Cultivating Carbon: An Exploration of Carbon Markets and Carbon Offsets in the Agricultural Sector

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This report explores the greenhouse gas (GHG) control policies of carbon markets and carbon offsets in the agricultural sector of the United States. To explore this topic, this report surveys and examines relevant literature and interprets this literature to assess the current status of agricultural carbon offsets. An analysis of relevant literature suggests that agricultural carbon markets and carbon offsets could potentially reduce carbon emissions, but they currently lack the accessibility, safety, and regulatory oversight to be an efficient or trustworthy investment. Creating effective agricultural carbon markets and offset projects will require political cooperation, extensive supervision, and expansion of the pool of eligible participants.

Approximately 15% of annual American GHG emissions are sequestered by the agricultural and forestry sectors, mostly from annual increases in forest stocks ("Estimates of Carbon Mitigation" 2). Many options exist for agricultural carbon mitigation. Agricultural carbon sequestration activities include "no-till crop management; conversion of cropland to grass, managed forests, grasslands, and rangelands; new tree plantings; anaerobic digesters and methane projects; wind, solar, or other renewable energy use; and forest restoration" (CRS Johnson 3). This wide range of projects offers many opportunities for farmers to generate carbon offsets. Soil carbon sequestration and conversion of agricultural lands to plant biomass are the two most promising of these activities in terms of emissions mitigated ("Estimates of Carbon Mitigation" 7).

Carbon offsets also have associated risks and considerations. To assess the effectiveness of agricultural carbon offsets in mitigating carbon emissions, this paper will explore benefits, considerations, and potential problems in implementing agricultural carbon sequestration schemes. The need for examples, however, merits a deeper focus that explores soil conservation and land conversion to plant biomass production.

BENEFITS OF AGRICULTURAL CARBON OFFSETS

High potential for soil carbon sequestration and plant biomass sequestration means high revenues for carbon offset producers. CRS Report RL34042 (Dec. 15, 2009) explains that carbon control legislation may allow the agricultural sector to generate carbon offsets and reinvest offset profits into agricultural emission-reduction technologies (p. 7–8). Both the United States Department of Agriculture and the United States Environmental Protection Agency believe that a strong carbon offset market in which agriculturalists could participate would benefit U.S. agriculture as a whole (CRS "Potential Implications" 2).

Some carbon offset projects may not require substantial departure from typical agricultural operations. Recommended practices for soil carbon sequestration, for example, include "mulch farming, conservation tillage, agroforestry and diverse cropping systems, cover crops…and integrated nutrient management" (Lal 1624), which farmers can practice alongside crop cultivation. Soil carbon sequestration practitioners can thus cultivate land used for sequestration, presenting dual uses for the same land. Also, because "timber harvesting has relatively little effect on carbon stored in the soil, except where followed by conversion of the site to an agricultural land-use" (Freedman, Stinson, and Lacoul 7), foresters could profit from carbon sequestration and timber sales with proper management.

In addition to generating and selling carbon offsets, farmers may reap other benefits from carbon sequestration. For example, the soil organic carbon retained and increased through soil carbon sequestration provides soil and ecosystem services, including water and nutrient retention, soil erosion reductions, soil ecosystem preservation, and pollution reduction (Lal 1626). Increasing soil carbon also increases soil productivity regardless of soil quality or agricultural intensity (Lal 1626), and "improved water quality downstream and in aquifers and improved slope stability on sites prone to erosion" also appear as benefits from afforestation projects (Freedman, Stinson, and Lacoul 11). Maintaining forestry also provides external benefits: examples include preserving watershed flow regimes, sustainable forest management (required to maintain forestry carbon projects), and conserving biodiversity, habitat, and topsoil (Kennett 599). In addition, a 2003 University of Newcastle report documents significant local benefits to air quality: the forest in a two-hectare region of city and forestland in Great Britain provided £199,367 to £11,373,707 in benefits, and reduced pollution enough to prevent ~59 to 88 deaths and ~40 to 62 hospital visits (Willis et al. 24).

CONSIDERATIONS AND RISKS ASSOCIATED WITH AGRICULTURAL CARBON OFFSETS

Discussing agricultural carbon offsets and markets involves several factors, including ability to produce offsets, timeframe demanded, and trustworthiness of offset production. Agricultural carbon offset producers also must account for risks in producing offsets, specifically if the carbon sequestered is less than initially believed. This portion of the report examines each factor in detail.

Relative Ability to Participate

Certain farmers and landowners may be better suited for offset production than others. For example, large-scale farmers enjoy economies of scale and lower transaction costs, and larger farms can have land designated for sequestration with enough remaining to practice other agriculture (CRS "Potential Implications" 20–21). Larger farms may also allow owners more autonomy: farmers capable of establishing individual offset projects have more flexibility in project design (Thomassin 1667). However, individually, offset producers likely generate too few offsets to serve the needs of carbon-emitting firms. In order to create sufficiently large offset parcels, offset producers thus need agents to bundle their offsets with offsets from other producers' projects. This necessary but additional expense raises costs for individual producers (Thomassin 1776).

Despite the advantages of large-scale farmers, small-scale farmers can participate in offset production, as "approximately 65% percent of the 6,000 farms enrolled in the CCX conservation tillage program had less than 450 acres and could thus be considered small farms" (CRS "Potential Implications" 24). In contrast to individual offset projects, pooled offset programs may better serve small farmers by enrolling multiple farmers in offset production according to a communal set of guidelines and restrictions. The pooled offset program restricts freedom of project design by forcing the farmers to conform to a specified project and uniform standards; however, the pooled program also reduces operating costs: costs for monitoring, measurement, and accreditation only apply to the project as a whole and not for each member of the offset pool (Thomassin 1667). This approach has an advantage over individual carbon offset projects that involve higher costs from individually undertaking measuring, monitoring, and accreditation procedures (Thomassin 1667). Ultimately, the approach that best serves an offset producer's needs depends upon the producer's means.

Finally, land ownership factors into whether farmers are eligible to participate in offset production. Agricultural offset projects require substantial time commitments to achieve projected sequestration. Offset contracts of 10 to 15 years or more prevent farmers with shorter leases from fulfilling project obligations. This disadvantage restricts participation to landowning or long-lease farmers ("Potential Implications" 17). Initially, extending availability simply appears to require shorter-term offset contracts; however, shorter timeframes raise concerns about credibility and permanence of sequestered carbon (CRS "Potential Implications" p. 17). Land lease agreements involving offset production are more complicated than typical lease agreements. These added complexities coerce lessees to maintain sequestration so that any offsets from that land remain stable. Unfortunately, these stipulations may also repel offset producers, restricting participation to landowning farmers (CRS "Potential Implications" 17–18).

Accreditation

Before an offset producer can produce salable offsets, the producer must prove the project can produce valid offsets. Accreditation involves demonstrating the project's ability to sequester and store carbon in accordance with particular guidelines. If the offset producer can prove the project's credibility, the project is accredited and becomes viable.

An important aspect of accreditation is additionality. Offset projects possessing additionality sequester carbon above a baseline; this baseline is set at the amount of carbon the area would sequester in the project's absence (Marland, McCarl, and Schneider 105). Specifically, additionality ensures each project leads to increased carbon sequestration—sequestration that the offset producer creates before starting the project (e.g., carbon sequestered by a long-established tree farm) is ineligible for accreditation. Proving additionality is important to producing credible offsets because "establishing a credible baseline—the estimated greenhouse gases emitted in the absence of the project—is critical to calculating the volume of emissions avoided by the project" (Taiyab 5).

Credibility and Monitoring

Constant monitoring becomes necessary because sequestration is a long-term, unpredictable process, and a project's estimated sequestration often differs from actual sequestration at the end. Offset producers seeking credibility might first "(1) identify or create a quantification protocol, (2) register, (3) report and verify emission reductions or offsets, and (4) certify those reductions before issuance of offset credits" (Freedman, Stinson, and Lacoul 4). Under these requirements, an offset producer must first sequester carbon to create offsets before making sales. Offset producers under the Kyoto Protocol, however, can sell offsets soon after accreditation, without significant sequestration actually occurring. Offset producers under Kyoto typically sell immediately and according to estimated sequestration; however, neither producer nor buyer knows the amount sequestered until the end (Schapiro 33). That offset producers can sell before delivering agreed-upon sequestration raises a concern: without project monitoring, offset producers might abandon projects after selling their offsets (Marland, McCarl, and Schneider 107–108). Constant monitoring is necessary to ensure projects continue operating and meet sequestration goals.

Another consideration is that monitoring techniques differ between offset projects. Monitoring soil carbon sequestration, for example, requires annual analysis of soil samples from multiple areas, whereas monitoring plant biomass sequestration only requires measuring above-ground plant biomass every five years (CRS "Potential Implications" p. 23). Sequestration projects of the same type may have different monitoring conditions due to differences in projects' scopes and durations; recent United States farm bills demand consistent agricultural sequestration projects to resolve this issue (CRS Johnson 8). The farm bills also suggest inadequacy in existing validation processes for agricultural carbon offsets, despite their inclusion as applicable offsets in many cap-and-trade systems (CRS Johnson 8).

A final consideration deals with limited agricultural sequestration capacity. Carbon sequestration rates decline as carbon storage reservoirs approach capacity. Thus, farmers must monitor sequestration rates and prepare for when carbon concentrations approach capacity. Lal (2004) illustrates reservoir capacity through soil carbon sequestration: while agricultural soils historically held soil carbon at concentrations much higher than their cultivation levels, recommended management practices [RMPs] only achieve ~50–66% of pre-cultivation carbon stocks (1623–1624). Offset producers must factor declining sequestration rates into their estimates.

Permanence

Permanence refers to undisturbed (permanent) storage of sequestered carbon. To protect the credibility of their projects and offsets, agricultural offset producers must maintain permanence by ensuring that carbon remains sequestered. If a project's sequestered carbon escapes—an event termed a "carbon reversal" or "nonpermanence"—the offset producer may end up with less sequestration than expected. Because of offset projects' long operation periods, maintaining permanence is an ongoing concern.

In many projects, nonpermanence can happen easily. In soil carbon sequestration projects, for example, "C remains in the soil as long as restorative land use, no-till farming, and other RMPs are followed" (Lal 1625); interrupting soil carbon management practices risks disturbing sequestered soil carbon and invalidating offsets. Farmers must thus maintain soil carbon conservation or lose their investment. If land ownership transfers between farmers, liability for nonpermanence may become problematic because "it may be difficult to pass the liability on from farmer to farmer when farm ownership changes" (Marland, McCarl, and Schneider 110).

Nonpermanence may sometimes be unavoidable. For example, natural disturbances like windthrow, ice, drought, wildfire, and insects can do serious damage to forests (Galik and Jackson 2210–2211). Insects are the most threatening, and outbreaks will worsen as global warming expands regions and date ranges in which destructive insects are viable (Galik and Jackson 2210–2211). Risks for forestry-based carbon sequestration activities are also higher than for crop farmers, as trees represent longer investments (CRS "Potential Implications" p. 12).

Small carbon reversals also occur from processes involved with the project. In soil carbon sequestration, landowners may lose soil carbon through erosion. Lal (2004) notes that that while some released carbon may become stored in soils elsewhere, much of its carbon returns to the atmosphere and counts against the project (1624–1625). While farmers cannot prevent erosion, recommended management practices can help minimize erosion. When measuring cultivated soils' sequestered carbon over time, it is important to also account for potential carbon emissions due to agricultural production. Lal (2004) mentions that most agricultural practices, including recommended management practices, require inputs containing carbon (1624). Soil carbon sequestration practitioners must count carbon released into the atmosphere against soil carbon sequestered.

In plant biomass sequestration projects, decaying plant matter releases sequestered carbon. Tree litter constantly releases carbon over time (Freedman, Stinson, and Lacoul 56), producing small but measurable sequestration reductions. If forest sequestration projects also produce timber, managers should note that "Harvesting and management of a timber site creates its own carbon emissions" (Willis et al. 21) due to decaying forest litter. Throughout the project, offset producers must account for such when calculating total sequestration.

Leakage

Another risk is "leakage," which is defined "as the net change—decrease or increase—in carbon benefits which occurs outside the project boundary and which is measurable and attributable to the project activity" (García-Oliva and Masera 351). Leakage is of concern when considering land conversion—Freedman, Stinson, and Lacoul note that "When forest, grassland, or wetland ecosystems are converted into agricultural or urbanized lands, large emissions of CO2 result" (2), and deforestation releases substantial carbon to the atmosphere. Indeed, the largest source of carbon sequestration—in an amount dwarfing all other carbon mitigation sources—is preventing deforestation (CRS “Estimates of Carbon Mitigation” p. 4). Market administrators must thus attempt to prevent carbon leakage from deforestation. Converting agricultural land to other purposes may produce carbon leakage because doing so diminishes food production capacity: large-scale conversion of cropland to other uses significantly reduces available food and raises food prices (CRS “Potential Implications” 8). Demand for food in this scenario may induce intensified agricultural production or conversion of land for agriculture, producing carbon emissions and creating carbon leakage.

Risk Management for Agricultural Carbon Offsets

Given risks associated with agricultural carbon offsets, farmers need means of securing investments. Thomassin (2003) discusses multiple risk management strategies: the first proposal involves offset producers adopting risk management plans “so that the seller could self-insure against reversals,” in which case “either the seller or the government could assume the liability of the reversal” (1174). In some cases, offset producers can practice risk management by taking precautions. For example, project managers can reduce losses with “appropriate forest management”—increasing frequency of forestry rotations and spacing individual trees farther apart (Galik and Jackson 2213). Pooled offset projects can also manage risk: project participants can reduce individual risk and loss potential by pooling and sharing it with other participants (Thomassin 1176).

Other strategies manage risk through offset distribution. One proposal involves “time-delayed crediting”: some offsets are withheld from sale as protection against nonpermanence and distributed later after a set period (Thomassin 1174). If an offset project sequesters fewer tons of CO_2 equivalent than are promised, the offset producer never receives payment for the reserve offsets; this method thus encourages offset producers to monitor and maintain projects. Another proposal demands offsets’ replacement during a carbon reversal, holding producers liable (Thomassin 1174). Wong and Dutschke provide an example that requires destruction of invalid carbon offsets within 15 days and replacement at seller’s expense in 120 days (p. 10). Replacing invalid offsets is not impossible with proper management; furthermore, this scheme allows carbon-emitting firms to invest confidently. A final proposal involves temporary validation, which Thomassin (2004) claims “provides the greatest flexibility for both buyer and seller in the offset market” (1174). This claim assumes buyers can determine whether to reduce emissions or purchase more offsets, and that temporary offsets’ validation timeframes allow sellers to make necessary operational changes (Thomassin 1174). Dutschke and Schlamadinger note, however, that temporary offsets may not offer lasting emissions reductions (1).

Farmers could retain salable offsets to provide buffers against carbon reversals. With large buffers, offset producers can achieve promised emission reductions even with carbon reversals. Buffer programs already exist: the Voluntary Carbon Standard demands a buffer payment in proportion to project risk, and some markets demand contribution to a buffer pool regardless of project type (Galik and Jackson 2213). Market-wide buffers secure participants against reversal by providing compensatory communal offset pools. A final proposal involves insurance, which imposes liability on insurers and encourages producers to cut insurance costs through risk management (Thomassin 1174). This proposal assumes offset insurance is available—few insurance companies offer carbon coverage due to added risk associated with unanticipated human disturbances, such as population and timber demand (Wong and Dutschke 5–6). On the other hand, policies following the Canadian model explored by Wong and Dutschke (2003) require insurance for project validation (9). Regardless, insurance is a promising risk management strategy if it becomes more prolific.

INTERPRETATION

Agricultural carbon sequestration presents an opportunity to mitigate large amounts of carbon. Because biological processes accomplish this feat, most offset programs need little maintenance apart from managing the physical stability of the area. Revenues from offset sales can also support investment in agriculture, and agricultural sequestration projects produce positive externalities that can benefit local areas.

Despite these boons, uncertainty regarding carbon markets and offset programs remains. Congress must first approve legislation for market guidelines and regulations. Such factors include baselines, allowances, trade pricing, and eligibility. CRS Report R41086 (Feb. 26, 2010) explains that “the [carbon market] program’s underlying requirements and protocols for any participating sector will substantially affect the availability and cost of offsets as well as the direct economic impacts” (CRS “Potential Implications” 6). Provided cap-and-trade legislation allows carbon offset trading, market administration must approve agricultural carbon offsets. Agricultural carbon offsets could benefit U.S. agriculture, but administrators could rule against agricultural offsets because of their risks. Market regulations may influence whether to support or oppose agricultural offsets, as strong regulations minimize nonpermanence through stronger safeguards. However, passing cap-and-trade legislation requires political consensus, and conflict often plagues U.S. politics.

Even if agricultural offsets become viable, whether farmers will engage in carbon sequestration projects is uncertain. The capacity for multiple land-uses presents a strong incentive, but farmers may be deterred by the extensive time commitments of agricultural offsets. There are also multiple additional deterrents to farmers making the necessary changes. CRS Report R41086 notes several such deterrents, which may include the desire to maintain a farming lifestyle, the ability to receive supplemental income from farms, the ability to bequeath farmland as inheritance, the capacity of farmland to serve as homeland, the risk of participating in carbon markets, the possibility of forfeiting farm benefits, and the potentially high transaction costs of carbon markets (CRS "Potential Implications" 7–8). Undertaking offset projects may also impose changes in land practices, as "converting cropland to forestland substantially alters the day-to-day, on-the-ground practices of the landowner, and requires a different set of tools and equipment" (CRS "Potential Implications" 13). Also, because "land availability is perhaps the most critical factor for farm and forestry offset projects" (CRS "Estimates of Carbon Mitigation" 8), profits from offset sales must outweigh opportunity costs from land-use activities the farmer abandons for sequestration. Some offset programs would not make farmers forsake their lands or lifestyles, but the consideration nevertheless remains important.

Establishing credibility is an issue because of additionality. Determining the baseline is complicated, as it is often unclear if a project that could sequester carbon is doing so for that reason. For example, van Kooten, Laaksonen-Craig, and Wang (2007) question additionality in soil carbon sequestration practices, as farmers may implement them to improve soil fertility and limit expenses instead of sequestering carbon (2). Schapiro (2010) takes issue with additionality along these lines, as "the process [of determining additionality] is fraught with obstacles of definition" (34). Evaluating additionality between different projects is problematic due to differing standards and values (CRS Ramseur 4). The question arises as to whether offset producers should receive payment for any sequestration project regardless of intent, especially because many offset projects produce external societal benefits.

There remains the consideration of sufficient monitoring and oversight. Offsets from many agricultural programs are difficult to verify (CRS "Estimates of Carbon Mitigation" 4), and monitoring and accreditation for European offset projects already call for substantial oversight staff and inordinate maintenance requirements (Schapiro 38). However, insufficient oversight means that "overestimating reductions is the trapdoor in the offset system. Study after study has demonstrated that CDMs have not delivered the promised amount of emissions reductions" (Schapiro 34). Addressing market needs requires many offset accreditation and validation firms, with multiple firms in every region practicing agricultural sequestration. While no reason exists for monitoring staff without an established market, carbon offsets remain a risky and impractical investment without monitoring to ensure validity.

CONCLUSION AND SUGGESTIONS

While agricultural carbon offsets present an important opportunity for carbon mitigation, too many loose ends remain.

Carbon market legislation remains unimplemented, and carbon markets require significantly more monitoring capacity. Drafting legislation requires political will and consensus noticeably absent from American politics; efforts must begin by fostering compromise and agreement. To found a carbon market, carbon monitoring must also address multiple carbon-emitting firms and sequestration activities. There is also little research regarding benefits of agricultural carbon sequestration. Many of the studies, papers and articles reviewed throughout this report focused on drawbacks with agricultural offsets or echoed a small list of benefits. Studying benefits from agricultural sequestration could help promote its implementation. Agricultural carbon sequestration activity could also increase through compensating individuals for associated external benefits. Finally, there are multiple barriers to producing agricultural offsets, including time constraints, land ownership, and accreditation requirements. Without sacrificing efficiency, carbon market administrators should negate impediments to eligibility.

Agricultural carbon offsets and markets remain a complicated but potentially viable means of reducing atmospheric concentrations of carbon dioxide. If additional research can address the current risks, inequities, and regulatory inadequacies, the agricultural sector may yet play a major role in mitigating greenhouse gas emissions and combating global warming.

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Literature Cited

[1] Dutschke, Michael and Bernhard Schlamadinger. "Practical Issues Concerning Temporary Carbon Credits in the CDM:" HWWA Discussion Paper No. 227. Hamburg, Germany: Hamburg Institute of International Economics, May 2003. Print.

[2] Freedman, Bill, Graham Stinson, and Paresh Lacoul. "Carbon Credits and the Conservation of Natural Areas." *Environmental Reviews* 17 (2009): p. 1–19.

[3] Galik, Christopher S. and Robert B. Jackson. "Risks to Forest Carbon Offset Projects in a Changing Climate." *Forest Ecology and Management* 257 (2009): 2209–2216. Print.

[4] García-Oliva, Felipe and Omar R. Masera. "Assessment and Measurement Issues Related to Soil Carbon Sequestration in Land-Use, Land-Use Change, and Forestry (LULUCF) Projects Under the Kyoto Protocol." *Climatic Change* 65 (2004): 347–364. Print.

[5] Kennett, Steven A. "National Policies for Biosphere Greenhouse Gas Management: Issues and Opportunities." *Environmental Management* 30.5 (2002): 595–608. Print.

[6] Lal, R. "Soil Carbon Sequestration Impacts on Global Climate Change and Food Security." *Science* 304.5677 (2004): 1623–1627. Print.

[7] Marland, Gregg, Bruce McCarl, and Uwe Schneider. "Soil Carbon: Policy and Economics." *Climatic Change* 51 (2001): p. 101–117. Print.

[8] Schapiro, Mark. "Conning the Climate: Inside the Carbon-Trading Shell Game." *Harper's Magazine* February 2010: 31–39. Print.

[9] Taiyab, Nadaa. *Gatekeeper Series, 121:* "The Market for Voluntary Carbon Offsets: A New Tool for Sustainable Development?" London: International Institute for Environment and Development, 2005.

[10] Thomassin, Paul J. "Canadian Agriculture and the Development of a Carbon Trading and Offset System." *American Journal of Agricultural Economics* 85.5, Proceedings Issue (December 2003): 1171–1177. Print.

U.S. Congressional Research Service.

[11] "Carbon Leakage" and Trade: Issues and Approaches (R40100; Dec. 19, 2008) by Larry Parker and John Blodgett.

[12] Estimates of Carbon Mitigation Potential from Agricultural and Forestry Activities (R40236; Jan. 26, 2010) by Renée Johnson, Jonathan L. Ramseur, and Ross W. Gorte.

[13] Market-Based Greenhouse Gas Control: Selected Proposals in the 111th Congress (R40556; Feb. 26, 2010), by Jonathan L. Ramseur, Larry Parker, and Brent D. Yacobucci.

[14] Potential Implications of a Carbon Offset Program to Farmers and Landowners. (R41086; Feb. 26, 2010) by Renée Johnson, Jonathan L. Ramseur, Ross W. Gorte, and Megan Stubbs.

[15] Provisions Supporting Ecosystem Services Markets in U.S. Farm Bill Legislation. (RL34042; Dec. 15, 2009) by Renée Johnson.

[16] Voluntary Carbon Offsets: Overview and Assessment (RL34241; May 7, 2009), by Jonathan L. Ramseur.

[17] United States Environmental Protection Agency. "Endangerment and Cause or Contribute Findings Under Section 202(a) of the Clean Air Act: Final Rule." *Federal Register* 40 CFR (Dec. 15, 2009): 66496-66546.

[18] van Kooten, Cornelis G., Susanna Laaksonen-Craig, and Yichuan Wang. "Costs of Creating Carbon Offset Credits via Forestry Activities: A Meta-Regression Analysis." Victoria: Resource Economics and Policy Analysis Research Group, 2007.

[19] Willis, Kenneth G., Guy Garrod, Riccardo Scarpa, Neil Powe, Andrew Lovett, Ian J. Bateman, Nick Hanley, and Douglas C. Macmillan. "Social and Environmental Benefits of Forestry Phase 2: The Social and Environmental Benefits of Forests in Great Britain." Edinburgh: University of Newcastle Centre for Research in Environmental Appraisal & Management, June 2003.

[20] Wong, Jenny, and Michael Dutschke. HWWA Discussion Paper No. 235: "Can Permanence Be Insured? Consideration of some Technical and Practical Issues of Insuring Carbon Credits from Afforestation and Reforestation" Hamburg, Germany: Hamburg Institute of International Economics, June 2003. Available at SSRN: <http://ssrn.com/abstract=419702> or <doi:10.2139/ssrn.419702>.