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Assessment of ‘Win Win’ Case Studies of Resource Management in Agriculture

ENGLISH NATURE

ENVIRONMENT AGENCY

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Author(s):
Sarah Bragg (BDB Associates), Alex Inman (Tamar Consulting), Caroline Manning (Tamar Consulting), Jamie Pitcairn (Momenta), Caroline Wood (Momenta)

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Research Contractor:
Momenta, Didcot,Oxfordshire
OX11 0QJ
0870 190 1900

Environment Agency's Project Manager:
Henry Leveson-Gower, Millbank Tower

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The Steering Group Membership is:

- Henry Leveson-Gower (Chair), Environment Agency
- Stefan Gabrynowicz, English Nature
- Rob Robinson, Environment Agency
- Dominic O'Neill, Environment Agency
- Dave Mathias, Environment Agency
- Bob Meriman, Environment Agency
- Pam Mason, DEFRA
- Martin Ryan, DEFRA
- Matthew Webb, DEFRA

Executive Summary

Farming practices and businesses in the UK will change considerably over the next few years. Reform of the European Union's Common Agricultural Policy (CAP), changing consumer preferences and a greater emphasis on the environment, particularly on diffuse water pollution, will all bring new challenges and opportunities for farmers.

Improving the environmental and economic performance of farming is a key objective of the CAP reform. However the shift to market-led approaches will bring uncertainty for many, and will require a more robust approach to business planning for all farm businesses. Experience from other industrial sectors indicates that resource efficiency is one of the keys to successful business management. Evidence of where there is a strong relationship between good environmental management and economic performance in the agricultural sector will be essential to both farmers and policy-makers.

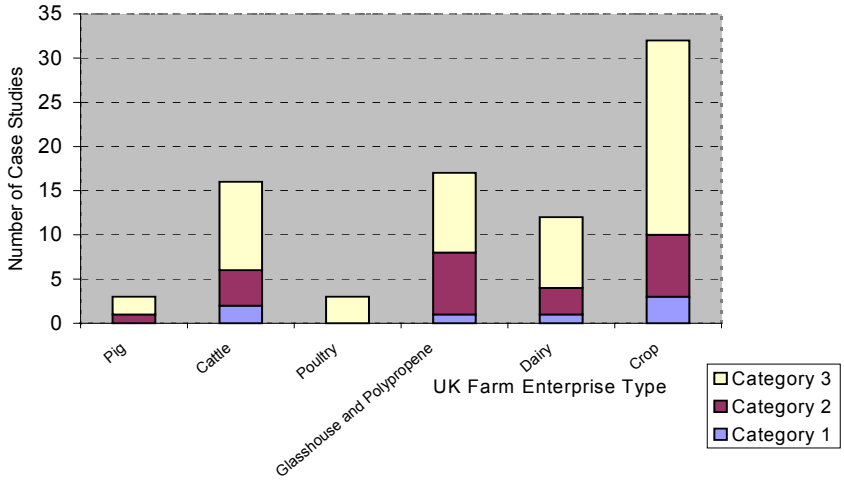
THE OBJECTIVE of this project was to establish a database of documented win win case studies of management on real commercial farms and to assess the overall potential for such win win outcomes for farming.

Criteria for a win win case study

Win 1 - Financial benefits for the farmer either through cost savings or increased revenue.
Win 2 - Environmental benefits through improved resource management practices.

THE METHODOLOGY involved an extensive investigation to obtain case study information through contact with 115 organisations. An evaluation of case studies against project criteria. Facilitation of dialog with key agricultural stakeholders to develop insight into the practical applicability of the win win approach.

THE RESULTS present 82 case studies of win win practices, however, only 54 of these case studies provided sufficiently detailed quantitative financial data for comparisons to be drawn and potential national savings extrapolated. For extrapolation and comparability between farm enterprises financial information had to be identified on per hectare or per animal basis.

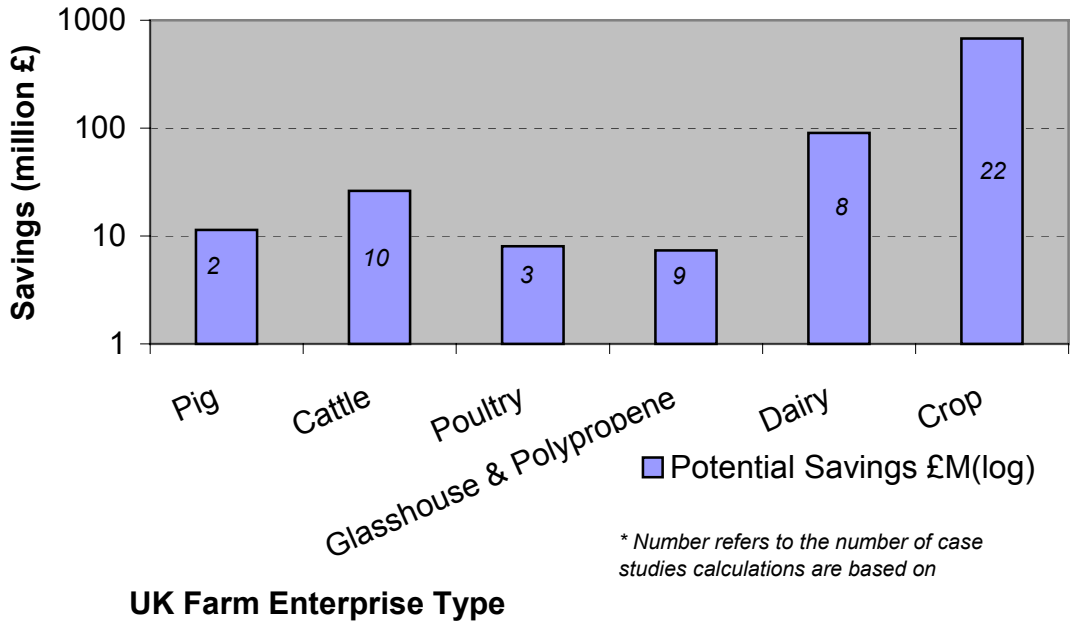


Graph E.1. *The availability of win win case studies per farm sector*

Category 1	Include quantitative data on cost savings but the practice is not easily adoptable or widely applicable.
Category 2	Include quantitative data and the resource management activities are easily adoptable and widely applicable but the financial data is not expressed on a per unit basis.
Category 3	Meet the win win criteria and present financial data on a per unit basis.

THE OPPORTUNITIES

Significant win win opportunities were identified for example; rainwater recycling could save a typical horticultural business £30,000/year and improvements in water and slurry management could save hill farmers nearly £1,000/year. The scarcity of case study data in some agricultural sectors precludes a robust 'across-the-board' aggregation of the total potential savings available to the agricultural industry, whilst there is also a lack of reliable data on the current and potential rate of uptake of these practices. Furthermore, in many cases increased and decreased costs of farm labour are not properly accounted for. However, case studies with quantitative cost savings on a per unit basis (per ha/per head) were used to calculate the potential cost savings for specific resource management opportunities in England and Wales. The results are presented in Graph E2.



Graph E.2. *Maximum Potential Savings to Agriculture (England and Wales)*

Estimated potential savings of about £960 million per year in England and Wales were identified via the resource management practices examined in these case studies. Potential savings range from about 0.7% of income in the poultry sector to about 14% of income in the crop sector. Over 80% of the estimated potential savings are in the crop sector, particularly in the cereals industry. A sensitivity analysis of the findings for cereals indicates that estimated potential savings for this sector is in the range of £358 million - £740 million per year, whilst total potential savings across all the sectors are therefore in the range of £700 million - £1.1 billion per year.

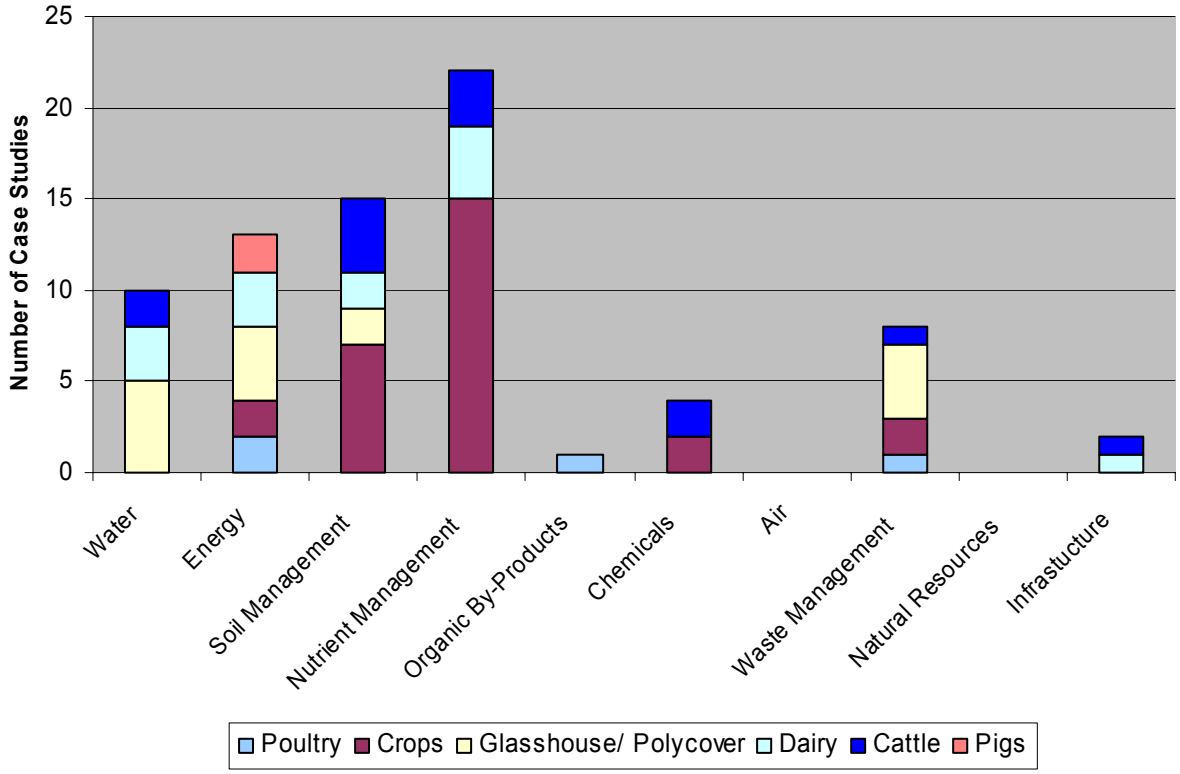
However, care needs to be taken in interpreting these findings. Firstly, the concentration of identified potential savings in the crop sector could indicate that most savings are in the crops sector or, that with greater research in other sectors, the savings potential for the entire agricultural sector is significantly greater than identified in this study. Secondly, these estimates should also be regarded as maximum possible savings via the resource management measures that have been examined as no allowance has been made for the extent of existing implementation of these measures. Furthermore, while the case studies used in this project focussed on resource management measures that are easily adoptable and widely applicable, they may not be suitable for all farms in the sector to which the measures apply for topographical or logistical reasons. Moreover, the financial estimates only partially allow for the opportunity costs of farmers' time in implementing the measures.

In DEFRA's guide (MAFF 2000a) the savings estimated for a wide cross section of agricultural practies range from 2% to 10%. This is consistent with figures identified in this study. A mixed farm could save up to £1,200/year through improved management of organic manure. The average farm income for this sector is £15,000/year (2003 Defra census), therefore the saving is 8% of farm income. Further

investigations must be conducted, but initial indications are that savings could be about 5% of the overall income for many sectors.

Good practice to reduce diffuse pollution

The level of diffuse pollution stemming from agriculture is widely regarded as significant. It is therefore encouraging to observe that 70% of the case studies (37 out of 54 case studies) focus on measures that can reduce diffuse source pollution. About half of the case studies identify cost savings derived from environmental improvements in soil and nutrient management (Graph E3). The additional diffuse pollution studies encompass water, organic by product and chemical management. It will be a challenge to persuade farmers to reduce the highest intensity of chemical and nutrient inputs, particularly in the crops sector. However, the crops case studies demonstrating savings through soil management may provide a useful tool for initiating and facilitating this behavioural shift.



Graph E.3. *To demonstrate the number of win win case studies with the potential to reduce diffuse pollution. (both category 2 & 3)*

BARRIERS TO IMPLIMENTATION OF WIN WIN OPPORTUNITIES

Various barriers to the uptake of win win opportunities were identified. The most significant of these is a lack of awareness that win win opportunities exist. This knowledge deficit is to a great extent attributable to the lack of measurement of many service costs e.g. water and electricity consumption or farmers management time prior to the implementation of improved practices. Contributing to this information deficiency is the difficulty in finding comparative case study information due to the diversity of organisations producing case studies and in these, a lack of sufficient detail on which farmers could base business decisions.

The agricultural community is also accustomed to environmental pay-wins and is therefore sceptical of the concept of win win. This lack of willingness to invest in facilities is particularly apparent in older age groups of farmers and in agricultural sectors typified by smaller independent enterprises rather than large business corporations. This appears to be the result of a wait and see attitude, as farmers face uncertainties about their own future viability in farming.

It is acknowledged however, that greater analysis is needed regarding these barriers and how they can be cost effectively reduced.

INFORMATION LIMITATIONS

There is a lack of systematic methodology in documenting case study information due to the diversity of organisations presenting case studies and the equally varied drivers for doing so. Few case studies were found in some sectors (see Graph E1.) such as pigs and poultry and for certain categories of management practice, such as air pollution management. Qualitative results suggest this is due to under investment and little research in more financially depressed agricultural sectors. A small proportion of the opportunities for farms are documented in case studies. Most case studies focus on waste management, nutrient management and water efficiency, as the financial outcomes from these are easily perceived in reduced costs. The savings and costs related to farmers' time are rarely calculated. When this does occur, the lack of a clear methodology on how to cost for time and labour creates inconsistencies between case studies.

THE FUTURE

Key agricultural stakeholders support the win win approach. Forty-two representatives of thirty stakeholder organisations in the agricultural sector attended the stakeholder consultation event, presenting a range of views from Government, NGO's, academia and consultancy. Many attendees were new to the win win concept in agriculture and interested in evaluating this new approach. The final consensus was support, agreeing this posed a potentially effective tool to change behaviour and improve the financial and environmental performance of the agricultural sector.

Agricultural stakeholders identified the need for further work: To harness the potential of win win case studies they identified the need to develop a full portfolio of case studies covering all sectors. These case studies must be rigorously reviewed to ensure reliable data and each must be sufficiently detailed to allow readers to assess the applicability of management practices. Effective communication is needed to convey the win win message to farmers. Stakeholders agreed that this message would be most effectively delivered and reinforced by a consistent voice through the existing advisory networks. To generate this unity, dialogue with stakeholders must be maintained and information centrally collated and electronically stored so it is easily accessible to all.

Project Conclusions

From analysis of case studies and stakeholder input, the project concluded that the win win approach presents considerable opportunities for organisations providing advice to farmers to promote positive outcomes for the agricultural industry and environment. However a range of issues need to be addressed:

Project Recommendations

Establishing data quality

1. Agree and adopt a fundamental reporting framework to ensure future case studies provide sufficient detail and quantitative information to allow comparison of the benefits and costs of management practices.
2. Develop a research programme to improve the quantification of the environmental benefits of win win resource management practices, linked to policy drivers such as the Water Framework Directive.
3. Establish a procedure of peer review for the evaluation of case studies.
4. Research baseline data on the level of current uptake of management practices.
5. Update the estimate of savings per sector as increased information becomes available.

Collaborating with existing systems

6. Foster the support of agricultural organisations.
7. Communicate the win win approach through the existing agricultural advice networks.
8. Promote the development of new case studies in compliance with an agreed framework, particularly case studies to plug the gaps in current coverage.
9. Measure and report on the results of whole farm environmental management plans.

Communicate the results effectively

10. Improve accessibility of information to farmers and advisors by centrally collating and electronically storing case studies.
11. Undertake awareness raising activities to elevate knowledge of the win win approach and case study resources available.

Contents

1 Introduction

1.1 Background

Consensus is building in England and Wales that farming practices and businesses will change considerably over the next few years. The report of the policy commission on the future of farming and food (the Curry Report 2002) 'Farming and Food: A sustainable future' set the agenda for change, focusing considerable attention on the development of practical strategies for the sector. In England, the '*Strategy for Sustainable Farming and Food'* was launched in December 2002 and in Wales, the strategy document '*Farming for the Future'* was released in 2001. Similar approaches have been taken in Scotland and Northern Ireland.

At the heart of each of these strategies is a vision of a more efficient, profitable and sustainable farming sector. The Policy Commission in England presented a vision of:

"A *profitable and sustainable farming and food sector that can and does compete internationally, that is a good steward of the environment, and provides good food and a healthy diet for people in England and around the world".*

Farming practices and businesses in the UK will change considerably over the next few years. Reform of the Common Agricultural Policy, changing consumer preferences and a greater emphasis on the environment will all bring new challenges and opportunities for farmers.

In England the report of the policy commission on the future of farming and food (the Curry Report 2002) 'Farming and Food: A sustainable future' set the agenda for change, focusing considerable attention on the development of practical strategies for the sector. Farming strategies have since been developed in England, the '*Strategy for Sustainable Farming and Food'* (December 2002) and in Wales, '*Farming for the Future'* (2001). Similar approaches have been taken in Scotland and Northern Ireland. At the heart of each of these strategies is a vision of a more efficient, profitable and sustainable farming sector. The Policy Commission in England presented a vision of:

"A *profitable and sustainable farming and food sector that can and does compete internationally, that is a good steward of the environment, and provides good food and a healthy diet for people in England and around the world".*

The changing business landscape means that this is a vital time to promote resource efficiency in agriculture. It is now widely recognised that improved resource management practices such as reducing water use and waste can achieve both financial and environmental benefits for the sector (a 'win win') and experience in other industry sectors has shown that these potential cost-savings are significant. A recent study estimated a potential cost saving of £2-3 billion per year across UK manufacturing sectors (Cambridge Econometrics and AEA Technology, 2003). This study assessed the broad scale implementation of win win practices identified in 50 case studies from industrial sectors to produce the overall estimate for potential cost savings. Independent consultants audited the financial data from all case studies to ensure accuracy and a grossing up methodology, similar to the one described in this report, was used to produce the overall estimate for potential savings.

Farming can have beneficial impacts on the environment. Many of the landscape and amenity benefits generated by farming form the key resource for other industries such as tourism. This research identified a number of research projects designed to specifically illustrate the benefits of good land management practices, and enhanced biodiversity. However, some management practices in farming are also known to have a significant negative impact on natural resources. These impacts include ground water and diffuse pollution, soil degradation and erosion, air pollution from ammonia emissions, contribution to climate change, and damage to the aesthetics of the landscape and wildlife habitats.

How can we optimise the benefits and minimise environmental degradation?

The main policy instrument currently used to encourage environmentally sensitive farming is the funding of agri-environment schemes (payments to farmers in return for implementing specific practices) and in future

this will be enforced in cross compliance criteria for single farm payments. However, promoting awareness of practices that are 'win wins' will significantly raise farmers' enthusiasm and cooperation with these schemes. Alerting farmers to practices that allow them to comply with environmental stipulations, so claim single farm payments whilst directly reducing management costs, so giving a double boost to net profits.

The research demonstrates there are already a number of opportunities for achieving 'win wins' in farming (Environment Agency, 2001a; MAFF, 2000a), but the information is fragmented and the opportunities not widely publicised. This project consolidates information and through a process of demonstration and consultation the project seeks support from stakeholders in the Agricultural Sector as a first stage in fostering a collaboration in developing the win win approach and taking these positive messages to farmers.

1.2 Project Aims

The aim of this project is to assess the role win win case studies may play in changing agricultural practices and then to make recommendations as to how such case studies could be exploited.

1.3 Project Objectives

The objectives of this project are:

- To identify and collate available win win case studies in agriculture with clear presentation of financial data.
- To identify gaps in case study documentation
- To research and establish data necessary to upgrade case studies to present the financial outcomes of win wins.
- To research and document new win win case studies to fill gaps in sectors with currently limited case study coverage.
- To determine the efficacy of win win case studies in estimating potential cost savings in the Agricultural Sector in England and Wales.
- To consult with key stakeholders on the role of win win information in a sustainable agriculture strategy.

1.4 Project Tasks

In achieving these objectives the following tasks were undertaken:

Identification of case study material

- Identification, analysis and presentation of existing win win case studies (see Box 1.1) to highlight their availability, use, scope and quality; and the potential financial and environmental benefits.
- Review of the availability of case studies and identification of gaps in sector coverage.

Plugging of gaps in case study coverage

Development of further Win win Case Study material to fill gaps in data coverage, through the:

- Identification and sourcing of data necessary to upgrade existing case studies.
- Collaboration with key organisations to identify new case studies.
- Refinement of primary information from the Westcountry Rivers Trust projects and development into new case study documentation. The target was to deliver 10 new case studies.

Collation and assessment of case studies

- Development of an Access Database containing details of all reviewed case studies.
- Evaluation of the environmental outcomes of adopted practices.

- Evaluation of the extent to which the case study subject is representative of its agricultural sector and the scope for replication of the management practice by other farms/agri-businesses.

Development of a methodology to estimate potential national financial savings.

- Estimation of the annual savings that could be made across the whole agricultural sector (based on the case studies identified), and execution of a sensitivity analysis of the dataset to determine the key factors influencing the calculation.

Consultation with Stakeholders at a Facilitation Workshop

- Identification of key stakeholders in Agriculture and recruitment of their participation in a consultation day to establish the opportunities for enhancing the environmental benefits available to agriculture through a win win approach, the challenges to collecting information and communicating outcomes.
- Documentation of opinions on the findings of this research and potential to develop the win win approach. Perhaps through an agreed structure for all case studies.

Presentation of Results

- Presentation of key findings from the research and consultation in a final project report.
- Presentation of conclusions and recommendations on the future development of the win win approach, arising from the research and stakeholder liaison.

Box 1.1 **- Definition of a win win case study.**

In the context of this project, 'win win case studies' are defined as documented case studies of real commercial farms achieving both:

Win 1 - Financial benefits for the farmer either through overall cost savings or increased savings (giving net profit).

Win 2 - Environmental benefits through improved resource management practices.

Note: The definition does not include case studies that achieve environmental benefits through payments to farmers (e.g., under agri-environment schemes). These are 'pay-win'.

Note: The focus of the project was on England and Wales. However, contact was made with key stakeholders in Scotland and Northern Ireland to confirm whether win win case studies have been developed in these countries.

1.5 Project Deliverables

- A searchable database of all Category 3 case studies.
- The project report, including methodology, results and recommendations.
- A Stakeholder consultation workshop to establish the role of win win case studies.

2 Methodology

The project methodology was developed in consultation with the Project Steering Group, which included representatives of the Environment Agency, English Nature and Defra (see Appendix 1). [2]

2.1 Key Tasks and Outputs

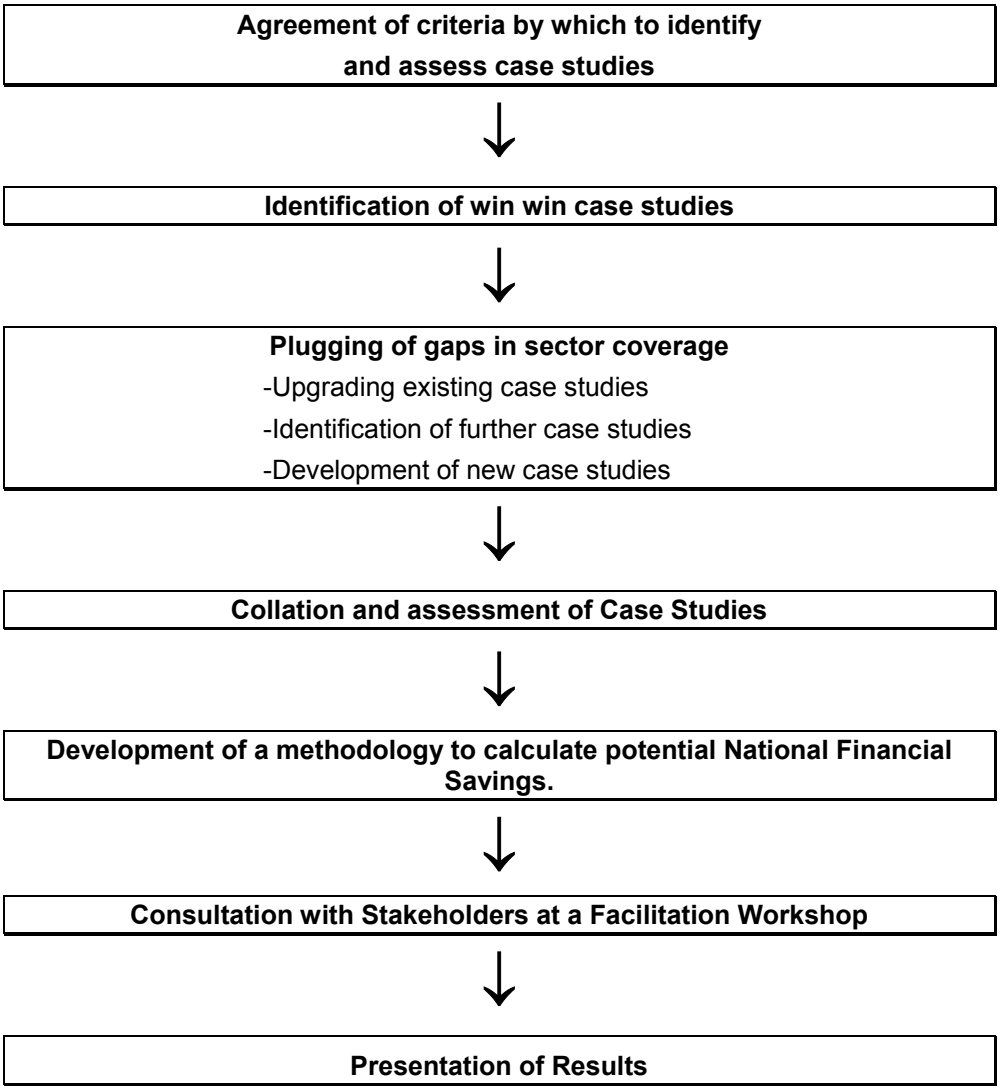


Figure 2.1 *Overview of key project tasks*

Details of the tasks outlined above are presented in the following chapter.

The methodologies were refined and developed through experience as the project progressed. An initial scoping study explored the type of information available, and taking stock of the results, three streams of work were undertaken to ensure a good coverage of case studies were available to this project and in the future. This involved revision and upgrading of existing case studies through the identification of missing

[2] The initial inception meeting with the Project Steering Group was held on 22 September 2003. An interim meeting was held on 30 October 2003. Results were discussed with the English Nature Socioeconomic Advisory Group on 4th February 2004.

The main research was conducted between October 2003 and June 2004.

data; consolidation of new case studies developed by West Country Rivers Trust and the development, marketing and management of a stakeholder facilitation day, designed to generate discussion and feedback on the potential value of win win approaches in future agro-environmental policy development.

2.2 Agreement on Criteria to Identify and Assess Case Studies

Clear, logical criteria for identifying and assessing case studies was needed to ensure an efficient and effective approach. A summary of the approach used is presented in Figure 2.2. Each case study identified was categorised and then classified according to farm enterprise type, resource management areas, environmental benefits and geographical region (listed in Table 2.1).

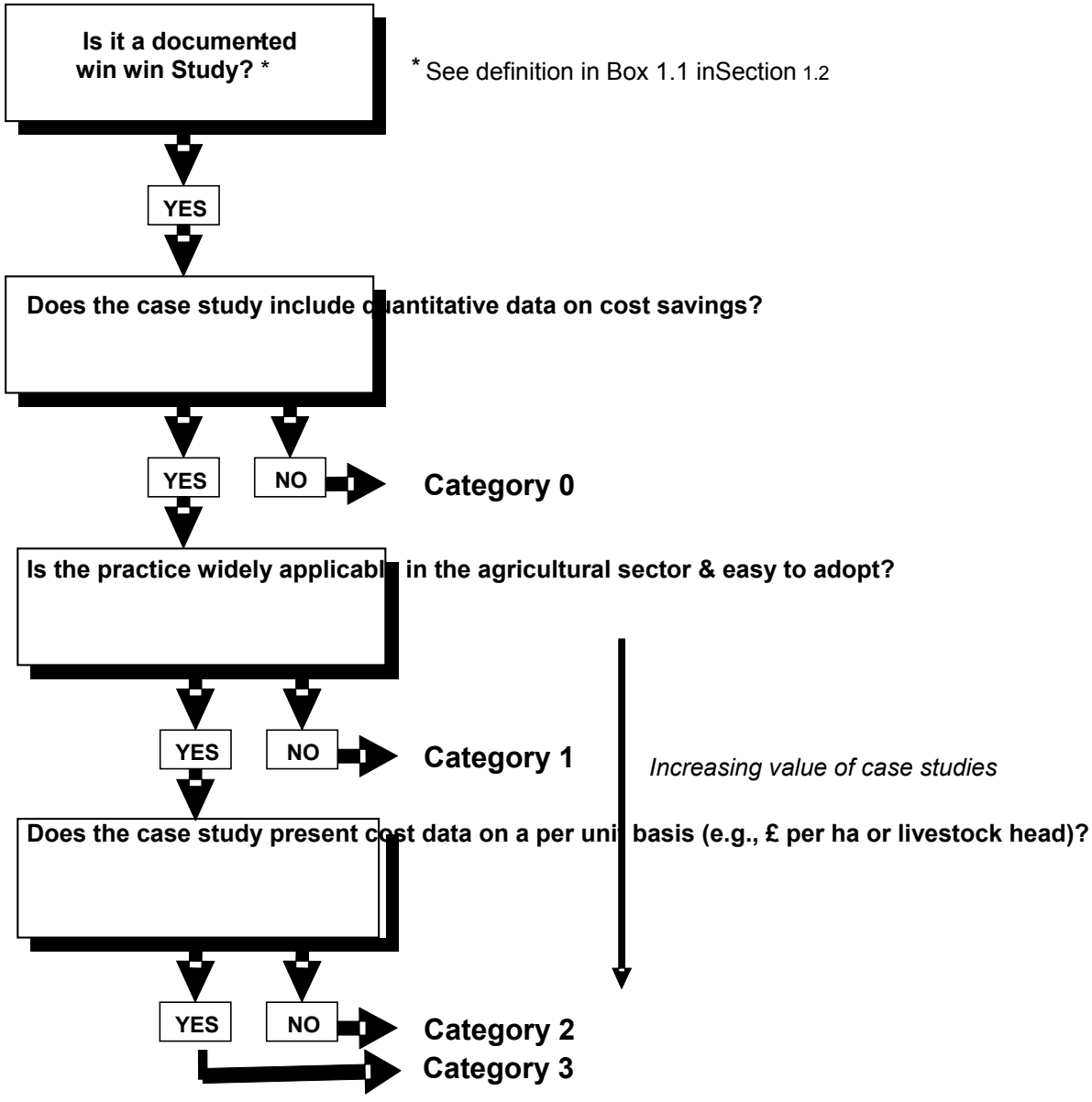


Figure 2.2 *Overview of the approach to identify and assess case studies*

The Categorisation of Case Studies:

Category 0 – Case studies that detail environmental benefits through adopting resource efficient management practices, but does not include quantitative data on cost savings.

Category 1 – Case studies that include quantitative data on cost savings but the practice is not easily adoptable or widely applicable. An example of a category 1 case study is where financial savings were documented but the initial capital investment required to realise the savings would preclude all but the largest farms from adopting the practice.

Category 2 – Case studies, which include quantitative data and the resource management activities, are easily adoptable and widely applicable but the financial data is not expressed on a per unit basis (e.g. £ per ha or livestock head). For example, a case study where the financial savings represent the farm holding as a whole and are not attributable to a specific resource management activity, for instance £700 of savings per farm were realised but from a range of different activities. These are very hard for farmers to use and also to gross-up to a national estimate. Moreover, without a precise idea of the basis for the savings there is always the risk of double counting.

Category 3 – Case studies that meet the above win win criteria, are easily adoptable and present financial data on a per unit basis. For example, a specific resource management activity (water minimisation) within a specific sector (dairy farm) realised savings of £2/per animal. This unit data holds the most power to persuade farmers to change their practices. Per unit figures can also be easily extrapolated to national figures using census data e.g. to produce a savings estimate for all the dairy cows in England and Wales.

Table 2.2 Classification of case studies according to *Farm enterprise types, resource management areas, environmental benefits and geographical regions*

Farm Enterprise (1)	Resource Management	Environmental Benefits	Regions (2)
• Crops • Glasshouse/ Poly cover • Dairy • Cattle & Sheep • Pigs • Poultry • Mixed	• Water • Energy • Soil • Nutrients • Organic by-products • Chemicals • Waste • Air • Infrastructure • Natural resources/ wildlife	• Reduced resource consumption • Improved water quality • Improved soil quality • Reduced risk of flooding • Improved air quality • Improved habitat • Improved biodiversity • Enhanced landscape	• North West • North East • Yorkshire & Humberside • East Midlands • West Midlands • South East • Greater London • South West • Wales • Scotland • Northern Ireland

(1) Individual farms typically include a mix of enterprises.

(2) Based on the planning regions of England plus Wales. As noted in Section 1.2, the focus of the project was on England and Wales. Scotland and Northern Ireland were included in the listing in case any particularly useful case studies were identified from consultation with key stakeholders.

2.3 Identification of Win Win Case Studies

Win win case studies were identified through a process of consultation with a range of organisations, and a detailed literature review. A list of organisations consulted is provided in Appendix 2.

Consultees were contacted initially by email and telephone calls. Initial contact targeting key organisations led to more of a networking approach as we received referrals to more specialist groups or individual experts.

The numbers of contacts and responses are summarised in Table 2.3.

Table 2.3 *Number of contacts and responses*

Sector	Organisations		Individuals [1]	
	Contacted	Responded	Contacted	Responded
Government	19	11	56	32
Trade associations	31	14	33	17
NGOs [2]	38	30	51	39
Academic bodies	17	15	32	27
Consultants	13	11	27	19
Other businesses	12	6	15	7
TOTAL	**130**	**87**	**214**	**141**

(1) *Several reported that they had forwarded the email to others within their organisation.*
(2) *Non-governmental organisations.*

2.4 Plugging Gaps in Sector Coverage

Analysis of the data from the scoping study revealed the largest potential for savings in the crops sector. The greatest numbers of case studies were identified in this sector, (table 2.4) leading to questioning as to whether there really are greater savings in the arable sector; or if the paucity of data in other sectors means that the opportunities in these sectors have yet to be identified.

The results of the scoping study were reviewed, scarcities in current case study information were identified and focus placed on researching case studies to fill these gaps (table 2.4), to present a more even coverage of the agricultural sectors. The aim was to have a minimum of 5 case studies for each enterprise type.

Table 2.4 *Case studies from the initial scoping and those required to fill data gaps.*

Enterprise Type	Crops	Glass house/poly cover	Dairy	Cattle & Sheep	Mixed	Pigs	Poultry
Number of Category 3 Case Studies	16	6	5	1	1	0	3
Additional Studies Needed	0	0	0	5	4	5	2
TARGET	16	6	5	6	5	5	5

Three streams of work were undertaken to fill the gaps in case study data, providing a more robust base for economic calculations and to provide a better basis to assist the win win approach (see box 2.1).

Streams of work:
- Upgrading of Category 2 Case Studies to Category 3 through the establishment of key data.
- Identification of further case studies through closer relationships with key organisations.
- Research and development of new case studies by West Country Rivers Trust.

2.4.1 Upgrading Existing Case Studies

A large number of case studies (category 2) were documented win wins but lacked detailed financial or scale data (hectare or per capita) to allow these case studies to be utilised in the estimate of overall national savings.

Through analysis of the results of the first phase of work case studies were identified that with little additional data could be upgraded to category 3 case studies, and therefore could be used in the estimate of overall national savings. Our approach is summarised in *Figure 2.4*.

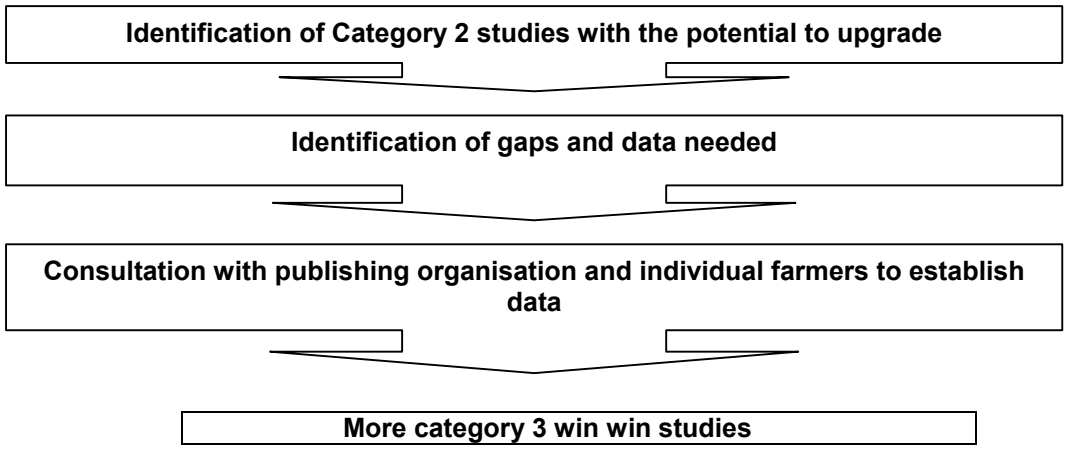


Figure 2.4a *Approach to upgrading initial case studies*

2.4.2 Identification of further case studies

Relationships were forged with key groups for example Institute of Grassland and Environmental Research IGER), Farming and Wildlife Advisory Group (FWAG) and Linking the Environment and Farming (LEAF) to establish support for the study and the development of the win win approach. The support of these organisations allowed us to access further sources of information that had not been available in the scoping phase. A targeted approach was adopted to focus on key bodies in the Cattle and Sheep, Pigs and Poultry Sectors.

2.4.3 Preparation of new case studies

Westcountry Rivers Trust (WRT) prepared new case studies.

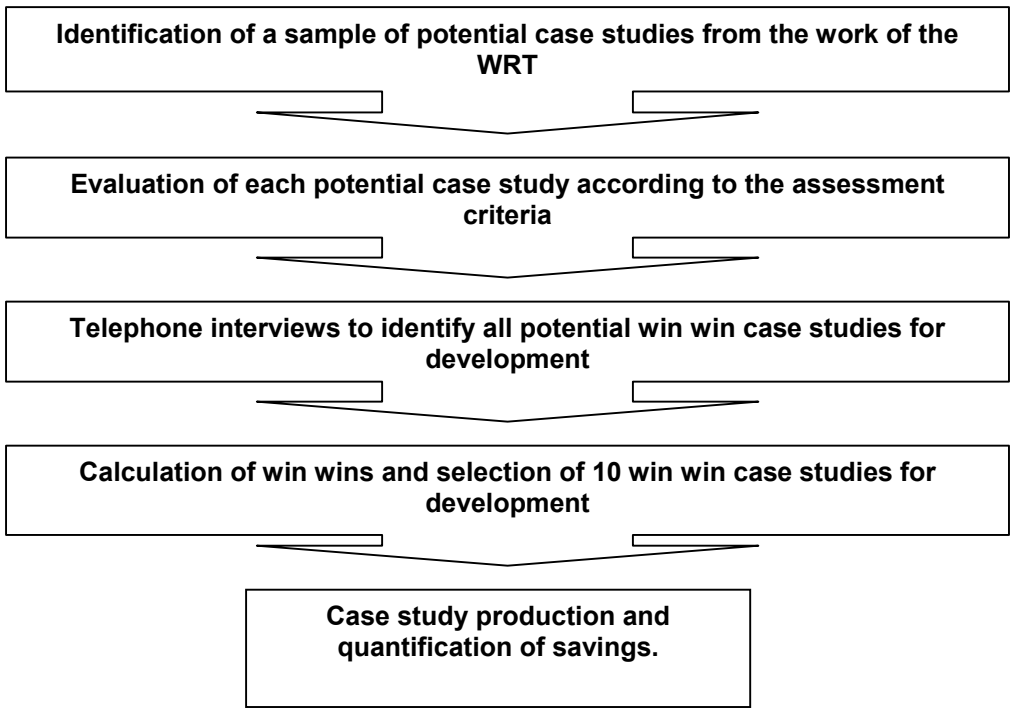
Background to Westcountry Rivers Trust

The WRT's agricultural projects include two catchment-scale projects in Devon and Cornwall and a third is currently underway. The first two projects, namely the Tamar 2000 SUPPORT Project and the Westcountry Rivers Taw/Torridge Project, involved working with more than 1,000 farmers and other landowners, and some 700 integrated farm management plans were developed. The third project, namely the Cornwall Rivers Project, started in January 2002 and will enable over 600 farm plans to be produced over three years. These projects provide a potentially valuable source of information for development of win win case studies for two reasons:

1. Economic benefits to the farmer feature as a key driver in the provision of farm advice.

2. Independent economic evaluations of the projects confirm the potential for economic benefits as a result of uptake of farm advice.

Figure 2.4b *Overview of the approach used to identify and assess new case studies.*[3]



The methodology used is presented in the following sections:

Identification of a sample of potential case studies from the work of the WRT[4].

Through their advisory work, West Country Rivers hold details on potential case study farms, farm advisors hold contact details and information relating to farm size, enterprise type and the resource management practice(s) advised on each holding. This information was used to identify potential case studies.

Evaluation of each potential case study according to the assessment criteria

All potential case studies that were already known to be a 'pay-win' were excluded at this stage. The resulting 'working sample' of potential case studies provided the basis for development of new win win case studies via telephone interviews with the contacts.

The selection of win win case studies for full development into Category 3 case studies was undertaken on the basis of the potential to increase the accuracy and scope of existing data and therefore to reduce the gaps in the results matrix presented by the scoping study. A target of 10 new case studies was selected to fulfil the data requirements of the project whilst operating within available operational and financial constraints.

Telephone interviews.

Data relating to uptake of resource management practices and the resulting costs and savings were obtained via telephone interview with each farmer in the working sample. Telephone interview was selected (i.e. as opposed to site visits) in order to enable all contacts to be approached within the operational constraints of the project. Interviews were conducted between March and July 2004.

A pro forma was designed in order to standardise the interview process and to enable data to be recorded clearly. For each interview, background information (e.g. relating to enterprise type and farm size) and resource management practice uptake was noted. Where uptake of a non pay-win practice with attendant

[3] The research was undertaken between March and July 2004.
[4] West Country Rivers Trust

environmental benefits had occurred (i.e. the potential for a win win case study existed), associated costs and savings were discussed with the farmer and economic data were recorded.

Case study development and quantification of savings.

Farmers provided estimates of costs and savings for undertaking resource management activities. (e.g. estimated % reduction in feed waste, estimated annual cost of fertiliser). Additional information was obtained from annually updated publications[5] i.e. *The Farm Management Pocketbook* (Nix, 2004) and *The Agricultural Budgeting and Costings Book* (ABC, 2004) and represents average/typical values (e.g. average farm worker hourly rate, average gross margin). Further sources included MAFF/DEFRA and Environment Agency publications. Farm plans produced by the WRT were used to confirm data where necessary (e.g. field size, yard area).[6] Unfortunately, it was not possible to fully estimate the opportunity costs of farmers' time in implementing these measures.

For each case study, data relating to the direct cost of adopting the change in practice and the annual saving for adopting the change in practice (either a direct saving or the cost arising if the practice was not undertaken) were used in order to calculate a net annual unit saving (i.e. the economic 'win').

All costs and benefits are presented in terms of an annual value. In order to enable comparison, the cost of those practices that require capital expenditure (e.g. yard cover) have been written off over a ten-year period with an additional capital charge of interest of 6% (6% is the current borrowing rate facing farmers). The term of ten years was arrived at through discussions with both farm advisers and farmers themselves as an agreed duration to service a significant loan.

2.5 Collation of Case Studies and Database Presentation

The identified case studies were collated and entered into a database. The database was designed to enable easy access to, and examination of, the case studies (using Microsoft Access). This incorporated search functions allowing data to be assessed by agricultural sector or resource management activity[7].

The database includes category 2 and 3 case studies. These are the win win case studies where quantitative data on cost savings are available and which relate to practices that are widely applicable and easily adoptable across the agricultural sector. (See Figure 2.2). The database enables individual case studies to be identified according to the enterprise type and resource management activity to which it relates.

To illustrate the functionality and layout of the database, the front-end and case study pages are included in *Appendix 4.*

2.6 Methodology to Estimate Potential National Cost Savings

The initial aim was to produce an estimate of the total potential cost savings from improved resource management in the agricultural sector by aggregating up the savings achieved in case studies. However, during the project it became clear that this aim was unrealistic given the limited number of documented win win case studies with quantitative cost data compared to the range of recognised opportunities. The estimate produced would greatly underestimate the total potential cost savings available. A single figure would also be an oversimplification in light of the difficulty in expanding any one management practice across the very diverse environments in the agricultural sector.

[5] The case studies should be regarded as preliminary estimates, albeit based on 'real' farm circumstances.
[6] Sources are referenced within each case study.
[7] Long-term use of the database (beyond the scope of this project) is to be reviewed and agreed by the project sponsors and other members of the Project Steering Group.

The following sub-tasks were completed:

- Development of a robust 'aggregation' methodology for estimating the total potential cost-savings in the agricultural sector in England and Wales *(see Appendix 6)*
- Production of estimates of the potential national cost-savings for individual practices highlighted by case studies (based on Steps 1 – 3 of the aggregation methodology);
- An expression of the identified potential cost savings for individual practices as a percentage of sector income.

2.7 Consultation with Stakeholders at a Facilitation Workshop

Throughout the course of the project key stakeholders were approached in order to identify relevant case studies. It was clear that the stakeholders had a wealth of very valuable information that could significantly enhance the methodology and provision of future advice to the agricultural sector. To formally capture this information, key stakeholders[8] from the Agricultural Sector, Academia, Government Offices and Agencies and Non Governmental Organisations were invited to a presentation of the project and facilitation day. During workshop sessions, facilitators engaged participants and scribes documented their views on the 'win win' approach and its value towards developing a more sustainable agricultural industry.

The proposition is that case studies of win win situations can be used to promote resource management on farms as a means of increasing farmers' incomes and helping to achieve environmental policy objectives. The aim was to assess stakeholders' opinions on the viability of this approach and to gain insight into methods of providing robust evidence in the future.

Summary of issues for the workshop

Issues for consultation with stakeholders at the workshop and desired outputs are:

1. Consult with stakeholders on the role of case studies in a strategy for sustainable agriculture, and the most effective ways to develop and disseminate useful case studies. In doing this, ensure that due consideration is given to the most effective methods to both raise farmers' awareness and stimulate changes in practices. This should include mechanisms to communicate to the farmer why the practice is applicable to him/her, how to assess the potential cost/benefits, and how to implement the practice.
2. Develop a strategy for securing and disseminating useful case studies.
    - Define the areas where case studies are most needed (e.g. practices that reduce diffuse pollution).
    - Identify a recommended format and content for case studies.
    - Engage support of organisations that are likely to generate useful case studies.
    - Identify a methodology for co-ordinating, auditing, reviewing, disseminating and updating case studies.

Consult with stakeholders on the strategy to ensure wide support, facilitate access to the best data available, and enhance the quality and reputation of the data outputs

The format of the workshops

Three workshops were run lasting 1 hour each. The delegates were split up into 3 focus groups/think tanks according to their background. Each focus group contained a mix of participants likely to be positive, negative or indifferent towards the 'win win' concept, thereby creating an appropriate dynamic to stimulate a balanced discussion.

[8] Appendix 8 presents the list of attendants.

Structure of the workshops[9]:

- 8-10 participants (max) seated in a semi-circle around the facilitator
- Scribe seated next to the facilitator using a standard flip chart
- 1 hour session

The three workshops covered the following topics[10]:

Workshop 1:	Reactions to the 'win win' case study approach
Workshop 2:	Review of methodology for developing case studies review
Workshop 3:	Assessment of methods of communicating the 'win win' message

Reporting methodology
To ensure all information was captured, a scribe was assigned to each workshop group. Information from scribe's was transcribed to an excel spreadsheet from which information from the various workshops could be grouped into key themes.

2.8 Development of Reporting Criteria

A framework reporting criteria was developed by Westcountry Rivers Trust to enable consistent and complete data collection in the development of new case studies.

Figure 2.8 *Westcountry Rivers' Reporting Framework*

CASE STUDY SUMMARY SHEET

Title	*e.g. Irrigation water minimisation, filtration and recycling*
Enterprise	e.g. Horticulture
County	e.g. Surrey
Source	e.g. Environment Agency
Financial saving	e.g. £798/ha
Payback	e.g. < 12 months

SUMMARY INFORMATION
Background
This case study was developed from information provided by …….

Size and type…ha	*e.g. Horticulture*
Objectives	
e.g.	*To reduce costs of ……* *To manage ….*

Resource management practice
e.g. Installation of a slow sand filtration unit and pumping system to enable the reuse of irrigation runoff

The need for the development of a standardised reporting framework and the key information for inclusion in this was discussed at the Stakeholder Consultation Day. Findings from this are reported in *Section 5.4* of this report.

[9] Appendix 9 presents the methodology for conducting the facilitation exercise
[10] *Appendix 7 presents the* agenda for the day.

3 Win Win Case Studies

3.1 Availability of Case Studies

A total of 82 case studies were identified and presented in a searchable access database and in *Appendix 3* of this study. Of these, 54 (category 3) win win case studies were identified which presented information that was suitable for aggregation purposes, i.e. data regarding cost savings on a per unit basis (either per hectare or per capita). In addition 21 (category 2) case studies were identified that presented win wins, however the financial information was not available on a per unit basis. Seven case studies (category 1) examined practices, which provided environmental benefits but did not provide information regarding financial savings.

Some studies included more than 1 'win win' management practice. Only in some of the case studies were the figures independently audited. Thus it is difficult to assess the reliability of the figures precisely and to be certain what costs were included and what were not. Nonetheless, there was no evidence that the authors of the case studies had any vested interest in the outcome. There was plenty of evidence that the authors were committed to providing information to help farmers economically and reduce their environmental impact. As such savings reported in these case studies were taken at face value and reported faithfully.

Beyond these, a small number of documented case studies show environmental improvements through payments to farmers (pay-win) that could not be included in this study.

There are currently a limited number of fully documented win win case studies of resource management in the agricultural sector in comparison with other business sectors. This appears to be due to a lack of coordination in documenting case studies and systematically capturing full information rather than a shortage of examples of practices with both financial and environmental benefits. The agricultural sector is the focus of a wealth of research projects and awareness-raising initiatives place emphasis on financial drivers to action. However there is currently much duplication of activities between organisations. A collaborative approach to documenting and pooling information would provide a very strong information base from which to develop the win win approach.

Table 3.1a *Overview of the number of documented win win case studies identified*

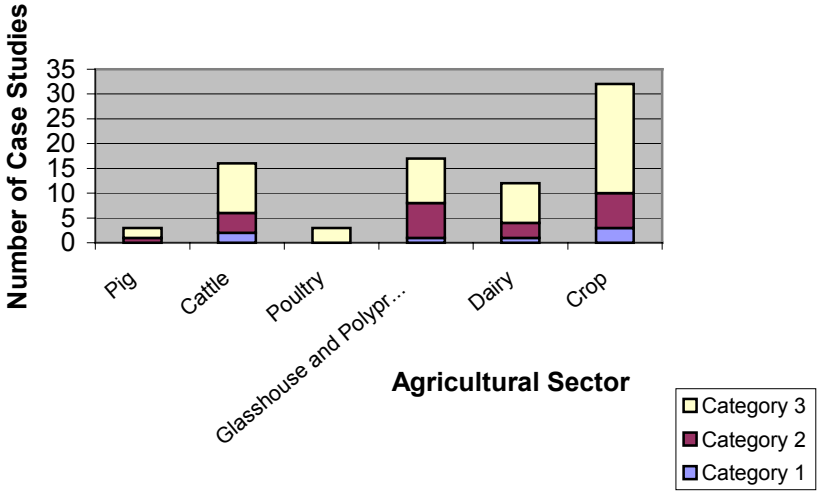
'WIN WIN' CASE STUDIES	
1. Environmental savings but no evidence of cost savings	7
2. Details of cost savings but not quantified on a per unit basis, so not viable for use in national estimates	21
3. Quantified cost savings valuable for aggregation purposes (savings per hectare or livestock head)	54
TOTAL	82

Table 3.1b *Availability of win win case studies for the various types of farm enterprises and the recognised opportunities for improving resource management*

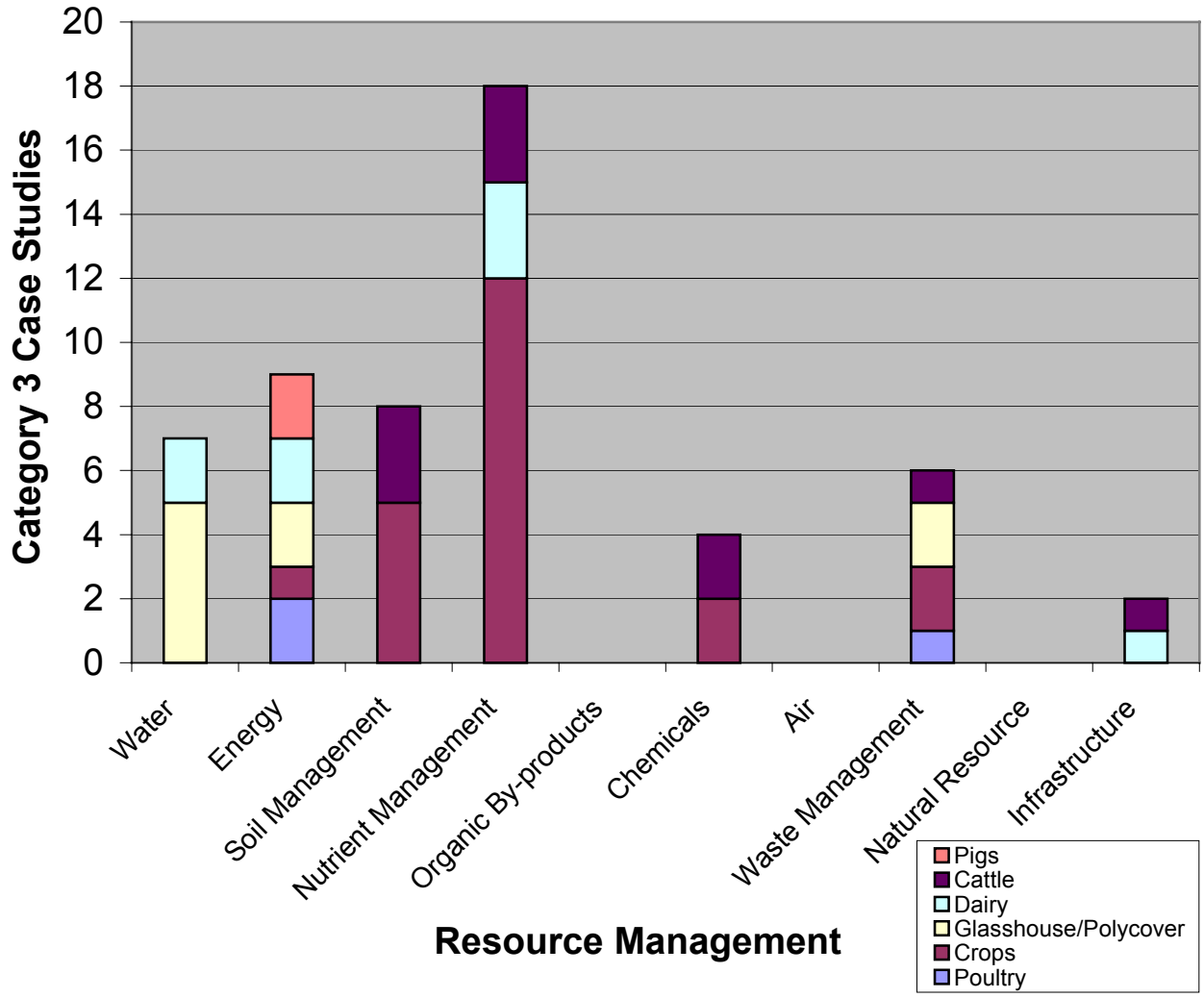
	Category	Poultry	Crops	Glasshouse/	Dairy	Cattle	Pigs	Total
Water	1		1	1				2
	2				1	2		3
	3		2	5	2			9
Energy	1							0
	2		1	2	1			4
	3	2	1	2	2		2	9
Soil Management	1		1			1		2
	2		2	2	2	1		7
	3		4			3		7
Nutrient Management	1							0
	2		3		1			4
	3		11		3	3		17
Organic By-products	1	1						1
	2	1						1
	3							0
Chemicals	1							0
	2							0
	3		2			2		4
Air	1							0
	2							0
	3							0
Waste Management	1		1					1
	2			2				2
	3	1	2	2		1		6
Natural Resource	1							0
	2							0
	3							0
Infrastructure	1		1					1
	2							0
	3				1	1		2

See section 2.2 for definitions of Categories of case study
Case study information is available in the Appendix; this gives details of the resource management activities more generally categorised in table 3.1b.

Graph 3.1a. *The Number of Category 1,2,3, case studies for each sector*



Graph 3.1b. *The Number of Category 1,2,3, case studies per resource management practice.*



Discussion:

1. The win win case studies identified cover only a relatively small proportion of the recognised opportunities for improved resource management across the various farming enterprises.
2. The largest numbers of existing case studies are associated with nutrient management, soil management and water and energy efficiency.
3. Category 2 case studies were not used for estimating national savings as the data was not sufficiently detailed, however they do provide useful indications of practices with beneficial environmental and economic performance. Category 2 case studies are especially important when they indicate savings within a sector that is not represented by any category 3 case studies. Indeed, there are case studies that represent financial savings in all of the sectors, this gives support to the concept that there are significantly higher savings available to agriculture than it was possible to identify in this study.

The table below shows the broad geographical range of existing documented win win case studies. Examples of good practices can be found throughout the country.

Table 3.1.c *Regional coverage of documented win win case studies in England and Wales*

Region [1]	No. of Case Studies	Region [1]	No. of Case Studies
North West	10	South East	2
North East	12	Greater London	0
Yorkshire & Humberside	11	South West	19
East Midlands	8	Wales	0
West Midlands	9	undisclosed	13

(1) Eight planning regions of England plus Wales

3.2 Main Sources of Case Studies

The main sources of existing win win case studies can be divided into:

- Government-funded research projects;
- Projects and initiatives undertaken by non-governmental organisations (NGOs);
- Collaborative research and awareness-raising initiatives involving government, industry, consultancy and non-governmental organisations.

Case studies are available individually or as:

- Whole Farm Case Studies
- Guidance documents.

3.2.1 Government-funded research projects

Key *government-funded research projects* that have generated case studies include projects on waste minimisation and nutrient management.

R&D Projects: Waste Minimisation

Significant research on waste minimisation opportunities in the agricultural sector began in the mid 1990s. Both the Environment Agency and MAFF (now Defra) commissioned research studies to identify opportunities to minimise waste on farms.

The Environment Agency commissioned BDB Associates to evaluate the opportunities for waste minimisation in agriculture (Environment Agency, 1996). Based on four farms, the study identified a range of opportunities and recommended a strategy to encourage a culture of waste minimisation in the industry. The report includes quantitative data on the potential cost savings on the audited farms. Based on the findings of this first study, the Environment Agency commissioned BDB Associates to develop a farmer-friendly handbook on best practices that bring cost savings and reduce diffuse pollution. Entitled 'Best Farming Practices – Profiting from a Good Environment', this handbook provides practical guidance using photographs and worked examples. (Environment Agency, 2000).

In the mid 1990s, the Ministry of Agriculture, Fisheries and Food (MAFF) and the BOC Foundation commissioned two projects on waste minimisation – both conducted by ADAS (Nicholson, R.J. and Baldwin, D.J., 1999). The first was to complete case studies of waste minimisation on farms. Opportunities were identified on ten farms resulting in estimated cost savings of £35,528 per year and an average annual cost saving of £710 per year. The potential environmental benefits were also documented and in some cases quantified. The second project completed further case studies (specifically on difficult/hazardous wastes) and produced a user-friendly manual on waste minimisation. This manual is entitled 'Opportunities for Saving Money by Reducing Waste on Your Farm' (MAFF, 2000). It is still being used by Defra to promote waste minimisation within the industry, and there are plans to update it.

R&D Projects: Nutrient Management

For many years the Government has commissioned a range of research studies on the effective utilisation of manure and slurry for their nutrient value. Three booklets were produced by

ADAS, the Institute of Grassland and Environmental Research (IGER) and the Silsoe Research Institute in 2001, funded by Defra (ADAS et al, 2001), and a fourth booklet on managing manure on organic farms was produced in 2002 by ADAS and the Elm Farm Trust (funded by Defra). These booklets include financial data and worked examples but no actual case studies. However, the findings on four demonstration farms have been documented in research papers written by ADAS and IGER and provide useful case studies ('Integration of farm manure nitrogen supply with commercial farm systems', ADAS, 2001). Various other farm-scale projects have being conducted and are ongoing. IGER led a project to evaluate techniques for ammonia abatement during slurry and manure application on eleven farms (the 'Pilot Farms Project'), which has now been extended. This did not quantify the full range of financial and environmental benefits but it is a useful source of information.

Similar farm-scale projects have been conducted by the Scottish Agricultural College and in Northern Ireland by the Department of Agriculture and Rural Development.

3.2.2 Non-governmental Organisations (NGOs)

A number of ***non-governmental organisations (NGOs)*** are working to promote the uptake of best practices by farmers (some receiving funding from EU Structural and Government funds for specific projects).

NGOs that have generated documented case studies include:

- LEAF (Linking the Environment and Farming);
- The Westcountry Rivers Trust;
- The Eden Rivers Trust
- Forum for the Future;
- The Kings Hay Farming Trust;
- RSPB (Royal Society for the Protection of Birds).

Key NGOs that have generated case studies *(more details in Appendix 2)*

LEAF (Linking the Environment and Farming)

- Charity established in 1991 to develop and promote integrated farm management (IFM) using "common sense farming practices that are both financially viable and environmentally responsible"
- Promotes IFM through its network of demonstration farms (currently 46) across Great Britain (summarised in leaflets and on the LEAF website)
- Two case studies on integrated crop management developed in the mid 1990s with TSB Agriculture and Andersons (now Aubourn Consulting)
- One LEAF case study in the booklet 'Waterwise on the farm'
- Eight brief case studies in the booklet 'Money Well Spent: A Guide to the Uptake of IFM on Lowland Livestock Farms'.

Kings Hay Farming Trust

- A charity specialising in dairy farming with approximately 3,000 members
- Provides members with practical information on all aspects of dairy farming through information sheets, reports, workshops and one to one advice
- One of its regular information sheets ('Farming Notes') presents a case study on catch crop grass after maize; another presents the results of a survey on water usage highlighting potential savings of up to £4,000 per year.

RSPB (Royal Society for the Protection of Birds)

- A charity with 1 million members, 1,300 staff and 180 nature reserves
- In 2002 the RSPB commissioned GFA-Race (part of the Royal Agricultural College) to produce farm case studies (from different farm types and geographical regions) to demonstrate that wildlife friendly practices are economically viable. The case studies include spreadsheets showing costs, revenues and total profits. However, the profits are generally due to income from the Countryside Stewardship Scheme – therefore these are generally 'pay-win' rather than 'win win'.

**Westcountry Rivers Trust were another important NGO key to this study, they are discussed in detail under whole farm studies..*

3.2.3 Collaborative Initiatives

Several ***collaborative initiatives*** generated documented case studies, including:

- The *Water Efficiency Awards* sponsored by the Environment Agency, Agriculture and Horticulture award sponsored by the NFU;
- The *Soil Management Initiative,* an independent organisation with members from government, industry, academia and consultancy;
- The *Allerton Project* involving the Allerton Research & Educational Trust and the Game Conservancy Trust;
- The *Focus on Farming Practice Project* sponsored by Farmcare, Agrovista Ltd and Hydro Agri Ltd, and the extension of this project – the Probe Project – sponsored by Defra, the Environment Agency and the RSPB;
- The *Boarded Barns Farm Study* led by Bayer Crop Science but involving a range of research organisations and consultants.

Key collaborative initiatives generating case studies

Water Efficiency Awards

- Developed and co-sponsored by the Environment Agency and Water UK in 2000
- 'Agriculture and Horticulture' category introduced in 2001 (involving the NFU)
- The Awards booklets for 2001 and 2003 contain a total of eleven case studies from agriculture and horticulture (Environment Agency, 2001 and 2003)
- Examples of practices include water recycling and solid set sprinkler irrigation.
- Selected case studies from these awards are included in the guidance booklet 'Waterwise on the Farm' produced by the Environment Agency in collaboration with the NFU and LEAF (Environment Agency, 2002)

Soil Management Initiative

- UK Soil Management Initiative Ltd (SMI) is an independent organisation created to promote the adoption of best practices to protect and enhance soil quality
- A collaborative initiative, members including ADAS, the Environment Agency, the Game Conservancy Trust, Monsanto, Cranfield University, Unilever and others.
- Produced 'A Guide to Managing Crop Establishment' featuring twelve case studies These include costings and work rates. Some include quantitative data on cost savings but most make qualitative remarks on the benefits of the practices. According to SMI, additional data exist but are not readily available.

The Allerton Project

- The Allerton Research & Educational Trust and Game Conservancy Trust collaborated on this project on the Loddington Estate in Leicestershire
- The project is reported in 'Where the Birds Sing – The Allerton Project: 10 Years of Conservation on Farmland'. This provides a detailed description of the conservation practices used and the environmental benefits.
- The project report presents quantitative data on environmental benefits relating to, for example, enhanced biodiversity (including a substantial increase in the number of birds, invertebrates and indigenous flora species). However, although the research concluded that environmental benefits could be maintained without impacting on farm profitability, limited quantitative data on cost savings are presented.

Focus on Farming Practice and Probe Projects

- Focus on Farming Practice was a ten year study comparing integrated farm management (IFM) and conventional farming on a 150 acre site on Farmcare's 5000 acres Stoughton Estate near Leicester.
- Sponsors: Farmcare (Cooperative Group), Agrovista UK ltd and Hydro Agri Ltd
- The Focus on Farming Practice Project report entitled 'The Case for Integrated Farm Management 1993 - 2002' presents considerable quantitative data on the costs and environmental impact of IFM compared with conventional practices.
- The study found that IFM and conventional farming have comparable costs until the price of wheat falls below £65/tonne when ICM is more profitable. However, it found that IFM provides environmental gains and indirect cost savings
- The Probe project is an extension of the Focus on Farming Practice Project and is sponsored by Defra, the Environment Agency and the RSPB.

Boarded Barns Farm Study

- The Boarded Barns Farm Study in Essex was funded by Bayer Crop Science in collaboration with a number of colleges, consultancy and NGOs
- The objective of the ten year study was to evaluate the environmental impact and financial viability of three farming systems – organic, integrated crop management (ICM) and conventional.
- The results and conclusions are summarised in a report entitled 'Food for Thought: Sustainable Food Production for the 21st Century Consumer'

3.2.4 Whole Farm Case Studies

Whole farm case studies are those that cover all resource management opportunities on an individual farm, and the actual cost savings and environmental benefits achieved.

Few fully documented 'whole farm' case studies have been identified, however there is a significant interest and growing number of organisations around the country producing whole farm plans for commercial farms. Discussions with stakeholders and FWAG (the Farming and Wildlife Advisor Group) indicate that funds are focused on priming uptake of these plans rather than measuring outcomes, so few case studies are published. Projects that have produced case studies from whole farm plans (Eden Rivers Trust and Westcountry Rivers Trust) have proved successful at facilitating uptake of best practices and provide good sources of case studies. If funds were available the follow up of whole farm plans would be a valuable area of focus.

Westcountry Rivers Trust

- Charity established in 1996 (now part of the National Association of River Trusts)
- Catchment-scale projects in the South West to reduce diffuse pollution and increase biodiversity by working with farmers to improve land management practices - using financial drivers (demonstrating financial benefits and targeting grant aid)
- Advisers produce integrated farm management plans for each farm (highlighting opportunities and priorities)
- >1,000 farms in total
- At the end of each project a sub-sample of farms have been revisited to conduct an economic evaluation of the project.
- Reported average net direct financial benefit of £2,700 per farm
- Only a relatively few documented case studies – approximately ten in the manual 'Best Farming Practices: Opportunities to Profit from Change' (including more than 130 Information Sheets).

Westcountry Rivers Trust provides particularly interesting examples of whole farm plans. The Trust has completed two catchment-scale projects and are currently conducting a third. The first two projects – 'Tamar 2000 SUPPORT' and 'Westcountry Rivers Taw/Torridge Project' were funded under the EU 5b structural fund in collaboration with local partners including MAFF (now Defra) and the Environment Agency. They involved working with more than 1,000 farmers and other landowners, and the development of more than 700 integrated farm management plans. A third project in Cornwall - the 'Cornwall Rivers Project' (funded with Objective 1 structural fund) - started in January 2002 will work with 600 farms over three years. These projects are a valuable source of information as they include a formal economic evaluation by an independent economist.

Economic evaluation of the Westcountry Rivers Trust's Taw/ Torridge Project

The economic evaluation report of the Westcountry Rivers Trust (WRT) Taw/Torridge Project provides an estimate of the likely net direct benefit accruing as a result of the project, and presents a benefit/cost evaluation based on the estimated net direct benefit. Measurement difficulties precluded a quantitative evaluation of the indirect/external benefits but these are assessed qualitatively. The results suggested that the average net direct benefit of the WRT project to farm-based businesses within the Taw/Torridge catchment was around £2,700 per business per year, with 80% of the benefits accruing to agriculture-related activities and 13% to tourism-related activities. This is equivalent to £27,000 per farm business over the 10 year planning horizon, or £19,924 per farm business if the costs and benefits over the planning period are discounted at 6%. The average cost of delivering a farm business plan was estimated at £2,200.

Based on the total direct costs and benefits of the project, the study estimated a benefit/cost ratio of 8.6 over the 10-year planning horizon, and a ratio of 6.4 if the stream of costs and benefits are discounted at 6%. This demonstrated that the project was highly cost efficient. Moreover, if net external benefits were also quantified, the expected benefit/cost ratio would demonstrate even greater social efficiency.

In this project it was possible to revisit many of the farms in the Westcountry Rivers Trust (WRT) Taw/Torridge Project and quantify the win win benefits derived from the farm management plans, and identify which were attributable to each resource management activity (i.e. improved nutrient use, reduced energy use etc.).

3.2.5 Guidance documents providing win win case study information.

Table 3.1.2 summarises the main guidance documents currently providing win win case study information. More guidance and awareness-raising documents containing real farm win win case studies are being developed. These are mainly used to draw attention to particular opportunities such as waste minimisation and water efficiency and the scale and quality of the case studies in these documents varies considerably.

Nevertheless, this demonstrates the increasing belief in the value of real farm case studies and perceived profit as a significant as a means of stimulating farmers' interest. However, the extent of influence and use of these documents is unknown.

Table 3.2.5 *Existing guidance documents including win win case studies*

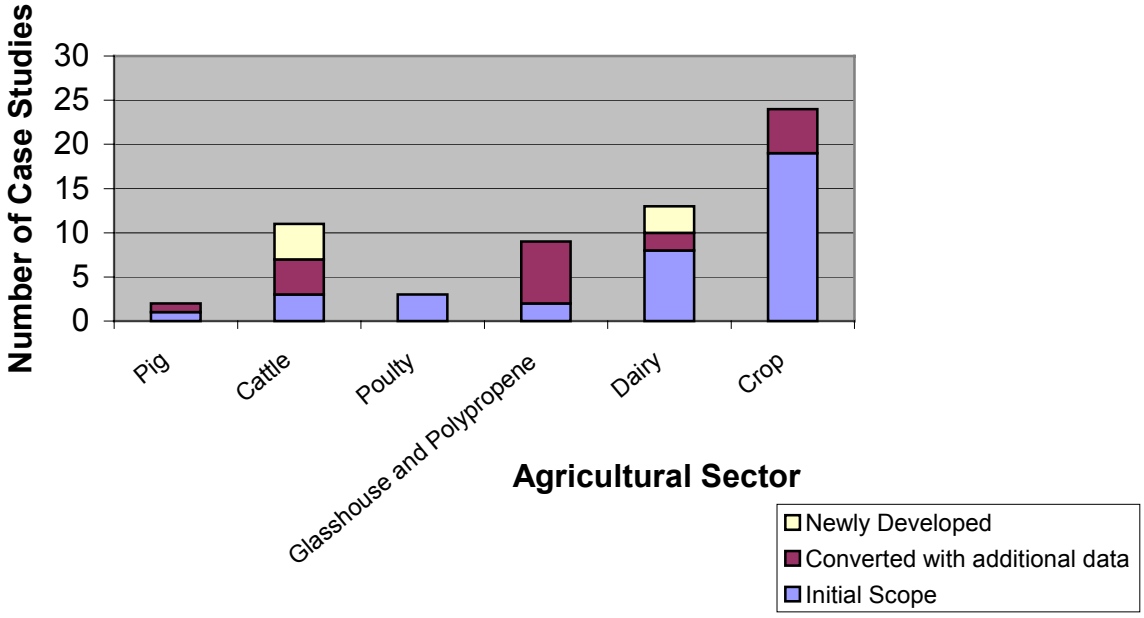
Title	Source
Opportunities to Save Money by Reducing Waste on Your Farm	Defra
Best Farming Practices – Profiting from a Good Environment	Environment Agency
Waterwise on the Farm	Environment Agency, LEAF and NFU
A Guide to Managing Crop Establishment	Soil Management Initiative
Best Farming Practices – Opportunities to Profit from Change	Westcountry Rivers Trust & BDB Associates (but use currently restricted to the Cornwall Rivers Project).

3.3 Sourcing Case Studies

A significant number of case studies were identified in the second research phase which helped to fill the gaps identified in the scoping study. The newly developed case studies focused on populating the cattle and dairy sectors and successfully took the number of case studies in both sectors to above the target levels. In addition the converted data also provided additional case studies for all sectors except poultry. It is evident that two sectors have proved difficult to source case studies for - pigs and poultry. Discussions with stakeholders identified a number of reasons for this:

- Uncertainty regarding the future prosperity of these industries has limited the amount of investment in these sectors.
- In tight financial situations little time is invested in making measurements of resource use on these farms.
- Both sectors are typified as either very small scale holdings with few animals or very large. The environmental outcomes of small holdings is little documented due to their limited individual impacts. Large intensive operations instigate resource management activities, such as energy savings as a commercial business decision and therefore do not externally report on these.

Graph 3.3. *How case studies were sourced*



4 Financial & Environmental Benefits

4.1 Methodology for Estimation of Potential Cost Savings

A methodology for developing estimates of total potential savings across England and Wales is presented in *Appendix 5*. The methodology outlines the steps required to produce robust assessments of the total potential national (England and Wales) savings for 'win win' management activities.

However, in order to develop reliable estimates of the total potential cost savings from improved resource management practices in the agricultural sector as a whole, the following key information is required:

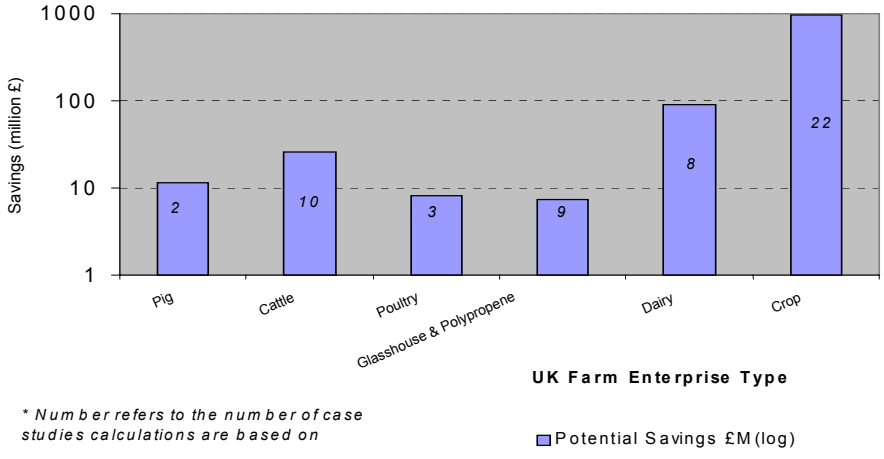
- Reliable quantitative data for the full range of win win management practices across each enterprise sector: it can be seen from *Table 3.1* that significant 'gaps' currently exist;
- Improved information on existing rates of uptake for win win practices within each enterprise type and reliable assessments relating to future uptake rates.

The steps outlined in *Appendix 5* were followed as closely as possible given the limited quantity of reliable case study data found to be available. In particular, the large number of case study 'gaps' for many 'win win' practices precluded a robust 'across-the-board' aggregation of the total potential savings likely to accrue in each enterprise sector (Step 5). Instead, estimates of potential national savings are presented on a practice-by-practice basis. The lack of information relating to current and future uptake rates also precluded the application of Step 4. The national savings presented are based on an assumption that, given all the case study practices utilised in the aggregation process are widely applicable and easily adoptable, uptake rates are 100%. They also assume that current uptake rates are zero, hence the descriptor "maximum potential" savings.

Further extensive research and consultation are recommended before the aggregation methodology can be fully and successfully implemented to produce robust estimates for total national savings across the agricultural sector as a whole.

4.2 Estimates of Maximum Potential Cost Savings

Estimates of potential national savings are presented on a practice-by-practice basis in Table 4.3. The figures in brackets are the practice's savings estimate presented as a percentage of total agricultural output (income) for the relevant enterprise sector. Graph 4.2 below illustrates the potential savings detailed in Table 4.2.



Graph 4.2. *Potential national savings to agriculture (England and Wales)*

The largest potential savings are in the crops (arable) sector. This is also the sector with the most case studies. For other sectors savings estimates are based on only limited numbers of case studies. Overall, the cost savings range from 0.7% of total enterprise income to 13%. The range may not indicate any sectoral differences in environmental performance, or opportunities for savings, bit simply reflect a paucity of data. With more data from other sectors, the potential savings may increase.

This study identifies a large range in potential savings of between 0.7 to 13% of sector income. Other studies indicate this figure would be closer to 10%. 'Opportunities for Saving Money' (MAFF, 2000) illustrates that a typical mixed farm will save up to £1200/year through the appropriate use of organic manure. Compare this with the average farm income in that sector of £15,000/year (2003 Defra census), it then represents a potential saving of 8%. Another study commissioned by the Environment Agency presents estimates of the cost to manufacturing businesses of failing to adopt best-practice in resource efficiency (Cambridge Econometrics and AEA Technology 2003). This report identifies potential savings within UK industry and manufacturing of between 5-7% of turnover. Based on this evidence it is estimated that with further investigation, the average potential savings per sector could be above 5%.

The greatest value in Table 4.2 is for savings from soil (& nutrient) management of cereals in the crop sector (£620 million per year). Fiftenteen case studies relating to this were identified, and the cost savings achieved by these practices covered ranged from £10/ha. per year to £253/ha. per year. The estimate in Table 4.2 is derived from a saving of £200/ha. per year. This value is from a case study on the adoption of a set of improved soil and nutrient management practices and encompasses many of the resource management changes covered in the other 15 case studies. While £200/ha. can be regarded as the 'best' estimate, a simple average of all 15 case studies indicated a potential saving of £111/ha. Taking this lower estimate, the potential national savings estimate is reduced to £358 million per year. An upper bound estimate of £740 million per year is provided by the highest case study saving identified (£253/ha).

Step 7 of the methodology outlined in *Appendix 5* proposes that 'reality checks' are undertaken through comparison of estimated savings with other 'top-down' evidence from published national data, industry and other stakeholder research. In DEFRA's guide "Opportunities for Saving Money" (MAFF 2000a) the savings estimates derived for a wide cross section of practies range from 2% to 10% per practice. These values are consistent with the figures given above. For example, electricity consumption is common to all types of agriculture, and its use for ventilation, heating and cooling is increasing. The guide provides an example where a pig farming enterprise saves over £3,800 representing electricity savings of 10%. Similarly, an example from a mixed farm saved £3,000 (£10/ha) by monitoring soil nutrient levels and utilising manure to enhance the soil condition.

*Caution must be used when using this type of data as:
-There is not enough data available to give high levels of confidence, due to the gaps in both number of case studies but also the geographical location and enterprise type.
-It was not possible to fully estimate the opportunity costs of farmers' time in implementing these measures.
-There is little understanding of the degree to which the practices have already been adopted and therefore, the value of savings that have already been realised.
-There has also been no analysis regarding the extent to which these measures may not be suitable for all farms in the sector to which they apply for topographical or logistical reasons.

Table 4.2 *Availability of win win case studies for the various types of farm enterprises and the recognised opportunities for improving resource management (data source: Agricultural & Horticultural Census: 2 June 2003 England, defra) *Based on Category 3 Studies.*

Key Resource Management Opportunities	**Savings for Farm Enterprises (£million/year)** *(%) Indicates the % of savings as a factor of total farm income per sector.*					
	Dairy	**Crops**	**Cattle**	**Pigs**	**Poultry**	**Glasshouse/ Poly-propagation**
Water						
Reducing use	10.4 *(0.4%)*					
Reducing leakage						
Reusing water	48.2 (*1.5%*)	120vegetables (*1.2%)*				[11]6.7
Using alternative sources						0.5
Energy				See note 18	1.9 *(0.2%)*[12]	
Reducing use		4.5 potatoes *(0.1%)*				[13]0.06
Reducing loss						
Recovery	6.3 *(0.3%)*					
Using alternative sources						
Soil		[14]620 cereals *(11%)*				
Reducing loss of soil & crop			12.1 (0.5%)			
Reducing cultivation						
Reducing damage to soils						
Nutrients		[15]Note				
Reducing use	15.5 (1%)					
Reducing loss						
Accurate application			4.2 *(0.2%)*			
Using alternative sources	6.6 *(0.3%)*		[16]6.1 *(0.4%)*			
Organic by-products						
Reducing production						

[11] This figure is based on a number of similar case studies so the average was used.
[12] Average of two case studies, which exemplified two energy management activities.
[13] This figure is based on two similar case studies where an average was taken.
[14] This figure represents the best estimate of £200/ha for cereal crops, which is taken from 15 case studies, which featured various methods of improved soil and nutrient management practice. A sensitivity analysis was also conducted to identify a high and low estimate for the potential savings given the scale of potential savings. The low estimate was £111/ha and the high estimate for cereals was £253/ha, this produced a range of potential savings for England & Wales of £358 - £740M/yr.
[15] The figure quoted under 'soil' also contained many case studies on nutrient management incorporated with soil management. To avoid double counting the estimated savings was included once.
[16] This saving is a combination of both nutrient management case studies and 2 case studies , which reduce the use of chemicals (fertilisers), as such they have been combined into one saving to avoid double accounting.

Key Resource Management Opportunities	**Savings for Farm Enterprises (£Mill)** *(%) Indicates the % of savings as a factor of total farm income per sector.*					
	Dairy	**Crops**	**Cattle**	**Pigs**	**Poultry**	**Glasshouse/ Poly-propagation**
Recovery (composting)						
Accurate application						
Improving storage						
Chemicals						
Reducing use		29.3 (0.5%)	2.4 *(0.1%)*			
Reducing loss						
Accurate application		11 vegetables *(0.1%)*				
Use of alternatives						
Waste						
Reducing waste		[17]3.5 beet *(0.1%)* 12.3 potatoes *(0.5%)* 21.4 cereals *(0. 3%)*	0.1(0.01%)		6.2 *(0.5%)*	
Reusing waste						0.1
Recovering value from waste		0.9 vegetables *(0.1%)*				
Air						
Infrastructure						
Improving hedges & ditches	2.1*(0.1%)*					
Improved stockholding			1.2*(0.1%)*	[18]8.7 *(1.2%)*		
Improving tracks & roads						
Natural resources/wildlife						
TOTAL (£million/year)	**89.1**	**822.9**	**26.1**	**8.7**	**8.1**	**7.36**
% of total income per farm sector (rounded)	**(3.6)**	**(13.9)**	**(1.3)**	**(1.2)**	**(0.67)**	**(Note 11)**

[17] This figure represents the average savings for two similar resource management activities
[18] This figure gave associated energy savings but the savings have been included in this section as it was improved stock holding that led to the energy savings

4.3 Evaluation of Environmental Benefits

The potential for substantial environmental benefits has been identified through this review process. These include:

- Reductions in diffuse pollution
- Improvements in Biodiversity
- Reduced water use
- Reduced Co2 emissions

However, quantification of environmental benefits has rarely been completed, probably because it is both difficult and expensive to accurately assess the environmental benefits. Adequate controls are hard to set up (i.e. equivalent farms where the case study has not been implemented) except perhaps on a large scale. This is a key area for future research and would help in developing Key Performance Indicators (KPIs). It may be in the first instance that indirect KPIs could be measured e.g. energy use per head of livestock, inorganic and organic nitrogen and phosphorus addition per hectare, water use per hectare, fuel use per hectare, pesticide applications (kg/ha or applications per year), or waste production per hectare or per head of livestock. More direct measures of performance could include faecal coliforms/litre in streams running passed farms, nutrient levels in receiving waters, particularly after application of fertilisers, or water quality indicators of eutrophication. All of these would require research to develop easily useable methodologies for measurement and then monitoring to note their utility particularly in driving best practice.

The database contains a matrix that enables the resource management activities to be cross-referenced with the environmental benefits that can be achieved through adopting the various examples of good practice. This is a useful tool in understanding the relationship between resource management and the environment.

4.3.1 Diffuse Pollution

Diffuse pollution is pollution of a river catchment that cannot be easily pin pointed to one discrete point of discharge. It is therefore very difficult to control. In agriculture the main pathways are surface water runoff and land drains. Land management practices have a critical influence on the initial concentration and pathway of pollution. However, the effects of pollution are greatly influenced by the climatic and geomorphologic conditions of the drainage basin.

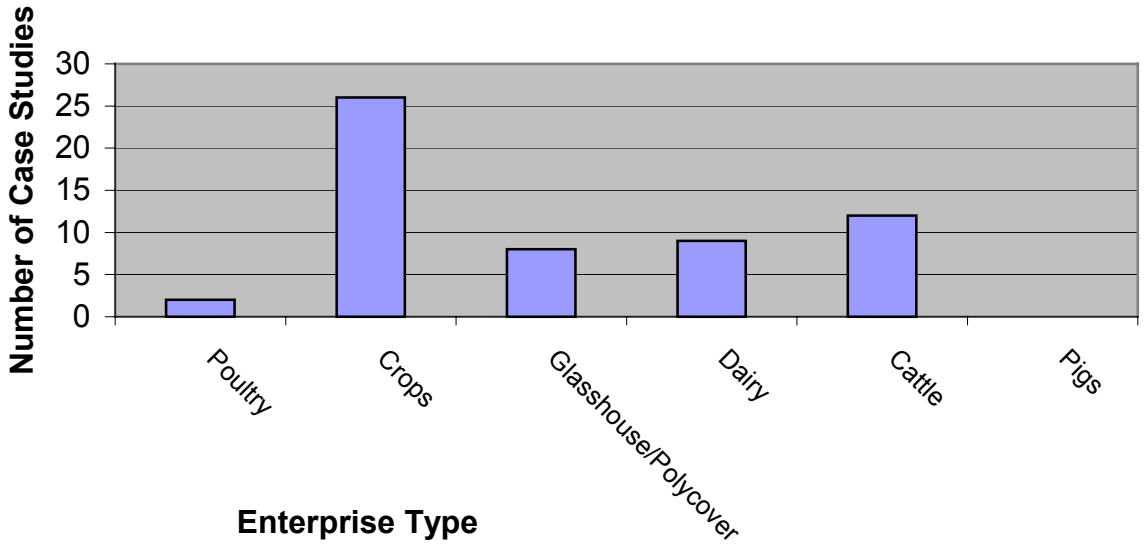
The Water Framework Directive requires the protection, restoration and enhancement of aquatic ecosystems to ensure the progressive reduction of water pollution. Most industries are now facing tighter discharge limits and the level of diffuse pollution stemming from agriculture is widely regarded as significant.

The main problems of diffuse pollution from agriculture are the erosion of top soil and subsequent sedimentation of water courses, contamination by nutrients (especially phosphorous and nitrogen), pesticides, herbicides and other chemicals and the addition of organic by-products, such as dirty water, slurry and manure into drainage systems.

The excessive levels of nutrients and material with a high biochemical oxygen demand results in eutrophication of water sources. This has many direct impacts, often leading to excessive algal growth, the loss of nutrient sensitive acquatic plants and a drop in levels of water oxidation. This ultimately impacts on the water resource's amenity value; for fishing, navigation and water sports and most significantly it degrades its value for drinking water both for humans and animals.

It is therefore encouraging to observe that 70% of the category 3 case studies (37out of 54 category 3 case studies) focus on measures that can reduce diffuse source pollution with a total 54 out of the total 82 (category 1,2,3) case studies representing measures that can reduce diffuse pollution (see table 4.3.1 on the following page). About half of the category 3 case studies identify cost savings derived from environmental improvements in soil and nutrient management (Graph E3). The additional diffuse pollution studies encompass water, organic by product and chemical management. It will be a challenge to persuade farmers to reduce the highest intensity of chemical and nutrient inputs, particularly in the crops sector. However, the 15 case studies of crops demonstrating savings through soil management may provide a useful tool for demonstrating good practice and initiating this behavioural shift.

Graph 4.3.1 *Case studies (Category 1,2,3) tackling diffuse pollution.*



The case studies identify a range of management practices that are beneficial in reducing diffuse pollution. These cover activities designed to:

- Reduce soil erosion and run-off by maintaining vegetative cover.
- Reduce fertiliser usage either by the increased use of manures (slow release fertilisers or minimising use, optimising timings and targeting applications)
- Reducing pesticide use through increasing the targeting of chemicals and increasing abundance of the natural predators.

Table 4.3.1 *Index of case studies reducing farm impacts on diffuse pollution.*

	Category	Poultry	Crops	Glasshouse Polycover	Dairy	Cattle	Pigs	TOTAL
Water	1		1	1				2
	2				1	2		3
	3		2	5	2			9
Soil Management	1		1			1		2
	2		2	2	2	1		7
	3		4			3		7
Nutrient Management	1							0
	2		3		1			4
	3		11		3	3		17
Organic By-products	1	1						1
	2	1						1
	3							0
Chemicals	1							0
	2							0
	3		2			2		4
TOTAL		2	26	8	9	12	0	54

**Shaded cells highlight the 37 Category 3 Case studies discussed in section 4.3.1*
Detailed examples of these case studies and management practices are presented in Appendix 9.

4.3.2 Biodiversity

During this research some information on farm biodiversity was found. The increased efficiency of agriculture over the last 50 years has lead to significant and widespread declines in many types of farmland wildlife.

Research conducted by the Centre for Ecology and Hydrology (CEH) has raised awareness of the problems facing farm wildlife and the practical techniques for managing farmland to improve biodiversity and maintain farm profitability. There are a number of organisations conducting research in an attempt to try and quantify the impact of biodiversity on the farmed environment. Some of these are detailed in *Boxes 4.1 and 4.2* below.

Box 4.3.2a Biodiversity research conducted by the Northmoor Trust

By implementing changes in the farming system and embarking on a programme of habitat creation and management, the Northmoor Trust aims to:

- Increase species diversity and population size of selected key species on the farm;
- Encourage wildlife from the nature reserve to spread onto farmland;
- Maintain beneficial ecological processes to reduce pest and weed problems

Baseline data have been collected and monitoring schemes and surveys established for rare arable flowers, farmland birds, bumblebees and butterflies. Many of the species belonging to these groups have suffered significant declines as a result of agricultural intensification. Surveys are also conducted to monitor the establishment of vegetation in conservation headlands and newly created field margins.

The Trust is currently developing research projects to investigate:

- Novel and practical techniques for enhancing biodiversity on farmland;
- Methods for improving the sustainability of farming practices

Research interests include; the impact of minimal tillage on beneficial and pest species, less environmentally damaging forms of slug control and methods for enhancing the biodiversity value of newly planted farm woodland.

Another valuable source of research is the project at Manor Farm, which is the home of The Farmed Environment Company (FEC). FEC is an independent company committed to increasing farmland biodiversity through innovative research and knowledge transfer.
The effect of modern farming on wildlife and the environment is well documented, and losses of wildlife habitat - such as hedgerows, wild flower meadows and ponds - have been widely publicised. Similarly, declines in many farmland bird species along with many other groups - including small mammals, invertebrates and plants - have been recorded. These are thought to have resulted from changes in agricultural practices including:

- The decline of mixed farming
- Switch from spring to autumn sowing
- More intensive land management

Box 4.3.2b The Manor farm project, part of the Farmed Environment Company (FEC)

FEC provides services to organisations in the agricultural, food and environmental sectors that wish to develop a better balance between food production and wildlife.

Manor Farm, home of FEC, is a modern, professionally managed arable enterprise of 164ha at Eddlethorpe, near Malton in North Yorkshire. The Manor Farm Project was established in 1998 using the site as a whole-farm experiment to prove that practical wildlife conservation and profitable farming can be effectively integrated.

At the start of the project, the Centre for Ecology & Hydrology (CEH) Monks Wood conducted a baseline survey to establish which plants, animals and habitats were present on Manor Farm. Satellite Global Positioning System technology was used to accurately map patterns of soil types and crop yields. This permitted the identification of areas on the farm that were not profitable for crop production and therefore may be suitable for development as environmental habitats. As a result various initiatives have been monitored:

Field Margins: Established margins on Manor Farm have provided a valuable addition to the suite of habitat types on the farm. They also provide a barrier to the spread of pernicious weeds from the hedge-bottom to the cropped area, thus lessening the need for chemical weed control.
Tree Island: Crop yields under trees and pylons are poor when compared to the open field and both the trees and farm machinery are damaged by farming under such obstacles. The use of tree islands on Manor Farm provides an ideal opportunity to sow such areas to benefit wildlife.
Hedgerows: Over 1km of new hedgerows has been planted. Cutting the hedges less frequently means that there are more berries for farmland birds.

These projects present very good indications of biodiversity improvements that result from an integrated approach to farming. However, there is still insufficient quantitative data to support the findings. Future work is required to quantify environmental benefits in such a way that they can be incorporated into win win savings assessments in a consistent and transparent manner.

4.4 Barriers to Implementation of Win Win Opportunities

Through discussions with farmers in the development of this project various qualitative observations were documented which identify barriers to the uptake of win win practices and availability of win win case studies. General trends were:

- A general lack of awareness that win win opportunities exist.
- Difficulty in finding comparative case study information due to the diversity of organisations producing case studies and the lack of detail on which to base business decisions.
- A lack of measurement of the costs (water and electricity consumption or farmers management time) incurred prior to the implementation of improved practices, therefore the evaluation of savings must be based on estimates.
- A preference for pay-wins. The payment primes action even if the activity alone would provide a win win.
- A lack of willingness to invest in facilities. This is particularly apparent in older age groups of farmers and in agricultural sectors typified by smaller independent enterprises rather than large business corporations. This appears to be the result of a wait and see attitude, as farmers face uncertainties about their own future viability in farming.

Research must be conducted to provide comprehensive information and a reliable portfolio of data on all case studies. This information must then be audited to ensure figures are realistic and reliable.

Further data is needed to:
- Quantify the financial benefits and document the full environmental outcomes from changed resource management practices.
- Determine the most effective use of public funds.
- Provide sufficient sector specific information to stimulate the uptake of best practices by farmers.

Achieving this long-term need will take time, political will and the support of all stakeholders.

5 Stakeholder Facilitation Workshop

The workshops were attended by forty-two representatives of thirty stakeholder organisations in the Agricultural Sector, Government, NGO's, Academia and Consultancy Services (see *Appendix 7*).

Feedback from workshops was documented by scribes and transcribed to an excel spreadsheet from which key themes were identified. These datasheets can be made available if required.

5.1 The Win Win Approach

There was general consensus that overall the win win approach is a powerful and effective tool to change behaviour if delivered through an overall system of advice provision. Case studies were not sufficient as a stand-alone product. Delegates were comfortable with the win win strategy and rapidly engaged in identifying means of further improving the approach to data collection and communication.

Delegates commented that the idea of win wins was currently better known to advisers and intermediaries than by the farmers themselves. Attendees from the South West of England indicated that they were well acquainted with the idea of win wins, through familiarity with the work of the Westcountry Rivers Trust.

Delegates accepted that adopting the win win approach would have significant benefits to communicating and creating positive outcomes for farmers and the environment, though feedback from all workshops groups indicated that this should be approached strategically and with care as there is currently a large amount of conflicting and confusing information delivered to an increasingly weary farming audience.

Evidence from the workshops indicated that additional benefits could be gained through:

- Improving the performance and consequently the reputation of farming.
- Providing validation for farmers currently undertaking such practices.
- Presenting a non-prescriptive form of government intervention.

5.2 Communications

5.2.1. Challenges

Communicating with farmers and generating uptake
Delegates' commented that farmers are overloaded with information (at times conflicting) from a plethora of sources causing them to ignore or mistrust many of the messages they receive. Some data in case studies was thought to be unrealistically high, this needs assessing as unrealistic savings estimates will have a negative effect and reduce the degree of confidence in the whole approach.

Uptake- Case study alone is not enough to prime change, but a good starting point. To give real value the case study material should be complimented with on farm support and further advice to enable a farmer to put case study information into context.
Drivers- The drive to act is highly depending on the type of farm, its profitability, and pressures from the supply chain

Barriers-. The need for investment is a barrier; in financial hardship farmers are less receptive to new ideas, there will be less uptake on less profitable farms, high initial investments will be off putting, older generations tend to be less willing to invest in change. Farming is traditionally grant driven, therefore, the fact that there is no initial payment will put many farmers off.

5.2.2 Opportunities

The focus groups were asked to identify that the best way to communicate the win win message to maximise their potential to change behaviour. Some key themes arose:

Synergies – Promote the synergies between the resource management activities and requirements under new legislation and government schemes (cross compliance and single farm payments), new regulation (WFD) and any relevant agri-environment schemes. This joined up approach will make it easy for the farmer to meet many objectives and to put the management activities into context with different schemes/requirements.

Integration- work with demonstration farms, farm advice services and other farm networks to present unified coherent messages. Deliver the same messages through supply chain mechanisms and industry bodies to familiarise farmers to the messages and so increase uptake of advice.

Positive Approach- Present as an opportunity to create a positive outcome and an important contribution to help implement impending policies e.g. Water Framework Directive, cross compliance regulation

Simplicity – keep the messages simple. Clear financial and timesaving

Generate Ownership – Identify Champions (locally elected FWAG representatives proposed) and involve farmers in the generation of case studies and communication of these. Thus maximising the uptake and level of trust in messages through peer group delivery of communications.

Targeted – a big advantage of case studies is that they can be used to target a specific environmental issue. If environmental issues can be prioritised then it will be possible to research management practices that reduce the environmental impacts in these specific areas and therefore advice can be targeted

5.2.3 Delivery

Management
The stakeholder groups considered how the approach could be delivered. It was suggested this could be through the development of:

- A Steering Group involving stakeholders
- A joint initiative between the Environment Agency, Defra, SEERAD, the NFU.

Method
There is a need for a centralised integrated body to coordinate the collection of case study data and manage the delivery of advice thought the correct existing dissemination networks. Some networks are more able to communicate specific issues. This hub will also maintain standards, consistency of data collection and quality of data whilst ensuring that the correct coverage of case studies is developed to address necessary issues. In addition to working through networks, communication could be augmented by the provision of a supportive helpline to direct enquires to the correct information source or body.

Key messages from the stakeholders were:

Integration: with other advice services to give unified, coherent messages, working through the supply chain and linking to the NFU and farmer groups

Local implementation: Work with local groups (e.g. FWAG) to identify champions to communicate with other farmers, developing peer group promotion encourages trust.

Intermediaries identified by Stakeholders

INTERMEDIARY GROUP	STAKE HOLDER RECOMMENDED
Farm Advisors	• Vets • Insurance brokers: poor environmental performance: insurance risk • Banks can promote good financially sound practice • Farm accountants • Commercial advisors • Defra funded Advisors: Adas pollution advisors, conservation/compliance advisors
NGOs	• FWAG
Government Agencies	• Regulators: Environment Agency • Defra • English Nature
Commercial Sector	• Buyers can use case studies to promote better practices by suppliers • Large farm consortiums can influence members • Land Agents • Suppliers
Training and Education Bodies	
Peer Group	• Champions • Farmer networks: local NFU, Country farming clubs, local FWAG committees
Farming Associations	• NFU

Delivery Media

- Internet: (Stakeholders suggested most farms have some access, locally or at home)
- Press: High Profile, Local and trade.
- Seminars, Training Programmes
- CD ROMs
- Direct Mail
- Awards

5.3 Developing Case Studies

The focus groups identified some fundamental issues relevant to the whole process of producing case studies:

Approach

- Prioritise activities to identify areas where most improvements must be made.
- Focus case study development on recognised commercial bodies.
- Target communications by region or industry sector (segments may be identified through the Farm Business Survey).
- Develop a whole farm economic assessment.
- Provide detail to allow users to contextually interpret information and apply practices.

Within this approach it is important that the following data is collected:

- Provide a quantification and evaluation of environmental risks and impacts.
- Clarify income versus spend and detail the return on investment.
- Ensure case studies include the time spent on initiatives.
- Ensure farms are typical of their sector.
- Include details of the farm size and ownership (tenant/contractor)

5.4 Data Required

- Ensure a very high standard of accuracy to ensure credibility of savings, exaggerated or inaccurate figures will undermine the whole project. This may be achieved by independent auditing of data by team of assessors.
- Establish the boundaries of impacts considered (farm, catchment, country, globe)
- Keep information on case studies current.
- Research to identify of how many of these practices farmers are already undertaking.
- Develop key indicators to measure environmental data and give a standardisation of criteria reported on to allow comparability e.g. use an electronic proforma.
- Identify a base line environmental performance from which win wins can advance
- Present regional details to allow for variations in geographical conditions and farming type.

5.5 Summary

The stakeholder consultation generated a very positive response to the win win approach. Considerable opportunities were identified to work in collaboration with farmer networks, advice services and stakeholders providing targeted, clear, positive and practical advice to farmers. Stakeholders shared a large amount of extremely valuable insights and very constructive feedback was received on how to take the work forward. These recommendations have fed into the overall conclusions and recommendations of this project.

6 Conclusions & Recommendations

6.1 Overall Success and Value of the Project

This project has focused attention on the current availability and use of 'win win' case studies of improved resource management in the agricultural sector. It has also provided information to help determine the future role of case studies and has furthered the development of a robust methodology for estimating the potential national cost savings from improved resource management practices within agriculture.

6.1.1 Strengths and Limitations

Strengths

- Many opportunities for win wins do exist
- Most impact is on diffuse pollution

Existing Opportunities

The win win case studies identified during this project show a range of financial and environmental benefits from improved resource management practices. Despite the limited number currently available, the case studies clearly demonstrate that there are opportunities to both save money and gain environmental benefits by improving resource management practices.

The estimated cost-savings from individual practices are very variable and range from £0.05 per bird within poultry farming (as a result of converting to compact fluorescent light bulbs) to £3500 per hectare for market gardening enterprises (as a result of a garden centre creating a pond for collection and recovery of irrigation water).

The environmental benefits, although not always specified in the case studies, are broad and include improvements to drinking water quality and river ecology (associated with the reduced risks of runoff, diffuse pollution and flood risk), landscape amenity (associated with, for example, both reduced cultivation and infrastructure improvements), biodiversity (arising from, for example, the reduced use of chemicals), sustainability (arising from reduced water and energy use and waste minimisation).

Limitations

- There are few case studies compared to the number of recognised opportunities for improved resource management throughout the agricultural sector.
- Little financial data is available from some case studies and where available there is considerable variability in inclusion and methodologies for estimating the costs of farmer's time.
- There is scarce data on the scale of environmental benefits of improved practices and uncertainty about the applicability of activities in some case studies across the agricultural sector.
- There is a lack of documented whole farm case studies showing cost savings and environmental benefits achieved from a range of resource management opportunities.
- Analysis of the barriers to the implementation of win-win opportunities and how they could be most cot-effectively reduced is quite limited and requires further consideration.

6.2 Availability, Use and Quality of Case Studies

The project findings show that the development and use of case studies in the agricultural sector have been limited and fragmented to date. Documented case studies have been used mainly to draw attention to particular issues and opportunities such as integrated crop management, water efficiency and improved soil management.

However, there is an increasing awareness of the value of case studies and several organisations have been, and are, developing case studies to help encourage the uptake of best practices. There is a vast pool of potential case studies to be drawn from the large and growing number of R&D projects and other initiatives in the sector, including scientific research, catchment-scale projects, demonstration farms and other awareness-raising initiatives. Many of these represent potential sources of case studies and/or data on the financial and environmental benefits of improved resource management. However, there is currently limited coordination and many projects reported a lack of resource devoted to follow-up and monitoring.

A total of 82 documented win win case studies were identified. These include comprehensive information on management practices and data on cost savings. However, only 54 of these case studies provided sufficiently detailed quantitative financial data (ie on a per unit basis either per ha/per head) for comparisons between practices to be drawn and for potential savings in England and Wales to be extrapolated. The case studies used represent only a relatively small proportion of the total number of recognised opportunities for improved resource management on farms; the largest number being associated with waste management, nutrient management and water efficiency.

The results confirm the hypothesis that there is significant opportunity for the agricultural industry to make financial savings while simultaneously providing broader environmental benefits. Estimated potential savings of about £960 million per year in England and Wales were identified via the resource management practices examined in these case studies. Potential savings range from about 0.7% of income in the poultry sector to about 14% of income in the crop sector. Over 80% of the estimated potential savings are in the crop sector, particularly in the cereals industry. A sensitivity analysis of the findings for cereals indicates that estimated potential savings for this sector is in the range of £358 million - £740 million per year, whilst total potential savings across all the sectors are therefore in the range of £700 million - £1.1 billion per year.

However, care needs to be taken in interpreting these findings. Firstly, the concentration of identified potential savings in the crop sector could indicate that most savings are in the crops sector or, that with greater research in other sectors, the savings potential for the entire agricultural sector is significantly greater than identified in this study. Secondly, these estimates should also be regarded as maximum possible savings via the resource management measures that have been examined as no allowance has been made for the extent of existing implementation of these measures. Furthermore, while the case studies used in this project focussed on resource management measures that are easily adoptable and widely applicable, they may not be suitable for all farms in the sector to which the measures apply for topographical or logistical reasons. Moreover, the financial estimates only partially allow for the opportunity costs of farmers' time in implementing the measures.

In DEFRA's guide "Opportunities for Saving Money" (MAFF 2000a) the savings estimates derived for a wide cross section of practies range from 2% to 10% per practice. These values are consistent with the figures given above for the enterprise sectors. For example, electricity consumption is common to all types of agriculture, and its use for ventilation, heating and cooling is increasing. The guide provides an example where a pig farming enterprise saves over £3,800 representing electricity savings of 10%. In addition, the same source suggest that a mixed farm will save up to £1200/year through the appropriate use of organic manure. Compare this with the average farm income in that sector of £15,000/year (2003 Defra census), it then represents a potential saving of 8%. Thus overall we may speculate that once further investigations are conducted, the average potential savings per enterprise sector could be about 5%.

Some case studies were bordering on win win e.g. the RSPB studies. In these cases, grant payments encouraged farmer action rather than straightforward cost reductions. For example in the study on "rotational hedgerow management and natural regeneration of field margins", field margins were only mown annually and hedge sides were cut every three years and tops every five years, as opposed to annual cuts. This approach saved the farmer £1620 per annum and qualified them for a grant of £2750 per annum. The loss in revenue from lower growth area was £2660 per annum. Thus the changes in practice were only made economic by the countryside stewardship scheme grant. As with most other case studies, the environmental and any social benefits were not quantified. Nonetheless, this suggests an additional category of potential savings to the agricultural sector that is dependent on agri-environment schemes. However, it is worth restating that the data presented in this report shows that environmental savings do also accrue from best practice that does not rely on grant support to be economically viable.

6.3 Future Role of Case Studies

The win win approach presents considerable opportunities to work in collaboration with farmer networks, advice services and stakeholders to provide targeted, clear, positive and practical advice to farmers. To ensure maximum value is gained by this approach, a full portfolio of current case studies must be developed. These case studies must be rigorously reviewed to ensure reliability of data and comprehensively detailed to allow readers to assess the applicability of various management practices. A range of organisations currently produce case studies. To improve farmers' and advisors' access to this information, case studies from these organisations must be centrally collated, electronically stored and accessible through a single point of contact. It is vital that the win win message from these case studies is communicated to farmers. A large number of advisory services currently communicate with farmers. To ensure the win win approach does not add to this crowded channel win win communications must be delivered with a consistent voice through the existing farmer networks.

6.4 Recommendations

Establishing data quality

1. Agree and adopt a fundamental reporting framework to ensure future case studies provide sufficient detail and quantitative information to allow comparison of the benefits and costs of management practices.
2. Develop a research programme to improve the quantification of the environmental benefits of win win resource management practices, linked to policy drivers such as the Water Framework Directive.
3. Establish a procedure of peer review for the evaluation of case studies.
4. Research baseline data on the level of current uptake of management practices.
5. Update the estimate of savings per sector as increased information becomes available.

Collaborating with existing systems

6. Foster the support of agricultural organisations.
7. Communicate the win win approach through the existing agricultural advice networks.
8. Promote the development of new case studies in compliance with an agreed framework, particularly case studies to plug the gaps in current coverage.
9. Measure and report on the results of whole farm environmental management plans.

Communicate the results effectively

10. Improve accessibility of information to farmers and advisors by centrally collating and electronically storing case studies.
11. Undertake awareness raising activities to elevate knowledge of the win win approach and case study resources available.

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Appendices

Contents

Appendix 1: List of Project Steering Group Members

- Henry Leveson-Gower (Chair), Environment Agency
- Stefan Gabrynowicz, English Nature
- Rob Robinson, Environment Agency
- Dominic O'Neill, Environment Agency
- Pam Mason, DEFRA
- Martin Ryan, DEFRA
- Matthew Webb, DEFRA
- Dave Mathias, Environment Agency
- Bob Meriman, Environment Agency

Appendix 2: List of Organisations Consulted

Government

Countryside Agency*
Countryside Council for Wales*
Cornwall County Council
Defra*
English Nature*
Environment Agency*
Environment Agency Wales*
Forestry Commission
Lake District National Park Authority
Local Government Association*
NI Dept of Agriculture and Rural Development*
NI Environment and Heritage Service*
Peak District National Park
Scottish Environment Protection Agency *
Scottish Executive*
Scottish National Heritage
Wales Waste Policy Unit*
Welsh Assembly Government*
Welsh Development Agency*

Consultants

ADAS*
Aubourn Consultancy Ltd*
Capenhurst Ltd
Creedy Associates
Elm Farm Research Centre*
Davidson Dennis Consulting*
Envirowise*
Farm Energy Centre*
Fieldfare Associates Ltd
Henry Doubleday Research Station
Inside UK Enterprise (IUKE)*
John Kay Consultants (to National Trust)*
Land Use Consultants*
Reading Agricultural Consultants*
Simon Draper Agronomy Ltd*
Water Research Centre (WRc)*

Non-governmental organisations (NGOs)

Action Energy*
Allerton Research and Education Trust*
Berks, Bucks and Oxon Wildlife Trust*
British Grassland Society*
BRE*
Composting Association, The
Cumbria Farm Plastics*
Cumbria Wildlife Trust
Devon Wildlife Trust*
Eden Rivers Trust*
Essex Wildlife Trust*
Forum for the Future*
Farming & Wildlife Advisory Group (FWAG)*
Hereford Wildlife Trust*
IUKE*
Kings Hay Farming Trust*
LEAF (Linking Environment & Farming)*
National Trust*
Norfolk Land Management Initiative (NALMI)*
Northmoor Trust*
North York Moors Land Management Initiative*
Ribble Catchment Conservation Trust
Royal Agricultural Society of England*
RSPB*
Severn-Vyrnwy Land Management Initiative*
Shropshire Wildlife Trust*
Soil Association*
Soil Management Initiative*
Sustain*
Tweed Foundation
Westcountry Rivers Trust*
Wildlife and Countryside Link*
Wildlife Trusts*
World Wildlife Fund*
Wye and Usk Foundation

** Response received.*

Appendix 2 (continued)

List of Organisations Consulted *(continued)*

Trade associations

Agricultural Engineers Association
Agriculture Industries Confederation*
Arboricultural Association
Association of Independent Crop Consultants*
Assured Food Standards c/o NFU*
Assured Produce*
British Institute of Agricultural Consultants*
British Pig Association*
British Potato Council*
British Poultry Council*
British Retail Consortium
British Turkey Information Service
British Veterinary Association
Country Land and Business Association
Crop Protection Association*
European Adjuvant Association
Farmers Union of Wales
Federation of Small Businesses*
Fertiliser Manufacturers Association*
Home Grown Cereals Authority
Horticultural Development Council*
Maize Growers Association*
National Association of Agricultural Contractors
National Farmers Union*
NFU Wales
National Farmers Union, Scotland*
National Office of Animal Health
Packaging & Industrial Films Association
UKASTA*

Academic organisations

Bishop Burton College
Centre for Ecology and Hydrology (CEH)*
Cirencester College*
Cranfield University
Duchy College*
Harper Adams Agricultural College*
Horticulture Research International*
Institute of Grassland and Environmental Research*
National Association for Land Based Colleges*
Scottish Agricultural College (SAC)*
Silsoe Research Institute*
University of Essex*
University of Exeter*
University of Plymouth*
University of Reading*
Imperial College at Wye*

Other business organisations

BASF plc*
Bayer Crop Science plc*
Co-operative Group*
Farmcare (Co-op)*
Farmex*
John Robinson Pond and Reedbed*
JSR Farming
Marshall Brothers
Orchard Close Nursery
Hillier Nurseries
Unilever plc*
United Utilities

* Response received.

Appendix 3: Summary of Case Studies

No.	Title	Source	Activity	Location	Inclusion	Justification
1	Allerton Project	Game Conservancy Trust 'Where the birds sing'	-Organic farming -Biodiversity -Set Aside -Headlands -Ponds	Leicestershire	No CAT 0	Financial loss
2	Boarded Barns farm study	Bayer Crop Science. 'Food for thought: Sustainable food production for the 21^{sst} century consumer'	-Integrated Crop Management -Organic Farming	East Anglia	Yes CAT 1	Financial Gains
3	Managing Manure on Organic Farms	ADAS/Elm Farm Research Centre	-Use on arable crops -Use on grassland -Solid manure composting	Berkshire	No CAT 0	-No financial data -Composite data
4	East Cliff Farm water preservation	Environment Agency Water Efficiency Awards 2003	-Reduced use and wastage	UK	No CAT 0	-No financial data
5	Osberton Grange Farms Solid Set Sprinkler Irrigation	Environment Agency Water Efficiency Awards 2003	-accurate water placement -reduced run-off	Nottinghamshire	No CAT 0	-No financial data
6	Place UK	Environment Agency Water Efficiency Awards 2003	-Recycling of water for bean sprouts	East Anglia	Yes CAT 2	-Financial Gains
7	Coolings Nurseries	Environment Agency Water Efficiency Awards 2003	-Rainwater Capture	Kent	Yes CAT 2	-Financial Gains
8	Denys E Head Ltd	Environment Agency Water Efficiency Awards 2003	-Water recycling		Yes CAT 3	-Financial Gains
9	Unigro	Environment Agency Water Efficiency Awards 2003	-Rainwater harvesting		Yes CAT 2	-Financial Gains
10	Ca Strawson Farming Limited	Environment Agency Water Efficiency Awards 2001	-Recycling of water	Nottinghamshire	No CAT 0	-No financial data
11	JR & m Weekes & Sons	Environment Agency Water Efficiency Awards 2001	-Water reuse and management	South Wales	No CAT 0	-No financial data
12	Nitcutts Nurseries	Environment Agency Water Efficiency Awards 2001	- Water filtration	Surrey	No CAT 0	-No financial data
13	Osberton Grange Farm	Environment Agency Water Efficiency Awards 2001	-Efficient watering programme		No CAT 0	-No financial data
14	Palmstead Nurseries	Environment Agency Water Efficiency Awards 2001	-Recycling and Computer controlled watering	Kent	Yes CAT 2	-Financial Gains
15	Bank Farm	LEAF	-Integrated Farm Management	Kent	No CAT 0	-No financial data
16	Greenhills Farm	LEAF	-Integrated Farm Management	Cheshire	No CAT 0	-No financial data
17	Midloe Grange Farm	LEAF	-Integrated	Cambridgeshire	No	-No financial

			Farm Management		CAT 0	data
18	Moorhouse Grange	LEAF	-Integrated Farm Management	Yorkshire	No CAT 0	-No financial data
19	Upper Booth Farm	LEAF	-Integrated Farm Management	Derbyshire	No CAT 0	-No financial data
20	Great Wollaston Farm	LEAF	-Integrated Farm Management	Shropshire	No CAT 0	-No financial data
21	Balliefurth Farm	LEAF	-Integrated Farm Management	Spey, Scotland	No CAT 0	-No financial data
22	Chris Mossman, Nant-y-bach	LEAF Time well spent , A guide to uptake of IFM on lowland livestock farms	-Organisation and planning	Ceredigion, Wales	No CAT 0	-No financial data
23	Greenhills farm	LEAF Time well spent , A guide to uptake of IFM on lowland livestock farms	-Animal Husbandry	Cheshire	No CAT 0	-No financial data
24	Blechemore Vale	LEAF Time well spent , A guide to uptake of IFM on lowland livestock farms	-Soil management	Wiltshire	No CAT 0	-No Financial data
25	Leverhulme Farm	LEAF Time well spent , A guide to uptake of IFM on lowland livestock farms	-Nutrient Management	The Wirral	No CAT 0	-No financial data
26	Great Wollaston Farm	LEAF Time well spent , A guide to uptake of IFM on lowland livestock farms	-Forage Utilisation	Shrewsbury	No CAT 0	-No financial data
27	Applesham Farm	LEAF Time well spent , A guide to uptake of IFM on lowland livestock farms	-Encouraging biodiversity	West Sussex	No CAT 0	-No financial data
28	Tony Bradley	Waterwise on the farm. LEAF, NFU,Environment Agency	-Recycling of milk cooling water	Hampshire	Yes CAT 1	-Financial savings
29	Sheepdrove Organic Farm	Forum for the future.	-Water Management	Wessex	Yes	-Financial savings
30-41	12 Case Studies	A guide to managing crop establishment Soil Management Imitative	-Reduced Cultivation -Direct Drilling -	Worcestershire, Rutland, Essex, Wiltshire, Leicestershire, Wiltshire, Leicestershire, Suffold, Cambridgeshire, Devon, Suffolk, Nottinghamshire	No CAT 0	-No Financial Data
42-61	Focus on Farming Practice	The case for integrated farm management Focus	-Integrated Farm Management	Leicestershare	No CAT 0	-Overall financial losses
62	20 Case studies of Environmental Improvements in Agriculture	Borders waste minimisation project	-Environmental improvements	Borders, Scotland Berwickshire, Selkirk, Peebleshire, Melrose, Kelso, Galashiels, Hawick	2 Included CAT 1	-No financial data for 18
63	Integration of farm manure nitrogen	Maff/Defra			Yes CAT 3	

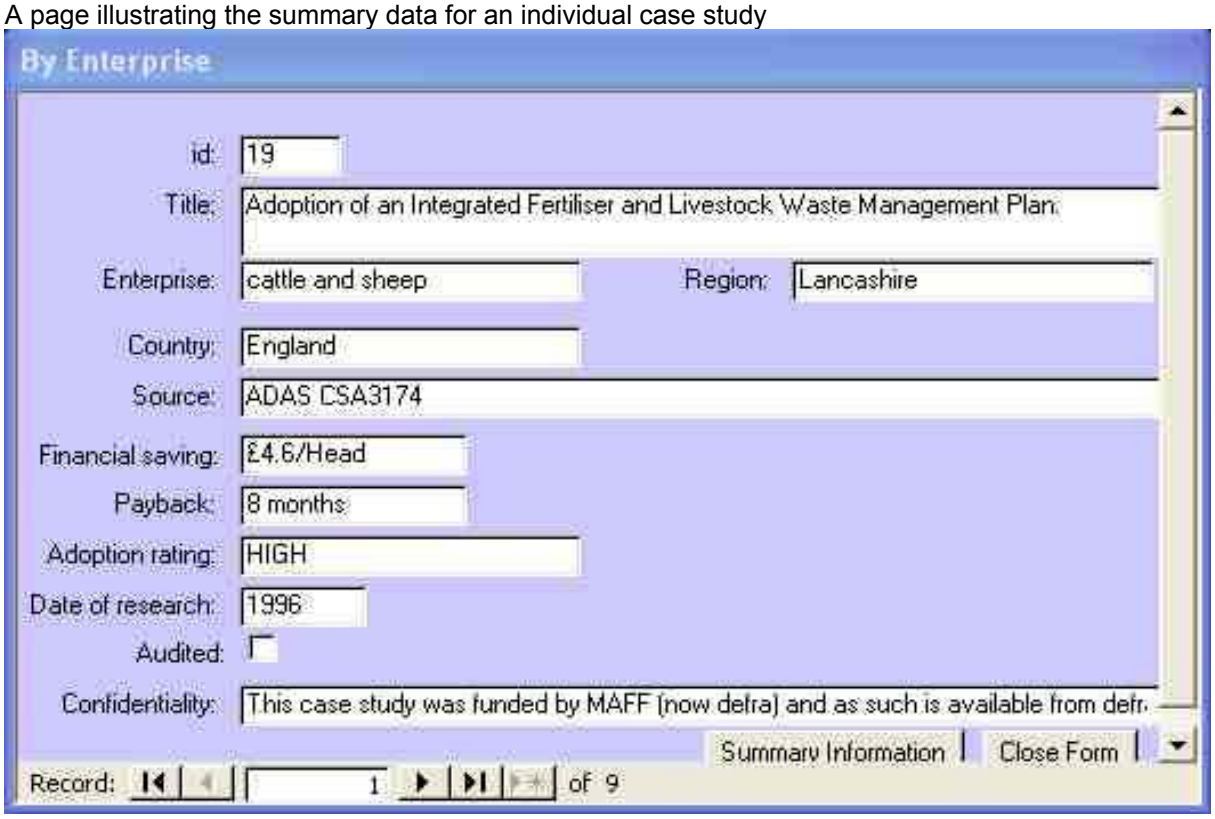
	supply within commercial farming systems					
64-93	Evaluation of Economic Benefits of the Tamar 2000 Project -30 Case studies.	Westcountry Rivers Trust	-Environmental Improvements	West Country Tamar	No CAT 0	-Cumulative data stated
94-103	10 Waste minimisation case studies	ADAS	-Waste minimisation on a range of farms. -Cover energy, feed, chemicals, packaging and plastics	Across the UK	Yes CAT3	-Good financial data
104 - 107	4 Studies of manure and slurry utilisation on the farm	ADAS	-Making the most of your manure.	UK	Yes CAT 3	-Good financial data
108	Stoughton Estate, Leicester	Farmcare (Co-op)	- Integrated Crop Management,	UK	No CAT 0	-No overall financial data
109	Heating management	National Pig Association	-Heating management in US Pig Farming	USA	No CAT 0	-USA based case study
110 - 114	5 Studies of Ecological management	GFA-RACE RSPB	-Environmental management for wildlife	UK	No CAT 0	-Good financial information
115	Probe Report	PROBE	-Integrated crop management	UK	No CAT 0	No overall financial data
116 - 120	5 Case studies from Seale Hayne	University of Plymouth	-Agronomic, economic and environmental aspects of composting	UK	Yes 1 CAT3	-Only 1 gave clear financial data
121	Livestock farm leaks	Westcountry Rivers Trust	-Managing water use	UK	Yes CAT 3	-Good financial information
122	Hill farm water management	Westcountry Rivers Trust	-Hill farm water optimisation	UK	Yes CAT 2	-Good financial information
123	Dairy farm dirty water control	Westcountry Rivers Trust	-Diversion from slurry	UK	Yes CAT 2	-Good financial information
124	Organic by products	Westcountry Rivers Trust	-Pig slurry on winter wheat	UK	Yes CAT 3	-Good financial information
125	Livestock manures on arable crops	ADAS	- Implementation of a nutrient management plan	UK	Yes CAT 3	-Good financial information
126	Broiler litter on potatoes	ADAS	-Broiler litter applied in spring	UK	Yes CAT 3	-Good financial information
127	Cattle slurry utilisation	ADAS	-Cattle slurry used on first cut silage ground	UK	Yes CAT 3	-Good financial information
128	Grass wilt programme	West Country Rivers Trust	Grass wilt to increase dry mater in ensiled material	UK	Yes CAT 2	-Good financial information
129	Feed cost reductions	ADAS	-Pig activated feeders	UK	Yes CAT 2	-Good financial information
130	Improved management of grain	ADAS	-Minimisation of wastage	UK	Yes CAT 3	-Good financial information
131	Improved care	ADAS	-Better stockmanship on a large pig unit	UK	Yes CAT 2	-Good financial information
132	Electricity savings	ADAS	-Utilisation of	UK	Yes	-Good

			dimmers on pig creep lights		CAT 2	financial information
133	Cultivation Conditions	ADAS	-Management of machine operation times	UK	Yes CAT 3	-Good financial information
134	Fuel cost reductions	ADAS	-Findings from 10 farms	UK	No CAT 0	-Cumulative data given
135	Combination implements	ADAS	-Using non powered cultivators	UK	No CAT 0	-Estimated data
136	Heating and Drying	ADAS	-Reduction in grain drying costs	UK	No CAT 0	-Estimated data
137	Infrastructure management	Farmers Weekly	-Construction of a new track to protect soil from damage	UK	No CAT 0	-No financial saving listed
138	Soil Erosion Management	Westcountry Rivers Trust	-Fencing and planting of river bank	UK	Yes CAT 2	-Good financial data
139	Soil nutrient management	Westcountry Rivers Trust	-Improve capacity to hold nutrients	UK	Yes CAT 3	-Good financial data
140	Infrastructure management	Westcountry Rivers Trust	- Rotational Ditch Clearance	UK	Yes CAT 2	-Good financial data
141	Under sowing of crops	Westcountry Rivers Trust	-Avoiding bare ground after maize harvest	UK	Yes CAT 3	-Good financial data
142	Comparison of crop establishment systems	DEFRA	-Plough vs reduced cultivation	UK	No CAT 0	-Generalised data, no single source
143	Minimum Tillage	Westcountry Rivers Trust	-Minimum tillage of soils	UK	Yes CAT 3	-Good financial data
144	Biocropping/reseeding clover	Westcountry Rivers Trust	-Reseeding of clover in a 10yr ley	UK	Yes CAT 3	-Good financial data
145	Hedge management	Westcountry Rivers Trust	-Reduced hedge cutting	UK	Yes CAT 3	-Good financial data
146	Buffer Zones	Westcountry Rivers Trust	-Reduced impact on margins	UK	Yes CAT 3	-Good financial data
147	New woodland creation	Westcountry Rivers Trust	-Planting of new woodland	UK	Yes CAT 3	-Good financial data
148	Reduced chamical Sprays	LIFE	-Integrated crop protection	UK	No CAT 0	-Generalised data no figure for overall saving
149	Success in Scotland	GC Scotland	-Management of timings of pesticide applications	Scotland	No CAT 0	-No financial data
150	Crop Rotation	DEFRA	-Managing farm pests	UK	No CAT 0	-No financial data
151	Soil nutrient testing	Westcountry Rivers Trust	-Regular checking	UK	No CAT 0	-Only estimated savings
152	Spatial targeting of fertilisers	Westcountry Rivers Trust	-Fertiliser only applied 10m into field	UK	Yes CAT 3	-Good financial data
153	Soils and crops	Westcountry Rivers Trust	-Management of out wintered stock	UK	Yes CAT 3	-Good financial data
154	Organic Farming	DEFRA	-Switch to Organic	UK	Yes CAT 2	-Good financial data
155	Mixed arable and livestock	DEFRA	-Mixed farming conversion to organic	UK	No CAT 0	-Cumulative data
156	Upland livestock farming	DEFRA	-Conversion to organic	UK	No CAT 1	- estimated savings
157	Field vegetables	DEFRA	-Box scheme operation	UK	No CAT 1	-Estimated savings

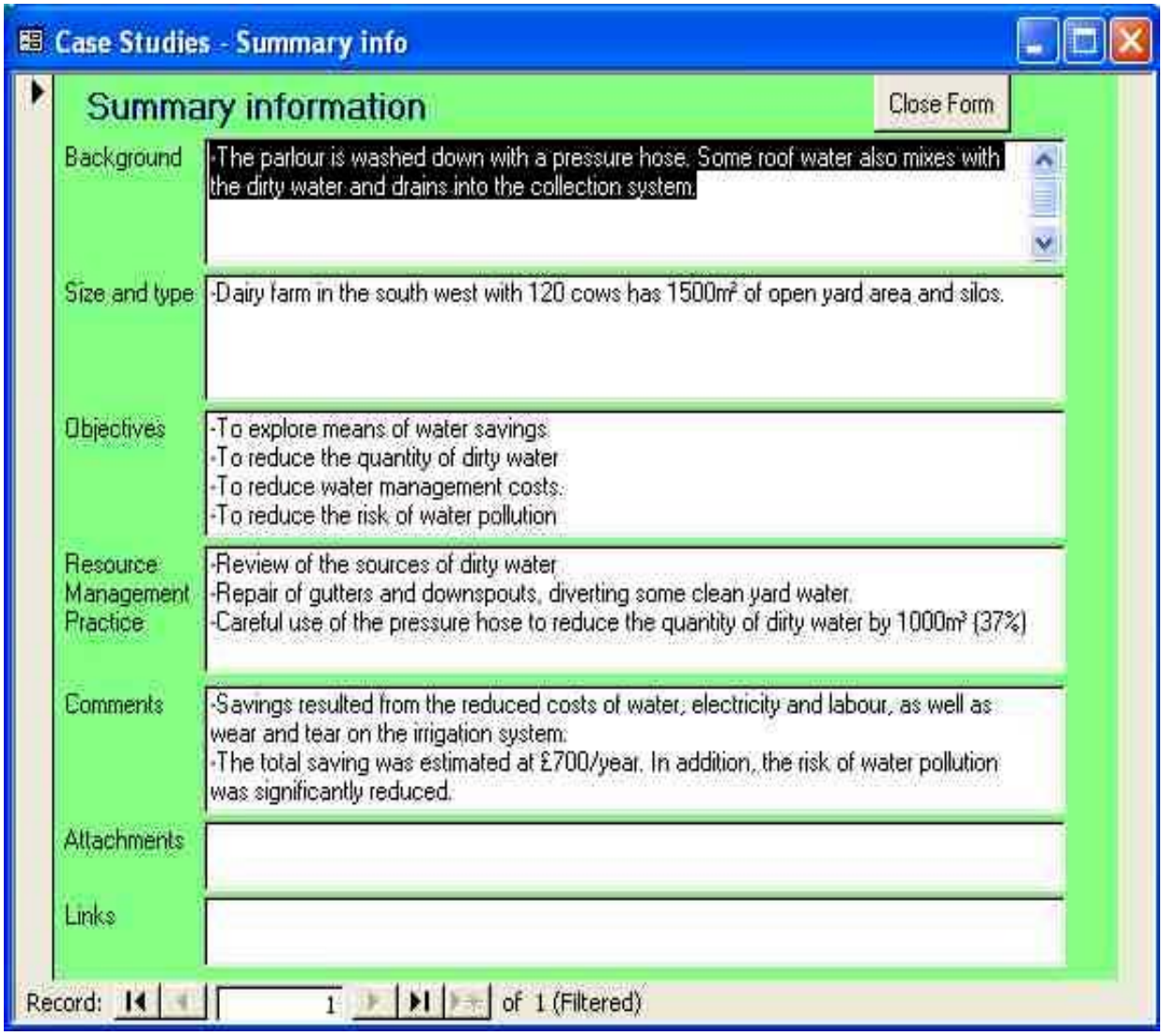
Appendix 4: Illustration of Database Pages

The front end of the database

A page illustrating the summary data for an individual case study



An example of a summary page



Appendix 5: Methodology for Estimation of Cost Savings

The following methodology outlines the steps required to produce robust assessments of potential national (England and Wales) savings for 'win win' management activities. These steps were followed as closely as possible in this project given the limited quantity of reliable case study data found to be available. In particular, the large number of case study 'gaps' for many 'win win' practices precludes a robust 'across-the-board' aggregation of the total potential savings likely to accrue in each enterprise sector. Further uncertainty is generated by the lack of reliable empirical data relating to (i) the applicability of practices across relevant farm types, sizes and structures and (ii) current and future 'uptake' rates.

Given these data limitations, certain components of the methodology were omitted from the estimation procedure followed in this project. Omitted components are indicated.

Key inputs for the methodology include the:

- database matrix illustrating, for each resource management practice, the availability, type and quality of case studies in each enterprise sector.

- spreadsheet/database listing, for each enterprise type where suitable case studies exist, the costs and savings associated with each resource management practice (with a reference to the source case study or studies).

- agricultural census statistics: e.g., head of cattle, land areas under different types of enterprise etc.

Clearly, the database matrix will have a large number of empty cells where no case studies are available (although case studies for certain practices may be transferable across one or more enterprises).

Methodology

The aggregation methodology comprises the following six steps:

Step 1

Extension of the spreadsheet/database, where required, to facilitate categorisation of case studies and estimation of national net savings

Inclusion of the following fields relating to 'applicability' issues:

- Fields that define the relevant population over which each case study's net savings can be appropriately aggregated:
  - field that defines any circumstances to which the case study's savings estimates might specifically relate, (e.g. farm size, herd size, cropping area, geographical area, etc)
  - fields to indicate the replication potential of each case study's results: i.e., whether savings are limited to specific farm sizes, locations, topographies, or other structural factors etc or whether savings can be reasonably transferred to all farm types and structures.

- Field for assessing, using expert judgement, net savings under different circumstances to those in the case study (for example, a case study shows savings of £30/ha, but these relate to a 'large' farm. Expert judgement might be used to estimate that the savings for a 'small' farm might be some 50% of those for a 'large' farm). Use of expert judgment in this manner means that it is possible to aggregate the assessed savings for other populations not covered by the case study (for example, 'small' farms as well as 'large' farms). *Judgements of this nature were not exercised in this project. Savings with limited or uncertain replication potential were either excluded from the aggregation exercise, were aggregated across the national population regardless of any structural differences that might produce different savings, or were aggregated only over the relevant sub-set of the total national population.*

Other considerations:

- Net savings should include any changes in annual yield that result from the management practice.

- Capital / fixed costs are best included as a separate field and written off over an appropriate planning period (10 years) using an interest rate of around 2.5% above the base rate (8%). This produces an annual depreciation and interest charge that can then be aggregated along with other costs.

Step 2

Selection of appropriate case studies from the spreadsheet/database to be used for aggregation purposes

The selection of appropriate case studies is depend upon:

- Availability of quantitative data
- Quality audit: reliability of quantitative data and collection process
- Replication potential:
  - representativeness of the case study's results for the relevant enterprise
  - applicability of the results across the specified national population, and
  - degree to which the relevant national population is well defined and measurable

Category 0 case studies**:** no quantitative data on cost savings.

Category 1 case studies: practice is not widely applicable or easily adoptable.

Category 2 case studies: report typical farm-level (or enterprise-based) net savings. In these cases, the enterprise-based savings can be utilised as a basis for robust aggregation only if (i) the farm type,

structure, size etc is well specified and (ii) the national population pertaining to the enterprise's specific type, structure and/or size etc is known.

Category 3 case studies: net savings are expressed in terms of per 'unit' of appropriate output per year, e.g. £/head or £/tonne (Non-monetary units such as m^3/head, kg/head, kWh/head, etc are readily converted to monetary units by multiplying by an average national 'price' (£ per m^3, per kg, or per kWh etc)). These can be readily aggregated over the relevant national populations.

In this project, only Category 3 case studies are included in the aggregation exercise.

Where a case study's results are presented as a percentage saving in terms of input use, although it is possible to derive an estimate of national savings by obtaining, from an appropriate source, a national input use figure (or value in £) and to appropriately reduce this value by the percentage indicated in the case study/studies, the problem with this approach is that it is impossible to know to what extent the national input use figure reflects savings already made (i.e. existing rates of practice 'uptake'). If some assessment of 'current uptake' is available, then the national input use figure could be upwardly adjusted to account for this, and a total national savings estimate (including both past and future savings) could then be safely derived. In the absence of a 'current uptake' figure, however, Steps 5 and 6 below are more problematic and the results less reliable. *The use for aggregation purposes of case studies where results are presented in terms of reduced input use was avoided in this study.*

Where two or more appropriate case studies exist for a particular 'win win' practice and both provide equally reliable and robust net savings estimates, provided the results relate to the same population they can reasonably be averaged. Alternatively, the smallest value can be used to provide a lower bound estimate of national savings, and the largest value can provide an upper bound estimate.

Step 3

Aggregation of net savings to produce an initial estimate of the total potential net national savings for each 'win win' practice

The calculation involves multiplication of the calculated net saving derived from the case study by the appropriate population relevant to the case study.

Example 1 ('activity-specific' case study):
A case study might report that installing simple dimmers on piglet creep lamps produces a net saving of £1 per head. The total UK pig breeding herd size is 558,000. The total potential net saving in the pig sector from installing creep lamp dimmers is therefore estimated to be £558,000.

This calculation is repeated for each separate management practice in each enterprise sector (i.e. each cell in the matrix) for which appropriate case studies exist.

Some case studies may relate not to individual practices but rather to a group of practices that collectively relate to more general 'resource' use, such as 'water', or 'energy' (as defined in the matrix's main resource headings). Similarly, some case studies may cite savings that span more than one enterprise sector. In such cases, care should be taken to avoid double counting.

Example 2 ('resource-specific' case study):
A survey might report that 'poor' energy efficiency in the dairy sector produces a cost of £24 per cow, while the same survey reports that 'good' efficiency could reduce this cost to £18 per cow. The net saving is therefore £6 per cow. The total UK dairy herd size is 2.2 million head. The total potential net saving from improved electricity systems in the dairy sector is therefore estimated to be £13.2 million.

Step 4 (not undertaken in this study)

Assessment of current and future uptake rates and estimation of 'potentially realisable' savings.

The practice-level national savings estimates derived in Step 3 represent the total potential savings assuming 100% uptake. Depending on past and future uptake rates, however, total potential savings can be subdivided into 3 components:

1. The percentage that has **already been 'realised'**; in other words where practice 'uptake' has already occurred
2. The percentage that is **unlikely to be realised** because uptake is limited by structural, topographical, logistical or attitude issues that could not be accounted for in Steps 1, 2 and 3
3. The remainder, in other words the percentage **likely to be realisable** in the future through continued practice uptake.

Assessments of these percentages for each management practice, or for groups of practices within each resource sector, are reliant on both national survey statistics and expert judgement. Assessments can be used to sub-divide the total potential national benefit values for each practice or sector in order to derive an estimate of the 'already realised' savings value and of the 'potentially realisable' savings value.

Clearly, assessment of component (2) will throw further light on the issues that potentially limit the uptake of specific win win practices, while component (3) provides an indication of the potential social payback that could be realisable through offering further incentive and encouragement to farmers to adopt 'win win' practices[19].

[19] Savings should be viewed as a social benefit: assuming a widespread practice adoption, the efficiency gains involved could produce, in the longer term, a downward shift in the industry supply curve which, depending on vertical linkages, would involve gains in downstream sectors of the food industry (i.e. manufacturers, retailers and consumers). The extent to which the savings accrue to the agricultural sector alone are dependent upon (i) the scale of practice uptake (ii) the speed of uptake and (iii) the nature of vertical competition within the food industry.

Step 5 (not undertaken in this study)

Aggregation of practice-based national savings estimates across (i) resource sectors and (ii) enterprise sectors, to produce total potential savings estimates on a sector-by-sector basis and a total potential savings estimate for the agricultural industry as a whole.

The application of Step 4 requires that the 'savings matrix' is full, or nearly full. In this case, aggregation of the national savings for each practice across all management practices for each enterprise sector would provide a total potential national saving for that enterprise sector, assuming the current and future practice uptake rates identified in Step 4. Aggregation across all enterprise sectors would provide a total potential national saving for each sector of the agricultural industry, again, assuming the current and future practice uptake rates identified in Step 4.

These estimates could be regarded as conservative estimates provided that:

1. the case study net savings have not been overstated (with any yield changes and capital costs appropriately accounted for);
2. the results are applied to the relevant sub-population within each enterprise sector;
3. where these are otherwise unavailable from case study material, appropriate, conservative assessments have been made of the savings likely to accrue to members of the other sub-populations within the enterprise sector;
4. where these are otherwise unavailable from case study material, appropriate, conservative assessments of savings are transferred across enterprise sectors;
5. double counting has been avoided
6. Assessments of current and future practice uptake rates are conservative.

In the likely event that, for most enterprise sectors, only a limited number of practice-related cases studies are available, the summed national savings results for each enterprise sector or for each resource sector are likely to considerably understate total potential savings in that sector.

Step 6

A sensitivity analysis of the key data and assumptions underpinning the calculations in Steps 3 to 6.

Systematic adjustment of the key inputs relating to, for example, population definitions and totals, uptake rates, and the case study cost assessments used (i.e. use of upper bound, lower bound and average savings estimates), will yield the extent to which the total potential net national savings figures both for each practice and across each sector may vary.

A limited sensitivity analysis was conducted in this project.

Step 7

Undertake reality checks by comparing the final estimates obtained with 'top-down' evidence from published national data, industry and other stakeholder research and other less auditable case studies, to ensure derived values are of a reasonable order and magnitude, and do not conflict with other national savings assessments that may have been made using different approaches and data.

A limited validation exercise was undertaken in this project.

Appendix 6: Win Win Case Studies Consultation Day Structure

09:30	Registration
10:00	Welcome from the Chair – Helen Richardson, Environment Agency
10:10	Policy Overview (Stephen Cane, LSK Programme Manager, Defra)
10:30	Win win case studies project overview (Jamie Pitcairn, AEA Technology)
11:00	Workshops – *Reactions to the win win case studies approach*
12:30	Lunch
13:30	Feedback on findings from morning workshops (Alex Inman)
13:45	Workshops – *Methodological Review* & *Communicating the 'win win' Message*
14:45	Coffee/tea
15:00	Presentation of findings from Methodological Review and Communications workshops
15:30	Concluding remarks
15:40	End of formal programme

Appendix 7: Facilitation Workshop Attendance List

Organisation	Name
AERU/STRC University of Hertfordshire	John Tzilivakis
Agricultural Policy	James Letts
Agriculture & the Environment Division	Keith Goulding
AICC	David Lines
BASF	Pamela Moult
Coed Cymru	David Jenkins
Crop Protection Association Ltd	Patrick Gouldsworthy
Defra	Katrina Mullan
Defra	Linda Kiff
Defra	Stephen Cane
EA Exeter	Richard Smith
English Nature	Stefan Gabrynwicz
Environment Agency	Jon Tanner
Environment Agency	Paula Orr
Environment Agency	Anthony Williamson
Environment Agency	Henry Leveson-Gower
Environment Agency	Helen Richardson
Farmcare	David Gardner
Farmline	Richard Cartright
FFD	Steve Robinson
Forestry Commission National Office For England	Alec Dauncey
Forum for the Future	Arun Narik
FWAG	David Proudley
FWAG	Benedict Rich
FWAG	Tom Munro
Lantra	Derek Hartshorne
Milk Development Council	Charlotte Bullock
National Trust	Dan Houseago
Northmoor Trust	Dr. Katy James
Northmoor Trust	Robin Buxton
Royal Haskoning	Helen Stark
RSPB	Dr. Sue Armstrong-Brown
RSPB	Peter Robertson
Rural Development Service (Defra)	Martin Ryan
Simon Draper Agronomy Ltd	Simon Draper
SRED	Dr. Lucy Harbron
Tamar Consulting	Alex Inman
Tamar Consulting	Jo Shanahan
The Soil Association	Lucy Rees
Unilever	Remi Wilkinson
Wildlife and Countryside Link (WCL)	Pippa Langford
WWF	Richard Perkins
	Jonathan Olver

Appendix 8: Facilitation Workshop Session Guide

This guide will provide an overview of the workshop and illustrates the type of issues/questions that will be discussed and hopefully answered during each of the three sessions. The agenda will detail the times for each of the breakout sessions.

Session 1: Reactions to the win win case studies approach

Format:

- 8-10 participants (max) seated in a semi-circle around the facilitator
- Scribe seated next to the facilitator using a standard flip chart
- 1 hour session
- Groups will be recorded using appropriate audio equipment
- Respondent confidentiality will be guaranteed

Group Dynamics:

- Groups will be split into 3 audiences: 'Intermediaries', 'Policy Community', and 'Supply Chain'. Details of attendees will be collected during recruitment to the event. Recruitment information will be used to select a mix of participants likely to be positive and negative/indifferent towards the win win concept, thereby creating an appropriate dynamic to stimulate balanced discussion

Topic Guide:

- Personal introductions (5 mins)

The facilitator will ask participants to introduce themselves by giving their name, the organisation they represent and the job role they currently hold

- Warm-up (10 mins)

The warm-up session will enable the facilitator to focus participants for the main stages of the exercise (the 'opportunities' and 'challenges' discussion) by involving them in a discussion that will help put the win win concept into context. Issues that will be addressed:

> What state of mind are farmers in at the current time in relation to their attitudes towards environmental compliance? Do they see environmental compliance as a cost or a benefit?

> What works best in terms of improving farmer up-take of better environmental management: the stick or the carrot?

- What are the Opportunities (20 mins)

> Does the win win approach **(n.b the concept, not case-studies specifically**) offer an opportunity to bring about real change in the way farmers manage natural resources? Why/why not?

> Does the development of ***standardised individual win win case studies*** offer an opportunity to bring about real change in the way farmers manage natural resources? Why/not?

- What are the Challenges (20 mins)

- Are there any challenges surrounding the development of the win win case studies approach? What are these?

- Summary and prioritisation (5 mins)
- The facilitator will briefly summarise the opportunities and challenges identified by the group

Session 2: Methodological review

Topic Guide:

- Personal introductions (5 mins)
- The facilitator will present a short .ppt presentation of a proposed standardised methodology for collecting, analysing and reporting win win case studies (10 mins)
  This presentation will include an outline of:
  - Where to get data
  - What data to collect
  - How to collect data
  - How to store data
  - How to use raw data to compute win win estimates
  - How data should be presented
- A discussion (35 mins) around the following questions?
  Is a standardised framework needed?
  Is the methodology outlined technically robust? Where are the shortfalls?
  Is the methodology outlined logistically feasible? Where are the shortfalls?
- A discussion (10 mins) to gauge overall support for the win win case studies approach and whether further effort should be spent on developing the initiative? Who else needs to be engaged in the process?

Session 3: Communicating the 'win win' message

Topic Guide:

- Personal introductions (5 mins)
- Facilitator will work with the group to develop a role-play scenario. The group becomes a marketing team responsible for promoting the win win case studies approach to ensure maximum uptake by farmers. How will the group achieve this outcome?
  This exercise will involve use of the flip chart to devise a marketing strategy. Facilitator will prompt the group with the following questions:

  Who should win win case studies be communicated to?
  How should win win case studies be communicated?
  Who should win win case studies be communicated by?
- The facilitator will present a short .ppt presentation containing a proposed case-study format and a version of the case-study database (5 mins)
- A discussion (10 mins) around the following questions?
  How appropriate are the proposed formats?
  How can they be improved?
- A discussion (10 mins) to gauge overall support for the win win case studies approach and whether further effort should be spent on developing the initiative? Who else needs to be engaged in the process?

Appendix 9: Case Studies Demonstrating Good Practice to Reduce Diffuse Pollution

Title: Reduced edge effect of broadcast fertiliser by use of fixed width spray booms.
Source: ADAS CSA3174 CASE STUDY No.: 23 Enterprise: Arable Region: Derbyshire
Size and type
157ha cropped twice with leeks, carrots, lettuce, stick beans and some cereals. Employing 65+ seasonal
Objectives
-Reduction in fertiliser usage, reducing the impacts on non-target habitats and the possible leaching into the water system. The improved coverage improves crop quality, reducing organic wastage.
Resource Management Activities
-The use of liquid fertiliser through a fixed width spray boom. This reduces wastage beyond crop boundaries and uses 10% less fertiliser. Liquid fertiliser reduces the quantities of non-organic waste to be disposed of, saving on 250 plastic fertiliser sacks and gives a more even coverage with benefits in overall crop quality.
-The more precise application reduces fertiliser consumption and therefore limits the capacity for leaching into water supplies and non-target habitats.

Title: Use of air assisted sprayer in pesticide application.
Source: ADAS CSA3174 CASE STUDY No.: 24 Enterprise: Arable Region: Derbyshire
Size and type
-157ha cropped twice with leeks, carrots, lettuce, stick beans and some cereals. Employing 65+ seasonal
Objectives
-Reduction in pesticide usage and limitation of non-target habitat disruption.
Resource Management Activities
-The use of an air assisted sprayer limiting the amount of pesticide spray drift into non-target habitats. Reducing overall pesticide usage and the impact it has on the environment, verges,

Title: Influence of beetle banks on cereal aphid predation in winter wheat.
Source: Ecosystems and Environment, 93 (journal) CASE STUDY No.: 34
Enterprise: Arable Region: Leicestershire
Background
-Beetle banks are mid-field ridges that provide over wintering habitat for invertebrate predators of
Size and type
-333ha farm comprising arable and s sheep flock in Leicestershire (Allerton Research and Education
Objectives
-To investigate whether natural predators dispersing from a beetle bank can reduce cereal aphid numbers in an adjacent crop of winter wheat.
Resource Management Activities
-Pest management - enclosures were used to manipulate predator densities up to 83m from a beetle bank. Invertebrate predators (beetles and spiders) dispersing from the beetle bank significantly reduced the number of aphids in winter wheat up to 83m away from the bank. Creating habitats for natural predators of cereal aphids and adhering to pest thresholds can reduce variable costs.
- Natural resource management - Beetle banks are included in the Countryside Stewardship Scheme which provides grants to partially offset the cost of establishing beetle banks and compensate for the loss in arable production thereafter.
-Biodiversity benefits
-Minimising insecticide inputs helps build up predator populations and increases overall invertebrate biodiversity in arable systems
-Beetle banks provide a wealth of invertebrate prey for farmland birds.
-Beetle banks provide ideal nesting sites for harvest mice.

Title: Integration of farm manure nitrogen supply within commercial farming systems.
Source: Defra CASE STUDY No.: 35 Enterprise: Mixed Region: Worcestershire
Objectives
-To investigate the benefits of improved manure applications on silage.
Resource Management Activities
-Revision of procedure, rather than applying manure in May via a broadcast method the manure was applied using a trailing shoe. The results proved that ammonia losses were 25% lower using the improved method rather than the standard broadcast technique. Therefore, more nitrogen was available for the crop. The environmental benefits that resulted were reduced diffuse pollution to water and air. Additionally, the soil texture improved which resulted in better yields

Title: Hill farm dirty water and slurry management.
Source: Westcountry Rivers Trust CASE STUDY No.: 37 Enterprise: Mixed Region: South West
Objectives
-To segregate clean water and prevent it mixing with slurry contamination
-To minimise water consumption through maximising the value of natural inputs
-To capture the nutrient value of the slurry contaminated water through application to the land
-To minimise the risk of fresh water contamination through slurry sources.
-To manage water and reduce the risk of flooding on the farm
Resource Management Activities
-Diversion of water: included renewing 30m of guttering & two downspouts
-Dirty water is irrigated to land.
Comments
-This is an easily adopted and low cost management activity, with good financial paybacks and a multitude of benefits for the farmer. Maximising resource usage, minimising consumption and managing pollution risks.
-The diversion of water saved £180/year. A similar quantity was collected in the slurry system and spread to land.

Title: Application of pig slurry to winter wheat.
Source: ADAS CASE STUDY No.: 38 Enterprise: Mixed
Objectives
-Reduce consumption of artificial fertilisers
-Improve utilisation of on-farm sources of nutrients
-Manage waste
-Improve soil structure and nutrient value
-Reduce risk of water contamination from pig slurry.
-Reduce costs
Resource Management Activities
-Application of pig slurry to land to provide N, P, K inputs for winter wheat production.
Comments
-This is an easily adopted strategy, presenting a win win scenario for the farmer. Reducing sources of pollution, improving soil structure and fertility and reducing overhead costs.
-The total saving on NPK fertiliser over the crop rotation allowing for extra total P and K in soil reserves is up to œ85/ha
-Allowing for the soil reserves a pig slurry application of 50m3/ha, supplies about half the N (90kg/ha) and sufficient P (100kg/ha) and K (125kg/ha).

Title: Composting of Farm Yard Manure
Source: Seale Hayne/Defra CASE STUDY No.: 39 Enterprise: Mixed Region:
Background
-Composting is a small cost to farmers. If the heaps are turned once it costs 20-30p/tonne of FYM and if turned three times £.20-1.30/tonne of FYM.
-Some nutrients are lost in the process.
-Particularly applicable to Organic Farms.
Size and type
-100 Milking Cows and Followers.
Objectives

-Reduced muck spreading effort.
-Improved incorporation of manure to the sward
-Reduced pollution potential

Resource Management Activities

-Composting 1200 tonnes of FYM from 100 milking cows and followers.
-Additional labour requirements to turn manure heaps when drying.

Comments

-This strategy is most cost efficient for organic farms. There is an additional cost involved in generating compost from manure, but payback results from the improved incorporation of this material into the sward and the more even spread of the material.

Title: Application of livestock manures on arable crops.

Source: ADAS CASE STUDY No.: 40 Enterprise: Mixed

Size and type

-300ha of combinable crops roots and 100 dairy cows

Objectives

-Improved resource efficiency
-Reduction in artificial inputs and costs
-Recycling of farm wastes
-Improved soil structure, reducing the potential for soil erosion
-Maximisation of crop yields

Resource Management Activities

-Utilisation of farmyard manure.
-Development of a farm nutrient management plan.
-Monitoring of soils on a 3yr cycle, previous problems involving low sugars and high amino acids occurred in sugar beet, whilst the potato crop suffered from excess nutrients
-Application of top up fertilisers when needed

Comments

-This is an easily adopted strategy, utilising readily available inputs, with good cost benefits. The monitoring of nutrients is a sensible approach to ensure maximum crop yield benefits.

Title: Application of broiler litter on potatoes.

Source: ADAS CASE STUDY No.: 41 Enterprise: Crops

Objectives

-Improved resource efficiency
-Decreased water contamination risk
-Decreased artificial farm inputs
-Decreased costs
-Improved soil structure

Resource Management Activities

-Broiler litter applied in spring and incorporated within 24 hours. Applied at a rate of 8t/ha this supplies 108 kg/ha of N, 120 kg/ha of P and 130 kg/ha of K for the following potato crop.
-The crop requirements are 220 kg/ha of N, 180 kg/ha of P and 300 kg/ha. However, making allowance for soil reserves and the broiler manure , only 112 kg/ha of N, 60 kg/ha of P and 170 kg/ha of inorganic fertilisers are needed.

Comments

-This makes good use of readily/cheaply available inputs with a good payback rate.

Title: Good soil management.

Source: Westcountry Rivers Trust CASE STUDY No.: 49 Enterprise: Arable Region: South

Size and type

-5 Ha forage Maize

Objectives

-Reduce soil compacting to enhance yields.
-Improvement of the soils capacity to hold water and nutrients.
-Reduction in damage and runoff.
-Enhancement of soil's ability to breakdown pesticides.
-To enhance crop yield.

Resource Management Activities

-To avoid compaction of the wet clay soil, slurry was not spread during the winter months.

-To achieve this flexibility to spread when conditions were suitable, the farmer ensured that he had sufficient slurry storage.

Comments

-This is a low cost strategy and good farming practice, with good financial payback.

-The production of maize at 33% dry matter (DM) was 13 tonnes of DM per ha. It is estimated that soil compaction would have reduced yields by 25%.

Title: Under sowing of crops to avoid bare ground nutrient loss.

Source: Westcountry Rivers Trust CASE STUDY No.: 51 Enterprise: Arable Region: South

Size and type

-5 Ha Maize crop.

Objectives

-To avoid bare ground after maize harvest from October until the following May, on soils which often cannot be autumn ploughed.

-To reduce weed growth

-To reduce soil erosion and loss of nutrients through run off.

-To provide winter cover for wildlife.

Resource Management Activities

-5 Ha Maize crop under sown with herbicide tolerant Italian Rye Grass for worm-free ewe/lamb winter and spring grazing. The under sown crop produced six tonnes DM/ha.

Comments

-This strategy affords good financial paybacks for the farmer and additional benefits of reduced soil damage and productivity loss associated with untimely operations, runoff and soil erosion.

Title: Minimum tillage for wheat.

Source: Westcountry Rivers Trust CASE STUDY No.: 52 Enterprise: Arable Region: Devon

Size and type

-Arable farm, Devon, 10ha of the steepest fields, -Wheat production.

Objectives

-Reduction in run-off.

-Reduction in soil erosion and nutrient losses.

-Reduction in crop damage from gullies and rills.

-Reduction in need to reinstate eroded soils and clean dirty ditches.

-Reduction in labour costs

-Reduction in machinery running costs

-Reduction in herbicides and fungicides usage

Resource Management Activities

-Use of minimum tillage for wheat in 2001 on 10Ha of steep fields rather than conventional cultivation.

Comments

-This strategy offered considerable financial paybacks, rewarding the farmer in labour savings on tasks such as ditch and highway cleaning and repair of rills and gullies.

Title: Re-seeding with Clover.

Source: Westcountry Rivers Trust CASE STUDY No.: 53 Enterprise: Arable Region: South

Size and type

-38 Ha Grassland.

Objectives

-Enhancement of soil nutrient value.

-Reduction in cost of mineral fertiliser applications.

-Reduction in bare earth state therefore reducing soil erosion potential.

Resource Management Activities

-Review of grassland management practice to diverge from the standard practice of applying N at 375kg/ha.

Comments

-This management practice is easily adopted with good financial returns and considerable benefits for the environment, enhancing soil status and reducing soil erosion and water pollution.

Title: Integrated Crop Management.

Source: Bayer CropScience CASE STUDY No.: 54 Enterprise: Arable Region: Essex

Background

-The Boarded Barns Farm Study is a long-term evaluation of the wider impact and viability of alternative farming systems

Size and type

-24 ha Arable farm on deep, acid clay loam in lowland Britain

Objectives

-Valuation of Integrated Crop Management

-To satisfy the demands for reliable and economic production and enhance the biodiversity and fabric of the countryside

Resource Management Activities

Integrated Crop Management of wheat

-Optimisation of the use of resources, a 30% reduction in the use of crop production products.

-The use of minimum tillage techniques, 20% reduction in overall inputs.

Comments

-The use of ICM generated good cost benefits, through the reduction in tillage energy costs, and the increase in wheat yields (topped 8t/ha), this strategy is highly applicable, though it will require considerable culture change in farming.

Title: Spatial targeting of fertilisers.

Source: Westcountry Rivers Trust CASE STUDY No.: 55 Enterprise: Arable Region: Devon

Size and type

-6.7 ha of grassland including some wetland areas

Objectives

-To reduce the impact of fertiliser on non-targeted areas such as boundaries and hedgerows.

-To prevent fertilisers from encouraging unwanted weed species in hedgerows.

-To protect hedgerow plants which are intolerant of high levels of N and the insects they harbour.

Resource Management Activities

-Restricted application of 268:0:40 (high impact) fertiliser to within 10m of field boundaries

Comments

-This strategy is highly applicable to a large number of enterprises, the farmer saves considerable fertiliser costs and labour time in fitting prill guards onto spreaders.

Title: Reducing nutrient losses by timely application of fertilisers.

Source: Westcountry Rivers Trust CASE STUDY No.: 57 Enterprise: cattle & sheep Region: South

Size and type

-82.9 ha, 120 Cattle

Objectives

-To minimise fertiliser inputs

-To minimise loss of fertiliser inputs

-To minimise pollution risk

Resource Management Activities

-Timely application of fertiliser to 5 ha of 'hams' (broad wetland floodplain areas) to avoid 50% loss of N during wet conditions

Comments

-This practise prevented an estimated loss of 50% of N inputs

-This case study is specifically applicable to wetland and floodplain areas. However, all farms have the potential to benefit from timely application of nutrients.

Title: Soil management to reduce erosion and loss of inputs.

Source: Westcountry Rivers Trust CASE STUDY No.: 62 Enterprise: Mixed Region: South West

Size and type

-69ha, -Beef and arable

Objectives

-To reduce soil damage, soil erosion and soil loss

-To reduce losses of inputs

-To maintain yields and productivity

-To reduce the risk of watercourse pollution.

Resource Management Activities

-3.2 ha of arable land (barley, forage peas, stubble turnip rotation) was undergoing severe erosion due to gully and plough pan development, with reductions in yield and productivity due to losses of inputs and topsoil. The area was ploughed using a vintage tractor in order to improve soil structure and infiltration capacity. Crop cover was subsequently maintained to protect the soil from future erosion.

Comments

-Deep ploughing the 3.2 ha to remove the pan and gullies took one day and was estimated to cost œ63 per ha- a total of £201.60 (Nix 2004).

-Improved soil management saved losses in yield estimated at 5% per annum and losses in productivity estimated at 25% over a 50 year period. The annual savings were estimated to be £25.2 per ha, £0.6 per ha for winter barley, forage peas and stubble turnips respectively- a total of £26.3 per ha per year

Title: Accurate irrigation through EMI scanning.

Source: Dalgety DDF/Fullpoint Probe Services/ Henry Thompson CASE STUDY No.: 65

Size and type

-Potatoes, 570 acres

Objectives

-To identify soil types to ensure the most sustainable crops and planting methods are adopted

-To monitor soil moisture content and so maintain an optimum level for growth with minimum runoff.

Resource Management Activities

-Potato fields were EMI scanned over 4 years.

-Fields were zoned according to the varying EMI readings received and top and subsoil samples taken and laser analysed to establish the silt/sand/clay fractions.

-Using this information DDF selected representative points in each field for the location of neutron probes as part of the FPS irrigation scheduling programme for the crops.

-Appropriate crops/varieties were planted in each field adopting the most sustainable direction of planting and selection of irrigation runs.

-During the growing season readings were taken at 7-day intervals by FPS and the information used to maintain soil moisture at the optimum level to give maximum crop growth and minimum run-off.

Comments

-Throughout the year over-irrigation was avoided, eliminating the detrimental effects it can have on the growing crops and soil erosion as well as reducing nutrient leaching through the soil profile and ultimately into watercourses.

-Across the 570 acres irrigation water use was reduced by an average of one inch/acre.

Title: Minimum Cultivation.

Source: Farmcare: Hydro Agri CASE STUDY No.: 69 Enterprise: Arable

Background

-One of the most comprehensive farm scale comparisons of 'Conventional' and 'integrated' farm practices was carried out at Focus on Farming Practice.

Size and type

-Integrated farming

Objectives

-To reduce the nitrate concentration in drainage water

-To reduce energy costs of cultivation

-To enhance the aeration of soil

-To enhance the biodiversity of the site.

Resource Management Activities

-Minimum cultivation and direct drilling in integrated plots.

-Blackgrass was controlled on the heavy soil by a two-year grass ley in the rotation.

-Slugs were controlled through seedbed consolidation and targeted seed treatment.

Comments

-Over a nine year period from 1993

-The number of cultivations and the cost of cultivations were lower for the integrated (3 cultivations/year, £75/ha) than the conventional plots (4 cultivations/year, £90/ha)

-Herbicide costs were lower for the integrated (œ36/ha) than the conventional (£40/ha) plots.

Title: White clover understorey and direct drill.

Source: IGER CASE STUDY No.: 69 Enterprise: Arable Region: Leicestershire

Key principles

-White clover can be used as an understorey in arable (Whole crop) Silage to fix N, reduce weed infestation and provide a haven for predatory insects that eat pests. Foliar fungal diseases are also ameliorated by changes in crop microclimate.

Objectives

-To reduce nitrogen fertiliser use
-To obviate the need for insecticides and fungicides
-To reduce the need for herbicides
-Create more beneficial conditions for wildlife
-To control erosion

Resource Management Activities

-Sow white clover understorey into a cereal nurse crop.
-After harvest the white clover remains and winter wheat is direct drilled into this.
-Three-Four successive crops are grown.

Comments

-Yields in this instance were only slightly lower than conventional cropping using standard farm practice
-This practice resulted in a large reduction in N fertiliser and agrochemical usage.
-The dense understorey creates a haven for beneficial invertebrates was created including predatory beetles and spiders which feed on pests. The permanent crop cover is also likely to promote small mammal and bird life.
-The maintenance of soil cover controlled erosion.
-The changes in crop architecture reduced the likelihood of foliar fungal attack on the cereal.

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Assessment of 'Win Win' Case Studies of Resource Management in Agriculture

Appendix of Case Studies

ENVIRONMENT AGENCY

Contents

1. Pigs

1.1 Installation of energy saving systems in a pig farm.

CASE STUDY	68	Enterprise:	Pigs	Region:	Berkshire
				Country:	England

Source **Farmex**

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emmissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption	High		
Financial savings:	£0.66/head/year	Payback:	<3 months
Date of	2003	Audited	0
Confidentiality:	Farmex Energy Saving Systems.		

Background

-This case study is the result of comparative trials of energy systems by Farmex.

Size and type

-Pigs
-15 flat decks with suspended radiant heaters and two stage extraction fan ventilation systems

Objectives

-To reduce the energy costs on a pig farm
-To reduce the environmental impact of pig farms
-To maintain high standards of conditions (heating and ventilation) in pig weaning units

Resource Management Activities

-Installation of the Farmex Energy Saving System

Comments

-The data covers the first 50 days of each batch of pigs.
-The average ventilation rate is changed little, but heating use is greatly reduced, the Energy Saving System rooms are better at maintaining temperature especially during the early stage of the production cycle when heat use is greater.

The cost of providing a controlled environment in Standard rooms is from 0.5o to 2.9p per pig per day (average is 1.49). In ESS rooms, environmental costs 0.1p to 0.7p (average 0.18p). Financial figures are based on 4.3 pence per kWh (unit of electricity)/ The base line cost of 75.4 pence per pig over this period is consistent with data from other farms. Financial costs do not include the cost of the Energy saving system, this is estimated at 10-15% of the saving.

1.2 Modification of piggy boxes

CASE STUDY 15 Enterprise: Pigs Region: Lancashire
Country: England

Source ADAS CSA3174

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption Medium
Financial savings: £2.1/Head/Year Payback: <9 months
Date of 1996 Audited 0
Confidentiality: This case study was funded by MAFF (now defra) and as such is available from

Background
-This case study was completed for MAFF in 1996.
Size and type
-170ha grass, 580 sows plys progeny to 30kgs, 5 members of staff.
Objectives
-Reduction in manufacturing inputs and feed wastage.
Resource Management Activities
-Conversion of boxes from a tier system to floor pens with new feeders.
Comments
-Highly applicable, demonstrates a rapid payback rate.

2. Cattle

2.1 Hill farm dirty water and slurry management.

CASE STUDY	37	Enterprise:	Cattle	Region:	South West
				Country:	England

Source **Westcountry Rivers Trust**

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption	Medium		
Financial savings:	£20/head	Payback:	2 Years
Date of	2003	Audited	0
Confidentiality:			

Background

-This is a worked example casestudy from West Countries River Trust.

Size and type

-A hill farm with an annual rainfall of 1200 mm on a roof of 600m² produced 720m³ (160,000 galls) of water

Objectives

-To segregate clean water and prevent it mixing with slurry contamination
-To minimise water consumption through maximising the value of natural inputs
-To capture the nutrient value of the slurry contaminated water through application to the land
-To minimise the risk of fresh water contamination through slurry souces.
-To manage water and reduce the risk of flooding on the farm

Resource Management Activities

-Diversion of water: included renewing 30m of guttering @ £20/m = £600, two downspouts @ £80 each = £160, 30m of clean water drainage @ £25/m = £750; a total of £1510 using farm labour.
-Dirty water is irrigated to land @ £0.5/m³.

Comments

-This is an easily adopted and low cost management activity, with good financial paybacks and a multitude of benefits for the farmer. Maximising resource useage, minimising consumption and managing pollution risks.
-The diversion of water saved £180/year. A similar quantity collected in the slurry system and spread to

2.2 Integration of farm manure nitrogen supply within commercial farming

CASE STUDY 35 Enterprise: Cattle Region: Worcestershire
Country: England

Source **Defra**

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption High
Financial savings: £52/head/Year Payback: Immediate
Date of 1998 Audited 0
Confidentiality: This report was commissioned by MAFF and is freely available - 'making better use of

Background

-This study comprises part of a larger programme of work conducted by MAFF to investigate the improved application of manure on first cut silage. The work is summarised in the series 'making better use of manure' - booklet 2.

Size and type

-Dairy Farming Enterprise, 170 dairy cows, 100 heifers.

Objectives

-To investigate the benefits of improved manure applications on silage.

Resource Management Activities

-Revision of procedure, rather than applying manure in May via a broadcast method the manure was applied using a trailing shoe. The results proved that ammonia losses were 25% lower using the improved method rather than the standard broadcast technique. Therefore, more nitrogen was available for the crop.

The environmental benefits that resulted were reduced diffuse pollution to water and air. Additionally, the

Comments

-This is a good report that has been verified and scientifically researched. The technique is universally applicable and easily adopted by farms in this sector. There is little capital outlay and an immediate return in investment.

2.3 Adoption of an Integrated Fertiliser and Livestock Waste Management Plan.

CASE STUDY	4	Enterprise:	cattle	Region:	Lancashire
				Country:	England

Source **ADAS CSA3174**

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption	High		
Financial savings:	£4.6/Head/Year	Payback:	8 months
Date of	1996	Audited	0
Confidentiality:	This case study was funded by MAFF (now defra) and as such is available from		

Background

-This case study was completed for MAFF in 1996

Size and type

-A tenanted dairy and sheep farm of 71 ha Grassland, supporting 70 Cows (50 dairy youngstock)+ 240 Breeding Ewes and employing 3 members of staff.

Objectives

-To derive more benefit from farm slurry by concentrating applications on silage production rather than grazing areas.
-To reduce the applications of phosphate and potash.

Resource Management Activities

-Reallocation of slurry application to targeted areas used for silage production rather than general grazing land. The application of slurry will have environmental benefits of improved soil structure and reduced applications of artificial fertilisers.
Additional benefits stem from increased grass production. If this grass production is not required further savings in fertiliser costs are anticipated.

Comments

-This scheme is widely applicable, with obvious cost benefits and universally available resources.

2.4 Cattle slurry used on first cut silage.

CASE STUDY 42 Enterprise: cattle and sheep Region:
Country: England

Source ADAS

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption High
Financial savings: £52/head/Year Payback: Immediate
Date of 2003 Audited 0
Confidentiality:

Background

-This is an ADAS, Manures worked example.
- An application of 40m³/ha of cow slurry supplies sufficient P (48kg/ha) and K (125kg/ha) and some N

Size and type

-Cattle Farming Enterprise.

Objectives

-To improve soil structure.
-To improve silage yields.
-To reduce organic waste.
-To reduce the risk of water pollution.
-To reduce fertiliser costs.

Resource Management Activities

-Summer application of slurry with 6% DM content on first-cut silage ground. This has a nutrient value of N 0.6kg/m³, P 0.6kg/m³ and K 3.2kg/m³.
-Reducing the NPK fertiliser inputs (at typical costs) for this crop by £37/ha

Comments

-This is an easily adopted strategy using readily available inputs with good cost benefits.
-Allowing for extra total P and K in soil reserves, the total saving on NPK fertiliser inputs for second and later cuts is up to £52/ha

2.5 Management of livestock farm leaks.

CASE STUDY 36 Enterprise: cattle and sheep Region: South West
Country: England

Source **Westcountry Rivers Trust**

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption High
Financial savings: £2788/Enterprise Payback: 1 year
Date of 2003 Audited 0
Confidentiality:

Background

-This is a worked example casestudy from West Countries River Trust

Size and type

-Livestock Farming Enterprise

Objectives

- Improved management of farm water usage.
-To reduce unnecessary resource consumption.
-To reduce contamination of water producing sources of dirty runoff on the farm.
-To reduce instances of water pooling and flooding.

Resource Management Activities

-Leak detection and repairs by the farmer (£7/hour)
-Commercial leak detection (£130/day)
-Repair of a surface water pipe leak of 50 litres/hour which drained to the slurry storage system, as well as a mains leak of 1m³/hour (for 3 months) which soaked away.

Comments

-This strategy is easily adopted and good farm management. The payback is considerable and rapid.
-The surface water leak of 50 litres/day is some 430m³/year at £0.81/m³ = over £350. 430m³ spread with slurry @ £1.80/m³ = £775. This is a total of over £1000/year for the surface water leak and £1788 over 3 months for the mains water: a total of over £2788.

2.6 Improved storage and handling of grain and silage.

CASE STUDY 44 Enterprise: cattle and sheep Region:
Country: England

Source ADAS

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption High
Financial savings: £10/Head/Year Payback: 1 Year
Date of 2003 Audited 0
Confidentiality:

Background

-This is an ADAS, Manures worked example.

Size and type

-350 Head of Cattle.

Objectives

-To reduce wastage of animal feed.
-To reduce costs.
-To reduce soil poaching.
-To enhance stock well-being.

Resource Management Activities

-Improving storage conditions and handling of grain and triple covering of silage by reusing cleaned plastic sheets to reduce aeration minimised wastage.
-Providing a feeder on well drained and hardened ground.

Comments

-This strategy is easily adopted, however, the costs and savings will be highly site specific.
-5% saving is made in feed wastage for outwintered beef cattle with an average 18 month feed cost of £200.
-Other benefits include reduced soil poaching and lameness which will improve stock well-being and

2.7 Integrated fertiliser and livestock waste management plan.

CASE STUDY 11 Enterprise: cattle and sheep Region: Shropshire
Country: England

Source ADAS CSA3174

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption High
Financial savings: £3.1/h/year Payback: 4 Months
Date of 1996 Audited 0
Confidentiality: This case study was funded by MAFF (now defra) and as such is available from

Background

-This case study was completed for MAFF in 1996.

Size and type

-A 121 ha farm with 61 ha grass, 12 ha forage maize, 75 suckler cows, 120 ewes, employing 1.5 members

Objectives

-To maximise the benefits from Farmyard Manure, reducing the applications of phosphate and potash in compound fertilisers.

Resource Management Activities

-Adoption of an intergrated fertiliser and livestock waste management plan, saving up to 8 tonnes of fertiliser and £1258 P.A. without any reduction in crop yield.
-Reducing the the use and manufacture of artificial fertilisers, the pollution risk of N&P and the amount of waste (sacks) generated by the farm.

Comments

-Integrated fertiliser plans may be widely adopted, with good pay back and minimal initial costs.

2.8 Reducing nutrient losses by timely application of fertilisers.

CASE STUDY	57	Enterprise:	cattle and sheep	Region:	South West
				Country:	England

Source **Westcountry Rivers Trust**

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption	Medium		
Financial savings:	£35.1/head/year	Payback:	Immediate
Date of	2000	Audited	0
Confidentiality:	Westcountry Rivers Trust		

Background

-This case study was developed from data derived from an economic review of the Westcountry Rivers Trust's Tamar 2000 Project undertaken in August 2000

Size and type

-82.9 ha
-120 Cattle

Objectives

-To minimise fertiliser inputs
-To minimise loss of fertiliser inputs
-To minimise pollution risk

Resource Management Activities

-Timely application of fertiliser to 5 ha of 'hams' (broad wetland floodplain areas) to avoid 50% loss of N during wet conditions

Comments

-This practise prevented an estimated loss of 50% of N inputs: a saving of £35.1 per ha on the costs of N inputs
-This case study is specifically applicable to wetland and floodplain areas. However, all farms have the potential to benefit from timely application of nutrients. The adoption rating is therefore 'Medium'.

2.9 Soil testing to optimise nutrient applications.

CASE STUDY 63 Enterprise: cattle and sheep Region: South West
Country: England

Source Westcountry Rivers Trust

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption High
Financial savings: £24.83/ha/year Payback: <1 year
Date of 2004 Audited 0
Confidentiality: Westcountry Rivers Trust.

Background

-This case study was developed from information provided by a farmer participating in the Cornwall Rivers

Size and type

-35ha
-Cattle and Sheep (some arable)
-Approximately 80 suckler cows and followers plus calves.

Objectives

-To optimise accuracy of fertiliser applications in order to reduce inputs and losses.
-To minimise mineral fertiliser applications and increase use of FYM and clover
-To improve soil structure and reduce the risk of erosion
-To reduce the risk of watercourse pollution

Resource Management Activities

-Soil testing of 28ha on a 4 yearly basis in order to optimise nutrient inputs

Comments

-The cost of soil testing was £90 (£6 per sample for 15 samples, plus 4 hours' labour at an average farm worker's cost of £7.25 per hour (Nix 2004). The samples were taken by the farmer and sent away for analysis. If the soils are tested on a 4-year basis the annual cost is £1.06 per ha.

The farmer estimated a 50% reduction in mineral fertiliser needs due to improved targetting of applications and increased use of slurry and clover. The mineral fertiliser saving was estimated to be 5 tonnes per annum at a cost of £145 per tonne. The overall annual saving in terms of mineral fertiliser costs was therefore estimated to be £25.89 per ha, minus the costs of soil testing (£24.83 per ha).

2.10 Clean and dirty water separation: yard cover.

CASE STUDY 60 Enterprise: cattle and sheep Region: South West
Country: England

Source **Westcountry Rivers Trust**

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption Medium
Financial savings: £4/head/year Payback: <1 year
Date of 2004 Audited 0
Confidentiality: Westcountry Rivers Trust.

Background

-This case study was developed from information provided by a farmer who was participating in the Cornwall Rivers Project.

Size and type

-140 Cattle

Objectives

-To reduce the quantity of dirty water and associated management costs
-To improve the stock health
-To reduce feed waste
-To reduce the risk of watercourse pollution

Resource Management Activities

-Covering the yard area (30m by 30m) and diverting water to clean drains

Comments

-The cost of covering the yard and diverting the water to clean drains was estimated to be 12K spread over a 10 year period at 6% interest the annual capital charge is £11.7 per head.

-The covered yard area is 900m2 and the average annual rainfall is 1.2m. An annual average of 1080m3 of rainwater is therefore excluded from the dirty water system- an annual saving of £756 (MAFF 2000) or £5.4 per head. In addition, annual savings of an estimated 10% for reduced veterinary bills and feed wastage were £1.4 per head and £8.9 per head respectively (Nix 2004). The total annual saving was therefore estimated to be £15.7 per head, minus the cost of the capital works I.e. £4 per head.

3. Poultry

3.1 Adjustment of feeding equipment to minimise wastage.

CASE STUDY	18	Enterprise:	Poultry	Region:	Herefordshire
				Country:	England

Source **ADAS CSA3174**

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption	High		
Financial savings:	£0.21/Head/Year	Payback:	Immediate
Date of	1996	Audited	0
Confidentiality:	This case study was funded by MAFF (now defra) and as such is available from		

Background

-This case study was completed for MAFF in 1996.

Size and type

-223 ha combinable crops, 123 ha grass, 56ha forage maize, 130 cows + followers, 28,000 turkeys per

Objectives

-To reduce wastage of animal feed.

Resource Management Activities

-Minimisation of feed wastage by fine tuning of feeding equipment, saving 12 tonnes of feed.

Comments

-A highly applicable waste management procedure with low effort but large rewards.

3.2 Reduction of light levels in turkey houses.

CASE STUDY 19 Enterprise: Poultry Region: Herefordshire
Country: England

Source ADAS CSA3174

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption High
Financial savings: £0.08/Head/Year Payback: Immediate
Date of 1996 Audited 0
Confidentiality: This case study was funded by MAFF (now defra) and as such is available from

Background

-This case study was completed for MAFF in 1996.

Size and type

-223 ha combinable crops, 123 ha grass, 56ha forage maize, 130 cows + followers, 28,000 turkeys per

Objectives

-To reduce energy consumption and improve stock welfare.

Resource Management Activities

-Reduction in light levels after 12 weeks of the 18 week turkey production period, reduces bird activity and thereby avoids injury and loss of market value of stock.

Comments

-An easily implimented and cost efficient strategy.

3.3 Conversion to compact fluorescent light bulbs.

CASE STUDY	14	Enterprise:	Poultry	Region:	Yorkshire
				Country:	England

Source **ADAS CSA3174**

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption	High		
Financial savings:	£0.05/Head/Year	Payback:	<3 Months
Date of	1996	Audited	0
Confidentiality:	This case study was funded by MAFF (now defra) and as such is available from		

Background

-This case study was completed for MAFF in 1996.

Size and type

-42 ha arable, 31,000 broilers X 5 crops per annum.

Objectives

-Improved energy efficiency.

Resource Management Activities

-The conversion of the two buildings from ordinary tungsten bulbs to compact fluorescent bulbs.

Comments

-Highly applicable, with a quick payback period.

4. Dairy

4.1 Dairy farm dirty water control

CASE STUDY	1	Enterprise:	Dairy	Region:	South West
				Country:	England

Source **Westcountry Rivers**

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption	High		
Financial savings:	£5.83/head/year	Payback:	Immediate
Date of	2003	Audited	0
Confidentiality:	Case studies from the Westcountry Rivers Trust/BDB Associates		

Background

-The parlour is washed down with a pressure hose. Some roof water also mixes with the dirty water and drains into the collection system.

Size and type

-Dairy farm in the south west with 120 cows has 1500m² of open yard area and silos.

Objectives

-To explore means of water savings
-To reduce the quantity of dirty water
-To reduce water management costs.
-To reduce the risk of water pollution

Resource Management Activities

-Review of the sources of dirty water
-Repair of gutters and downspouts, diverting some clean yard water.
-Careful use of the pressure hose to reduce the quantity of dirty water by 1000m³ (37%)

Comments

-Savings resulted from the reduced costs of water, electricity and labour, as well as wear and tear on the irrigation system.
-The total saving was estimated at £700/year. In addition, the risk of water pollution was significantly reduced.

4.2 Composting of Farm Yard Manure.

CASE STUDY 39 Enterprise: Dairy Region:

Country:England

Source Seale Hayne/Defra

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption Medium

Financial savings: £3.60/Head/Year Payback: 1 Year

Date of Audited 0

Confidentiality:

Background

-Composting is a small cost to farmers. If the heaps are turned once it costs 20-30p/tonne of FYM (total £240-£360), and if turned three times £1.20-1.30/tonne of FYM.
-Some nutrients are lost in the process.
-Particularly applicable to Organic Farms.

Size and type

-100 Milking Cows and Followers.

Objectives

-Reduced muck spreading effort.
-Improved incorporation of manure to the sward
-Reduced pollution potential

Resource Management Activities

-Composting 1200 tonnes of FYM from 100 milking cows and followers.
-Additional labour requirements to turn manure heaps when drying.

Comments

-This strategy is most cost efficient for organic farms. There is an additional cost involved in generating compost from manure, but payback results from the improved incorporation of this material into the sward and the more even spread of the material.

4.3 Adoption of an Integrated Fertiliser and Livestock Waste Management Plan

CASE STUDY 2 Enterprise: Dairy Region: Lancashire
Country: England

Source ADAS CSA3174

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption High
Financial savings: £14.90/ha/year Payback: 3 Months
Date of 1996 Audited 0
Confidentiality: This case study was funded by MAFF (now defra) and is available from ADAS

Background

-This case study was completed for MAFF in 1996.

Size and type

-A tenanted dairy and sheep farm of 71 ha Grassland, supporting 70 Cows (50 dairy youngstock)+ 240 Breeding Ewes and employing 3 members of staff.

Objectives

-To derive more benefit from farm slurry by concentrating applications on silage production rather than grazing areas.
-To reduce the applications of phosphate and potash.

Resource Management Activities

-Reallocation of slurry application to targeted areas used for silage production rather than general grazing land. The application of slurry will have environmental benefits of improved soil structure and reduced applications of artificial fertilisers.
Additional benefit stem from increased grass production. If this grass production is not required further savings in fertiliser costs are anticipated.

Comments

-This scheme is widely applicable, with obvious cost benefits and universally available resources.

4.4 Integration of farm manure nitrogen supply within commercial farming

CASE STUDY 3 Enterprise: Dairy Region: various
Country: England

Source Defra

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption High
Financial savings: £83/head/year Payback: Immediate
Date of 1998 Audited -1
Confidentiality: This case study was funded by MAFF (now defra), 'Making better use of manures on

Background

-This case study was completed for MAFF in 1996

Size and type

-102 ha Grassland, supporting 130 Cows + followers and employing 2 members of staff

Objectives

-To reduce artificial fertiliser usage and maximise the utilisation of natural sources. Enhancing the Farmer's perception of the fertiliser value of organic manure.
-To reducing the enrichment of soil N and P status.
-To reduce the loss of nutrients to ground water and through surface run-off.
-To minimise the non-natural waste generated (Polypropylene bags) on the farm.

Resource Management Activities

-The adoption of an ADAS Fertiplan reduces the farm's applications of phosphate and potash and makes better use of slurry as a fertiliser. A programme revising the timing and application rates of fertiliser maximises the effectiveness of inputs, improves soil management and minimises the negative environmental consequences of runoff.
-The adoption of the new programme potentially results in an increase in grass production and inherent cost benefits and reduces artificial frertiliser use by 6.2 tonnes.

Comments

-The cost benefits and availability of resources render this approach highly applicable to the majority of farms in this sector.

4.5 Management and monitoring of land damage from out-wintered stock.

CASE STUDY 56 Enterprise: Dairy Region: Devon
Country: England

Source Westcountry Rivers Trust

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption High
Financial savings: £61/Head/Year Payback: 1 Year
Date of 2002 Audited 0
Confidentiality: Case Study published by Westcountry Rivers Trust.

Background

-A case study from West Country Rivers Trust.

Size and type

-5 ha grassland supporting out-wintered stock

Objectives

-To protect the grass and soil from serious damage in wet weather
-To reduce costs of reseeding damaged grassland

Resource Management Activities

-Regular inspection of soli and sward
-Movement of stock to better drained land in wet conditions before serious poaching occurs.

Comments

-This approach is highly replicable, it is cost neutral and the results were good, 10% less grass needed to be restored and the recovery of the grass resulted in an early spring 'bite'.

4.6 Fencing of riverbanks to prevent stock breakout.

CASE STUDY 59 Enterprise: Dairy Region: South West
Country: England

Source Westcountry Rivers Trust

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption Medium

Financial savings:	£0.5/head/year	Payback:	<4 years
Date of	2004	Audited	0
Confidentiality:	Westcountry Rivers Trust		

Background

-This case study was developed from information provided by a farmer who had participated in the Tamar 2000 Project.

Size and type

-121.4 ha
-250 Cattle

Objectives

-To control stock breakout across a boundary river in order to eliminate the need for stock retrieval, increasing farm business efficiency and managing the quality of the river habitat.

Resource Management Activities

Fencing of 500m of river frontage using permanent post and wire and electric fencing.

Comments

-The cost of fencing is estimated to be £1 per m (ABC 2004) a total cost of £500. It is assumed that farm labour was used to erect the fence and was absorbed into the farm's running costs.
-An estimated annual saving of £130.50 is based on an average of 6 stock breakouts per year of 3 hours' duration each, at an average farm worker's hourly cost of £7.25 (Nix, 2003)
-Additional savings may be realised in association with:
-Improved stock health
-Improved water and fishery quality and reduced risk of pollution
-Maintainance of farm capital value via reduced loss of agricultural land to erosion e.g. the cost of grade 3 agricultural land is £7878 per ah (Nix 2003) the long run cost of bank erosion is therefore £7.9 per m2 with the annual saving dependent on the rate of erosion.

4.7 Soil testing to optimise fertiliser inputs to grass silage.

CASE STUDY 61 Enterprise: Dairy Region: South West
Country: England

Source Westcountry Rivers Trust

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption High
Financial savings: £13.70/ha/year Payback: <1 year
Date of 2004 Audited 0
Confidentiality: Westcountry Rivers Trust.

Background

-This case study was developed from information provided by a farmer participating in the Cornwall Rivers

Size and type

-34ha
-Dairy

Objectives

-To optimise accuracy of fertiliser application in order to reduce inputs and losses
-To improve soil structure and reduce the risk of erosion
-To reduce the risk of watercourse pollution

Resource Management Activities

-Soil testing of 9.3 ha of grass silage on a 4 year basis in order to improve efficiency of fertiliser inputs.

Comments

-The cost of soil testing was £60, the samples were taken by the farmer and sent off for analysis. If soils are tested on a four year basis the annual cost is £1.61 per ha.

-The farmer estimated a 25% reduction in fertiliser costs as a result of soil testing. An estimated annual saving of £13.70 per ha is based on a 25% reduction in a total average fertiliser cost of £61.27 per ha for grass silage (Nix, 2004) minus the costs of soil testing.

-Additional savings may be realised in association with reduced costs of labour and machinery.

4.8 Installation of a dairy heat recovery unit.

CASE STUDY	5	Enterprise:	Dairy	Region:	Lancashire
				Country:	England

Source **ADAS CSA3174**

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption	Medium		
Financial savings:	£30.2/head/Year	Payback:	<3 Years
Date of	1996	Audited	0
Confidentiality:	This case study was funded by MAFF (now defra) and as such is available from		

Background

-This case study was completed for MAFF in 1996.

Size and type

-A tenanted dairy and sheep farm of 71 ha Grassland, supporting 70 Cows (50 dairy youngstock)+ 240 Breeding Ewes and employing 3 members of staff.

Objectives

-Reducing energy use by 50%, therefore saving the farmer electricity costs with environmental benefits of reduced resource useage and air emissions.

Resource Management Activities

-Installation of unit utilising gas from bulk milk tank to heat water. The recycling of heat to warm water will reduce the farms overall electricity useage which has environmental benefits geographically removed from the farm, measured in reduced CO2 emissions and reduced resource consumption.

Comments

-The uptake of this scheme may be limited by the need for considerable financial investment with a long pay back period.

5. Crops

5.1 Reduction in Potato waste generation and disposal.

CASE STUDY	6	Enterprise:	Crops	Region:	Nottinghamshire
				Country:	England

Source **ADAS CSA3174**

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption	MEDIUM		
Financial savings:	£40/ha/Year	Payback:	15 Months
Date of	1996	Audited	0
Confidentiality:	This case study was funded by MAFF (now defra) and as such is available from		

Background

-This case study was completed for MAFF in 1996.

Size and type

-A 530 ha farm with 72 ha potatoes, employing 8 members of staff.

Objectives

-To reduce the quantity of waste (damaged/green/bruised potatoes) and to improve disposal methodology via segregation of organic and inorganic waste streams.

Resource Management Activities

-A TQM approach, examining methodology to reduce process induced damage to potatoes. Involving a review of grading and waste segregation equipment to improve segregation and reduce waste.
-30 tonnes of waste minimised P.A. , this intern reduces the amount of leaching of effluent from waste (substandard potatoes) and the potential for disease transmission/Viral propogation from the dumped

Comments

-The scheme generates substantial cost benefits however uptake may be limited by the high upfront capital costs.

5.2 Application of broiler litter on potatoes.

CASE STUDY 41 Enterprise: Crops Region:
Country: England

Source ADAS

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emmissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption High
Financial savings: £120/Ha/Year Payback: Immediate
Date of Audited 0
Confidentiality:

Background

-This is an ADAS, Manures worked example.

Size and type

-Potato Growers.

Objectives

-Improved resource efficiency
-Decreased water contamination risk
-Decreased artificial farm inputs
-Decreased costs
-Improved soil structure

Resource Management Activities

-Broiler litter applied in spring and incorporated within 24 hours. Applied at a rate of 8t/ha this supplies 108 kg/ha of N, 120 kg/ha of P and 130 kg/ha of K for the following potato crop.
-The crop requirements are 220 kg/ha of N, 180 kg/ha of P and 300 kg/ha. However, making allowance for soil reserves and the broiler manure , only 112 kg/ha of N, 60 kg/ha of P and 170 kg/ha of inorganic fertilisers are needed.

Comments

-This is an easily adopted strategy making good use of readily/cheaply available inputs with a good payback rate.
-The saving against the nutrient requirements of potatoes reduces the NPK fertiliser inputs (at typical costs) for this crop by £87/ha. The total saving on NPK fertiliser inputs over the crop rotation is about

5.3 Reduction in sugar beet wastes.

CASE STUDY	7	Enterprise:	Crops	Region:	Nottinghamshire
				Country:	England

Source **ADAS CSA3174**

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption	Medium		
Financial savings:	£16/ha/Year	Payback:	13 months
Date of	1996	Audited	0
Confidentiality:	This case study was funded by MAFF (now defra) and as such is available from		

Background

-This case study was completed for MAFF in 1996.

Size and type

-A 530 ha farm with 55 ha sugar beet, employing 8 members of staff.

Objectives

-To reduce crop losses due to dirty crops and poor cleaning while loading.

Resource Management Activities

-Improved harvester operation through participation on training courses, potentially saving the 25 tonnes of beet currently wasted P.A.
-Cleaner beet will result in reduced disease in the live beet and disease stemming from on-farm dumping. The minimisation of dumping will enhance the landscape value of the farm and reduce the potential risk for run off water pollution.

Comments

-The level of priority and profile of this issue to the farmer may limit uptake of this approach.

5.4 Reduction in Potato waste generation and disposal.

CASE STUDY 8 Enterprise: Crops Region: Nottinghamshire
Country: England

Source ADAS CSA3174

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption Medium
Financial savings: £24/ha/Year Payback: <2 Years
Date of 1996 Audited 0
Confidentiality: This case study was funded by MAFF (now defra) and as such is available from

Background

-This case study was completed for MAFF in 1996.

Size and type

-A 570 ha farm with 85 ha Potatoes, employing 5 members of staff.

Objectives

-To reduce the accumulated waste generated in harvesting and processing potatoes.
-Reducing the possibility of disease carry over from dumped potatoes (possibly saving on disease control programmes).

Resource Management Activities

-Examination of equipment and grading decisions to reduce the accumulated waste from the current level of 4% by weight (30 tonnes P.A.).
-Sorting and removal of stones from reject sample.

Currently outgrades are sold for stockfeed.

Comments

-The high capital costs of this action may limit uptake.

5.5 Improved machine operation/processing of sugar beet harvesting.

CASE STUDY 9 Enterprise: Crops Region: Nottinghamshire
Country: England

Source ADAS CSA3174

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption Medium
Financial savings: £27.2/ha/Year Payback: 11 Months
Date of 1996 Audited 0
Confidentiality: This case study was funded by MAFF (now defra) and as such is available from

Background

-This case study was completed for MAFF in 1996.

Size and type

-A 570 ha farm with 45 ha sugarbeet, employing 5 members of staff.

Objectives

-To reduce the harvesting losses through improved monitoring , cleaner loader adjustment and

Resource Management Activities

-Through improved machine operation less rogue beet is found in subsequent crops, therefore reducing opportunities for disease development and the need for spray programmes.
-Cleaner loaders ensure that less beet and material is dumped, reducing the risk of disease and effluent contamination of water.

Comments

-The actions are highly applicable and result in good pay back figures.

5.6 In-situ grading and trimming of salad and vegetable crops.

CASE STUDY	25	Enterprise:	Crops	Region:	Derbyshire
				Country:	England

Source **ADAS CSA3174**

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emmissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption	Medium		
Financial savings:	£95/ha/Year	Payback:	10 months
Date of	1996	Audited	0
Confidentiality:	This case study was funded by MAFF (now Defra) and as such is available from		

Background

-This case study was completed for MAFF in 1996.

Size and type

-157ha cropped twice with leeks, carrots, lettuce, stick beans and some cereals. Employing 65+ seasonal

Objectives

-Reduction in odour from decayed concentrated waste, reduced energy consumption in transport, improved nutrient cycling to the soil, reduced disease spreading and reduced organic waste disposal

Resource Management Activities

-The use of field rigs for grading and trimming of excess material, leaving it in the field. The material deposited at the pack house is relatively clean, minimising the use of wash water and the concentration of BOD entering the sewage system.

Comments

-High capital costs may limit the uptake of this strategy however there are considerable environmental and cost benefits.

5.7 Removal of small potatoes from field to reduce the number of volunteer

CASE STUDY	21	Enterprise:	Crops	Region:	Shropshire
				Country:	England

Source ADAS CSA3174

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emmissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption	High		
Financial savings:	£40/ha/Year	Payback:	Immediate
Date of	1996	Audited	0
Confidentiality:	This case study was funded by MAFF (now Defra) and as such is available from		

Background

-This case study was completed for MAFF in 1996.

Size and type

-265 ha cereals, 123 ha potatoes, 90 ha sugarbeet, 30 ha grass, 220 sows plus progeny to bacon weight.

Objectives

-Reduction of the use of agrochemicals and improvement of harvest efficiency.

Resource Management Activities

-Removal of small potatoes from the field using the early potato lifting web throughout the harvesting period. Avoiding the use of agro-chemicals to control the growth of volunteer potatoes and providing a market for small potatoes (an extra income of up to £5000).

Comments

-Highly applicable with multiple paybacks and minimal expenditure.

5.8 Operation of machinery dictated by soil conditions.

CASE STUDY 47 Enterprise: Arable Region:

Country: England

Source ADAS

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emmissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption High

Financial savings: £60/Ha/Year Payback: Immediate

Date of 2003 Audited 0

Confidentiality: ADAS

Background

-This is an ADAS, Manures worked example.

Size and type

-Mixed Farm

Objectives

-Protection of soil structure, compacting and runoff losses
-Reduction in labour time
-Reduction in resource consumption
-Improve farm efficiency
-Reduction in costs.

Resource Management Activities

-To ensure machines are not operated under wet or unsuitable soil conditions

Comments

This management activity is easily adopted with no additional outlay. The strategy requires some culture change, but in this example it saved the farmer 40% of fuel costs and considerable man hours.

5.9 Minimum tillage for wheat.

CASE STUDY 52 Enterprise: Arable Region: Devon
Country: England

Source Westcountry Rivers Trust

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emmissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption High
Financial savings: £80/Ha/Year Payback: Immediate
Date of 2002 Audited 0
Confidentiality: Westcountry Rivers Trust

Background

-A case study from West Country Rivers Trust.

Size and type

-Arable farm, Devon.
-10ha of the steepest fields.
-Wheat production.

Objectives

-Reduction in run-off.
-Reduction in soil erosion and nutrient losses.
-Reduction in crop damage from gullies and rills.
-Reduction in need to reinstate eroded soils and clean dirty ditches.
-Reduction in labour costs
-Reduction in machinery running costs
-Reduction in herbicides and fungicides useage

Resource Management Activities

-Use of minimum tillage for wheat in 2001 on 10Ha of steep fields rather than conventional cultivation.

Comments

-This strategy offered considerable financial paybacks, rewarding the farmer in labour savings on tasks such as ditch and highway cleaning and repair of rills and gullies.

5.10 Re-seeding with Clover.

CASE STUDY 53 Enterprise: Arable Region: South West
Country: England

Source Westcountry Rivers Trust

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emmissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption High
Financial savings: £123/ha/Year Payback: 2 Years
Date of 2003 Audited 0
Confidentiality: Westcountry Rivers Trust

Background

-A case study from Westcountry Rivers Trust.

Size and type

-38 Ha Grassland.

Objectives

-Enhancement of soil nutrient value.
-Reduction in cost of mineral fertiliser applications.
-Reduction in bare earth state therefore reducing soil erosion potential.

Resource Management Activities

-Review of grassland management practice to diverge from the standard practice of applying N at 375kg/ha.

Comments

-This management practice is easily adopted with good financial returns and considerable benefits for the environment, enhancing soil status and reducing soil erosion and water pollution.

5.11 Integrated Crop Management.

CASE STUDY 54 Enterprise: Arable Region: Essex
Country: England

Source **Bayer CropScience**

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption Medium
Financial savings: £200/Ha/Year Payback:
Date of 1995 Audited 0
Confidentiality: This casestudy is reported in 'Food for Thought' Sustainable Food Production for the 21st Century Consumer.

Background

-The Boarded Barns Farm Study is a long-term evaluation of the wider impact and viavility of alternative farming systems

Size and type

-24 ha Arable farm on deep,acid clay loam in lowland Britain

Objectives

-Valuation of Integrated Crop Management
-To satisfy the demands for reliable and economic production and enhance the biodiversity and fabric of the countryside

Resource Management Activities

-Integrated Crop Management of wheat
-Optimisation of the use of resources, a 30% reduction in the use of crop production products.
-The use of minimum tillage techniques
-20% reduction in overal inputs.

Comments

-The use of ICM generated good cost benefits, through the reduction in tillage energy costs, and the increase in wheat yields (topped 8t/ha), this strategy is highly applicable, though it will require considerable culture change in farming.

5.12 Spatial targeting of fertilisers.

CASE STUDY 55 Enterprise: Arable Region: Devon
Country: England

Source Westcountry Rivers Trust

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emmissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption High
Financial savings: £101/ha/Year Payback: 2 Years
Date of 2002 Audited 0
Confidentiality: Case Study published by Westcountry Rivers Trust

Background

-A case study from West Country Rivers Trust.

Size and type

-6.7 ha of grassland including some wetland areas

Objectives

-To reduce the impact of fertiliser on non-targeted areas such as boundaries and hedgerows.
-To prevent fertilisers from encouraging unwanted weed species in hedgerows.
-To protect hedgerow plants which are intollerant of high levels of N and the insects they harbour.

Resource Management Activities

-Restricted application of 268:0:40 (high impact) fertiliser to within 10m of field boundaries

Comments

-This strategy is highly applicable to a large number of enterprises, the farmer saves considerable fertiliser costs and labour time in fitting prill guards onto spreaders.

5.13 Application of livestock manures on arable crops.

CASE STUDY 40 Enterprise: Arable Region:
Country: England

Source ADAS

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emmissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption High
Financial savings: £100/Ha/Year Payback: Immediate
Date of 2003 Audited 0
Confidentiality: ADAS

Background

-This is an ADAS, Manures worked example.

Size and type

-300ha of combinable crops roots and 100 dairy cows

Objectives

-Improved resource efficiency
-Reduction in artificial inputs and costs
-Recycling of farm wastes
-Improved soil structure, reducing the potential for soil erosion
-Maximisation of crop yields

Resource Management Activities

-Utilisation of farm yard manure.
-Development of a farm nutrient management plan.
-Monitoring of soils on a 3yr cycle to identify any potential problems, previous problems involving low sugars and high amino acids occurred in sugar beet, whilst the potato crop suffered from excess nutrients

Comments

-This is an easily adopted strategy, utilising readily available inputs, with good cost benefits. The monitoring of nutrients is a sensible approach to ensure an improvement in farm performance and maximum crop yield benefits.

5.14 Good soil management.

CASE STUDY 49 Enterprise: Arable Region: South West
Country: England

Source Westcountry Rivers Trust

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emmissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption High
Financial savings: £244/Ha/Year Payback: Immediate
Date of 2003 Audited 0
Confidentiality: Westcountry Rivers Trust

Background

-A case study from West Country Rivers Trust

Size and type

-5 Ha forage Maize

Objectives

-Reduce soil compacting to enhance yields.
-Improvement of the soils capacity to hold water and nutrients.
-Reduction in damage and runoff.
-Enhancement of soil's ability to breakdown pesticides.
-To enhance crop yield.

Resource Management Activities

-To avoid compaction of the wet clay soil, slurry was not spread during the winter months.
-To achieve this flexibility to spread when conditions were suitable, the farmer ensured that he had sufficient slurry storage.

Comments

-This is a low cost strategy and good farming practice, with good financial pay backs.
-The production of maize at 33% dry matter (DM) was 13 tonnes of DM per ha. At £975 per ha, the crop was worth £4875. It is estimated that soil compaction would have reduced yields by 25%. Good practice therefore saved the farmer £244 per ha, a total of £1220.

5.15 Soil management to reduce erosion and loss of inputs.

CASE STUDY 62 Enterprise: Arable Region: South West
Country: England

Source Westcountry Rivers Trust

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption Medium
Financial savings: £26.3/ha/year Payback: <3 years
Date of 2004 Audited 0
Confidentiality: Westcountry Rivers Trust.

Background

-This case study was developed from information provided by a farmer who was participating in the Cornwall Rivers Project.

Size and type

-69ha
-Beef and arable

Objectives

-To reduce soil damage, soil erosion and soil loss
-To reduce losses of inputs
-To maintain yields and productivity
-To reduce the risk of watercourse pollution.

Resource Management Activities

-3.2 ha of arable land (barley, forage peas, stubble turnip rotation) was undergoing severe erosion due to gully and plough pan development, with reductions in yield and productivity due to losses of inputs and topsoil. The area was ploughed using a vintage tractor in order to improve soil structure and infiltration capacity. Crop cover was subsequently maintained to protect the soil from future erosion.

Comments

-Deep ploughing the 3.2 ha to remove the pan and gullies took one day and was estimated to cost £63 per ha- a total of £201.60 (Nix 2004).

-Improved soil management saved losses in yield estimated at 5% per annum and losses in productivity estimated at 25% over a 50 year period. The annual savings were estimated to be £25.2 per ha, £0.6

5.16 Minimum Cultivation.

CASE STUDY	69	Enterprise:	Arable	Region:	Leicestershire
				Country:	England

Source **Farmcare: Hydro Agri**

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption Medium

Financial savings: £19/ha/year Payback:

Date of 2002 Audited 0

Confidentiality: Focus on Farming Practice managed by Farmcare Stoughton Estate.

Background

-One of the most comprehensive farm scale comparisons of 'Conventional' and 'integrated' farm practices was carried out at Focus on Farming Practice. This project was sited and managed by Farmcare Stoughton Estate. Work began in 1993 and continues.

Size and type

-Integrated farming

Objectives

-To reduce the nitrate concentration in drainage water
-To reduce energy costs of cultivation
-To enhance the aeration of soil
-To enhance the biodiversity of the site.

Resource Management Activities

-Minimum cultivation and direct drilling in integrated plots.
-Blackgrass was controlled on the heavy soil by a two year grass ley in the rotation.
-Slugs were controlled through seedbed consolidation and targetted seed treatment.

Comments

-Over a nine year period from 1993
-the number of cultivations and the cost of cultivations were lower for the integrated (3 cultivations/year, £75/ha) than the conventional plots (4 cultivations/year, £90/ha)
-Herbicide costs were lower for the integrated (£36/ha) than the conventional (£40/ha) plots.

5.17 White clover understorey and direct drill.

CASE STUDY 75 Enterprise: Arable Region: Devon
Country: England

Source IGER

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emmissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption Medium
Financial savings: £138/ha/Year Payback:
Date of 2003 Audited 0
Confidentiality: Institute of Grassland and Environmental Research. Work conduceted by R O Clements, funded by a Defra grant and EU Money.

Background

-This case study was developed by RP Clements of IGER and funded by a Defra and subsequent EU grant.

Key principles
-White clover can be used as an understorey in arable (Whole crop) Silage to fix N, reduce weed infestation and provide a haven for predatory insects that eat pests. Foliar fungal diseases are also

Size and type

-White clover understorey and silage crop
-Plots grown in conjunction with control plots using conventional practice

Objectives

-To reduce nitrogen fertiliser use
-To obviate the need for insecticides and fungicides
-To reduce the need for herbicides
-Create more beneficial conditions for wildlife
-To control erosion

Resource Management Activities

-Sow white clover understorey into a cereal nurse crop.
-After harvest the white clover remains and winter wheat is direct drilled into this.
-Three-Four successive crops are grown.

Comments

-Yields in this instance were only slightly lower than conventional cropping using standard farm practice No.:-This practice resulted in a large reduction in N fertiliser and agrochemical usage.
-The dense understorey creates a haven for beneficial invertibrates was created including predatory beetles and spiders which feed on pests. The permanent crop cover is also likely to promote small mammal **:** and birdlife.
-The maintainance of soil cover controlled erosion.
:-The changes in crop architecture reduced the likelyhood of foliar fungal attack on the cereal and reduced

5.18 White clover understorey and direct drill.

CASE STUDY 76 Enterprise: Arable Region: Devon
Country: England

Source IGER

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emmissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption Medium
Financial savings: £163/ha/Year Payback:
Date of 2003 Audited 0
Confidentiality: Institute of Grassland and Environmental Research. Work conduceted by R O Clements, funded by a Defra grant and EU Money.

Background

-This case study was developed by RP Clements of IGER and funded by a Defra and subsequent EU grant.

Key principles
-White clover can be used as an understorey in arable (Whole crop) Silage to fix N, reduce weed infestation and provide a haven for predatory insects that eat pests. Foliar fungal diseases are also

Size and type

-White clover understorey and silage crop
-Plots grown in conjunction with control plots using conventional practice

Objectives

-To reduce nitrogen fertiliser use
-To obviate the need for insecticides and fungicides
-To reduce the need for herbicides
-Create more beneficial conditions for wildlife
-To control erosion

Resource Management Activities

-Sow white clover understorey into a cereal nurse crop.
-After harvest the white clover remains and winter wheat is direct drilled into this.
-Three-Four successive crops are grown.

Comments

-Yields in this instance were higher than conventional cropping using standard farm practice
No.:-This practice resulted in a large reduction in N fertiliser and agrochemical usage.
-The dense understorey creates a haven for beneficial invertibrates was created including predatory beetles and spiders which feed on pests. The permanent crop cover is also likely to promote small mammal **:** and birdlife.
-The maintainance of soil cover controlled erosion.
:-The changes in crop architecture reduced the likelyhood of foliar fungal attack on the cereal

5.19 Undersowing of crops to avoid bare ground nutrient loss.

CASE STUDY 51 Enterprise: Arable Region: South West
Country: England

Source Westcountry Rivers Trust

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emmissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption High
Financial savings: £79/Ha/Year Payback: Immediate
Date of 2003 Audited 0
Confidentiality: Westcountry Rivers Trust

Background

-A case study from West Country Rivers Trust

Size and type

-5 Ha Maize crop.

Objectives

-To avoid bare ground after maize harvest from October until the following May, on soils which often cannot be autumn ploughed.
-To reduce weed growth
-To reduce soil erosion and loss of nutrients through run off.
-To provide winter cover for wildlife.

Resource Management Activities

-5 Ha Maize crop undersown with herbicide tolerant Italian Rye Grass for worm-free ewe/lamb winter and spring grazing. The undersown crop produced six tonnes DM/ha with a Relative Feed Value (RFV) of £12/tonne. This was worth £360 plus the value of the nutrient retention of £35 (estimated value of nitrogen mopped up at £7/ha), a total of £395.

Comments

-This strategy affords good financial pay backs for the farmer and additional uncosted benefits of reduced soil damage and productivity loss associated with untimely operations, runoff and soil erosion.

5.20 Application of pig slurry to winter wheat.

CASE STUDY 38 Enterprise: Arable Region:
Country: England

Source ADAS

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emmissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption High
Financial savings: £85/ha/Year Payback: Immediate
Date of 2003 Audited 0
Confidentiality:

Background

-This is an ADAS, Manures worked example.

Size and type

-Mixed Enterprise with Pigs and Winter Wheat.

Objectives

-Reduce consumption of artificial fertilisers
-Improve utilisation of on-farm sources of nutrients
-Manage waste
-Improve soil structure and nutrient value
-Reduce risk of water contamination from pig slurry.
-Reduce costs

Resource Management Activities

-Application of pig slurry to land to provide N, P, K inputs for winter wheat production.

Comments

-This is an easily adopted strategy, presenting a win-win scenario for the farmer. Reducing sources of pollution, improving soil structure and fertility and reducing overhead costs.
-The total saving on NPK fertiliser over the crop rotation allowing for extra total P and K in soil reserves is up to £85/ha
-Allowing for the soil reserves a pig slurry application of 50m³/ha, supplies about half the N (90kg/ha) and sufficient P (100kg/ha) and K (125kg/ha).

5.21 Reduced edge effect of broadcast fertiliser by use of fixed width spray

CASE STUDY	23	Enterprise:	Arable	Region:	Derbyshire
				Country:	England

Source **ADAS CSA3174**

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emmissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption	Medium		
Financial savings:	£44/ha/Year	Payback:	< 1 year
Date of	1996	Audited	0
Confidentiality:	This case study was funded by MAFF (now Defra) and as such is available from		

Background

-This case study was completed for MAFF in 1996.

Size and type

-157ha cropped twice with leeks, carrots, lettuce, stick beans and some cereals. Employing 65+ seasonal

Objectives

-Reduction in fertiliser useage, reducing the impacts on non target habitats and the possible leaching into the water system. The improved coverage improves crop quality, reducing organic wastage.

Resource Management Activities

-The use of liquid fertiliser through a fixed width spray boom. This reduces wastage beyond crop boundaries and uses 10% less fertiliser, saving £4000. Liquid fertiliser reduces the quantities of non-oraganic waste to be disposed of,saving on 250 plastic fertiliser sacks and gives a more even coverage with benefits in overall crop quality.
-The more precise application reduces fertiliser consumption and therefore limits the capacity for leaching

Comments

-Requires investment and a management change, but offers good cost benefits.

5.22 Use of air assisted sprayer in pesticide application.

CASE STUDY	24	Enterprise:	Arable	Region:	Derbyshire
				Country:	England

Source **ADAS CSA3174**

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emmissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption	Medium		
Financial savings:	£82/ha/Year	Payback:	5 months
Date of	1996	Audited	0
Confidentiality:	This case study was funded by MAFF (now Defra) and as such is available from		

Background

-This case study was completed for MAFF in 1996.

Size and type

-157ha cropped twice with leeks, carrots, lettuce, stick beans and some cereals. Employing 65+ seasonal

Objectives

-Reduction in pesticide useage and limitation of non-target habitat disruption.

Resource Management Activities

-The use of an air assisted sprayer limiting the amount of pesticide spray drift into non-target habitats. Reducing overall pesticide useage and the impact it has on the environment, verges, hedgerows and

Comments

-This method requires some investment and a change in practice, but offers good financial rewards.

6. Horticulture

6.1 On-sale of vegetable pack house waste.

CASE STUDY	26	Enterprise:	Horticulture	Region:	Derbyshire
				Country:	England

Source **ADAS CSA3174**

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emmissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption	High		
Financial savings:	£118.15/Ha/Year	Payback:	Immediate
Date of	1996	Audited	0
Confidentiality:	This case study was funded by MAFF (now Defra) and as such is available from		

Background

-This case study was completed for MAFF in 1996

Size and type

-157ha cropped twice with leeks, carrots, lettuce, stick beans and some cereals. Employing 65+ seasonal

Objectives

-Reduction in odour from decay of concentrated waste
-Reduction in effluent emptying into the sewage system.
-Reduction in energy inputs to transport waste and spreading it to the fields.

Resource Management Activities

-The recycling of packhouse vegetable waste for reuse as beef cattle feed.
-The waste is collected in skips and taken to neighbouring farms, 320 tonnes of waste is minimised per

Comments

-This strategy offers a win-win scenario for the farmer, a reduction in costs and a financial gain from sales of waste.

6.2 Re-use of floating polythene crop cover.

CASE STUDY	22	Enterprise:	Horticulture	Region:	Derbyshire
				Country:	England

Source **ADAS CSA3174**

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emmissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption	High		
Financial savings:	£39/ha/Year	Payback:	Immediate
Date of	1996	Audited	0
Confidentiality:	This case study was funded by MAFF (now Defra) and as such is available from		

Background

-This case study was completed for MAFF in 1996.

Size and type

-157ha cropped twice with leeks, carrots, lettuce, stick beans and some cereals. Employing 65+ seasonal

Objectives

-Reduction in non-biodegradable inputs and waste.

Resource Management Activities

-A proportion of the polythene crop cover is recovered each season for re-use. This reduces the need to purchase new polythene by 37%, saving £6259 per annum and reducing the landfill disposal cost by £922 and saving 30 tonnes of waste.

Comments

-This is easily adopted and offers good financial incentives to do so.

6.3 Rainwater recycling and computer controlled VPD watering system.

CASE STUDY 31 Enterprise: Horticulture Region: Kent
Country: England

Source Environment Agency Water Efficiency Awards 2003

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption Medium
Financial savings: £758/ha/Year Payback: 5 Years
Date of 2003 Audited 0
Confidentiality: Environment Agency Water Efficiency Awards 2003

Background

Size and type

Objectives

Resource Management Activities

Comments

6.4 Garden Centre Pond for collection and recovery of irrigation water.

CASE STUDY 29 Enterprise: Horticulture Region:
Country: England

Source **Environment Agency Water Efficiency Awards 2003**

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emmissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption Medium
Financial savings: £3500/ha/Year Payback: 14 months
Date of 2003 Audited 0
Confidentiality: This case study was published in the Water Efficiency Awards 2003 for the Environment

Background

-This casestudy was entered as an example of good practice in the Environment Agency Water Efficiency Awards 2003.

Size and type

-Garden Centre with an irrigated plant area of 1 ha.

Objectives

-To reduce water consumption through collection and recycling of irrigation water.

Resource Management Activities

-Construction of a pond for collection of surplus irrigation water and rainwater from warehouse roof and glasshouses and storm water from roads and yards. Pumping of water to a storage tank for irrigation uses.

Comments

-This is a sensible and efficient measure for a nursery/garden centre where water losses from irrigation systems are high.

6.5 Reservoir capture of water and installation of VPD irrigation.

CASE STUDY 67 Enterprise: Horticulture Region: Kent
Country: England

Source Water UK and Environment Agency Water Efficiency

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption medium
Financial savings: £758/ha/year Payback: <5 years
Date of 2001 Audited 0
Confidentiality: Water UK and Environment Agency.

Background

Size and type

-Nursery producing 1,000,000 container grown shrubs for the amenity market

Objectives

-Water minimisation through: Water recycling and re-use to enable expansion of the business
-To reduce water costs, managing water use.
-To reduce labour costs
-To improve plant quality

Resource Management Activities

-Construction of drainage to collect water from buildings (polythene tunnels, outdoor beds, buildings)
-Storage of water in a holding lagoon
-Pump system to transfer this from the holding lagoon to a reservoir
-Construction of a 6,000,000 gallon reservoir
-Irrigation control using a Vapour pressure deficit system (VPD) to ensure plants are only watered when needed and in the right quantities.

Comments

-The project has high initial capital costs £73,000 to install the reservoir and pumps, £18,000 for the V.P.D, £19,000 for the drainage recycling and installation. Against the high water consumption costs the payback period for this work is between 4 and 5 years. The VPD and drainage recycling schemes can be repaid between 18 months and two years.
Water shortages are a threat to such a business, therefore developing a self sufficiency in supply was of high importance. However considerable construction and initial costs are incurred leading the adoption rating to be considered 'low'.

6.6 Recycling Water for Bean Sprout Production.

CASE STUDY	77	Enterprise:	Horticulture	Region:	Norfolk
				Country:	England

Source **The Environment Agency Water Efficiency Awards**

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emmissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption	Low		
Financial savings:	£35,806/ha/year	Payback:	3 Years
Date of	2003	Audited	0
Confidentiality:	The Environment Agency Water Efficiency Awards 2003.		

Background

-NFU Agriculture and Horticulture Category of the Environment Agency Water Efficiency Awards 2003 held in partnership with the NFU.

Size and type

-Market Gardens cropping strawberries, raspberries, blackberries, rhubarb and bean sprouts on farmland.
-Employing 63 full time staff and approximately 600 seasonal pickers.
-This case study focusses on the bean sprout production which was identified as the crop with the highest water consumption following a review of the water use on the whole site.

Objectives

-To save water and maintain the high level of yield, quality and quantity

Resource Management Activities

-Review of the water use by monitoring on-site meters.
-Consultation with a filtration and separation systems specialist and a microbiologist to advise on the development of a re-circulation systems to capture excess water in the irrigation process for re-use.
-Collection, filtration and recycling of irrigation water.

Comments

-The project has resulted in impressive water savings and enabled the company to demonstrate its commitment to water efficiency and wider environmental issues to both staff and customers.
-Since its introduction in 2001 a 38% reduction in water requirements for bean sprout production has been achieved.
-The company calculate that £12,2000 of water costs are saved annually.
-This case study focuses on a highly intensive form of production, the financial savings have been

6.7 Rainwater Capture and Long Term Storage/Treatment.

CASE STUDY 78 Enterprise: Horticulture Region: Kent
Country: England

Source The Environment Agency Water Efficiency Awards

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emmissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption Low
Financial savings: £931.5/ha/Year Payback: 4 years
Date of 2003 Audited 0
Confidentiality: The Environment Agency Water Efficiency Awards 2003.

Background

-NFU Agriculture and Horticulture Category of the Environment Agency Water Efficiency Awards 2003 held in partnership with the NFU.

Size and type

-Retail nursery producing on-site 65% of all plants sold equating to over one million plants per year
-Employing 55-60 staff

Objectives

-To reduce reliance on mains water supply
-To reduce the amount of water flowing across the site causing flooding and irritation to neighbours
-To collect the water running from greenhouse and other structures (2 acres of buildings)
-To reduce the amount of pollution from fertilisers running off the site

Resource Management Activities

-Construction of a rainwater capture system
-Construction of a reservoir capable of storing 2.2million litres of harvested rainwater and irrigation run-off from a large proportion of the Production Nursery.
-Installation of two 10ft filtration tanks that between them hold 30 tonnes of specially selected sand and gravel layers.
-Development of a 200ft long gravel reed bed containing Norfolk Reeds (phragmites australis)
-Watering controlled by computer carried out at night to reduce evapotranspiration.
-Installation of drip irrigation to ensure exactly the right amount of water is put directly onto plants.

Comments

6.8 Sealed climate controlled facilities for horticultural production (Unigro).

CASE STUDY 80 Enterprise: Horticulture Region: Kent
Country: England

Source The Environment Agency Water Efficiency Awards

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emmissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption medium
Financial savings: £12,000 Payback: 5 years
Date of 2003 Audited 0
Confidentiality: The Environment Agency Water Efficiency Awards 2003.

Background

-NFU Agriculture and Horticulture Category of the Environment Agency Water Efficiency Awards 2003 held in partnership with the NFU.
-Unigro, a private limited company developed a sealed climate controlled facility to make its operation more

Size and type

-Pesticide-free fruit, vegetables and herbs

Objectives

-To ensure maximum yields per hectare
-To control the use of water resources
-To develop economic cultivation of Class A crops for 12 months of the year.
-To gain independence from the climate
-To economise on energy and labour
-To eliminate the use of pesticides
-

Resource Management Activities

-Development of a tunnel providing a controlled environment and suitable for fully commercial operation
-Computer controlled environments managing temperature, humidity, light, co2 and irrigation
-Redesign of the irrigation system to give precise delivery and volumes of water and nutrients
-Introduction of the Aquacell water storage system beneath the building, together with rain harvesting this reduces the dependency on mains supply water. This system enables a single storage area to provide water for irrigation, cooling and collection and storage of recovered heat energy.

Comments

-During an 18 month trial period the growing conditions were recorded and evaluated on a database to establish a balanced cultivation protocol
:-The system resulted in the lowest possible water use to maximise crop yield, 30% less than conventional growing.
:-Water use has reduced from 18,000m3 per year to 9,000 m3 with associated savings of £12,000 per annum.
-A major requirement of all Greengro sites is the provision of land for the 'Wilderness Project', this scheme requires an acre of land for each growing room on the site to be set aside for restoration to natural habitat and the enhancement of biodiversity.

6.9 Irrigation water minimisation, filtration and recycling.

CASE STUDY 81 Enterprise: Horticulture Region: Surrey
Country: England

Source The Environment Agency Water Efficiency Awards

Resource Management Activities Addressed in this Case Study

Water Management	Pest Management
Soil Management	Nutrient Management
Energy Management	Non-natural Waste
Air Emmissions	Infrastructure
Natural Resource	Organic material

Environmental benefits

Improved Water Quality	Improved Biodiversity
Improved Air Quality	Improved soil quality
Energy Management	Reduced risk of flooding
Reduced Resource	Enhanced Landscape

Ease of adoption Medium

Financial savings:	£267/ha/year	Payback:	<1 year
Date of	2001	Audited	0
Confidentiality:	The Environment Agency Water Efficiency Awards 2001.		

Background

-Environment Agency Water Efficiency Awards 2001

Size and type

-Plant Nursery
-100% dependent on mains water

Objectives

-To improve water efficiency and stability of supply
-To efficiently recycle water whilst removing plant pathogens and hazardous chemicals
-To maintain crop quality

Resource Management Activities

-Installation of a slow sand filter to recycle run-off and excess water from irrigation
-Routine maintainance of the filter to ensure minimal clogging
-Control of flash flooding on the site

Comments

-The annual mains water bill was £64143, this was reduced to £24119.
The practice resulted in:
-Recycling of 20% of water used.
-Improved environmental awareness of staff
-Substantial cost savings

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