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Practitioner's Perspective

Ecosystem Services Markets Conceived and Designed for US Agriculture

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For the last few decades, a patchwork of compliance and voluntary ecosystem service (ES) markets have operated throughout the United States, targeting different pollutants, from different sources, at varying geospatial scales. Existing markets have never addressed agricultural pollutants in a comprehensive way that is amenable to working agricultural lands. Agricultural production accounts for 8.4% of US greenhouse gas (GHG) emissions (USEPA 2019); is the largest identified source of impairments for rivers and streams (USEPA 2020) and the second largest identified source for lakes, reservoirs, and ponds; and accounts for approximately 80% of consumptive water use (USDA ERS 2020).

Agriculture has not been well covered by ES markets for three primary reasons. These markets treat agricultural sources the same as point sources of pollution. They lack a systems approach capable of comprehensively addressing GHG, water quality, water use, and other ecological challenges on working landscapes. Disparate markets and piecemeal approaches have lacked programmatic investments to integrate technologically advanced data collection, monitoring, reporting, and verification (MRV) capabilities. For several reasons, agricultural producers have been reluctant or unable to participate in ES markets. However, the Ecosystem Services Market Consortium (ESMC), a member-based organization formed in 2019, is designed to incentivize and scale outcomes-based environmental performance across the sector.

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The ESMC is launching a national-scale, voluntary, private trading market conceived of and designed for the agricultural sector. ESMC's market was designed based on lessons from past private and public ES market initiatives. Private ES markets are supported by past legislative and policy actions. Section 2709 of the 2008 Farm Bill authorized the US Department of Agriculture (USDA) to "facilitate the participation of farmers, ranchers, and forest landowners in emerging environmental markets." A later USDA Natural Resources Conservation Service policy position allows "all returns to agricultural producers from the sale of environmental credits generated by the adoption of conservation practices, whether or not they are paid for in total or part by USDA conservation programs, accrue to them solely" (Kling and Secchi 2011).

ESMC provides quantified, salable credits representing improvements in soil carbon (C) sequestration, GHG mitigation, water quality impacts, and water use efficiency. Additional attributes such as biodiversity and habitat conservation will be added in 2022 or later. ESMCs innovations include a systems approach to track agricultural impacts, technological development, reduced transaction costs, seamless connections between credit supply and heterogeneous market demand, and market rules that facilitate producer participation while ensuring the integrity of environmental improvements. ESMC's systems approach centers around economic and environmental sustainability and resiliency, tying each to improvements in GHG, water quality, and water use performance. The ability to stack assets based on systems improvements and advanced technology utilization are reducing transaction of credit quantification, monitoring, reporting, verification, and sales. Reduced transaction costs will increase producer profits and thus the incentive to participate.

Both voluntary and compliance markets are governed by rules specifying which entities can generate credits, how, and under what conditions. Conventional market definitions of permanence and additionality used in existing GHG markets are not suited to dynamic, working farms and ranches, but are rather designed for static, more controllable systems like energy production or wastewater treatment facilities. By requiring that projects provision ES in permanence (variably defined as 40 to 100 years) (UNFCC 2014), markets effectively disqualify agricultural producers whose environmental performance changes with climatic variation and fluctuates according to annual crop selection, tillage, and fertilization decisions.

Such vast time horizons do not correspond with producer's planning timelines, ability to manage risk, and status as price-takers in the food and beverage supply chain. For C assets, ESMC sets 20-year permanence requirements for two 10-year enrollment periods, corresponding to the length of time

required to build soil C levels to the point of near saturation (West et al. 2013). Water quality and use efficiency assets do not require permanence, because their benefits are not permanent. By relying upon soil C testing and modeling, ESMC's outcomes-based, practice-agnostic approach allows each participant to generate credits how they see fit. In other words, ESMC does not require adoption of a practice or certain practices, but instead allow producers to adopt beneficial practices most likely to enhance outcomes for their systems in their geographies. ESMC's hybrid asset quantification approach combines soil sampling and modeling based on individual producer actions.

Practice-neutrality and a 20-year enrollment horizon reduce the barriers to entry for producers, regardless of management style or size, and allows producers the flexibility they need to make critical management decisions in response to market signals and resource needs.

A revised vision of additionality is also a central feature of ESMCs market. Credits are deemed additional if they represent an environmental improvement that occurs compared to the baseline, which is the environmental status when a participant enrolls. Existing ES markets for agriculture use baselines targeting adoption of specific practices, such that "early adopters" of these practices are typically disqualified from market participation. Markets with baselines corresponding to modest environmental performance might raise stewardship levels of the average producer, but then bring about a plateau past which no additional conservation adoption occurs. Conversely, a high-performance baseline could exclude the majority of producers by requiring significant improvements before they are even eligible to generate credits. Such has been the case with the US Environmental Protection Agency's historic policy on water quality trading, which requires producers to meet their load allocation identified in the watershed's total maximum daily load (TMDL) before generating credits (USEPA 2003). ESMC's approach redefines this issue by setting a baseline for each participant. Individualized baselines incentivize continuous improvement for each participant and have the potential to garner sector-wide participation and to scale outcomes.

ESMC is working with its partners and members to advance the state of science and develop new MRV technologies and platforms to improve asset quantification and verification. For instance, ESMC is making investments in in-field C testing technologies, remote sensing quantification and verification capabilities, and new data management platforms that reduce the transaction costs associated with ES credit generation. A traditional ES credit's value is comprised mostly of incurred transaction costs, meaning the producing entity receives a small portion of the actual credit value.

Remote sensing will allow ESMC to minimize transaction costs associated with MRV. Existing markets largely rely on multiple in-field site visits, often years after practices were changed. The MRV platform will allow producers to seamlessly upload data via application programming interfaces (APIs) from their preferred farm management and record keeping software. Producer data, governed by data privacy agreements, will populate the models, and modeling results tied to spatially explicit grids and rasters allow credit purchasers to track outcomes within their supply chains. Data on GHG mitigation, nutrient and sediment loading reductions, and water conservation can be aggregated for reporting at various spatial scales according to field, farm, watershed, sourcing area, or administrative boundaries.

ESMC's science-based, outcomes-based credits are underpinned by soil C field sampling and model quantification. As ESMC expands beyond its pilot regions, launching nationally in 2022 with a goal of touching 101 million ha (250 million ac) by 2030 and 263 million ha (650 million ac) by 2050, it will continue to advance the state of science by corroborating model results with ground observations from every region and production system. With scale, models become more accurate and testing and monitoring less expensive. ESMC's ambition and unique strategy lies in its approach to scale its program nationally and create a positive feedback loop between low transaction costs, high participation, and transparent, reliable ES assets.

The most underappreciated impediments to well-functioning ES markets are trust and user friendliness. There are vast literatures on market design, modeling techniques, and regulatory landscapes, but even the best designed market with the most accurate tools and ideal policy conditions cannot create impact at scale if producers do not participate. ESMC estimates the combined potential near-term demand for C and water quality credits at $13.9 billion, with C and water quality credits valued at $5.2 billion and $8.7 billion, respectively. To ensure farmer and rancher acceptance, ESMC has involved them in each step of its program design, development, and piloting.

ESMC makes use of existing networks of trust, and the program design facilitates relationships among farmers, between farmers and their advisors, or between farmers and their customers and market demand. Buyers, primarily corporate entities seeking to mitigate their supply chain impacts, and sellers, who are agricultural producers, are well represented in ESMC's governance, science, development, and deployment structure. The MRV platform will offer displays of only relevant data for each program participant. Producers can see their production data and results. Market administrators and verifiers will be able to quantify, monitor, and verify assets using producer data and external inputs, such as satellite imagery, soil test results, and weather and soil maps.

Buyers will be able to purchase credits and mitigate supply chain impacts without accessing the personally identifiable information of their suppliers. The platform will engender trust among all market participants; facilitate and mediate each transaction; and serve as the locus for credit generation, monitoring, reporting, and verification.

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