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**BUSINESS APPROACHES TO AGRI-ENVIRONMENTAL MANAGEMENT:
INCENTIVES, CONSTRAINTS AND POLICY ISSUES**

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**BUSINESS APPROACHES TO AGRI-ENVIRONMENTAL MANAGEMENT:
INCENTIVES, CONSTRAINTS AND POLICY ISSUES**

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PUBLISHER'S NOTE

The views expressed in this document are those of the author, and do not necessarily reflect those of the Organisation or its Member countries

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FOREWORD

This report was prepared by Dr Chantal Line Carpentier (Commission for Environmental Cooperation, Montreal, Canada) and Professor David E. Erwin (Portland State University and Winrock International, United States of America), for discussion in the Joint Working Party on Agriculture and the Environment.

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**BUSINESS APPROACHES TO AGRI-ENVIRONMENTAL MANAGEMENT:
INCENTIVES, CONSTRAINTS AND POLICY ISSUES**

by Chantal Line Carpentier¹ and David E. Ervin²

Steady progress has been made over the past decade in improving methodologies for analysing the economic and environmental effects of agricultural policy reform. An “ideal” methodological framework should include the dynamic shifts in geo-spatial production and environmental relationships, linkages to other sectors, indirect and spillover effects, and the influences of agri-environmental policy including R&D (Ervin 2000). Although the empirical analyses have not captured all elements of the ideal framework, they have advanced considerably (*e.g.*, Beghin, et al).

One neglected aspect of analysis is the farm or agribusiness manager’s response to the public’s growing demand for environmental quality. In particular, the recent trend toward voluntary business environmental management³ (BEM) has received scant attention, yet many large and some small firms have taken the initiative to integrate environmental management into their business systems, rather than await often inflexible government directives. Scholars and policy officials agree that voluntary BEM initiatives are necessary, but not sufficient, to attain social environmental objectives in a cost-effective manner (Khanna; OECD 2001). Public programs, preferably approaches that set performance standards, when feasible, and allow flexible business responses, remain essential to provide adequate incentives for BEM and assure the social objectives are met. Thus the private BEM approaches generally can be viewed as complements to cost-effective public agri-environmental programs.

BEM does not appear to be as common in agriculture as other sectors. The reasons might include any combination of the following:

- The scale, size, and nature of operations — individual farms scattered in the landscape generating diffuse pollution are not as visible to the public as larger industries’ pipes or stacks.
- Exposure to consumer concerns — farmers are at the beginning of the production chain and do not generally deal directly with consumers and boycotters.

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 2. Professor, Environmental Studies, Portland State University (ervin@pdx.edu), and Senior Policy Analyst, Wallace Center for Agricultural and Environmental Policy, Winrock International. Senior authorship is not assigned. The authors thank Darryl Jones, Wilfrid Legg and Luis Portugal for helpful review comments.
 3. The professional literature commonly uses “corporate environmental management” (CEM) to refer to voluntary business environmental management initiatives. Because agriculture has many firms that are not corporations, the more inclusive label of business environmental management, BEM, is used here.

- Buffer from market forces — a variety of government support programs tend to buffer farmers from market forces.
- The nature of government environmental programs — fewer mandatory regulations and standards affecting agriculture.

Underlying forces suggest that more farms and agribusinesses will move in that direction. Improved environmental quality has become a broadly held public objective in virtually all OECD countries, due in part to the positive income elasticity of demand for environmental goods and services. Based on a comparison of income elasticities of demand, the values of a farm's environmental effects will likely rise relative to the values of food and fibre (Crosson). Thus, with continued income growth, it is not a matter of whether to control pollution or increase environmental services from farms and agribusiness, but by how much, with what mechanisms, and how fast. For example, direct marketing, an increasing trend in North America, reconnects farmers to consumers and is one way to foster BEM⁴.

There is a growing appreciation that government policies must be augmented by private initiatives to achieve cost effective and sustainable solutions to agri-environmental problems. An increasing number of farms and agribusinesses are experimenting with new production processes that use systemic approaches to environmental management (OECD 1998). Examples of practices include precision applications of chemicals and water that reduce on- and off-farm leakages, crop rotations for biological pest control to replace toxic pesticides, advanced composting processes for organic agriculture production to replace synthetic fertilisers, animal husbandry reflecting animal welfare critics, and marketing food products with environmental attributes that certain consumers desire.

This paper addresses business environmental management in agriculture, in particular the incentives and constraints farmers face in pursuing such initiatives, and related policy issues. We begin by listing the basic forces that should encourage more BEM, and review the theory and empirical findings, mostly for non-agricultural industries. Next, we revise the typical formulation of a business' profit function to reflect voluntary environmental management decisions in agriculture. The third part of the paper uses this business agri-environmental model to discuss the potential implications for public and private agri-environmental policy, including research and technology development (R&D). The closing section identifies research, data and educational needs such that BEM can complement agri-environmental programs in OECD countries.

Economic Research on Business Environmental Management⁵

Business managers face a bewildering array of national, state (provincial) and local environmental programs in most OECD countries. The transaction, administrative and compliance costs of meeting the diverse program requirements, some working against each other, can be substantial. Many businesses also face markets that increasingly reward the environmental performance of their firm or product. One managerial approach to reduce environmental program costs, retain operating flexibility, and capture market returns for environmental quality attributes is to undertake voluntary actions that meet or exceed public environmental standards (Reinhardt). As the transaction and administrative costs of diverse public programs increase and the market for "green" products expands, business managers, including farmers,

4. Most examples in this paper are North American reflecting the authors' knowledge and experience, but similar examples can be found throughout other OECD countries.

5. This section and the next builds on a book chapter by David E. Ervin and Frank Casey "The Changing Economics of Agriculture and the Environment" in *Agricultural Policy for the 21st Century*, Iowa State University Press, L. Tweeten and S. Thompson, editors, 2002.

have increasing incentives to pursue private environmental initiatives as a profit-maximising strategy, *ceteris paribus*. Though still a minority, some companies are replacing end-of-the pipe reactive strategies with more holistic approaches including more efficient production processes, preventive strategies, cleaner technologies and procedures throughout the product life cycle (OECD 2001).

A number of businesses are indeed starting to view environmental management as an integral part of their long-run strategy for maintaining competitiveness (Esty and Porter; Reinhardt). The reasons are diverse, and often firm-specific, but are basically grounded in the recognition that the public's robust demand for improved environmental conditions will not likely abate. The increasing demand for environmental quality has manifested itself mostly in the policy arena since 1970 through an increasing number of programs and/or higher standards. Now the public's demand is increasingly surfacing in the market with firms supplying a variety of "green" products. Recent actions by Ford and General Motors to increase the fuel efficiency of their sport utility vehicles illustrate the potential actions by major corporations. A broadening segment of consumers and investors are rewarding firms that supply competitively priced products that possess environmental qualities. Some firms are adopting BEM strategies in response to market and other pressures by non-governmental interest groups.

Types of voluntary business environmental initiatives

Research on "voluntary" business environmental initiatives is young, but growing rapidly (Lyon and Maxwell; Reinhardt; OECD 2001). Segerson and Li and Khanna chronicle the evolution of thought and interpret the varied strands of theory on BEM. Unfortunately, only sparse empirical tests of hypotheses have been performed, of which very few have been in agriculture. A common theme from the nascent literature is that businesses that adopt voluntary environmental initiatives, including agricultural firms, do so to capture gains from flexibility such as designing pollution prevention systems that best fit their operations, rather than responding to government directed practices (Casey et al.; OECD 2001).

However, the possible motives for adopting BEM are broader, ranging from entering new green markets with differentiated products, to gaining "first-mover" advantages over competitors, to persuading regulators to delay inflexible controls, and to avoiding interruptions to trade. The privately-led environmental initiatives need not come solely from the business sector. Indeed, the roles of environmental non-governmental organisations (ENGOS) in stimulating BEM may also be important, although they are one of the least appreciated and studied forces of these "voluntary" business actions. For example, without pressure from ENGOS, Home-Depot's and Lowes' decisions to buy certified wood and Starbuck's decision to buy Fair Trade shade coffee (grown under forest canopy) would have not been announced so early. Such incidents are forcing major multinationals to show goodwill or to build social capital in terms of demonstrated environmental and social investments to avoid being the victim of pressure or boycotts by ENGOS. However, the potential roles for ENGOS extend beyond pushing the firms to adopt certain practices. For example, they have started providing criteria and third party certification to assure consumers they get what they pay for (*e.g.*, ECO-OK bananas, coffees, etc. of Rainforest Alliance, and SmartWood of the Forest Stewardship Council). Some ENGOS are building alliances with private firms to help deliver essential services, such as technical assistance and certification.

As in other business sectors, the farm or agribusiness manager may pursue one or more of three types of voluntary initiatives:

- *Unilateral initiatives* by individual firms to control pollution or by industry groups to establish industry standards or to self-regulate. The Chemical Manufacturers Association's "Responsible Care" program to reduce hazards from the manufacture and use of chemicals is an example of group action. This private collective action followed closely on the heels of the

Bhopal chemical spill disaster in India. Also in the U.S., a group of farmers under the Land Stewardship Project is voluntarily implementing non-point source pollution controls (Land Stewardship Project). In the U.S. Pacific states, farmers are changing their practices to minimise impacts on salmon habitat and market their products as “salmon-safe.” More and more agricultural counties are moving towards an appellation that links the product sold not only to the process but also to the region where it is produced. Examples include Humboldt Harvest (Humboldt County), Lake County, and Siskiyou County in California.

- ***Bilateral or negotiated agreements*** between the government and private firms that usually contain a voluntary environmental target and a timetable for reaching the target (OECD 2001). One bilateral approach is the U.S. Environmental Protection Agency’s (EPA) Project XL, initiated in 1995, that allows a firm to violate some statutory requirement if it can demonstrate that it will achieve higher environmental performance. For example, Kodak requested relief from the requirement that it wait 90 days after submission of pre-manufacture notice before beginning manufacture of new chemicals. Kodak requested that it wait 45 days instead of 90 days because it intends to use EPA's pollution prevention framework in the development of its products to ensure that its products are as environmentally benign as possible. To date, 50 final project agreements have been approved with companies, cities, utilities, and government services such as Postal Service. Another example is the U.S. Pork Producers Council negotiations with the EPA on “voluntary” strategies for reducing air and water pollution emissions from large confined animal facilities in the mid-1990s, ostensibly to avoid more direct controls that would restrict growers’ options. OECD (2001) identifies 300 bilateral or negotiated agreements in the EU and 300,000 in Japan.
- ***Government incentive programs*** designed to induce voluntary participation by individual firms (farms). The programs may include educational, technical assistance, financial or other incentives. This type of program has been the predominant approach for agri-environmental management in OECD countries. Examples include payments for the protection of environmentally sensitive areas in the UK, the Eco-Management Auditing Scheme in the EU, and payments for land set aside under the U.S. Conservation Reserve Program (CRP).⁶ Government incentives are popular in the U.S., where 40 different programs have been identified (OECD 2001).

6. Although these programs are voluntary and contain incentives, not all conform to the spirit of new business-led strategies that firms be granted broad flexibility to reengineer their production systems. Indeed, some programs require the firms to implement specific practices to be eligible for the payments and thereby often restrict the flexibility of farmer responses. The U.S. Environmental Quality Incentives Program (EQIP) has departed from the traditional model to some degree by granting more flexibility in designing farm-specific practices, but evidence on its performance is not yet available.

Pacific Rivers Council — Salmon-safe

Launched in 1997, Pacific Rivers Council's Salmon-Safe program works to restore water quality and salmon habitat in the agricultural watersheds of the Pacific Northwest (PRC, 2000). One of the tools to achieve this goal is the Salmon-Safe certification of farmers and retailers. Salmon-Safe evaluates farms that are using conservation practices benefiting native salmon and certifies them if certain standards are met. The program also promotes the products in the marketplace through public education and marketing efforts which certified farmers hope will confer some market advantage, either market share or price premiums. The PRC has completed a two-year retail marketing promotion for Salmon-Safe farmers in more than 200 natural food stores and supermarkets, including Fred Meyer stores throughout the western United States. More than 10,000 acres have been certified Salmon-Safe, including both organic and conventional farms. Certified products include Salmon-Safe wines, fruits, juices, rice, and dairy products. Practices address riparian area management, water use management, erosion and sediment control, chemical use management, and animal management.

The unilateral and bilateral efforts are likely to increasingly spill into agriculture due to robust public demands for environmental improvement, such as reducing nonpoint pollution. However, OECD (2001) finds limited evidence demonstrating the environmental effectiveness of these agreements, and recommends that they be implemented with other policy instruments, such as ambient environmental performance standards. Khanna reinforces this point in a recent review of the BEM literature:

“The theoretical literature surveyed here shows that the efficiency and effectiveness of voluntary approaches can be enhanced if there are stringent legislative threats” (p.321).

BEM may be seen as a way to avoid inflexible regulations, especially those requiring specific pollution control technologies, known as technology-design standards. However, the literature makes clear that performance-based regulatory standards and voluntary BEM are complements, not substitutes. Although agriculture has not been subject to as many environmental regulations as other industrial sectors, the numbers appear to be growing. A recent assessment of the situation in the European Union, U.S., Canada, Australia and New Zealand suggests that an increasing number of environmental regulations apply to agriculture, especially at the sub-national level (Brouwer et al.).

Types of motivations for voluntary BEM initiatives

Early research on BEM in agriculture divided the driving forces into compliance-push, and demand-pull categories (Batie and Ervin). Compliance-push forces generally emanate from the expectation of stronger public environmental program requirements. Demand-pull forces are led by private market/consumer preferences for specific environmental quality attributes. The BEM literature now identifies six types of motivations, although evidence on most of these motivations is sparse in agriculture⁷. More than one may apply to a firm. For example, the owners of Stahlbush Island Farms in Oregon argue that successful BEM must be a systems approach that links all input, production and marketing operations (Chambers and Eisgruber).

7. See Swinton et al. for a discussion of processors contracting growers to use green technologies. OECD identifies five drivers (1) government policies and regulations, (2) commercial and economic considerations, (3) corporate image, (4) codes of conduct, and (5) growing pressures from financial/investment community.

Improve productivity. Some authors argue that the creation of integrated production and marketing systems and other tasks necessary to implement a BEM program, such as environmental audits, can lead to cost reductions and/or opportunities for new products⁸ (Esty and Porter; Reinhardt). It is possible that, by evaluating their operations in the light of public or market environmental concerns, firms may find productivity gains and/or cost savings due to new information and R&D. For example, Dupont's Nylon facilities achieved a 99.8% conversion of ingredients to products and by-products, leaving only 0.2% of waste to be treated (Tebo). The plant reduced waste treatment costs and increased business value by turning more of its ingredients into useful products and less into waste. Kodak, facing negative public responses to its disposable camera adapted by producing a single-use camera that is returnable for recycling. Approximately 77% of the components are recycled, and the return and recycle system has considerably decreased costs for Kodak. Productivity gains may also come from improved management of the firm's natural resources that lowers production costs in the short-term or long-run. Examples in agriculture include increased irrigation efficiency as water supplies decrease or reduced erosion of fragile topsoils. Boggess and colleagues estimated productivity gains for a subset of dairy farms that adjusted to higher nutrient pollution control standards for Lake Okechobee. The regulations encouraged these dairy farms to adopt new production technologies that simultaneously reduced water pollution and improved net returns. Some other dairy farms moved to new locations to avoid the added regulatory costs, a lesson that not all farms will find BEM profitable in all situations.

It is natural to ask why the firms did not discover the savings prior to the new standards or pressures from ENGOs. The reasons are likely similar for not discovering any innovation prompted by other public policy shifts. In some cases, missing markets or poorly functioning public institutions may hinder such discoveries. For example, OECD (2001) reports that though 82% of managers believe sustainable development offers business value, only 17% had made significant progress in this regard. Only one percent thought sustainable development was a passing fad. A review of U.S. agri-environmental regulations found that, in many cases, the increase in management and other costs was more than compensated by the reduction in fertiliser and pesticide costs from increased precision of application (Carpentier and Ervin). A review of the empirical evidence by the OECD (2001) concludes that overall there appears to be a positive correlation between environmental and commercial/financial performances.

Differentiate products for "green" consumers and investors. Although still a small portion of the market, retail products and investment funds that emphasise environmental objectives are increasing rapidly in many OECD countries. Successful product differentiation on environmental grounds requires that the firm discover or create: (a) a willingness among customers to pay for the quality attribute(s), (b) an ability to communicate credible information about its product, and (c) protection from imitation by competitors (Reinhardt). Environmental actions by firms to gain entry into foreign markets, such as product recycling, fall in this category. Some food retailers have begun "natural foods" programs to meet growing consumer demand, such as for foods produced under integrated crop management (ICM) in EU countries (Brouwer and Bijman) and organic methods (DiMitri and Richman). However, part of this growth may reflect perceived reductions in health risks rather than environmental effects. The growing market for shade-grown less intensively-produced coffee is another example in agriculture of responding to green consumerism (CEC 1999). There is some evidence in export-oriented countries such as New Zealand that the switch to more environmentally benign production methods has been fostered by demand further up the processing and retailing chain (Brouwer, et al). There is increasing evidence that companies that invest in BEM can do at least as well economically as other companies (OECD 2001; Asmundson and Foerster). More than 200 "green funds", including Environmental Value Fund, and the Global Care Asia Pacific Fund have also emerged. In the U.S., socially responsible funds make up 12% (by asset value) of funds

8. An array of methodologies are available to assist managers in conducting a systematic search for potential benefits from reducing environmental wastes and reusing environmental byproducts, such as life cycle assessments.

under active management (Social Investment Forum), while they represent much less elsewhere. Eighty percent of the socially responsible U.S. funds use an environmental screen. There is also an increasing number of specialised environmental rating companies that are providing financially relevant environmental information such as Sustainable Asset Management Switzerland, Safety and Environmental Risk Management Rating Agency Ltd (UK), Innovest Strategic Value Advisors (US), Kinder, Lydenberg, Domini & Co. Inc (US), and Michael Jantzi Research Associates (Canada).

Pre-empt or mitigate future environmental regulations. Lyon and Maxwell cite ARCO's introduction of reformulated, cleaner gasoline as an example of this strategy. The pulp and paper, poultry and hog industry's principles are examples in natural resource based industries. OECD (1998) noted this same motivation as a major factor in farmers voluntarily forming community-based associations to achieve improved environmental conditions. Such incentives may loom larger for agriculture as the public and ENGO pressures rise to remedy water pollution problems. A U.S. example is the excess of nutrients largely from fertiliser applications runoff or leaching causing a 'dead zone' in the Gulf of Mexico. However, the transaction costs of building coalitions of diverse farming interests may restrict effective voluntary initiatives in such cases. OECD (2001) also reports that the shift away from command-and-control and towards performance and market-based approaches has been an important motivator for BEM. To continue the motivations, standards need to be raised regularly to reflect the advances being made by industry leaders. This category of motivations also includes actions to assure foreign market access that might otherwise be closed by non-tariff trade barriers. The case of trade in products of agricultural biotechnologies may apply here.

Strategically manage competitors. Incurring additional costs to improve environmental performance may increase some firms' profits if the actions cause competitors' costs to rise even further than their own (Salop and Scheffman). Firms known as "first movers" may create a strategic cost advantage by forcing their competitors to follow their examples. Part of the reason for Ford's recent decision to push for higher fuel efficiency performance of its sport utility vehicles may have been to raise its competitors' costs. GM's quick response suggests that it may work. As the standards on pesticides tighten under the U.S. Food Quality Protection Act, the incentive for a major agribusiness supplier to capitalise by moving first to "over-comply" increases.

Redefine markets to capture more value. This strategy combines cost reduction, product differentiation, and competitor management to shift market conditions and capture more value along the supply and marketing chains (Reinhardt). Chambers and Eisgruber describe how Stahlbush Island Farm managers lessened their "environmental footprint" by using diverse crop rotations, growing nitrogen sources, reducing or eliminating pesticides, protecting ground water, engaging in soil and product residue testing, water reuse, recycling and composting. The authors claim a key requirement that allows the use of such environmentally friendly techniques is their ability to identify and contract with customers in advance of production. Another requirement is the existence of a market segment willing to pay for the perceived quality attributes. Examples also exist in the wildlife arena whereby some ranchers have differentiated their wool or beef products as made with "predator friendly" production systems (Robles). The increase in labels of control of origin, a "place-based" label aimed at protecting proprietary food-production and processing methods, falls in this category. A label of origin informs consumers of the production and processing method used for the product. This signal creates the opportunity for producers to receive an incentive to grow and process their food and fibre using sustainable practices. Branded products are also easier targets for consumer boycotts; thus firms and farms producing these products have an incentive to produce them with greater care for the environment.

Manage risk and uncertainty more effectively. Reinhardt argues this strategy can be effective, particularly if it serves as a source of competitive advantage. A firm is naturally concerned with the risk of financial harm from environmental incidents. The types of financial harms include the cost of cleanup from an

environmental accident, legal liability for environmental damage, foregone profits due to the interruption of business practices pursuant to an environmental accident, and losses caused by a damaged reputation in the eyes of government officials, consumers and the public. If large confined animal facilities are threatened with large non-compliance penalties and legal suits, pre-emptive voluntary action may be a least cost approach for some. If a product is likely to be the target of an ENGO boycott, pre-emptive actions may also prove cost-effective. Corporate image and brand value was identified by the World Business Council for Sustainable Development's survey as the top list of drivers for BEM initiatives (OECD 2001). Companies such as Shell Corporation have included sustainable development principles into their strategy after boycotts from environmental groups (*e.g.*, the GreenPeace boycott of Shell in reaction to the proposal to dispose of Brent Star in the North Sea). Companies that use environmental responsibility to enhance their corporate image have increased sales, attracted more capital, and improve their chances to recruit, retain, and motivate employees (OECD 2001).

Factors influencing the adoption of BEMs

Given the early stage of research on factors that affect the adoption of BEM strategies, the findings are not robust, and sometimes inconsistent. However, some themes have emerged. A brief summary of major findings follows. Readers are referred to Khanna, Lyon and Maxwell and Segerson and Li for comprehensive reviews of the evidence and interpretations for policy.

The probability to undertake voluntary business environmental initiatives appears to increase for: (1) larger firms; (2) firms with higher R&D intensities; (3) firms with poorer environmental records, (4) firms facing increased future government regulation, and greater pressure from community, environmental and industry groups; (5) firms closer to consumers, (6) publicly traded firms; and (7) firm specialised in narrowly-defined product areas.

The major findings related to investor pressure are: (1) investors react negatively to higher than expected levels of toxic emissions, (2) firms are rewarded for superior environmental performance, and (3) firms respond to environmentally-induced investor pressure by improving their environmental performance. OECD (2001) also finds that eco-efficiency is seen by investors as a proxy for good management. Specific empirical evidence on agriculture is virtually non-existent.⁹

Many of the findings should apply to agri-businesses. However, with the exception of labels of origin, the reasons may not apply to farms because of their small size and heterogeneous production characteristics and the relative lack of environmental regulation. As farms get bigger and more vertically integrated, such as large confined animal facilities, they may be better able to capture economies of scale and lessen the cost of environmental programs and may be easier to regulate as point sources.

A Business Decision Model for Agri-Environmental Initiatives

A stylised model of a firm's decisions about voluntary environmental initiatives helps frame hypotheses about those decisions and identify needed research. This model differs from typical formulations used to analyse farmer responses to agro-environmental programs in important ways. For example, product quality differentiation (*e.g.*, through vertical integration, contracting or label of origin) with some influence by

9. This statement does not include the empirical work on farmers' responses to voluntary and compensatory government programs, such as for land set aside, which has been researched extensively. However, that research usually approaches the subject from the perspective of farmer incentives to maximize net benefits using government programs that require specific practices, not from implementing a BEM approach.

firms over price, and the administrative/transaction costs¹⁰ in environmental management decisions are treated explicitly. Also, the model is cast as a multi-period, dynamic decision process that includes investments in R&D, equipment, and education.

First, consider a standard static economic model of a farmer's environmental management decisions to identify differences with the model of voluntary initiatives:

$$\text{Max } [(P \times Q) - (PC + CC) + GP] \text{ Such that } EQ \leq EQ^* \quad (1)$$

where: P is a vector of given product prices (*i.e.*, the farmer is a price taker), Q is a vector of undifferentiated products, PC is a vector of production and marketing costs for the products, CC = environmental compliance costs for the farm, including private treatment or remediation expenditures, and GP = government payments for environmental management, which can be positive, *e.g.*, cost-share for practice adoption, zero, or negative in cases where penalties are applied when the farm's level of environmental quality achieved, EQ, is less than or equal to a compulsory public environmental standard, EQ*. It has been argued that the added cost of agricultural production in the temperate zone due to previous mismanagement and environmental deterioration are not felt in a short enough time horizon to be taken into account into the farmer's profit optimisation decision. Therefore, PC is not a function of EQ for farmers in equation (1) and environmental effects are not internalised into farmers' decisions. In that case, and in the case of diffuse pollution where regulations are difficult to enforce, EQ may well be below EQ*.

Assuming a specific technology set that produces a constant or increasing amount of pollution per unit of output, the compliance costs (CC) are a direct function of the level of Q produced. Such a formulation of farm environmental management leads inevitably to a trade-off between improved environmental quality and short-run profit. In this static model, the only way to hold the farmer's profit constant is to compensate him for the reductions in output or the increased costs to change technology to reduce pollution per unit of output.¹¹ This is precisely what happens in some of the agri-environmental programs of OECD countries. For example, the U.S. pays farmers to take environmentally fragile lands out of production under the CRP (offsetting the cost of lost output), or provides cost-sharing to install pollution control equipment under other compensation programs. Such approaches are often preferred because of the diffuse nature of non-point pollution and the high costs of enforcing direct controls, and because of the strong lobbying power of agricultural groups (present in most OECD countries). These factors help explain why standards, such as EQ*, have not often been applied to farming. However, as noted above, direct controls (regulations) are increasing, especially in some parts of agriculture, *e.g.*, large confined animal facilities. Compulsory standards will likely stimulate the search for BEM approaches in those sectors.

The inclusion of environmental services (*e.g.*, reduction of pollution, and less resource intensive and/or biodiversity friendly practices) requires alterations to the farmer's profit function as environmental services enter consumer (market) demand functions and the production, cost and market supply functions (Antle). Assuming that the farmer's utility can be approximated (under certain limiting assumptions¹²) by

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10. Transaction costs according to Coase are the costs of search and negotiation in completing market or non-market contracts or agreements. They are part of the administrative costs of running a business, but are separated here for emphasis as they may differ under voluntary environmental agreements.
 11. The simple formulation also begs the question of a farmer's economic rationality if he or she undertakes uncompensated voluntary environmental initiatives.
 12. This formulation does not include the potential for personal benefits to the farm operator or owner from particular environmental actions or performance. However, Sen; Hirschman; Etzioni; and; Casey and Lynne all suggest that the single-utility, profit maximization model can be restructured as a multiple-utility model, and tested to integrate personal (non-use) values associated with environmental actions. Examples

maximising profits over time horizon T ($t=1\dots T$), and that increasing the farm's environmental quality, EQ , generates some environmental services that can be marketed, Z , the objective function can be expressed as¹³:

$$\text{Max } \sum_t [(P_t' \times Q_t') \delta(EQ)_t + (P_{Zt} \times Z) - (PC_t' + IC_t + TC_t) + GP_t'] \text{ Such that } EQ <, =, \text{ or } > EQ^* \quad (2)$$

where: t = time period t (the t subscript has been dropped below for ease of exposition); P' = is a vector of prices for a vector Q' of differentiated (with environmental or health quality attributes) and undifferentiated food and fibre products; $\delta(EQ)$ = consumer good will parameter for the firm's overall environmental performance with a value greater than one when recognisable environmental benefits are created, a value of one when no recognisable environmental benefit is created, and a value less than one but greater than zero when recognisable environmental damages are created; P_Z is a vector of prices received for provision of a vector of marketable environmental services (Z) by the farm, such as wildlife viewing or carbon sequestration; PC' = a vector of production, processing and marketing costs; IC = investment costs for system reengineering, and human capital (education and training)¹⁴; TC = a vector of transaction costs and other administrative costs of "green" production and marketing systems, and GP' is as described earlier, although it may be different in magnitude. Note the environmental compliance costs (CC) become part of the firm's production, marketing and processing costs in this formulation. Ceteris paribus, EQ and Z decreases with output, thus to reduce environmental impacts and increase Z supplied, either Q must be reduced ($Q' < Q$) or must be produced with "cleaner" technology. Either action involves short term costs, either through the opportunity costs of foregone revenues or new investments in technology and human capital. Whether net profit will increase or not with increased EQ is indeterminate a priori, depending upon specific farm, market, environmental and policy factors.

In contrast to the model in (1), each variable in the profit function (2) is dependent on the level of EQ achieved, emphasising the integrated nature of systemic BEM. In much BEM literature, the farm's EQ performance is theorised to exceed EQ^* , *i.e.*, super-compliance. This outcome is not guaranteed, especially in agriculture, because of the uncertain environmental effects of the new production and pollution prevention techniques, and the excessive costs of monitoring on-the-ground performance. For example, such monitoring problems may allow unscrupulous farmers to claim a price premium for practices they have not changed.

The first component, $(P' \times Q') \delta(EQ)$, is the market revenue from selling food and fibre products. Farmers may collect a price premium for individual differentiated products and increase their revenue over that possible from selling environmentally-undifferentiated commodities by: (1) creating products that have higher recognisable environmental benefits or lower environmental costs than comparable products, and/or (2) using a production process that causes higher environmental benefits or lower environmental costs than competitors. The requirements for capturing the benefits of product differentiation are: (a) find or create a customer willingness to pay for an environmental quality attribute (*i.e.*, increase P to P'); (b) establish credible information about the environmental attributes to differentiate the product that increase price and/or market share, *e.g.*, private or public third-party certification systems; (c) defend the innovation

of such non-use values include farmers' preferences for specific landscape attributes, and preservation of threatened or endangered species on one's land.

13. Although the analysis focuses on environmental issues, the model also is applicable to perceived health and animal welfare benefits created by the farm.
14. The annual expense for investments in new production equipment, marketing systems, *e.g.*, certification, and training management and labor falls conceptually under PC' . However, it is treated separately from PC' in this formulation to emphasize that the technology set is not fixed, but can be reengineered.

against competitors' imitations, such as through patents (Reinhardt), or in agriculture by branding or establishing a certificate of origin.

The farm's overall environmental performance recognised by the public and its reputation factor, $\delta(EQ)$, should move in the same direction. The value of $\delta(EQ)$ reflects the level of 'environmental goodwill' associated with the production techniques or environmental services provided by the farm, above and beyond or instead of the price premium, which in turn affects returns from its products. Esty and Porter and Reinhardt argue that firms can potentially increase their product prices (*i.e.*, $P' > P$) and/or market shares by establishing a reputation for excellent environmental stewardship (*i.e.*, $\delta(EQ)$ greater than one). Prominent examples of this strategy include Ben and Jerry's, Patagonia and the Body Shop. In contrast, if the public perceives negative environmental impacts from the farm, they may boycott the farm's products and negatively affect revenues (*i.e.*, $\delta(EQ)$ is less than one but greater than zero). As the last case, if the farm's actions do not convey recognisable environmental effects, then $\delta(EQ)$ equals 1, and no revenue effect will occur. To the authors' knowledge, such a firm 'environmental goodwill' factor has yet to be estimated and tested for significance with econometric methods.

The second component, $(P_Z \times Z)$, is the revenue generated by selling a subset of the environmental services in organised markets. Examples include wildlife and landscape access, and carbon sequestration credits. Some opportunities already exist for this type of environmental business. For example, some ranchers provide fee-based recreation, such as hunting and fishing. The difficulty in finding reliable monetary values for some of the environmental services hinders the determination of a profit maximising level of environmental services to supply. Contingent valuation and other non-market valuation methods can be employed in situations where credible values can be estimated, but much research and data collection are necessary to establish reliable values for farmer decision making.

The third component captures the various costs of doing business - the sum of production, marketing and processing (PC'), investment (IC), transaction and other administrative (TC) costs. Generally PC' and IC are positive functions of EQ achieved in the short run because added resources are needed to produce the environmental quality attribute(s). However, this may not be the case in the long run. The discounted sum of the two costs over the firm's planning horizon depends on the equilibrium levels of EQ and Z chosen under the specification of benefits and costs of voluntary agreements, and is therefore indeterminate a priori. It also depends on the discovery of potential "innovation offsets" in which firms lower their long-run unit costs after adopting voluntary initiatives (Porter and van Der Linde; Tebo). Net gains may not be realised if non-competitive or missing markets hinder the search for such production and marketing innovations (Palmer, Oates and Portney). The transaction costs under a voluntary environmental initiative, TC , depend on the search and negotiation costs and other administrative costs. For example, it is conceivable that the transaction costs of implementing a green marketing system in early stages could be substantial, because the markets are thin or new with high search costs. However, these added costs may be offset by saved transaction and other administrative expenses associated with involuntary compliance. The net effect is uncertain, and depends on the particular situation. For instance, in agriculture these costs may be large due to the large number of farms scattered around the landscape.

The final component (GP') is the positive government payments for re-engineering the production, processing and marketing systems or other expenses, or the negative penalties for non-compliance. The agriculture sector in many OECD countries has a long history of receiving cost-share payments to voluntarily install certain practices considered to improve conservation and environmental performance. A variety of instruments (*e.g.*, land rental contracts, easements) are used to compensate farmers for certain environmental services under the "provider gets compensation" rule (Brouwer, et al; Hanley, et al.). Wu and Babcock show the potential net social benefits of such programs primarily depend on lower costs of implementation or enforcement (compared to regulation) versus the deadweight loss from public financing of the voluntary program expenditures.

The use of positive incentives to provide environmental services from agriculture is subject to limitations. First and foremost, OECD (2001) found that voluntary measures alone are not sufficient to achieve the socially optimum level of environmental services. Second, studies of past U.S. cost-share payment programs often have found that they did not gain the most possible environmental value per dollar of expenditure. The EQIP program rules have improved this allocation by targeting high priority geographic areas and state-wide resources of special concern. Third, it is difficult for farm operators to predict future government payments for making long-term investment decisions about agri-environmental initiatives. Permanent or long-term contracts, *e.g.*, easements, for voluntarily selling environmental services are one approach to reduce such uncertainty. Finally, the increasing use of penalties and law suits for certain forms of agricultural production is increasing (*e.g.* large confined animal facilities) suggests some decline in public support for subsidy approaches when serious problems are perceived to merit a compulsory approach.

The standard farm decision models adapted for environmental technology design or performance standards are well known. The models add a technology or pollution constraint that forces the farm to internalise its external costs in its profit maximising decision. First-order conditions show that the marginal value of production is equal to the cost of inputs *plus* the environmental penalty times the marginal environmental damage resulting from one more unit of output. In the model presented in equation 2, farmers may choose to reduce their environmental damage voluntarily and thus not face a penalty (such as a tax) or reduce environmental damage in response to an environmental payment. In summary, the farm's problem is to decide whether the production, investment, marketing, and transaction costs (including productivity improvements and avoided non-compliance penalties), $PC_t + IC_t + TC_t$, of providing increased recognisable environmental services outweigh the expected revenues from increased prices and sales, $(P_t' Q_t') \delta(EQ)_t + (P_z Z)$, in addition to new market revenues for environmental services and potential government payments or penalty (GP') in choosing the desired level of environmental performance.

Reinhardt theorises that industry structure and impending changes in that structure, the relative importance of human capital, and the time horizon for evaluation affect the likelihood of firm cost savings under voluntary environmental initiatives. He offers two general observations about evaluating potential cost savings: (1) the baseline is critical to evaluation - as the price of environmental resources (and non-compliance) rises, it makes good sense to invest in ways to reduce their use, and; (2) few short-term private gains are possible, but in the longer-term, the opportunities may be more widespread. A "green" firm may also hold a relative cost advantage if it undertakes strategic "first-mover" environmental initiatives to disadvantage its competitors. In this model, investments in human capital and new production and marketing systems are made to allow for (but not guarantee) the possibility of a private EQ that exceeds the public EQ* standard (*i.e.*, super compliance). This potential outcome contrasts with the static version that always implies a profit-EQ trade-off, and thus EQ is always less than or equal to the public standard without government payments.

An Eco-Labeling Illustration

The model helps us analyse farms' strategies such as pollution prevention, green marketing, and eco-labelling. In agriculture, the most obvious examples are the emergence of a variety of eco- and origin-labels suggesting that some farmers believe it can increase market returns for their products and their farms. In a period of low agricultural prices and increased attempts by farmers to direct-market their products, such labelling may provide an opportunity for value-added marketing. These labels, unlike product-oriented (ingredient) labels, are process-based (see shade-grown coffee and The Food Alliance examples in boxes).

The Food Alliance — TFA certified

In Oregon and Washington, 50 farmers have completed the process of getting the seal of approval from the Food Alliance. The TFA seal indicates that farmers use sustainable agricultural practices. These practices include reduction or elimination of pesticides, conservation of soil and water, and safe and fair work conditions. These products are sold through stands, markets, or retail stores (34 retail stores have become co-operating members). The cost of certification is \$600 plus \$0.0025 of sales going to the Food Alliance, and other management cost needed to conform to the Food Alliance requirement. Informal reports suggest the TFA certified farmers have not benefited from price premiums to date, nor have they noticed increased sale shares. However, wine growers, for example, find that the same practices that make their farms sustainable are those that make good quality wine (The Food Alliance).

The success of eco- or origin labels depends on consumers' willingness to buy the products over competing brands, and perhaps pay a premium. To capture and maintain the demand for health and environmental quality attributes, consumers must be assured that they are getting what they are paying for. Today, there are at least 25 major labelling schemes for environmental goods in the United States alone. However, many North Americans do not know about them and when they do become aware they exist, the array of claims and certification labels is often confusing. Various third party certifiers have emerged to ensure consumers that the environmental quality claim(s) on a product about farm practice and process are actually accurate. Certification schemes can be private (such as Eco-OK), or public as the first national standards for the labelling and processing of organic food adopted in the United States in 2000. A recent conference on eco-labelling identified five issues that would help realise the potential market benefits identified in equation 2 through eco-labelling: (1) ensuring that products can be found on the shelves (2) adequately training salespeople on products and labels; (3) ensuring that the supply is large enough to meet the demand; (4) negotiating pricing, sourcing, and shelf spaces, and; (5) increasing the capacity of certifiers to keep up with increasing demand from the farmers (Food Alliance 2000).

Shade-grown coffee

Shade coffee is so-named because it is grown under the forest canopy, as opposed to coffee grown in full sunlight. By preserving most of the local ecology intact, shade coffee farmers can rely on natural predators and the natural barriers inherent in a diverse environment, which reduces the need for chemicals. The diverse vegetation also maintains the soil's natural fertility and complex structure thus reducing the need for commercial fertilisers to nurture their plants' growth. Certified shade coffee assures consumers that its production in a standing forest has helped to protect important bird habitat, conserve the diversity of native trees, prevent the loss of topsoil and its nutrients. Shade coffee also has an added socio-economic dimension since many small landowners and their families rely on revenues from coffee grown under shade conditions and benefits from other forest products – such as firewood, medicinal plants and fruit – for their livelihoods. North American residents benefit from shade-coffee because these plantations provide a wintering habitat for shared species such as migratory birds and butterflies that move to the U.S. and Canada in the other seasons (CEC 1999).

The role of environmental reputation, $\delta(EQ)$ is less obvious in agriculture. The most obvious examples would be in cases where improving environmental management practices does not correspond to a product

certification (like organic and thus a price premium may not be collected) but increases the visibility of the farm products and their sales (*e.g.* ISO14,000 certification for plants). Visits to the farms to consume environmental services, Z, may also increase direct farm product sales. Although the magnitude, and even the existence, of this reputation factor have not been tested empirically, a good environmental reputation may also lead to greater share values for publicly traded companies, thus reducing IC and PC'.

Promoting BEM Initiatives

Facilitating more BEM in agriculture would be a major change from current agri-environmental policies in most OECD countries. Present policies use government programs to entice farmers with payments to undertake selected practices that address single issues such as waste management, erosion control, etc. For the most part, the current policies emphasise specific input changes, are not designed to be economically self-sustaining, and are often technology-based rather than human capital based. An example is the temporary removal of cropland from production under a CRP rental contract to control erosion or for other environmental purposes. Once the contract and payments expire, the farmer's economic incentive will be to replant the field, but not necessarily in a system that meets socially desired environmental conditions.

Under policies to promote more BEM, farmers would be encouraged to build their capabilities to develop integrated production, processing and distribution systems that reduce wastes or leakages, serve growing green food and fibre markets, avoid financial and other penalties from environmental spills or other episodes, and identify opportunities to sell environmental services, such as carbon sequestration credits. This change is fundamental because it emphasises the acquisition of new human capital to shape the adoption and implementation of BEM. Once acquired, the human capital can be applied to unforeseen environmental problems as they emerge and to new technology and market developments. This reusable feature likely makes BEM approaches more sustainable over uncertain long run environmental and economic conditions than many current approaches. It also would change the nature and level of public financial assistance needed and open up opportunities for private-public collaborations in financing and delivering the services. It is important to emphasise again that promoting more BEM is not a panacea for solving agri-environmental problems through voluntary private actions. Rather, BEM should be viewed as a complement to public policies that assure the attainment of the desired social level of environmental services associated with agricultural production at least cost.

Promoting BEM would involve policies in the areas of education and technical assistance; certification; sharing costs of adjustment; and research and technology development.

Education and Technical Assistance: Case studies suggest that the potential benefits identified in the model, such as productivity improvements that lower PC' and marketing new environmental services (Z), are highly dependent upon the quality of management. Managers who wish to pursue BEM would benefit from the following education and technical assistance programs (Batie and Ervin):

- Agricultural ecology and pollution prevention.
- Total quality management systems.
- Green marketing.
- Contracting (for vertical (supply chain) and horizontal linkages, *e.g.*, co-operatives).

Certification. The ability to effectively differentiate a “green” product and achieve a price premium, P’, often requires a private or public certification system. Policies are needed in the following areas to implement the necessary elements of a certification system.

- Standard setting.
- Monitoring performance.
- Enforcement.
- Marketing differentiated products.

Sharing costs of adjustment. Case studies also reveal that firms often incur up-front costs (PC’, IC, or TC) to transition their operations to BEM approaches and achieve potential productivity or marketing gains. Smaller alternative farms may also have problem accessing sufficient credit to finance initial BEM actions. For farmers’ actions that provide off-farm environmental benefits, public programs in the following areas can be used to share the costs of that transition and provide needed financing:

- Transition risk reduction (production and marketing).
- Equipment replacement.
- Technical consultants to assist with new operation procedures.
- Credit line for partially financing BEM initiatives.

Research and Technology Development (R&D). Many OECD country governments have long histories of supporting public research to assist with the development of their agricultural sectors. The main thrust of those programs has been focused on achieving productivity gains and cost reductions. In the development of a new generation of agricultural systems, the pursuit of productivity will be integrated systemically with improved environmental service flows. In other words, an alternative measure of productivity that includes social services other than food and fibres needs to be researched. Policies to promote R&D in the following areas will help foster this integrated approach to production and environmental management:

- Environmentally compatible production technologies (using a measure of productivity that includes social goods).
- Ecologically sustainable approaches to pest control.
- Public– private R&D partnerships and financing sources.

The role of R&D is timely because the traditional public and private research roles in leading the discovery and application of new agricultural systems has reversed in many OECD countries. The theory of induced innovations argues that increasing factor scarcity prices will drive entrepreneurs to deliver new technologies to reduce factor scarcity. However, this theory will not apply to public agri-environmental goods and services unless effective scarcity values exist via regulation or other incentives (Ervin and Schmitz). When markets for environmental goods and services are missing or poorly functioning, we should not expect the technologies developed under private or public R&D systems to capture effectively the full social costs. Public research has traditionally filled that gap under the assumption that basic and applied science delivers autonomous innovations. However, shifting farms away from heavy reliance on chemical pesticides to "integrated pest management" (IPM) and organic agriculture in general will only

happen with assistance from public R&D because the market returns to support private R&D in these areas do not capture the full social benefits and productivity is still mainly measured in terms of bushels per hectare. Another issue that must be addressed is the path dependency of certain areas of development such as the infamous pesticide treadmill where stronger pesticides must be developed to counter growing pest resistance.

Further work needs

Environmental quality and other quality attributes promise to play more influential roles in the future of OECD country agricultures, both domestically and in trade. While publicly-led programs will continue to play influential roles, funding may well limit their ability to meet the increasing relative demand for environmental services. For example, national (nominal) funding in the U.S. has held fairly steady since 1992 between \$3.2 and \$3.7 billion annually, but likely declined in real terms (Zinn). The leading edge of agri-environmental management appears to be shifting to the private sector, or to public-private initiatives, and to sub-national levels. Both private for-profit and non-profit organisations (such as environmental charitable trusts) are taking part in this trend. The changing economics of agriculture and the environment requires further work in the following topic areas.

1. Assessing the consumer demands for different environmental quality attributes of food and fibre products and production systems. This analytical task will give insight into the areas where market forces may lead and public R&D and voluntary-incentive programs can play supportive roles. It will also help understand which product attributes are capable of differentiation.
2. Estimating the long-run economic returns to production systems that conserve environmental services with rising scarcity values. We tend to focus on current technologies and prices in our agri-environmental analyses, but history tells us that neither is a good guide to the future. More theoretical and empirical work on the effects of rising environmental prices (values) is needed.
3. Research is needed on a new definition of (social) productivity that includes all environmental and social services provided by farming. For instance, the social product (value) of an additional 500 metric tons of maize must include the negative and positive effects on biodiversity, public water depletion, and other nonmarket effects.
4. Analysing and estimating the roles of transaction and other administrative costs in alternative agri-environmental program design and implementation. This area of economic inquiry has been neglected by the economics profession despite Coase's compelling arguments about the importance of transaction costs in the economics of the real world (Coase). Incentives to lower transaction costs as environmental programs proliferate may be key in stimulating voluntary environmental actions, and in ensuring those actions deliver their full potential for environmental quality improvement. Potential roles of public, for-profit and non-profit organisations should be included.
5. Analysing the limitations to BEM in agriculture due to the small size of the enterprises, the predominance of nonpoint pollution processes, and the heterogeneity of production-natural resource relationships. The lack of traceability for most nonpoint pollution poses a key constraint for public agencies and private firms in implementing voluntary initiatives that deliver desired market and social outcomes.

6. Analysing the potential roles of ENGOs in furthering privately led agri-environmental management, such as monitoring, eco-labelling and certification schemes, and providing technical assistance. This analysis should include a comparison of the costs and returns of for-profit and non-profit institutions in providing such services to producers.
7. Analysing the potential roles best played by the public sector in providing non-rival and non-exclusive services to further business-led agri-environmental management, such as eco-system wide monitoring and R&D for production systems that reduce transboundary environmental wastes, increase environmental services, or improve the link between environmental and financial performance, or providing financing or risk reduction schemes.
8. Investigating the influence of evolving agricultural industry structure on the feasibility of voluntary environmental strategies. Under what conditions will increasing horizontal and vertical linkages assist or hinder BEM strategies in agriculture, and ensure or detract from the delivery of potential environmental quality improvement?
9. Assessing the private sector roles and economic contributions of agricultural producers to supply environmental services, such as carbon sequestration. The growing recognition of the capacity of agriculture to provide environmental services will stimulate policy proposals, and analysts must be prepared to estimate their effects.

The shift toward more private environmental initiatives, either via markets or government programs, in agriculture means that farmers and agribusiness have more opportunity to be rewarded for innovations that supply consumers' and voters' desired environmental quality attributes, and penalised for negative effects. A growing number of firms, mostly outside agriculture, have decided that undertaking voluntary environmental initiatives offers a higher long-run profit strategy than responding to government-dictated programs. Ironically, this strategy could produce more environmentally and economically sustainable production and marketing system innovations than past agri-environmental programs, such as temporary land retirements, that have dominated U.S. agriculture for the last 15 years.

The OECD's Joint Working Party seems particularly well situated to address the following work areas: (1) the consumer demand for environmental attributes of food and fibre products; (2) the long-term social returns to production systems that conserve environmental services, in conjunction with its work on sustainable agriculture; (3) the roles of transaction and administrative costs in agro-environmental programs; (4) the development of social productivity measures, and (7) the analysis of appropriate roles for the public sector to foster BEM in agriculture (including small and medium sized farms).

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