The Ecosystem Services Market Consortium (ESMC): Ecosystem Services Markets Conceived and Designed for Agriculture

Lessons learned from two decades of agriculture carbon market programs

The Ecosystem Services Market Consortium (ESMC) is launching the first ecosystem service market program dedicated exclusively to agricultural working and conservation lands. The full-scale market will launch in 2022. The ESMC is a national-scale market conceived of and designed for US farmers and ranchers. ESMCs program, which is currently in full pilot and demonstration mode with more than 40 members from across the agricultural supply chain, provides outcomes-based, quantified, salable credits representing improvements in soil carbon sequestration and retention, net greenhouse gas (GHG) mitigation, water quality impacts, and water use efficiency. ESMC's approach was designed to incorporate the successful elements of previous ecosystem service trading markets while overcoming the mistakes and pitfalls that plagued them. ESMC, however, is more than just a synthesis of lessons learned from past markets. ESMC's innovation lies not only in the incorporation of all of these parts, but also in driving technological development and research, creating new agriculture-focused market rules that accommodate the needs of buyers and sellers, developing social capital and systems to connect every corner of the market to reduce market failure risks, and demonstrating the proper role for government to spur action and mobilize change in the sector.

This paper draws heavily on work conducted by the Coalition on Agricultural Greenhouse Gases (C-AGG), including C-AGG's work over several years supporting USDA Conservation Innovation Grant (CIG) projects focused on carbon market opportunities for US agriculture. The paper identifies and summarizes the most and least successful elements of past markets. These elements are broadly categorized into policy, technological, economic, and social capital categories, and served as guideposts for the development of ESMCs market. Viewed comprehensively, ESMC's blueprint and program aims to make the agricultural sector more sustainable and resilient by addressing the environmental, economic, and social barriers to achieving and scaling improved ecosystem service impacts from working agricultural and conservation lands through a market-based approach.

Market Design

Current markets are hampered by risks associated with market design. Markets created without regards to matching supply and demand, or without ensuring that all market participants have the requisite tools or access to participate, or are prepared to participate when needed (e.g. having ample verifiers familiar with agricultural production systems who can

act in a timely fashion) or who can certify the programs and resulting assets are virtually absent in current markets. ESMC's total market planning and design overcomes these risks by creating the necessary tools, incentives, and participation agreements to create a full-service market. All the players in the agricultural supply chain and ESMC market are testing the full market design together. This approach will ensure delivery of outcomes by ensuring necessary trading volumes, participation, and ability to monetize assets at scale.

The first, and perhaps, most significant category of barriers related to market design include the rules governing who can participate and under what conditions. Existing carbon and water asset markets markets were designed for point source pollution approaches, as were the rules of participation, and thus apply more to large point source facilities like power plants. These facilities can utilize monitors and/or indicators of GHG production according to known and predictable formulas. Point source market design rules make it easy for a project developer to aggregate and scale such projects, given the ease of computing changes in emissions. When applied to biological agricultural systems, however, these rules and associated requirements present a significant barrier to entry for farmers and ranchers, especially considering that more than 2 million independent agricultural producers must managed their systems according to their region, weather, precipitation, climate, and to address pests, diseases, and other issues that require flexibility of management approaches. Additionally, agricultural protocols that track and allow only one specific practice and one specific GHG or other outcome or attribute are not sustainable and not flexible enough to capture how farmers and ranchers farm and ranch, which is a systems-based approach based on their soils, regions, climate and weather and production systems. Agricultural systems require flexibility of management and thus flexibility in tracking management changes, and market rules must accommodate this flexibility to engage farmers and ranchers at scale. The result is that in existing markets, transaction costs associated with agricultural project development, data collection, monitoring, reporting, and verification and credit development are disjointed, largely unconnected, and traditionally outweigh the value of credits generated. The result is market signals that don't provide enough of an economic incentive for agricultural producers to participate. ESMC's aligned programmatic approach addresses these critical barriers in a full-service market that reduces or negates the individual and collective risk of each of these market failures.

Additionally, because most ecosystem service impacts in question are treated as market externalities, their true value is not currently reflected in monetization of these credits. While ESMC believe that valuation of ecosystem services will improve as society continues to grapple with continued degradation of natural resources and the need to enhance outcomes and improvements, that is not within our control to fix, at present. Market design is within our control, and is where we have focused our attention.

Further, the market concepts of additionality and permanence have served as the basis of voluntary and regulatory markets to date. While these tenets have helped ensure that transacted credits can be linked to improved environmental outcomes that don't shift adverse effects elsewhere, their implementation has largely prevented qualifying agroecosystems from participating, given the biological nature of these systems. Markets define "additionality" to determine which actions or interventions contribute to improved environmental outcomes and are thus eligible to earn credits. Markets strive to only award credits to actions that wouldn't have occurred without the incentive provided by the market. If an intervention is not

additional, one cannot claim that a transaction is creating 'new' changes in outcomes. This rule inherently determines that any good actions already occurring cannot be rewarded, which is a known perverse impact, particularly in a sector in which adoption of beneficial practices and impacts remains relatively low. Each determination of additionality is made with reference to a baseline, or a determination that "but for this policy, this action would not have occurred", which is highly subjective. Past and current markets, which largely use project- or area-wide baselines, thus disqualify the innovations or early-adopters from market participation. Because early adopters are the teachers from whom more risk-adverse farmers and ranchers learn, the outcome has made it difficult to scale any desired impacts.

ESMC's approach adapts existing notions of baselines and additionality to account for systems-based approaches and to reward actual outcomes. We look at the baseline status at the farm scale – what systems are in place on each farm or ranch at enrollment, and what new practices or systems are adopted -- and we monitor and report the outcomes associated with the new practices and systems on an annual and an ongoing basis. This will allow us to reward system-based approaches that move the needle with regard to generating assets of interest, rather than to focus on individual practices. A market with adaptive baselines embraces the concept of "continuous improvement" and rewards each producer for gains in water use efficiency, nutrient management, and soil organic carbon content. Moreover, we believe ecosystem service markets should reward rather than penalize innovators and early adopters. ESMC has created a 3-year lookback provision to credit stored soil carbon going back 3 years when producers who enroll have average soil carbon content that is higher than the county average – a sign of past and ongoing good management.

GHG global warming potentials (GWP) are generally expressed on a 100-year time scale, and similarly, carbon sequestration projects in existing carbon markets are expected to sequester or mitigate carbon emissions for 40-100 years in order to be considered "permanent." Like additionality, the concept of permanence is not easily translated to biological systems, where carbon stocks fluctuate depending upon management and climactic factors. The carbon cycle, by its nature, is a biological cycle, and is not 'permanent' per se. The focus instead should be on increasing the amount of biological carbon and the duration of residence time of this carbon in beneficial sinks, including soil sinks. Tracking the status of these sinks, and the amount and residence time of carbon in them, in a manner that is linked to agricultural systems management is the approach taken by ESMC. We can and will track changes in soil carbon sinks at the farm and ranch scale and at larger scales, as well as the management systems that enhance these sinks and their residence time; we will reward these activities through the market, and show how the resilience associated with these outcomes benefits the farmer and rancher above and beyond the market payments, by improving bottom lines. The resulting impacts benefit society also.

In addition, ESMC has built a market with buyers and sellers at the table who are helping to refine the market design and pilot test the protocols while investing together in additional R&D to enhance market functionality. The majority of ESMC market demand is from corporate entities operating in the agriculture, food and beverage sectors. Our market and protocol design address these buyers' needs – which currently accounts for the majority of demand -- as well as those of heavy emitters and regulated emitters, such as the oil and gas industry. ESMC's protocols generate ecosystem service assets that meet standards in supply chain sustainability

initiatives as well as in voluntary and compliance grade carbon and water markets. ESMC assets meet corporate entity requirements to calculate, track and mitigate the environmental impacts in their supply chains. Buyer and seller participation as well as a commissioned demand-side analysis[1] has shown that the market is legitimate, viable, scalable, and capable of transforming the sector. Buyer 'buy-in' reduces uncertainty for sellers who traditionally have not seen value in these markets, while demonstrating that buyers are willing to work with farmers and ranchers to achieve mutual goals. Beside multi-stakeholder participation and buy-in, ESMC also differs from past markets because of the circumstances surrounding the market's development and launch. Consumer and investor demand for sustainable agriculture products, increasing levels of communication and integration throughout agriculture supply chains, and high rates of technological advancement in the sector and in the ESMC market will help to truly transform these markets.

Beside failing to design markets to meet the needs of primary stakeholders, past and current ecosystem services markets struggle to connect buyers and sellers, requiring middle-men or one-off transactions. An example is a water utility looking for upstream nutrient reductions. Farmers and ranchers in the utility's watershed may be well-suited to meet the utility's needs, but since these two groups aren't typically in contact, coordination is time- and resource-intensive. Because such transactions remain one-off deals, there has been a chicken and egg question with regards to matching supply and demand. A farmer will not incur the upfront costs of generating a credit without certainty that there is a buyer, and that the sale will offset the required monitoring, reporting, verification, and listing fees. Similarly, a buyer can't meet demand through credits that don't exist – or that don't exist when needed, or from credits for which real and opportunity costs are higher than the current costs of coming into compliance or meeting a voluntary sustainability target.

ESMC's market design addresses these risks in the market asset development and delivery chain by establishing a fully-functioning marketplace and transaction hub and by addressing the value proposition to all players and stakeholders in its design and development. Farmer and rancher engagement, technical assistance, asset quantification, verification, certification and credit generation and transactions are all included. By including all players and critical stakeholders in the market design, testing and buildout, and by fulling addressing verification and certification requirements up front, ESMC has reduced uncertainty about supply and demand as well as about verification and certification. Each transaction is mediated by standards-based protocols and rules and procedures that are being field-tested and refined during the piloting phase. The complete infrastructure design replaces the need for one-off transactions happening randomly across the asset development and market landscape. Past markets have defined and set the standard for bringing multiple producers together under a single body or project developer, but ESMC's full-service structure and programmatic investments removes the need for middlemen and thus minimizes costs associated with project development, asset generation, verification, certification and sale, which currently occur in different arenas and under different groups of paid players.

The ability to cut out intermediaries and thus reduce cost and risk is made possible by a market built around the market's supply chain. ESMC's approach can also increase transparency

[1] https://ecosystemservicesmarket.org/wp-content/uploads/2019/09/Informa-IHS-Markit-ESM-Study-Sep-19.pdf

in agricultural supply chains by connecting and harnessing previously siloed data at each stage in the supply chain – production, handling, processing, transport, and manufacturing. Agricultural technology and the use of application programming interfaces (APIs) can facilitate these connections by allowing management systems in each stage of the supply chain to share data. For example, with producer consent, nutrient application data collected by a tractor can be shared throughout the supply chain to inform a calculation of GHG and water quality impacts for a food product. The sharing of this data is predicated on data privacy and ownership agreements, established relationships, and the potential for producer value or profit from a sustainability premium or credit transaction. The proliferation of data ownership norms and the establishment of supply chain relationships is a relatively new phenomenon that ESMC seeks to further bolster through its multi-stakeholder effort. To this end, ESMC has followed the American Farm Bureau Federation and other grower and industry groups' Ag Data Transparent Core Principles and will seek certification through that initiative. Certification against this standard means that ESMC can ensure clarity around the collection, use, storage, and transfer of producer data so they can make informed decisions relative to their participation in the marketplace.[2]

As a general rule, market efficiencies increase with increased access and participation. For instance, markets operating within a single, small watershed inherently limit the number of buyers and sellers, the impacts that can be achieved, and thus the efficiencies of scale that can be achieved. Smaller markets tend to lead to incongruities between supply and demand. While certain ecosystem services have a localized impact (e.g. water quality), ESMC will nonetheless operate at a national scale in order to facilitate robust market participation and activity.

ESMC is also unique in developing a system that stacks credits that monetize different ecosystem services attributes developed on the same lands. ESMCS' protocols incorporate a single quantification approach that creates carbon / GHG, water quality, and water use impacts of agricultural management systems and generate three separate, salable assets that can be sold together in a stacked asset or disaggregated to meet the needs of different willing buyers. While the price of a carbon credit may not cover the full cost of credit generation and sale in today's markets, coupling these credits with water quality and use efficiency assets will tip the balance in favor of producers and generate greater societal returns in an outcomes-based market.

Finally, a logical but necessary change that has yet to infiltrate these markets is the use of scientific sampling for verification approaches. Risk-based, randomized sampling approaches are used in all aspects of our lives, including medicine, insurance and even security screenings. ESMC has adopted a science-based, risk-based randomized sampling approach to retain the rigor of verification approaches while drastically reducing and hopefully largely eliminating the need for on-the-ground verifiers to visit a farm or field typically months or sometimes years after the fact to verify whether a practice or practice change occurred. Coupled with remote sensing, satellite imagery, and other forms of documented evidence, this approach will increase transparency and rigor while reducing verification costs and resource requirements that have hampered these markets from scaling.

[2] https://www.agdatatransparent.com/

Technology

Programmatic investments in ecosystem service markets from agriculture are imperative to scale science-based, standards-based quantification of outcomes in a verified, certified marketplace while reducing transaction costs. Technology, broadly referenced here to include improved quantification of ecosystem services assets from natural and working lands (e.g. direct sensors and microsensors as well as improved biophysical and biogeochemical models, improved soil carbon sampling and monitoring technologies), and technologies to electronically capture and store irrefutable evidence required for verification and certification (e.g., use of georeferenced apps and time and date-stamped photos and satellite imagery linked to process models), is critical in reducing transaction costs associated with ecosystem service markets and in building confidence that the assets are accurate representations of agreed upon units of ecosystem services. Also, technological advances can offer user-friendly tools and interfaces for all market players to engage without undue burden. These investments to build a scalable market focused on US agriculture have not previously been made, and are a key to scaling ESMC's market.

Inherent field-scale uncertainty surrounding the environmental impacts of, and thus quantification of impacts generated by specific management practices and systems-based approaches in agriculture is best addressed through new and developing technologies. These include the use of direct measurements (e.g. soil carbon) and sensors under development now (e.g. in-ground soil carbon and nitrous oxide sensors), coupled with robust, real-time modeling that can track and reflect impacts of new conservation and regenerative agriculture systems approaches, particularly in today's changing climate. Default values and meta-models based on past practices including limited rotations and non-regenerative systems-based approaches are not robust enough to capture real changes happening in various US regions and production systems. Nor can such practice-based meta-models possibly help to interpret and track trends in outcomes or impacts in a way that can reinforce which new systems-based approaches are moving the needle the most, by region and by production system, in order to create a positive feedback loop for producers within ESMC.

Similar to the question around baselines, market rules also decide the appropriate level of rigor for impact quantification, as well as how to achieve greatest confidence in quantification. Biogeochemical process models can track changes in ecosystem services impacts from agricultural systems at scale, and can calculate structural and data uncertainty of model outputs. The confidence in model accuracy is improved the larger the scale of operations and use. Insufficient data, or data of the wrong scale and scope, may not reflect actual conditions or outcomes on the ground. For instance, some tools and calculators use lookup tables with national, or even global averages or default values for soil carbon stocks or changes in GHG emissions associated with implementing a certain practice. Such tools and tables often do not reflect the regional, or even farm to farm variations in management decisions or soil and weather conditions, nor can they track outcomes, since they are based on past observances of past practices. Similarly, they cannot represent the myriad ways in which a producer can implement a conservation practice or suites of practices. ESMC protocols are practice neutral, allowing flexibility in producer decision making, but establish a pay for performance system based on ecosystem service impacts and outcomes. Using cover crops as an example, models

cannot distinguish between cover crops that are planted to fix nitrogen, provide forage, or stabilize soil; the various seeding rates and methods; and the termination timing and methods, but do need to recognize their contribution to carbon sequestration, GHG emissions, and water quality. ESMC has developed science-based, standards-based protocols that will ensure quantification rigor keyed to market needs while providing user-friendly tools and interfaces to minimize hassle and burden for users – particularly farmers and ranchers – while tracking beneficial systems-based impacts of regenerative practices.

The choice between data-intensive models that are cumbersome for producers and simple, unreliable models is becoming less essential due to advances in precision agriculture, data governance, and rural connectivity. US agricultural producers are increasingly using software on their operations to collect, store, and manage production and financial records; to track external weather, GPS, soil, and market data; and to forecast yields and generate recommendations for management activities such as pesticide and nutrient applications. The USDA Economic Research Service's *Agricultural Resources and Environmental Indicators, 2019* report, defines precision agriculture as "tractor guidance systems that use a global positioning system (GPS), GPS yield and soil mapping, and variable-rate input technology (VRT) applications." The use of these technologies has grown steadily over the last two decades and across commodities[3]. While there are still difficulties sharing and formatting these data to allow interoperability of software and models, the mere availability of these data is helping overcome current and past trade-offs between user-friendly and scientifically robust quantification approaches. ESMC is investing in advanced analytical technologies and platforms.

The availability of more rigorous data is due in large part to technological advancements made in monitoring and computing power for predictive analysis. With respect to monitoring, satellite imagery and sensing has become ubiquitous and relatively inexpensive compared to even a decade ago. Increasingly available production data is supported by improvements in basic scientific knowledge surrounding soil health and agricultural production systems. Advancements in our understanding of soil structure, water holding capacity, the soil microbiome, organic matter, and nutrient cycling make each calculation behind a carbon, water quality, or water use credit more scientifically sound.

These data also help reduce the transaction costs associated with monitoring, reporting, and verification. They partially obviate the need for in-person site visits because conservation practices can be monitored and verified remotely. For instance, satellite imagery can track and verify tillage and cover crop practices, and link to biogeochemical process models through algorithms. Nutrient application and irrigation records, gathered from farm machinery in real time and processed by third-party farm management software, can be confidentially shared with verifiers.

Social Capital

An important yet underappreciated impediment to ecosystem service market success is a lack of social capital, or networks of communication, cooperation, understanding and trust among market participants. Market rules and procedures must be known and agreed, but so

[3] https://www.ers.usda.gov/webdocs/publications/93026/eib-208.pdf?v=2348.3

must the long-term value proposition of market participants and stakeholders. To date, agricultural producers have not been mainstreamed into development of ecosystem service markets and protocol design, development, and testing. Most existing protocols were designed by well-intentioned and -qualified academics, non-profits, and corporate sustainability managers; gained universal approval among these groups; and were then published and released for use in the field. Like any product whose design doesn't consider the needs and desires of its primary user, these markets largely have not succeeded or scaled.

ESMC designed and is building a market with the participation of and to meet the needs of all stakeholders because a successful market will have the support and confidence of buyers, sellers, and critical stakeholders such as scientists and environmental NGO's. To scale the desired impacts from the agricultural sector that are clearly desired by society and corporates and others in the agricultural supply chain, ESMC's market is farmer-based and farmer-facing first and foremost. Farmers more readily trust, identify with, and learn from their fellow farmers than representatives of environmental NGOs, government agencies, or corporate sustainability departments. However, this conventional wisdom is rarely incorporated into design of ecosystem service markets or sustainability initiatives. The messenger is just as important as the message. This realization manifests itself in the establishment of peer-to-peer learning initiatives or corporate sustainability initiatives that make use of farmers' existing relationships with agricultural retailers and advisors.

Unlike traditional protocols, ESMC developed its protocols with farmers and ranchers and scientific experts and is piloting and field-testing every aspect of the protocols and the program with farmers and ranchers and other stakeholder before undergoing final scientific review, public comment and certification. Researchers and technical experts and agricultural producers have been involved since its inception. Beyond ensuring functionality and rigor in the field, producer involvement and testing helps to cultivate buy-in by getting producers to take a stake in the result. The buyers, primarily corporate entities seeking to mitigate their supply chain impacts, and sellers, agricultural producers, are all well represented in ESMC's governance, science, research, development and deployment structure, as are public agencies (USDA, DOE and EPA).

Policy

Ecosystem service markets are best established as free and open markets based on clear market rules, high quality information, and transparency of data and information. Markets will thrive with appropriate rules and transparency, and will drive price discovery to reflect societal and corporate demand for natural resource protection and enhancement in the form of ecosystem services derived from the agricultural sector, including climate mitigation and resilience, water quality, and water use. ESMC's market has been designed to not require any policy changes due to its private free-market approach.

Supportive public policies can undergird free markets, as commonly happens today. For instance, federally funded research can improve the state of monitoring, reporting, and verification of ecosystem services assets, including through the development of new and improved technologies. For instance, distributed technologies to provide rapid and accurate in-field soil carbon testing, more accurate and repeatable soil bulk density tests, or satellite and drone remote sensing technologies that are capable of feeding into quantification models and

databases can improve the rigor of ecosystem services asset quantification, monitoring, reporting and verification. Examples of this include USDA investments in OpTIS (a satellite imagery technology to track conservation tillage and cover crop use); investments by DOE ARPA-e and the National Science Foundation in in-ground soil sensors to detect changes in soil carbon and in nitrous oxide and methane which can enhance the rigor of models over time. National agreement on criteria for or test methods to measure soil carbon content of soils, including certification of laboratories that do the testing, would help to ensure harmonization of testing approaches across the landscape. Updated, accurate databases such as the SSURGO database maintained by USDA, to reflect updated soils information at a more granular scale across agricultural lands, as well as more accurate reflection of soil carbon content at different depths, by region and production system, would help improve confidence in observed changes and the design of soil carbon testing and monitoring criteria in these markets. Or, continual updates to conservation practice standards to reflect new, improved or regional or production-system specific variations in conservation practices will ensure practice standards remain current over time. Additionally, increased scientific knowledge pertaining to the economics of adoption of various practices and systems approaches that improve ecosystem services outcomes at the field, farm and regional and production scale will benefit farmer adoption of these systems and help to improve the functioning and performance of these markets.

To be useful in markets, all carbon, water quality, and water use calculators, assessment tools, and biogeochemical process models must be fully and transparently documented and have associated peer-reviewed literature assessing their rigor for use as intended. The documentation for these models must be available and updated to allow certifiers to assess their applicability and rigor. If tools or tool-based interfaces are used for market approaches, documentation and peer review of the tools is also required, including specific transparency on models that may be used and how they are used, as well as whether and when any default values or emissions factors are used, when and how. Without this documentation tools cannot be independently assessed for or utilized in markets, regardless of how they were created or by whom.

Additionally, models require data in order to be parametrized, validated, and optimized for use at different scales throughout the nation, and USDA and other federal partners regularly collect data that can be used for these purposes, but which is not always made accessible. Having access to collected data, and ensuring that all data collected in the future be made available in a harmonized and compatible approach can improve market function.

Government agencies can also provide greater clarity around credit or asset ownership, credit or asset stacking, and should facilitate inter-sectoral credit trading. USDA has a long-standing policy position that producers own the environmental assets or credits they generate, regardless of whether cost-share from public conservation programs helped them achieve the credited environmental outcomes[4][5]. Other federal and state agencies should provide the same assurances, as well as clarity and certainty around the ability to stack ecosystem service credits. For an ecosystem service market to succeed in the agriculture sector, it must tackle at least the

[4] https://www.govinfo.gov/content/pkg/FR-2019-11-12/pdf/2019-24367.pdf
[5] https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1045650.pdf

tripartite challenge of climate adaptation and mitigation, water quality degradation, and water use in farm production[6], since all are related to climate change. Federal agencies must make it clear that the same land can generate carbon, water quality, and water use credits at the same time in order to achieve outcomes-based impacts at scale. Allowing stacked credits will incentivize systems approaches to agricultural sustainability that address all three problems comprehensively and holistically while also reducing transaction costs. These assets are clearly of value to society as well as to farmers and ranchers; better recognizing their value, and reflecting the valuation in markets, will only come when we collectively resist the desire to insist on these outcomes at no cost to anyone.

Fully functioning private ecosystem service markets can also be enhanced via public-private partnerships that leverage resources. ESMC's recent award of a $10.3M grant from the Foundation for Food and Agriculture Research (FFAR), which ESMC is matching with private and philanthropic contributions and in-kind support of members and stakeholders, is an excellent example of such a partnership in support of private markets to benefit farmers and ranchers as well as society.

It is essential that any investments and advances in technologies or policies by government are coupled with strong commitments to voluntary, non-regulatory approaches. In order for voluntary conservation approaches to be adopted at scale, market participants must have faith that the rules of the game will remain constant, and that their investments in building out ecosystem service markets and attendant technologies will not be used for regulation. This could be facilitated with the use of "certainty" assurances linked to the ecosystem services contract period.

Overly restrictive or ill-conceived market rules have hindered the expansion and proliferation of ecosystem service markets for agriculture, as previously discussed. Whether these requirements are imposed voluntarily or through government intervention, the result is the same. The Environmental Protection Agency, for instance, promulgated a 2003 policy to promote water quality trading that offered "non-binding and non-mandatory recommendations and guidance for permitting authorities to consider when establishing and implementing water quality trading programs for NPDES permit compliance.[7]" The policy, though non-binding, came from the NPDES regulating agency and functioned as a de-facto rule on water quality trading.

The 2003 policy recommended that individual nonpoint sources not generate water quality credits until they meet their load allocation identified in the watershed's TMDL prevented participation in the markets. Meeting a load allocation represents a relatively high level of environmental performance, and leaves little performance left to trade. Earlier this year, EPA began revisited this policy and (1) released a memorandum that established six principles for encouraging market-based approaches: watershed-scale implementation, adaptive management, banking credits for future use, flexibility in baselines, credit stacking, and financing for nonpoint practices[8]; and (2) requested public comment on policy approaches to implement components of a new, more flexible strategy. After 16 years, EPA recognized that

[6] Biodiversity credits and habitat conservation credits and other ecosystem service attributes will be added to the ESMC asset generation protocols in future.

[7] https://www.regulations.gov/document?D=EPA-HQ-OW-2019-0415-0001

[8] https://www.epa.gov/sites/production/files/2019-02/documents/trading-policy-memo-2019.pdf

nonpoint pollution reduction strategies, research on BMP performance, monitoring technologies, and mapping and modeling capabilities have all made significant strides that would allow for a more modern, flexible, and hands-off approach to water quality trading[9]. EPA's recent moves to promote water quality trading should be met by similar policies from USDA, DOI, and all other federal agencies interfacing with private landowners.

A market that incentivizes systems approaches to agricultural sustainability is well positioned to help offset the impacts of other industries, too. Agricultural production is unique in its diversity; 2 million farms operate at different sizes and scales in different regions facing different resource pressures[10]. Each has the ability and flexibility to address resource needs beyond the farm gate in its area and should be allowed and encouraged to do so. Regulatory agencies must recognize that agricultural producers can provide relatively cost-effective carbon sequestration, water quality improvements, and water use efficiency gains to regulated entities such as utilities and point source polluters. Their ability to do so will drive demand and spur market participation among farmers and ranchers. To date, government agencies have tended toward regulation as a way to spur environmental action. While compliance requirements have served as regulatory drivers for market participation in some areas, they have also made voluntary credit generation cumbersome. Past markets and current scientific research needs point to government's proper role as an enabler of markets. Federal agencies can advance our understanding of ecosystem dynamics and spur technological innovations and conservation standards that would make free market-based approaches more transparent and reliable. Federal government support as described can help facilitate markets and can obviate the need for expanded regulatory approaches.

[9] https://www.regulations.gov/document?D=EPA-HQ-OW-2019-0415-0001

[10] https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_1_US/usv1.pdf

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