DEVELOPING POLICIES FOR AGRICULTURE AND THE ENVIRONMENT

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ABSTRACT

Environmental considerations provide impetus to the reform of agricultural policies. The appropriate integration of agricultural and environmental policies can bring 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 our knowledge of the policy effects, in particular their environmental impact, and continue to develop analytical instruments to assess these.

In this Bulletin, several integration instruments such as the regulatory approach, the economic incentive approach, the cross-compliance approach and the advisory approach, are examined. Consistency between farm income support and environmental objectives is enhanced through compliance mechanisms. In practice, agricultural policy is likely to adopt a cross-compliance approach, by making income support payments contingent on compliance with environmental standards. However, in order to successfully integrate agricultural and environmental policy programs, information on the costs and benefits of alternative proposals is needed. In this way, the net benefits of an integrated program can be determined.

INTRODUCTION

Agriculture has always been very closely associated with the environment, since it has a major impact on land use, soil, water, biodiversity and the landscape. Conventional agricultural policies which support commodity prices and income support can insulate farmers from market signals. They may also have environmental implications, by encouraging more intensive land use, including heavy applications of agricultural chemicals. Intensive agriculture may disrupt the ecological balance and involve a loss of public goods such as the countryside as a public amenity.

An increased awareness of the environmental relevance of agriculture has emerged over the last decade. It is based on a growing concern over the consequences of agricultural policies that indirectly have a negative environmental impact. This may include the pollution of surface and groundwater resources, the acidification and erosion of soil, and the loss of biodiversity.

There is a general recognition of the need to enhance the beneficial impact of agriculture on the environment, and reduce its harmful impact. Environmental problems in agriculture are generally caused by a combination of missing markets and policy failure. In many countries, markets fail to ensure the sustainable use of agricultural resources or maintain the environmental quality demanded by society.

Reconciling the need for a safe and sufficient food supply and environmental quality is a challenge. The change in agricultural policies in favor of free markets and reduced agricultural assistance is starting to signal to farmers what will contribute to these aims. Currently, many countries are developing policies which integrate agricultural and

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environmental concerns. These make a conscious tradeoff between competing agricultural and environmental objectives. An increasingly wide range of policy instruments are being employed. Administrative structures and legislation are being revised and redefined, and the relationship between environmental quality, and the input and output factors of agricultural production, is receiving greater scrutiny.

The Bulletin 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 the environmental impact of agricultural policies, and the economic effects of alternative environmental policies on agriculture. Section IV presents various approaches to integrating agricultural and environmental policies. The goals and principles for policy integration are identified, leading to a discussion of the environmental linkages of agriculture. Various approaches to harmonize policies are summarized. Finally, Section V gives some conclusions.

Agriculture and the Environment

Understanding links between agriculture and the environment is critical to integrating agricultural and environmental policies. Agriculture has close and complex links with the environment. The natural environment supplies the resources (i.e., soil, water and air) for agricultural production. In turn, it is shaped by these activities. The extent of the environmental impact depends on the structure of agriculture, the amount of land and other resources used, and the effects of farming practices on ecosystems at a local and national level. The impact of agricultural production on the environment may be both beneficial and harmful. It may change the quality and quantity of local resources, which are also the basis of natural habitats, biodiversity and landscape.

The major environmental impacts of agriculture are shown in Table 1. These include changes in soil quality, water quality, air quality and biodiversity. Farming systems can help maintain the 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, the degradation of habitats, the loss of biodiversity and natural landscapes, and soil erosion.

Farmers have a crucial role in controlling environmental quality, through their dual responsibilities as producers of food and as custodians of the countryside. Farmers ensure the continued economic viability of agricultural production, safeguard the natural resource base of the farm, maintain or enhance other ecosystems influenced by farming activities, and provide a natural amenity, the rural landscape (OECD 1993). Sustainable agriculture involves farm practices and systems that are compatible with these roles. In general, sustainable agriculture involves three aspects: an economically viable agricultural production system, the maintenance or enhancement of the natural resource base and ecosystems affected by agricultural activities, and the provision of natural amenities, including landscapes (OECD 1998a).

Agriculture is linked to the environment, and there is a mutual interdependence between the two, which could be seen as a kind of joint production.

Table 1. Some major environmental impacts associated with agriculture

<table>
<thead>
<tr>
<th>Elements</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil quality</td>
<td>Erodibility, nutrient supply, moisture balance, salinity</td>
</tr>
<tr>
<td>Land quantity</td>
<td>Area and management of agricultural land</td>
</tr>
<tr>
<td>Water quality</td>
<td>Nutrient, pesticide and sediment runoff and leaching</td>
</tr>
<tr>
<td>Water quantity</td>
<td>Irrigation consumption, water retention capacity</td>
</tr>
<tr>
<td>Air quality</td>
<td>Emission of odors, ammonia and greenhouse gasses</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>Survival of animal and plant species</td>
</tr>
<tr>
<td>Wildlife and semi-natural habitats</td>
<td>Diversity of animal and plant habitats associated with farming</td>
</tr>
<tr>
<td>Rural landscape</td>
<td>Conservation of areas shaped by farming</td>
</tr>
</tbody>
</table>

Source: Modified OECD (1998a)
There are various definitions of joint production, but in essence they all refer to a situation where a firm produces two or more outputs that are linked. A key characteristic of jointness is that an increase or decrease of the supply of one output affects the levels of the others. If for technical or other reasons, it is impossible to separate an agricultural commodity from its positive or negative environmental outputs, the environmental impact of agricultural production practices is more profound. Practices or programs aimed at influencing the level or type of environmental output will directly affect the level of commodity production. The extent of the production response will depend on the degree of jointness.

Fig. 1 shows the relationship between agricultural output and environmental benefits, as a way of illustrating the concept of joint production (Latacz-Lohmann 2000, Kown and Kim 2000). The production possibility frontier (PPF) shows all the technically efficient combinations of agricultural outputs and environmental benefits that can be produced, given a particular 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 a low level of agricultural output, an expansion output would yield environmental benefits, such as enhancing the landscape. This complementary relationship between the two outputs has been interpreted as a positive externality of agriculture, or simply the result of a “multifunctionality” 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 production, as a result of a decreasing share of natural (non-agricultural) land in the landscape and more intensive land use. 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 efficient for producers. Such practices are assumed to result in severe environmental disruption, hence the positive slope of the PPF in this segment. The social optimum (point C) lies within segment BD. However, in the absence of suitable 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 will tend to overproduce commodities. This would result in an outcome around point D in the Figure, or the point P' which indicates the minimum level of environmental quality as enforced by regulations.

**AGRICULTURAL POLICIES AND ENVIRONMENTAL QUALITY**

Agricultural policies, including price and income supports, were not originally developed to affect environmental quality in any way. They included no explicit conservation objectives.
Agricultural policies influence farming practices mainly by changing the relative costs and returns of using resources in agriculture, or by imposing direct restrictions on output and input use. In particular, agricultural policies influence farming activities through changes in:

- The relative prices of inputs and outputs;
- Direct and indicate restrictions on the use of inputs and outputs;
- Incentives (or disincentives) for adopting new practices;
- Impediments to resource movement; and
- Agricultural and rural infrastructure (OECD 1998b).

The main objectives of agricultural policy are to support farm incomes and ensure a stable and reasonably priced supply of food. These objectives are achieved through a complicated system of farm programs that insulate the farm sector from the market economy by artificially supporting the prices of certain commodities, and controlling their supply. Each mechanism employed to support commodity prices, farm incomes and control the supply goals has secondary, and unintentional, effects on environmental quality. As well as price supports, agricultural policies may include trade barriers, subsidies for inputs and direct payments to farmers.

In general, agriculture is affected by a number of measures reflecting multiple policy objectives and changes in priorities over time. As shown in Table 2, increasing or sustaining a high price for a particular commodity sends strong signals to farmers to produce more of it, and to use more agricultural chemicals in producing it.

It is increasingly recognized that price supports provided to farmers have encouraged them to expand their production, making intensive use of potentially polluting inputs such as chemical fertilizers and pesticides.

However, the effects of agricultural policies on the environment also involve some uncertainties. To make things more complex, many policies are administered on a commodity basis, 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 impact. The effects of changes in policies and production practices on the environment are often gradual and cumulative. It may take some time before they become noticeable and measurable.

Table 3 shows the general effects on farm prices and farm incomes of policies directed toward environmental protection. A comparison of Table 2 and Table 3 shows how the two sets of policies may support or contradict each other. The major complementary effect is that environmental regulation may sometimes enhance price supports and income goals. 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 in Korea strongly encourages the development and use of land-saving agricultural technologies, including fertilizers and pesticides. On the other hand, environmental regulations offer environmental subsidies, while extension programs attempt to promote environmentally friendly production technologies. The net effect is that each set of policies cancels out some of the influence of the other.

**HOW TO INTEGRATE AGRICULTURAL AND ENVIRONMENTAL POLICIES**

**Goals and principles**

Integration means to make whole, or to bring different parts together. Policy integration requires that policy instruments designed to achieve a particular objective in one sector should first be assessed in terms of their effects on other sectors. Conflicts and inconsistencies are common in agricultural policy programs. They arise because the policies have different goals.

For example, an environmental policy to control non-point source pollution in agriculture must consider the effects on farm incomes and water quality. Similarly, agricultural policies designed to raise farm incomes must be assessed in terms of their effect on the environment. Thus, an integrated approach requires that we consider simultaneously the potential impact of environmental policy on agricultural production, incomes and prices.

Integrating agricultural and environmental policies requires a clear understanding of the fundamental concepts underlying sustainable development (OECD 1998a). 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 means the transfer of his stewardship of environmental and other assets to others.
### Table 2. Environmental effects of agricultural policy

<table>
<thead>
<tr>
<th>Policy instrument</th>
<th>Total soil erosion</th>
<th>Loss of wildlife habitat</th>
<th>Application rates of agricultural chemicals</th>
<th>Total use of agricultural chemicals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raise commodity prices</td>
<td>⬆</td>
<td>⬆</td>
<td>⬆</td>
<td>⬆</td>
</tr>
<tr>
<td>Tie farm income support to production levels</td>
<td>⬆</td>
<td>⬆</td>
<td>⬆</td>
<td>⬆</td>
</tr>
<tr>
<td>Reduce risks</td>
<td>⬆</td>
<td>⬆</td>
<td>⬇</td>
<td>⬆</td>
</tr>
<tr>
<td>Subsidize credit</td>
<td>⬆ ⬇</td>
<td>⬆</td>
<td>⬆</td>
<td>⬆</td>
</tr>
<tr>
<td>Short-term acreage requirements</td>
<td>⬇</td>
<td>No effect</td>
<td>⬆</td>
<td>⬇</td>
</tr>
<tr>
<td>Establish domestic standards</td>
<td>No effect</td>
<td>No effect</td>
<td>⬆</td>
<td>⬆</td>
</tr>
</tbody>
</table>

Note: Arrows indicate the direction of the net effect (increase or decrease). They do not imply whether the effect is "good" or "bad".

Source: Modified from Reichelderfer (1990), p. 208.

### Table 3. Economic effects of environmental policies on the agricultural sector

<table>
<thead>
<tr>
<th>Environmental policies</th>
<th>Farm production costs</th>
<th>Commodity prices</th>
<th>Net farm income</th>
<th>Cost to taxpayers and government</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulated use of inputs</td>
<td>⬆</td>
<td>⬆</td>
<td>⬆ ⬇ 2)</td>
<td>No effect 3)</td>
</tr>
<tr>
<td>Taxes on agricultural chemicals</td>
<td>⬆</td>
<td>⬆</td>
<td>⬆ ⬇ 2)</td>
<td>⬆</td>
</tr>
<tr>
<td>Subsidies for selected farming practices</td>
<td>No effect</td>
<td>No effect</td>
<td>⬆</td>
<td>⬇</td>
</tr>
<tr>
<td>Research into, and extension of, sustainable technology</td>
<td>⬇</td>
<td>⬇</td>
<td>⬇</td>
<td>⬇</td>
</tr>
</tbody>
</table>

Note: 1) Arrows indicate the direction of the net effect. They do not imply whether the effect is "good" or "bad".
2) Effect on total revenue depends upon price elasticity of those commodities affected by demand
3) Not including transaction costs, including administrative and enforcement costs.

To achieve sustainability, the public decision processes must incorporate the shadow prices of environmental quantity and quality. Shadow prices reflect the social opportunity costs of using the resources, whether they are traded in markets or allocated in some other manner.

Conservation of the natural resource base has emerged as a goal of environmental policy. This is critical, because agricultural production relies heavily on the quality and quantity of the natural resource base. Furthermore, agriculture produces a wide array of positive environmental services, and affects the quality of environmental resources used by the public.

While these broad goals give us a general policy direction, we need more specific principles to develop programs for integrating agricultural and environmental policies. The following principles to achieve integrated agricultural and environmental policies have been formulated by OECD (1993).

- View rural countryside assets as a source of agricultural products and environmental services;
- Promote comprehensive resource use efficiency by directly or indirectly including environmental shadow prices;
- Alter agricultural commodity program provisions that cause distortions in inputs, or crop and livestock outputs, which result in environmental degradation;
- Encourage farmers to recognize that it is in their and society’s best interests to maintain and enhance their asset base;
- Promote pollution prevention rather than waste management;
- Target specific environmental objectives rather than use broad agricultural and environmental initiatives;
- Apply the principle “The polluter pays”;
- Create an administrative framework which can promote integration.

As mentioned above, the basic principle for integrating agricultural and environmental policies is: “The polluter pays”. This principle states that the polluter should be held responsible for any environmental damage he causes, and bear the expenses of preventing pollution. OECD adopted this principle in 1972, to encourage the rational use of scarce environmental resources.

Instruments of policy integration

Integrating agricultural and environmental policies has three dimensions (OECD 1989). First, there is institutional integration — the development of administrative structures designed to ensure greater co-operation among the ministries and various agencies responsible for agriculture and the environment.

Second, there is the need for integrative procedures, including the development of agreed objectives. The need to integrate agricultural and environmental policies has now become formally recognized by most countries. This has led to the revision of procedures for policy formulation.

Third, there is a whole set of integrative instruments. These are sometimes subdivided into three broad categories: regulatory instruments, economic instruments and moral suasion (Opschoor and Vos 1989, Office of Technology Assessment 1995).

- The traditional instruments of agri-environmental policy are regulatory or administrative. They try to influence the environmental performance of polluters directly, by regulating the processes or products used, or by abandoning or limiting the use of potential pollutants through licensing, standards and zoning.
- Instruments of agri-environmental policy are labeled economic if they affect probable costs and benefits of alternatives, in this way influencing the decisions taken. Economic instruments are based on the polluter-pays-principle. Subsidies are economic instruments only if they influence the cost-benefit ratio of certain activities in the direction of a reduced impact on the environment.
- The moral suasion approach is used to bring about a voluntary change in behavior. Basically, this involves greater awareness of environmental issues, and a greater sense of responsibility in individual decision-making. This approach often uses the threat of possible regulations in order to bring about voluntary change, supported by economic incentives and disincentives.

I do not want to go deeper into a theoretical discussion of environmental instruments. Instead, I should like to focus on the question: what kind of
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 a coercive approach, such as regulations or environmental taxes, to a voluntary approach such as technical assistance and subsidies.

**Regulatory approach**

The regulatory approach is the most important set of policy instruments. Regulatory action may restrict the availability of environmentally hazardous agricultural inputs, or prohibit the use of environmentally damaging production practices. It can be applied uniformly to all farmers, or may target specific farming operations or particularly vulnerable production areas. The most common adverse effect of environmental regulations is a change in the distribution of incomes within the farming sector. Other effects include an increase in the cost of agricultural production, with the possibility of higher consumer prices and decreased trade competitiveness.

In practice, the regulatory approach has only been employed if the perceived environmental costs are high. The political and administrative structure of many countries, prevents the strict enforcement of regulations. Only the most blatant offenses are penalized. Because of these limitations, it is usual to use voluntary programs to achieve the desired state of the environment and 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. Nor is it possible to account for all externalities, or 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 appropriate sanctions can be targeted more precisely than economic incentives. In particular, they do not require a knowledge of the nature of damage functions, and are not sensitive to price variations.

**Economic incentive approach**

There is now widespread interest in the use of economic instruments to complement regulatory instruments for environmental management. These include taxes on farm inputs which are sources of pollution, on farm emissions, or taxing farmers for their failure to meet required levels of environmental quality. An approach being tried in several countries is the use of input taxes to reduce the use of agricultural chemicals.

Fertilizer charges as high as 100% are needed to reduce pollution significantly. However, taxes of only 10 - 20% may have a favorable effect. Kim and Kim (2001) showed that a tax of 100% on the nitrogen in chemical fertilizer leads to a reduction of 14.6% in fertilizer use and a fall of 0.3% in rice yield and 3.1% in farm income. Generally, taxes raised in this way are used to finance pollution control and finance research into improving input use.

A subsidy program might pay farmers who use environmentally friendly production practices such as sound nutrient management or integrated pest management (IPM). When the issue is not one of pollution, but rather one of maintaining or enhancing the environment, incentive schemes are particularly effective. The administrative costs of incentive-based approaches are often significantly lower than regulatory schemes. Most governments have a strong preference for this approach.

**Cross-compliance**

Cross-compliance means that a farm’s operations must meet certain requirements in order for the farmer to be eligible for assistance under government support schemes. Farmers claiming support under one program have to meet the rules for that program and certain obligations of other programs. This makes a link “across programs”, giving rise to the term “cross-compliance” (Baldock and Michell 1995).

Cross-compliance is a marvelous way of ensuring that participants in commodity programs keep to minimum standards of environmental conservation. It has increased the consistency between farm commodity programs and environmental objectives, yielding significant environmental gains. For example, participants in some programs have been obliged to use fertilizer and pesticides in stipulated ways.

Various forms of cross-compliance and their consequences for the agricultural sector and the environment have not yet been fully examined. However, the requirements may be made in a variety of ways (Dwyer, Baldock and Einschutz 2000):

- One or several conditions which apply across the board must be fulfilled.
• A choice can be made from several sets of conditions, as a kind of a package system.
• An even more flexible opinion is the points system, whereby several options are combined to achieve the required number of points.

Point systems or package systems are a more flexible approach, as they enable farmers to select the options that fit in best with the actual situation on their farms. This is important, because certain options may be feasible in some areas but not in others.

Advisory approach

Voluntary or direct advisory approaches to farmers are widely used in most OECD countries to achieve agricultural objectives (OECD 1993). To be successful, they must take into account all the economic conditions faced by farmers. Problems have been encountered if advisory methods alone are used, to try and 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 help farmers to adopt environmentally benign practices. Assistance may include providing data on soil quality, disseminating information about new sustainable practices, and helping farmers prepare conservation plans.

Providing the public with information may increase the use of conservation practices by farmers. Training, education and demonstration projects spread information and make farmers aware of the environmental effects of alternative farming practices. Such programs are completely voluntary. Their effectiveness largely depends on whether a given practice provides enough benefits to farmers to offset the cost of adoption.

The relative efficiency of a voluntary program increases if:
• There is no rivalry between different government services;
• Government services are less expensive than those provided by the private sector; and
• Enforcement costs are low compared to those of regulations and restrictions.

Wu and Babcock (1999) showed that voluntary programs are more efficient than compulsory ones only if there is less government expenditure under the voluntary program. The comparative advantages of the voluntary approach include lower enforcement costs, and avoiding duplication with the private sector.

SOME CONCLUSIONS

Coordinating agricultural and environmental policy objectives can be achieved, either through efforts to integrate agricultural and environmental policy instruments, or through independent reform of agricultural policy and, environmental policy, or both. Agricultural policies such as price or income supports were not originally developed to affect environmental quality in any way.

In recent years, there has been an increase in policy measures to address environmental issues in agriculture. Environmental concerns are giving an added impetus to the reform of agricultural policies. During this reform process, opportunities exist for the integration of agricultural and environmental policies. Such integration can bring multiple benefits, by ensuring that policy goals are reached for the lowest possible cost. It also helps ensure that the burdens which agricultural policies can impose on the environment are fully accounted for.

We need to know more about the effects of policies, in particular their environmental impact. We also need better analytical instruments to assess them. One-size-fits-all solutions are unlikely to be successful in dealing with agricultural and environmental problems. Soils, climatic conditions, crops and management practices very widely in different parts of any country. Practices that work well on one farm may be environmentally damaging or too expensive on another.

The development of integrated policies requires more effort to achieve complementary objectives, and to make conscious trade-offs between competing objectives. For example, consistency between farm income support and environmental protection has been enhanced through cross-compliance. This makes the payment of income support 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. In addition, the distribution of cost and benefits of an integrated approach will have a major impact on its political acceptability.
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