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POLICY DEVELOPMENT FOR INTEGRATING AGRICULTURE AND THE ENVIRONMENT*

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Key words: polluter-pays principle, economic-incentive approach, cross-compliance, regulatory approach

ABSTRACT

To better understand policy integration, it is necessary to improve the knowledge of the policy effects, in particular their environmental impacts, and continue to develop analytical instruments to assess them. In this paper, several integration instruments such as regulatory approach, economic incentive approach, cross-compliance approach and advisory approach are being examined. Consistency between farm income support and environmental objectives has been enhanced through compliance mechanisms. In practice, agricultural and environmental policy approach is more likely to adopt a cross-compliance approach, making income support payments contingent upon the recipients' compliance with pre-determined environmental standards.

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I. Introduction

Agriculture has been very closely associated with the environment since it has a major impact on land use, soil, water, biodiversity and landscape. Conventional agricultural policies which provide commodity specific price and income support can insulate the procedures from market signals and may also have environmental implications, such as encouraging greater intensity of land and other chemical input use, disruption of ecological balance and loss of countryside amenity. An increased awareness of the environmental relevance of agriculture has emerged over the last decade from a growing concern about the consequences of agricultural policies that indirectly encourage negative environmental impacts. This may include pollution of surface and ground water resources, acidification and erosion of soil, and loss of biodiversity and landscape amenity.

There is a general recognition of the need to enhance the beneficial, and to reduce the harmful, environmental impacts of agriculture. Environmental concerns in agriculture are generally caused by a combination of missing markets and policy failure. Where there are missing markets to ensure a sustainable use of agricultural resources and provide the level of environmental quality demanded by society, it is largely due to environmental externalities associated with agricultural production activities. Reconciling the need for sufficient and safe food with environmental quality is challenging. The reform of agricultural policies focused on market orientation, reduced agricultural assistance, and environmental conservation is starting to signal farmers as to what will contribute to these aims. Currently, many countries have been introducing and developing agriculture and environment policy integration. A better integration of agriculture and environmental policies would provide mutual benefit and enable conscious tradeoffs to be made between competing agricultural and environmental objectives. In an effort to implement policy integration, an increasingly wider range of policy instruments are being employed, and administrative

structures and legislation are being revised and redefined, and the relationship between environmental quality and input and output factors of agricultural production is receiving greater scrutiny.

The essential theme of this paper is the need for developing policy integration between agriculture and environment. The paper is organized into five sections. Section II discusses the relationship between agriculture and the environment. Section III examines agricultural policies and environmental quality. It covers environmental effects of agricultural policies and economic effects on the agricultural sector of alternative environmental policies. Section IV presents approaches to integrating agriculture with environmental policies. Goals and principles for policy integration are identified, leading to a discussion of the environmental linkages of agriculture and finally an outline of approaches to harmonize policies. Finally, Section V presents concluding remarks.

II. Agriculture and the Environment

Close and complex correlation exists between agriculture and the environment. Understanding the correlation between agriculture and the environment is critical to integrating agriculture with environmental policies. The environment supplies the natural resources (i.e., soil, water and air) for agricultural production activities and is shaped by those activities. The extent of the environmental impact depends upon agricultural structures, the amount of land and other resources used, and the effects of farming practices on ecosystems at local, regional, and national levels. Agricultural production activities have both beneficial and harmful impacts on the environment through changing the quality and quantity of locally available natural resources, which are also the foundations for natural habitats, biodiversity, and landscape.[1] Thus, agriculture is both a source and receptor of environmental

[1] There is also strong hesitancy to acknowledge conflicts between agriculture and environmental quality. For more detailed exposition on the relationship between agriculture and the environment, see Lichtenberg (2002).

externalities.

The major environmental impacts on agriculture may be characterized, as shown in Table 1. Agriculture generates a wide range of environmental impacts such as soil, water, air quality and biodiversity. A farming system can help maintain traditional landscape, preserve habitats and biodiversity, and contribute to the sustainable management of water and soil resources, including flood and landslide prevention. On the other hand, agricultural production activities can also lead to pollution or contamination of surface and ground water, degradation of habitats, biodiversity and landscape, soil erosion, and soil and water problems. Thus, farmers have an important role in controlling environmental quality through their dual and complementary responsibilities as producers of high quality food and as custodians of the countryside. Farmers ensure the continued economic viability of agricultural production, the stewardship of the natural resource base of the farm, maintenance or enhancement of other ecosystems influenced by farming activities, and the provision of natural amenity (OECD 1993). Sustainable agriculture involves farm practices and systems that are compatible with these roles. In general, sustainable agriculture involves four aspects: an ongoing economically viable agricultural production system, maintenance or enhancement of natural resource base and ecosystems affected by agricultural activities, and the provision of natural amenity and rural aesthetic qualities (OECD 1998a).

TABLE 1. Examples of major environmental impacts associated with agriculture

Elements	Characteristics
Soil quality	Erodibility, nutrient supply, moisture balance, salinity
Land quantity	Area of ecological management in agricultural land
Water quality	Nutrient, pesticide and sediment runoff and leaching
Water quantity	Irrigation consumption, water retention capacity
Air quality	Emission of odors, ammonia and greenhouse gas
Biodiversity	Animal and plant species
Wildlife and semi-natural habitats	Diversity of animal and plant habitats associated with farming
Rural landscape	Conservation of areas shaped by farming

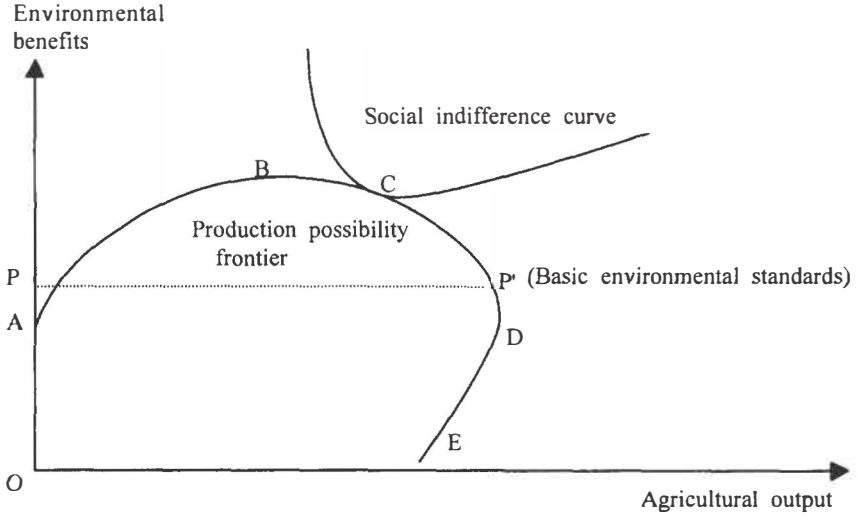
Source: Modified OECD (1998a).

As mentioned above, agriculture is jointly linked with the environment. There exist joint production possibilities between agriculture and the environment. In the case of such jointness, i.e., if the technical interdependencies or shared production factors make it impossible to separate the commodity from the positive or negative environmental output, the environmental impact of agricultural production practices is more profound. Practices or programs aimed at influencing the level or composition of environmental output will directly affect the level of commodity production. The extent of the production response will depend on the degree of jointness.[2] Figure 1 which shows a country's production possibility for agricultural and environmental benefits is a graphical depiction of the concept of joint production (Latacz-Lohmann 2000; Kwon and Kim 2000). The production possibility frontier (PPF) shows all technically efficient combinations of agricultural output and environmental benefits that can be produced within a country's resource endowment. The dotted line PP' represents basic environmental standards (e.g., fertilizer and pesticide application standards). The PPF is drawn in three segments. The segment AB indicates that, at some low level of agricultural output, an expansion of agricultural output would yield environmental benefits, e.g. in the form of enhanced landscape quality or provision of semi-natural habitats. This complementary relationship between the two outputs has been interpreted as a positive externality of production agriculture or simply the result of a 'multi-functionality' of agriculture. In contrast, segment BD represents a competitive relationship between the level of commodity output and the level of environmental quality. Environmental quality declines with increasing agricultural

[2] There are various definitions of joint production, but in essence they all refer to situation where a farm produces two or more outputs that are inter-linked. A key characteristic of jointness is that an increase or decrease of the supply of one output affects the levels of the others. The reasons for jointness are technical interdependencies, existence of public inputs and allocable but fixed inputs (Kwon and Kim 2000).

production as a result of a decreasing share of natural (non-agricultural) land in the open landscape and increasing land use intensities. The resulting negative joint products such as water and air pollution, soil erosion, habitat and biodiversity loss, have been interpreted as a negative externality of intensive agriculture. Segment DE, finally, shows "inefficient technology choices" such as fertilizer application rates beyond levels that are internally efficient for producers. Such practices are assumed to result in severe environmental disruption, hence the positive slope of the PPF in this segment. Assuming well-behaved consumer preferences, the social optimum (point C) must lie within segment BD. It is clear that in the absence of agricultural and environmental policies, the social optimum is likely to be missed. From a theoretical point of view, it could be argued that if the environment is unpriced, farmers would tend to overproduce commodity output, leading to outcomes around point D in this graph, or the point P' which indicates a minimum level of environmental quality as prescribed by regulations.

FIGURE 1. Relationship between agricultural output and the environmental benefits



III. Agricultural Policies and Environmental Quality

Agricultural policies including price and income supporting programs were not originally developed to affect environmental quality in any way. They included no explicit conservation objectives. Agricultural policies influence production patterns, farming practices, and input use mainly by changing the relative costs and returns of using resources in agriculture, or by imposing direct restriction on output and input use. In particular, agricultural policies influence farming activities through changes in:(1) relative output prices and/or input costs, (2) direct and indirect restrictions on output and input use, (3) incentives for developing and adopting new technologies and practices, (4) impediments to resource movement, (5) agricultural and rural infrastructure, and (6) training and education (OECD 1998b).

The main objectives of agricultural policy are to support farm income and ensure a stable and reasonably priced food supply. These multiple objectives are achieved through a fairly complicated system of farm programs that insulate the farm sector from the market economy by artificially supporting certain commodities' prices and managing the supply of those commodities. Each mechanism employed to simultaneously achieve commodity price support, farm income support, and supply control goals has unique, secondary, and unintentional effects on environmental quality. Agricultural support is administered by way of different policy measures, such as price supports, trade barriers, quantitative restrictions on outputs, subsidies to inputs, and direct budgetary payments. In general, agriculture is affected by a combination of measures, reflecting multiple policy objectives and changes in priorities over time. The incentives and disincentives of these different measures, in combination with market developments and technical progress, influence the scale and composition of production, the farming practices employed and inputs used, and the effects on the environment. As shown in Table 2, increasing or sustaining a

high price for a particular commodity sends strong signals to farmers to produce more supported commodities and increase agro-chemical use rates in their production.

It is increasingly recognized that price support provided to farmers has encouraged expansion of output using production methods which are intensive in the use of potentially polluting inputs such as chemical fertilizers and pesticides. Subsidization of certain production factors encourages their enhanced use due to lower effective market prices.

However, the effects of agricultural policies on the environment involve non-linearities and uncertainties. Additional complexities arise from the fact that many policies are administered by commodity, whereas the environmental effects of agriculture are resource-specific. Furthermore, there can be a considerable time lag between a change in a policy and its environmental impacts. The effects of changes in policies and production practices on the environment are often gradual and cumulative, and it may take extended periods of time before they become noticeable and measurable.

Table 3 shows the general effects on farm prices and income policies directed toward environmental protection. A comparison of Table 2 and Table 3 highlights the complementary aspects and conflicts between the sets of policies. The major complementary effect is that environmental regulation can, under some circumstances, enhance the commodity price support and aggregate income goals of agricultural policy.

The major conflict arises from the diametrically opposed signals that agricultural and environmental policies send to farmers. On the one hand, the current set of farm programs strongly encourages the development and use of land-saving agricultural technologies, including fertilizers and pesticides. On the other hand, environmental regulation induces, and direct environmental subsides and some aspects of public research and extension attempt to encourage a shift toward environmentally benign production technologies. The net effect is that each policy set cancels out some of the influence of the other while

inefficiently consuming professional time and public monies.

TABLE 2. Environmental effects of agricultural policy

Agri-policy instrument	Net effect on-			
	Total soil erosion	Loss of wildlife habitat	Rate of agro-chemical use	Total use of agro-chemicals
Raise commodity prices	↑	↑	↑	↑
Tie farm income support to production levels	↑	↑	↑	↑
Reduce risk	↑	↑	↓	↑
Subsidize credit	↑ ↓	↑	↑	↑
Require short-term acreage requirement	↓	No effect	↑	↓
Establish domestic standards	No effect	No effect	↑	↑

Note: Arrows indicate direction of net effect (increase or decrease) and do not imply whether the effect is good or bad.
Source: Modified from Reichelderfer (1990), p.208.

TABLE 3. Economic Effects on Agricultural Sector of Alternative Environmental Policies[1)]

Environmental policies	Farm production cost	Commodity prices	Aggregate farm income	Taxpayers and gov't budget
Regulation in input use	↑	↑	↑ ↓ [2)]	No effect[3)]
Taxes on agri-chemicals	↑	↑	↑ ↓ [2)]	↓
Subsides on farming practices	No effect	No effect	↑	↓
Research and extension of sustainable technology	↓	↓	↓	↓

Note: 1) Arrows indicate direction of net effect and do not imply whether the effect is good or bad.
2) Effect on total revenue depends upon price elasticity of demand affected commodities.
3) Except transaction costs including administrative and enforcement costs.
Source: Modified from Reichelderfer (1990), p.215.

IV. Approaches to Integrating Agricultural and Environmental Policies

1. Principles for Managing the Environment and Agriculture

Integration means to make whole or to bring parts together. Successful integration requires policy-makers to give full consideration to the effects of their policies on the objectives of all other sectors. For example, when introducing an environmental policy to control non-point source pollution in agriculture, it is necessary to consider its impact on farm income and water quality. Similarly, agricultural policies designed to maintain farm income must be examined for their effect on the environment. Thus, an integrated approach to formulating and developing sustainable agricultural policies requires that simultaneously full considerations must be given to the potential impact of environmental policy on agricultural production, incomes and prices.

Integration requires that full account be given to environmental objectives during the formulation of agricultural policies and, similarly, discernment of which environmental policies must reflect a recognition of their potential impact on agricultural production, incomes and prices. In practice, policy integration necessitates the creation of institutional arrangements, the use of administrative procedures, and the formulation and implementation of policies which result in more efficient and equitable achievement of related objectives. These objectives may be conflicting or complementary. When these objectives are in conflict, integration is essential to ensure that the economically and socially "correct" trade-off should be made.

The development of integrated policies requires efforts to achieve greater complementary objectives and to make conscious trade-off between competing objectives. It requires the development of policies that are preventive and anticipatory rather than reactive. Unintegrated policies are characterized by the

belated recognition of their consequences for the objectives of other sectors.

Integration of agricultural and environmental policies requires a clear understanding of the fundamental concepts of underlying sustainable development. While there are various definitions of sustainable development depending upon the problem and institutional context, the following three common precepts have emerged (Pearce 1989):

(1) *Sustainability is about being fair to the future, or intergenerational welfare*. More specifically, the central goal is to maintain a certain environmental stock, or its equivalent, for current and future generations. For the individual farmer, intergenerational welfare is accounted for in the transfer of stewardship of environmental and other assets to others.

(2) *To achieve sustainability, the public decision processes must incorporate the shadow prices of environmental quantity and quality dimensions*. Shadow prices reflect the social opportunity costs of using the resources, whether traded in markets or allocated in some non-market manner. Implementing real shadow pricing ensures that the agricultural resources are allocated to high value use in the present or the future.

(3) *Conservation of irreversible environmental assets is critical to a sustainable natural resource base*. Sustainability of the natural resource base has emerged as a goal of environmental policy. The application of sustainability criteria to agriculture is critical because agricultural production relies heavily on the quality and quantity of the natural resource base, and produces a wide array of positive environmental services and affects the quality of environmental resources utilized by the public.

While these broad goals of sustainability are essential to a clear understanding of general policy directions, the articulation of more specific principles is necessary to develop programs for

integrating agricultural and environmental policies. Since the concept of sustainable development is immature in practice, the principles stated below do not necessarily always tie in well with the precepts described above. The following principles reflect the current state of policy formulation to achieve integrated agricultural and environmental policies (OECD 1993):

(1) View rural countryside assets as a source of agricultural products and environmental services.
(2) Promote comprehensive resource use efficiency by directly or indirectly including environmental shadow price
(3) Alter agricultural commodity program provisions that cause input and crop or livestock output distortions which result in environmental degradation
(4) Encourage farmers to recognize that it is in their interest and that of society to maintain and enhance the farmer's asset base.
(5) Promote pollution prevention over waste management.
(6) Target specific environmental objectives rather than employ broad agricultural and environmental initiatives.
(7) Apply the polluter-pays principle
(8) Create the administrative framework to promote integration

As mentioned above, the basic principle for integrating agricultural and environmental policies is the polluter-pays-principle (PPP), which states that the polluter should be held responsible for environmental damage caused and bear the expenses of carrying out pollution prevention measures. However, much of agricultural pollution is diffused, from non-point sources, and some forms are difficult to trace and may be apparent only in the long term. So it may be difficult to determine precisely who is the polluter. In reality, most of the difficulties in applying the PPP are associated with identifying the polluter, finding cost-effective enforcement methods and finding equitable methods of allocating the cost of off-farm control measures to groups of farmers. The discussion of goals and principles for managing agricultural and environmental policies helps to identify some

basic steps or approaches for better achieving integration objectives.

2. Procedures and Criteria of Policy Integration

Integration requires that policy instruments designed to achieve particular objectives in one sector must be subjected to prior assessment for their effects on other sectors. For example, when introducing an environmental policy to control non-point sources of pollution in agriculture, it is necessary to consider the effects on farm income and water quality. Similarly, policies designed to maintain farm income must be examined for their effects on the environment. Thus, better integration of agricultural and environmental policies will provide mutual benefits and, where necessary, enable conscious trade-offs to be made between competing agricultural and environmental objectives.

Recognition of the interdependence of agricultural and environmental policies has led to the revision of procedures for policy formulation. There are three dimensions to integration procedures (OECD 1989):

First, there is the institutional integration that requires the development of administrative structures designed to ensure greater collaboration, co-operation and communication among agencies responsible for interdependent or related policies. Institutional arrangements for integrating agricultural and environmental policies create laws which require integration, coordination among related ministries, national and local governments, and departments of agencies. Institutional arrangements are often a necessary precondition to the successful integration of agricultural environmental policies. Coordination among ministries, departments, and national and local governments is achieved through a broad cross-section of mechanisms. When several ministries or departments are responsible for the management of the rural environment, it is difficult to clearly establish the limits of each ministry's or department's role. Recognition of this problem has led to the

redefinition and reassignment of responsibilities of certain joint agricultural and environmental objectives to a specific agency. Another approach has been the establishment of clearly identified environmental units within agricultural ministries. These units usually have the responsibility for ensuring that all the likely effects of agricultural policy on the environment are considered.

Second, there is the use of integrative procedures which includes the development of agreed objectives such as the use of environmental impact assessment and the holding of public inquiries. Public inquiries are becoming more common as is the involvement in decision-making of a plethora of groups interested in agriculture and the environment including farmers' associations, environmental groups, and consumers' groups. Committees, task forces, working groups and issue specific inter-agency group are assisting with the responsibility for finding integrated solutions to agricultural and environmental problems. Legislation can also play a major role in promoting integration especially when it is used to specify the nature of agreed objectives and outline mandatory administrative procedures.

Third, there is a whole set of integrative instruments, which through a series of interactions on each other can provide an optimal mix of trade-off. There are a number of different ways for classifying agri-environmental policy instruments. Agri-environmental policy instruments are sometimes subdivided, as a first approximation, into three broad, sometimes overlapping categories: regulatory instruments, economic instruments and moral suasion (Opschoor and Vos 1989; Office of Technology Assessment 1995).

1) The traditional instruments of agri-environmental policy are of the regulatory or of the administrative type aimed at directly influencing the environmental performance of polluters by regulating processes or products used, by abandoning or limiting the discharge of certain pollutants through licensing, setting of standards and zoning.
2) The environmental policy instruments are labeled economic if they affect estimates of costs and benefits of alternative

actions open to economic agents, with the effect of influencing decision-making. Economic instruments are based on the polluter-pays-principle. Commonly-used subsidies are economic instruments only insofar as they influence the cost-benefit-ratio of certain activities in the direction of a reduced use of the environment.

3) The moral suasion approach is used in order to bring about a voluntary change in the behavior of economic agents. Basically this involves the internalizing of environmental awareness and responsibility into individual decision-making by applying pressure and/or persuasion either indirectly or directly. This approach has characteristics in common with both the regulatory and the economic instruments as it uses the threat of possible regulations in order to bring about voluntary, more flexible settlements and behavioral change, often supported by economic incentives and disincentives.

3. Effective Instruments for Agri-Environmental Policy

This paper does not cover a theoretical discussion of environmental instruments; instead it focuses on the relevance of the following question: what kind of economic and regulatory instruments for environmental protection can be applied to the agricultural sector? Agri-environmental policy generally refers to a group of programs that encourage farmers to adopt environmentally sound production practices. Policy instruments or tools range from involuntary approaches, such as regulation or environmental taxes, to voluntary approaches such as technical assistance and subsidy programs.

Regulatory Approach

Regulations force farmers to reduce or eliminate the use of certain inputs for adopting specific pollution reduction technologies. Direct regulation is the most commonly used approach to reduce point source pollution. The regulations achieve a reduction in pollution levels by requiring operators to

meet minimum design standards for various treatment technologies or by requiring operators to comply with minimum performance standards based on actual emission levels. Regulatory requirements lie at the far end of the policy spectrum in terms of the degree to which participation is voluntary. In the name of public health and safety, a number of practices are banned and safe application methods are required. The ban on the production and application of some agro-chemicals (such as DDT) is one such example.

Regulatory requirements can be the most effective of all policy tools in effecting changes to improve environmental quality, assuming that regulations are adequately enforced. The regulatory approach is thus the most important set of instruments in an integrated agricultural and environmental policy area. Regulatory action can be taken to restrict the availability of environmentally hazardous agricultural inputs or prohibit the use of environmentally damaging production practices: it can be uniformly applied to all farmers or targeted to specific types of farming operations or to particularly environmentally sensitive production regions. However, regulatory requirements can be the least flexible of all policy instruments, requiring that farmers reach a specific environmental goal or adopt specific practices. Farmers are not free to determine their own level of participation, based on their costs. Unless regulators know farm specific regulations, the agri-environmental effort is not necessarily directed toward farmers who can make change at lowest cost. Consequently, regulatory approaches can be less flexible and less efficient than economic incentives. The most prevalent adverse effect of the environmental regulations is a change in the distribution of income within the farm sector. Other effects include an increase in the average cost of agricultural production, with the possibility of rising consumer prices and decreased trade competitiveness. In practice, the regulatory approach has been employed under circumstances when perceived environmental costs are high. The political and administrative structure of many countries, however, prevents the strict enforcement of regulations

and only the most blatant of offences are penalized. Within this limit, it is usual to use advisory and voluntary incentive programs to achieve the desired state of the environment, the economy and social well-being.

If all externalities of agricultural policies could be internalized and all changes in relative prices anticipated, near-perfect incentive systems could be designed. However, it is impossible to anticipate changes in input costs, impossible to account for all externalities, and impossible to know all the local effects of a national incentive-based system. Moreover, often the information costs associated with such schemes are prohibitive. In many cases regulations, backed by appropriately enforced sanctions, can be more precisely targeted than economic incentives. In particular, they do not require knowledge of the nature of damage functions and are not sensitive to price variations.

Economic Incentive Approach

Economic incentive-based policies can provide incentives (payments to farmers) designed to encourage environmentally beneficial activities, or negative incentives (farmers pay taxes) designed to discourage environmentally harmful activities. The use of economic incentive instruments as a complement to regulatory instruments for environmental management is recently receiving attention as a means of achieving policy integration. In general, there are the following three kinds of economic incentive approaches such as environmental taxes, environmental subsidies, and the tradable permit system.

First, environmental taxes are per-unit charges for actions contributing to environmental degradation. Charges may be associated with farm emissions (such as a fixed amount of money per pound of soil lost) or with input uses (such as fertilizers or pesticides). They can be assessed on all units, or just on the number of units emitted or used above a given threshold. Total tax payments would depend on the farmer's compliance, the further from the environmental goal, the higher the payment.

Farmers who meet those goals might incur no additional costs from a tax program. When taxes are levied on a polluting input (such as chemical fertilizer), farmers will reduce their use of that input and substitute other, less polluting inputs to reduce costs. The extent of the change in input use depends on the sensitivity of the demand for the polluting input to price change, which can vary from one area to another. Generally, the tax revenue is used to finance pollution control programs and research projects directed toward improving input use and reducing pollution. In practice, an approach being tried in several countries is the use of input taxes to reduce agro-chemicals. To significantly reduce pollution, fertilizer charges on about 100 percent rate are needed. Experience with levies in the vicinity of 10 to 20 percent is favorable.[3]

Second, environmental subsidies are payments awarded for reducing pollution levels or for developing environmentally-friendly production practices to do so in the future. The subsidy programs might be effected through direct payment, grant programs, loans at below-market interest rates, or tax concessions. Farmers would enhance the environmental performance of the agricultural sector if they are provided with proper economic incentives to include the environmental costs and benefits of their activities in their production decision. In practice, cost-share and incentive payments as a variant of subsidy programs are two methods commonly used to encourage farmers to voluntarily adopt less polluting practices.[4] Cost-sharing payments cover some or all of

[3] Kim and Kim (2001) showed that a levy of 100 percent to nitrogen ingredient of chemical fertilizer leads to a reduction of 14.6% in fertilizer use, 0.3% in rice yield, and 3.1% in farm income. Thus, based on 1998 prices it can be expected that a doubling of nitrogen prices (i.e., a 100% nitrogen tax rate) will reduce nitrogen use in rice cultivation on average by 15%. This reduction will probably not lead to important yield and income reduction.

[4] In the United States, Environmental Quality Incentive Program was enacted in 1996 Farm Act to combine and refocus a number of longstanding conservation cost share/incentive payment program. This program provides technical, financial, and educational assistance for a wide range of agri-environmental activities (Classen and Hollan 2000).

the start-up and/or installation costs of implementing less polluting management practices. Incentive payments could be set to voluntary contracts spanning a number of years, ensuring continuity of practices over time. These programs increase the likelihood that farmers will adopt such practices by reducing the net cost of doing so. The larger the payment, the greater the range of practices likely to be adopted and the higher the number of likely participants. However, the subsidy programs may be expensive for taxpayers to fund because participation will increase as payment rates rise.

Third, tradable permit systems are based on establishing markets for the right to pollute. Under such a system, the government issues a fixed number of permits (or right to pollute) in a given region and then allows a market to develop by letting polluters trade these rights among themselves. In practice, pollution permits are defined either as credits or allowances, which differ in the intent of the initial allocation. With credit-based systems as the most common approach in tradable permit systems, polluters earn marketable credits for emitting below an established standard. If instead the trading system uses allowances, each permit gives the bearer the right to release some amount of pollution based on pre-established environmental objectives. For example, the allowable nitrogen pollution (expressed as a unit of nitrogen fertilizer) is initially set at the national or regional level, corresponding with the area concerned. The executive permit board sells permits to emit nitrogen to the farmer, or issues them free. The permit allows the farmer to pollute provided that the permitted amount is not exceeded. Farmers who do not use their full quota can either increase production or sell the unused quota to another farmer. As a permit system imposes a ceiling on the maximum nitrogen use or nitrogen surplus, the environmental effects are quite clear. In this system, farmers decide by comparing the costs of buying permits with costs of the technical measures needed to reduce emissions. Tradable permit systems are still in the embryonic stage of development with much of the evolution taking place in the

United States and the European countries. As yet, there is only limited evidence of how effective these instruments are in establishing viable markets for pollution right specifically in the agricultural sector.[5]

Cross-Compliance Approach

Compliance mechanisms require a basic level of environmental compliance as a condition of eligibility for other programs. Cross-compliance means that a farm's operational management has to meet certain requirements in order for its owner to be eligible for assistance under government support schemes.[6] Farmers claiming support under one program had to meet the rules for that program and certain obligations of other programs: thus making a link "across programs" which gave rise to the term "cross-compliance" (Baldock and Michell 1995). So, cross-compliance means making income support dependent on meeting certain environmental and conservation objectives in the context of market and price policy.

Cross-compliance is a marvelous idea for ensuring that commodity program participants adhere to minimum standards for protecting society's interests in environmental conservation. Compliance mechanisms have greatly increased consistency between farm commodity programs and environmental objectives, yielding significant environmental gains. Their conceptual appeal and political success have thus made them models for chemical compliance aimed at requiring farm program participants to adhere to specified fertilization and pesticide use practices.

Cross-compliance is an important aspect in integrating

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[5] For more detailed application of tradable permit systems, Folmer and Gabel (2000, pp.184-192).

[6] The concept of cross-compliance as a policy term was originated in the United States in the 1970s. The use of the term 'cross-compliance' has been extended since 1980, both within the US and elsewhere, to refer to linkages between agricultural and environmental policies. For more detailed exposition on cross-compliance approach, see Baldock and Michell (1995).

agricultural and environmental policies. The various forms of cross-compliance, the consequences for the agricultural sector, and the possible advantages to the environment have not yet been fully examined. However, the income support requirements can be given shape in a variety of ways (Dwyer, Baldock and Einschutz 2000):

(1) one or several conditions which apply across the board must be fulfilled,

(2) a choice can be made from several sets of conditions like a package system,

(3) an even more flexible opinion is the points system, whereby several options are combined by selecting a number of activities to achieve the required number of points.

Compared with more detailed requirements for individual options, a point system or package system is a more flexible approach, as those systems enable the farmer to select a number of options that fit in best with actual situations at his farm and to take into account differences in farm practices. This is important because certain options may be feasible in some areas but not in others.

Advisory approach

Advisory approaches using education and technical assistance are used to persuade farmers to voluntarily adopt less polluting practices. Voluntary or direct advisory approaches to farmers are extensively used in most OECD countries to reduce non-point source pollution (OECD 1993). This approach may be combined to lower the initial costs of adoption by helping farmers to develop and install the new practices. Successful agricultural advisory approaches take full account of all the economic conditions faced by farmers. Problems have been encountered in using only advisory methods to persuade farmers to adopt environmentally-friendly farming practices. Consequently, in most countries, advisory approaches are supplemented by regulations

and economic incentives. In addition, education and technical assistance provide information to farmers to facilitate the adoption or use of more environmentally benign practices. Assistance can range from providing data on soil quality, or disseminating information about new sustainable technologies or practices to helping farmers prepare conservation plans.

Public information gathering and distribution may increase the use of conservation practices by farmers unaware of their effectiveness or unsure about how to adopt them. Training and education, and demonstration projects also affect farming activities by spreading information and creating awareness of the environmental effects of alternative farming practices. They can encourage environmental stewardship, but they can also have negative environmental consequences if they are solely aimed at increasing production and yields. These kinds of programs are completely voluntary, with effectiveness largely dependent upon whether a given practice creates benefits for farmers that offset the cost of adoption.

The relative efficiency of the voluntary program increases when (1) the degree of rivalness of government services decreases, (2) government services are less expensive than equivalent private effort, and/or (3) enforcement costs of voluntary programs are low compared to the mandatory program. The voluntary program is likely to be more efficient than the mandatory program when government services are less competitive and cost less than equivalent private services. Wu and Babcock (1999) showed that voluntary programs are more efficient than a program that mandates adoption if and only if the deadweight losses of government expenditures under the voluntary program. The comparative advantages of the voluntary approach include reducing enforcement costs and avoiding duplication of private initiatives.

V. Concluding Remarks

The resultant conflict in policy objectives can be addressed either

through efforts to integrate agricultural and environmental policy instruments or through independent reform of agricultural policy, environmental policy, or both. Agricultural policies including price or income support were not originally developed to affect environmental quality in any way. Over recent years there has been an increase in the range and extent of policy measures and approaches to address environmental issues in agriculture. Environmental considerations provide added impetus to the reform of agricultural policies. Opportunities exist and are emerging for the integration of agricultural and environmental policies during the reform process. An appropriate integration of agricultural and environmental policies can result in multiple benefits, by ensuring that policy goals are reached at least cost and that the burdens which agricultural policies can impose on the environment are fully accounted for. To better understand policy integration, it is necessary to improve the knowledge of the policy effects, in particular their environmental impacts, and continue to develop analytical instruments to assess them. One-size-fits-all solutions are unlikely to be successful in dealing with agricultural and environmental problems. Soil, climatic conditions, crop, and management practices vary widely among from locale to locale. Practices that work well on one farm may be environmentally ineffective or overly expensive on another. In this paper, several integration instruments such as the regulatory approach, the economic incentive approach, the cross-compliance approach and the advisory approach are examined. The development of integrated policies requires efforts to achieve greater complementary objectives and to make conscious trade-off between competing objectives. Consistency between farm income support and environmental objectives has been enhanced through compliance mechanisms. In practice, agri-environmental policy is more likely to adopt a cross-compliance approach, making income support payments contingent upon the recipients' compliance with pre-determined environmental standards.

However, in order to integrate agricultural and environmental policy programs, information on the costs and

benefits of alternative proposals is needed so that the net benefits of an integrated program can be determined. Additionally, the distribution of costs and benefits of an integrated approach will have a major impact on political acceptability.

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