A Review of Recent PES Model Design Implementation in the United States

PES Program Implementation

US Pilot and Model Programs

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Payment for Environmental/Ecosystem services (PES) programs have been an active part of the landscape of environmental corrective policy since the 1930's in the United States. At that time an extended historically significant drought and poor agricultural soil management practices combined to strip the land of topsoil leading to desertification of the Midwest. This man-made environmental phenomenon led to massive dust storms which killed livestock, sickened the human population, and drove millions from their homes and livelihood. It is estimated that the winds blew away an average of 480 tons of topsoil per acre over an area of 10 million acres losing an average of 5 inches per acre.[1]

The Federal Government of the United States introduced programs involving education and payments to landowners under the Department of Agriculture to change agricultural practices, and take some marginal land out of agricultural production. Daniel Benjamin argues that sustainable agricultural and PES practices in the 1930's had a desired impact in the US; "Substantial payments from the Agricultural Adjustment Administration (AAA) went to farmers who engaged in approved erosion control practices. Taken together, these programs alleviated erosion during the late 1930s,"[2] As substantiation for this argument Benjamin addresses similar droughts of the 1950's and 1970's which failed to have the environmental impact of the past due to programs implemented and continued beyond the 1930's particularly in the development of soil conservation districts with the force of law requiring agriculture to comply with best practices in soil management. As a matter of evidence it is somewhat supportive of the effectiveness of the soil conservation practices initiated by the 1930's PES programs, but does not have the strict controls to test the theory. The erosion did stop; the dust storms abated. They did not reappear in later drought years. The urgency of the emergency at the time precluded the establishment of controls to test the theory in the 1930's. Further arguments suggest that farm size also contributed to more intensive agriculture practices (small farms, more intensity) which led to greater environment degradation during the dust bowl era. As farm size grew in later years, and a more corporate and co-op style of agricultural management became the norm, agriculture intensity was reduced causing factors

[1] Daniel K. Benjamin, "Dust Bowl Reconsidered", Property and Environment Research Center, Volume 22, Number 4, Winter 2004, http://perc.org/articles/dust-bowl-reconsidered, (Accessed 11/28/2012).
[2] Ibid.

contributing to the dust bowl to decline.[3]

The concept of PES programs has evolved over time to encompass a variety of societal needs as recognition of ecosystem degradation has ramifications not only where degradation occurs, but extends beyond political borders with potential worldwide ramifications to the human population. "Hundreds of PES schemes are now being implemented around the world covering four main ecosystem services: water provisioning, carbon sequestration, landscape amenity, and biodiversity conservation."[4] Do the current implementations of the various PES programs offer sustainable cost effective societal benefits? What are some of the critical components to a PES program that secure a successful program? This paper will examine some current and ongoing PES programs in the US to examine these issues.

"PES schemes are designed to stimulate transactions in which a well-defined environmental service is bought by at least one user from at least one provider. The payments involve a positive incentive to the provider, and are conditional on performance."[5] Generally, PES programs are directed at land owners who are engaged in some form of agriculture. The objective is to reserve some part of the land to meet one of the above four main ecosystem services. From the perspective of most land owners involved in agriculture, the PES program must offset the lost opportunity in food and income generation when converting land to ecosystem services. Some PES programs are direct funded by ecosystem service users such as water service providers, and power generating facilities that need clean water for power generation and drinking water. Third party funding by governments and conservation groups acting as agents for society at large are the other primary sources of funding.

PES program design is critical to the successful implementation of the program, providing both benefits to the provider (seller) and agency (purchaser). Shabman and Lynch, writing of a Northern Everglades water retention PES pilot program list 5 program essentials which include; defining the

[3] Hansen, Zeynep K., and Gary D. Libecap, "Small Farms, Externalities, and the Dust Bowl of the 1930s", Journal of Political Economy 112(3), (2004), p 665-94.

[4] Rodrigo Arriagada and Charles Perrings, "Making Payments for Ecosystems Services Work", United Nations Environment Programme in collaboration with ecoSERVICES Group, Arizona State University, Publishing Services Section, Nairobi, ISO 14001:2004 manufacturer

[5] Rodrigo Arriagada and Charles Perrings, "Making Payments for Ecosystems Services Work", United Nations Environment Programme in collaboration with ecoSERVICES Group, Arizona State University, Publishing Services Section, Nairobi, ISO 14001:2004 manufacturer

buyer, contract design, price making, regulatory compliance, and contract verification as the primary components for program design. These 5 essentials were developed from real time experience developing a 5 year PES pilot program on an experimental basis to determine the feasibility for a future scale up in 2012. For investment planning a provider needs a guaranteed minimum annual payment over the contract lifetime regardless of externals not under the control of the provider or agency (rainfall as the uncontrolled external in this PES). For budget planning, an agency needs to accurately predict future budget outlays and be able to commit funds to future payments. It is necessary to assure payment certainty while still making payment contingent on actual service provision(s) discounting externals not under agency or provider control.[6]

Development and agricultural practices have impacted the Everglades environment by rushing storm water to and through the everglades wetlands with long term severe impact to the environment of the region. The service provided by the ranchers under the Northern Everglades PES pilot program involved holding water back for a period of time in wetlands, ditches, and soil profiles, with release of the water in different volume, phase and pathway than would be the case without the service. Measurement would involve the number of acre feet that did not flow in the drainage network of the site in a water year with the water management program, as compared with the water that would have flowed without the water management program.[7] Eight large landholding ranches were selected from 14 applicants and data collected pre-program to establish base-line numbers for water flow above and beyond existing regulatory requirements. Payment would be based upon verified water retention services on a fixed term with water retained not to exceed a pre-determined amount and not to be less than pre-contract stage.

Ranchers participating in the program view the program as another profit center to add to their

[6] Leonard A. Shabman and Sarah Lynch, "The Florida Ranchlands Environmental Services Project: Field Testing a Pay-for-Environmental Services Program", *Resources*, Spring 2007 (165), http://www.rff.org/Publications/Pages/PublicationDetails.aspx?PublicationID=11407, (Accessed 11/30/2012)

[7] Leonard A. Shabman and Sarah Lynch, "Verifying Contract Compliance in the Northern Everglades Payment for Environmental Services Program," http://www.farmfoundation.org/news/articlefiles/1751-Shabman%20Lynch%20Verfing%20PES.pdf, 4/24/2012, (Accessed 11/30/2012)

agriculture mix. Data available from one ranch dedicating 3,700 acres of land (out of 10, 000), to the project received 5% of its overall revenue of 1.87 million dollars from the program or approx. $93 thousand dollars. Since the on ranch water management requires a relatively low investment in new infrastructure, the initial capital outlay can be low, making the investment return attractive. The payment covers operating cost, and reduced revenue from reduced cattle production during wet years due to high water. The water retention on the ranch helps to reduce phosphorus loads downstream and retains as much as 0.6 acre feet (195,512 gallons) of water per acre during the wet season as opposed to unrestricted water flow pre-program. Longer wet periods help maintain habitat for plants and animals, normalize water flow and reduce phosphorus runoff through the everglades.[8]

The data collected and success achieved under this pilot PES program has led the agencies involved to ramp up the design for the next stage of implementation with 2 acre feet of water retention per acre targeted with 150,000 acres under contract. This will require 500 contracts in place with an average of 3,000 acres per parcel. The challenge of ramping up to this scale will involve assuring compliance with the number of contracts, including rapid enforcement for non-compliance, and the cost associated with data capture, quality assurance, quality control and enforcement. Most data is captured electronically with instrumentation using solar panels for power, similar in scope to the stream hydrology equipment that has been in use by NOAA for decades. The technology is readily available and not overly costly. The scale up and logistics involved working with up to 500 landholders overseeing 150,000 acres will be the real challenge. The greater acre foot holdback proposed will also impact landscape design and challenge other agricultural use during wet periods above and beyond the impact experienced using the 0.6 acre foot requirement under the pilot program. A reverse auction bid system will be used to select participants (sellers), with the PES program managers selecting the most cost effective environmental service providers. The contract commitment will be for ten years. This program is moving forward as a result of demonstrated success in achieving pre-established goals and demonstrating that it can become a

[8] Environmental Markets; Farm of the Future, United States Department of Agriculture; Office of the Chief Economist, http://www.usda.gov/oce/environmental_markets/files/Buck_Island_Ranch_Brief.pdf, 4/29/2011, (Accessed 11/30/2012).

part of revenue generation in the agricultural mix for the participants while providing environmental benefits. Evidence for the pilot program suggests achievement of PES objectives without a shift of environmental degradation to other regions. Key to future success is the ability to scale up both PES objectives and the number of service providers without a shift of environmental degradation to other sections within the producer's pervue or other regions.

The Office of the Chief Economist of the USDA highlights a number of initiatives as part of successful design and implementation of PES programs. Public programs jumpstart innovation as many market based conservation initiatives depend on dedicated "seed funding" from state, local, and Federal partners to help cover program development and landscape modification costs. Creative financing is often needed to cover upfront costs and participants should seek out creative financing mechanisms, such as low-interest loans and capitalization of future payments. Securing demand is critical as landowners must identify clear, reliable sources of demand in order to generate additional ecosystem services on their land. In many cases regulation from the Clean Water Act, Safe Drinking Water Act, and Endangered Species Act drives demand in the U.S. Teamwork and aggregation are essential in developing an effective PES program. Farming, ecological, legal, and financial expertise, as well as buy in from landowners, environmentalists, investors, regulators, and other government agencies must be part of the program. Landowner cooperatives can help bring the delivery of ecosystem services to scale. Since ecosystem services function at a landscape scale, it makes sense to aggregate best management practices through group participation.[9] Individual case studies also illustrate that benefits to the land owner are also derived from diversification of risk by participation in payments for ecosystem services.

As an example of diversification of risk, the Sacramento River Ranch, a 3,960 acre farm along the Sacramento River in Northern California chose to combine traditional agriculture with payments for ecosystem services to establish a profitable model for sustainable agriculture. The ranch diversified its crop mix in its most productive acreage, and converted the more marginable areas to wetland and

[9] Environmental Markets; Farm of the Future, United States Department of Agriculture; Office of the Chief Economist, http://www.usda.gov/oce/environmental_markets/farm.htm, 4/28/2011, (Accessed 11/30/2012)

wildlife habitats. The adjacent Sacramento metropolitan area provided demand for mitigation credits as required by Federal and state legislation.[10] Sacramento River Farms has sold Valley Elderberry Longhorn Beetle (an endangered species) credits ($85,000 acre) to public and private developers, Salmonid habitat credits ($100,000 per credit) to private developers and the Corp of Engineers, and Swanson's Hawk habitat credits ($7,500 per acre) to developers for habitat destruction mitigation. They are also creating a wetland bank which is anticipated to sell credits at $100,000 per acre. These credits made up 53% of Sacramento River Farms gross revenue in 2008 – 2009. The mitigation credits are released over a 5 year period which provides cash flow over time to smooth out poor agricultural production years. In 2010, hay prices collapsed in the local market so cash flow from the mitigation credit purchases offset the potential losses resulting from poor agricultural prices for hay.[11]

In this PES, Federal and State environmental regulation drives the (primarily) private market to seek solutions to meet Federal guidelines. The consumer and developer share cost associated with the mitigation credits so the benefactors of development are supporting the PES solution. The success of this PES program is driven by active development locally and the need for offsetting environmental credits to meet Federal and State law for habitat destruction and clean water regulations. The land converted to environmental use acquires a permanent easement so a well-developed market knowledge and strategy must be employed to ensure success. There must be sufficient demand within the local market to drive this model for a PES solution. The PES provider under this model must have access to substantial start up resources (loan, investors, etc.) to initiate development of the PES solutions. They must develop first and then market credits. It requires a team of experts; lawyers, biologist, engineers, finance, to create a workable plan for both financial and regulatory approval. Substantial effort is required for regulatory approval under this system. Streamlining the approval process would enhance this category of PES solutions. This PES produces benefits beyond the status quo with results exceeding what would be expected without the PES in place. It does, however, provide a mechanism for environmental

[10] United States Department of Agriculture; Office of the Chief Economist, "Sacramento River Ranch," http://www.usda.gov/oce/environmental_markets/files/Sacramento_River_Ranch_Brief.pdf, 4/29/2011, Accessed (11/30/2012).
[11] Ibid.

degradation in other areas by shifting degradation which may have occurred anyway through variance to the credit system.

Somewhat similar in model design to the Sacramento River Ranch PES project, the Big River and Salmon Creek Forests in Northern California purchased by The Conservation Fund created a demonstration project for a sustainable forest model by creating a financially viable, working forest. The area was subject to growing residential and vineyard agricultural pressure. The collapse of timber prices has added economic pressure to maintaining the forest in light of more profitable short term uses. The loss to society includes stream degradation, habitat loss for species some of which are endangered, and loss of a viable commodity. "The potential loss of the wood products industry accentuates several major challenges. One challenge is retaining private forests in forest cover. Private forests provide significant public benefits in the form of various goods and services, including watershed protection, wildlife habitat and open space... Thus it is in society's interest to retain the majority of these lands in forest cover... But with a decline of major markets for wood products, what incentives will these private owners have to retain or manage their lands as forest? Where timberlands are located in expanding metropolitan regions or in remote locations suitable for second homes, subdivision is a profitable possibility."[12]

With a combined 16,020 acres of Redwoods and Douglas firs, this land encompasses the rare ecosystem of a temperate rainforest, and bridges two other large state protected holdings, a state park and state forest. This forest and the surrounding area produce almost half of the states timber, and 16 percent of the local jobs.[13] The model employed in this project reduces timber harvest below historical

[12] Susanna Laaksonen-Craig, and George E. Goldman and William McKillop, "Forestry, Forest Industry, and Forest Products Consumption in California", University of California, Division of Agriculture and Natural Resources, http:// http://anrcatalog.ucdavis.edu/pdf/8070.pdf, 2003, (Accessed 12/1/2012).

levels and lengthens restoration periods for harvested areas while still contributing significantly to the local economy. This sustainable harvest plan maintains timberland which generates carbon credits which are then sold to companies such as UPS, the Disney Company, and the Pacific Gas and Electric Company. The forest still contributes nearly 3 million board feet of high quality Redwood and Douglas fir saw timber per year. In the four years from 2007-2010 it averaged 1.5 million dollars in revenue from timber production which is 53% of the total revenue generated by the property. Carbon offset credits contribute another 36% of revenues. Charitable contributions and restoration grants result in the other 11% of revenue. The Conservation Fund has contracted 1,094,578 Climate Reserve Tonnes (CRT, a verified metric ton of sequestered carbon dioxide) with a value which exceeds seven million dollars.[14] The climate Reserve Tonnes are greenhouse gas sequestration above and beyond what would be projected to happen anyway without the efforts of the ecosystem service provider. Sequestration calculations are performed by an outside third party. Carbon sequestration credits diversify the revenue source for the forest and enabled the Conservation Fund to weather the dramatic decline in timber prices in 2009 and 2010.

The key elements required for this PES model implementation was a market for carbon credits, public policy in place with enforcement capabilities which requires private market carbon producers to offset excess production when expanding operations, and creative financing strategies to allow an entrepreneurial approach to sustainable forest management, and a large enough landscape to have an expectation of financial viability.[15] Financing for the project entailed the use of state grants and low interest loans using funds from "grey" infrastructure project financing sources (projects generally for municipal wastewater plants). This allowed The Conservation Fund to acquire below-market-loan

[13] Susanna Laaksonen-Craig, and George E. Goldman and William McKillop, "Forestry, Forest Industry, and Forest Products Consumption in California", University of California, Division of Agriculture and Natural Resources, http:// http://anrcatalog.ucdavis.edu/pdf/8070.pdf, 5/5/2006, p. 10, (Accessed 12/1/2012).

[14] United States Department of Agriculture; Office of the Chief Economist, "Big River and Salmon Creek Forest," http://www.usda.gov/oce/environmental_markets/files/Big_River_Brief.pdf, 4/29/2011, (Accessed 12/2/2012).

[15] North Coast Forest Conservation Program and The Conservation Fund, Ariela Summit, ed., Louise E. Buck, ed., Sara J. Scherr, ed., "Financing Biodiversity, Water Quality, and Climate Change Mitigation in the Big River and Salmon Creek Forest of California," EcoAgriculture Partners, 730 11th St. NW #301, Washington, DC 2001, http://www.ecoagriculture.org/documents/files/doc_360.pdf, 5/2011, (accessed 11/30/2012).

guarantees from the State of California to finance a substantial portion of the land purchase and water restoration projects. The housing crisis resulted in a dramatic decline in the price of delivered logs in 2009 and 2010, but the sale of offsetting carbon credits allowed The Conservation Fund to continue to make loan payments and break even on the land purchase. It is important to note that the forest produced no timber between 2009 and 2010 due to the mortgage crisis and housing collapse. The average revenue figures cited include this lack of production and enhance the support generated by carbon offsets in the budget during this revenue data period. The forest sequesters carbon, continues to provide timber production, preserves jobs for the surrounding area, protects the water resources, and provides the habitat for 193 wildlife species. The forest is now permanently protected under a conservation easement from development, subdivision, overharvesting, and conversion to non-forest use.

This PES project appears to meet the key objectives established from the outset. In time the area was likely to be developed, resources depleted or removed for development. The forest is protected, appears to be financially viable, and provides a model for other large landowners seeking methods of retaining their resources to embrace. Concerns arise however, that the conservation efforts within the forest will simply shift resource production outside of the area to other states or Canada. Historically, California imports much more in timber products than it produces. In addition, companies which purchase carbon offsets are simply shifting their carbon footprint with purchased offsets without a mechanism to actually reduce their carbon production. The model works from local/regional resource protection, but may shift some of the burden of resource depletion and environmental degradation elsewhere.

The Southern Minnesota Beet Sugar Cooperative (SMBSC) lies within one of the largest beet sugar production regions in the nation, and is the largest sugar beet processing facility in the world. The processing facility has grown to become the largest through a combination of PES initiatives and an indirect benefit associated with putting the PES into effect. Southern Minnesota agriculture centers around sugar beets, however, this area of Minnesota also was home to many wetlands. Farming practices involved draining the land and placing infrastructure in place to move water off of the land as

quickly as possible into watersheds of the Minnesota River which fed eventually into the Gulf of Mexico. Point source discharge of phosphorus and runoff from agricultural practices has led to severe degradation of the local watershed with consequences tracked as far as the Gulf of Mexico. Phosphorus leads to algae blooms which depletes dissolved oxygen in the waterways resulting in aquatic death and "dead zones" where aquatic life is severely limited or non-existent. Year to year averages have demonstrated the expansion of "dead zones" in the Gulf of Mexico over decades. The Clean Water Act of 1972 provided a legislative framework within which the SMBSC had to negotiate practices which would allow for an expansion of processing capability (220 percent over existing capacity). The PES program established to meet Clean Water Act regulatory requirements worked by trading point source phosphorus production resulting from expansion of processing facilities and new waste water treatment plant expansion for a reduction in upland agricultural runoff of phosphorus laden water.

SMBSC has grown into a highly successful business model for farming. It is composed of 587 Sugar beet growers in 17 counties with approximately 120,000 acres of sugar beet production are stockholders of the cooperative. It employs nearly 350 full time employees and adds approximately 170 million dollars to the local economy.[16] The PES program had one of the first ingredients for pre-defined success; landscape scale. The second tenet for successful implementation was working within the regulatory framework which included The Minnesota Pollution Control Agency (MPCA), and The Federal Governments Clean Water Act of 1972 through the permitting mechanism of the National Pollution Discharge Elimination System (NPDES). Engineering and consulting assistance was provided to SMBSC through the Barr Engineering Company, and the Minnesota Center for Environmental Advocacy (MCEA). A prior point source/non-point source trading program had been established in 1997 in Minnesota involving the Rahr Malting Company. It was the first in Minnesota and one of the first in the country. This trading program served as the model for establishing the structure of an agreement with the regulatory bodies to allow expansion of the facilities for SMBSC. The requirements

[16] Adam Birr, Ariela Summit, ed., Louise E. Buck, ed., Sara J. Scherr, ed., "The Watson Partners and the Southern Minnesota Sugar Beet Cooperative," EcoAgriculture Partners, 730 11th St. NW #301, Washington, DC 2001, http://www.ecoagriculture.org/documents/files/doc_349.pdf, 5/2011, (accessed 11/30/2012).

under the NPDES permit for Rahr Malting Company would serve SMBSC as well. The trading program requirements under the Rahr Malting Company NPDES permit included equivalence, additionality, and accountability for discharge levels: "Equivalence refers to the physical substitution of nonpoint reductions traded for point source loads, taking into account all relevant factors. Additionality requires that nonpoint source load reductions that are credited to a point source in a trade would not have occurred otherwise, in the absence of trading. Accountability refers to the need to ensure that a trade satisfies the above criteria of equivalence and additionality, and that terms of the trade agreement are being lived up to." [17]

SMBSC Phosphorus trade reduction credits would take the form of implementing a cover crop over sugar beets, and stream bank restoration. Cover crop implementation provided a total of 86% of the credits generated in the program, and stream bank restoration provided 14%. Only 61% of the credits produced were needed to meet NPDES regulations for the point source wastewater treatment plant permit (requirements are 2.6 times the annual phosphorus discharge limit), leaving an additional 39% of the credits available. SMBSC pays producer farmers for all credits even though they are not required. There currently is demand but no established market mechanism for the sale of the additional credits. SMBSC receives inquiries for phosphorus discharge credits from Waste Water Treatment Plants (WWTP) throughout the state and has requested that the state implement a trading mechanism to establish a market for credits.

Farmers have benefitted from the direct payment from credits produced in a number of ways. The credits ($4.00 per acre) for program implementation do not cover the total cost for actual application of the Best Management Practices (BMP's). Cover crop cost is approximately $2.16 for each $1.00 received. However, in 2009, the average revenue per acre for the 355 participating growers increased by 2.23 percent over growers who did not implement the program. This came about by

[17] Jeff UDD PE, State of Minnesota, Minnesota Pollution Control Agency, Industrial Division, "Draft - National Pollution Discharge Elimination System (NPDES)/State Disposal System (SDS) Permit MN0031917," Attachment 2, Page 4, http://www.pca.mn.gov/index.php?option=com_k2&id=715_1248a1315a91e0ead67f851640883724&lang=us&task=download&view=item , (Accessed 12/1/2012).

reduced soil erosion and crop loss from wind and water sources during the initial phase of sugar beet plant establishment. The cover crop protects the soil from wind and water and enhances soil health by adding biomass, absorbing excess nutrients, and reducing compaction.[18] The watershed receives substantial reductions in phosphorus load relative to maintaining the status quo (NPDES requirements are 2.6 times the point source discharge rate, plus credits are overproduced in this market). Farmers have expanded production since processing capacity has increased while reducing their impact on their local, as well as distant, environment (rivers and Gulf of Mexico). Expanded capacity for processing has benefited the coop, and increased revenues. The high participation rate provides landscape scale, and SMBSC grower participation is expected to increase given the higher yields and peer pressure of participating growers. Curt Watson of Watson Partners adds: "As a grower in a cooperative, you have the benefit of ownership. If the coop is doing well you do well. In the same way, if the coop is struggling, it will reflect on your bottom line. As a grower, you want the coop to succeed. Therefore you work hard at growing the best crop you can. In addition, there is personal pride in being part of a larger group working together. As owners, it is 'our coop', not 'their coop'."[19]

The enforcement of the program parameters begins with signing contracts between growers and SMBSC each year (new contracts are written for each year. The number of participating growers changes year to year and has been increasing). Growers are required to plant a cover crop on the acres designated as sugar beet fields. SMBSC photographs before and after images of each sugar beet plot which are then reviewed and graded. SMBSC computes the number of credits achieved for the year. An independent third-party randomly selects 10 percent of the contracted fields for audit of compliance and credit calculations. A final audit report is prepared for SMBSC. All information collected, photographs, contracts, audits, and credits are sent to the MPCA for approval. Upon approval from the MPCA, payment for cover crops is calculated and checks written to contracted growers who appropriately

[18] Adam Birr, Ariela Summit, ed., Louise E. Buck, ed., Sara J. Scherr, ed., "The Watson Partners and the Southern Minnesota Sugar Beet Cooperative," EcoAgriculture Partners, 730 11th St. NW #301, Washington, DC 2001, http://www.ecoagriculture.org/documents/files/doc_349.pdf, 5/2011, (accessed 11/30/2012).
[19] Ibid.

implemented the BMP's.[20]

This PES program entails a number of success parameters suggested earlier in the paper. Landscape scale, demand from a buyer which is collectively owned by the sellers in this case, contract design, regulatory compliance oversight, and contract verification. This PES is self-funded by the increase in capacity for processing which it permitted. The growers benefitted from an increase in productivity brought on by greater processing capacity even though the actual payment from the PES does not cover all cost of implementing the BMP's. They have also experienced an increase in yield with greater sustainability by implementing the BMP's. The creation of a market for excess phosphorus discharge credits would likely reduce the difference in BMP implementation cost and discharge credit income. The local watershed and extended waterways have reduced phosphorus loads benefitting society as a whole. Reduced erosion is a side benefit for the growers. It does not appear to create a shift in resource depletion or environmental degradation to other regions. End results were unlikely to have occurred without the PES.

The examples provided herein suggest that PES program design must include provisions for large scale implementation for effectiveness. Large landholdings or cooperatives piecing together smaller parcels with common enforcement and motivations appear to lend themselves to a more viable implementation of a PES model. A buyer with the necessary motivations and resources must be available for the PES to succeed. Environmental regulation from a Federal and State level appear to be significant motivating factors in the U.S. A team of professionals working together to design program objectives, methods, contracts, and enforcement parameters are necessary for PES implementation. One recurring issue is the establishment of a market mechanism for payment from purchaser to a provider. Federal or state assistance in establishing a set of criteria, and potentially cross political border market trading mechanisms might facilitate PES implementation. The SMBSC program demonstrates the need

[20] Adam Birr, Ariela Summit, ed., Louise E. Buck, ed., Sara J. Scherr, ed., "The Watson Partners and the Southern Minnesota Sugar Beet Cooperative," EcoAgriculture Partners, 730 11th St. NW #301, Washington, DC 2001, http://www.ecoagriculture.org/documents/files/doc_349.pdf, 5/2011, (accessed 11/30/2012).

for regulatory recognition of market trades of excess credits. Providing such a mechanism might engender additional demand for creation of PES programs given the time, expense, and work involved in establishing a viable PES. Access to capital is critical in developing most PES programs since up-front cost can be substantial before revenue is generated from model implementation. Demonstrated risk deferment through alternative revenue sources can spur PES development. The examples denoted within these pages are PES programs established within a large industrialized, stable nation with substantial access to capital, an existing bureaucratic structure with environmental awareness, a generally well educated agrarian producer, and an established rule of law. These programs may not scale well to nations which have weak or non-existing institutional infrastructure and capital. Due to the landscape scale of the projects in a developed nation, random control criteria for establishing evidence of validity of concept is difficult to pursue. Some projects develop pilot programs to establish validity of concept and determine pitfalls and solutions before rolling out a full scale up. Many projects rely on BMP's established through research and practice on a small scale and extend them to PES programs of much larger scale with the expectation that the small scale success will follow through on a larger implementation. Success in the pilot program engenders faith in the concept that the PES programs will scale. Many of the projects addressed in this paper are in the transition from pilot to scale up. Some of PES programs addressed in these pages serve as models for adaptation. These projects appear to offer potential solutions, but may require "tinkering" of various aspects of the model to fit local conditions, and may fail to deliver expected results when adapted elsewhere. Unintended consequences are potential pitfalls when adapting pilot, or model programs to other environments. The dedication and creativity of the PES provider, PES purchaser, and regulatory bodies involved in the PES program will have a significant impact on the success of the programs adopted from the model or pilot PES programs. PES programs are not simple implementations, and require substantial time, dedication, and funding to establish.

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