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REGENERATIVE AGRICULTURE AND PAYMENT FOR ECOSYSTEM SERVICES

PRESENTED TO THE VERMONT HOUSE COMMITTEE ON AGRICULTURE AND FORESTRY

Rep. Carolyn Partridge, Chair and Rep. Rodney Graham, Vice Chair

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EXECUTIVE SUMMARY

Regenerative agriculture may provide numerous benefits to the state of Vermont, including increased food security and ecosystem conservation; however, this approach may be much more expensive to farmers than conventional practices. Payment for Ecosystem Services (PES), a process whereby farmers receive monetary or in-kind compensation for protecting various ecosystem assets, offers a potential solution to this dilemma. This report includes a summary of PES literature as well as a case study analysis of prior and existing PES programs in a variety of contexts. By breaking down the case studies into specific, relevant dimensions, we have established policy options for structuring a payment system that may appropriately and efficiently incentivize regenerative agriculture, should the Agriculture and Forestry Committee seek to promote regenerative agriculture. These policy options include balancing the involvement of market and government actors, avoiding strict and overly complicated contracts, and framing the program with market-specific language. Additionally, programs that target a specific ecosystem service and establish efficient measurement systems may be most effective. Finally, a successful PES system would seek to build coalitions of many actors, heavily involve the participation and voices of local communities, and establish a feedback system for involved landowners. We hope that these policy options will provide the Vermont House Committee on Agriculture and Forestry with greater context and information for seeking to design a Vermont-specific PES program.

1 INTRODUCTION: AGRICULTURE AND ECOSYSTEM SERVICES

Beyond food, we rely on agriculture for its far-reaching and long-lasting impacts on the environment, particularly in deterring soil erosion, flood mitigation, and atmospheric carbon dioxide. Fostering the adoption of sustainable agricultural practices is thus crucial for the health of our communities and the planet. However, modern agriculture relies heavily on extractive practices such as intensive tillage, monocultures, the use of inorganic fertilizers, and chemical pest control, which are designed to maximize potential yield for a given piece of land. Despite the short-term economic benefits of these practices, they may degrade soil quality, pollute local water sources, and prevent carbon uptake in soil, which may make them harmful in the long-run to both the farmland itself and the environment as a whole.[1] One study projected that if we continue with the current rates of soil destruction caused by modern extractive agriculture practices, there will no longer be enough arable topsoil to feed ourselves within the next fifty years.[2]

In response to the harms of extractive agriculture, there has been a growing movement to shift towards regenerative agriculture. **Regenerative agriculture** is instead characterized by practices that protect and replenish the environment by integrating organic farming, agro-ecology, and holistic management.[3] However, this is not a simple switch—significantly changing current agricultural practices entails high fixed costs for farmers; the highly competitive nature of agricultural markets will

punish farmers as they attempt to transition towards regenerative agriculture. Thus, even if the potential long-run returns are high, it may not be possible for farmers to finance such a shift.

In order to incentivize this transition for farmers, one possible solution is to place market value on desirable **ecosystem services** (ES), the processes and benefits produced by natural ecosystems, created by regenerative agricultural practices. An increasingly popular way of doing so is through **Payments for Ecosystem Services** (PES), an incentive scheme that places economic value on a certain ecosystem service and provides payments to the people that provide these services. The use of these payment structures has grown significantly in the past twenty years, but has focused primarily on forest conservation and watershed management, rather than agriculture.

Looking specifically to agriculture in Vermont: where does Vermont fit into the context of regenerative agriculture and PES? Agricultural practices in Vermont cause significant water pollution, most notably the phosphorus pollution in Lake Champlain, which stimulates excessive growth of algae, which can be toxic to pets and people.[6] In addition to water pollution, Vermont suffers from a large amount of floods due to centuries of altering rivers; further soil erosion from extractive agricultural practices will only worsen this issue into the future.[7] Current agricultural practices in Vermont have therefore already degraded the environment and significantly impacted the lives of Vermonters. Knowing the harms of extractive agriculture, should Vermont seek to incentivize farmers to adopt regenerative agriculture, and how might Vermont implement a PES system?

2 PURPOSE STATEMENT

Presently, the extractive agricultural practices of Vermont contribute to low soil quality and high water pollution, among other environmental issues. Vermont may thus benefit from looking at the growing movement towards regenerative agriculture and the various payment schemes to incentivize farmers to adopt these methods, including Payment for Ecosystem Services (PES). A large number of PES schemes have been implemented around the world in the past twenty years, but the majority of research on these systems has been done on developing countries, whose economic and agricultural structures are very different from that of Vermont. This makes it difficult to apply past findings to the context of Vermont.

In this report, we highlight a number of case studies in the United States and one in Costa Rica, in order to study the results of PES systems in a variety of contexts. The state has a unique struggle to balance economic growth, historical tradition, and ecosystem health, and we understand that no single case study will encompass the needs of Vermont in a PES system. Because of this, we break down and examine each study using a multi-dimensional approach, evaluating each based on situation and success. Further, we consider community opinion on regenerative agriculture and PES in order to be as informed as possible throughout our research and policy options stages.

From our case study research, we have established a comprehensive list of policy options and recommendations for the Committee on Agriculture and Forestry to consider when assessing the utility of regenerative agriculture and Payment for Ecosystem Services in Vermont.

3 LITERATURE REVIEW

In this section, we will discuss academic research conducted on the benefits of regenerative agriculture, the ways of valuing ecosystem services, and the organization of past and current PES systems. Particularly, we will assess the findings of PES systems, including both the features that enhance improvements in socio-economic and environmental outcomes and their tradeoffs and limitations.

3.1 BENEFITS OF REGENERATIVE AGRICULTURE

At its core, regenerative agriculture aims to improve soil health, which results in a variety of environmental and social benefits. Rhodes (2017) emphasizes that regenerative agriculture may increase the amount of soil organic carbon and also build new soil.[8] This provides numerous environmental benefits, such as drawing down carbon from the atmosphere; improving soil health; and increasing soil fertility, crop yields, water retention, and aquifer recharge—all of which lessen the impacts of floods, drought, and soil erosion.[9] Additionally, soil quality is essential in determining the productivity and profitability of a farm. A study on the effects of regenerative farming systems on corn production found that insecticide-free, regenerative farms had 10 times fewer pests; furthermore, despite having 29 percent lower grain production, these regenerative fields saw 78 percent higher profits.[10] These results demonstrate that profit is positively correlated with the particulate organic matter of the soil, not the yield.[11] Moreover, Brevik et al. (2018) highlight the importance of good soil health for human health, pointing to the supply of nutrients in soil in relation to good nutritional content of the crops, exposure to pathogens in soil, and inhalation of airborne soil particles causing respiratory problems.[12] Thus, adopting regenerative agriculture practices results in diverse environmental, economic, and social benefits, most of which are left unaccounted for in farmers' tradeoff considerations.

3.2 WHAT CONSTITUTES PES?

Payment for Ecosystem Services is a form of conservation that offers a comparatively direct strategy to encourage conservation.[13] By acknowledging tradeoffs and harmonizing competing land-use interests, PES endeavors to promote both environmentally and economically sound farming practices. To execute these goals, PES systems ascribe monetary value to ecosystem services for the purpose of compensating farmers, ranchers, and landowners for tending to their land in a way that protects and enhances ecosystem services. Several qualities comprise PES: voluntary participation in transactions, specific ES being valued, an ES buyer, an ES provider, and the provision of ES as secured by the ES provider.[14]

3.3 VALUING ECOSYSTEM SERVICES

In order to incentivize the transition to regenerative agriculture techniques, land must be systematically valued to introduce PES initiatives. Assigning economic value to ecosystems is a complex, yet vital prerequisite in the establishment of PES. There are a number of methods for initiating this procedure. The Ecosystem Valuation Toolkit (EVT) is a tool generated by Earth Economics that contains a database of various ecosystem valuations as well as a calculator to estimate the dollar per acre value based on those findings.[15] The measurement of value per acre is ubiquitous when it comes to valuation metrics of ES. COMET-Farm, a tool produced by the USDA Natural Resources Conservation Services and Colorado State University, estimates the carbon footprint of farms or ranches using

information on local farming practices and spatial climate and soil data that accounts for annual change in environmental quality.[16] Finally, the Revised Universal Soil Loss Equation (RUSLE) from USDA and the University of Tennessee estimates soil quality by examining soil loss due to various types of erosion.[17] Together these tools are used to value land and, in some systems, to help determine whether regenerative farming practices have indeed been adopted.

3.4 EVALUATING PES STRUCTURES

After the land is assigned a monetary value, there are a number of choices to be made in the construction of payment schemata. As a result, PES projects can be easily tailored to community or environmental needs. In terms of oversight, PES programs have been implemented by governments, run by foundations funded through federal dollars, or conducted exclusively through community donations. Due to this diversity, there is neither consensus on how to structure PES nor generalizable findings. To extrapolate relevant details, we draw upon a series of review studies that sample a wealth of PES cases in order to observe broader trends. Our assessment of past PES research has been parsed into four sections: a review of the socio-economic effectiveness of various PES structures, the environmental effectiveness of various PES structures, tradeoffs, and takeaways for policy.

3.4.1 SOCIO-ECONOMIC EFFECTIVENESS

There is extensive research that establishes the most effective model for PES programs. Relevant factors include: community engagement, enforcement procedures, and the mode of financial compensation. In terms of community engagement, PES programs have better socio-economic and environmental results when they are tailored to community needs, constructed with community involvement, and rigorously enforced.[18] Furthermore, whether PES design is market-based (user-financed) or government-led results in different outcomes: when PES programs are both market-based and have a specific ES lens, higher compliance is exhibited, resulting in more enriching outcomes.[19] Within these systems, payment type is also significant. In-kind compensations, or the exchange of goods and services rather than cash payments, have been demonstrated to have a higher degree of success.[20] In cases without in-kind compensation, problems such as corruption and unequal distribution of money arise.[21]

3.4.2 ENVIRONMENTAL EFFECTIVENESS

Due to the structural variation of PES, patterns are essential in establishing success. For instance, a study of 22 PES cases in Germany and the United States found that positive environmental effects were exhibited in cases where trustworthy third-party evaluation, lengthier contracts (10–30 years), and voluntary involvement were present.[22] Furthermore, the structural advantage of a narrow ES focus is reiterated in an environmental setting with the presence of easily observable environmental benchmarks.[23] Incentives additionally have a powerful effect on these environmental outcomes: PES produces a "direct and possibly more equitable" mode of achieving environmental goals when compared to other options.[24] However, the efficacy of PES goals is highly variable and depends on more than the environmental context.[25]

3.5 TRADEOFFS

A number of tradeoffs arise when the aforementioned factors are implemented, including cost-effectiveness, equity concerns, and other unintended consequences of PES systems. Such downstream effects are important to weigh when implementing PES initiatives. However, research on the more specific nature of tradeoffs and how to weigh them tends to be scarce.

3.5.1 COST-EFFECTIVENESS CONCERNS

PES can be limited by cost-effectiveness concerns due to high transaction costs and the asymmetry of information between the buyer and the seller. Bullock et al. (2011) discuss how documenting ES, negotiating and enforcing contracts, and dealing with regulatory issues all contribute to high transaction costs.[26] Moreover, information asymmetry arises from the buyer intending to maximize ES with a given budget and the seller aiming to maximize her own well-being; this cycle leads to compliance failures, lack of additionality, and spillover effects.[27] Compliance failures, when sellers do not fulfill the requirements of the PES contract, require monitoring and litigation, which further increases transaction costs. Furthermore, additionality in the context of PES refers to the ES that would have been provided without the program. PES schemes that include sellers who already provide the ES of concern are inefficient, because they are paying sellers who will conserve regardless. An efficient PES scheme should thus maximize additionality by specifically targeting sellers who do not already provide the ES of concern; however, this information is difficult for buyers to uncover, and excluding these sellers might be difficult to implement equitably.[28]

The spillover effects of PES programs refer to a variety of unintended consequences, including displacing production into land not under contract or causing these agents to increase production in response to higher prices created by the decreased supply of the sellers.[29] While research finds that adopting a narrow ES focus produces better measures of additionality and more tailored programs, by focusing on a narrow environmental goal, other "non-targeted services" are inevitably sacrificed.[30] For instance, in focusing on incentivizing carbon sequestration, other environmental initiatives are sidelined, reducing the cost-efficiency of a program.

3.5.2 EQUITY CONCERNS

PES programs frequently come with a variety of equity concerns. James and Sills (2019) consider the barriers to participation, including transaction costs and land tenure.[31] Due to the voluntary nature of PES, landowners will only participate when their expected gains are greater than the opportunity and transaction costs of the program, which will inherently benefit larger and more productive landowners. These transaction costs thus can be a large barrier to entry for poorer owners of smaller land.[32] In an evaluation of the PES program in Costa Rica, Porras (2010) describes the difficulties of expensive transactions costs and the high fixed costs of the requirement of the program, saying that "attempts to reduce the entry costs for small farmers have not been entirely successful, and most small farmers still face significant barriers to entry."[33]

3.5.3 OTHER CONCERNS

Other potential tradeoffs of PES programs include limitations concerning restoration of ES and biodiversity. Bullock et al. (2011) list several of these limitations, including questionable long-term sustainability, skewing activities towards those favored by investors, and the negative social impacts of reducing access to lands undergoing restoration.[34] Long-term sustainability is a particular concern when the benefits of the program may take years or even decades to accrue, which may make it difficult to keep the program running long enough to see results. Furthermore, PES schemes tend to skew activities towards the interests of those funding the program, which can lead other services and biodiversity to be neglected.[35] Finally, the potential negative social effects of PES programs that reduce access to land have not been explored in depth.

3.6 TAKEAWAYS

In sum, PES for regenerative agriculture has immense potential for success if executed carefully. Regenerative agriculture has vast capacity to improve Vermont ecosystems were the protection of ES to be incentivized. To maximize socio-economic benefits of PES initiatives, successful programs would seek to: enhance community involvement, include rigorous enforcement, be market-based, and provide in-kind compensation. To enhance environmental outcomes, PES initiatives would also focus on: third party evaluation mechanisms, encouraging longer-term contracts (10–30 years), rely on voluntary participation, and have a narrow ES focus. While the positive impacts of trends are well substantiated in the literature, it is important to note that many studies hinge on data collected in developing countries. In turn, this information is constrained as it has limited external validity in the Vermont context. Furthermore, PES systems are not without tradeoffs. Most notably, there exists: high transaction costs, information asymmetry, equity concerns, the lack of ensured long-term sustainability, and the necessary omission of other valuable ES focuses.

4 VERMONT CONTEXT

Each PES system must be designed within the specific context of its operating area. Thus, before diving into our case study analysis, it is important to set the context for Vermont in terms of depleted Ecosystem Services and existing agricultural regulations and conservation programs. This will guide our discussion of which elements of PES programs would be most applicable to Vermont.

4.1 ECOSYSTEM SERVICES

Vermont is rich with natural land and resources that all contribute to keeping the state clean and livable for the residents of Vermont, tourists, and nearby communities. Forests cover 78 percent of the state, providing clean air and water, healthy soil, temperature regulation, and carbon dioxide sequestration, among many other services.[36] Vermont also has over 800 lakes and ponds, which provide hydroelectric power, food, swimming and recreational opportunities, wildlife habitat, and more.[37] Farmland, which covers about 21 percent of Vermont, can also provide essential ecosystem services depending on the kinds of agricultural practices used, either regenerative or extractive.[38]

However, much like the rest of the world in a time of climate crisis and environmental degradation, these existing ecosystem services are depleting. Most notable is the extensive water pollution that runs off into rivers and lakes, to the point where Lake Champlain has been officially declared impaired from water pollution.[39] Water pollution limits of the use of approximately 15 percent of lakes and 20

percent of streams in Vermont.[40] Agriculture is a primary contributor to this water pollution, due to runoff of nitrates, phosphorus, manure, pesticides, and other agricultural products.[41] In fact, nearly half of all runoff into Lake Champlain is from agricultural sources.[42] The nitrates and phosphorus pollution, which occurs from excessive use of fertilizer, causes cyanobacteria, which can lead to skin rashes, sore throats, and other health problems.[43] Water pollution in Vermont thus limits and undermines the ecosystem services provided by lakes, ponds, and rivers, damaging the environment and economy of Vermont. Additionally, Vermont suffers from an increasing number of floods, which have caused a large amount of damage and destruction in the past several decades. Soil erosion from extractive agricultural practices contributes to the frequency and intensity of flooding. There were 14 federally declared flood zones in Vermont between 2005 and 2015.[44] The flooding from Tropical Storm Irene alone caused $63 million in insurance claims, $153 million in state and local costs, and $603 million in federal outlays, just for Vermont.[45] These issues suggest that Vermont needs significant reforms within its agricultural domain, in order to prevent further water pollution and soil erosion.

4.2 EXISTING REGULATIONS AND PROGRAMS

An important existing set of regulations for water quality in Vermont is the Required Agricultural Practices (RAP), established in 2015 in reaction to the growing water pollution problem. It delineates standards that all farms must comply with to reduce the impact of agricultural activities on water quality.[46] This includes nutrient, manure, and water storage standards, to limit the amount of pollution runoff. It also provides resources in both technical and financial assistance for farmers to help them follow the RAPs.

Additionally, there are a number of existing conservation programs working to protect forests and farmland. The Vermont Farmland Conservation Program is managed by the Vermont Housing and Conservation Board (VHCB), a nonprofit organization focusing on affordable housing and land conservation for Vermont.[47] The program works by purchasing development rights to productive farmland and ensuring that the land stays protected and is available for farming in the future.[48] The VHCB also runs a number of other conservation programs, including the Farm & Forest Viability Program, which offers advising and technical assistance to farmers and businesses and provides Water Quality Grants to help farmers invest in water quality related on-farm infrastructure.[49] These grants are funded by the State of Vermont. The VHCB provides funding to the Vermont Land Trust (VLT), a nonprofit conservation organization that has a large-scale forest and farmland conservation program that also provides grants to farmers on conserved land.[50] Additionally, Vermont's Natural Resource Conservation Districts (NRCDs) are a group of fourteen districts across Vermont that work with private landowners and farms to promote and implement conservation programs.[51] By working on a local level within the district, they are able to provide solutions and resources in addressing environmental concerns and coordinating conservation land use practices. Finally, a new conservation program in Vermont that directly targets agricultural waste and water pollution is the pay-for-phosphorus program, which will pay farmers for each pound of phosphorus reduced from implementing conservation practices.[52] The program is voluntary and flexible for farms, and provides incentive payments for enrollment, as well as payments for improving cost-effectiveness.

Thus, there are a number of existing regulations and conservation projects in Vermont. Given this, a potential PES system in Vermont would benefit from linkages to these regulations and to the existing conservation organizations in order to be most effective.

5 METHODOLOGY

We have selected five distinct Payment for Ecosystem Services programs to serve as our case studies. These include the Pagos por Servicios Ambientales in Costa Rica, the Conservation Reserve Program in the United States, the Yuba Watershed Forest Resilience Bond in Northern California, the Ranchlands Environmental Services Project in Florida, and the Bobolink Project in New England. We gathered publicly available information on these programs and personally interviewed individuals involved with the smaller programs in order to fully understand how these programs were designed and implemented. The individuals we interviewed include:

- **Abby Gritter**: The chief of staff at Blue Forest Conservation, the non-profit behind the Yuba Watershed Forest Resilience Bond.
- **Dr. Patrick Bohlen**: A head biologist on the Florida Ranchlands Environmental Services Project, who managed the team involved in documenting ES on the land in the pilot program.
- **Margaret Fowle**: A conservation biologist with Audubon Vermont involved in the Bobolink Project.

These programs were largely successful, and all of them are either still ongoing or have been expanded into larger scale programs. By examining these five different case studies, each with a different design and implementation, we are best able to generalize our findings to the Vermont context.

In order to understand the ways in which PES systems operate, we have analyzed each case study on five different dimensions. These dimensions are:

1. **Ecosystem Services**: We discuss which Ecosystem Services that each program targets. Some programs target a specific ES, while others cover a wide range of ES. This will help to determine how focused or wide-ranging a potential program for Vermont would be.

2. **Land classification and targeted landowners**: By establishing the amount and type of land involved in each program, we can understand the scope of each program relative to their successes. Additionally, we discuss how the program targets involved landowners, to better understand how Vermont might determine which landowners should participate in a potential PES program.

3. **Payment structures and contracts**: We assess which programs are market-based, government-funded, or some combination of private and public funds, in order to determine the advantages and disadvantages of each structure. Additionally, we analyze the contract structures, such as the duration of contracts, frequency of payments, and how payment amount is determined.

4. **Evaluation of land and ecosystem services**: Understanding how each program evaluates land before, during, and after the program can inform to what extent a program in Vermont would need to invest into land evaluation. Does the program measure ecosystem services throughout the duration of the contract, or are estimates calculated afterwards?

5. **Community consensus and feedback mechanisms**: Finally, it is important to understand how the local community responded to each program, to determine if PES programs are generally viewed positively by the public. Additionally, we discuss the ways in which the programs designed feedback systems for participating landowners, to understand how Vermont may incorporate stakeholder feedback.

Although all programs were successful, we also briefly discuss program success at the end of each case study to understand how each dimension translates into outcomes.

6 CASE STUDIES

In this section, we discuss each case study in detail and analyze each of their dimensions in order to uncover which elements were most successful and which could have been improved. The case studies are as follows, in order from least to most similar to the situation in Vermont. The first two are large-scale national programs, while the last three are smaller programs that are more local in scope.

1. **Pagos Por Servicios Ambientales** (Costa Rica): This was the first large-scale PES program, and despite its vast differences from the context in Vermont, we included this program because of its relevance to the international discussion of PES programs and the large amount of research that has been conducted on its successes and failures.

2. **Conservation Reserve Program** (U.S.): This program uses public funds to pay landowners to remove land from agricultural production, and as such is relevant to Vermont's goal of paying farmers to use more regenerative practices.

3. **Yuba Watershed Forest Resilience Bond** (California): This program uses private investors to fund forest restoration on public lands in Northern California. While different from the goal of regenerative agriculture, it demonstrates an alternate way to fund ES through private capital investment rather than government funds.

4. **Florida Ranchlands Environmental Services Project** (Florida): This project paid landowners in the Northern Everglades to store and manage water runoff. Again, while the goals are different from that of Vermont, it provides an important example of how government agencies can work with local organizations and landowners to achieve ES goals.

5. **Bobolink Project** (Rhode Island, Vermont, Connecticut, and Massachusetts): This project uses individual donations to pay landowners to protect birds. Since it operates in New England, the context is more similar to that of Vermont, and it provides a way of using a different source of funding—individual private donations.

The rest of this section thus goes into each case study in detail, along each of the dimensions described in Section 5. Additionally, Table 1 shows the costs and acres involved in each program.

***Table 1**: Average cost and acres involved for each program*

	Costa Rica PSA	U.S. CRP	Yuba FRB	Florida Ranchlands	New England Bobolink
Average cost/year	$10 million[53]*	$1.63 billion[55]	$875,000[57]	$1.2 million[59]**	$27,700[61]***

Average acres/year	154,441 acres[54]	29.4 million acres[56]	15,000 acres[58]	11,781 acres[60]	568 acres[62]
Average cost/acre/year	$65/acre	$55/acre	$58/acre	$102/acre	$49/acre

*Based on the average amount received from 3.5 percent fuel tax.
**Based on the amount initially allocated by state and private funds to the pilot program.
***Based on donations received in 2013 and 2019. Costs depend entirely on the amount of donations received.

6.1 PAGOS POR SERVICIOS AMBIENTALES (PSA) (COSTA RICA)

Established in 1997 through the 1996 Forestry Law 7575, Costa Rica's *Pagos por Servicios Ambientales* (PSA) program was the first PES program to be implemented at the national scale.[63] This program aims to compensate private forest landowners for ES such for "reforestation, sustainable forest management, and forest conservation."[64] Extensive research has been conducted on this program and its outcomes provide an important look inside the features of nationalized PES programs.

6.1.1 ECOSYSTEM SERVICES

Forestry Law 7575 created the structure for rewarding landowners for a range of services. In this robust program, PES are divided into four categories: carbon payments, biodiversity conservation payments, watershed protection payments, and tourism payments. Per Forestry Law 7575, such environmental services include:

> "[The] mitigation of [greenhouse gas] emissions through reduction, fixation, capture, storage, and absorption or carbon; [the] protection of water for urban, rural, or hydroelectric use; biodiversity conservation for conservation, sustainability, or scientific investigation; and [the] protection of ecosystems or scenic natural beauty for tourism or science."[65]

In spite of this seemingly broad scope, the PSA program focuses primarily on achieving these goals vis-à-vis the forestry sector. Most significantly, the law established the National Forest Financing Fund (FONAFIFO), the main driver of the PSA program, to support additional ES related to "forest conservation, reforestation, and sustainable forest management."[66]

6.1.2 LAND CLASSIFICATION AND TARGETED LANDOWNERS

With FONAFIFO's three aforementioned targets, forests across Costa Rica are chosen to be part of the program, with the ultimate goal of decreasing some of the highest deforestation rates in the world. While forests across the nation are able to participate, land owner demographics tend to be concentrated on those who are wealthier and own larger plots of land in poorer areas.[67] For those with large landholdings "production capacity and incomes" reduce the barriers to participation and provide increased flexibility.[68] The average participant has higher educational attainment, is more likely to reside in an urban area, is less reliant on on-farm resources, has higher income, greater access to information, and operates more productive farms when compared to non-participants.[69]

6.1.3 GOVERNMENT INVOLVEMENT IN PAYMENT STRUCTURES AND CONTRACTS

The governing board of FONAFIFO is chaired by individuals from the Ministry of Environment and Energy, the Ministry of Agriculture, and the National Banking System.[70] There are also seats reserved

for private sector representatives from the forestry industry who are appointed via the National Forestry Office.[71] This hybrid public-private staffing allows the board to make decisions characteristic of private companies while remaining under government oversight.[72]

The purview of FONAFIFO and its relationship with the Costa Rican government grants the PSA program with diverse funders, both private and public. In 2001, the *Ley de Simplificación y Eficiencia Tributaria* provided 3.5 percent of federal tax revenue to the PSA program.[73] Non-public sources of funding stem from the private hydroelectric industry: producers enter into contracts where they reimburse FONAFIFO for payments to landowners upstream of watersheds.[74] The rest of PSA budgetary needs are met by the Ministry of Environment and Energy funds, donations from international actors and organizations, and profits associated with forest activities.[75]

In terms of contracts, landowners involved in with the PSA program are paid for protecting forestland.[76] FONAFIFO is the body which is responsible for signing legal contracts—which detail how land can be used and facilitates the transfer of ES rights—with landowners.[77] For ES providers, compensation takes the form of USD/ha/year and such contracts can last five, ten, or fifteen years.[78] Depending on the ES being offered, contracts can range from US$41/hectare/year to US$294/hectare/year averaging out to US$42/hectare/year.[79]

6.1.4 EVALUATION OF LAND AND ECOSYSTEM SERVICES

For Costa Rica, the evaluation of land was primarily conducted in academic studies, rather than by the program itself.[80] While initial studies assessed the value of forest ES as part of the consultation process, the program itself did not undergo evaluation of the involved land prior to the start of the program.[81] Because of this, it has been harder to determine ES produced from the PSA.[82] Forest cover seemed to increase after the program started, but it is difficult to disentangle that from other government policies targeting deforestation, as well as the fact that landowners who were willing to participate in this program were most likely less willing to engage in deforestation even without the program, just from selection bias.[83] Due to the lack of baseline level ES, academic studies that have sought to estimate improvements in ES must grapple with these issues.

6.1.5 COMMUNITY CONSENSUS

The program was popular among landowners at the beginning, as interested landowners far outweighed the available funds.[84] Due to the national scope of the project, there is little indication that the Costa Rican government has extensively tapped into public and local opinion.[85] Research indicates that communities are less likely to be involved in the design and implementation of such national PES programs; simultaneously, due to the slow spread of information, many communities where there is no history of PES involvement are unlikely to have heard of programs despite their benefits.[86] Importantly, participants in the PSA program, despite enjoying improved environment quality, cite obstacles such as financial barriers and concerns over project management; however, there is limited indication that the government surveys participants and makes reforms based on local criticism.[87] Notably, many of the obstacles referenced by enrolled landowners are related to the lack of information and federal assistance.[88]

6.2 CONSERVATION RESERVE PROGRAM (U.S.)

The CRP was established in the Farm Bill of 1985 to control soil erosion and seeks to improve water quality, reduce soil erosion, and increase habitat for endangered and threatened species.[89] The program pays farmers to remove environmentally sensitive land from agricultural production and instead plant species to help improve environmental quality. The program is formulated by the USDA, but it is operated by the Farm Service Agency (FSA) and assisted by the Natural Resources Conservation Service (NRCS) to provide technical assistance and the Commodity Credit Corporation (CCC) to fund the program and operate the contracts.[90]

6.2.1 ECOSYSTEM SERVICES

The main focus of the Conservation Reserve Program (CRP) is to preserve soil quality by reducing erosion and protecting soil productivity in fragile croplands, but the program aims to protect a variety of ecosystem services across the U.S.[91] Protection stretches to include water resources, wetlands, wildlife habitat, honey bee and pollinator protection, climate change mitigation through GHG reductions, soil health, and flood prevention.[92]

6.2.2 LAND CLASSIFICATION AND TARGETED LANDOWNERS

The total amount of land involved in the CRP varies year-to-year, but is typically between twenty and thirty-five million acres of cropland.[93] The NRCS oversees land eligibility and implementation on the ground while state forestry agencies provide technical assistance to farmers enrolling newly forested land.[94] To be eligible for the 2021 registration, the land must be planted with an agricultural commodity four of the six crop years from 2012 to 2017.[95] The land must also be physically capable of being planted, meaning that there cannot be any planting restrictions due to an easement or other legally binding barrier.[96] By specifically targeting active farmland, the program ensures that the USDA is not paying farmers to save land that would not be used anyways. Additionally, the cropland must have a weighted erosion of index eight or higher, be expiring CRP acres, or be located in a national or state CRP conservation priority area.[97] This ensures that the land is of interest to the USDA and meets the program's conservation goals.

6.2.3 GOVERNMENT INVOLVEMENT IN PAYMENT STRUCTURES AND CONTRACTS

The CRP is a government-run program that integrates financial incentives. Contracts are operated by the Commodity Credit Corporation (CCC), a federal program subject to the USDA that funds the program. Producers can set offers in accordance with soil-specific maximum rental rates and choose wildlife-enhancing plant covers to improve EBI ranking in the application process.[98] Payments occur on an annual basis and contracts span ten to fifteen years.[99] There are three payment types that the CRP employs: rental payments, cost-share assistance, and financial incentives. Rental payments, which are calculated prior to enrollment, are dependent on the relative productivity of the soils and the average dryland crop rent.[100] Cost-share assistance is granted to participants who have established approved vegetative cover on eligible land, but cannot make up more than 50 percent of a participants' costs.[101] Finally, financial incentives are additional payments from the USDA that are aimed at improving the condition of resources, promoting forest management, or enhancing wildlife habitats.[102] The different types of payments allow flexibility in contracts across different types of farmers and land. Looking across the three payment types, the average payment amounts to $83 per acre.[103]

6.2.4 EVALUATION OF LAND AND ECOSYSTEM SERVICES

Land before enrollment is quantitatively evaluated in order to determine its acceptance into the program. Land involved in applications are ranked using their Environmental Benefits Index (EBI). The EBI rankings are determined using a point score based on the land's relative environmental factors, including wildlife habitat and air and water quality benefits that would result from a contract, allowing the FSA to promote the enhancement of the desired Ecosystem Services.[104] The FSA then selects the highest ranked offers that provide the most environmental benefits relative to cost, thus improving cost effectiveness. After enrollment, the CRP utilizes the Natural Resources Analysis Group and the Economic Policy and Analysis Staff as the primary analytical resource for benefit evaluation.[105] Their estimations on nitrogen, phosphorus, and sediment reduction are based on the Environmental Policy Integrated Climate model and the Agricultural Policy Environmental eXtender model.[106] Their estimates on carbon sequestration are developed through the Agricultural Research Service, the U.S. Geological Survey, and the U.S. Forest Service.[107] Additionally, the CRP conducts Monitoring, Assessment and Evaluation Projects to quantify the actual environmental benefits to water quality and quantity, wildlife, and rural economies.[108]

6.2.5 COMMUNITY CONSENSUS

The CRP has historically been a very popular program among landowners, as demonstrated by the competitive nature of the program. However, there has been a consistent decline in participation in recent years due to decreases in incentive payments and amount of cost sharing by the FSA.[109] Enrollment in 2020 was at 22 million acres—the lowest level since 1987.[110] This indicates that the popularity of CRP is directly related to the offered benefits by the government. In terms of program feedback, farmers are able to contact their local FSA office to get assistance and share grievances with the program. The FSA has state offices, and there are USDA help centers in counties to access FSA services and receive assistance.[111] However, changes to the program are made at a federal level, meaning that individual farmers ultimately have little control over the state of the program.

6.3 YUBA WATERSHED FOREST RESILIENCE BOND (CALIFORNIA)

The Forest Resilience Bond (FRB) is a market-based program started in 2018 as part of the Morgan Stanley sustainable investment challenge by four M.B.A. students at U.C. Berkeley. It is currently managed by the Blue Forest Conservation group.[112] The FRB uses private capital to finance the restoration and improvement of forest health.[113] In this model, the Pay-for-Performance Bond (PFP Bond), takes these private capital investments in public impact bonds to fund forest improvements in public land.[114] Hence, the FRB aims to lessen unnaturally high forest density and clean up debris across the United States, with the first project concentrated in Northern California.[115] There are numerous parties involved with the FRB project, including government bodies, nonprofits, and private stakeholders.

6.3.1 ECOSYSTEM SERVICES

Similar to the Costa Rican PSA, The FRB is focused on forest health.[116] Where the Costa Rican national forests have been deforested by humans at a rapid rate, the California forests have been anguished by wildfires due to unnaturally dense growth.[117] The lack of cleanup on forest floors and the delay of natural, smaller wildfires has increased the risk and scale of fires that demolish the forests, removing any ecosystem services that can provide for the surrounding environment.[118] The ultimate goal of the FRB is to re-establish forest ecosystem services by lessening the devastating forest fires.[119]

6.3.2 LAND CLASSIFICATION AND TARGETED LANDOWNERS

The FRB is different from other programs in that rather than using public funds to pay private landowners, the FRB uses private investors to pay for improvements on public lands. All land involved in the program is operated by the U.S. Forest Service, making coordination much easier for the Blue Forest Conservation group.[120] The pilot program involved 15,000 acres, but it has since been expanded to reach 275,000 acres of both public and private lands in Northern California.[119]

6.3.3 GOVERNMENT INVOLVEMENT IN PAYMENT STRUCTURES AND CONTRACTS

The FRB is a market-based program that uses private capital to finance the restoration and improvement of forest health on publicly operated land.[121] Another way that this program is different is that the forest restoration is funded by the investors, and the investors then receive returns once the ecosystem services are met. Investors include insurance companies, pension funds, foundations dedicated to forest quality, and the USDA.[122] The payment to investors is funded by the California Fire Agency, the Tahoe National Forest, the Yuba Water Agency, water utilities, and other public agencies.[123] Presently, the FRB provides $4 million in funds from investors through market-based contracting with private funding while keeping public land accessible.[124] These payment structures allow what normally constitutes nine to ten years of forest clean up to be completed in three years.[125]

The contracts were initially designed by Blue Forest Conservation to be pay-for-performance, meaning that payments would be contingent upon positive outcomes.[126] However, the Yuba Water Agency cut this element early on at the request of stakeholders, and changed it to a cost-sharing contract to avoid the complexity and costs associated with tying outcomes to payments.[127]

6.3.4 EVALUATION OF LAND AND ECOSYSTEM SERVICES

The program had scientists and other experts on board to undertake ongoing land evaluation throughout the program.[128] These evaluations were then used to produce reports on the success of the program.[129] In the Yuba project, success is evaluated as a finished clean-up. To evaluate program success, nine federal, state, tribal and nongovernmental partners established the North Yuba Forest Partnership in 2019, which was a collaborative effort focused on forest restoration across 275,000 acres of public and private lands in Northern California. This partnership plans to evaluate and finance more than $100 million previously unfunded restoration using FRB.[130]

6.3.5 COMMUNITY CONSENSUS

Although there was no direct community surveying for the Yuba Project, stakeholder relationships are positive, as shown through continued business, utility, and continued interest from the forest service through the pilot and the larger scale programs. The program worked with existing legal authorities, and did not have to change any laws or roles of existing government agencies to get the project underway.[131] The project also had support from the South Yuba River Citizens League, a local environmental group that wanted to establish a similar program for years but could not find the funds.[132] As such, the local community was involved and excited to participate in wildfire prevention and habitat protection.[133] Additionally, to receive feedback, the program had a partner organization who served as implementation manager, the National Forest Foundation, that dealt with on the ground contracting.[134]

6.4 FLORIDA RANCHLANDS ENVIRONMENTAL SERVICES PROJECT (FLORIDA)

The Florida Ranchlands Environmental Services Project (FRESP) ran from 2005 to 2010 in which eight ranchers in the Lake Okeechobee Watershed were paid to store and manage water runoff and rainfall by flooding previously dry areas of their land.[135] The goal of this project was to test the efficacy of certain scientific models and payment structures in order to implement a long term project to reduce nutrient runoff in ground and lake water, specifically targeting the phosphorus load.[136] Success of the pilot program led to the basin-wide water dispersal program and Northern Everglades-Payment for Ecosystem Services program.[137]

6.4.1 ECOSYSTEM SERVICES

The pilot Florida Ranchlands Environmental Services Project is focused on watershed health, specifically in water storage, topsoil health, and water quality.[138] By capturing and storing water across the watershed on private lands, this project focuses on modifying existing water management structures and strategies to (1) reduce the phosphorus load in surface water drainage and (2) reduce flooding.[139]

6.4.2 LAND CLASSIFICATION AND TARGETED LANDOWNERS

While the target ecosystem service is to reduce the phosphorus load in water, the program must still target land and specific landowners to store and maintain the water. In order to provide specific services, targeted land must have enough space for water storage and evaluation.[140] Because of this, private ranches in the Lake Okeechobee Watershed, often with owners involved in conservation work, are targeted to be a part of this program.[141] Many of the targeted ranch owners have pre-existing water management infrastructure and enough land to section off to the service.[142] The pilot program for the Ranchlands project had a total of eight ranches involved, totaling at approximately 152,821 hectares of land with approximately 3,604 hectares of that dedicated to water retention sites.[143]

6.4.3 GOVERNMENT INVOLVEMENT IN PAYMENT STRUCTURES AND CONTRACTS

The FRESP program is a hybrid of a market-based and government-run program, because it is funded through government agencies as well as private organizations and actors. This program operates through the sale of rancher services to government agencies.[144] State and federal agencies involved with the program include: the South Florida Water Management District, Florida Department of Agriculture and Consumer Services, the Florida Department of Environmental Production, and the U.S. Department of Agriculture Natural Resource Conservation Services.[145] Due to initial problems with phosphorus and freshwater levels, the Florida State Legislature introduced two additional initiatives to supplement FRESP, further involving governmental agencies in the program structure (see appendix for details).[145]

NE-PES contracts with ranchers for ten-year fixed terms where annual payments are provided, granted the appropriate documentation is provided of "water management services."[146] Contracts take into consideration the changing nature of environmental factors that may influence ecosystem

services; annual rainfall, for instance.[147] Funding for the program is drawn from the $3 million committed by the State of Florida in addition to upwards of $3 million from federal as well as private donors.[148]

6.4.4 EVALUATION OF LAND AND ECOSYSTEM SERVICES

The Florida project utilizes extensive water measurements and models to evaluate the land before and during the program. Before contracts were derived, FRESP conducted pre-assessments of the land and water management areas (WMAs), measuring water levels and water flow.[149] These assessments helped determine the expected services that the landowner would provide in the contract, based on the site-specific assessments and operations.[150] To evaluate the land throughout the program, scientists used measurement systems for water levels and flow that could be checked at any given time.[151] Quantifying increases in water retention proved to be simpler and more accurate than quantifying reductions in phosphorus runoff, meaning that by taking the more cost-effective route, they agreed to receive less information on phosphorus load reduction.[152] In order to quantify the Ecosystem Services provided by the ranchers in the duration of the program, they compared actual water retention to predicted water retention, using an extensive hydrological modeling system designed by the scientists with the program given a certain site and year.[153] Thus, the program was able to evaluate success in improving Ecosystem Services through the land evaluation undertaken before and during the program.

6.4.5 COMMUNITY CONSENSUS

The pilot program received large support across the board because it was designed with every stakeholder's interests in mind.[154] It was established by a coalition of state agencies, private landowners, and conservation organizations that each benefited in a different way from the program.[155] For agencies, contracting to private landowners that can provide large watershed benefits on their land is much cheaper and more effective than building and improving new and old public works systems. For landowners, this program creates a new source of revenue, particularly for those who are pressured to sell or use their land for less eco-friendly uses. Nearly all contacted landowners were more than happy to participate in the program.[156] For conservation organizations, they are able to achieve their goals of improving watershed management and nutrient help. In terms of feedback, the pilot program was so small that it was easy for all involved ranchers to share concerns with the program operators.

6.5 BOBOLINK PROJECT (MA, RI, CT, and VT, U.S.)

The Bobolink Project, operating in New England with considerable participation from Vermont landowners, is a small-scale PES intervention funded by donations.[157] This project has important lessons for Vermont as it represents a specific and ongoing, albeit privately run, PES endeavor in the state. The projects provide farmers with financial aid so that they can delay the harvest of hay from grasslands; this delay of the cutting period allows Bobolink birds to nest and hatch.[158]

6.5.1 ECOSYSTEM SERVICES

The Bobolink Project is the smallest scale project of the selected case studies with the most specific and enumerable service goal. Targeted at hay-harvesting farmers, this project aims to restore dwindling populations of the once-abundant hayfield, meadow, and grassland birds, specifically the Bobolink.[159] However, effects of this project stretch far beyond just restoring bird populations in the local environment; despite their specific focus, when these conservation and regenerative farming methods are in practice, many other ecosystem services, such as improved soil health, follow suit.[160]

6.5.2 LAND CLASSIFICATION AND TARGETED LANDOWNERS

As the smallest project, it follows that the Bobolink Project has targeted the smallest amount of land with 928 acres of grassy farmland currently involved.[161] Farmers and landowners in the north eastern United States (including RI, CT, MA, and VT) comprise the project's target audience. These individuals are provided with payments to compensate losses due to delayed hay harvests or grassland cutting in order to renew avian hayfield species.[162] This program is still growing: approximately 500 acres and 15 landowners were involved in 2017 compared to 928 acres from 15 landowners in 2019.[163]

6.5.3 GOVERNMENT INVOLVEMENT IN PAYMENT STRUCTURES AND CONTRACTS

The Bobolink Project, which originated as a grant-funded university research study on reverse auction practices, is a privately operated PES program.[164] Despite crossing state borders through its wide net of funders, the project pools all donations to pay farmers.[165] Due to its market-based structure, this program operates independent of government oversight with Mass Audubon, Audubon Vermont, and NH Audubon providing oversight and administrative assistance.[166] Farmers whose property meets the guidelines for Bobolink nesting enter into contracts with the project managers to not "mow or otherwise disturb their participating hay fields during the grassland bird breeding season."[167] Notably, 90 percent of the Bobolink Project's protected acreage is in Vermont.[168]

6.5.4 EVALUATION OF LAND AND ECOSYSTEM SERVICES

For the Bobolink project, land is evaluated prior to enrollment to ensure that it meets the necessary criteria, similarly to the CRP. Farmers go through an application process, and if selected they are allowed to enroll their fields into the project. The project ranks applicants' fields and chooses those that are the most biologically suitable for nesting grassland birds. More specifically, fields must be at least 20 acres of pure grassland, be of circular or ovular shape, and be situated near other fields rather than trees or urban development.[169] Then, for selected fields, the project looks at the bid per acre price set by the farmer and selects the most cost effective offers first, updating payments per acre until the pool of donor funds is exhausted.[170]

After being enrolled into the program, the land is evaluated by ecologists who count the number of male and female grassland birds to determine how successful plots of land and cutting practices have been in protecting the birds. This helps determine when to cut the hay in the grasslands to avoid cutting it during nesting times. Thus, evaluation of success relies primarily on the number of birds protected by the land, rather than the land quality itself.

6.5.5 COMMUNITY CONSENSUS

Landowners have generally viewed the program positively: one year, participating members put signs up on their yard to demonstrate their involvement and encourage others to participate.[171] Due to the growing popularity of the program amongst landowners, there is currently greater demand than the

supply of donations can support. As a result, annual payments have decreased from $160/acre to approximately $50/acre; this is largely driven by the reverse auction structure and the competitive benefits of placing lower bids on non-farmland.[172] While donations have increased from $32,000 in 2013 to $46,400 in 2019, the project has also had to turn away bids for an additional 492 acres due to insufficient funding.[173]

Despite decreasing program benefits in the form of payments, the Bobolink project continues to have high enrollment, indicating that the program remains popular among local communities.[174] However, these decreasing payments are beginning to push out working farms who may face financial losses by enrolling normally productive land in the program.[175] Instead, the program is now primarily used by non-farmers who would not use the land for other productive purposes.[176] This also produces a trap where those who are currently delaying harvests independent of the project are not rewarded for their ES.[177] This shows that, just like the CRP, popularity of the program relies on the benefits provided to the landowners. Additionally, the program does not include a direct way for landowners to provide feedback and get responses, although it is more than possible for landowners to reach out with issues if necessary.[178]

7 POLICY OPTIONS FOR VERMONT

The case studies in this research present a diverse selection of ES, involved populations, government involvement, contract and payment structures, community feedback, and evaluation procedures. Assuming that Vermont wants to move forward with establishing a PES system, we have summarized key lessons learned in each of the case studies to present the best policy options for a potential PES system in Vermont. These core takeaways are presented in order of their relevance to Vermont, with number one being the most relevant and nine being the least relevant.

1. **While it is feasible to target a wide range of ES, beginning with a specific ES focus and then scaling up is advised.**

It is possible to target a wide range of ES in a singular program, as exemplified by the PSA and the CRP, both of which generate a variety of ES. Since regenerative agriculture produces numerous ecosystem benefits, a PES system in Vermont that pays farmers to adopt regenerative practices over extractive ones can produce a multitude of ES benefits, without the need to target one specifically. However, it is also easier to measure success and provide remuneration with a specific ES target and evaluation procedures tailored to measuring outcomes for that ES. Dr. Patrick Bohlen with the FRESP project and Margaret Fowle of the Bobolink Project both cited the success of their respective programs due to the specificity of the ES focus.

In Vermont, the success and relevancy of specific ES programs has been demonstrated. For instance, the pay-for-phosphorous program and the Farm and Forest Visibility Program both have limited targets, phosphorus pollution and water quality respectively, which can easily be evaluated and implemented. It is thus up to Vermont to determine the scope and scale of a program which will better achieve their long-term goals—a broad program that can address many ES, or a more efficient program that is targeted to one or two ES of interest, in order to best target those services.

Beyond this framework, it is also possible to target ES not by focusing on just one or two, but by targeting specific plots of land with relevant services.[179] While the PSA covers a wide range of ES, the program initially suffered from some cost inefficiency. Towards this, one study found that by

considering environmental benefits, threats, and participation costs in site selection, total ES outputs with a given budget nearly doubled.[180] The importance of land selection in enhancing outputs is evident in other case studies as well. For instance, both CRP and the Bobolink project established a scoring system to evaluate and rank land based on its possible environmental contributions, if enrolled in the program. Systems that prioritize the most environmentally sensitive land or the land with the lowest desired rental rates makes programs more cost effective without sacrificing ecosystem services. As such, it may be of interest for Vermont to establish a similar scoring or ranking system when determining land enrollment to increase cost-efficiency and better target ES improvement. Therefore, specificity within land selection is also critical in maximizing the provision of ES.

2. **Both market-based and government-run programs can be effective, but establishing a balance is best.**

Market incentives integrated with government oversight proved a valuable recipe for stimulating and maintaining interest and ES outputs. In Costa Rica, the hybrid nature of FONAFIFO allowed government bodies to operate much like private organizations without sacrificing access to government funds and oversight. For FRESP its reliance on government and other agencies made it able to navigate policy and regulatory hurdles, maintain positive community relationships, and manage finances.[181] Additionally, while the Forest Resilience Bond was heavily funded by private investors, it required later funding from public agencies, again displaying the importance of the role of the government in acting on behalf of the public in securing Ecosystem Services. These public-private relationships help bolster the longevity and flexibility of PES programs; in turn, a state-run Vermont PES program would benefit from building ties with private landowners, conservation programs, and environmentally minded stakeholders to build capital and adjust to changing market forces. If Vermont chooses not to adopt a full PES program, funding aspects of market-run programs—like the Water Quality Grants provided by the Farm and Forest Visibility Program or those provided by the Vermont Land Trust—is another feasible option.

3. **The presence of land evaluation procedures and measurement systems is critical, but avoiding the establishment of overly expensive systems is also important.**

Importantly, nearly all PES systems observed included some systematized land evaluation prior to enrollment and then following enrollment to ensure ES were being produced. The PSA was the only program that did not evaluate land before implementation—which posed problems for scientists attempting to evaluate the ES provided by the program as there were no baseline levels.[182] More in-depth evaluation allows for more detailed evaluation of benefits, but it also requires more time and money investment for each of the involved landowners. For instance, hydrologists on the FRESP project installed measurement systems on all of the initial land in the project, which limited the number of landowners that could enroll in the initial project.[183] Having a less rigorous evaluation allows for greater participation in the program and lower costs, but with less information on the benefits produced. For instance, land evaluation for the CRP was done primarily by third parties after the program ended, which allowed for less precise evaluation but required less upfront costs to landowners.

Additionally, when designing measurement systems, it is important to ensure that all parties agree on the metrics used, to avoid problems when analyzing the success of the program. Dr. Bohlen discussed how a lack of consensus among hydrologists in the FRESP project about the metric used to measure watershed improvement made it difficult to make conclusions about the success of the program.[184]

4. **Successful payment structure may be either contingent on performance or guaranteed, depending on the ease of quantifying performance.**

While it would be most efficient to pay landowners based on performance of land and ES provided, it can be a difficult process without extensive ES measurement systems. Additionally, this process may be politically challenging, particularly considering any unexpected issues that might prevent a landowner from fulfilling their side of the contract. FRESP decided to pay landowners a set fee every year, regardless of performance, to avoid such issues.[185] For similar reasons, the Yuba Water Agency had to change the contract structure of the Forest Resilience Bond to be cost-sharing, rather than pay-for-performance.[186] On the other hand, the Bobolink Project used payments contingent on performance as without checks on farmer activity, as grassland birds would otherwise be unable to nest and hatch.

This aspect of determining payment structures must be viewed in combination with the metrics and evaluation measures used to assess ES outputs. Having more specific metrics makes it easier to evaluate success and in turn inform payment structure. Therefore, it is recommended that payment structures be harmonious with ES evaluation choices.

5. **It is important to maintain flexibility in PES contract structures and incentives for participation to ensure landowners are reimbursed.**

It is important to maintain flexibility throughout the arrangement of contracts. Contract and payment structure have a large impact on program participation, as evidenced by the PSA, CRP and Bobolink Project. For those projects, decreased payments due to diminished political attention caused significant drops in participation. Moreover, the CRP was forced to increase cost sharing and incentive payments so that farmers did not lose money by virtue of their participation.[188]

The struggle over maintaining financial incentives was the largest adverse impact of community involvement. Engaged landowners are critical for sustained program support and program expansion. In these projects, those with unproductive land were able to stay in the program while landowners using the land for agricultural purposes were pushed out due to weak, inflexible financial incentives. This poses a problem for incentivizing regenerative agriculture practices that would benefit Vermont farms. Greater flexibility in payment and contract structures would give Vermont greater ability to ensure that productive farmers (whose land accounts for 21 percent of Vermont acreage) are willing to participate actively in the program. Moreover, payments should depend on the location of the land with more productive and valuable land receiving higher payments as seen with NE-PES contracts.

6. **It is important to build coalitions of multiple actors for increased outreach and funding.**

All of the smaller programs (FRB, FRESP, and Bobolink) emphasized the importance of building coalitions with many involved actors. Vermont should thus aim to partner with many organizations to implement a PES program, including conservation, environmental, agriculture, and other organizations. Larger and better-organized partners mean more influence and scale for the program.

A study of the PSA found that significant amounts of donor funding can be an important catalyst for conservation programs, because a number of technological and administrative improvements in the PSA were due to substantial funding from outside organizations.[188] Abby Gritter from the FRB in Yuba discussed that there is a rapid growth in interest in investing in environmental and sustainability projects in recent years, and Vermont may be able to reach out to sustainability minded investors to increase available funding for a PES program.[189] Additionally, the smaller programs highlighted the importance of working within existing authorities and regulations.

7. **Involving local voices is important to tailoring program needs and sustaining program interest.**

Involving local communities in program specifics can serve as an efficient resource to help tailor programs to the local contexts. For programs at the national scale, such as the PSA and the CRP, input from communities was less likely to be heard and incorporated into the structure and execution of programs. The PSA additionally struggled as information regarding the benefits of the PSA program was not disseminated well.[190] Integrating local voices has the potential to better situate programs into the region of focus. For instance, both the FRB and the FRESP projects heavily involved local communities and were thus able to have local input into the program design and implementation.[191] A PES system in Vermont should heavily involve the participation of existing sustainable agriculture organizations as well as other conservation groups, in order to fully incorporate the input of all stakeholders. This flows into the following policy recommendation which involves the task of gauging public opinion in the first place.

8. **It is important to integrate feedback systems into program designs to enhance community voices and to maintain flexibility.**

Despite the importance of these factors, it must be noted that landowners frequently cite environmental benefits and eco-friendly practices as core reasons for their participation or continued participation in programs. Increased outreach to these engaged individuals is therefore considered a net positive. Moreover, by facilitating community feedback systems the number of landowners who engage in environmentally friendly practices that produce valuable ES without receiving payments can be assessed. Many programs, such as the Bobolink Project, fail to account for those who provide ES free of charge, and accounting for those individuals and their motives for non-participation in PES systems is insightful.[191] In Vermont, the existence of the Required Agricultural Practices and other regulations and farmer compliance with these regulations may also be better assessed and contextualized into PES programs.

9. **Market-specific language is beneficial in program design.**

Finally, it is crucial to think about the language used in program design and the way that Vermont seeks to frame a PES program. For instance, Dr. Bohlen commented that the language of buyers and sellers in the FRESP project was very powerful, and better helped involved actors understand interactions between the "buyer" government agencies and the "seller" landowners.[193] Additionally, a study looking at the PSA program found that framing the program as a market encouraged Costa Ricans to "view their ecosystems as an essential component of national infrastructure, and to be more willing to financially support the conservation and sustainable management of critical ecosystems on public and private lands."[194] As such, framing a PES program as a market to buy Ecosystem Services can help both stakeholders and citizens understand more clearly the role of economic forces in environmental protection.

8 CONCLUSION

In a time of increasing environmental degradation due to extractive agricultural practices, Vermont has good reason to consider establishing an incentive program for regenerative agriculture. PES programs are growing in popularity and use around the world as a way of creating a market for environmental and ecosystem services. In this report, we examine the structure of five different PES programs in order to inform future PES systems in Vermont. Understanding that no existing project will fit all of the needs of Vermont, we divide each case study into core dimensions that range from target ecosystem service to community consensus and evaluate success in those parameters and as a whole. Through this dimensional analysis we have outlined evidence-based conclusions on policy options for a Vermont-specific PES system that we hope can holistically inform the Vermont House Committee of Agriculture and Forestry, should they seek to establish a PES program.

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