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Exploiting HGCA-funded R&D on soil management for profit and GAEC compliance

by

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1 ABSTRACT

The reform of the Common Agricultural Policy has created a new set of circumstances. Failure to meet environmental requirements in particular soil management will lead to loss of subsidy. The circumstances in which such a loss may occur could include the use of minimum tillage on heavy soils in a wet season. The projects reviewed in this study predated CAP reform and therefore do not specifically address this area. A number of circumstances exist which could lead to a loss of subsidy.

The projects covered in this review are as follows:

1 Reduced cultivations: Research, development and advisory needs under changing economic circumstances. Research Review No. 48.
2 Factors affecting cereal establishment and its prediction. Research Review No. 51.
3 Effects of establishment technique and number of management passes on winter wheat production costs. Project Report No. 311.
4 Non-tillage management of Oilseed Rape using the “autocast” technique. Project Report No. 55.
5 Trash distribution and cultivation depth in minimal tillage and direct establishment systems. On going project No. 2799.
6 Influence of green manuring in wheat rotations under different cultivation systems. On going project No. 2800.
7 Improving crop profitability by using minimum cultivation and exploiting grass weed ecology. Project No. 2469.
8 Developing a cost effective procedure for investigating within field variation of soil conditions. Project Report No. 296.
9 Evaluation of non-intrusive sensors for measuring soil physical properties. Project Report No 302.
10 Description of spatial variation in soil to optimize cereal management (2004). Project Report No 330.
11 Developing methods to improve sampling efficiency for automated soil mapping (2005). Project Report No. 364.

The financial farm business models used in the course of the review incorporate the Single Farm Payment and Entry Level Scheme monies and estimate likely reduction of this payment as a consequence of the failure to comply with Good Agricultural and Environmental

Conditions (GAEC). The models indicate that whilst the loss of subsidy is important, the reduction in crop output as a result of poor establishment can lead to a larger financial loss.

Minimum tillage, direct drilling and autocast can provide significant benefits however it is vital to carefully select the soil type and season in which such techniques are used. Failure to do this can result in a worse result both economically and environmentally.

Further work on soil spatial variation may potentially provide information to allow Farmers to both optimise nutrient use and also meet their environmental obligations. However the work to date has not yet provided any tangible benefits to Farmers. At the time of the original report only Electro Magnetic Induction (EMI) was commercially available to Farmers and appeared to provide the most useful information relating to yield and soil properties.

A number of topics within the work reviewed may warrant further research. These can be found in section 2 and at the end of the individual project reviews in section 5. The design of this research needs to consider the requirement of Farmers to take account of Good Agricultural and Environmental Conditions (GAEC), including physical soil properties.

Farmers are continuing to seek practical guidance. Whilst it would be sensible for further research work to consider this, it may also be sensible to exploit existing work in light of the new demands placed upon Farmers.

2 RECOMMENDATIONS

Cultivation Methods and Establishment

1) Defra publications on soil management for land managers are very comprehensive and are supported by a well funded body of research. Any soils related research work funded by the HGCA should take into account that which has already carried out by Defra and others and should deliver tangible benefits to levy payers.
2) It should be a requirement of all future research in the areas of cultivations and crop establishment that suitable and appropriate soil measurements are made and recorded.
3) Ideally all research projects should attempt to quantify both the environmental and economic benefits of the outcomes of the work to levy payers.
4) Practical guidelines on the advantages and disadvantages of reduced tillage on different soil types from both an environmental and economic perspective need to be drawn up.
5) Given the existing data it should be possible to develop practical guidelines for crop establishment based on soil type and cultivation technique.
6) Further work could look at approaches to improve soil structure in loams and clays to improve establishment, this could include incorporation of bio waste products and recycled gypsum.
7) More information is required by Farmers to reduce the risk of soil erosion and run-off. This would need to be carried out in conjunction with the Defra guidelines and taking into account any existing work being funded by Defra.

Precision Farming

8) The use of controlled traffic to minimise soil compaction should be further investigated.
9) Farmers require guidance in order to exploit yield mapping data to make decisions about variable rate management. Therefore it is suggested that consideration is given to whether it is possible to prepare such guidance, from existing or future research.
10) There are a number of key research projects that have been undertaken in the whole area of measuring soil physical properties and spatial variability of a range of parameters. The impression is that they haven't yet delivered all their potential. HGCA levy payers would benefit from bringing together the researchers involved in these areas with commercial service providers in order to move this key technical area forward.

11) Existing spatial variation work suggests that it would be sensible to see what opportunities exist to enable Farmers to meet their environmental obligations e.g. application of Nitrogen fertiliser. Any further work in this area needs to be targeted at Farmer's environmental obligations as well as their economic requirements.

3 BACKGROUND

As a result of the Foot and Mouth crisis in 2001 the Government set up the Independent Policy Commission on the Future of Farming and Food, led by Sir Don Curry. Whilst the report exposed many of the weaknesses and failures of the food chain as a whole, it also set out a new vision for the long-term future and how this could be achieved. The vision of the Curry Commission was that of a sustainable and competitive food and farming sector, which could have a significant role to play in the rural economy whilst also delivering positive environmental changes.

The main conclusion from the Curry Commission was that the whole food chain needed to reconnect with its customers, the Global economy, the countryside and the environment. It also identified the long term problems faced by the sector across the three key elements of sustainability:-

Economically:- Profitability was found to be generally low with incomes for farmers having fallen to their lowest levels since the 1930s. Productivity was also low and variable, estimated to be nearly 20% behind World leaders in food production. Investment in capital and people was also poor with a generally low knowledge and skills base.

Environmentally:- Whilst agriculture was shown to have many significant environmental benefits it also had many negative impacts. Damage included the effect of emissions, water pollution and the adverse impact on biodiversity.

Socially:- When linkages to UK jobs in sectors such as food and drink manufacturing and tourism were made the importance of agriculture to the UK economy was shown to be significant. However, the impact of low incomes and morale, isolation and stress on farmers and their families could have a serious impact on rural communities.

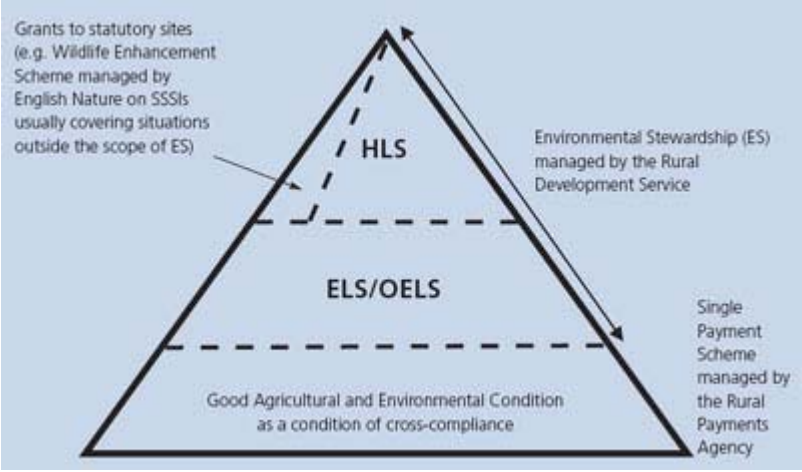
To overcome the problems identified with the future sustainability of the food and farming sector the Curry report emphasised that change was both necessary and desirable. It reinforced the need for action by individual businesses, by the industry working together and by a range of government departments.

As a result of the recommendations made by the Curry commission Defra set out England's "Strategy for Sustainable Farming and Food" in December 2002. This fundamentally changed the relationship; one in which, in the long-term, farming and food would be

unsubsidised but not unsupported. As this strategy developed further, by 2003 the central thread to Defra's strategy included the implementation of the reforms of the Common Agricultural Policy (CAP). The implication being that farmers would be given greater freedom to farm to the demands of the market with subsidies decoupled from production, whilst at the same time being rewarded for environmentally friendly farming practises. As a result of the reform of the CAP in England, ten major CAP payment schemes have been replaced by one new single payment scheme.

To qualify for a subsidy through the Single Payment Scheme Farmers will have to meet cross compliance standards and requirements. There are two types of cross compliance 1) Statutory management requirements which result from EU directives and regulations and 2) Standards to keep land in Good Agricultural and Environmental Condition (GAEC). In addition to subsidy payments through the Single Payment Scheme, Environmental Stewardship schemes are also available whereby compliance with a range of standards rewards the Farmer with additional payments. The Entry Level Scheme (ELS) and Organic Entry Level Scheme (OELS) are available to all Farmers who are eligible and comply with the required standards; the Higher Level Scheme (HLS) is competitive and similar to the former Countryside Stewardship Scheme (see below).

Fig 1. Structure of payment schemes following the reform of the CAP



GAEC for Soils

A key area of cross compliance for the Single Farm Payment is compliance with GAEC for soils. The aim is to manage soils to improve their agricultural potential whilst at the same time reducing the potential for negative impacts on the environment. Well managed soils are an important element of good farm management and sustainable farming systems. Poor soil structure can lead to patchy crops, poor crop growth and yields as well as an increased susceptibility to pests and diseases. It may also result in poor drainage, which in turn will lead to ponding, run-off and soil erosion. Well managed soils will result in a reduced risk of erosion and compaction as well as potentially increasing crop yields and quality. In order to claim entitlement under the SPS it is necessary to comply with the three basic GAEC soil protection standards (Defra 2004 update *Single Payment Scheme:- Information for farmers and growers in England)*. Additionally in 2006 this will include the completion of a Soil Protection Review.

Soil management for the Entry Level Scheme

To enter both the ELS and OELS schemes it will be necessary for Farmers to prepare a Farm Environment Record, part of this record will require a risk assessment of soil erosion on an individual field basis. This Soil Management Plan will require detailed assessments at the field scale in order to identify varying degrees of risk both of run-off or soil wash as well as erosion. In order to satisfy the criteria for ELS/OELS both a Soil Protection Review and a Soil Management Plan will be required. These will also need to be updated on an annual basis.

4 INTRODUCTION.

HGCA-funded research on soil management, cultivations and crop establishment has generally focused on yield optimisation and variable cost reduction. Management of costs through reduction in seed rates, minimisation of cultivations and improved management of pesticide use has been the key to sustaining profitable arable production in an increasingly competitive global market. However, the financial constraints on arable production are changing in the light of CAP reforms and the decoupling of payments from production. Yield optimisation and the management of fixed and variable costs will continue to be important but compliance with legislation will also have a significant financial impact on profitability. As a consequence HGCA commissioned a review of existing HGCA-funded research projects that were either completed within the last few years or were near completion and that may relate to specific requirements under Good Agricultural and Environmental Conditions (GAEC) and Stewardship Schemes.

Aim.

The aim of the review was to re-evaluate and further exploit the findings from these key HGCA research projects in soil management, cultivations and crop establishment. This information could then be used to potentially maintain or increase whole farm profitability in light of decoupled payments whilst complying with GAEC including Sustainable Soil Management.

Approach.

In consultation with HGCA the project team identified 11 key research project reports (listed below), which fell into the areas of soil management, cultivations and crop establishment. Further details of these project reports are given in section 5.1, 5.2 and 5.3.

1 Reduced cultivations: Research, development and advisory needs under changing economic circumstances. Research Review No. 48.
2 Factors affecting cereal establishment and its prediction. Research Review No. 51.
3 Effects of establishment technique and number of management passes on winter wheat production costs. Project Report No. 311.
4 Non-tillage management of Oilseed Rape using the “autocast” technique. Project Report No. 55.

5 Trash distribution and cultivation depth in minimal tillage and direct establishment systems. On going project No. 2799.
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Whole farm models

The initial approach was to try and identify key agronomic practises and approaches described in the project reports and incorporate the data into farm business models. The models were to be developed from those already described and evaluated in the project report T2635 "Evaluation of HGCA Research Project reports 234 and 235" by Graff-Baker & Redrup, 2002. The intention was to have farm business models that could incorporate technical data such as cultivation technique, number of equipment passes, labour requirements and energy use as well as final crop yield and quality. It was recognised that in some cases the agronomic practise for optimal crop production may not be compatible with GAEC and Statutory Management Requirements (SMR). For this reason the farm business models would be flexible to allow for inclusion or exclusion of decoupled payments either through SPS or ELS. However, the initial evaluation of all the project reports by the project team highlighted the lack of detailed information required to run the farm business models in their entirety as well as a general lack of detailed financial data. The nature of the data available limited the use of the models to illustrate the economic impact of high rainfall on a light and heavy land farm. The analysis (see section 5.5) considered the consequences on (i) crop output (ii) direct costs (iii) overhead or indirect costs (iv) subsidy in the form of the Single Farm Payment and Entry Level Scheme monies (v) rent and finance and (vi) profit.

Initial evaluation

In consultation with HGCA the project team decided the environmental benefits in addition to the economic ones should be assessed. It was felt that the best method would be to evaluate the HGCA project reports by scoring the key messages from them in terms of their likely economic or environmental impact. A negative impact was scored as -1, no impact as 0 and a positive impact 1.

It is important to emphasis that this evaluation used data and findings contained directly within the reports, rather than anything implied in the longer term or as a result of possible further work.

The following table summarises this assessment.

Project	**Environmental benefit**	**Economic benefit**
Research Review 48	0	1
Research Review 51	0	1
Project No. 296	0	0
Project No. 302	0	-1
Project No. 311	1	1
Project No. 330	0	-1
Project No. 364	0	0
Project No. OS 55	0	1
Project No. 2469	1	1
On-going project no. 2799	1	0
On-going project no. 2800	1	-1

SWOT analysis

Having carried out an evaluation of the findings of the HGCA project reports based on their likely economic or environmental impact the project team then analysed these further in terms of their potential Strengths, Weaknesses, Opportunities or Threats to the future economic or environmental sustainability of farm businesses. This approach helped to identify areas where research reports gave conflicting or confusing messages and also helped to identify gaps where further work may be required.

5 SUMMARY OF FINDINGS

5.1 Soil Management and Cultivations "Reviews" (2 reports)

Research Review No. 48.
Reduced cultivations: Research, development and advisory needs under changing economic circumstances. (2002).

D B Davies and J B Finney.

Background.

This project report was funded by HGCA and was an updated review following on from Research Review No 5 "Reduced cultivations for Cereals 1988". The review was required as a result of the renewed pressure on cereal growers to reduce their establishment costs, through reductions in labour and machinery, whilst maintaining maximum levels of winter planting and high yields. The authors reviewed the technical and economic changes in the industry as well as on-going research programmes. They also consulted widely in the industry and identified areas where knowledge needed to be updated and/or further research was required. Although this report was completed prior to the reform of the CAP and the development of the Single Payment Scheme, many of its conclusions are still relevant as are some of the recommendations for future work, which have still to be addressed.

Environmental benefits. Score 0.

Both the advantages and disadvantages of reduced tillage were summarised in the report, however, the general conclusion was that environmental benefits on farm, as distinct from trials work, are unclear, sometimes contrary and far from assured.

The authors of the report support this conclusion with several key comments:-

1) "adoption of reduced tillage purely because it is widely and persuasively promoted is a recipe for failure"
2) "potential disadvantages of reduced tillage were poor establishment, worse grass weed problems and more topsoil compaction resulting in run off"
3) "..to expect the general application of shallow tillage to control surface run-off is to overlook that reduced tillage has always to be tailored to site and soil condition"

4) "the improvements in soil quality resulting from long term reduced tillage …need to be evaluated on farms to find out to what extent these improvements are achieved in commercial situations"

Economic Benefits. Score 1

Reduced cultivations offer an opportunity to reduce costs through labour and energy savings. However, reduced tillage systems will not be applicable in all situations, the use of the plough will still be more economic and practical in some cases.

The authors state:-

1) "reducing input into cultivations offers real opportunities for improving farmers' returns"
2) "reduced yields should not and need not be accepted as part of a lower-cost establishment system"
3) "farmers interviewed were well aware that a change to reduced tillage would be profitable only if labour costs per hectare could be reduced…..this meant investment in new implements and larger tractors which in turn would raise machinery costs in the initial years".

Areas for further research

1) There would be benefit from carrying out an environmental quantitative analysis of the advantages and disadvantages of reduced tillage in relation to soil management.
2) Optimum inputs for reduced tillage situations need to be established and a cost: benefit analysis carried out.
3) Methods to handle straw chopping and spreading need to be developed further.
4) The use of controlled traffic to minimise soil compaction should be further investigated.
5) Practical guidelines on the advantages and disadvantages of reduced tillage on different soil types from both an environmental and economic perspective need to be drawn up.

Research Review No. 51.
Factors affecting cereal establishment and its prediction. (2003)

J J Blake, J H Spink and C Dyer.

Background.

This research review evaluated existing research literature on cereal establishment whilst also collating and analysing data from a large number of field experiments carried out over the last 25 years. These consisted of over 1250 individual records from 27 different sites. Due to the large number of research trials included in the evaluation the conclusions drawn tended to be fairly general. A review of the scientific literature indicated the importance of a range of soil characters, which could affect the ability of the seed to germinate and subsequently emerge, these included seed-to-soil contact and water status. Factors affecting emergence were largely those that influenced impedance, for example clod size distribution or sowing depth. The authors were unable to analyse some of the historic data due a lack of information on sowing depth, seedbed quality and soil moisture.

The authors found that an overall average autumn establishment was 67% rather than the generally accepted benchmark of 85%. Sowing date had the greatest effect on establishment, which was generally linked, to soil temperature. Although rainfall did also have an effect on establishment depending upon soil type. A large number of soil types were represented in the data but were grouped into sands, clay and loams; establishment was highest in the sandy soils with an average of 90%, there was little difference between clays and loams with an average establishment of 60-65%. Cultivation type did not seem to have a significant effect on establishment however; there were not a large enough number of cultivation types represented within the data for valid statistical comparisons.

Environmental benefits. Score 0.

There were no environmental benefits identified or discussed within this report.

Economic benefits. Score 1.

No economic assessment of the findings from this review is given in the report, however, there are key areas where economic advantages could be identified:-

1) Early sowing is beneficial for crop establishment allowing for a reduction is seed rate, and hence seed costs.
2) Crop establishment was found to be highest in sandy soils possibly allowing for a reduction in seed rate as compared with clay and loam soils, again potentially reducing seed costs.
3) Early sowing of crops with better establishment would allow more time to complete drilling early reducing risk and costs.

Areas for further research

1) Sandy soils were much better for crop establishment (90% establishment compared with 60-65% in clays and loams). The authors compared the data from sandy soils with data from clays and loams, however, many of these soils were in fact clay loams, which meant that little differentiation was achieved between the two. The reason for sandy soils resulting in better establishment was due to soil structure allowing for better seed:soil contact. Further work could look at approaches to improve soil structure in loams and clays to improve establishment.
2) Data on the effect of cultivation technique on crop establishment is lacking, this requires further work.
3) Based on 1 and 2 under Economic benefits above, together with other additional data such as rainfall it should also be possible to develop practical guidance.
4) The review identified “a serious deficiency in the monitoring and appropriate measurement of seed bed characteristics, which is essential in predicting seedling establishment. This lack of monitoring of soil and seedbed condition even extends to those experiments claiming to compare different soil management and seed bed cultivation systems”. It is recommended that a requirement of all future research in this subject area is that suitable soil measurements are made and recorded.

5.2 Soil management and Cultivations "Trials" (5 reports)

Project Report No. 311.
Effects of establishment technique and number of management passes on winter wheat production costs (2003)

S M Knight.

Background

The aim of this project was to reduce the unit cost of consecutive wheat crop production without reducing output by focusing on the interaction between lower-cost establishment and minimum pass husbandry. Trials were conducted on three soil types i) light chalk land soils, ii) medium loam soil and iii) heavy chalky clay loam. Variables examined were establishment method, use of take-all seed treatments and the number of in-crop husbandry passes, i.e. two 'minimum' pass systems (3 & 4 core passes) compared with a 'control' treatment of 7 core passes.

Environmental benefits. Score 1.

1) Minimum tillage and direct drilling were shown to produce just as good, if not better, yields on light chalk and medium loam soils. Less energy is expanded using these techniques as compared with ploughing hence reducing greenhouse gas emissions.
2) Minimum tillage on light soils is less likely to result in soil erosion than ploughing.
3) The project demonstrated a negative environmental effect of minimum tillage and direct drilling on heavy clay soils in a wet season when ponding and surface run-off occurred.
4) The project also demonstrated the adverse build up of grass weeds when using minimum tillage and direct drilling both in medium loam and heavy clay soils.
5) Reductions in fungicide inputs were only sustainable in dry years when the disease pressure was low.

Economic benefits. Score 1

1) The project demonstrated that higher yields were achievable from minimum tillage and direct drilling on light chalk soils. There are dual benefits; lower cultivation costs and improved yield with a consequent effect on profitability.
2) In a wet autumn on heavy clay soils there was a positive economic benefit from ploughing.
3) Perhaps not surprisingly the project demonstrated increased yields from an increased number of fungicide and nitrogen passes through the crop. However, in general, these increases were not sufficiently great that they resulted in an overall economic advantage when the additional costs of application were taken into account.
4) A combination of minimum tillage and minimum pass husbandry improved overall margins by an average of £120/ha on light chalk land soils and £52/ha on heavy clay soils. On the medium loams the best combination of direct sow and a minimum pass gave an improvement of £36/ha.

Areas for further research.

a) The existing data contains no information on the effects of different cultivation techniques on surface run-off of water and on soil erosion.
b) The project mentions the build up of grass weeds on heavy land but it was not conducted over a long enough period of time to assess the full economic impact of this build up.

Project Report No. OS55

Non-tillage establishment of oilseed rape using the "autocast" technique. (2002).

B Freer.

Background

This project report describes the method of "autocasting" whereby oilseed rape is sown by spreading the seed into the stubble of the preceding crop as it is harvested. The greatest problem was found to be slug damage as they could feed undetected on the soil surface but underneath the straw mulch. Soil condition was also found to be critical for success; if there was no surface tilth as a result of compaction then establishment was likely to be poor. Self-structuring clays such as Hanslope series were found to be the best candidate for this technique. An advantage of not disturbing the soil surface was the absence of an autumn flush of weeds such that in many cases a broad-leaved herbicide was not required representing a considerable saving.

Environmental benefits. Score 0.

There are positive and negative environmental effects with the use of "autocast" hence the zero score.

1) From a GAEC perspective, "autocast" in some circumstances has advantages. On well structured soils there is less risk of soil erosion and surface run off, in the absence of any cultivation.
2) With zero soil disturbance there will be minimal mineralisation of nitrogen and potentially reduced leaching of nitrogen and phosphate.
3) A reduced number of passes will result in the use of less fossil fuel, and hence lower greenhouse gas emissions.
4) Less weed control is required due to non-disturbance of the soil surface preventing an autumn flush of weeds.
5) A negative environmental factor is the high risk of slug damage resulting in the potential for the increased use of slug pellets.

Economic benefits. Score 1.

1) There is an economic advantage to using the "autocast" system as the establishment costs and time inputs are reduced. The cost of establishing oilseed rape by "autocast" has been estimated as £32/ha as compared with £140/ha using a ploughing technique.
2) There is considerable time saving in using "autocast" at a busy time of year, less men and machinery resources are required.
3) Herbicide input costs can also be reduced although more care needs to be taken with slug control.
4) A negative impact is that in some situations the technique is not 100% reliable. "Autocast" cannot be used on all soil types and care needs to be taken when deciding to take this approach. Compacted soils or those with poor soil structure and surface tilth are not ideal.

Areas for further research

Events have overtaken this project. Many farmers now use reduced pass systems for establishing oilseed rape by mounting units similar to the "autocast" on a range of different cultivators.

The area of "autocast" has probably been sufficiently investigated although further cost: benefit analysis of a range of oilseed rape establishment techniques including broadcasting and drilling may have some virtue. Comparing the risk of soil erosion and water run-off as a result of the different systems would also be of value.

On going project No. 2799

Trash distribution and cultivation depth in minimal tillage and direct establishment systems.

Lead participant The Arable Group.

Background.

This is an on-going project and so a final report has yet to be submitted. The project aim is to determine the effects of trash distribution, stubble length and cultivation depth on the establishment and yield of winter wheat sown direct or after minimal tillage. Comments and evaluations made on this project are only based on the Annual Project Reports available from HGCA so may not reflect the final outcomes of the work.

Environmental benefits. Score 1

1) There is potentially an energy saving from direct drilling compared with other cultivation techniques that involve an increased number of passes or depth of cultivation, this will help to reduce greenhouse gas emissions as well as having a cost benefit.
2) Less soil disturbance is likely to lead to less surface run-off and/or soil erosion, which is a requirement of GAEC.

Economic benefits. Score 0

The economic benefits of raking straw at present seem to be inconclusive although further data from the project may help to clarify the situation. There are some indications that raking trash prior to direct drilling can improve yield. The overall yield of direct drilling on heavy land was significantly lower than when using a minimum tillage technique. There was no increase in yield when raking in front of the minimum tillage system.

Areas for further research

As previously stated this project has not yet been completed so it is too early to give any recommendations, however, the key questions that need to be answered from this work are:

1) does raking straw lead to a consistent yield increases?
2) are there more benefits from raking straw when using direct drilling or minimum tillage?
3) is it the case that the deeper you cultivate the less influence there is from trash?

On going project No. 2800

Influence of green manuring in wheat rotations under different cultivation systems.

Lead participant The Arable Group.

Background.

This is an on-going project and so a final report has yet to be submitted. The project aim is to assess whether the effect of green manure is influenced by cultivation system. Comments and evaluations made on this project are only based on the Annual Project Reports available from HGCA so may not reflect the final outcomes of the work.

Environmental benefit. Score 1

The project has been investigating the use of green manure (white mustard) planted prior to continuous wheat and on set aside prior to the establishment of wheat. To date the environmental benefits cannot easily be assessed as positive or negative, however, microbial bio-mass was found to increase hence the positive score.

Economic benefit. Score –1

The economics of planting green manure crops in a wheat rotation were inconsistent both in terms of the establishment technique of wheat and whether it was in front of either continuous wheat or planted on set-aside. The costs of establishing the green manure have not yet been assessed.

Areas for further research.

This project is on going, further year on year comparisons will help to clarify the potential for environmental and economic benefits of this approach.

Project No. 2469

Improving crop profitability by using minimum cultivation and exploiting grass weed ecology.

Lead partner: ADAS.

Background.

This project was designed to assess the level of blackgrass seed dormancy and therefore exploit the opportunity to control blackgrass without the use of selective herbicide through promoting germination prior to drilling.

The project also sought to contain the infestation within a reduced cultivation system but without increasing the reliance on herbicides and increasing resistance.

Environmental benefit. Score 1

The project identified a correlation between temperature during June and July and dormancy. Therefore the project has identified the opportunity for the farmer to include temperature (during these months) in his or her consideration of how and when to cultivate for and drill the subsequent crop. Consequently there is the possibility of identifying those seasons for which (i) less herbicide and / or (ii) less fuel for cultivations could be used and / or (iii) an optimum drilling date.

Economic benefit. Score 1

The opportunity to identify those seasons in which less fuel and/or herbicide could be used has clear economic benefits in addition to the above environmental ones.

Areas for further research.

A reliable method of predicting which seasons provides the opportunity for promoting early germination and therefore when and how less fuel and / or herbicide can be used.

A guide as to how and when to use both non-selective herbicide and reduced cultivation with which to reduce cost and the environmental impact of ploughing and the use of selective herbicides.

5.3 Soil Variation (4 reports)

Project Report No. 296.
Developing a cost-effective procedure for investigating within-field variation of soil conditions (2003).

R M Lark, H C Wheeler, R I Bradley, T R Mayr and P M R Dampney.

Background

The aim of this project was to develop a cost-effective method for investigating soil variability within fields as an aid to farm-level decisions for the adoption of variable rate management of inputs. The assumption was that not all fields would merit variable rate management and so cost effective methods of investigation using cheap and available sources of data would help to determine whether variable management within a field was feasible and cost effective.

The authors took the approach that the scale and magnitude of variation in yield, as measured by yield maps, could act as an indicator for more detailed assessment of a field either by an expert or through extensive soil sampling. The division of fields into zones whereby the season-to-season variation of crop yield was more or less uniform within a zone could be used to identify the spatial structure of key variables of soil properties, which influenced crop performance within these zones. It was demonstrated that in all fields at least some measure of soil variables were significantly associated with the zonation of the field based on yield data. Using the analysis of historic yield maps in conjunction with detailed soil sampling methods the project developed a classification tree which could be used as a decision support tool to support on farm decisions.

Environmental benefit. Score 0.

There are no comments in the report about any possible environmental impacts from the project outcomes.

Economic benefits. Score 0.

Although it could be argued that zoning fields and varying inputs by variable rate technology could have an economic impact (both positive and negative) this was not analysed within the report.

Areas for future work.

This project was the precursor for other project reports also reviewed in this study and so some of the future work coming from this report has been addressed. However, no decision tool, which allows Farmers to exploit yield-mapped data to make decision about variable rate management, yet exists in the public domain.

Project Report No. 302.
Evaluation of non-intrusive sensors for measuring soil physical properties. (2003).

J A King, P M R Dampney, R M Lark, H C Wheeler, R I Bradley, T Mayr and N Russill.

Background.

The aim of this project was to evaluate the practical usefulness and applicability of three soil sensor technologies for measuring and mapping important soil physical properties within fields and to develop robust protocols for using them on farm. The sensor systems that were evaluated were Electro-Magnetic Induction (EMI), which measures the apparent electrical conductivity of the soil (ECa), Ground Penetrating Radar (GPR) and spectral reflectance. Of the three systems only EMI was commercially available to farmers at the time of the project although spectral reflectance measurements were available from some satellite image providers. The project attempted to identify the best sensor technique, or combination of techniques by investigating different sensor configurations, the associated accuracy of the measurements and the stability at different times of measurement during the season.

Environmental benefit. Score 0.

Due to the nature of this research project, no specific evaluation of the likely environmental benefits that could be derived from the application of any of the sensor technologies was made.

Economic benefits. Score –1

At the time that this project was carried out the use of all three sensor technologies was still at the experimental phase. As a result, the application and use of these technologies at the farm level would inevitably incur a significant cost. Although it could be argued that this cost may be less than the equivalent cost of lab based soil analyses, no direct comparisons were made.

Areas for future work.

1) Since this research project was carried out a number of commercial companies have developed services around spatial soil sampling, the use of EMI scanning and spectral reflectance primarily of crop canopy characteristics. Further detailed research is probably not cost effective or necessary. However, an independent evaluation of the services available and their relative merits and cost: benefit would be of value to levy payers.
2) There are a number of key research projects that have been undertaken in the whole area of measuring soil physical properties and spatial variability of a range of parameters. It could be beneficial to bring together the researchers involved in these areas with commercial service providers in order to move this key technical area forward.
3) Existing spatial variation work suggests that it would be sensible to see what opportunities exist to enable Farmers to meet their environmental obligations e.g. application of Nitrogen fertiliser. Any further work in this area needs to be targeted at Farmer's environmental obligations as well as their economic requirements.

Project Report No. 330.

Description of spatial variation in soil to optimise cereal management (2004).

M A Oliver and Z L Carroll

Background

This project aimed to determine the causes of variation in yield through extensive and detailed soil, crop and environmental surveys in order to support on-farm decision making to ameliorate some, or all of these causes. The rationale behind the project was that site-specific crop management requires detailed information about the level of variation in a range of soil properties. The project team accepted that the types of intensive sampling described within the project report were likely to be beyond the scope of most farm budgets to acquire. They therefore also attempted to explore the potential use of ancillary data, such as yield, elevation, the soils apparent electrical conductivity (from EMI surveys) as well as aerial photographs to provide intensive and relatively cheap information as a substitute for expensive soil data.

The project demonstrated that many soil properties were consistent both within the topsoil and subsoil level with similar patterns of variation. They did find that in some cases several soil properties varied at a similar spatial scale that matched some of the ancillary data. However, ancillary data and soil properties, both between and within fields, often varied from place to place, making generalisations difficult. Such moving correlations with fields demonstrated the level of complexity involved. Perhaps surprisingly, the crop attributes monitored showed a weak relationship to final yield and most soil properties. Comparing all sources of ancillary data, the use of EMI survey data appeared to be the most promising with aerial imagery the least. This may have been different had spectral reflectance imagery been more available at the time of the study.

The project identified the fact that farmers would obtain more valuable information from analysing both the sub soil as well as the topsoil, instead of just the latter. Root analysis in the study also suggested that compaction is an issue which could be easily addressed and could have a positive impact on yield.

Environmental benefits. Score 0.

As has been the case in other similar project reports, the environmental benefits have only been alluded to rather than specifically demonstrated or quantified.

Economic benefits. Score -1.

The project team themselves identify the fact that extensive soil, crop and environmental parameter sampling is expensive and generally beyond the normal budget for most farm businesses. They do recognise the need for substitute methods of obtaining such data and look at the use of ancillary data. Although this would obviously reduce the costs compared with lab analysis, ancillary data, particularly from say EMI scanning, this would also have a cost associated with it. This research project was carried out at a time when the commercial application and provision of sensor technology data was in its infancy. As the technology develops it should be possible to undertake a robust economic assessment.

Project Report No. 364.

Developing methods to improve sampling efficiency for automated soil mapping (2005).

B P Marchant, R M lark and H C Wheeler.

Background

The aim of the project was to develop a method to sample spatial variables in such a way as to make such sampling both efficient and cost effective. The rationale was that prior to this project, with an unknown level of spatial variability within a field, farmers and agronomist ran the risk of over-sampling for a given parameter thus incurring unnecessary costs.

Having developed an approach to optimize sampling the project team showed that they could develop a scheme whereby they could successfully use models to predict the potential error of any variance, they also demonstrated that under different underlying levels of spatial variation, such as from crop and soil parameters, the resulting sampling scheme was able to provide adequate estimates of the variogram. This approach also allowed for the disposal of some sampling points from which to map the given variable.

From this initial approach, the project team developed a fully adaptive sampling scheme. As a result, they recommended an initial set of "reconnaissance" phases, which would enable an initial indication of the level of sampling, required to identify the level of variability present in a given situation. Using an iterative process from each of these "reconnaissance" sampling phases, it was possible to justify whether further sampling was necessary before moving on to a final sampling phase for mapping.

The project outcome was a set of algorithms, which could potentially be used to achieve substantial efficiencies in sampling. The long term goal was to apply some of these algorithms into a simpler sampling model, which could potentially be used by farmers and agronomists.

It should be noted that essentially this project was carried out as a piece of strategic research with relevance to HGCA rather than with the primary aim of generating immediate solutions to levy-payers' problems.

Environmental benefits. Score 0.

As this piece of research was strategic rather than applied in nature there were no directly measurable environmental benefits.

Economic benefits. Score 0.

As this piece of research was strategic rather than applied in nature there was no attempt made to carry out an economic assessment of the likely financial benefits.

Areas for further research

1) This work demonstrates that there is scope to make the sampling of spatial variables less uncertain through the methods described. These need to be developed further in order for them to be applied at a practical, levy-payer level.
2) Laboratory analysis of soil and crop samples is inevitably expensive and unlikely to be economically practical in intensive sampling regimes in the long term. However, there is potential to couple the approaches described in this work with the potential development of the use of remote sensing technologies, such as EMI scanning, in the future.
3) There is potentially merit in having a better understanding of spatial variability of soil and crop parameters in order to optimize variable inputs thereby reducing environmental contamination through excessive inputs. The work described in the project report needs to be developed further, at a practical in-field level, in order to demonstrate and quantify the economic and environmental benefits.

5.4 SWOT analysis

Cultivations and establishment (Environmental)

Strengths

- Minimum tillage and direct drilling uses less fuel than alternative techniques (311)
- Significant reductions in fuel use from auto casting oilseed rape (55)
- Reduced risk of surface run off and erosion from auto casting in the absence of surface compaction (55)
- Potentially reduced weed burden and therefore control from auto casting (55)

Weaknesses

- Reduced tillage on farm provided unclear and sometimes conflicting environmental benefits (48)
- Increased use of slug pellets due to auto casting (55)
- High rainfall means more ploughing and therefore more fuel (48)

Opportunities

- To reduce fungicide inputs in a dry season (311)
- The availability of reliable reduced cultivation techniques may encourage farmers to adopt a management system that uses less fuel and pesticide rather than pursuing a high input approach particularly under the circumstances of decoupled subsidy and low crop prices (48)
- Poor experience of reduced cultivations will encourage farmers to revert to conventional methods which potentially use more fuel and pesticide (48)
- Low rainfall and good soil structure allows reduced cultivation (48)
- Reduce the level of blackgrass taking account of the level of seed dormancy (2469)

Threats

- Ponding and surface run off from minimum tillage and direct drilling on heavy clay soils in a wet season (311)
- Adverse build up of grass weeds from minimum tillage and direct drilling on medium loam and heavy clay soils (311)
- Poor experience of reduced cultivations will encourage farmers to revert to conventional methods which potentially use more fuel and pesticide (48)

SWOT analysis – Cultivations and establishment (Economics)

Strengths

- Reduced seed rates from early sowing (51)
- Sandy soils allow reduced seed rates (51)
- Higher yields from minimal tillage on light chalk soils (311)
- A more reliable margin is available from a wheat crop on heavy wet soils by ploughing compared with other techniques (311)
- Minimum tillage combined with minimum pass husbandry increased margins on a variety of soil types (311)
- Significant savings in establishment are available from auto casting Oilseed Rape (55)
- Less labour and fuel is used when auto casting compared with the alternatives (55)
- Reduced herbicide costs are possible with auto casting Oilseed Rape (55)
- Economies of scale are possible when designing the establishment policy for a particular farm, but may rely on some form of cooperation with nearby businesses (48)
- Minimum tillage and direct drilling uses less fuel than alternative techniques (311)
- Significant reductions in fuel use from auto casting oilseed rape (55)

Weaknesses

- Auto casting is a less reliable technique on compacted soils and can result in crop failure leading to an increase in overall cost and a reduction in yield (55)
- Increased use of slug pellets due to auto casting (55)
- High rainfall means more ploughing and therefore more fuel (48)

Opportunities

- Starting drilling early reduces the risk of crop failure and therefore provides a more reliable profit (51)
- Reduced cultivations can reduce labour and energy costs (48)
- To reduce fungicide inputs in a dry season and therefore reduced cost (311)
- The availability of reliable reduced cultivation techniques may encourage farmers to adopt a management system than uses less fuel and pesticide rather than pursuing a high input approach particularly under the circumstances of decoupled subsidy and low crop prices (48)

- Low rainfall and good soil structure allows reduced cultivation (48)
- Reduce the level of blackgrass to taking account the level of seed dormancy (2469)

Threats

- Reduced cultivations in the wrong circumstance can lead to an increase in labour and energy / fuel costs (48)
- Higher yield from extra nitrogen and fungicide may not be economic (311)
- Poor experience of reduced cultivations will encourage farmers to revert to conventional methods which potentially use more fuel and pesticide (48)

SWOT analysis - Spatial Variation (Environment)

Strengths

- Any change in technology that may give an increase in the precision of information over what is done now constitutes an advance
- It has been shown that at present, zoning fields and targeting sampling can achieve benefits without much more sampling effort than is commonly used now. This can be supported by the existing local knowledge.

Weaknesses

- A large proportion of research on spatial variability to date has been focused on N management.
- Although zoning fields and target sampling will provide benefits over and above more simple strategies some measure of variation will still exist.

Opportunities

- Project findings demonstrate that Farmers could add value to yield maps, which has not hitherto been possible. There is scope to develop methods to facilitate the interpretation of yield map data so aid future soil and crop management.
- Sound information on soil physical properties is important; EMI sensing could provide valuable information on how to sample for this.
- Whilst some properties could be determined automatically, the key is developing methods to use and interpret the information.
- Given the pressure on farmer's time, methods that could aid sampling strategies and data interpretation whilst reducing management time would be of great benefit.

Threats

- Projects highlight that it is important to follow basic protocols and ensure the use of good quality labs otherwise soil analysis data will have no value and may even give mis-leading information.

SWOT analysis - Spatial Variation (Economic)

Strengths

- Any change in technology that may give an increase in the precision of information over what is done now constitutes an advance
- It has been shown that at present, zoning fields and targeting sampling can achieve benefits without much more sampling effort than is commonly used now. This can be supported by the existing Farmer local knowledge.

Weaknesses

- It is likely that different sampling strategies would be needed to sample different variables, this adds complexity & makes data interpretation difficult.
- Fewer than 500 Combines have yield mapping equipment.
- To date it has been difficult to interpret the data for future decision making.
- Throughout the research projects there is little robust data on cost: benefit analysis, this is in part due to the strategic nature of some of the research, the lack of financial data at the time and also changes in the CAP which happened after the inception of the work.
- Given the extreme pressure on Farmer time and budgets it is important to quantify the benefits of improved soil sampling and yield monitoring to the end user. This cannot be achieved without realistic financial evaluations.

Opportunities

- Project findings demonstrate that Farmers could add value to yield maps, which has not hitherto been possible. There is scope to develop methods to facilitate the interpretation of yield map data so aid future soil and crop management.
- Whilst some properties could be determined automatically, the key is developing methods to use and interpret the information.
- Given the pressure on farmer's time, methods that could aid sampling strategies and data interpretation whilst reducing management time would be of great benefit.

Threats

- Although changes in technology may be an advance in increasing the precision of information over what is done currently, such advances may not be economic.
- Projects highlight that it is important to follow basic protocols and ensure the use of good quality laboratories; otherwise soil analysis data with have no value and may even give mis-leading information.

5.5 Economic Assessment

The base model originally used in 2002 (Project Report T2635 *'Evaluation of HGCA Research Project Reports 234 and 235'* by Graff-Baker and Redrup) has been updated to take account of developments on the model farm in the last four years. The model incorporates a Single Farm Payment and income from the Entry Level Scheme. Changes have been made to sales prices and input prices to reflect current market conditions. The system of crop establishment has been altered to minimum tillage from a plough-based system. The main consequence of this change from the base model of 2002 has been the reduction of full time labour from two to one employed man.

An initial evaluation of all the project reports by the project team has highlighted the lack of detailed information with which to run the farm business model. Many of the projects have not been specifically designed to provide financial information. There has been little reference to environmental factors that have to be considered in complying with GAEC (Good Agricultural and Environmental Conditions). The authors have kept the modelling to a simple scenario, making logical assumptions where the data has not been supported from the reviewed project work.

The base model has assumed a 500 ha farm growing combinable crops and sugar beet. In the main, minimal cultivation techniques have been used to establish cereals. The labour force comprises the proprietor and full time employee with temporary labour as required.

The Single Farm Payment and Entry Level Scheme receipts have been estimated at £220.70/ha (£89/ac). The profit is £24/ha (£10/ac) after allowing for rent and finance of £165.4/ha (£67/ac).

The project team concluded that the major challenge in complying with GAEC would be in a wet autumn. Wet conditions on a heavy clay soil would test the model farm's ability to comply with the regulations in GAEC 3 (Waterlogged Soil). Two scenarios have been reviewed looking at the model farm as a heavy land farm in a wet autumn utilising minimal tillage and a similar scenario but reverting to crop establishment based on ploughing.

Heavy and Wet (Min Tillage)

It has been concluded that the yield of all crops would be compromised as a consequence of establishing crops on heavy land in wet conditions (Project Report 311). The first wheat

yields have been reduced by 0.25 t/ha to 1.5 t/ha, the latter reduction applied to wheat sown late after sugar beet. Inputs have been adjusted to take account of establishment in poorer conditions, particularly seed costs. Labour costs and fuel costs have been increased marginally to take account of slower work rates over an extended period of time. Single Payment has been reduced by 3% with the result of being judged non compliant for GAEC 3.

A consequence of these changes has been to reduce profitability from £12,182 to a loss of £10,400. The single largest impact has been the reduced yield. The reduction in Single Farm Payment of £3311 has been relatively minor compared to the reduction in output through consequence of yield of £13,189.

Heavy and Wet (Plough)

The model has been revised to take account of ploughing rather than relying on minimal tillage. Overhead costs have been increased to take account of a higher power requirement (an additional tractor), slower work rates and additional investment in machinery. As a result of making these changes, overhead costs have increased by £17,365 compared with the standard model relying on minimum tillage. It was concluded that there would be no reduction in the yield of crops established at the normal time, as the ploughing system would result in more reliable seed beds in a wet autumn. A reduction has been applied only to the yield from wheat after late lifted sugar beet. The farm was considered to be cross compliant with GAEC 3 utilising this system.

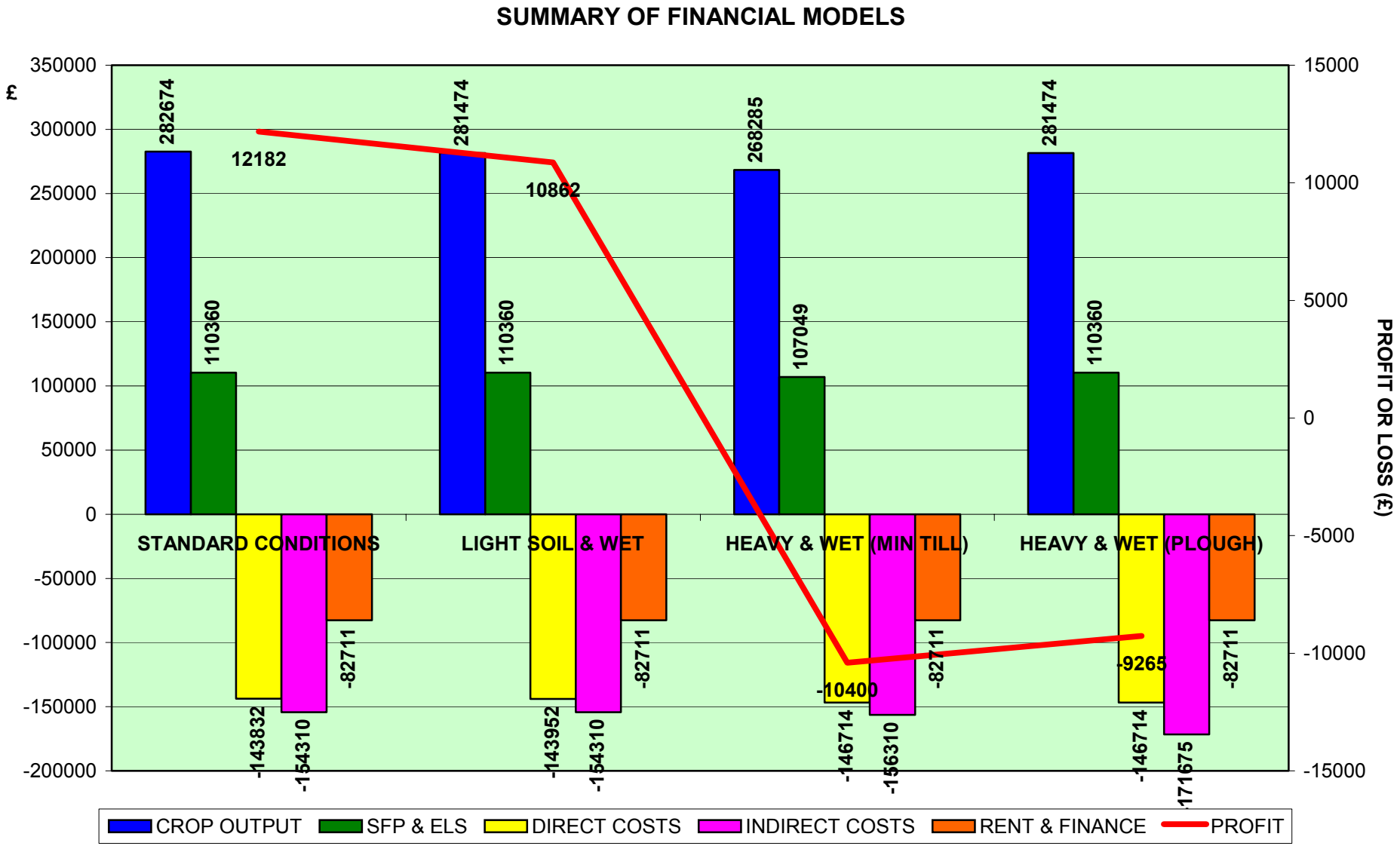
The resultant "profit" has been a loss of £9265. The farm avoided any reduction in Single Farm Payment and substantial yield loss, but was penalised through increased overhead costs. The net loss was similar to the model utilising minimal tillage in a wet autumn.

Light Soil Wet Autumn

The impact of wet conditions on a light soil was considered to be minimal. A yield reduction had been applied to wheat established after late lifted sugar beet. Otherwise no other changes had been made to this model compared with the standard. It was concluded that minimum tillage would work satisfactorily on light soils in a wet autumn, providing the farmer let the land partially drain after significant rainfall. The impact of breaching GAEC cross compliance on this farm was been considered to be minimal with a marginal reduction in profitability resulting from yield reduction rather than breaching cross compliance.

SUMMARY

The results of the modelling are illustrated in graph shown below. This limited modelling demonstrates that there is a possibility of breaching cross compliance as a result of inappropriate cultivation technique, particularly on a heavy soil type. However, in consideration of the overall economic perspective, care must be taken not to increase overheads to such an extent that they increase more than a consequence of any yield loss or reduction in Single Farm Payment. It is assumed that any cross compliance penalty is considered to be limited to a non-farm effect, and although it might be severe in the particular year, is nevertheless rectifiable. *(See Appendix II for guidance for UK Paying Agencies).*


SUMMARY OF FINANCIAL MODELS
£
350000
300000
250000
200000
150000
100000
50000
0
-50000
-100000
-150000
-200000
15000
10000
5000
0
-5000
-10000
-15000
PROFIT OR LOSS (£)
282674
110360
-143832
-154310
-82711
12182
281474
110360
-143952
-154310
-82711
10862
268285
107049
-146714
-156310
-82711
-10400
281474
110360
-146714
-171675
-82711
-9265
STANDARD CONDITIONS
LIGHT SOIL & WET
HEAVY & WET (MIN TILL)
HEAVY & WET (PLOUGH)
CROP OUTPUT
SFP & ELS
DIRECT COSTS
INDIRECT COSTS
RENT & FINANCE
PROFIT

APPENDIX I

STANDARD CONDITIONS (BASE MODEL)

BUDGETED FARM PROFITABILITY

for the Year Ending

September 30th 2006

Prepared on behalf of

HGCA Model Farm
Project 3163

BTR / HM100

4th January 2006

HGCA PROJECT 3163 UK FARM

PROFITABILITY SUMMARY

Year Ending September 30th 2006

GROSS MARGINS	Budget		
Crop	**Ha**	**£ Total**	**£ /Ha**
1st Wheat (Feed)	84.50	28,924	342.3
2nd Wheat (Class 1)	58.13	16,555	284.8
2nd Wheat (Class 2)	58.13	14,201	244.3
Winter Barley (Feed)	114.86	27,141	236.3
Winter Oilseed Rape	74.38	19,956	268.3
Non Rotational Set Aside	40.00	0	0.0
Sugar Beet	40.00	22,500	562.5
1st Wheat late sown	30.00	9,564	318.8
Single Farm Payment and ELS		110,360	220.7
Non Farmed Area			
TOTAL GROSS MARGIN	500.00	249,203	498.4
OVERHEAD COSTS			0.0
Labour		33,700	67.4
Power		97,260	194.5
Administration		9,950	19.9
Property Costs		13,400	26.8
Total Overheads		154,310	308.6
Pre Rent and Finance		94,893	189.8
Rent and Finance		82,711	165.4
MANAGEMENT PROFIT (LOSS)		**12,182**	**24.4**

CROP GROSS MARGINS

0	TOTAL		1st Wheat (Feed)		2nd Wheat (Class 1)		2nd Wheat (Class 2)		Winter Barley (Feed)		Winter Oilseed Rape		Non Rotational Set Aside		Sugar Beet		1st Wheat late sown	
OUTPUT	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha
Crop Area	500.00		84.50		58.13		58.13		114.86		74.38		40.00		40.00		30.00	
Tonnes			802.75	9.50	435.98	7.50	450.51	7.75	861.45	7.50	260.33	3.50			2,000.00	50.00	225.00	7.50
0 Price/Tonne			65.00		80.00		70.00		65.00		145.00				23.17		80.00	
Haulage Allowance															3.00			
Total Crop	282,674	565.3	52,179	617.5	34,878	600.0	31,536	542.5	55,994	487.5	37,748	507.5	0	0.0	52,340	1,308.5	18,000	600.0
Other Sales	0	0.0	0	0.0														
Area Aid	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0			0	0.0
Home used during year	0	0.0																
Home used cl. valuation	0	0.0																
Total Home Used	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
TOTAL OUTPUT	**282,674**	**565.3**	**52,179**	**617.5**	**34,878**	**600.0**	**31,536**	**542.5**	**55,994**	**487.5**	**37,748**	**507.5**	**0**	**0.0**	**52,340**	**1,308.5**	**18,000**	**600.0**
DIRECT COSTS	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha
Combined HS & purchased	18,543	37.1	2,620	31.0	2,209	38.0	1,976	34.0	3,561	31.0	1,488	20.0			5,400	135.0	1,290	43.0
0	0	0.0																
Total Seed	18,543	37.1	2,620	31.0	2,209	38.0	1,976	34.0	3,561	31.0	1,488	20.0	0	0.0	5,400	135.0	1,290	43.0
Nitrogen	39,416	78.8	7,098	84.0	6,104	105.0	5,348	92.0	9,189	80.0	6,248	84.0			2,280	57.0	3,150	105.0
Base Fertilisers	11,524	23.0	1,876	22.2	1,290	22.2	1,290	22.2	2,550	22.2	1,651	22.2			2,200	55.0	666	22.2
Total Fertilisers	50,940	101.9	8,974	106.2	7,394	127.2	6,638	114.2	11,739	102.2	7,899	106.2	0	0.0	4,480	112.0	3,816	127.2
Autumn Herbicides	16,242	32.5	3,803	45.0	2,616	45.0	2,616	45.0	3,331	29.0	2,826	38.0					1,050	35.0
Spring Herbicides	8,372	16.7	845	10.0	581	10.0	581	10.0	1,149	10.0	1,116	15.0			3,800	95.0	300	10.0
Fungicides	20,870	41.7	4,648	55.0	3,720	64.0	3,720	64.0	5,628	49.0	1,413	19.0			240	6.0	1,500	50.0
Insecticides	3,612	7.2	845	10.0	756	13.0	756	13.0	689	6.0	446	6.0			0	0.0	120	4.0
Growth Regulators	6,730	13.5	1,521	18.0	1,046	18.0	1,046	18.0	2,757	24.0							360	12.0
Total Sprays	55,825	111.7	11,661	138.0	8,720	150.0	8,720	150.0	13,553	118.0	5,802	78.0	0	0.0	4,040	101.0	3,330	111.0
Other Crop Costs	0	0.0																
Swathing	2,603	5.2							0	0.0	2,603	35.0						
Casual Labour	0	0.0																
Lifting	6,200	12.4									0	0.0			6,200	155.0		
Drilling	1,720	3.4									0	0.0			1,720	43.0		
Haulage	8,000	16.0									0	0.0			8,000	200.0		
TOTAL DIRECT COSTS	**143,832**	**287.7**	**23,254**	**275.2**	**18,323**	**315.2**	**17,334**	**298**	**28,853**	**251.2**	**17,792**	**239.2**	**0**	**0.0**	**29,840**	**746.0**	**8,436**	**281.2**
GROSS MARGIN	**138,843**	**277.7**	**28,924**	**342.3**	**16,555**	**284.8**	**14,201**	**244.3**	**27,141**	**236.3**	**19,956**	**268.3**	**0**	**0.0**	**22,500**	**562.5**	**9,564**	**318.8**

SINGLE FARM PAYMENT AND ELS INCOME

SFP and ELS	Sundry Income	£ Ha
Single Farm Payment	95,360	190.7
Entry Level Scheme	15,000	30.0
Environmental Schemes		0.0
Other Rents		0.0
Other Income		0.0
Deposit Account Interest	0	0.0
Total Non Farming Income	**110,360**	**220.7**

OVERHEAD COSTS

LABOUR	Total	£ Ha
Regular Wages	20,200	40.4
Employment Costs (NIC etc)	1,950	3.9
Other Regular Costs		0.0
Casual Wages	10,000	20.0
Community Charge	1,550	3.1
Total Labour	**33,700**	**67.4**
POWER	Total	£ Ha
Machinery Depreciation	49,010	98.0
Secondary Leasing		0.0
Machinery Repairs	22,500	45.0
Fuel (Tractor & Drier) Electicity	22,000	44.0
Electricity		0.0
Vehicle Tax & Ins	3,750	7.5
Haulage		0.0
Contract and Hire		0.0
Other Power Costs		0.0
Total Power	**97,260**	**194.5**
ADMINISTRATION	Total	£ Ha
Office Costs	2,600	5.2
Professional Fees	2,750	5.5
Telephone Costs	1,950	3.9
Insurance	1,400	2.8
Subscriptions	750	1.5
Miscellaneous	500	1.0
Other Administration Costs		0.0
Total Administration	**9,950**	**19.9**
PROPERTY COSTS	Total	£ Ha
Property Depreciation	5,250	10.5
Property Repairs	5,500	11.0
Water & Drainage Rates	850	1.7
Lime & General Sprays	1,800	3.6
Property Taxes		0.0
Storage		0.0
Other Property Costs		0.0
Total Property Costs	**13,400**	**26.8**
RENT AND FINANCE	Total	£ Ha
Rent	75,000	150.0
Bank Charges	850	1.7
Lease & HP Interest		0.0
Other Loan Interest		0.0
Bank Interest	6,861	13.7
Other Rent & Finance Costs		0.0
Total Rent & Finance	**82,711**	**165.4**

TOTAL FIXED COSTS	**237,021**	**474.0**

FIXED ASSET AND DEPRECIATION SCHEDULE

Assets	Year Acquired	Projected Life Yrs	Final Year	Projected Purchases	Projected Sales	Original Cost	Depn Rate	Opening WDV	Depn for Year	Closing WDV
				£	£	£	%	£	£	£
LAND										
			0						0	0
Total				0	0	0		0	0	0
PROPERTY							0.00%			
Continous flow drier & eqp			0				8.00%	50,000	4,000	46,000
Stores			0				2.00%	62,500	1,250	61,250
Total				0	0	0		112,500	5,250	107,250
INVESTMENTS										
			0						0	0
Total				0	0	0		0	0	0

Assets	Year Acquired	Projected Life Yrs	Final Year	Projected Purchases	Projected Sales	Original Cost	Depn Rate	Opening WDV	Depn for Year	Closing WDV
				£	£	£	%	£	£	£
MACHINERY										
Combine			0				20.0%	55,000	11,000	44,000
Tractor 250hp			0				20.0%	40,000	8,000	32,000
			0						0	0
Tractor 110 hp			0				20.0%	26,000	5,200	20,800
Materials Handler			0				20.0%	28,000	5,600	22,400
Farm Vehicle			0				25.0%	9,000	2,250	6,750
Plough			0				15.0%	1,900	285	1,615
Power Harrow Combination 4m			0				20.0%	2,500	500	2,000
Cultivator Drill 4m			0				20.0%	20,000	4,000	16,000
Cambridge Rolls			0				10.0%	2,250	225	2,025
Discs			0				15.0%	8,000	1,200	6,800
Packer / press			0				10.0%	6,000	600	5,400
Subsoiler			0				10.0%	2,500	250	2,250
Fertilser spreader			0				15.0%	2,500	375	2,125
Sprayer			0				20.0%	12,500	2,500	10,000
Grain Trailers			0				10.0%	8,000	800	7,200
Topper			0				15.0%	2,500	375	2,125
Hedgecutter			0				10.0%	4,500	450	4,050
Sundries			0				10.0%	5,000	500	4,500
Cleaner / Loader			0				10.0%	5,000	500	4,500
4m Pre drilling stubble cultivator			0				20.0%	22,000	4,400	17,600
Total				0	0	0	18.6%	263,150	49,010	214,140

PRINCIPLES OF PREPARATION

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4 Balance sheets except where otherwise stated are prepared on a "going concern" and not a "realisation" basis.

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6 All the figures in these papers have been prepared net of Value Added Tax.

7 Gross Margins - The income elements for crops and produce, including trading livestock, are based on a realistic estimate of sale proceeds prepared either by the client or the Company. Valuation of arable crops will, except where otherwise stated, be included at full realisation value less costs to be borne, regardless of the timing of sale. Valuations of breeding livestock are, except where otherwise stated, included on a constant value basis in opening and closing valuations. Valuations of trading livestock are, except where otherwise stated, valued at realistic market value at the date of valuation.

8 Depreciation of machinery and buildings has, except where otherwise stated, been calculated on a Reducing Balance Basis at the Company's rates. In the case of machinery, the opening balance is the written-down-value at the given date or 'farm sale' valuation as agreed by our client. In the case of buildings or improvements to fixed assets, the opening balance will be the written-down-value or the net cost of the improvements as appropriate.

9 Unless otherwise stated bank interest charges on overdrafts will be deemed to include general bank charges.

10 The naming of agrochemicals within these papers has, where relevant, been done for budgeting purposes only. In no way does the mention of any chemical imply a recommendation for its use. Before the use of any chemical our client must satisfy her/himself that the manufacturers full product recommendations are both followed and understood.

LIGHT SOIL AND WET WEATHER
BUDGETED FARM PROFITABILITY
for the Year Ending
September 30th 2006

Prepared on behalf of
HGCA Model Farm
Project 3163

BTR / Light & Wet 4th January 2006

HGCA PROJECT 3163 UK FARM(LIGHT AND WET)

PROFITABILITY SUMMARY

Year Ending September 30th 2006

GROSS MARGINS	Budget		
Crop	**Ha**	**£ Total**	**£ /Ha**
1st Wheat (Feed)	84.50	28,924	342.3
2nd Wheat (Class 1)	58.13	16,555	284.8
2nd Wheat (Class 2)	58.13	14,201	244.3
Winter Barley (Feed)	114.86	27,141	236.3
Winter Oilseed Rape	74.38	19,956	268.3
Non Rotational Set Aside	40.00	0	0.0
Sugar Beet	40.00	22,500	562.5
1st Wheat late sown	30.00	8,244	274.8
Single Farm Payment and ELS		110,360	220.7
Non Farmed Area			
TOTAL GROSS MARGIN	500.00	247,883	495.8
OVERHEAD COSTS			0.0
Labour		33,700	67.4
Power		97,260	194.5
Administration		9,950	19.9
Property Costs		13,400	26.8
Total Overheads		154,310	308.6
Pre Rent and Finance		93,573	187.1
Rent and Finance		82,711	165.4
MANAGEMENT PROFIT (LOSS)		**10,862**	**21.7**

CROP GROSS MARGINS

0		TOTAL		1st Wheat (Feed)		2nd Wheat (Class 1)		2nd Wheat (Class 2)		Winter Barley (Feed)		Winter Oilseed Rape		Non Rotational Set Aside		Sugar Beet		1st Wheat late sown	
OUTPUT		£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha
	Crop Area	500.00		84.50		58.13		58.13		114.86		74.38		40.00		40.00		30.00	
	Tonnes			802.75	9.50	435.98	7.50	450.51	7.75	861.45	7.50	260.33	3.50			2,000.00	50.00	210.00	7.00
0	Price/Tonne			65.00		80.00		70.00		65.00		145.00				23.17		80.00	
	Haulage Allowance															3.00			
	Total Crop	281,474	562.9	52,179	617.5	34,878	600.0	31,536	542.5	55,994	487.5	37,748	507.5	0	0.0	52,340	1,308.5	16,800	560.0
	Other Sales	0	0.0	0	0.0														
	Area Aid	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0			0	0.0
TOTAL OUTPUT		**281,474**	**562.9**	**52,179**	**617.5**	**34,878**	**600.0**	**31,536**	**542.5**	**55,994**	**487.5**	**37,748**	**507.5**	**0**	**0.0**	**52,340**	**1,308.5**	**16,800**	**560.0**
DIRECT COSTS		£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha
	Combined HS & purchased	18,663	37.3	2,620	31.0	2,209	38.0	1,976	34.0	3,561	31.0	1,488	20.0			5,400	135.0	1,410	47.0
	0	0	0.0																
	Total Seed	18,663	37.3	2,620	31.0	2,209	38.0	1,976	34.0	3,561	31.0	1,488	20.0	0	0.0	5,400	135.0	1,410	43.0
	Nitrogen	39,416	78.8	7,098	84.0	6,104	105.0	5,348	92.0	9,189	80.0	6,248	84.0			2,280	57.0	3,150	105.0
	Base Fertilisers	11,524	23.0	1,876	22.2	1,290	22.2	1,290	22.2	2,550	22.2	1,651	22.2			2,200	55.0	666	22.2
	Total Fertilisers	50,940	101.9	8,974	106.2	7,394	127.2	6,638	114.2	11,739	102.2	7,899	106.2	0	0.0	4,480	112.0	3,816	127.2
	Autumn Herbicides	16,242	32.5	3,803	45.0	2,616	45.0	2,616	45.0	3,331	29.0	2,826	38.0					1,050	35.0
	Spring Herbicides	8,372	16.7	845	10.0	581	10.0	581	10.0	1,149	10.0	1,116	15.0			3,800	95.0	300	10.0
	Fungicides	20,870	41.7	4,648	55.0	3,720	64.0	3,720	64.0	5,628	49.0	1,413	19.0			240	6.0	1,500	50.0
	Insecticides	3,612	7.2	845	10.0	756	13.0	756	13.0	689	6.0	446	6.0			0	0.0	120	4.0
	Growth Regulators	6,730	13.5	1,521	18.0	1,046	18.0	1,046	18.0	2,757	24.0							360	12.0
	Total Sprays	55,825	111.7	11,661	138.0	8,720	150.0	8,720	150.0	13,553	118.0	5,802	78.0	0	0.0	4,040	101.0	3,330	111.0
	Other Crop Costs	0	0.0																
	Swathing	2,603	5.2							0	0.0	2,603	35.0						
	Casual Labour	0	0.0																
	Lifting	6,200	12.4									0	0.0			6,200	155.0		
	Drilling	1,720	3.4									0	0.0			1,720	43.0		
	Haulage	8,000	16.0									0	0.0			8,000	200.0		
TOTAL DIRECT COSTS		**143,952**	**287.9**	**23,254**	**275.2**	**18,323**	**315.2**	**17,334**	**298**	**28,853**	**251.2**	**17,792**	**239.2**	**0**	**0.0**	**29,840**	**746.0**	**8,556**	**285.2**
GROSS MARGIN		**137,523**	**275.0**	**28,924**	**342.3**	**16,555**	**284.8**	**14,201**	**244.3**	**27,141**	**236.3**	**19,956**	**268.3**	**0**	**0.0**	**22,500**	**562.5**	**8,244**	**274.8**

SINGLE FARM PAYMENT AND ELS INCOME

SFP and ELS	Sundry Income	£ Ha
SFP (No penalty)	95,360	190.7
ELS (No penalty)	15,000	30.0
Environmental Schemes		0.0
Deposit Account Interest	0	0.0
Total Non Farming Income	**110,360**	**220.7**

OVERHEAD COSTS

LABOUR	Total	£ Ha
Regular Wages	20,200	40.4
Employment Costs (NIC etc)	1,950	3.9
Other Regular Costs		0.0
Casual Wages	10,000	20.0
Community Charge	1,550	3.1
Total Labour	**33,700**	**67.4**
POWER	Total	£ Ha
Machinery Depreciation	49,010	98.0
Secondary Leasing		0.0
Machinery Repairs	22,500	45.0
Fuel (Tractor & Drier) Electicity	22,000	44.0
Electricity		0.0
Vehicle Tax & Ins	3,750	7.5
Haulage		0.0
Contract and Hire		0.0
Other Power Costs		0.0
Total Power	**97,260**	**194.5**
ADMINISTRATION	Total	£ Ha
Office Costs	2,600	5.2
Professional Fees	2,750	5.5
Telephone Costs	1,950	3.9
Insurance	1,400	2.8
Subscriptions	750	1.5
Miscellaneous	500	1.0
Other Administration Costs		0.0
Total Administration	**9,950**	**19.9**
PROPERTY COSTS	Total	£ Ha
Property Depreciation	5,250	10.5
Property Repairs	5,500	11.0
Water & Drainage Rates	850	1.7
Lime & General Sprays	1,800	3.6
Property Taxes		0.0
Storage		0.0
Other Property Costs		0.0
Total Property Costs	**13,400**	**26.8**
RENT AND FINANCE	Total	£ Ha
Rent	75,000	150.0
Bank Charges	850	1.7
Lease & HP Interest		0.0
Other Loan Interest		0.0
Bank Interest	6,861	13.7
Other Rent & Finance Costs		0.0
Total Rent & Finance	**82,711**	**165.4**

TOTAL FIXED COSTS	**237,021**	**474.0**

FIXED ASSET AND DEPRECIATION SCHEDULE

Assets	Year Acquired	Projected Life Yrs	Final Year	Projected Purchases £	Projected Sales £	Original Cost £	Depn Rate %	Opening WDV £	Depn for Year £	Closing WDV £
LAND										
			0						0	0
Total				0	0	0		0	0	0
PROPERTY							0.00%			
Continous flow drier & eqp			0				8.00%	50,000	4,000	46,000
Stores			0				2.00%	62,500	1,250	61,250
Total				0	0	0		112,500	5,250	107,250
INVESTMENTS										
			0						0	0
Total				0	0	0		0	0	0

Assets	Year Acquired	Projected Life Yrs	Final Year	Projected Purchases £	Projected Sales £	Original Cost £	Depn Rate %	Opening WDV £	Depn for Year £	Closing WDV £
MACHINERY										
Combine			0				20.0%	55,000	11,000	44,000
Tractor 250hp			0				20.0%	40,000	8,000	32,000
			0						0	0
Tractor 110 hp			0				20.0%	26,000	5,200	20,800
Materials Handler			0				20.0%	28,000	5,600	22,400
Farm Vehicle			0				25.0%	9,000	2,250	6,750
Plough			0				15.0%	1,900	285	1,615
Power Harrow Combination 4m			0				20.0%	2,500	500	2,000
Cultivator Drill 4m			0				20.0%	20,000	4,000	16,000
Cambridge Rolls			0				10.0%	2,250	225	2,025
Discs			0				15.0%	8,000	1,200	6,800
Packer / press			0				10.0%	6,000	600	5,400
Subsoiler			0				10.0%	2,500	250	2,250
Fertilser spreader			0				15.0%	2,500	375	2,125
Sprayer			0				20.0%	12,500	2,500	10,000
Grain Trailers			0				10.0%	8,000	800	7,200
Topper			0				15.0%	2,500	375	2,125
Hedgecutter			0				10.0%	4,500	450	4,050
Sundries			0				10.0%	5,000	500	4,500
Cleaner / Loader			0				10.0%	5,000	500	4,500
4m Pre drilling stubble cultivator			0				20.0%	22,000	4,400	17,600
Total				0	0	0	18.6%	263,150	49,010	214,140

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HEAVY SOIL, WET WEATHER AND MINIMAL CULTIVATION

BUDGETED FARM PROFITABILITY

for the Year Ending

September 30th 2006

Prepared on behalf of

HGCA Model Farm
Project 3163

BTR / Heavy & Wet 4th January2006

HGCA PROJECT 3163 UK FARM(HEAVY AND WET)

PROFITABILITY SUMMARY

Year Ending September 30th 2006

GROSS MARGINS	Budget		
Crop	**Ha**	**£ Total**	**£ /Ha**
1st Wheat (Feed)	84.50	27,995	331.3
2nd Wheat (Class 1)	58.13	13,881	238.8
2nd Wheat (Class 2)	58.13	11,876	204.3
Winter Barley (Feed)	114.86	22,604	196.8
Winter Oilseed Rape	74.38	17,111	230.1
Non Rotational Set Aside	40.00	0	0.0
Sugar Beet	40.00	22,500	562.5
1st Wheat late sown	30.00	5,604	186.8
Single Farm Payment and ELS		107,049	214.1
Non Farmed Area			
TOTAL GROSS MARGIN	500.00	228,621	457.2
OVERHEAD COSTS			0.0
Labour		34,700	69.4
Power		98,260	196.5
Administration		9,950	19.9
Property Costs		13,400	26.8
Total Overheads		156,310	312.6
Pre Rent and Finance		72,311	144.6
Rent and Finance		82,711	165.4
MANAGEMENT PROFIT (LOSS)		**(10,400)**	**(20.8)**

CROP GROSS MARGINS

0	TOTAL		1st Wheat (Feed)		2nd Wheat (Class 1)		2nd Wheat (Class 2)		Winter Barley (Feed)		Winter Oilseed Rape		Non Rotational Set Aside		Sugar Beet		1st Wheat late sown	
OUTPUT	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha
Crop Area	500.00		84.50		58.13		58.13		114.86		74.38		40.00		40.00		30.00	
Tonnes			802.75	9.25	406.91	7.00	421.44	7.25	804.02	7.00	241.74	3.25			2,000.00	50.00	180.00	6.00
0 Price/Tonne			65.00		80.00		70.00		65.00		145.00				23.17		80.00	
Haulage Allowance															3.00			
Total Crop	268,285	536.6	52,179	617.5	32,553	560.0	29,501	507.5	52,261	455.0	35,052	471.3	0	0.0	52,340	1,308.5	14,400	480.0
Other Sales	0	0.0	0	0.0														
Area Aid	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0			0	0.0
Home used during year	0	0.0																
Home used cl. valuation	0	0.0																
Total Home Used	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
TOTAL OUTPUT	**268,285**	**536.6**	**52,179**	**617.5**	**32,553**	**560.0**	**29,501**	**507.5**	**52,261**	**455.0**	**35,052**	**471.3**	**0**	**0.0**	**52,340**	**1,308.5**	**14,400**	**480.0**
DIRECT COSTS	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha
Combined HS & purchased	19,937	39.9	2,873	34.0	2,441	42.0	2,151	37.0	3,905	34.0	1,636	22.0			5,400	135.0	1,530	51.0
0	0	0.0																
Total Seed	19,937	39.9	2,873	34.0	2,441	42.0	2,151	37.0	3,905	34.0	1,636	22.0	0	0.0	5,400	135.0	1,530	51.0
Nitrogen	39,416	78.8	7,098	84.0	6,104	105.0	5,348	92.0	9,189	80.0	6,248	84.0			2,280	57.0	3,150	105.0
Base Fertilisers	11,524	23.0	1,876	22.2	1,290	22.2	1,290	22.2	2,550	22.2	1,651	22.2			2,200	55.0	666	22.2
Total Fertilisers	50,940	101.9	8,974	106.2	7,394	127.2	6,638	114.2	11,739	102.2	7,899	106.2	0	0.0	4,480	112.0	3,816	127.2
Autumn Herbicides	16,242	32.5	3,803	45.0	2,616	45.0	2,616	45.0	3,331	29.0	2,826	38.0					1,050	35.0
Spring Herbicides	11,828	23.7	1,690	20.0	1,163	20.0	1,163	20.0	2,297	20.0	1,116	15.0			3,800	95.0	600	20.0
Fungicides	20,870	41.7	4,648	55.0	3,720	64.0	3,720	64.0	5,628	49.0	1,413	19.0			240	6.0	1,500	50.0
Insecticides	3,612	7.2	845	10.0	756	13.0	756	13.0	689	6.0	446	6.0			0	0.0	120	4.0
Growth Regulators	4,762	9.5	1,352	16.0	581	10.0	581	10.0	2,067	18.0							180	6.0
Total Sprays	57,313	114.6	12,337	146.0	8,836	152.0	8,836	152.0	14,013	122.0	5,802	78.0	0	0.0	4,040	101.0	3,450	115.0
Other Crop Costs	0	0.0																
Swathing	2,603	5.2							0	0.0	2,603	35.0						
Casual Labour	0	0.0																
Lifting	6,200	12.4									0	0.0			6,200	155.0		
Drilling	1,720	3.4									0	0.0			1,720	43.0		
Haulage	8,000	16.0									0	0.0			8,000	200.0		
TOTAL DIRECT COSTS	**146,714**	**293.4**	**24,184**	**286.2**	**18,671**	**321.2**	**17,625**	**303**	**29,657**	**258.2**	**17,940**	**241.2**	**0**	**0.0**	**29,840**	**746.0**	**8,796**	**293.2**
GROSS MARGIN	**121,572**	**243.1**	**27,995**	**331.3**	**13,881**	**238.8**	**11,876**	**204.3**	**22,604**	**196.8**	**17,111**	**230.1**	**0**	**0.0**	**22,500**	**562.5**	**5,604**	**186.8**

SINGLE FARM PAYMENT AND ELS INCOME

SFP and ELS	Sundry Income	£ Ha
SFP (after 3% penalty)	92,499	185.0
ELS (after 3 % penalty)	14,550	29.1
Environmental Schemes		0.0
Total Non Farming Income	**107,049**	**214.1**

OVERHEAD COSTS

LABOUR	Total	£ Ha
Regular Wages	20,200	40.4
Employment Costs (NIC etc)	1,950	3.9
Other Regular Costs		0.0
Casual Wages	11,000	22.0
Community Charge	1,550	3.1
Total Labour	**34,700**	**69.4**
POWER	Total	£ Ha
Machinery Depreciation	49,010	98.0
Secondary Leasing		0.0
Machinery Repairs	22,500	45.0
Fuel (Tractor & Drier) Electicity	23,000	46.0
Electricity		0.0
Vehicle Tax & Ins	3,750	7.5
Haulage		0.0
Contract and Hire		0.0
Other Power Costs		0.0
Total Power	**98,260**	**196.5**
ADMINISTRATION	Total	£ Ha
Office Costs	2,600	5.2
Professional Fees	2,750	5.5
Telephone Costs	1,950	3.9
Insurance	1,400	2.8
Subscriptions	750	1.5
Miscellaneous	500	1.0
Other Administration Costs		0.0
Total Administration	**9,950**	**19.9**
PROPERTY COSTS	Total	£ Ha
Property Depreciation	5,250	10.5
Property Repairs	5,500	11.0
Water & Drainage Rates	850	1.7
Lime & General Sprays	1,800	3.6
Property Taxes		0.0
Storage		0.0
Other Property Costs		0.0
Total Property Costs	**13,400**	**26.8**
RENT AND FINANCE	Total	£ Ha
Rent	75,000	150.0
Bank Charges	850	1.7
Lease & HP Interest		0.0
Other Loan Interest		0.0
Bank Interest	6,861	13.7
Other Rent & Finance Costs		0.0
Total Rent & Finance	**82,711**	**165.4**

TOTAL FIXED COSTS	**239,021**	**478.0**

FIXED ASSET AND DEPRECIATION SCHEDULE

Assets	Year Acquired	Projected Life Yrs	Final Year	Projected Purchases £	Projected Sales £	Original Cost £	Depn Rate %	Opening WDV £	Depn for Year £	Closing WDV £
LAND										
			0						0	0
Total				0	0	0		0	0	0
PROPERTY							0.00%			
Continous flow drier & eqp			0				8.00%	50,000	4,000	46,000
Stores			0				2.00%	62,500	1,250	61,250
Total				0	0	0		112,500	5,250	107,250
INVESTMENTS										
			0						0	0
Total				0	0	0		0	0	0

Assets	Year Acquired	Projected Life Yrs	Final Year	Projected Purchases £	Projected Sales £	Original Cost £	Depn Rate %	Opening WDV £	Depn for Year £	Closing WDV £
MACHINERY										
Combine			0				20.0%	55,000	11,000	44,000
Tractor 250hp			0				20.0%	40,000	8,000	32,000
			0						0	0
Tractor 110 hp			0				20.0%	26,000	5,200	20,800
Materials Handler			0				20.0%	28,000	5,600	22,400
Farm Vehicle			0				25.0%	9,000	2,250	6,750
Plough			0				15.0%	1,900	285	1,615
Power Harrow Combination 4m			0				20.0%	2,500	500	2,000
Cultivator Drill 4m			0				20.0%	20,000	4,000	16,000
Cambridge Rolls			0				10.0%	2,250	225	2,025
Discs			0				15.0%	8,000	1,200	6,800
Packer / press			0				10.0%	6,000	600	5,400
Subsoiler			0				10.0%	2,500	250	2,250
Fertilser spreader			0				15.0%	2,500	375	2,125
Sprayer			0				20.0%	12,500	2,500	10,000
Grain Trailers			0				10.0%	8,000	800	7,200
Topper			0				15.0%	2,500	375	2,125
Hedgecutter			0				10.0%	4,500	450	4,050
Sundries			0				10.0%	5,000	500	4,500
Cleaner / Loader			0				10.0%	5,000	500	4,500
4m Pre drilling stubble cultivator			0				20.0%	22,000	4,400	17,600
Total				0	0	0	18.6%	263,150	49,010	214,140

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7 Gross Margins - The income elements for crops and produce, including trading livestock, are based on a realistic estimate of sale proceeds prepared either by the client or the Company. Valuation of arable crops will, except where otherwise stated, be included at full realisation value less costs to be borne, regardless of the timing of sale. Valuations of breeding livestock are, except where otherwise stated, included on a constant value basis in opening and closing valuations. Valuations of trading livestock are, except where otherwise stated, valued at realistic market value at the date of valuation.

8 Depreciation of machinery and buildings has, except where otherwise stated, been calculated on a Reducing Balance Basis at the Company's rates. In the case of machinery, the opening balance is the written-down-value at the given date or 'farm sale' valuation as agreed by our client. In the case of buildings or improvements to fixed assets, the opening balance will be the written-down-value or the net cost of the improvements as appropriate.

9 Unless otherwise stated bank interest charges on overdrafts will be deemed to include general bank charges.

10 The naming of agrochemicals within these papers has, where relevant, been done for budgeting purposes only. In no way does the mention of any chemical imply a recommendation for its use. Before the use of any chemical our client must satisfy her/himself that the manufacturers full product recommendations are both followed and understood.

HEAVY SOIL, WET WEATHER AND CONVENTIONAL CULTIVATION

BUDGETED FARM PROFITABILITY

for the Year Ending

September 30th 2006

Prepared on behalf of

HGCA Model Farm
Project 3163

BTR / Heavy & Wet (plough) 4th January 2006

HGCA PROJECT 3163 UK FARM HEAVY & WET (PLOUGH)

PROFITABILITY SUMMARY

Year Ending September 30th 2006

GROSS MARGINS	Budget		
Crop	**Ha**	**£ Total**	**£ /Ha**
1st Wheat (Feed)	84.50	27,995	331.3
2nd Wheat (Class 1)	58.13	16,207	278.8
2nd Wheat (Class 2)	58.13	13,911	239.3
Winter Barley (Feed)	114.86	26,337	229.3
Winter Oilseed Rape	74.38	19,807	266.3
Non Rotational Set Aside	40.00	0	0.0
Sugar Beet	40.00	22,500	562.5
1st Wheat late sown	30.00	8,004	266.8
Single Farm Payment and ELS		110,360	220.7
Non Farmed Area			
TOTAL GROSS MARGIN	500.00	245,121	490.2
OVERHEAD COSTS			0.0
Labour		37,700	75.4
Power		110,625	221.3
Administration		9,950	19.9
Property Costs		13,400	26.8
Total Overheads		171,675	343.4
Pre Rent and Finance		73,446	146.9
Rent and Finance		82,711	165.4
MANAGEMENT PROFIT (LOSS)		**(9,265)**	**(18.5)**

CROP GROSS MARGINS

0	TOTAL		1st Wheat (Feed)		2nd Wheat (Class 1)		2nd Wheat (Class 2)		Winter Barley (Feed)		Winter Oilseed Rape		Non Rotational Set Aside		Sugar Beet		1st Wheat late sown	
OUTPUT	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha
Crop Area	500.00		84.50		58.13		58.13		114.86		74.38		40.00		40.00		30.00	
Tonnes			802.75	9.50	435.98	7.50	450.51	7.75	861.45	7.50	260.33	3.50			2,000.00	50.00	210.00	7.00
0 Price/Tonne			65.00		80.00		70.00		65.00		145.00				23.17		80.00	
Haulage Allowance															3.00			
Total Crop	281,474	562.9	52,179	617.5	34,878	600.0	31,536	542.5	55,994	487.5	37,748	507.5	0	0.0	52,340	1,308.5	16,800	560.0
Other Sales	0	0.0	0	0.0														
Area Aid	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0			0	0.0
Home used during year	0	0.0																
Home used cl. valuation	0	0.0																
Total Home Used	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
TOTAL OUTPUT	**281,474**	**562.9**	**52,179**	**617.5**	**34,878**	**600.0**	**31,536**	**542.5**	**55,994**	**487.5**	**37,748**	**507.5**	**0**	**0.0**	**52,340**	**1,308.5**	**16,800**	**560.0**
DIRECT COSTS	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha	£ Total	£ Ha
Combined HS & purchased	19,937	39.9	2,873	34.0	2,441	42.0	2,151	37.0	3,905	34.0	1,636	22.0			5,400	135.0	1,530	51.0
0	0	0.0																
Total Seed	19,937	39.9	2,873	34.0	2,441	42.0	2,151	37.0	3,905	34.0	1,636	22.0	0	0.0	5,400	135.0	1,530	51.0
Nitrogen	39,416	78.8	7,098	84.0	6,104	105.0	5,348	92.0	9,189	80.0	6,248	84.0			2,280	57.0	3,150	105.0
Base Fertilisers	11,524	23.0	1,876	22.2	1,290	22.2	1,290	22.2	2,550	22.2	1,651	22.2			2,200	55.0	666	22.2
Total Fertilisers	50,940	101.9	8,974	106.2	7,394	127.2	6,638	114.2	11,739	102.2	7,899	106.2	0	0.0	4,480	112.0	3,816	127.2
Autumn Herbicides	16,242	32.5	3,803	45.0	2,616	45.0	2,616	45.0	3,331	29.0	2,826	38.0					1,050	35.0
Spring Herbicides	11,828	23.7	1,690	20.0	1,163	20.0	1,163	20.0	2,297	20.0	1,116	15.0			3,800	95.0	600	20.0
Fungicides	20,870	41.7	4,648	55.0	3,720	64.0	3,720	64.0	5,628	49.0	1,413	19.0			240	6.0	1,500	50.0
Insecticides	3,612	7.2	845	10.0	756	13.0	756	13.0	689	6.0	446	6.0			0	0.0	120	4.0
Growth Regulators	4,762	9.5	1,352	16.0	581	10.0	581	10.0	2,067	18.0							180	6.0
Total Sprays	57,313	114.6	12,337	146.0	8,836	152.0	8,836	152.0	14,013	122.0	5,802	78.0	0	0.0	4,040	101.0	3,450	115.0
Other Crop Costs	0	0.0																
Swathing	2,603	5.2							0	0.0	2,603	35.0						
Casual Labour	0	0.0																
Lifting	6,200	12.4									0	0.0			6,200	155.0		
Drilling	1,720	3.4									0	0.0			1,720	43.0		
Haulage	8,000	16.0									0	0.0			8,000	200.0		
TOTAL DIRECT COSTS	**146,714**	**293.4**	**24,184**	**286.2**	**18,671**	**321.2**	**17,625**	**303**	**29,657**	**258.2**	**17,940**	**241.2**	**0**	**0.0**	**29,840**	**746.0**	**8,796**	**293.2**
GROSS MARGIN	**134,761**	**269.5**	**27,995**	**331.3**	**16,207**	**278.8**	**13,911**	**239.3**	**26,337**	**229.3**	**19,807**	**266.3**	**0**	**0.0**	**22,500**	**562.5**	**8,004**	**266.8**

SINGLE FARM PAYMENT AND ELS INCOME

SFP and ELS	Sundry Income	£ Ha
SFP (No penalty)	95,360	190.7
ELS (No penalty)	15,000	30.0
Total Non Farming Income	**110,360**	**220.7**

OVERHEAD COSTS

LABOUR	Total	£ Ha
Regular Wages	20,200	40.4
Employment Costs (NIC etc)	1,950	3.9
Other Regular Costs		0.0
Casual Wages	14,000	28.0
Community Charge	1,550	3.1
Total Labour	**37,700**	**75.4**
POWER	Total	£ Ha
Machinery Depreciation	55,125	110.3
Secondary Leasing		0.0
Machinery Repairs	25,000	50.0
Fuel (Tractor & Drier) Electicity	26,000	52.0
Electricity		0.0
Vehicle Tax & Ins	4,500	9.0
Haulage		0.0
Contract and Hire		0.0
Other Power Costs		0.0
Total Power	**110,625**	**221.3**
ADMINISTRATION	Total	£ Ha
Office Costs	2,600	5.2
Professional Fees	2,750	5.5
Telephone Costs	1,950	3.9
Insurance	1,400	2.8
Subscriptions	750	1.5
Miscellaneous	500	1.0
Other Administration Costs		0.0
Total Administration	**9,950**	**19.9**
PROPERTY COSTS	Total	£ Ha
Property Depreciation	5,250	10.5
Property Repairs	5,500	11.0
Water & Drainage Rates	850	1.7
Lime & General Sprays	1,800	3.6
Property Taxes		0.0
Storage		0.0
Other Property Costs		0.0
Total Property Costs	**13,400**	**26.8**
RENT AND FINANCE	Total	£ Ha
Rent	75,000	150.0
Bank Charges	850	1.7
Lease & HP Interest		0.0
Other Loan Interest		0.0
Bank Interest	6,861	13.7
Other Rent & Finance Costs		0.0
Total Rent & Finance	**82,711**	**165.4**

TOTAL FIXED COSTS	**254,386**	**508.8**

FIXED ASSET AND DEPRECIATION SCHEDULE

Assets	Year Acquired	Projected Life Yrs	Final Year	Projected Purchases £	Projected Sales £	Original Cost £	Depn Rate %	Opening WDV £	Depn for Year £	Closing WDV £
LAND										
			0						0	0
Total				0	0	0		0	0	0
PROPERTY							0.00%			
Continous flow drier & eqp			0				8.00%	50,000	4,000	46,000
Stores			0				2.00%	62,500	1,250	61,250
Total				0	0	0		112,500	5,250	107,250
INVESTMENTS										
			0						0	0
Total				0	0	0		0	0	0

Assets	Year Acquired	Projected Life Yrs	Final Year	Projected Purchases £	Projected Sales £	Original Cost £	Depn Rate %	Opening WDV £	Depn for Year £	Closing WDV £
MACHINERY										
Combine			0				20.0%	55,000	11,000	44,000
Tractor 250hp			0				20.0%	40,000	8,000	32,000
Tractor 150 hp			0				20.0%	35,000	7,000	28,000
Tractor 110 hp			0				20.0%	26,000	5,200	20,800
Materials Handler			0				20.0%	28,000	5,600	22,400
Farm Vehicle			0				25.0%	9,000	2,250	6,750
Plough			0				15.0%	14,000	2,100	11,900
Power Harrow Combination 4m			0				20.0%	20,000	4,000	16,000
Power Harrow			0				20.0%	8,000	1,600	6,400
Cambridge Rolls			0				10.0%	2,250	225	2,025
Discs			0				15.0%	8,000	1,200	6,800
Packer / press			0				10.0%	12,000	1,200	10,800
Subsoiler			0				10.0%	2,500	250	2,250
Fertilser spreader			0				15.0%	2,500	375	2,125
Sprayer			0				20.0%	12,500	2,500	10,000
Grain Trailers			0				10.0%	8,000	800	7,200
Topper			0				15.0%	2,500	375	2,125
Hedgecutter			0				10.0%	4,500	450	4,050
Sundries			0				10.0%	5,000	500	4,500
Cleaner / Loader			0				10.0%	5,000	500	4,500
Total				0	0	0	18.4%	299,750	55,125	244,625

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APPENDIX II

Appendix 3

UK cross compliance failures – (provisional) payment reduction matrices for 2006

These payment reduction matrices are designed as guidelines to assist in determining the appropriate and proportionate penalty should cross compliance standards and/or requirements be breached. These matrices have been created in line with Council Regulation 1782/2003 and Commission Regulation 796/2004.

Each case will be assessed individually, taking into consideration factors specified in the CAP Regulations and exemplified in the following matrices. As these matrices represent a broad guideline only, the precise reduction will depend on the circumstances of the individual case. Where there are multiple breaches (of separate requirements) these are likely to attract a higher rate of reduction than a single breach. The final level of reduction will be assessed taking into account the full picture of any non-compliance found throughout the year.

Guidance for UK Paying Agencies for fixing payment reductions for *negligent* breaches

<table>
<tr><th>Intent</th><th>Extent</th><th>Severity</th><th>Permanence</th><th>% reduction (see note)</th><th>1st repetition (see note)</th><th>2nd repetition</th><th>3rd repetition</th><th>4th repetition</th></tr>
<tr><td rowspan="12">Negligent</td><td rowspan="6">Limited to an on-farm effect</td><td rowspan="2">Minimum</td><td>Rectifiable</td><td>0% (Warning letter) or 1%</td><td rowspan="3">3%</td><td rowspan="3">9%</td><td rowspan="3">15%</td><td rowspan="3">81%</td></tr>
<tr><td>Permanent</td><td rowspan="2">1%</td></tr>
<tr><td rowspan="2">Medium</td><td>Rectifiable</td></tr>
<tr><td>Permanent</td><td rowspan="3">3%</td><td rowspan="3">9%</td><td rowspan="3">15%</td><td rowspan="3">81%</td><td rowspan="3">100%</td></tr>
<tr><td rowspan="2">High</td><td>Rectifiable</td></tr>
<tr><td>Permanent</td></tr>
<tr><td rowspan="6">Not limited to an on-farm effect</td><td rowspan="2">Minimum</td><td>Rectifiable</td><td>1%</td><td>3%</td><td>9%</td><td>15%</td><td>81%</td></tr>
<tr><td>Permanent</td><td rowspan="2">3%</td><td rowspan="2">9%</td><td rowspan="2">15%</td><td rowspan="2">81%</td><td rowspan="2">100%</td></tr>
<tr><td rowspan="2">Medium</td><td>Rectifiable</td></tr>
<tr><td>Permanent</td><td>5%</td><td>15%</td><td>45%</td><td>100%</td><td>100% (plus exclusion from scheme in following year*)</td></tr>
<tr><td rowspan="2">High</td><td>Rectifiable</td><td>3%</td><td>9%</td><td>15%</td><td>81%</td><td>100%</td></tr>
<tr><td>Permanent</td><td>5%</td><td>15%</td><td>45%</td><td>100%</td><td>100% (plus exclusion from scheme in following year*)</td></tr>
</table>

*Subject to clarification from the European Commission

Note

The key rules on penalties are at Articles 65 to 67 of Commission Regulation EC no. 796/2004.

Guidance for UK Paying Agencies for fixing payment reductions for *intentional* breaches

Intent	Extent	Severity	Permanence	% reduction for first breach (see note)	1st repetition (see note)
Intentional	Limited to an on-farm effect	Minimum	Rectifiable	15%	100% (plus exclusion from scheme in following year*)
			Permanent	20%	
		Medium	Rectifiable		
			Permanent	30%	
		High	Rectifiable		
			Permanent	50 – 100%	
	Not limited to an on-farm effect	Minimum	Rectifiable	30%	
			Permanent	40%	
		Medium	Rectifiable		
			Permanent	60%	
		High	Rectifiable		
			Permanent	100%	

*Subject to clarification from the European Commission.

Note
The key rules on penalties are at Articles 65 to 67 of Commission Regulation EC no. 796/2004.