**Environmental RTDI Programme 2000–2006**

# Identification of Environmental Variables for Use in Monitoring for the Evaluation of the Rural Environment Protection Scheme (REPS)

# (2001-EEA/DS10-M2)

## Synthesis Report

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Prepared for the Environmental Protection Agency

by

Teagasc

and

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## DISCLAIMER



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# 1 Project Background, Aims and Objectives

## 1.1 Introduction

The aim of this study was to identify and select quantitative environmental attributes for a monitoring programme that may be integrated into an environmental evaluation of Ireland’s agri–environmental scheme. This was achieved primarily by reviewing a range of agri–environmental indicators and suggesting indicators that would be appropriate for monitoring the Rural Environment Protection Scheme (REPS).

The study conducted a desk review to collate information on current best practice in monitoring for environmental quality. A Project Group (comprising representatives from the Environmental Protection Agency (EPA), Department of Agriculture and Food (DAF), Teagasc, and the project supervisors) advised on the ongoing development of the project. There was a consultation process with national experts, and with a selection of stakeholder organisations with an interest in monitoring the environmental impact of the REPS.

## 1.2 The Agri–Environment Regulation

The 1992 Common Agricultural Policy (CAP) included a requirement that Member States establish agri–environmental schemes (the Agri–Environment Regulation, Council Regulation [EEC] No. 2078/92). Following the CAP reforms in Agenda 2000, agri–environmental schemes are now included as Chapter 6 in the composite Rural Development Regulation (1257/99).

Member States are obliged (Article 16, Regulation [EC] No. 746/96) to implement monitoring and evaluation of *environmental, agricultural and socio–economic* impacts under their respective agri–environmental programmes.

Evaluation of the environmental effectiveness of agri–environmental policy is becoming increasingly important in order to satisfy EU requirements, to demonstrate value-for-money to taxpayers, and to avoid accusations of trade distortion. The development of monitoring methods and the implementation of a more comprehensive national-scale monitoring scheme may further the long-term interests of farmer participation and reward from agri–environmental schemes.

## 1.3 The Rural Environment Protection Scheme (REPS)

REPS was established in Ireland in 1994, and has the following objectives:

- to establish farming practices and production methods which reflect the increasing concern for conservation, landscape protection and wider environmental problems;
- to protect wildlife habitats and endangered species of flora and fauna; and
- to produce quality food in an extensive and environmentally friendly manner.

## 1.4 Evaluation of the Environmental Performance of the REPS

In the first evaluation in 1999, the chapter ‘Environmental impact of the REP Scheme’ commented that:

“*A weakness of the implementation of the REP Scheme to date has been the absence of comprehensive environmental baseline data... this is unfortunate as it appears that the Scheme has been well designed and well promoted amongst the farming community. Instead, the evaluation has had to fall back largely on the requirements made of farmers in the individual REP Scheme plans... there is a need for baseline data and monitoring of the Measures dealing with habitat and landscape.*”
(Department of Agriculture, Food and Rural Development, 1999, pp. 52–53).

The task of identifying agri–environmental indicators with which to monitor the scheme in a retrospective manner is challenging. Nonetheless, it is an essential first step in establishing a more comprehensive monitoring programme with which to more directly evaluate the environmental effectiveness of the specific agri–environmental objectives of the Irish scheme. This study aims, at least in part, to address these issues by suggesting a potential suite of appropriate indicators for a more comprehensive monitoring programme.

## 1.5 Focusing the Project

In agreement with the Project Group, this study identified three major agri–environmental themes that encompass most of the agri–environmental aims of the REPS:

- Landscape
- Biodiversity
- Agronomy.

A comprehensive (though not exhaustive) list of possible agri–environmental indicators in the categories of landscape, biodiversity and agronomy was identified and evaluated for their suitability for use in monitoring the REPS in terms of the following criteria:

- Relevance/importance
- Reliability/validity
- Responsiveness
- Logistical feasibility/effort of sampling
- Cost
- Data availability.

There is a degree of subjectivity in the scoring of indicators according to the above criteria. However, the criteria represent a rational basis for the decisions of inclusion.

There is some duplication of indicators between sections; for example, a number of the indicators presented for landscape monitoring and evaluation overlap with indicators presented in the biodiversity section, particularly those referring to habitats. Such indicators are of additional value as they can provide data on more than one category simultaneously.

# 2 Monitoring of Agri–Environmental Schemes

## 2.1 What Does ‘Monitoring’ Mean?

A number of definitions of ‘monitoring’ are available, but some recurring themes are as follows:

- Firstly, monitoring requires the *a priori* setting of specific and measurable objectives and targets, against which the collected data can be compared.
- Secondly, the sampling design and strategy should be capable of collecting sufficient data to permit an unambiguous analysis of the data.
- Thirdly, comparison of the expected objectives and the collected data permits an objective evaluation of whether the recommended practices are having an impact and/or need to be modified (Fig. 2.1).

Thus, it should be clear that monitoring differs from a survey. A survey has been described as ‘*an exercise in which a set of qualitative or quantitative observations are made, usually by means of a standardised procedure and within a restricted period of time, but without any preconception of what the findings ought to be*’ (Hellawell, 1991). A crucial difference between monitoring and a survey centres on the extent to which each method is *purpose oriented*.

Monitoring should be purpose driven, and should aim to collect information for comparison with predefined objectives, targets or limits. Such an emphasis on the comparison of collected data with quantitative objectives forms the basis of the objective decision-making that supports evaluation. Although monitoring involves the collection of data, evaluation uses the data to interpret the effectiveness of the scheme and to make decisions on the basis of the evidence. In this way, the evaluation process can:

- identify the extent to which the scheme objectives are being fulfilled, and
- identify any changes that may be required to bridge the gap between policy aims and policy outcomes (Fig. 2.1).

The simple conceptual model in Fig. 2.1 reflects the

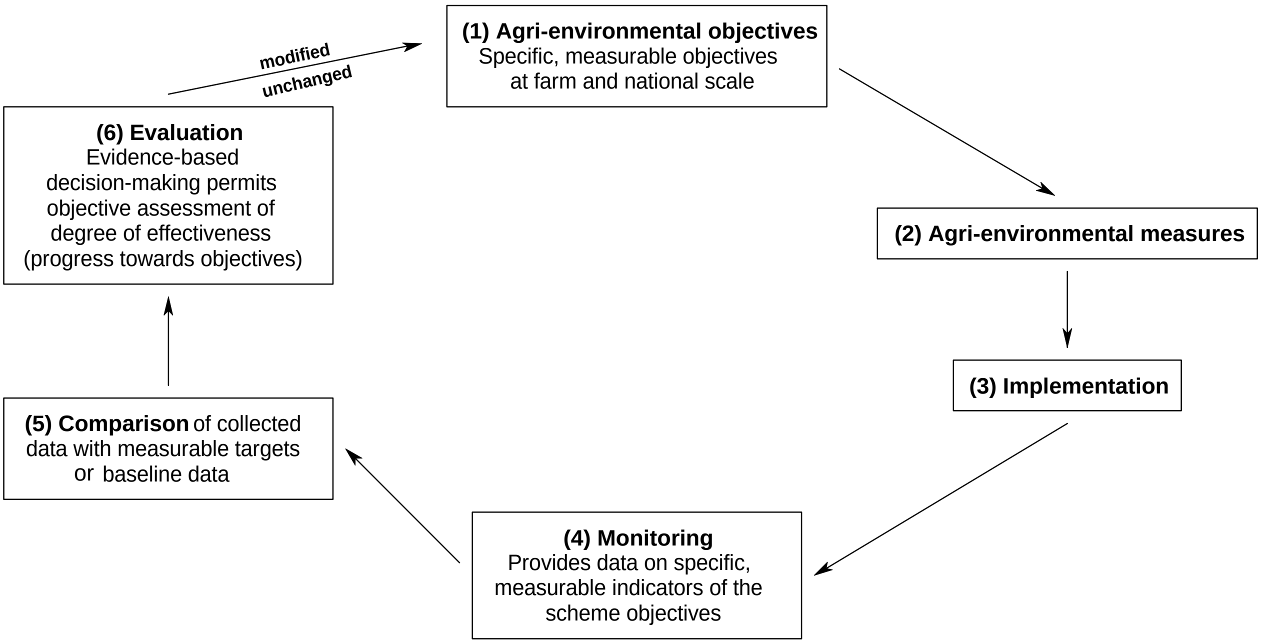


**Figure 2.1. Simple conceptual model of the contribution of a monitoring programme to an evaluation of environmental effectiveness.**

guiding principles presented above. Data collected for specified indicators can be compared with targets or baseline data; this comparison then feeds into an evaluation process. The evaluation process feeds back into the scheme and, where necessary, amendments are made to measures in order to improve the effectiveness of these measures. As such, the evaluation of agri–environmental programmes is an iterative process that facilitates the flexibility required for continued improvement of agri–environmental schemes.

# 3 Selection of Agri–Environmental Indicators

## 3.1 Tiered Approach to Indicator Selection

There is an extensive range of potential indicators of agri–environmental schemes, some of which are more general than others. Therefore, the three categories of Landscape, Biodiversity and Agronomy were each subdivided into three tiers of indicators (basic, moderate and advanced). Broadly speaking, the basic, moderate and advanced tiers correspond to differences in the rigour, quality or requirements of the following issues:

- Data availability
- Expertise required
- Logistical effort
- Quality of information
- Validity of causal mechanisms.

Indicative characteristics of the three tiers are as follows.

### 3.1.1 Basic tier

- Data available or easily collectable (through REPS plans, REPS 5V form, Central Statistics Office, National Farm Survey, etc.).
- Does not require high level of expertise to monitor.
- Straightforward to implement (easy to obtain).
- Data could be collected from each participating farm.
- However, does not provide high-quality data on the performance of a scheme (low validity).

### 3.1.2 Moderate tier (to complement and add to data from basic tier)

- Data may or may not be available, but are easily collectable.
- A moderate level of expertise required (general environmental scientist, ecologist, planner with environmental training).
- Data could be collected from a high proportion of participating farms (and control farms).
- Provides medium- to high-quality data on the performance of a scheme (medium validity).

### 3.1.3 Advanced tier (to complement and add to data from basic and moderate tiers)

- Data not available for each farm.
- A moderate to high level of expertise required for sampling and monitoring.
- Involvement of universities recommended at this level, thus incorporating scientific research in addition to monitoring.
- Data to be collected from a sample of participating farms (and control farms).
- Provides high-quality data on the performance of specific objectives of a scheme (high validity).

# 4 Landscape Indicators

## 4.1 Landscape Indicators: Basic Tier

| Landscape indicators (basic tier) | Measurement | Comment |
|---|---|---|
| **Number of REPS farms per unit area** | • Number of REPS farms per defined area | |
| **Number of REPS farms participating in supplementary measures** | • Supplementary Measure A<br>• Long-term set-aside<br>• Organic farming | |
| **Intensity of land use** | • Area of tillage per utilised agricultural area (UAA)<br>• Number of crops per arable area<br>• Number of crops per rotation<br>• Area of permanent grassland per UAA | |
| **Forestry on REPS farms** | • Area of land under forestry<br>• Afforestation rate | |
| **Features of archaeological and/or historical interest** | • Number of features to be retained<br>• Type of feature<br>• Average number of features per farm on sites and monuments register (SMR)<br>• Average number of new features per farm not previously recorded on SMR | |
| **Presence/occurrence of traditional farm buildings, listed buildings** | • Number of traditional farm buildings for retention/renovation | |
| **Farmyard screening** | • Proportion of the farmyard given to shelter/tree cover | |
| **Management of heritage features** | • Proportion of farmers that practise active management of heritage features, e.g. fencing off, restoration, allow grazing | |

## 4.2 Landscape Indicators: Moderate Tier

To complement and add to basic tier data.

| Landscape indicators (moderate tier) | Measurement | Comment |
|---|---|---|
| **Diversity of wildlife habitats** | • Number of farms with e.g. >3 or >6 habitats<br>• Number of farms with minimum of 3–6% of area occupied by natural/semi-natural habitat<br>• Number of farms with >15% habitat<br>• Habitat removal (ha)<br>• Habitat creation (ha)<br>• Net change (ha) | A monitoring programme would need a clearly defined list of the relative conservation value of the different habitats found on farmland<br><br>Habitat diversity indices |
| **Tree cover (commercial)**<br>**Plantations on REPS farms** | • Previous land use<br>• Mostly conifer<br>• Deciduous/conifer<br>• Mostly deciduous | |
| **Tree cover (non-commercial)**<br>**Woodland on REPS farms** | • Mostly conifer<br>• Deciduous/conifer<br>• Mostly deciduous | |
| **Litter/farm refuse management**<br>**Plastic recycling (fertiliser bags, silage wrapper)** | • Recycling and farm waste collection | |
| **Farmyard wildlife**<br>**Provision for nests of birds, bats and other wildlife in farm buildings** | • Proportion of farm buildings with nesting<br>• Barn Owl<br>• Swallow<br>• House Martin<br>• Bats<br>• Other species | Features in the farmyard can be made wildlife friendly<br>Other species can be identified using Biodiversity Action Plans in the future |

## 4.3 Landscape Indicators: Advanced Tier

To complement and add to basic and moderate tier data.

| Landscape indicators (advanced tier) | Measurement | Comment |
|---|---|---|
| **Habitat distribution** | • Habitat inventories and vegetation maps | Dependent on data availability, e.g. remote sensing |
| **Linkage among wildlife habitats** | • Presence of wildlife corridors | Connectivity indices<br>Fragmentation indices |
| **Connectivity of grasslands** | | Connectivity indices |
| **Mean patch/field size (of agricultural parcels)** | | |
| **Length and distribution of different edges** | | |
| **Length of hedgerow pre-dating AD 1700** | | |

# 5 Biodiversity Indicators: Protection of Wildlife Habitats and Endangered Species of Flora and Fauna

## 5.1 Biodiversity Indicators: Basic Tier

| Biodiversity indicators (basic tier) | Measurement | Comment |
|---|---|---|
| **Genetic diversity: preservation of rare domestic breeds** | • Number of participants in rare breeds supplementary measure<br>• The number of registered females of listed rare breeds | |
| **Areas of Natural Heritage and Special Areas of Conservation covered by REPS** | • Number of participants in Measure A<br>• Area of different categories of designated areas managed under the REPS | |
| **Habitat audit: availability of wildlife habitat on farmland (outside targeted areas)** | • Number of habitats<br>• Types of habitat<br>• Percentage cover of habitats on farmland | A monitoring programme would need a clearly defined list of the relative conservation value of the different habitats found on farmland |
| **Level of management recommended for each habitat** | • Retention/maintenance/ improvement/ enhancement | |
| **Length of hedgerows and stone walls** | • Length of hedgerows and stone walls (m) per UAA/ha | |
| **Area of cereal margins under environmental management** | • Area of cereal margins under REPS management | |
| **Length of watercourse receiving maintenance** | • Length of watercourse (m) under management (including fencing) | |

## 5.2 Biodiversity Indicators: Moderate Tier

To complement and add to basic tier data.

| Biodiversity indicators (moderate tier) | Measurement | Comment |
|---|---|---|
| **Area of semi-natural grassland** | • Define grassland type according to Fossitt (2000)<br>• Grassland area (ha) | |
| **Diversity of wildlife species** | • Number of species present<br>• Presence/absence of particular species<br>• Conservation status of species present | A list of wildlife species of conservation concern would need to be identified. Examples might include orchids, bats, frogs, etc. |
| **Management of areas for breeding waders and waterfowl** | • Size of area<br>• Number of species of waterfowl<br>• Estimated population sizes<br>• Timing of mechanical operations<br>• Timing of grazing/mowing<br>• Application of fertilisers<br>• Application of slurry | This example demonstrates how monitoring can be targeted towards a particular wildlife group. Such monitoring could be applied to other selected groups |
| **Botanical diversity of field margins** | • Botanical diversity of field margins<br>• Botanical diversity of grassland<br>• Diversity of non-cultivated plants/rare arable weeds | A simplified scoring system could be devised, e.g. >5 species or plant groups, >10, etc. |
| **Hedgerow quality** | • Length, height, width (<1 m, 1–2 m, >2 m)<br>• Density (length or volume of hedge per hectare)<br>• Management regime<br>• Number of mature trees<br>• Diversity of tree species<br>• Diversity of plant species<br>• Gappiness | |
| **Watercourses (channels that usually convey water for 9 months) and drains (which do not convey water for this period)** | • Width<br>• Height of bank<br>• Depth of water<br>• Slope of sides<br>• Number of aquatic plant species<br>• Proportion of area covered by aquatic plant species<br>• Emergent vegetation present<br>• Width of buffer strip between water course and agriculturally managed area<br>• Frequency and timing of key management practices | |

## 5.3 Biodiversity Indicators: Advanced Tier

To complement and add to basic and moderate tier data.

| Biodiversity indicators (advanced tier) | Measurement | Comment |
|---|---|---|
| **Threatened species** | • Trends in distribution and abundance of threatened species of fauna dependent on agricultural practices<br>• Trends in threatened species of flora dependent on agricultural practices | Would require trained biologist/zoologist |
| **Botanical diversity** | • Botanical diversity of field margins<br>• Botanical diversity of grassland<br>• Diversity of non-cultivated plants/rare arable weeds<br>• Proportion of competitor, stress-tolerator and ruderal species | More detailed survey than moderate tier. Would require trained botanist |
| **Habitat quality** | • For example, depending on habitat:<br>• Number of plant species per unit area<br>• Dominant species<br>• Proportion of competitor, stress-tolerator and ruderal species (CSR)<br>• Proportion of grass species<br>• Proportion of broadleaved plant species<br>• Proportion of bare ground<br>• Presence of desirable plant species, e.g. tussock-forming species and those attractive to invertebrates<br>• Height of sward in mid-summer<br>• Absence of pernicious weeds<br>• Time since last ploughed<br>• Time since last mown<br>• Time since last grazed<br>• Time since last application of slurry or fertiliser<br>• Time since last application of herbicide | This would be a method of assessing the quality and conservation value of specific habitats. The presence of rare species associated with those habitats under investigation is a key indicator of its quality. Would require a trained ecologist |
| **Invertebrate diversity** | • Sampled in crop/grassland and field margins/ hedgerows<br>• Pollinators such as butterflies and moths, bees and hoverflies<br>• Other potential indicator groups include carabid beetles, spiders, parasitoid wasps, collembola, and staphylinid beetles | Insect groups are frequently used as indicators of wider wildlife diversity<br>Would require trained entomologist/zoologist |

# 6 Agronomic Indicators

## 6.1 Agronomic Indicators: Basic Tier

| Agronomic indicators (basic tier) | Measurement | Comment |
|---|---|---|
| **N fertiliser** | • Change in use of N fertiliser at farm-scale since joining the REPS | |
| | • Inorganic N fertiliser sales | (Regional rather than farm-scale) |
| | • Changes in stocking rate (contribution of organic N) | Reduction in livestock units per UAA since participating in the REPS |
| | • Total N use on REPS farm (organic and mineral)<br>• Number of cuts of silage | |
| **P fertiliser** | • Change in use of P fertiliser at farm-scale since joining the REPS | |
| | • Inorganic P fertiliser sales | (Regional rather than farm-scale) |
| | • Stocking rate (contribution of organic P)<br>• Soil tests for phosphorus levels<br>• Change in phosphorus index over time on REPS farms<br>• Proportion of soils on REPS farms at different phosphorus levels | |
| **Soil management** | • Timing of inorganic fertiliser application<br>• Soil pH<br>• Lime use | |
| **Organic manures** | • Months of available slurry storage on the farm<br>• Storage method for slurry<br>• Storage method and management of farmyard manures (area covered)<br>• Integration of organic manures into nutrient management plan<br>• Amount of manure/slurry spread on land<br>• Timing of organic nutrient/manure applications | |
| | • Location of organic nutrient/manure application | This assesses uniformity of spreading across fields |
| **Water management** | • Presence/absence of system to separate clean and dirty water<br>• Area of long-term set-aside | |
| **Silage storage** | • (Including silage effluent management) | |
| **Stocking rate** | • Reduction in livestock units per UAA on REPS farms<br>• Rough grazing/uplands livestock units per grassland and fodder crops area | |
| **Farmyard investment in nutrient management** | • Amount of capital investment in farm facilities<br>• Number and value of Control of Farmyard Pollution Grants awarded | |

## 6.2 Agronomic Indicators: Moderate Tier

To complement and add to basic tier data.

| Agronomic indicators (moderate tier) | Measurement | Comment |
|---|---|---|
| **Nutrient management** | • Nutrient balance N (farm gate)<br>• Nutrient balance P (farm gate) | |
| | • Methods used to prevent fertiliser being spread into hedgerows and water courses | Machinery adjustments. Distance of tramlines from hedgerow/waterbody (tillage areas) |
| | • Nitrate losses from agriculture to freshwater in selected catchments | e.g. ranking scheme for risk of nitrogen loss/transport (Magette, 1998) |
| | • Phosphorus loss | e.g. phosphorus losses from agriculture to freshwater in selected catchments e.g. ranking scheme for risk of phosphorus loss/transport (see Magette, 1998) |
| **Pesticide use** | • Intensity of use of pesticides, e.g. pesticide type, volume used, toxicity<br>• Application methods to prevent drift of spray | |
| **Riparian zones** | • Length/proportion of watercourse fenced off<br>• Width and length of riparian vegetation adjacent to watercourse (intercept groundwater discharge) | |

## 6.3 Agronomic Indicators: Advanced Tier

To complement and add to basic and moderate tier data**.**

| Agronomic indicators (advanced tier) | Measurement | Comment |
|---|---|---|
| **Nutrient management** | • Clover cover (contribution of clover to N supply)<br>• Autumn soil testing for residual N<br>• C:N ratio of organic nutrient/manure | |
| **Water quality and watercourse management** | • Chemical analysis of water quality<br>• Biological index of on-farm streams<br>• Condition of receiving waters (groundwater and surface water) | It is extremely difficult to relate these indicators to REPS practices. Such direct measures of water quality are confounded by many variables. National-scale data on water quality are available from River Basin Districts and the EPA |
| | • Water quality of farm wells<br>• Presence of pathogens and nitrates in farm wells | Trained technician required to collect these data |

# 7 Discussion and Conclusions

## 7.1 Interpretation of Monitoring Data and Scheme Evaluation

A number of studies have advanced the conceptual development of the contribution of monitoring data to the evaluation of agri–environmental policy (including agri–environmental schemes) (e.g. Goldsmith, 1991; Hellawell, 1991; Countryside Council for Wales, 1996; Lee and Bradshaw, 1998; Noss, 1999; Duelli and Obrist, 2003; Kleijn and Sutherland, 2003; Primdahl *et al.*, 2003). A conceptual model of how monitoring data facilitate the evaluation of agri–environmental policy is demonstrated in Fig. 7.1. Notably, the flow diagram is dependent on the initial specifications of the objectives of an agri–environmental programme. Such specifications would include the nomination of specific, quantitative environmental improvements that are required of the scheme and the management practices required to achieve these objectives (these correspond to particular Measures). The selection of appropriate indicators may best be conducted at this stage also.

Monitoring is conducted to investigate whether these objectives are being addressed. Simply put, the information that is collected from the monitoring exercise can be compared with the original, expected environmental improvements (see below). Such a comparison facilitates objective decision-making about the effectiveness of the scheme.

In instances where there appears to be no benefit from participation (a Measure is ineffective), two main possibilities arise (assuming that the indicator is appropriate and not confounded by time lags and similar issues). Firstly, there is low compliance and the recommended management practices are not being implemented (compliance inspections may indicate the likelihood of this possibility). Secondly, the recommended management practices *are* being implemented, but these

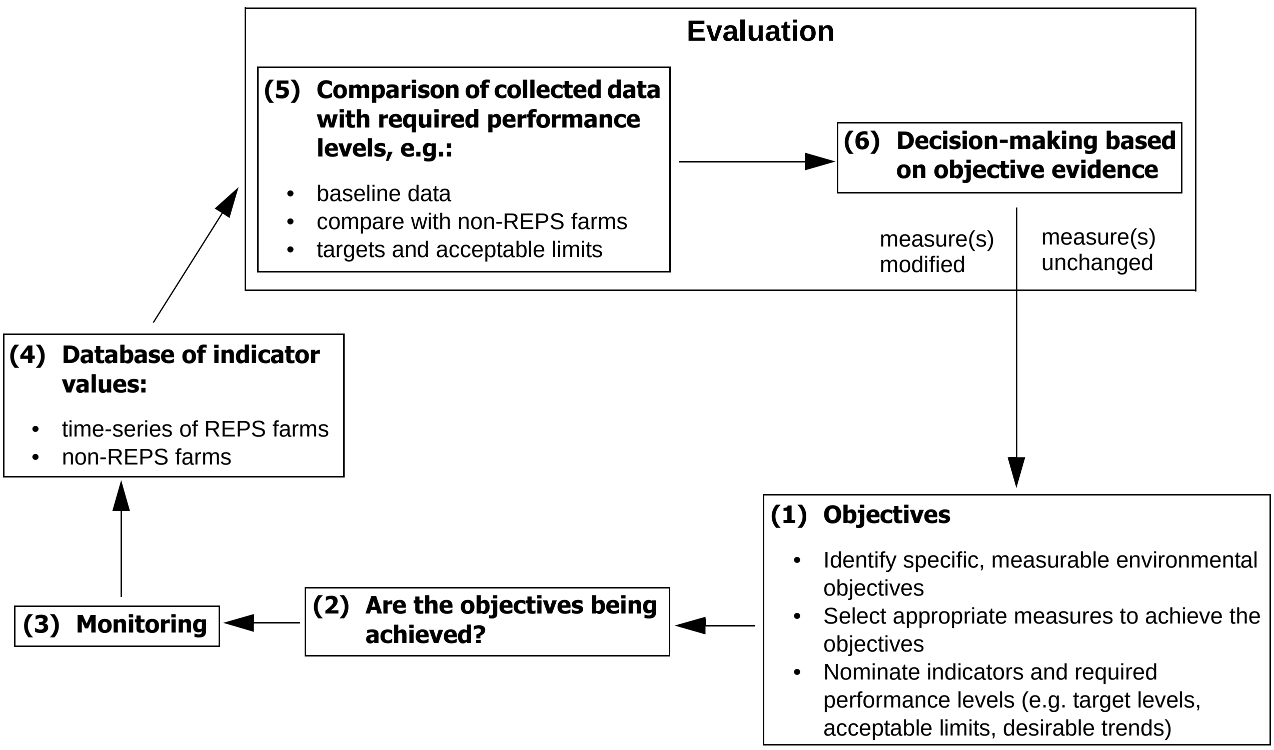


**Figure 7.1. Flow diagram of the inter-relationship between scheme objectives, monitoring, indicators and scheme evaluation.**

practices are not sufficient to achieve the desired environmental objective. In the latter case, this would point to the need to modify the specifications of the Measure.

The evaluation model proposed in Fig. 7.1 is crucially dependent on a number of possible comparisons with collected data (see Fig. 7.2). The collected data may be compared with:

1. **Baseline data.** The comparison of current and previously collected data permits an objective, quantitative comparison of changes in an agri–environmental indicator over time (e.g. Fig. 7.2A).

2. **Data from non-REPS farms.** One would expect an environmental benefit on REPS farms that is over and above that observed on non-REPS farms. Over time one could detect (and expect) emerging trends that demonstrate the added value of the REPS (for example, compare Fig. 7.2B and C). Note that there are very important statistical issues to be addressed when selecting farms and conducting comparisons of REPS and non-REPS farms: care is needed in interpreting such data. Simply put, REPS and non-REPS farms are composed of many different farming systems. In addition, REPS and non-REPS farms are not random subsamples of Irish farms: certain farming systems and farm types are far more likely to join the REPS than others. Environmental comparisons of REPS and non-REPS farms may (but not necessarily) confirm selective participation of farm types, rather than demonstrate the benefits of scheme participation (see Carey *et al.*, 2002).

3. **Target levels.** Initially, observed data may be used to confirm that farm practices are attaining levels set out in Good Farming Practice, as required by agri–environmental schemes. Additionally, the observed data may be used to compare the observed data with specific, measurable, target levels that exceed good farming practice and that REPS participants are required to attain (e.g. Fig. 7.2D).

In practice, a combination of all three of the above options may be necessary and acceptable. For example, the

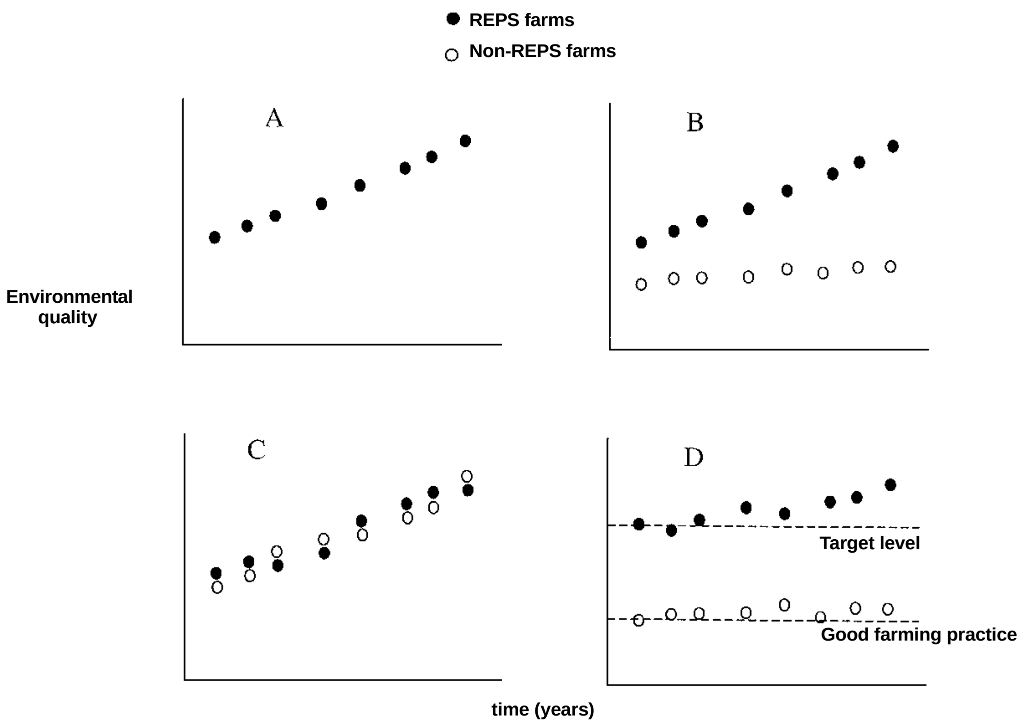


**Figure 7.2. Illustration of the use of monitoring data (for an indicator) to support scheme evaluation and demonstration of environmental effectiveness. Monitoring data can deliver an objective demonstration of improvements over time (A). This information is best accompanied by data from non-participating farms (B) to prove a benefit over and beyond what may have happened anyway (e.g. scenario in C). Data from monitoring can also be compared with specified and quantitative environmental requirements (D).**

potential problems in the comparison of agri–environmental data from REPS and non-REPS farms can be overcome by the measurement over a period of time, which may demonstrate benefits of scheme participation (e.g. Fig. 7.2B). In practice, particular combinations of the above approaches are more appropriate for some indicators than for others.

As an example, the following data provide a REPS versus non-REPS comparison, and a comparison with baseline data; the combination of approaches makes a more persuasive argument for the effectiveness of the scheme. Thus, between 1994 and 1997 average fertiliser application rates on REPS farms decreased from 70 to 61 kg nitrogen per hectare and from 13 to 10 kg phosphorus per hectare; on extensive non-REPS farms in the same period, average fertiliser application rates decreased from 98 to 85 kg nitrogen per hectare and from 16 to 14 kg phosphorus per hectare (Department of Agriculture, Food and Rural Development, 1999).

## 7.2 Indicator Selection is Dependent on Specific Objectives

The difficulties in setting quantitative targets for many of the agri–environmental indicators were acknowledged by the Project Group, experts and stakeholders groups during the project. Indeed, the original project proposal highlighted the potential difficulty in describing quantitative targets.

In hindsight, it is apparent that the construction of a measurable indicator and a quantitative target level is crucially dependent on the presence of specific, measurable objectives. Therefore, the construction of a measurable indicator and a quantitative target level will be confounded if the agri–environmental objectives are not sufficiently specific or measurable. In effect, it will be difficult to propose an indicator and interpret the data if there is ambiguity about the desired environmental state that is to be ‘indicated’. It is reasonable to expect that some objectives and measures have more generality than others; correspondingly, some indicators have more generality than others. However, it would be useful to have greater clarity about which objectives and measures are intended to be broadly applicable in a general context, and which objectives are intended to achieve more specific agri–environmental improvements.

Unfortunately, this study made relatively little progress in suggesting target values. Despite specific requests, most stakeholders and experts did not comment at the level of detail required to provide quantitative targets. This was probably for a number of reasons. Most likely, however, is that neither the Project Group nor the experts and stakeholders had a sufficiently clear understanding of the specific and measurable environmental objectives of the REPS. Therefore, the task of setting quantitative targets not only required the setting of targets, but also required a detailed description of the environmental objectives of the scheme. Although a potentially very useful exercise, this would be a much bigger undertaking than was possible during this project, and was not an original objective.

Nevertheless, our investigation of different uses of monitoring in environmental evaluation suggests that other approaches are available (see Figs 7.1 and 7.2) that are not so dependent on the specification of quantitative targets, although this is desirable (see above).

## 7.3 Implementation of a Monitoring Programme: the Tiered Approach

This study proposes a tiered approach to the implementation of a monitoring programme for the REPS. The three tiers reflect the different resource demands and quality of information provided by a monitoring programme. The ‘basic’ tier corresponds to indicators that may already be collected, or are potentially easily collected, whereas the ‘advanced’ tier corresponds to those indicators for which new monitoring by experts will be required. This approach was decided upon as a result of expert consultation and was also suggested in a recent comprehensive review of biodiversity and agri–environmental indicators (Büchs, 2003).

Following the development and selection of a core set of indicators (which would be applicable across different farming systems in different regions), one could identify relevant data collected from existing data-collection exercises (e.g. National Farm Business Survey and National Farm Facilities Survey, existing REPS plans, research projects, etc.). There may be a considerable logistical effort (and therefore cost) required to implement an adequate level of monitoring to collect data that correspond to the selected indicators. Many of these data listed in the basic tiers have been used in previous evaluations of the REPS. There is also a possibility of incorporating data from other existing farm surveys, and adding extra questions to such surveys in the future.

We recommend that additional indicators from the moderate and advanced tiers be used to augment the basic-tier data. To achieve this, however, it is necessary to further clarify and specify some of the current aims of the REPS and its agri–environmental objectives. Clarity in the objectives is a precursor to implementation, monitoring and evaluation. Such clarification is necessary before appropriate indicators and targets (at regional and national level) can be identified.

The agri–environmental objectives of the REPS seek to cover a broad spectrum of agri–environmental concerns:

- the conservation of landscape, and endangered species of flora and fauna;
- the addressing of 'wider environmental problems'; and
- the fostering of environmentally friendly methods of food production.

The specific landscape features to be protected need to be quantified. The endangered species of flora and fauna to be conserved need to be clearly identified, including the necessary processes with which to achieve this objective. Defining what is meant by 'environmentally friendly farming' is very subjective and open to a variety of interpretations.

Another benefit is that greater clarity of objectives will clarify the expectations of stakeholders. While such clarification may increase the level of expectation that the stated objectives will be attained, it would also have the distinct advantage of reducing unrealistic levels of expectation.

## 7.4 Implications for Scheme Design

Whilst this document focuses on monitoring, the first important step is that the recommended management practices (the actions) are appropriately implemented. Monitoring is the tool with which to measure the effectiveness of actions. The evaluation process identifies any needs for improvement that inevitably arise, and decides on the best course of action for more effective achievement of the objectives. As demonstrated in Figs 2.1 and 7.1, there are clear linkages between the processes of scheme design, monitoring and evaluation.

Towards maximising such linkages and achieving the clarity mentioned in the previous section, we recommend as best practice a consideration of the needs of a monitoring programme *at the design stage* of a scheme (whether this is the initial design of a scheme or the design of modifications to a scheme). This contrasts with a consideration of the needs of a monitoring programme as a bolt-on activity that occurs after (or separate to) the design of a scheme.

Thus, when future modifications of the REPS are being designed, the template shown in Box 7.1 may assist in achieving greater integration across all the aims of scheme design, implementation, monitoring and evaluation. This proposed template reflects an implementation of the evaluation process described in Figs 2.1 and 7.1, which is based on the maxim 'If you can't measure it then you can't manage it.'

## 7.5 Overview of the Implementation of a Monitoring Scheme

During consultations with stakeholders, there were different interpretations of how a monitoring scheme might be implemented. During the course of the project, when requested, we explained our understanding and expectations of a monitoring programme to some (though not all) of the stakeholders. Indeed, several stakeholders requested information on this issue in their submissions. For clarity, this is briefly described, as follows:

> *Effective monitoring is not a stand-alone activity and should form part of an integrated process. For example, the aims of agri–environmental schemes to improve facets of environmental quality need to be translated into specific, unambiguous and measurable objectives. Once the objectives are decided upon, management practices should be implemented that should achieve the objectives. Monitoring is intended to measure what progress is being made toward the objectives. Thus, monitoring has an important input to the evaluation process, which aims to identify the extent to which policy objectives are being fulfilled, and identify any changes that are required to bridge the gap between policy aims and policy outcomes. As such, the evaluation of agri–environment programmes is an iterative process that facilitates the flexibility for improvement of agri–environmental schemes* (from Finn, 2003).

Although there is a certain element of speculation about the detail, our broad vision of the implementation of a monitoring programme is as follows. In practice, we

**Box 7.1. Suggested template for integrating scheme design, implementation, monitoring and evaluation.**

1. What environmental issue is being addressed by a Measure?
2. What are the objectives of a Measure?
3. What are the specific agri-environmental objectives and targets?
4. What management practices would be expected to achieve these objectives?
5. What effects are such management practices expected to produce?
6. In what time frame will such effects become apparent, and the objectives be achieved?
7. In what farm situations would a Measure and its management practices be expected to be most appropriate?
8. In what farm situations would a Measure and its management practices be expected to be least appropriate or not appropriate at all?
9. What research supports the validity and appropriateness of these management practices?
10. What indicators would measure the achievement of these objectives?
11. How would the data on the indicators be best collected?
12. How would the indicator data be analysed to conclusively demonstrate that the objectives are, or are not, being attained?
13. If the data indicate that the objectives are not being attained, then what modifications to the Measure, its management practices and/or its objectives are likely to be required?

envisage that monitoring will be conducted by an independent team of environmental scientists with expertise in, for example, water quality, ecology, and agricultural management. This team may require four to ten persons, depending on several factors. This team would visit a proportion of farms participating in the REPS, as well as some farms not participating in the REPS. The team would inform a farmer that they wish to visit the farm, and would spend several hours taking various measurements, talking with the farmer, etc. The measurements collected would correspond to the agri–environmental indicators for the scheme. The independent team of specialists would be responsible for the collection, analysis and interpretation of the data.

Monitoring of the environmental effectiveness of the scheme should not be confused with inspections of compliance. Environmental monitoring would examine the effectiveness of the scheme and its measures in delivering environmental benefits. The source of the data should remain anonymous, and there would be no repercussions for individuals whose performance is below what might be expected. This is in contrast to inspections of compliance with REPS measures, which falls under the remit of the Department of Agriculture and Food, and penalises individual farmers for non-compliance.

## 7.6 Experimental Design and Logistics

Relatively few environmental monitoring programmes have been established for agri–environmental schemes, and there are even fewer published results. Of the 26 European countries that implement agri–environmental schemes, a comprehensive review identified 62 studies from five EU countries and Switzerland that investigated the impacts of schemes on biodiversity (Kleijn and Sutherland, 2003). With the possible exception of the UK and the Netherlands, that study identified '*a lack of research examining whether agri–environment schemes are effective*'. The authors commented that '*In the majority of studies, the research design was inadequate to assess reliably the effectiveness of schemes... The lack of robust evaluation studies does not allow a general* *judgement of the effectiveness of European agri–environment schemes*.' Thus, many studies were not able to address their objective of investigating the effectiveness of biodiversity schemes (despite the logistical effort and financial resources invested in the studies). The findings of Kleijn and Sutherland are a salutary lesson of the need for careful planning and appropriate expertise when designing monitoring studies.

To be effective, monitoring requires a thorough planning of the objectives of the monitoring programme, the experimental design, data sampling methods, data analysis and data interpretation. Only when all of these elements are satisfactory can monitoring reliably and usefully inform evaluation.

The logistical effort required to achieve an adequate level of monitoring can be considerable, and reinforces the importance of a carefully planned monitoring programme to ensure effectiveness and value for money. Carey *et al*. (2002) surveyed a range of wildlife indicators across 451 sites in England (and 49 additional sites where boundary features only were surveyed); Kleijn *et al*. (2001) surveyed wading birds in 78 fields in the Netherlands; Feehan *et al*. (2002) surveyed field margins on 60 farms in Ireland. It is also worth remembering that these surveys were concerned with wildlife only; other surveys may be necessary for other agri–environmental objectives, e.g. water quality, soil condition, soil fertility, agro-chemical applications, landscape character, etc. Each of these issues may well require significant subject-specific expertise in design, execution and analysis (modified from Finn, 2003).

Another recent study conducted interviews with 789 farmers participating in agri–environmental schemes across 22 case-study areas in nine EU Member States and Switzerland and with 211 non-participating farmers (Primdahl *et al*., 2003). Based on 12 agri–environmental indicators, farmers were questioned on their farming practices. Compared to non-participant farmers, participating farmers undertook more agri–environmental activities that would be expected to maintain or improve environmental quality (although it is difficult to quantitatively interpret the exact magnitudes of the environmental effects). Nevertheless, the study identified indicators that were being commonly used across a variety of schemes and demonstrated clear and convincing evidence that agri–environmental policies had influenced the management practices of farmers in ways that would clearly *be expected* to have positive environmental impacts.

## 7.7 Identification of Appropriate Indicators: the Importance of Dialogue

There is no perfect indicator, but there are many indicators that are adequate for monitoring the environmental effectiveness of agri–environmental initiatives. The potential difficulties involved in indicator selection, however, strongly suggest that consultation with relevant experts and stakeholders is crucial to inform judgement on those indicators that are an acceptable trade-off against what is '*feasible, affordable and manageable*'.

For their part, experts need to communicate the associated possible imperfections and limitations of indicators to policy-makers:

"*Both the reasoning behind the choice of indicator and the methodology by which it is derived from available data should be communicated alongside the indicator itself together with any caveats or limitations to usage: transparency and relevance are crucial to the adoption and correct usage of indicators*." (Moxey *et al*., 1998).

During this study, the involvement of expert researchers and stakeholders was very productive. The willingness of stakeholders to be involved and to contribute was a remarkable resource, and we have received many excellent suggestions and numerous comments that have improved the project. In turn, the pragmatic and focused nature of the stakeholder involvement with monitoring issues will ultimately contribute to the national debate on these issues.

A key issue in this study is the more precise definition of the objectives of agri–environmental schemes and the desired environmental state to be achieved. As the REPS continues to modify existing measures and add new ones, the agri–environmental indicators may need to be changed in response. Continued dialogue with a range of agri–environmental stakeholders should provide valuable assistance to this process.

This study provided an important and rewarding opportunity for dialogue with specialists and stakeholders. The identification of indicators in this desk study was a necessary first step in the design of a monitoring programme for the Rural Environmental Protection

Scheme. Future discussion between policy-makers and such groups is important to further clarify the precise composition of the indicators for a more comprehensive monitoring of the environmental impact of the REPS.

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