C-AGG/CSU/NRCS Workshop Summary:
Enhancing COMET-Farm & modeling tools to reduce voluntary market transaction costs for agricultural offset projects

Tuesday, March 8, 2016

Hyatt Regency Sacramento

Meeting Objectives:

- *Identify whether/how COMET-Farm and modeling tools can be used to reduce transaction costs associated with developing voluntary carbon market offset projects for the agriculture sector, especially small volume projects.*
- *Identify enhancements to COMET-Farm and modeling tools for use in for voluntary carbon markets, including opportunities to streamline data entry and minimize uncertainty.*
- *Identify specific scenarios where COMET-Farm and other decision support tools: (a) have facilitated cost-effective project planning and implementation; and/or (b) have posed challenges or hurdles for project developers to cost-effectively plan and implement offset market projects.*

Session 1: Understanding Project Development Needs & Transaction Costs

Session Objective: *Gain an understanding of offset project transaction costs based on market requirements. A summary of research findings and a project case study will be presented.*

Adam Chambers with USDA-NRCS opened the workshop with a short history and background on the genesis of the workshop. He presented an overview on the phases of market development, from the development phase to emerging markets, early market phases, and finally to a scaled robust transactional marketplace. Currently, carbon markets fall between the emerging market and early market phases. The emerging market phase is characterized by a testing of market rules and protocols, exchange of the first pilot transactions, and a mix of funding sources that include grants and program related investment. When a market has entered the early market (scaling) phase, the market will begin to see a stabilizing of regulations, a decrease in transaction costs, and more mainstream funding sources.

Market development can be a long road as Adam exemplified with a brief overview of water quality trading markets. In order to develop fully functioning markets, reliable policies and regulations must be in place, sufficient organizing capital is required, appropriate deal structures and agreed upon transaction models are necessary, price discovery must occur, and finally an influx of catalyzing capital must be added. The remainder of the workshop focused on how to reduce transaction costs and increase certainty to establish some of these market requirements.

Kate Zook with the USDA's Office of Environmental Markets provided an overview of how transaction costs breakdown for projects in the carbon offset space. She conducted both desk research and interviews with parties involved credit development to better understand the magnitude of costs and the factors that influence these costs (referred to as the cost influencers). When project costs are broken down, project development, validation and verification make up the majority of the costs to bring credits to market. Although project development costs are not necessarily "transaction costs," they do add up - including land owner outreach, legal costs, and project installation. For validation and verification, site visits constitute the bulk of these costs.

To reduce project implementation and verification transaction costs, there are several levers that can pulled. Project developers can scale up projects to achieve economies specifically around verification; protocols can reduce or embrace uncertainty, meaning allow for a higher uncertainty level for a reduced number of generated credits, to balance credits generated with level of effort required, and use a generic baseline determination; and project developers and registries can work together to continually improve protocols based on lessons learned during implementation to make the protocols as easy as possible to implement. Given the challenges and costs associated with project implementation, USDA is interested in exploring whether, and if so how, COMET-Farm and other tools might be expanded to be more useful in a market context to aid in data collection, pre-project GHG assessments to understand a project's credit potential, and simplification of project baseline and outcome calculations.

Sheldon Zakreski with The Climate Trust (TCT) provided an investor's perspective on transaction costs and market development challenges. TCT and other investors view transaction costs as fixed and fairly well understood. The major challenge the community faces is GHG quantification uncertainty, i.e., an inability to accurately predict the number of tons a project will generate, and the price of offsets at the time of sale. The latter is unpredictable due to high market volatility. Given these two challenges, investors are most interested in large scale projects (>100,000 tons) since scale can make these uncertainties easier to absorb and reduce overall uncertainty on a per-acre basis due to the advantages of scale. However, a single land owner is typically unable to satisfy this scale, so project developers and aggregators are essential to deliver projects at scale and take on most of the associated project implementation risks.

Over the years, multiple models have been developed to bring larger projects to market, including cost sharing between landowners and project developers and paying landowners a flat fee based on acres enrolled. While there are benefits and challenges to both approaches, at this stage in market development the best path forward is to the provide financial certainty to the landowner. The remaining challenge is how to lower the risks and barriers project developers face when attempting to develop projects in developing markets?

Some of the proposed ideas for reducing project developers' risks and costs include:

- The use of online emission calculators and biogeochemical process models for baseline and project calculations since field measurements are neither possible nor practical;
- Reducing the burden of acquiring monitoring evidence by making it more inclusive and less prescriptive;
- Automation of data collection such as the use of an API to gather field data from tractors and farm machinery that is already collecting valuable model inputs;
- The use of look-up tables or default values for GHG emissions reductions estimates;
- Tiered offset approaches that tie value to GHG estimation rigor; and
- Use of insurance mechanisms or buffer pools to reduce market risk.

Given USDA's presence and interest in supporting market development, participants suggested that USDA could aid in market demand and investor confidence by purchasing offsets, which is an option currently under consideration.

The discussion concluded with an acknowledgement that there is still progress to be made in this space.

Session 2: Lessons learned from offset market projects in rice management systems

Session Objective: *Gain an understanding of project development challenges from a current offset project and explore how models and tools might reduce transaction costs.*

Bill Salas with Applied GeoSolutions, Shahira Esmail with Terra Global Capital and Rori Cowan with American Carbon Registry presented some lessons learned from implementing and generating credits from a rice offset project focused on changing rice management systems. Bill summarized the use of a biogeochemical process model to quantify estimated changes in GHG associated with the project, which required rigorous model calibration and validation. He also discussed how model uncertainty was calculated and incorporated into the protocol. Shahira discussed the challenges she faced as a project developer and Rori helped the group understand protocol requirements and how tools can be used to cost-effectively meet project requirements.

The Denitrification-Decomposition (DNDC) model, a mechanistic biogeochemical process model, was originally designed as a research model to quantify nitrous oxide (N_2O) emissions from agricultural practices. The model has since expanded its scope to include methane (CH_4) and carbon dioxide (CO_2) emissions. For the rice project, the DNDC model estimates CH_4 released from the plant, from the rice system, during drainage, and emissions directly from the water column. To determine model structural uncertainty, i.e. how close modeled emissions changes are to measured emissions changes at the field scale, an independent validation was conducted to compare these differences for all rice growing regions in the US. The results of this exercise showed that the model is not biased, meaning it performed the same across all regions, it can be used in all rice growing regions using the same calibration. Further, the theory of large numbers[1] can be applied to calculate model structural uncertainty. To calculate the final uncertainty value, the anticipated size of the program area was compared to the probability curve generated from the calibrated model runs to determine a final uncertainty deduction. In addition to structural uncertainty, input uncertainty was also quantified to a 10% confidence level after Monte Carlo simulations were run based on the soil texture, soil pH, and soil bulk density.

Process model validation is necessary if models are used for carbon offset protocol quantification. If a model is shown to be unbiased, project developers and registries can confidently use the model and allow for aggregation to reduce uncertainty and increase the possible number of credits generated. Unfortunately, the majority (80%) of the work that was conducted to validate DNDC and calculate its structural uncertainty for this project is only applicable to rice systems. However, 20% of the time spent developing the framework to quantify uncertainty can be applied to other systems.

To enhance the model's utility and further reduce project development costs, a Webtool version of the model was created to automatically extract and format soils data from NRCS databases and daily weather data from PRISM to meet model requirements. These downloads are based on field location coordinates entered into the tool. The Webtool also helps users perform a crop calibration step, create all DNDC inputs required by the protocols, including data required for input uncertainty Monte Carlo runs, and stores the data for verification purposes.

Remote sensing (RS) technologies can also be employed for monitoring purposes to prove rice fields meet eligibility requirements of the protocols and to reduce verification costs by providing evidence that a change in practices occurred as required. RS can be used to identify and monitor the following:

- Tillage practices – RS can map crop residue and changes in residue over time;

[1] According to the Theory of Large Numbers, the average of the results obtained from a large number of model runs should eventually converge on the expected value, minimizing uncertainty.

- Cover crops – RS can map the presence and absence of cover crops, and show their vigor to estimate how well crops are taking up N and to estimate how well they are reducing erosion; and
- Rice water management - wet seeding versus dry seeding practice utilization.

RS is valuable but not a complete answer; it must be integrated into a strategic risk based sampling protocol for verification and eligibility assessment.

The use of models within market protocols are governed by ISO 14046-2 standards, which state that offsets must be real, additional, permanent, accurate/quantifiable, transparent, verifiable, and conservative. Models must be able to produce results that satisfy these requirements to be incorporated into registry protocols. Currently, ACR's rice protocol and nutrient management protocol allow the DNDC model to be used to perform project calculations. The nutrient management protocol is currently undergoing a revision that will make the protocol model agnostic, which is raising some tough questions such as how does ACR ensure that two different models will produce materially similar quantification results, so that market certainty and credibility are maintained? This remains an open question that the registry is Working to address.

Shahira shared her experience developing a rice project on rice farms in CA and the Mississippi River delta using ACR's methodology and the DNDC model for field-level GHG quantification. Typical project development steps are as follows:

- Recruit eligible participants;
- Collect field data and monitoring evidence (e.g., planting date via geo-tagged photos, harvest data via date-stamped receipt from the mill);
- Identify critical and non-critical calculation parameters;
- Perform regional and field-specific model calibration;
- Run model simulations;
- Perform Monte Carlo input uncertainty analysis;
- Calculate structural uncertainty; and
- Perform final emission reduction calculations.

The most challenging aspects of project development for this particular project include:

- the gathering of historic field data;
- strict monitoring data requirements dictated by the protocol, including reliance solely on prescribed pieces of evidence;
- the lack of a compelling business case to attract producers;
- and soft market demand.

In this first of its kind project, Terra Global learned a few valuable lessons including the fact that growers must be present during every step of project development and ideally protocol development; aggregation and technology can and will lower transaction costs; and because current carbon pricing is not enough to recruit participates there needs to be additional income opportunities such as from premium pricing or stacking of other environmental benefits (e.g., soil organic carbon, soil erosion benefits, biodiversity, habitat conservation) to make the business case more attractive.

To reduce some of these barriers to project development, Terra Global developed the PRESTO tool that automates GHG quantification for the ACR and California Air Resources Board rice protocols, automates some of the quality assurance and quality control (QA/QC) reducing the project developer's QA/QC burden. The tool is also being further developed to allow for real-time data input by growers that will be integrated with data from field sensors and instrumentation using uniform data formats. This will also help with the gathering of evidence for verification. While this solves some of the identified project development challenges, the low market price signal and poor business case challenges remain.

Session 3: Leveraging COMET tools for Offset Projects: Challenges and Opportunities

Session Objective*: Gain insights on opportunities to enhance COMET-Farm for voluntary market projects. Discuss user requirement challenges for project developers and voluntary registries to scope potential enhancements to COMET-Farm.*

CSU has developed a suite of decision support tools to help land owners understand the impacts of management practices on land-based GHG emissions fluxes. COMET-Farm is an online platform designed to provide a means for non-GHG specialists to easily estimate farm scale GHG emission baselines and to explore conservation scenarios involving alternative management, land use, and livestock herd strategies. COMET-Farm is not a model, but rather a platform that hosts a suite of models (including Daycent and DNDC) that estimate GHG emissions and changes in emissions in all of the major GHG source and subsource categories known to be attributed to land use and management. The quantification methods found in the platform are currently synced with USDA's methods document published in July 2014.

COMET-Farm consists of a web-interface that captures user input data, which are then combined with farm-specific remote sensing and geospatial databases that are fed into an estimation module. Development of an uncertainty estimator is currently underway, though at present COMET-Farm does not produce uncertainty estimates associated with GHG estimates. The estimation module contains a DayCent simulation and 40 other empirical and dynamic models associated with manure, enteric, soil carbon, soil nitrous oxide, and other agricultural source/sink quantification methods.

COMET-Planner, another tool within the COMET suite, is a simpler screening tool that provides rapid estimates of potential GHG reductions associated with implementation of NRCS Conservation Practices. Both COMET tools are designed to perform conservation scenario analysis. COMET-Planner covers a much larger area than COMET-Farm and has a higher level of uncertainty associated with the estimates it generates. COMET-Farm has a longer associated learning curve, requiring 60-90 min to understand how to use the cropland module and another 5-10 minutes per field or livestock herd for data entry. Currently, the majority of users of COMET tools (n~2000) are NRCS staff, Regional Conservation Program staff, NGO staff and individuals, researchers, and academics.

Suggestions for Enhancements to COMET Tools (if goal is market use) from participants:

- Ability to export COMET-Farm into COMET-Planner;
- Robust uncertainty calculations associated with GHG estimates;
- Ability to batch upload, process multiple fields and run the fields through the COMET methods, recognized as a major need to allow for project aggregation;
- Field testing with landowners and farmers to identify their needs;
- Ability to quantify reversals of emissions reductions;
- Ability to run scenario analyses across landscapes to produce more robust pre-project calculations based on soil type, weather data, and potentially other factors that have a large impact on GHG fluxes;
- All spatial scales (i.e., site, region, jurisdiction) should be quantifiable;
- An estimation of the cost savings/economics of practice changes (may be outside of tool scope);
- Create a repository/archive for documents/images/documentation that can be used as evidence during verification;

- Sync NRCS maps (latitude/longitude, hectares, boundaries) with tool, so they can be easily pulled into a project scenario; and
- Provide an option to importing remote sensing data, particularly for larger projects given the costs associated with processing the RS images

Session 4: A Path Forward

Session Objective*: Prioritize recommendations for enhancing COMET-Farm and models to meet the needs of project developers and registries in voluntary markets.*

Participants were asked to provide concrete suggestions for the use of tools like COMET-Farm to streamline project implementation and reduce transaction costs. The group provided the following suggestions:

- allow photographs from the field to be uploaded to a cloud-based system and used as evidence of activities occurring. The ability for project developers to view none proprietary or business sensitive farmer driven model inputs and pictures, run calculations, and generate a report that shows changes in emissions;
- Create multiple views (e.g., farmer, project developer, verifier) within the tool so everyone has customized dashboards relevant to their piece/scale of the project implementation phase;
- Make the tool easier for farmers to run which could be accomplished by creating APIs to the precision agriculture equipment they are using on-farm to collect data;
- Consider including DNDC in addition to DayCent in the platform since this is already being used for project development and has been approved for use in the rice and nutrient management protocols;
- Consider branding COMET-Farm for use as a top-down identification tool, but be careful to not limit its ability to scale in the future. We need tools that allow for quick assessments over time in addition to tools for estimating tons for markets; and
- Allow the tool to facilitate multi-emission source mitigation projects since this is likely where projects will need to go in the future to make project development more financially viable.

The group also discussed whether markets are the right vehicle for small projects. If the goal is to achieve environmental benefits, there are multiple pathways and strategies that can be pursued. The group encouraged everyone to consider that there may be more efficient ways to achieve these benefits outside of markets. Participants also encouraged CSU and USDA to look at the Alberta market for lessons learned and strategies to reduce transaction costs understanding that this market is not as rigorous as the voluntary market in the US, so some of these lessons would not directly transfer to the current conversation. A few participants highlighted the ability of Alberta's market to maintain low transaction costs given the market participants' ability to aggregate within protocols, to use a statistically based verification approach, and to pay minimal registry fees. While some aspects of this model are likely unique to Alberta, others may help the CA and voluntary markets become more viable and attractive to investors and project developers.