly submitted to USAID using the ACC reporting feature.

3. TOOL COMPARISON

As there are a number of recent detailed comparison studies that compare GHG calculators for a variety of agriculture, forestry and other land use accounting of emissions and removals, the assessment focused on a small subset of tools/calculators that are used by agencies or organizations similar to USAID for carbon accounting and rapid assessment across project portfolios. The detailed studies include those conducted by FAO, US Department of Agriculture (USDA), Colorado State University and the Global Environmental Facility (GEF)[10].

For the assessment, we focused on tools that were most similar to ACC, with special attention to the following characteristics:

- Complete project accounting of all sources of GHGs similar to ACC
- Freely available for use in the public domain
- Currently used by bilateral/multilateral agencies in reporting GHG benefits from agriculture, forestry, land use change and climate change mitigation projects
- Covers the range of activities in AFOLU sector similar or greater to ACC

[10] Colomb, 2012; Denef, 2012; C-AGG, 2010; Eve, 2014; Milne, 2012

Tool Name	Usable for Report to Funding Agencies?	Usable by non-technical personnel?	Usable by Program Managers?	Usable by Implementing Partners?	Usable by Scientists?
AFOLU Carbon Calculator (v2)	Yes	Yes	Yes	Yes but Some may Require Training for Accurate Reporting	Yes
Ex-Ante Carbon Tool	Yes	Training Required	Training Required	Training Required	Yes
Carbon Benefits Project	Yes	Training Required	Yes, Detailed Assessment may Require Training	Yes, Detailed Assessment may Require Training	Yes
Agriculture and Land Use Tool	Inventory	Training Required	With Training	With Training	Yes
Cool Farm Tool	Yes	Yes	Yes	Yes	Yes

Table 5. Analysis of other GHG tools characteristics, usability and target audiences (after Milne, 2012)

A summary of a larger subset of tools from the review studies is included in Annex 4. The summary provides a tabular summary comparison of 15 major calculators that are used for national GHG inventories, farm-scale carbon footprinting, project design and evaluation, and a variety of other purposes, and is provided to illustrate the range of tools available and used by a variety of stakeholders.

The Assessment focused on four tools for comparison with ACC in detail: the Ex-Ante Carbon Tool (EX-ACT), the Carbon Benefits Project (CBP), the Agriculture and Land Use (ALU) Tool, and the Cool Farm Tool. These tools are currently used by USG Agencies, bilateral and multilateral development agencies (World Bank, FAO, GEF), and private sector or research organizations.

Table 5 portrays which calculators are appropriate for use in the "Report to Funding Agency" cycle. The ALU tool is not specifically designed for reporting to funding agencies, but primarily for national or regional GHG inventories. While it does not a suitable tool for ex-ante estimates of project ERs, it does have functionality that would improve the AFOLU Calculator.

Table 6. Comparison of GHG tools based on methodological characteristics and suitabiity for USAID projects in AFOLU sector

Tool Name	Required Inputs by User	Advanced Inputs	Uncertainty	Indirect emissions	Spatially Explicit	Overall GCC Fit Estimate
USAID AFOLU Calculator	Project area, time, admin units, activity(s)	Effectiveness, all data may be tailored (no crosschecking)	No (tutorial data on how to calculate uncertainty)	No	No	
EX-ACT	Area, project background/ activities, land use by baseline and project scenario	Local and project field data.	Yes for emission factors	Yes	No	Medium
Carbon benefits project	Area, project background/strategy/goals, activities. Land use by baseline and project scenario	Local and project field measurements, incl. spatial data sets.	Yes	Yes	Yes	High
ALU	Project area and structure	Most project data can be customized.	Entered by user	No	Yes (can export to GIS)	High
Cool Farm Tool	Location, area, climate, crop, soil, livestock type, numbers	Detailed sub-variables for farm dynamics, e.g. fertilizer use.	No	Yes	No	Low-Medium

In addition to the attributes above, we considered the issue of accessibility. To that end, we found that all the calculators were available to users in one fashion or another. All of the calculators are free to access although some require registration for full access. The online interfaces for ACC v2 and CBP proved exceptionally easy to use, significantly lowering the threshold when compared to EX-ACT and ALU's Excel interfaces. Spreadsheet tools prove more transparent and easier to modify and do not require internet access to function, unlike the ACC v2.

Additional significant differentiating features:

- While the other calculators can be considered *ex-post*/*ex-ante* calculators, ACC v2 is actually structurally neither but might be applied for *ex-ante* purposes.

- There were processing and reporting issues associated with CBP which turned out to be due to a shift in the location of their servers and was resolved. These issues were only resolved by contacting customer service from the CBP team, which might be a deterrent for broad usage by agencies like USAID.

- Cool Farm Tool incorporates many interesting features, including scenario development. It is tailored to the food-provision sector and reviews like Tuomisto *et al.* (2015) concluded it was the only tool suited for global accounting of small farms.

- All of the calculators are designed for use at the global level.

- All calculators can perform at the IPCC Tier 1 level. All, with the exception of ACC v2, can perform at the Tier 2 level, with CBP capable of reporting at the Tier 3 level as well.

We selected two final calculators to consider after the course filter application process. Although ALU is a useful calculator, it is intended for inventory purposes. As such, we set it aside. The Cool Farm tool is very useful for its intended audience but because of its lack of a comprehensive treatment of AFOLU issues, funding agency reporting, and a lack of spatial functionality and uncertainty estimates we do not feel that it warrants further consideration. As such, we proceeded with a further study of CBP and EX-ACT.

It should be noted that it is entirely possible that no one calculator will solve all needs. ALU, for example could be used for future inventory work. In addition, ALU has important lessons that could be learned for ACC v2 development. For example, ALU breaks down the calculation process into four parts. In addition, through the assessment process, ALU continually crosschecks and conducts QA/QC on input data.

CARBON BENEFITS PROJECT (CBP)

Developed by Colorado State University and funded by GEF, the Carbon Benefits Project (CBP) combines tools with contextual guidelines and protocols. The tool is intended for GEF projects to report to on their GHG ERs. CBP is web-based and offers much of the functionality of EX-ACT with the added benefits of spatially explicit analysis and more in-depth consideration of leakage and permanence. CBP is applied to projects such as sustainable forest management and REDD+.

The toolset contains a simple and detailed assessment tool, and they are complimentary to each other. The simple assessment provides a standardized system for GEF to measure, monitor, model and forecast C stock changes and GHG emissions. The user inputs initial land use and baseline and project scenarios. GHG flux is calculated based on gain/loss, stock comparisons and annual emissions. The algorithms are derived from IPCC 2006[11]. CBP delivers IPCC Tier 1, spatial input

[11] IPCC, 2006 Guidelines

and output, leakage, socioeconomic and guidance modules, uncertainty estimates, graphs, ease of use, extensive training literature and tutorials.

The detailed assessment tool examines the impact of projects on carbon stocks and greenhouse gas emissions. Suitable for detailed reporting where there is a reasonable focus on climate change mitigation and/or multiple land management changes on areas with several combinations of soil type and climate. Users have the option to improve carbon and greenhouse gas balance estimates by inputting project specific information (from field measurements or local data sets).

The tool delivers emissions by source type for the initial land use, baseline scenario, and project scenario. Tons CO2e are provided per activity (agroforestry, A/R, forest management and forest protection). Detailed benefits by IPCC source category are also given. The project report comes as a PDF report with charts, maps, metadata. Alternately, the tool can generate an Excel Workbook (one worksheet per emission source). The output structure is: calculation name, source and sub-source category, start date of the project, report period, type of assessment (simple or detailed), assessment step (initial land use, baseline scenario, or project scenario), date and time the report was generated, and the greenhouse gas flux equation (CBP, 2011).

CBP also offers the ability to utilize spatially explicit data in the project definition phase. This is notable as ACC v2 allows one to upload GIS files but it is not able to use them as part of a geospatial analysis.

One of the interesting features of the CBP detailed assessment is the ability to upload field data (Figure 3). This is not a required step. Rather, field data can be included to redefine uncertainty results, to develop higher Tier results and/or as part of the tool's built-in field data guidance utility.

In order to put the calculator in context, Figures 4 and 5 are provided to detail the CBP reporting process. The generated reports are for a simple assessment. More extensive analysis is available with the detailed assessment. Figure 4 demonstrates how CBP provides a UNFCC/IPCC standard summary table. Figure 5 is the third page of a three-page table of the different sources and sinks.

EX-ACT TOOL

EX-ACT was developed by the Food and Agriculture Organization (FAO) to provide anyone developing agriculture and forestry projects (programme officers, funding agencies, and ministries) with a tool to estimate the impact of projects on GHG emissions and carbon sequestration (Bernoux et al. 2010). Although it was first developed for ex-ante analysis it can be used for project tracking. The tool consists of an Excel file and is free to download from the FAO website[12].

EX-ACT has mostly been developed using the IPCC Guidelines for National Greenhouse Gas Inventories in conjunction with other methodologies and reviews of default coefficients. It assesses the impact of agriculture and forestry activities on carbon stock changes per unit of land, and CH4 and N2O emissions in t CO2e per hectare per year. The tool covers all GHG emissions

[12] http://www.fao.org/tc/exact/en/

linked with land use, land use change and forestry (LULUCF) activities covered by the IPCC 2006 Guidelines plus some additional sources. This means it covers emissions associated with the following: carbon stock changes during land-use conversion, biomass or residue burning, flooded rice cultivation, organic soils, livestock production and inputs of lime, fertilizer and manure. In addition, the tool provides comprehensive coverage of non-land-use emissions associated with agriculture, such as those from the production, transport, storage and transfer of agricultural chemicals and emissions from energy use and infrastructure (electricity and fuel consumption associated with buildings and irrigation systems, both construction and maintenance).

The output of EX-ACT is a carbon balance resulting from project activities. Output is not spatially explicit. This is accompanied by a rough estimate of uncertainty (a percentage rounded up to the nearest 10 percent), which is calculated using the method given in the IPCC 2006 Guidelines. Issues of leakage are not addressed specifically but could be addressed by manipulating input information if the user decided to do so. Permanence is not addressed, but the uncertainty results could be used to highlight categories where problems of permanence might arise. No analysis of social or economic impacts is included, although output has been used to feed into economic analysis using Marginal Abatement Cost Curves[13].

EX-ACT was originally designed to work at the scale of the development project (from thousands to millions of hectares) many of which are at the landscape scale. The user determines the scale so it can easily be used at the landscape scale. Advantages of use for a landscape-scale assessment include the wide range of ecosystem types and activities and emissions sources covered by the tool, including non-agricultural emissions associated with various land-use activities. A drawback is that it does not have a spatial element, so users will derive a single output for the entire geographic area they describe; however, this is broken down by land-use categories.

EX-ACT was not designed for carbon markets and is not certified. However when compared to the BioCarbon Fund project and Climate Community and Biodiversity Alliance standard, it gave similar results in terms of total carbon sequestered. EX-ACT has already been used in 30 projects and policy appraisals concerning 24 different countries and so is being widely used[14]. It has recently been used on a large- scale ex-ante assessment of two rural development projects in Brazil dominated by smallholder farmers[15]. It has a permanent team dedicated to its development and maintenance.

4. AGENCY COMPARISON

The tools described in the previous section are used by a number of government agencies, bilateral and multilateral development agencies and institutions for estimating the impacts of activities and projects in agriculture, forestry and land use change. Several agencies have contributed to the development of methodologies, data and tools for the climate change mitigation or emissions reductions impacts of projects as well, such as FAO support for EX-ACT and GEF support for

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[13] Bockel *et al.* 2012

[14] World Bank, 2016. Carbon footprinting of ARD projects

[15] Branca *et al*. 2013

CBP tools. Integra used interviews with technical specialists and key personnel at US government agencies, bilateral and multilateral institutions, the tools and methodologies followed by some of these institutions are compared with the USAID GCC monitoring and evaluation approach for AFOLU projects.

The U.S. Environmental Protection Agency (EPA), USAID and USFS supported the development of the Agriculture and Land Use (ALU) tool by Colorado State University, primarily for quantification and inventory of GHG emissions and removals in the agriculture and forestry sectors, for reporting to the UNFCCC. The ALU tool has been used for capacity-building in Asia and Latin America through USG efforts like SilvaCarbon, as a tool for national and regional GHG inventories and reporting. As the review in the section above indicated, the ALU tool is not primarily designed for evaluating project ERs, or generating *ex-ante* estimates of GHG ERs, but is an advanced tool with a robust methodology for GHG inventories in the AFOLU sector.

The World Bank uses EX-ACT and IPCC methodologies for its project portfolio in Agriculture and Rural Development (ARD) and Forestry (afforestation/reforestation, sustainable forest management and forest conservation activities). WB recently supported the development of a detailed online training course for EX-ACT, as well a review study applying it to ARD portfolio projects[16]. The free availability of the tool, standardized methodology and comparability of estimates across a wide variety of project profiles are key aspects of EX-ACT that make it well-suited as a tool for WB projects. The World Bank also uses the Carbon Assessment Tool for Sustainable Forest Management (CAT-SFM) and complementary CAT-AR tool for afforestation/reforestation projects for some projects as well.

The Global Environment Facility (GEF) has been developing standardized methodologies for accounting for GHG impacts of funding of sustainable land management activities and projects, as well as supporting the development of standardized methodologies for multilateral development institutions like the World Bank group. GEF is supporting the development of methodologies based on the World Resources Institute (WRI) standards[17]. Recent guidance from the GEF for estimating GHG benefits of AFOLU projects recommend the use of EX-ACT and the Carbon Benefits Project (CBP) tools, depending on the type of activity. CBP was developed with support from UNEP and GEF, and as discussed in the previous section, the tool developers anticipate additional support for development of additional features of CBP. The GEF guidelines recommend assessment of GHG impacts for the duration of GEF support, and for 20 years post-project support[18].

The United Kingdom's Department for International Development (DfID) uses the International Climate Fund (ICF) Hectares indicator, which is a quantitative measure of the area of avoided forest cover loss. The Hectares indicator is based on a risk-based classification of forest area, instead of using average historical forest loss rates[19], combined with the Hansen/University of

[16] World Bank/FAO, 2016. Carbon Footprinting of ARD projects: Testing the EX-ACT tool.

[17] Bhatia *et al*. 2014. (World Resources Institute)

[18] GEF Guidelines for Greenhouse Gas Emissions Accounting and Reporting for GEF projects, GEF Council Meeting, June 02-04, 2015

[19] Tipper *et al*. 2014

Maryland forest cover loss data to determine the number of hectares of avoided loss of forest cover. DfID does not prescribe the use of a tool like EX-ACT or the AFOLU Calculator for annual reporting of estimated emissions reductions, and is currently evaluating the use of the Hectares indicator for a metric of estimated emissions reductions for land-based projects. The indicator also does not currently have a methodology for estimating the impact of policy, law or governance interventions on changing deforestation or emissions from land use/land use change.

V. RECOMMENDATIONS & FUTURE DIRECTIONS

USER INTERFACE

The ACC is an accessible, user-friendly tool that is easy for users from a broad variety of backgrounds to use. For new/non-specialist users, the ACC platform could provide training materials in the form of sample projects, training exercises and contextual support for entering data on project activities. These users also would benefit from simple quality assurance procedures within the ACC to ensure that estimates do not exceed certain logical boundaries. For more advanced users, USAID staff, project implementers and other users with some technical knowledge and understanding of GHG accounting for AFOLU projects, the ACC is a series of tools and a platform for project design, evaluation and collaboration that lags behind other tools and has potential to be a more sophisticated tool.

At present, these users are unable to work collaboratively on project estimates, or use past projects or reporting years for the same project to develop subsequent years' reporting of ER estimates. The ACC is designed to send reports directly to USAID, but projects cannot easily be viewed or shared by users, nor can users interact to benefit from the knowledge and experience of the user community. The user interface could be substantially improved if users could view and search the project database by activity, year, location, and other criteria to see past projects or other similar projects, and the linked documentation and data used to develop advanced ER estimates. The groups feature currently only allows users within a group to see projects that have been added by users, and there is no forum for collaboration between users.

The user community also is unable to interact or learn from other users about tool features or ways to improve data quality. The ACC could also offer advanced users additional features, like GIS capabilities to show project boundary areas, and subset data according to specific project areas, instead of administrative units. This functionality would also allow the user community to visualize project activities spatially, and improve reporting accuracy. This functionality currently exists in other tools, such as the Carbon Benefits Project and Global Forest Watch – Carbon. These platforms allow users to import a variety of data, including GPS data, GIS shapefiles, field data and remote sensing data, and provide guidance for improving carbon accounting estimates for projects. Users can also export data from these platforms into spreadsheets, GIS files and other reporting formats. Adding similar types of functionality, or enabling ACC to provide data that can be used on platforms like Global Forest Watch, would enhance the user experience to a great extent.

METHODOLOGY & DATA

At the project level, the ACC needs to improve the spatial and temporal aspects of projects and activities. In addition to explicitly considering these bounds of the project, the ACC should also account for leakage and permanence risks in projects using a methodology that is congruent with other tools and widely accepted methodologies. This is especially true for forest protection activities, where the inconsistencies between annual estimates of ERs can differ by orders of magnitude. These changes in project emissions estimates over time have been a challenge for reporting for several USAID projects. The ACC should also account for uncertainty in the emissions factors. The uncertainty for several emissions factors can be reduced significantly by improving the spatial subsetting of data for project areas, instead of aggregating data to subnational/administrative units. This would mean moving the ACC towards a tiered accounting methodology, following IPCC guidelines and similar to the approach in tools like EX-ACT and CBP.

The effectiveness tool is also an area of considerable concern: it relies on subjective criteria, may not apply in all situations, there is no documentation as to how users calculate or overridden their effectiveness. In addition, the tool does not directly address the issues of permanence or indirect omissions. Effectiveness impacts individual indicators as well as total emissions reductions and, as such, has a complex effect on uncertainty. We found that while some of the issues that necessitated the development of the effectiveness tool were valid, the manner in which it was implemented warrants revision.

As mentioned before the ACC is missing a spatial component. Spatial subsetting is only used in the administrative unit selection process and again there is no crosschecking of spatial integrity. The lack of explicit geospatial functionality impacts the following critical tool futures:

- Project boundaries
- Leakage
- Permanence
- Spatial uncertainty

As with many of its peer calculators, the ACC lacks much in the way of multi-temporal analysis and reporting. For example, the ACC does not allow for the integration of discrete yearly results into a long-term record. Furthermore, the database is not structured in a way that allows for year-to-year comparisons. The ACC does not report individual years relative to previous years reported or relative to a long term climate for carbon trend. This issue is mostly specific to the ACC database and the ACC reporting structure and is not a fundamental flaw in the Calculator.

The final observation we made is that remote sensing datasets are not static. Depending on what type of data is concerned, it needs to be regularly revised, both to include additional timesteps and to address versioning. What this amounts to is that the ACC would benefit from a data management plan, one that included curation of key data sets such as forest cover. An additional benefit of a curated data set is that it allows for a data collection to realign itself to meet changing project goals and protocols.

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ANNEX II. USER SURVEY RESULTS

See Attached pdf document

ANNEX III. CASE STUDY DATA

Forest Protection					
Activity	**Location**	**Area**	**Archive 2011**	**Scenario 1**	**Scenario 2**
PA-Birougou NP	Gabon, Ogooué-Lolo	69,000	1,182,087	1,342,083	26,974
Activity #2793 - 301001 PA Lope NP	Gabon, Ogooué-Ivindo	497,000	8,560,127	7,772,814	29,974
3010002 PA Waka NP	Gabon, Ngounié	107,000	1,830,583	1,803,705	9,806
PA_Ivindo NP	Gabon, Ogooué-Lolo	300,000	5,139,509	4,760,098	29,320
Activity: #18311 - 4030001 PA Odzala Kokoua NP - 2011	Republic of Congo, Cuvette-Ouest	1,350,000	20,216,547	19,174,417	109,685
Activity: #2817 - 4050001 PA Boumba Bek & Nki NPs	Cameroon, Est	547,620	1,513,672	1,710,138	45,984

Activity: #2803 - 4010003 PA Mwagne NP	Gabon, Ogooué-Ivindo	116,500	2,006,549	1,969,687	7,621
Activity: #2823 - 4050015 ERZ Ngoila Mintom	Cameroon, Est	860,350	2,378,087	2,686,766	72,245
FP Salonga NP - Model 2 Values	DRCongo, Équateur	3,656,000	43,104,225	33,583,305	3,257,298
PA_Virunga	DRCongo, Kivu	788,000	1,175,607	1,163,616	1,085,935

Activity	Location	Area	Archive 2011	Scenario 1	Scenario 2
ERZ -Bordamur Ikoy Corridor	Gabon, Ngounié	180,000	102,010	26,987	38,982
ERZ- West Waka Concessions	Gabon, Ngounié	115,000	65,173	172,418	249,028
Activity: #2805 - 4010007 ERZ Okana Valley: BORDAMUR/SOFAC/STIBG/EFNB	Gabon, Wouleu-Ntem	948,600	537,591	152,328	137,095

Activity: #2806 - 4010009 ERZ Rougier/Ivindo GN	Gabon, Ogooué-Ivindo	288,779	163,657	45,460	65,664
Activity: #2808 - 4010014 ERZ Djidji River watershed	Gabon, Ogooué-Lolo	278,878	158,046	42,377	61211
4010016 ERZ Minkebe-Ivindo interzone logging complex	Gabon, Ogooué-Ivindo	875,221	496,005	137,791	199,032
Activity: #2810 - 4010017 ERZ Mwagna Djoua Zadie	Gabon, Ogooué-Ivindo	1,812,500	1,027,180	285,350	412,172
Activity: #2812 - 4030004 ERZ Ngombe FMU (wildlife management in timber)	Republic of Congo, Sangha	1,101,000	623,959	181,436	372,951
#2815 - 4030013 ERZ Jua-Ikie/Tala Tala	Republic of Congo, Sangha	1,292,486	732,478	212,987	437,806
Activity: #2819 - 4050004 ERZ Bounba Bek/Nki peripheral logging zones	Cameroon, Est	631,290	210,684	58,996	144,707
Activity	**Location**	**Area**	**Archive 2011**	**Scenario 1**	**Scenario 2**

CBNRM North Lope	Gabon, Ogooué-Ivindo	2,697	480	1,545	2,232
CBNRM - Oua	Gabon, Ogooué-Ivindo	67,100	11,934	38,517	55,505
Activity: #2807 - 4010012 CBNRM Ivindo River	Gabon, Ogooué-Lolo	60,163	10,700	33,351	48,057
Activity: #2818 - 4050002 CBNRM 9 Community hunting areas+ 2 pilot hunting areas	Cameroon, Est	135,000	14,139	45,902	112,591
Activity: #2820 - 405007 CBNRM 4 pilot hunting areas (Boumba Bek & SE Nki)	Cameroon, Est	304,730	31,915	103,850	254,129
Activity: #2821 - 405008 CBNRM Community forestry Zone	Cameroon, Est	22,821	7,616	2,131	5,226
LS_8 CBNRM #19742 Luilaka River	Democratic Republic of the Congo, Équateur	108,200	14,967	52,441	337,119
LS_8 CBNRM #19773 Montoko River	Democratic Republic of	555,400	76,827	268,643	1,726,990

	the Congo, Équateur				
CBNRM 19712 Lotoi Lokoro	Democratic Republic of the Congo, Bandundu	379,400	52,481	183,334	1,178,578
Agroforestry					
Activity	**Location**	**Area**	**Archive 2011**	**Scenario 1**	**Scenario 2**
CBNRM Bwisha	Democratic Republic of the Congo, Kivu	5,678	607	27,586	27,586
CBNRM Djuma	Democratic Republic of the Congo, Kivu	7,277	778	35,354	35,354
CBNRM Mwenda	Democratic Republic of the Congo, Kivu	1,447	155	7,030	7,030

CBNRM - Kinigi	Rwanda, Ruhengeri	5,000	313	24,292	24,292