

**Sustainable Development Research in Agriculture:
Gaps and Opportunities for Ireland**

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Introduction

In Ireland, agriculture and forestry occupy over 70% of the total land area and thus have a major impact on the physical environment. As the Department of Agriculture and Food's most recent policy statement points out (DAFRD, 2000), much of this impact is positive. The rural landscape, which is an important tourist resource as well as an amenity for local populations, is to a large extent a by-product of our agricultural systems. However, there is also concern about the negative impacts which agriculture may have and the growth of unsustainable farm practices. In particular, agriculture is seen to contribute to water pollution, greenhouse gas emissions and reduced bio-diversity (DAFRD, 2000). The recent report on *Eco-Friendly Farming* (DAFRD, 2002) provides a succinct summary of the global commitments and EU law which Ireland is obliged to implement to encourage a more sustainable agriculture, as well as providing a summary of the actions which are being taken to meet these obligations, including discretionary national action.

The concept of sustainability has many dimensions. It can be used to mean economic sustainability, social sustainability, institutional sustainability as well as environmental sustainability. The environmental sustainability agenda in agriculture, which is the topic of this paper, covers the protection of the resource base, the reduction of negative externalities and the promotion of positive externalities. Principal issues include water quality and quantity, air quality, soil erosion, biodiversity, and landscape protection as well as food safety and animal welfare. The agenda includes:

Water quality and quantity concerns:

- Issues here include leaching of nutrients and pesticides, water extraction and drainage and flooding. Contamination of both ground and surface waters caused by high levels of production and use of manure and chemical fertilisers is a serious problem, particularly in areas of intensive livestock or specialised crop production.

Air quality concerns:

- The issues here are emissions of ammonia and greenhouse gases. At EU level, agriculture is responsible for about 8% of total greenhouse gas emissions but due to the pastoral nature of Irish farming, the proportion here rises to 30%.

Biodiversity concerns:

- Issues include genetic, species and ecosystem diversity. The intensification of agriculture has led to widespread reduction of species and habitats.

Landscape concerns:

- The marginalisation of agricultural land can lead to its abandonment if farming ceases to be viable. Alternatively, intensification of agriculture can lead to the loss of important landscape features such as hedges and ponds, the enlargement of fields and the replacement of traditional farm buildings with industrial structures. Rights of access may be restricted in interests of more efficient farming.

Soil erosion concerns:

- Overgrazing particularly in mountain areas has led to the erosion of vegetation cover with the consequent loss of soil, the silting of rivers, etc.

Food safety and animal welfare concerns

- The issue here is the effect of agricultural practices on human health and animal well-being rather than the physical environment. There is concern about the consequences for the quality and safety of the food supply of the increasing use of pesticides and drugs, as well as the consequences of introducing genetically-modified organisms.

The policy and institutional context for sustainable development in agriculture

Agriculture has been, and is, a highly regulated activity in the EU. While farmers are increasingly subject to food safety and environmental regulations, the objective of much agricultural regulation has been market price stability and farm income support. To this end, most major commodities are governed by market regimes under the EU's Common Agricultural Policy with the objective of supporting prices to farmers through regulated import access, the implementation of minimum prices through intervention buying and aids to private storage, provision for domestic subsidies to encourage increased domestic demand, and provision for export subsidies to facilitate the export of production surplus to domestic requirements at the guaranteed price level.

During the 1970s and 1980s high guaranteed prices stimulated the growth of agricultural output, leading to increasing EU self-sufficiency and growing budget costs of disposing of agricultural surpluses. Attempts to reduce guaranteed price levels were largely unsuccessful during this period, although milk quotas introduced in 1984 were successful in stabilising dairy regime expenditure. It was not until the MacSharry reform in 1992 which combined reductions in support prices with compensation payments to farmers to make up for the loss of income that the first significant CAP reform was achieved. This reform was succeeded by the Agenda 2000 reform in 1999 which followed the same formula. Direct payments now make up almost 70% of Irish farm income as a result even though reform, in both cases, was limited to arable crops, beef and sheepmeat.

The conclusion of the GATT Uruguay Round in the mid-1990s added to pressures to move agricultural policy in a more market-oriented direction. The Agreement on Agriculture agreed at the end of that round required the EU to convert its variable import levies to fixed tariffs, set limits on the value and volume of subsidised exports and also capped the value of domestic support. Further talks are under way in the WTO Doha Development Round which are expected to lead to further reductions in all three elements as part of the move towards a progressive and substantial reduction in trade-distorting agricultural support.

At the same time, there is a strongly-held view at European level which argues that European agriculture is a multi-functional agriculture, whose value lies not only in its food production but also in its contribution to landscape preservation and the countryside. This role is contrasted with the industrialised agricultural systems perceived to characterise US and Australian agriculture, for example, or the large-scale farming of Latin America. In this context, multifunctionality refers to any unpriced spillover benefits that are additional to food production. The claimed benefits range from environmental values, rural amenities, cultural values, rural employment and rural development as well as food security. In a policy context, the

importance of multifunctionality is that it provides an additional justification to provide support to agricultural production with a view to enhancing these spillover benefits.

The key elements in this concept of multifunctionality are:

- the existence of multiple commodity and non-commodity outputs that are *jointly produced* by agriculture (the supply side). The idea behind joint production is that the non-commodity output can only be produced as a by-product of farming activity (in the same way that wool is a joint product with lamb or mutton). Thus farming activity should be supported in order to ensure the supply of the desired non-commodity output.
- the fact that some of these non-commodity outputs possess the characteristics of *public goods and/or externalities* with the result that markets for these goods do not exist or function poorly (the demand side). If the non-commodity benefits could be priced and sold separately, farmers would be automatically remunerated for them and no public policy issue would arise.

The major policy question in EU (and Irish) agriculture at present is how to encourage a more competitive agriculture in the context of the move to a more market-oriented policy, which is sustainable in environmental terms, and which also provides the appropriate level of non-priced public good outputs. These policy goals must be pursued in the context of limited budget resources for EU agricultural policy and the constraints of WTO agricultural policy.

Scale for application of sustainable development principles

There are four relevant levels for the practical application of sustainable development principles in agricultural policy.

The *EU level* is crucial because it is here that agricultural policy is determined. Agricultural policy rests on two pillars – the first pillar of market price and income support, and the second rural development pillar. Both pillars of agricultural policy are relevant to sustainable agricultural development. Most observers agree that the high price support policies under the CAP, even if not the sole cause, have encouraged intensification with detrimental environmental impacts. On the other hand, the gradual substitution of direct payments for market price support has opened the possibility of using cross-compliance to leverage income support payments to provide environmental benefits. Unlike price support, which benefits recipients regardless of their agricultural practices, direct payments can be linked to the pursuit of particular agricultural practices (cross-compliance). Strengthened cross-compliance is one of the proposals in the CAP Mid-Term Review (meaning that income support payments could be withheld where farmers are not observing good agricultural practice as set out in the relevant regulations).

The CAP second pillar is also highly relevant to sustainable agriculture concerns. Under the Rural Development Regulation, governments can choose from a menu of instruments to promote agricultural and rural development, including an agri-environment scheme which incentivises farmers to provide environmental benefits over and above the minimum level set out in the code of good agricultural practice. Other measures relevant to sustainable agricultural development include investment

aids for anti-pollution measures. The main drawback of second pillar schemes at present is the limited budgetary support in comparison to that available for market regimes and direct payments. One of the Commission's Mid-Term Review proposals is that there should be dynamic modulation, which means that a certain percentage (increasing over time) would be taken from existing direct payments (for farmers in receipt of payments above a certain threshold) and transferred to fund additional rural development expenditures.

The *national level* is the second level for applying sustainable development principles. At least two areas of decision-making are important at the national level. The first is the legislative one of assigning property rights in rural resources and operationalising the polluter pays principle. Property rights determine what environmental standards should be required of farmers without direct compensation and for which environmental services farmers should be compensated. For example, it would be generally accepted that farmers should not be compensated for restrictions on pesticide use or on fertiliser applications in nitrate vulnerable zones. On the other hand, farmers who deliberately seek to create habitats for bird species or to restore wetlands might be seen as providing environmental services which go beyond 'normal agricultural practice' and thus be entitled to compensation for these services. But the line will always be a controversial one. It is a political, or philosophical, issue whether a particular agricultural practice, for example, one that preserves bird habitat or wetland, constitutes avoidance of harm (and, therefore, is not deserving of compensation) or constitutes provision of a public service (and, hence, is deserving of compensation).

The second area of national decision-making is the policy one of implementing schemes and regulations to ensure that sustainability objectives are met. While policy interventions must respect EU rules, considerable national discretion exists particularly in second pillar schemes. The design of environmental instruments, the level of funding provided for them, monitoring and evaluation are all important functions at the national level.

The *local level* is the third level where sustainable development principles can be implemented. While regional and local decision-making is relatively underdeveloped in Ireland, the potential exists for interventions at watershed level or in particular topographical areas (uplands management, management of conservation areas). Local authorities, LEADER groups, agricultural and tourism co-operatives and other local development bodies have important roles to play.

The fourth and final level for the application of sustainable development principles is the *farm level*. It is through farmers' day-to-day decision-making that sustainable development is put into practice. While incentives and regulations are important instruments to encourage sustainable decision-making, gaining the understanding and support of the farming community for compliance and adherence to these principles is vitally important. Environmental regulation has a mixed record in this respect, and the lessons from successful partnerships need to be learned and systematised so that best practice in this area can be identified and spread.

Needed research to improve implementation of sustainable agriculture policy

As noted, the objectives of a sustainable agriculture are set out in the Department of Agriculture and Food's strategy document Agri-Food 2000 (DAFRD, 2000) and more recently in the Eco-Friendly Farming report (DAFRD, 2002). The contribution which agriculture can make to Ireland's climate change strategy is discussed in DOELG (2000). Specific research priorities to underpin this strategy are set out in this section.

Strategies for reform of agricultural policy

As noted in the previous section, agricultural policy is moving in a more market-oriented direction although there is still debate both on how far it should go and the direction it should take. Different reform strategies will have different implications for agricultural sustainability, and there is a need for further research on the sustainability implications for Ireland of different reform options. A number of *a priori* hypotheses can be formulated.

For example, lower effective agricultural prices will lead to a reduction in agricultural output.¹ Given the pastoral nature of Irish agriculture, and the contribution which livestock in particular make to Ireland's greenhouse gas emissions, lower agricultural output can make a decisive contribution to meeting the agricultural sector's target for reduced GHG emissions. For example, simulations with the FAPRI-Ireland agricultural sector model show that the effect of the decoupling proposals alone in the Mid-Term Review, through reduced suckler cow numbers, would meet the reduction target in its entirety (Teagasc, 2003). Whether this is the most cost-effective way of meeting the target is another matter, but it does underline the potential for CAP reforms to have far-reaching environmental consequences.

Second, lower effective agricultural prices will lead to more extensive land use and less use of purchased inputs such as fertiliser and pesticides. While this will be welcomed in regions with the more fertile soils, it could lead to the abandonment of more marginal land or, at least, its withdrawal from agriculture on poorer soils or in upland regions. The environmental implications of both consequences of lower prices need further investigation.

Third, the introduction of direct payments into the CAP has made possible an additional agri-environment policy instrument, namely, cross-compliance. It is not possible to attach environmental conditions to market price support, as all farmers benefit regardless of the way they manage their land or their animals. However, explicit conditions can be, and have been, attached to the receipt of direct payments, and one of the objectives of the Mid-Term Review is to strengthen this conditionality. From an environmental perspective, this is superficially an attractive way of obtaining more environmental leverage on land management because it appears relatively costless. However, if the underlying rationale for direct payments is disputed, cross-compliance can be a figleaf which may be used to justify expenditure which is

¹ By effective prices is meant the price to which farmers respond in setting their output. It may be the market price, or it may be the market price plus direct payments when the payments are coupled to production. Effective prices can be reduced by a reduction in market prices or a decoupling of direct payments.

otherwise of questionable value. Indeed, whether there are environmental benefits from the existing level of cross-compliance is a question which should be investigated further.

Fourth, constraints on increasing the EU budget imply that there is a continual tension over resources between the first and second pillars of the CAP. The Mid-Term Review proposes to address this tension through dynamic modulation, that is, a gradual reduction in the direct payments farmers receive under pillar 1 of the CAP (above a certain franchise) to be transferred into pillar 2 schemes, including agri-environment and afforestation. Such transfers are naturally opposed by those who would otherwise receive these payments, and it would be helpful to know whether and to what extent there would be environmental or other benefits if such transfers were made.

These are just some examples of areas in which further reform of CAP market regimes will have implications for agricultural sustainability (see Convery et al., 2001 for a more detailed discussion). Detailed modelling of agricultural markets, input use, land use changes and environmental interactions is required to be able to simulate the range of possible scenarios. Existing models with their strong agricultural roots need to be extended to enable them to take adequate account of the environmental impacts of reform.

Impacts of sustainability constraints on production

Given that farming is asked to meet particular sustainability or environmental objectives such as improved water quality or lower greenhouse gas emissions, the economic question of interest is how these objectives can be met most efficiently, i.e. at least cost. There is a wide research agenda in the production economics and farm management area to determine optimal farm-level strategies to meet sustainability targets. Different strategies will be required depending on the sustainability objective, for example, the menu of available strategies to reduce greenhouse gas emissions will be different to those designed to increase biodiversity, or reduce water pollution. But in some cases there may be synergies or economies of scope between strategies, so that the cost of jointly meeting a number of sustainability targets may be less than the cost of meeting each of them individually. This area of research is particularly important in the context of the future competitiveness of Irish agriculture. One of the main arguments put forward by producer groups against any tightening of environmental standards, particularly if implemented on a unilateral basis, is that it may damage the competitive position of the industry. Although the argument is irrelevant at a conceptual level, provided that the negative externalities are completely internalised, it may carry some political weight.² Accurate estimates of the cost of individual environmental standards is thus important, also in order to compare these costs against the expected benefits from their implementation.

² The caveat is important. For example, if additional agricultural production is associated with higher levels of water pollution, and the marginal social value of the agricultural production is less than the marginal social cost of the water pollution, then there is no national gain from promoting agricultural production for its own sake. The argument is more complex in the case of carbon taxes to reduce greenhouse gas emissions where much of the benefit may accrue to individuals outside the country. The argument for compliance here is part of the collective action problem that binding all countries to take part can ensure a higher level of welfare for everyone.

Options for reducing agricultural pollution

Water pollution is probably the single most urgent sustainability issue facing Irish agriculture. The failure to implement the Nitrates Directive since 1991 has been associated with a steady deterioration in water quality in lakes and rivers, much of it the result of unsustainable agricultural practices. While a government decision to designate the entire country as a Nitrate Vulnerable Zone has now been taken, research should continue to determine if this is, indeed, the least cost and most effective way of tackling the pollution problem. A number of issues need additional research, preferably at individual catchment level.

First, in specific catchments, agriculture is probably not the only source of pollution load. Nutrients entering particular watersheds may come from urban and agricultural runoff, industrial and municipal point source discharges, rural septic systems and atmospheric deposition. In these cases, decisions must be made about which sources to control and to what degree. Because the costs of reducing pollution can vary greatly from one source to another, the choices made can have a large impact on the overall costs of water quality protection. Economic considerations would favour allocating greater responsibility to sources with lower abatement costs, but legal, political and equity issues will also be taken into account in policy-making.

Second, more information is needed on the types of environmental policy instrument which should be used to achieve the desired outcomes. 'Command and control' or regulatory instruments have been the dominant approach in environmental policy. These instruments involve mandated use of specific pollution control technologies, or adherence to input restrictions, product standards, emission quotas or other regulations. However, there is a growing interest in the use of economic incentives and market-based approaches that have the potential to achieve environmental quality goals at lower costs than command and control instruments. In agriculture, there has been a lot of emphasis on voluntary compliance ('codes of conduct') as well as financial aid to encourage and facilitate adoption of environmentally friendly technologies, but the evidence suggests that these measures alone are not sufficient. Some proposals have been made to introduce market-based instruments into agri-environment policy (e.g. the removal of the VAT rebate from fertiliser, see Scott, 1997). Further research to investigate the feasibility, design and use of alternative agri-environmental policy instruments is highly desirable.

Stimulating the production of public goods

Where public environmental goods are joint products with agricultural production, then encouraging additional agricultural output may be an efficient way to ensure the production of these goods. But jointness needs to be proved rather than assumed, and if there is some flexibility in the proportions in which the environmental good and food are produced, then there is a case for targeted agri-environmental policies. Depending on the allocation of initial property rights, policy instruments can include subsidies, management agreements, regulatory controls and planning restrictions, or even public or quasi-public ownership. Much work still needs to be done in Ireland to determine the optimal mix of policies given the environmental objectives in place.

Subsidies play an increasingly important role as expenditure on REPS, the agri-environment scheme, has grown and is set to grow further following the Partnership Agreement with the farm organisations in May 2003. The philosophy behind REPS, which is the Irish implementation of an EU scheme, is that farmers should be compensated for the additional expenses incurred in providing positive environmental benefits over and above good farming practice. However, with the management of the scheme in the hands of the Department of Agriculture and Food, arguably more attention has been paid to its potential to transfer income to farm families than to maximising its environmental impact. While there are undoubtedly environmental benefits arising from the participation of farms in REPS, whether a re-design of the scheme might not yield greater environmental benefits for the same expenditure is worthy of research. Much of the benefit to date has been in the form of reduced pollution where, arguably, compensation should not be paid.

Management contracts with farmers have some theoretical advantages but there is an active literature on how to design these contracts to avoid problems of moral hazard and adverse selection. Also, the costs of monitoring management agreements may be much higher than with flat-rate payments. There seems to be almost no research in Ireland contributing to this literature.

Biofuels and energy cropping

Sustainability is not just a concept to be applied within agriculture. Agriculture may also be in a position to contribute to wider national sustainability goals. The most obvious area concerns the use of agricultural resources to produce sustainable energy resources. Considerable work has been done in Ireland in a number of areas: the production of oilseeds (particularly rape) for use as a biofuel; short-rotation forestry as an energy crop; and slurry digesters to produce methane as a fuel. To date, these alternative energy sources are not competitive on market price with fossil fuels. Apart from the necessity to maintain technical research in these areas to try to improve cost the efficiency of production, socio-economic research is also needed, for example, to identify where subsidies may be justified on the grounds of externalities or other market failures in the energy market, to identify the cash flow implications for farmers of investing in these alternatives, to examine market opportunities, etc. The use of agricultural land for wind farming is also of growing importance in particular rural areas and is beginning to make a small contribution to on-farm income. While not an agricultural sustainability issue in itself, wind farms in rural areas do raise issues of conflicting property rights (their impact on visual amenity, noise pollution, etc.) and economic analysis has a role in identifying the trade-offs.

Organic agriculture and GMOs

Organic agriculture has had a relatively slow take-off in Ireland and the market for organic produce, although growing, is still relatively underdeveloped. Research on the sustainability impacts of organic and conventional farming in an Irish context is still relatively limited. The constraints to increasing the role of organic farming have been discussed in a number of reports, but ongoing monitoring and evaluation of market developments, marketing channels, production costs and consumer perceptions is desirable.

The issues around GMOs are different. Whatever about the scientific evidence on the lack of environmental damage or health effects of GMOs to date, consumer perceptions are all important. The EU has now almost put in place the legal framework which will allow it to lift its moratorium on the approval and use of GM seeds and foods. However, many retail chains have declared in favour of GM-free foods, and it looks like a segmented market structure may emerge. The production, market and trade effects of alternative strategies for the regulation of GMOs, also taking into account Ireland's emerging reputation for pharmaceutical industries, need careful research and evaluation.

Farm structure and environmental sustainability

Conventional wisdom assumes that there is a negative relationship between farm size and the environment, but there is limited empirical support for this proposition. The relationship, if it exists, is indirect rather than direct. Environmental impact is determined by land use intensity, and the presumption is that larger farms make more intensive use of their land, and thus leave a larger environmental 'footprint' than do smaller farms. Production motivation may also be a differentiating factor, with larger farms assumed to be run on more commercial, profit-making lines with less regard for intrinsic values such as appreciation of natural capital while smaller farms, more deeply embedded into their local communities, are assumed to take a longer-term attitude to the protection and safeguard of natural capital. Research to determine the relationship between farm structure and sustainability would be very valuable as it might help to target policy more effectively. It is probable that the relationship differs for different aspects of the natural environment. For example, larger farms might be expected to have larger field sizes and thus a lower density of hedgerows or field boundaries than smaller farms. On the other hand, larger farms may be more able to set aside areas for habitat, or to afford investment in pollution control.

Valuation of environmental costs and benefits

By definition, agricultural sustainability issues arise because of market failures; the market places an inadequate price, or no price at all, on the use of particular natural resources or on the generation of environmental goods. Often, this is the result of failing to define property rights in the environment, and government intervention (through taxes, subsidies or regulations) may be justified to correct these market failures.

However, the identification of a market failure does not help to define the appropriate *extent* of intervention. We can all agree that agricultural pollution is a bad thing, but it does not follow that the optimal level of pollution is zero. After a point, the costs of preventing the last unit of pollution will greatly exceed the marginal damage, which such pollution may cause. Defining the appropriate level of pollution control requires that we can measure the marginal damage which pollution causes (as well as the cost of reducing pollution to that level). Similarly, there will be widespread agreement that there are positive amenity benefits from the visual landscape produced by sensitive agricultural land management, and that the public may be willing to pay farmers to maintain such landscapes. But this is not a *carte blanche* to provide unlimited agricultural support for this purpose. Payments to farmers have an opportunity cost in terms of other benefits which are foregone, and it only makes sense to provide amenity payments to farmers (or other payments for the provision of

environmental goods) up to the point where the marginal benefit to the public is at least as great as the marginal cost of providing this support. Defining the appropriate level of 'landscape production' or other environmental good requires that we can measure the marginal benefit associated with that production and compare it with the opportunity cost of the resources necessary to ensure its provision.

Thus, in developing appropriate sustainability policies, there is a huge role for *valuation*. Economists distinguish between different types of values. User value measures how much consumers are willing to pay to actually enjoy an experience themselves, e.g. walking in upland areas. Option value is the value placed upon the ability to use an environmental benefit in the future or to prevent environmental damage. For example, even if I don't engage in hill-walking at present, I may put a value on protecting my right to do this in the future. Existence value is the willingness to pay to ensure the survival of an environmental asset even where I may never have the intention of experiencing the asset now or in the future. Protecting whales, or a particular species of bird or butterfly, may fall into this category. I may simply feel better off knowing that these species continue to exist. Finally, bequest value is the value assigned to future generations from their ability potentially to enjoy the asset.

The question is how to measure these values for any particular asset. Three methods are commonly used. Use values can be measured by either the travel cost method or the hedonic price method. But contingent valuation is the only valuation method that can estimate non-use values. A sample of individuals, whether users or non-users, are asked for their willingness to pay to preserve or protect a particular environmental asset (or alternatively, how much they would need to receive in order to compensate them for the loss of the asset). There is still considerable methodological debate about the use of contingent valuation techniques to value non-market goods, and there is considerable expertise in the use of this technique in QUB. Support both to improve the methodology and to gain experience in the application of valuation techniques to agricultural sustainability issues in Ireland should have a high priority.

Comparative studies of agri-environmental studies

Ireland is not alone in grappling with problems of agricultural sustainability, and the fact that we operate under a common agricultural policy with 14 other countries (soon to be 24) means that the value of comparative studies is particularly high. A useful place to start is with North-South comparisons, as there are important differences in the way the North of Ireland (within the UK policy context) has tackled some of the same agri-environmental problems. A number of EU-wide research projects have resulted in a deepening of our understanding of comparative agri-environmental policy-making, although the central issues addressed in these studies are not necessarily priority issues here (Brouwer and Lowe, 1998, Brouwer and Van der Straaten, 2002). There may thus be value in stimulating further comparative work around issues of particular interest and concern in Ireland where the research questions would be determined here rather than elsewhere.

Tools and techniques to measure progress towards sustainable development

Sustainable agriculture indicators are important in improving transparency, accountability and ensuring the success of monitoring, control and evaluation of

sustainable agriculture measures. Much work has been undertaken within international organisations such as the OECD, the European Environmental Agency, the US Department of Agriculture and Agriculture and Agri-Food Canada on this issue with a view to developing such indicators (see OECD, 2001; EEA, 2001, ERS, 2003, AAFC, 2000). In the case of agriculture, this is complicated by the fact that the environmental impacts of agriculture tend to be site-specific, so that aggregate indicators at the macro level actually tell very little. Indicators tend to be based on a Driving-Force-Pressure-State-Impact-Response-framework.

At the centre of the framework is the current *state* of the agricultural environment and how this has changed over time. State indicators might highlight undesirable changes which need to be combated, as well as provide information on desirable states which should be preserved. The second step is to identify the *pressures* which have brought about undesirable change or the benefits resulting from farming which help to preserve or enhance the environment. The third step is to link these pressures to the *driving forces* in the economy. Driving forces might include input use, land use, trends in farm management etc. that are directly influenced by agricultural policy. Finally, it is desirable to monitor how society's *response* to these issues is working.

The objectives of the exercise are to identify the key agricultural sustainability issues that are of concern; to understand, monitor and evaluate the relationship between agricultural practices and their beneficial and harmful environmental effects; and to assess the extent to which agricultural policies are responding to the need to promote sustainable agriculture.

Some sustainability indicators of this kind are included in the CAP Rural Development Plan 2000-2006 produced as part of the National Development Plan. However, the indicators are proposed only in the context of scheme participants rather than for the agricultural or land use sector as a whole. Work by the Heritage Council and the Teagasc Environmental Research Centre is also linked to the development of agri-environmental indicators. Ultimately, such indicators should be incorporated into a comprehensive picture of agricultural sustainability by preparing a set of environmental accounts for agriculture. Initial work in this direction has been undertaken by Scott (1999) and Curtis and Eakins (2003) and further work to build on this would be very desirable.

Stakeholders' contribution to sustainable development

The private sector has an important stake in sustainable agricultural and rural development.

Farm organisations play a dual role in sustainable agricultural development. Much of their effort is directed to reducing the cost of environmental policy measures on agriculture, or shifting this cost to the general taxpayer. However, farm organisations particularly at local level also take part in management groups to manage rural resources and are thus directly involved in implementation issues.

Other rural resource users are increasingly organised to promote their viewpoints on the use of rural resources. These include water users (anglers and fishermen) whose experience of or livelihoods may be adversely affected by deteriorating water quality; walkers and participants in other leisure pursuits in the countryside; and

environmental groups promoting bio-diversity, the protection of peatlands and bird habitats.

Other important groups are the food industry (and especially smaller food firms which trade on reputation in niche markets for high quality produce often produced in a craft or artisan manner) and the tourist industry, and particularly rural tourism, which depends on maintaining open access and an attractive visitor experience to maintain and increase its number of bed nights.

The contribution of private stakeholders to date would largely be in the area of lobbying and representation rather than research. However, they have an important role in helping to identify relevant research topics on the sustainability agenda.

The principal public agencies with an input into sustainable agricultural development are government departments, local authorities, local rural development bodies such as LEADER, and a range of statutory organisation with either an advisory or regulatory remit (Heritage Council, Environmental Protection Agency, etc.).

The Department of Agriculture and Food is the principal actor among this group, with legislative and policy responsibility for agri-environment schemes. It also has a small research fund which supports peer-reviewed research including in the sustainability area. The Department of the Arts, Heritage, Gaeltacht and the Islands and now the Department of the Environment, Heritage and Local Government (through Dúchas and its successor) is also an important player with responsibility for designated areas (national parks, Natural Heritage Areas, Special Areas of Conservation and Special Protection Areas) and through its promotion of the National Sustainable Development Strategy. Local authorities have an increasingly important role in rural environmental management through their planning functions (residential development and industrial development in rural areas), through their environmental monitoring functions and through the enactment of bye-laws which may require farmers, for example, to prepare nutrient management plans. The Environmental Protection Agency (EPA) is increasingly involved in agricultural sustainability issues. Licensing has been extended to cover intensive pig and poultry enterprises and the EPA also has a role in promoting research (including training of postgraduate students) through the RDTI research programme.

The research community includes Teagasc, the universities and the Institutes of Technology, and research institutes such as the ESRI. Teagasc – the agricultural development authority - combines the functions of agricultural research, advice and education; each area impacts on sustainable agricultural development. The Teagasc Environmental Research Centre based at Johnstown Castle undertakes research on agri-environment issues. Important recent contributions include its fertiliser use recommendations (for example, the recent downward revision in phosphate use requirements), and recommended changes in feeding regimes to reduce greenhouse gas emissions. On the advisory side, some Teagasc advisors function as REPS planners assisting farmers to draw up plans for environmentally-friendly farming and monitoring these plans. On the education side, agricultural education courses highlight and increase awareness of the environmental impact of farming practices.

The universities have an active interest in sustainable agricultural development both in the science and social science (including geography) departments. Much research work is presented in conference papers or published in monograph form, and may not be that easily accessible. The EPA has begun to compile an inventory of research. The research output of the universities has been strengthened through the HEA Programme of Research in Third-Level Institutions, which has led to the establishment of a number of 'thematic' multi-disciplinary research centres on university campuses, some of which would have a definite role in research on agricultural sustainability, and through the establishment of Research Councils which fund more blue-sky research projects. Funding under the EU Framework Programmes has been important generally for Irish research though the particular contribution these have made to research into sustainable agriculture is not readily to hand. The ESRI has made a significant contribution in a number of areas relevant to sustainable agriculture through its Environment Policy Centre.

Despite the wide variety of bodies and institutions interested in the area of sustainable agricultural development, the overall research effort could be improved by dealing with the three 'f's' – funding, focus and fragmentation.

- (a) Good quality research will not be done in the absence of funding. It is therefore important to maintain funding instruments with a regular call for funding.
- (b) Focus refers to the need to identify particular research themes and areas of interest to stakeholders and to promote a critical mass of research in these areas. Too often, research takes the form a single student PhD or individual research project and the opportunity of gains through synergy and a continuity of commitment is lost.
- (c) A feature of the research community is its fragmentation across many different institutions. It may therefore be useful to consider ways in which funding instruments might be used to encourage greater interaction and inter-institutional collaboration (including inter-disciplinary collaboration) through focused presentations by those commissioning research, the creation of centres of excellence (whether virtual or otherwise) with long-term core funding, internet discussion forums on particular topics, etc.

Agenda to progress sustainable development policy

Main issues

The main issues in the agricultural sustainability debate as identified above include:

- The impact of agricultural policy reform on the natural environment
- Reducing the adverse impacts of agricultural intensification
- Promoting environmental stewardship and the delivery of public goods
- Defining property rights in rural resources

Policy and institutional conflicts

There are inevitable areas of conflict between a productivist agricultural agenda seeking to maintain and improve the competitiveness of Irish agriculture in the face of difficult market and income conditions and the desire to protect, safeguard and enhance the natural environment. Good research can help towards the resolution of

these conflicts in a way which maximises overall social welfare. A feature of the debate on agricultural sustainability is the dominant role of the EU. This is not only because of the importance of EU agricultural policy in determining the policy context for farming activity, but also because much of the running on the sustainability agenda has been forced by EU directives.

Research priorities

Important areas for further research include:

- Evaluation of the implications of alternative CAP reform strategies for the sustainability agenda.
- Evaluation of the cost of individual environmental standards at farm level and implications for the cost competitiveness of Irish agriculture
- Evaluation of alternative policy instruments and options to address negative environmental externalities, particularly water pollution and greenhouse gas emissions.
- Evaluation of alternative policy instruments and options to promote the production of public goods associated with farming practice and output.
- Evaluation of the opportunities for renewable energy sources in agriculture
- Evaluation of the market potential for and constraints on the development of organic agriculture
- Evaluation of the economic consequences of alternative strategies for the regulation of GM crops and livestock
- Evaluation of the relationship between farm structure and the sustainability agenda.
- Improvement in the techniques of valuing environmental goods and environmental damage and the wider application of these techniques in the sustainability debate
- Improvement in the design and construction of agricultural sustainability indicators leading, in conjunction with improved valuation estimates, to improvements in the construction of a set of environmental accounts for agriculture.

References

Agriculture and Agri-Food Canada, 2000, *Environmental Sustainability of Canadian Agriculture: Report of the Agri-Environmental Indicator Project*, Montreal.

Brouwer, F. and Lowe, P., 1998, *CAP and the Rural Environment in Transition: A panorama of national perspectives*, Wageningen Pers

Brouwer, F. and Van der Straaten, J. eds, 2002, *Nature and Agriculture in the European Union*, Cheltenham, Edward Elgar.

Convery, F., Fry, J., Matthews, A., O'Shea, S. and Pender, A., 2001, European Union agri-environmental policy - issues and pitfalls, in Clinch, P., Schlegelmilch, K., Sprenger, R. and Triebswetter, U. (eds), *Greening the Budget: Budgetary Policies for Environmental Improvement*, London, Edward Elgar, pp. 248-274.

Curtis, J. and Eakins, J., 2003, *Environmental Accounts for Ireland 1994-2000*, Dublin, Stationery Office.

Department of Agriculture, Food and Rural Development, 2000, *Agri Food 2010: Main Report*, Dublin, DAFRD.

Department of Agriculture, Food and Rural Development, 2002, *Eco-Friendly Farming*, Dublin, DAFRD.

Department of the Environment and Local Government, 2000, *National Climate Change Strategy*, Dublin, DOELG.

European Environment Agency, 2001, *Towards agri-environmental indicators: Integrating statistical and administrative data with land cover information*, Topic Report No 6.2001, Copenhagen.

Newton, D. and Erickson, A., 1998, *Agri-environmental Indicators: Literature Review and Annotated Bibliography*, Washington, D.C., USDA Economic Research Service - AFSIC.

OECD, 2001, *Environmental Indicators for Agriculture Volume 3: Methods and Results*, Paris.

Scott, S., 1997. *The Fiscal System and the Polluter Pays Principle*, Aldershot, Ashgate.

Scott, S., 1999, *Pilot Environmental Accounts*, ESRI Report No. 136, Dublin, Stationery Office.

Teagasc, 2003, *An Analysis of the Effects of Decoupling of Direct Payments from Production in the Beef, Sheep and Cereal Sectors*, Report prepared for the Department of Agriculture and Food, Teagasc.