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Baselines in Environmental Markets: Tradeoffs Between Cost and Additionality

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Over the past few decades, conservation programs have provided incentives to farmers to make production decisions that place a priority on environmental improvements in addition to production of commodities (Claassen et al., 2007). More recently, markets have been developed or proposed that allow farmers to sell "credits" for environmental improvements in water quality, carbon sequestration, wetlands restoration, and other areas. These markets use an environmental baseline to help determine whether the proposed improvements qualify for market credits, and, if so, the number that should be awarded.

Selection of a baseline emissions level is often a critical and contentious element of program design for carbon or water-quality credit markets. Baselines help ensure that credits generated for sale through markets are "additional" (i.e., the environmental improvements qualifying for offset credits would not have taken place in the absence of the market or program incentive). Additionality is frequently cited as a requirement in defining the integrity of environmental improvement credits (Three-Regions Offsets Working Group, 2010). Giving credits or payments for changes that have already been implemented, or are likely to be implemented soon even in the absence of the program, can undermine the environmental gains expected from the program.

Due to the complexity and costs associated with defining, measuring, and verifying environmental baseline levels across heterogeneous landscapes, program managers may face a tradeoff between the precision with which changes in environmental performance can be estimated and the cost of refining those estimates. Balancing these two considerations is often the motivation behind selection of a particular baseline in environmental market design. Other market design considerations include those related to program eligibility restrictions, scope of measurement (i.e., accounting for leakage), offset permanence, and measurement uncertainty.[1] This brief focuses exclusively on baselines to clarify their role in the larger context of offset market design.

[1]See Murray et al. (2007) for an explanation of some of these other design issues.

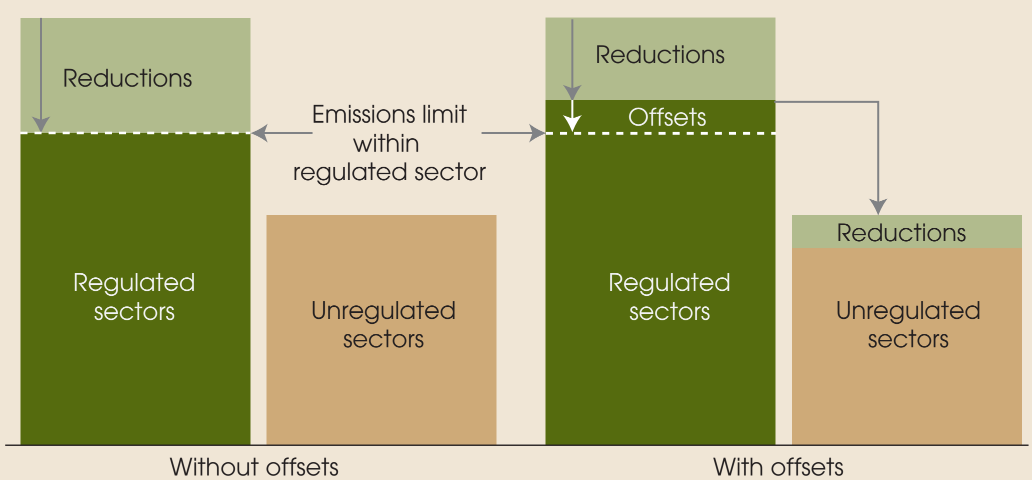
Baselines help achieve environmental objectives

The importance, and complexity, of ensuring the integrity of environmental credits is particularly relevant in the context of offset market development, where credits for environmental reductions in an unregulated sector (offsets) can be used to substitute for required reductions in a regulated sector (see box, "Offsets as a Regulatory Compliance Option"). To achieve the environmental objectives of the regulated sector, the offset credits from the unregulated sector must be equivalent in long-term environmental impact to the required reduction that would have had to occur in the regulated sector. If a full offset credit is awarded to an activity that would have occurred anyway (a "nonadditional" offset credit), and that credit can be used to substitute for a full ton of emissions reduction in a regulated sector, the total emissions reduction achieved when offset markets are permitted may be lower than that achieved without offsets, and the environmental objective associated with the regulation may not be met.

Offsets as a Regulatory Compliance Option

Debate surrounding market solutions to the Nation's environmental problems (e.g., water quality, climate change, and wetland protection) has included discussions on whether to allow sectors that are not regulated under emissions legislation to voluntarily supply emissions reductions that can substitute for required reductions in regulated sectors. Such reductions—called "offsets"—represent a compliance alternative for regulated parties; rather than reduce their own emissions, regulated entities can purchase reductions within unregulated sectors to offset those emissions. Most offset markets are driven by regulations that generate demand for low-cost pollution reduction. When offset transfers are not permitted, the required reduction is achieved entirely within the regulated sector. When offsets are available as a regulatory compliance option, the required reduction is shared across regulated and unregulated sectors (see figure). Regulated sectors will only choose to purchase offsets within the unregulated sectors if such offsets are cheaper than reducing emissions directly. If low-cost emissions reduction potential exists within unregulated sectors, alternative compliance options like offsets create the potential to lower the aggregate cost of compliance with the regulation. Offset payments from the regulated to the unregulated sector provide an incentive for those reductions to occur. If offsets represent an amount of emissions reduction equivalent to that which would have occurred in the regulated sector, the transaction should result in the same aggregate reduction in emissions.

Distribution of emissions reductions under offset programs



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Determining additionality, however, can be costly. Strict adherence to the additionality criteria requires program managers to award payments or offset credits only to those improvements in emissions levels that go beyond what constitutes current or projected "business-as-usual" (BAU) reductions over time. Ideally, one could project with certainty each individual farmer's production and management decisions into the future (in the absence of an offset market) and the implications of those decisions for farm-level emissions. Payments or credits could then be awarded only to those projects that would not have happened without the market incentive. But estimates of current emissions or forward-looking BAU emissions tend to be imprecise. They can also be expensive to develop, as information is needed on characteristics of each farm participating in the program, including soil, weather, historical farming practices, existing capital stock, availability of funding for supplemental conservation activities, and operator stewardship values, priorities, financial condition, and expertise.

The costs associated with implementing such a baseline—including estimating, measuring, and monitoring practices and emissions—can substantially raise the costs associated with establishing and operating an offset program. Selection of the baseline from which additionality will be determined has implications for the implementation costs associated with a market, the cost to farmers of generating credits (and the price at which those credits are sold), the number and types of farmers who may benefit from trading, and, ultimately, the number of credits that are traded and the size of the market that is created. A tradeoff therefore exists between the implementation costs associated with program elements designed to verify additionality—which if overly burdensome can result in failure of the market and loss of the opportunity to lower compliance costs through offset trading—and the environmental toll of not verifying additionality and potentially expending conservation resources on emissions reductions that would have occurred anyway or that have already occurred.

Baselines help balance cost and environmental uncertainty

One approach to balancing the tradeoff between cost and the uncertainty of the environmental impact is to select a baseline emissions level that is less costly than others to estimate and verify but may also be less precise in validating additionality. For example, in lieu of actual calculations or BAU projections, market design rules often define a baseline emissions level or practice that acts as a proxy for actual or expected emissions but is less costly to estimate or observe. Therefore, depending on the baseline definition chosen, the baseline emissions level may or may not represent environmental performance on a particular field prior to a farmer's application for market credits.

Potential baseline emissions levels can be distinguished according to a number of different characteristics:

- Whether the levels are defined by a baseline technology/practice
- Whether the levels are defined by conditions in a baseline year
- Whether the levels are constant (static) or projected out over time (dynamic)
- Whether the levels are calculated at the farm level or at a larger sector level

The baseline standard can be defined either by the emissions associated with a particular practice or by the emissions associated with a particular year. In the case of a baseline practice, any emissions reductions beyond the estimated reductions associated with adoption of a particular technology or practice are considered creditable. In the case of a "baseline year," any emissions reductions that improve performance beyond the estimated emissions associated with a given year are considered creditable (see box, "Baselines and Additionality in Existing and Proposed Environmental Offset Markets"). If a program is established in 2012, for example, its design may be such that 2010 is the baseline year and credits will be awarded to any projects that generate reductions relative to performance in 2010. Similarly, a program established in 2012 with a "current condition" baseline would specify 2012 as the baseline year.

A dynamic performance baseline reflects baseline emissions projected over time based on assumptions related to changes in farm practices and environmental performance. Projections can be based on such factors as historical extrapolations, estimates of technology development and adoption rates over time, and changes in cost effectiveness. Much like the concept of a projected BAU emissions path, dynamic baselines recognize that, even without a market in place, available technologies and performance will continue

Baselines and Additionality in Existing and Proposed Environmental Offset Markets

Selman et al. (2009) identified 51 water quality trading programs that are active or under development in the United States. While no uniform rules exist for establishing a baseline in water quality trading markets, the U.S. Environmental Protection Agency's (EPA) Water Quality Trading Policy provides guidance on appropriate baselines: "For example, where a Total Maximum Daily Load has been approved or established by EPA, the applicable… nonpoint source load allocation would establish the baselines for generating credits. For trades that occur where water quality fully supports designated uses, or in impaired waters prior to a TMDL being established, the baseline for … nonpoint sources should be the level of pollutant load associated with existing land uses and management practices that comply with applicable state, local or tribal regulations." Ghosh et al. (2009) report that most existing point-nonpoint water quality trading programs use a static date-based baseline definition, while a handful, including programs in Lower Boise, ID, Kalamazoo, MI, and Conestoga, PA, specify a minimum practice baseline to define a baseline emissions level.

Within the United States, three major regional carbon trading programs exist or have been proposed: the Regional Greenhouse Gas Initiative (RGGI), the Western Climate Initiative (WCI) and the Midwestern Greenhouse Gas Reduction Accord. The WCI and the Midwestern Accord are still considering recommendations on how offsets might fit into their trading program, including what types of agricultural projects will be eligible, if any, and what baselines would be used. The Midwestern Accord Advisory Group recommends that to ensure additionality of offsets, "the baseline should use standardized criteria (including but not limited to performance standards, financial feasibility criteria, market penetration, and project start date) that serve to exclude 'business as usual' projects from eligibility" (www.co2offsetresearch.org/policy/MGGRA.html, accessed October 31, 2011).

RGGI, the most mature of the trading programs, only allows a single type of agricultural project to generate offset credits—avoidance of methane emissions through installation of anaerobic digesters for agricultural manure management. The baseline emissions levels are determined by estimating site-specific uncontrolled manure storage conditions. To ensure additionality, "offset projects must provide reasonable assurance that they are achieving emissions reductions that would not otherwise have occurred in the absence of the offset provisions of RGGI" (RGGI, 2007). Manure management projects are exempted from those additionality requirements if the project is located in a State with less than 5 percent market penetration of digesters or is designed to handle the average annual manure of 4,000 or fewer dairy cows, though these RGGI exemptions are subject to State modification.

to evolve so that ensuring "additional" improvements would therefore entail measuring improvements relative to a changing baseline emissions level.

Baseline emissions levels can also be defined either at the sector level or at the farm level. Sector-level baselines compare a participant's performance against that of the sector, on average, to determine if further reductions should qualify for market credits. The implications of baselines defined by sectoral behavior differ among farmers considered as "good stewards" and those considered as "underperformers" (distinguished by performance levels that have either exceeded or not yet reached the sectoral average). Farm-level baselines, in contrast, compare a participant's performance against a baseline level or practice that has been determined based on characteristics of that farm (i.e., historical, current, or projected patterns of production for that farm or field). While sector averages are easier to estimate and verify than farm-level performance (either historical or projected), they are less likely to accurately capture the actual emissions improvement value of a given project than are baselines calculated based on farm-level analysis.

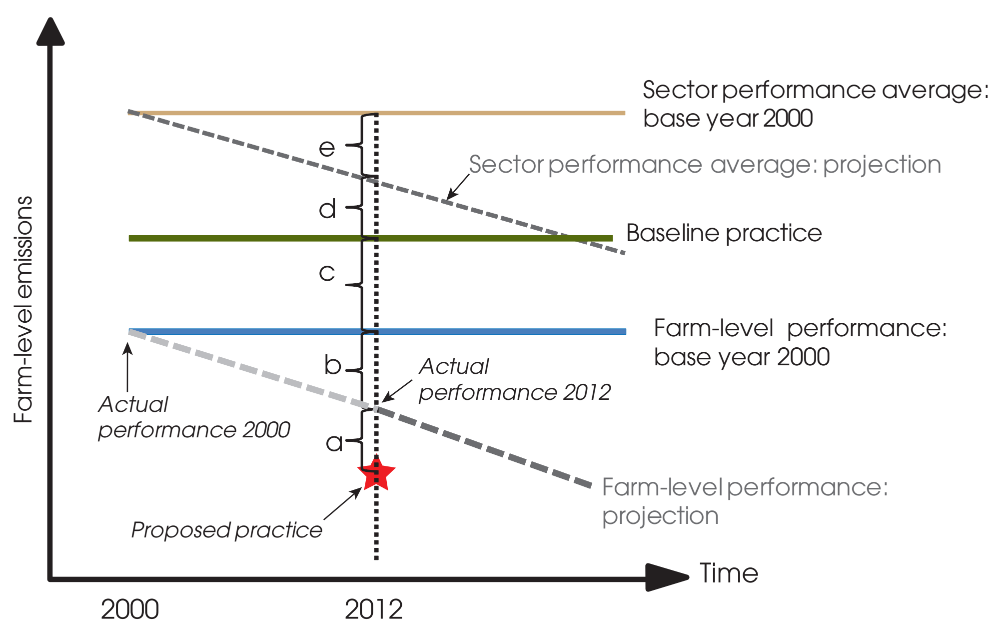
Different baselines credit different actions and actors

Different definitions of baseline are associated with different baseline emissions levels, so the number of market credits awarded to a given project is highly sensitive to how the baseline is defined (see fig. 1). The farm used as an example in the figure is an early adopter of good practices and has a current emissions level that is much lower than that of the sectoral average or of an emissions level associated with a baseline practice or technology. Note that while figures 1 and 2 illustrate a case where baseline performance levels (in the absence of a trading program) improve over time, it is also possible that agricultural systems in the absence of a program would intensify in response to changing market or technological conditions, leading to baseline performance levels that decline over time.

Depending on how baseline emissions levels are defined, the farm could be awarded credits ranging from (a) to (a+b+c+d+e) for moving from its actual 2012 performance level to the proposed level illustrated by the red star. In this scenario, use of a sector-level baseline overestimates the benefits associated with the proposed project and qualifies more reductions for offset credits or payments than satisfy the additionality criterion. When participating in a program that defines baseline emissions according to sector-level performance in 2000, the farm could receive (a+b+c+d+e) credits for implementing the proposed practice. However, assuming that the farm-level projection accurately captures the farm's likely BAU decisions, only the (a) credits are truly additional; all other emissions reductions would occur anyway (in fact, already have occurred), even in the absence of offset market incentives.

Figure 1

Environmental credits awarded under different baseline scenarios; case of a good steward who is an early adopter of best practices



Baseline emissions level selected	Amount of carbon credits awarded
Farm-level performance: base year 2000	a + b
Farm-level performance: projection	a
Baseline practice	a + b + c
Sector performance average: projection	a + b + c + d
Sector performance average: base year 2000	a + b + c + d + e

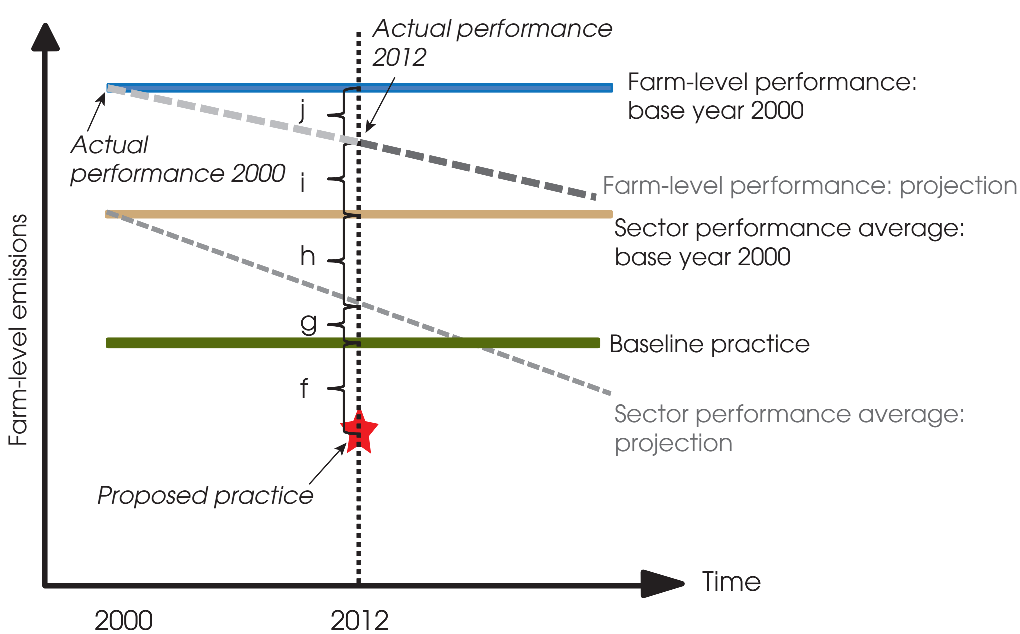
Source: USDA, Economic Research Service.

The opposite would hold if the applicant farm were an underperformer proposing a project to qualify for market credits. If the farm's emissions exceeded the sectoral average, use of a sectoral-average baseline emissions level would underestimate the potential environmental benefits of the project and award fewer credits for the project than are actually additional (see fig. 2). In the scenario illustrated in the figure, if the underperforming farmer applied for credits, a market using the sector's average performance in 2000 as a baseline would authorize credits for (f+g+h) improvements. It would not consider the emissions improvements designated by (i) to be creditable, even though those improvements are also "additional" according to the BAU criterion. Furthermore, if the market defined its baseline emissions level as that corresponding to the baseline practice shown, it would offer the underperforming farmer only (f) credits in exchange for (f+g+h+i) improvements.

If equal numbers of good stewards and underperforming farmers participate in the market, the environmental integrity of the market could hold, on average. However, use of a sectoral-average baseline lowers the costs of supplying offsets for good stewards by awarding offset credits for practices that are already in place, or would have been adopted anyway. This gives good stewards a competitive advantage and makes it more difficult for farmers with less-than-average performance to participate in the market. While this result can be perceived as a way to reward farms for having adopted environmentally responsible practices in the past, its primary rational is that it creates an incentive for early adopters to maintain

Figure 2

Environmental credits awarded under different baseline scenarios; case of an underperforming farm



Baseline emissions level selected	Amount of carbon credits awarded
Farm-level performance: base year 2000	f + g + h + i + j
Farm-level performance: projection	f + g + h + i
Baseline practice	f
Sector performance average: projection	f + g
Sector performance average: base year 2000	f + g + h

Source: USDA, Economic Research Service.

those practices. By definition, however, offsets awarded to early adopters for actions already taken will be nonadditional;[2] if awarded in large enough numbers, such offsets can compromise the integrity of the overall emissions reduction objective.

Dynamic baselines that acknowledge that farm practices and behavior change over time and that attempt to project the effects of such changes are the most consistent among the baseline types with the additionality "ideal" of awarding credits over time based on the degree to which performance with the program would differ from actual emissions in each time period without the program. BAU projections are inherently imprecise, however. If a projected baseline emissions path underestimates the actual BAU performance improvement rate at the farm or sector level, the program will recognize some emissions reductions as additional that should actually be considered BAU and overaward credits or payments to the farm. If, on the other hand, a projected baseline emissions path is overambitious in predicting adoption of new technology and improvements in performance, the program will be too stringent in its allocation of offset credits. Baseline emissions levels calculated from an overestimated adoption rate rather than a path of actual BAU behavior can increase the cost of the environmental improvements achieved through the offset market by eliminating a subset of potential environmental improvements from qualification for credits.

Baselines fit into a broader policy context

Policymakers selecting baselines for environmental markets face a range of issues related to environmental integrity, costs, technical capacity, resource stewardship, and producer responsibility. In policy discussions that address offset markets, the emphasis placed on additionality has focused attention on the baseline as the program design element that is most relied upon to validate additionality when determining whether environmental improvements should qualify for payments or credits. As stated earlier, the costs of estimating a baseline that closely approximates a BAU projection, and therefore, if accurate, comes closest to representing a true additionality criterion, may be high. Policymakers may therefore consider selecting a market baseline that is less costly to estimate and verify but may also be less precise in validating the additionality of reductions.

To improve the likelihood that qualifying reductions are in fact additional, or to compensate for the environmental compromises implied by awarding credits to nonadditional activities, stakeholders have proposed a variety of complementary market design elements. Such elements include farm eligibility restrictions, reductions in credits awarded to eligible practices ("safety margin" or buffer requirements), and, in the case of offset markets, adjusted trading ratios between offsets and regulated sector reductions or adjustments to the regulatory cap itself. These mechanisms reduce the likelihood that nonadditional credits compromise the environmental integrity of the trading program, but they may also reduce the potential compliance cost savings associated with establishing the market as an alternative for regulatory compliance.

Improved data and monitoring and measurement capacity will lower costs and enable more precise and cost-effective approximations of baseline and proposed environmental performance across multiple environmental dimensions. Such improvements will be critical to long-term efforts to establish robust technical baselines and quantification methodologies that support development of environmental markets.

[2]West Virginia's proposed guidance for a statewide water quality trading program reads, for instance: "Nonpoint sources entering the trading program who have implemented management practices that exceed the baseline are eligible to receive credits for their prior commitment to land stewardship" (West Virginia Department of Environmental Protection, 2009). Maryland's nutrient trading website states that once baseline requirements have been met, "[t]radable credits can be generated from any existing or planned agronomic, structural, or land conversion practice which you can show has or will result in additional reductions" (www.mdnutrienttrading.com/farmers/q2.php, accessed December 13, 2010).

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