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Green Accounting for Agriculture[1]

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1. Introduction

Why green accounting? Like many of the things my colleague and friend Martin Whitby worked on I at first thought, in my youthful arrogance, that it was a waste of space and not a matter that serious economists dealt with. Yet the longer I wallow in agricultural policy – seeing it mostly during my career as an academic, briefly from the inside of the European Commission and more recently from the perspective of a rural membership organisation – I come to the view that the current major challenges in European rural policy are really about rural resource economics (Whitby and Willis, 1978).

Over a period of years, and especially influenced by a year in The agricultural directorate of the European Commission I came to feel that the debates surrounding European agricultural policy for the last two or more decades could be seen as an expression of different judgements about the magnitude of certain market characteristics, in particular, market failure. The rural policy debate seemed to resemble the way that Begg *et al*. (1997) characterised the debates in macroeconomics of the 1970s to 1990s. They suggested these could be seen as different judgements about market clearing, uniqueness of long-term equilibrium, expectation formation, and the relative importance of the long and short run. In the case of rural policy, much of the debate might be characterised as different judgements about the extent of, and thus the importance of market failure, and how to deal with it.

One view is the (neo)classical common agricultural policy (CAP) reform school exemplified by Tangermann (1991) and his proposal to replace CAP direct payments with a bond, decoupled, not only from production, but also from land. On this view, the sooner the market distortions created by the CAP are removed the better; any consequential non-market side-effects of this removal of support can then be addressed. Another school (which happens to be closer to the path chosen in the three CAP reforms – 1993, 1999 and 2003) takes the view that market failures, in the form of positive and negative externalities, are pervasive in the land management sector, and thus that some kinds of correctives are justified.[2] Anyone

[1] The views in this paper are those of the author and not necessarily those of his organisation. I am deeply grateful for the constructive comments offered by several colleagues who acted as informal reviewers; remaining faults are my own.

[2] There is of course a deep gulf between arguing that some kinds of corrective actions are justified, to supporting the present policy, which I am not seeking to do.

tempted to argue the latter line would be interested in the evidence of the magnitude of these failures. This was my motivation for taking an interest in attempts to estimate such magnitudes.

Adger and Whitby (1993) set the early pace in green accounting for agriculture in Britain[3] with their paper 'Natural Resource Accounting in the Land Use Sector: Theory and Practice'.[4] The next set of estimates were provided by Pretty *et al*. (2000) in a paper entitled 'An Assessment of the Total External Costs of UK Agriculture', in which they announced that 'we calculate the annual total external costs of UK agriculture in 1996 to be £2343m (range for 1990–1996: £1149m to £3907m)', and they further argued that this was an underestimate as only those effects which gave rise to financial costs (e.g. to public bodies and water companies) were included. Hartridge and Pearce (2001) asked 'Is UK Agriculture Sustainable? Environmentally Adjusted Economic Accounts for UK Agriculture'. A year later, a large study was published by the Environment Agency (2002) 'Agriculture and Natural Resources: Benefits, Costs and Potential Solutions'. The most recent contribution, and most comprehensive to date has been provided by eftec/IEEP (2004) in their 'Framework for Environmental Accounts for Agriculture'. Four of these five are studies in welfare economics. The *ad hoc* calculations performed by Pretty *et al*. (2000) are outside this paradigm and are not conducted in a recognisable economic accounting framework. They omit positive externalities and include a mix of environmental and certain human health (Bovine Spongiform Encephalopathy-related) effects.

It was interesting to see the speed with which these estimates found their way into Government publications,[5] particularly those proclaiming the Government's Sustainable Development Strategy Department of Environment, Food and Rural Affairs (DEFRA) 2002a,b, 2003, 2004. No matter how carefully authors note the qualifications and limitations of their estimates, and refrain from drawing policy conclusions, some figures are just too seductive to be left to the academics. The environmental cost of agriculture is one such figure.

This paper digs deeper into these issues: first by summarising the results of the five green accounting exercises to date, then by explaining more fully the eftec/IEEP approach which also underlies most of the rest of the paper. Section 4 considers some conceptual issues and section 5 some empirical issues. In section 6, despite the clear dangers of drawing policy conclusions from green accounts, a number of policy concerns are discussed.

2. Five Green Accounts of UK Agriculture

The UK's DEFRA has taken a keen interest in green accounting and sponsored directly the Hartridge and Pearce (2001) and eftec/IEEP studies, and, indirectly, the

[3] There is of course a parallel development of this work for agriculture in other countries, see UN Statistics (2003), and for national economies, e.g. the work of Pezzey *et al*. (2005) for Scotland.

[4] See also Whitby and Adger (1996).

[5] The growing emphasis on environmental impacts and sustainability was evident in the Ministry of Agriculture, Fisheries and Food (MAFF) (e.g. by the Environment chapter in Agriculture in the UK in 2000) before the creation in 2001 of the Department of Environment, Food and Rural Affairs (DEFRA), and has certainly been boosted since.

Table 1
Calculations of the environmental effects of agriculture

£million	Whitby and Adger (1988 data at 1998 prices)	Pretty *et al.* (1990–1996 at 1996 prices)	Hartridge and Pearce (1998 data at 1998 prices)	Environment Agency (2000 data at 2000 prices)	eftec/IEEP (2003 data at 2003 prices)
Depreciation of natural capital					
Water	12	231	428	203	470
Air		1113	585	760	956
Soil	n/e	96	21	264	9
Landscape	n/e	99		n/e	
Habitat and species	66	27	38	n/e	
Waste	n/e	n/e	n/e	n/e	15
Nuisance	n/e	n/e	n/e	n/e	n/e
Total	78	1566	1072	1227	1450
Appreciation of natural capital					
Water		n/e		n/e	
Air	150	n/e		n/e	
Soil	n/e	n/e		n/e	
Landscape	1008	n/e	225	n/e	488
Habitat and Species		n/e	370	n/e	740
Waste	n/e	n/e	n/e	n/e	
Nuisance	n/e	n/e	n/e	n/e	n/e
Total	1158	n/e	595	n/e	1228
Net economic adjustment	+1080	−1566	−477	−1227	−222

n/e denotes 'not estimated', as opposed to blanks which indicate net appreciations or depreciations in the other half of the table. Some estimates are derived from the original studies (see text).

Environment Agency work. Despite very obvious difficulties of comparisons across studies and even of summing totals within studies, the temptation to do both is irresistible. Indeed one of the main purposes of monetised accounting is precisely to enable this to be done. The dangers are that the concepts measured are sometimes not comparable, the physical and financial data refer to different periods, and sometimes the implicit counterfactual policies are not the same. DEFRA included a summary table in the Environment chapter of Agriculture in the UK for 2002.[6] Table 1 combines this table with the summaries compiled in Hartridge and Pearce (2001; pp. 41–44) and, with some adjustments, the eftec/IEEP results.[7]

[6] DEFRA (2002a,b) pp. 119–120.

[7] In the Whitby and Adger figures, the £66m landscape depreciation is their estimate of 'defensive expenditures' on SSSIs, and the £12m water costs refer to nitrates in drinking water. In the Pretty *et al.* estimates, the human health costs are omitted as not environmental, the landscape cost refers to their estimates of hedgerow and stone wall damage, and 'habitat and species' is the sum of biodiversity/wildlife damage and bee colony losses. For Hartridge and Pearce landscape, is the sum of their estimates for agricultural landscape plus forest and woodland, while 'habitats and species' is the sum of their ESA and SSSI figures. Adjustments used to raise the eftec/IEEP figures to UK level are explained in section 3.

Because it is conceptually the most fully developed, and empirically the most comprehensive, and because it is also the most recent, the eftec/IEEP categorisation of seven impact categories – water, air, soil, landscape, habitat and species, waste, and nuisance – is used to structure Table 1. As discussed in Section 3, this analysis is based on a clearly and explicitly stated green accounting framework which distinguishes, or seeks to distinguish: flows, stock changes and stock levels; effects attributable to agriculture versus those attributable to other sectors; and the effects on economic welfare versus those on other sectors. The figures in the rightmost column of Table 1 derived from their study have been crudely raised to UK level where the authors' figure was calculated only for some of the four UK territories. Moreover, the welfare effects and effects on other sectors have been summed and the net appreciations and depreciations for the seven impact categories are shown separately.

It might be objected that it was not the intention in two of these studies to compile green economic accounts. The Pretty *et al*. and Environment Agency analyses do not use this terminology nor do they always use the concepts of economic accounting.[8]

Hartridge and Pearce take their analysis right through to the stage of adjusting the conventional UK agricultural accounts for 1998: subtracting negative flows, i.e. the depreciation of natural capital, and adding the positive flows, the appreciation of natural capital. However, they do so with great nervousness, as discussed in section 6 below.

The clearest lesson from this table is that extreme caution must be exercised in using these data. Pearce (2004) has observed that green accounting is in its infancy, noting that it took over a century to formulate international protocols for general national economic accounts. Despite this warning, about how green the field is, it is somewhat immodestly, and surprisingly claimed in the eftec/IEEP study that given the huge progress over the last decade in conceptual development, 'the [green] accounting framework presented ... does not suffer from any gaps in theoretical development'.[9] Even allowing for the decade or more between the earliest and latest estimates in Table 1, it is clear from the details of these studies that the empirical basis for constructing such accounts certainly does suffer from gaps. The alleged completeness of the conceptual framework will be questioned.

Some lessons from the table are as follows: (i) agriculture has positive and negative effects which, to date, have been estimated as of similar orders of magnitude. (ii) There is considerable variation in individual components which often differ by a factor of 2 or more. (iii) There seems to be some agreement that the biggest negative effects are damage to air and water, with the former perhaps twice the latter. (iv) The biggest positive effects are on habitat and species, and on landscape with the latter generally smaller than the former. (v) The choice of sectoral boundaries makes a rather big difference; the Whitby and Adger study (1993) analyses the whole land-based sector (i.e. agriculture and forestry) and comes up with a very

[8] For example, Pretty *et al*. do not use Willingness To Pay measures of damage, they tend to use costs imposed on others, or estimates of the costs of remediation. In conventional economic accounts these would show up for the sector incurring such costs.

[9] eftec/IEEP (2004), p. 86. The results for the Sustainability of Scotland estimated by Pezzey *et al*. (2005) suggest there is still some way to go in nailing down the conceptual framework.

different conclusion for the impact on air.[10] Given these observations and the different selections of impacts included in the studies, it is not surprising that the net economic adjustment which emerges (even ignoring the difference in sign!) differs by a factor of 7 (from Pretty *et al*. to eftec/IEEP).

The eftec/IEEP authors declined not only to sum their results, but also to draw conclusions on any of the four purposes which they suggested for producing monetised environmental accounts, viz:

1. an economic measure of the sustainability of agriculture and a truer measure of the quality of life;
2. an indication of the extent to which agriculture is a net contributor to the nation's wellbeing, as well as how it affects the welfare generated by other sectors;
3. information that can be used for priority setting within agricultural policy; and
4. inputs to cost–benefit analysis for agricultural and related environmental policies.

Because of 'current limitations on data and incomplete understanding of the linkages between agricultural practices and inputs, and environmental and economic outcomes' the authors concluded that 'these remain goals rather than reality for the moment'.[11]

3. The eftec/IEEP Accounting Framework

This study was commissioned jointly by DEFRA and the governments of the devolved regions of the UK.[12] Its purpose was 'to identify data sources for the environmental impacts of agriculture and to develop methodologies that would enable us to produce an account to give an adjustment to the aggregate agricultural accounts showing this impact.' The researchers were asked to provide the information for the UK and for the four nations.[13]

The final report is extremely well structured and clearly written. First, it provides a summary of the theoretical basis for green accounts linked to the concept of weak sustainability.[14] Second, using the so-called DPSIR methodology[15] it provides a description and quantification of the physical effects, both positive and negative, of agriculture on the environment. Third, it summarises the relevant literature on the economic value of these impacts and develops the grandly named 'benefits transfer' method to make this operational. Fourth, it pulls together the physical and economic data using so-called 'linking data', to explain the agricultural contribution of the effects. Fifth, it pulls these elements together to construct a table of 'Estimated

[10] Much of this is associated with the measurement of the effect of land use change on carbon.

[11] eftec/IEEP (2004) Executive Summary p. iii.

[12] The Department of Agriculture and Rural Development, Northern Ireland, The Welsh Assembly Government, and the Scottish Executive.

[13] England, Wales, Scotland, Northern Ireland.

[14] Pearce and Atkinson (1993).

[15] DPSIR is the acronym for Driving forces, Pressures, State of the environment, Impact on final end points, and policy Responses) and seems to be attributed to the European Environment Agency.

monetary adjustments to agricultural accounts'. Finally, it provides a discussion of the gaps in empirical information which must be filled to complete the green agricultural accounts. A comprehensive list of 216 references account for above-mentioned data, and the detailed workings and origins from which all the results were derived are contained in well-presented annexes. This is an exemplary piece of work.

The value to the research clients, the government departments, lies in four areas: the methodology; the judgements on what environmental impacts should be studied and how to go about this; the empirical results derived; and in the identification of the gaps in information to which future research should be directed. The gaps identified were a mixture of effects which could not be quantified because there were no relevant research results available (e.g. the impact of agriculture on the rural tourist industry[16]), and gaps in the geographical coverage of the data (e.g. the positive impact of agriculture on habitats was only available for England and not the other three nations).

These gaps stopped the consultants summing the results for the categories of effects which they were able to quantify. There is no suggestion at all that there were other reasons for not aggregating the information which was found.[17] Great trouble was taken over the consistency between the concept measured (flows of environmental services), the counterfactual policy (no UK agriculture), the economic variable (willingness to pay), the year to which the flow refers (2003) and currency (pounds in 2003 prices). In these circumstances, it does not seem to violate the principal table of results to raise them to the UK level where necessary. This has been done in Table 2 using, admittedly crudely, total population or agricultural area as raising factors for the four devolved nations.[18] The table shows the seven categories of impact of agriculture on the environment which were considered (column 1). For each, the descriptors of the accounting adjustments (in column 2) indicate what was measured. Separate calculations were made for the welfare costs of these on society as a whole (first block) and for the inter-sectoral effects of agriculture on other sectors of the economy (second block). Wherever possible, the magnitudes of the impacts of these effects for the year 2003 were separately calculated for the four UK devolved regions. Merged

[16] Intersectoral economic effects would not normally be a part of a national accounting framework being conducted to measure welfare. In principle these impacts will be correctly measured by the outputs of the affected sectors. They are mentioned here as of interest when the purpose is to assemble a framework capable of being used for a number of purposes. For the specific purpose of measuring externalities they would not be relevant.

[17] It is well known that conventional economic accounts are not able accurately to measure *all* the flows of economic activity in every sector of the economy. For example, the black economy thrives in certain sectors, such as child-minding and other such personal services, and small household repairs and maintenance. The fact that the accounts are not complete is therefore is no reason to refrain from summing the components which are available and drawing policy conclusions from them.

[18] A more scientifically robust way of raising the England or England & Wales figures to the UK would have been to go back to the component parameters of the calculations and used different multiples or 'linking data', but the point of doing this arithmetic here is to open some lines of argument and perspectives rather than to consider the precision of the estimates.

Table 2

Estimated monetary adjustments to agricultural accounts (£million, central estimates)

Impact category	Accounting adjustment	England	Wales	Scotland	N Ireland	UK	Raised figures for the UK	Raising factor used
Adjustments for welfare impacts on society								
I. Water	*Value of water pollution arising from agricultural production*							
	Inland	−48	−1	−14	−7	−71	−71	
	Coastal	−3				E&W only	−3	Population
	Value of water abstraction	−36				E&W only	−59	Population
II. Air	*Value of air pollution arising from agricultural production*							
	Global	−543	−109	−143	−95	−889	−889	
	Regional	−43	−7	−10	−7	−67	−67	
III. Soil	Value of (net) soil erosion on-farm on future yields	n/e						
IV. Landscape	Value of landscape amenity services by the current provision of landscapes (within the agricultural sector)	124		321	45	488	488	
V. Habitat and species	Value of habitat and species protection services provided by current land use (within the agricultural sector)							
	Habitats	225				E only	433	Agricultural area
	Species					307	307	
VI. Waste	Value of waste pollution and disamenity arising from agricultural production					−15	−15	
VII. Nuisance	Value of noise and odour disamenity arising from agricultural production	n/e						

Table 2
(*Continued*)

Impact category	Accounting adjustment	England	Wales	Scotland	N Ireland	UK	Raised figures for the UK	Raising factor used
Adjustments for impacts on other sectors								
I. Water	Cost of water pollution clean-up							
	Gov't	−2		−0.1		E, W & S	−2	Population
	Water company					−181	−181	
	Costs of flooding					−153	−153	
II. Air	Included in measure above	–						
III. Soil	Cost of off-site soil erosion					−9	−9	
IV. Landscape	(+) e.g. Value of landscape to tourism	n/e						
V. Habitat and species	(+) e.g. Value of habitats and species to tourism	n/e						
VI. Waste	None	–						
VII. Nuisance	(−) e.g. cost of dealing with nuisance complaints	n/e						
Total impacts raised to UK level (and shown in Table 1)								
I. Water							−470	
II. Air							−956	
III. Soil							−9	
IV. Landscape							488	
V. Habitat and species							740	
VI. Waste							−15	
VII. Nuisance							0	
Total negative impacts							−1450	
Total positive impacts							1228	
Net overall impact							−222	
Raising factors:	Population, million, mid-2002 estimates Nat Stats website		49.6	2.9	5.1	1.7	59.2	
	Agricultural area, '000 ha, DEFRA Agriculture in UK 2003.		9210	1589	5802	1106	17,707	

Source: eftec/IEEP (2004) Table E.3.

cells indicate that data were available only for combinations of these regions or for the UK as a whole. To this table has been added by this author, the right-most column of results raised for the UK (using the raising factors shown); the third block which aggregates the welfare and inter-sectoral effects; and the sum of positive and negative impacts and the net overall impact of the measured effects.

It can be seen that the overall impact of UK agriculture on the UK environment in 2003 was negative, valued at −£222m. This was made up of the positive impacts of £1228m on landscape (40%), habitat and species (60%), and the somewhat larger negative impacts on water, air, soil, waste and nuisance of £1450 m of which two-thirds is on air. In turn, nearly all (93%) is the global cost of greenhouse gas (GHG) emissions, of which methane accounts for 38% (mostly enteric fermentation in farm animals) and nitrous oxide 51% (principally from livestock manure and inorganic fertiliser). The size of the effects of these gases essentially reflects not marginal inefficiencies, but the relative global warming potential (GWP) of methane (21) and nitrous oxide (310) compared with carbon dioxide (1), which remains the same wherever production takes place.

Table 2 contains five rows marked n/e – no estimates available. Two of these are for the welfare costs: soil erosion on future farm yields, and the noise and odour arising from agricultural production. The three rows with missing data from the effects of agriculture on other sectors are for the value of landscape, and of habitats and species, to tourism and recreation, and the costs on other sectors of dealing with agricultural nuisance.[19]

It is also important to emphasise what an annual analysis as set in Table 2 does not set out to show. Such an analysis neither shows the year-end stocks of the various categories of natural capital, nor the change in stock of natural capital over a long period. It purports to show the flow of services and the net appreciation/depreciation of the stock of natural capital during the period to which the data apply. This is why the positive flows for habitat and species measured for 2003 might come as a surprise to those who have been indoctrinated by various organisations to expect large depreciation in natural capital – e.g. as indicated by the decline in farmland birds index since 1970.

4. Some Conceptual Issues

4.1. *Green accounts and sustainability*

To the practitioner, it is extremely valuable to find, in the eftec/IEEP report, a short but highly accessible account of the theoretical framework behind these accounts, and one which explicitly shows the link between such accounts and the concept of sustainable development.[20] This is summarised as follows.

In essence, the task of green accounting is to adjust the conventional National Product by adding the sum of net changes in each of 'i' assets (denoted ΔX_i) multiplied by its shadow price p_i where the assets, in principle, include all forms of

[19] Some specific points about each of these are made in the empirical section 5 below.

[20] The theoretical framework is found in Chapter 2 and Annex 2 of eftec/IEEP (2004).

produced capital, environmental or natural capital, human capital and social capital.[21] The changes in assets can of course be positive – a build-up, investment or appreciation of capital, or negative – a depreciation or consumption of capital. This adjustment is

$$\text{gNNP} = C + \sum p_i \Delta X_i = C + S_G$$

where gNNP is the green Net National Product, C is the total value of consumption including environmental amenities, and S_G is the net or 'genuine' savings in the economy, i.e.

$$S_G = \sum p_i \Delta X_i.$$

The underlying concept here is that S_G is a measure of net change in total wealth. Sustainable development is generally defined as that rate of consumption in an economy which leaves wealth intact, i.e. does not compromise the consumption of future generations. It is not difficult to imagine that gNNP might be nicely growing (even if at a lower rate than that of GNP) because produced and human capital are increasing, and in the process allowing more and more goods and services to be produced, yet at the same time this might be eating into natural capital at such a rate that this is unsustainable. For example, if the economy is churning out a great deal of pollution such that environmental assets are depreciating, this may sooner or later catch up with us and bring about a fall in (green and unadjusted) the National Income.

This simple way of formulating the adjustment of national accounts has provided several ways of defining and analysing the concept of sustainable development. This has been done by comparing savings and investment in the various forms of capital; by looking at total wealth per capita; and by trying to define sustainable consumption. Two concepts of sustainability are discussed, weak and strong, the difference between them centres around the extent to which there is substitutability between natural and other capital. Under weak sustainability, it is assumed that these forms of capital can substitute for one another, or at least some of them can, at least over some range. Thus weak sustainability can be defined as the condition that 'genuine' savings are non-negative.

$$S_G \geq 0.$$

That is, provided capital is not shrinking then the flow of national income is sustainable. Furthermore, given the definition of 'genuine savings', as the sum of the value of investment in, and depreciation of, all forms of capital, then assuming some substitutability of the different forms of capital, as long as investment in produced and human capital exceeds any depreciation in natural capital, we can describe the economy as (weakly) sustainable. An unsustainable economy would be the one where S_G is negative.

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[21] Economists have not yet managed to wean the Sustainable Development Commission and Forum for the Future (2005) from their 'five capitals': natural, human, social, manufactured and financial. Furthermore, because there is no agreement on how to measure social capital or what its components are, it is dropped from the eftec/IEEP proposed green accounting framework.

There is less agreement on the definition of strong sustainability. Some define it as allowing no substitutability between natural and other forms of capital, whereas others allow that there may be some substitutability but suggest that we should behave as though there is none. This would not only require that genuine savings are non-negative, as under weak sustainability, but also that there is no depletion of the stock of natural capital.

Compared with the everyday discourse on sustainability which typically goes no further than referring to the three pillars – economic, social and environmental – and vague concerns about the tradeoffs between them, the theoretical framework above seems a model of clarity and precision. However, this clouds over if the focus is either widened or narrowed. If there is disagreement about the appropriate definition of sustainability at the national level, then we are certainly going to run into challenges as we consider the nation within the global economy and environment, or as we disaggregate either by sector of the economy, or by individual components of natural capital.[22]

4.2. *The open economy and trade*

As we move to an open economy, there are several reasons we might have to adjust the above model. Consider an open economy which is dependent on imports of some natural resources. If it uses more (or less) of such resources then this has an impact on resource prices which should be reflected in valuations in both the unadjusted economic accounts and some of the green components. This is noted in the eftec/IEEP study although no adjustments were made; in effect, this implies the small-country case.

But another issue seems not to be acknowledged: this concerns the treatment of global environmental effects of domestic pollution. As this applies particularly to air pollution which all estimates, to date, show to be the largest element of agriculture's negative environmental impact, this seems a critically important point to clarify. We can picture a single economy, call it A, which satisfies the least demanding version of strong sustainability; i.e. whatever depletion of certain categories of its 'own' stock of natural capital, this is at least matched by overall appreciation in other categories of natural capital, and it may or not be adding to its stocks of produced and human capital. If all economies were able to achieve this state, then it could be claimed that we have a sustainable world.

Supposing the world is not sustainable in this way. For example, suppose some other economies calculate that their stock of natural capital shows net depreciation. Suppose further that a reason for this is that economy A is a net importer of certain goods, the production of which is inherently polluting or resource depleting. In other words, it is not just country A which cannot produce these goods without pollution or resource depletion (which might be why they have decided to import them), but that no other country can do so either. Two classic agricultural examples are ruminant livestock products and rice which are copious producers of GHGs every where in the world. Of course, if the

[22] This is another manifestation of the difficulty economists face in persuading public opinion that monetising phenomena such as environmental values (just as the value of human life) can be usefully done.

extent of such pollution does vary, for example by agro-climatic zone, then relocation of production from a more to a less-polluting zone can be helpful, and should be sought. But fundamentally, this becomes an issue of sustainability of consumption rather than production.

How should green accounts deal with this issue? One option is to stick to the accounts as defined and accept that if all countries do their best to achieve unilateral sustainability then eventually the world will become sustainable.[23] An alternative is that we have to focus explicitly on imports and correct the domestic accounts for known environmental effects associated with each.

The first seems an inadequate response. A critical purpose of constructing green accounts is to be able to sum the components (over effects and sectors) and to be able to compare them from one year to another. In turn, the main point of such comparisons is to be able to draw some conclusions about whether economic development (growth in NNP) is becoming less or more environmentally damaging; i.e. moving towards or away from a sustainable growth path.[24] When we are dealing with global commons such as the atmosphere,[25] it would be close to meaningless to ignore whether domestic action taken to reduce domestic depletion of natural resource stocks has been done so at the expense of exporting the pollution (particularly GHGs) or depleting the global resource.[26] This might well apply also to some aspects of water quality which can affect the (international) marine environment, and it can apply to landscapes, habitats and species.[27] Of course to take account of this would add another block to Table 2, to deal with imports of agricultural goods, and would require an extra set of data. But, in principle, this is not so demanding; as a first approximation, it can be assumed that the adjustment for the imports of these globally affected impact categories can be done exactly as for the domestic production. If it is known that, for example, imported beef have a diet and live in conditions such that GHG emissions are generally higher or lower per unit of production than UK conditions, then of course such factors can be embedded in the calculations.

An objection to introducing an imports block into green accounts (sectoral or national) will no doubt be made on the grounds that this moves away

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[23] The mechanism is presumably that as each country struggles one way or another to internalise pollution costs, these are gradually transmitted to consumers and ultimately around the world.

[24] When and if sustainability really is adopted by all government departments – as it is DEFRA's stated ambition to do – and the political debate centres around the growth rate of the green national income, these inter-temporal comparisons will be commonplace.

[25] This point is particularly important for sectors, such as agriculture, where air pollution is calculated to be the most serious pollutant.

[26] This is, of course, recognised in the Kyoto provisions, e.g. for trading in quantified emissions reduction (Articles 6 and 17) and in the clean development mechanism (Article 12).

[27] As well as the physical spillovers occasioned by trans-boundary air and water pollution and by migratory species such as birds, we should also recognise option and non-use values of landscapes, species and habitats. The eftec/IEEP authors frequently suggest restricting the population affected by these latter three aspects of natural capital, or applying some distance decay functions to their value. Yet there is much evidence in the form of international campaigns on behalf of 'foreign' landscapes, habitats and species (natural grasslands, rain forest, birds and turtles) to indicate that other countries' natural assets are valued too.

from the intention to measure green accounts for domestic *production* sectors (agriculture).[28] The addition redefines the sector as the domestic consumption of agricultural produce (at farm gate or wholesale level). But as long as this is done consistently for all sectors, is this a problem? Raising the issue in this way can lead us into a fruitless chicken-or-egg problem; there is no production (or pollution) without consumption; yet, traditionally, we calculate national accounts by considering production sector rather than consumption sector. The point is that without a correction for imports which impact, in their production, on globally relevant natural resources, we risk drawing incorrect conclusions.[29]

4.3. *Defining sectors and impact categories of natural capital*

The framework devised can, in principle, be applied to all sectors of the economy. Just as the economic accounts are summed over sectors to derive the national accounts, so too presumably, the adjusted accounts can be aggregated. In this very process there is an implicit substitutability between categories of natural capital and across sectors. Thus negative impacts in one sector may be netted out by positives in another sector. This raises concerns about the interpretation of sustainability: the more disaggregated the analysis, particularly the larger the number of categories of natural capital, the more demanding the requirement that there is no depletion of natural capital. This consideration prompts the question of whether there is an objective basis for deciding how to categorise natural capital, particularly the 'correct' level of aggregation. It is easy to see that, *in extremis* with a highly disaggregated definition of sectors and natural capital, strong sustainability renders the concept of sustainable development an oxymoron.

4.4. *The baseline or counterfactual*

Choosing the baseline or counterfactual against which to measure the adjustments necessary for green accounts seems, at first glance, to pose conceptual as well as practical problems. However, eftec/IEEP[30] provide a full and convincing explanation which dispels this as an issue for green accounting. The essence is that, for accounting purposes, the counterfactual policy or situation from which environmental impacts are measured is the same as the counterfactual from which the conventional accounts are measured, namely zero output of the sector concerned, however implausible this at first seems. Thus the environmental costs are the gross total of such costs, and, as the eftec/IEEP authors say, 'how much

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[28] Another way of expressing this is that national accounts are fundamentally about national welfare and were not designed to draw conclusions about sustainability. The 'correct' procedures will relate to the purpose of the accounting.

[29] The political economy point here is that domestic producer interests will naturally oppose unilateral national action to curb pollution which has a global impact if there is no corresponding action on imports. Otherwise, such action is a straightforward exporting of both jobs and pollution.

[30] Ibid Annex 2, pp. 8–11.

of this [total cost] should be avoided is a policy issue, not an accounting issue.'[31] Provided that analysts are always careful to estimate the total such costs for all categories of effects and all sectors then the accounts will be internally consistent.[32] Furthermore, the usefulness of such accounting procedures is that they provide an analytically clear baseline against which different situations can be measured, for example the total costs in a future year (or even back-calculated for a previous year), or the total such costs under a different assumed set of policy choices. The practicalities of making these comparisons might well be difficult, but there is no conceptual problem.[33]

In conclusion, it can certainly be claimed that enormous strides have been made on the conceptual framework for green agricultural accounts. However, the distinction between 'mere accounts' and 'policy-relevant measures of environmental costs and benefits' is indeed subtle. As soon as green accounts are assembled they will of course be used to judge sustainability – that was a principal reason for constructing them – and there can hardly be a more important policy question. Yet we do seem still to be quite some way from agreeing how the accounts can be used in principle to judge sustainability. The strong-sustainability enthusiasts seem unlikely to be persuaded that the weak version is sufficient. Moreover, the calculation and use of an individual sectoral or national green account in the context of pollutants of the global commons, particularly air, is not satisfactorily resolved. If, as some suggest, GHG pose the greatest threat to humankind, and as air pollution is the largest negative environmental impact of agriculture, this deserves more attention.

4.5. *Time horizon*

The implicit time horizon in the theoretical framework is infinite. Analytically, this is understandable and allows some important simplifications. However, as soon as we consider applying the framework to real questions of policy and resource allocation, this becomes meaningless. Even the (relatively long) time scale for which we are concerned about global warming pales into insignificance beside the length of cycles between ice ages (e.g. 70,000 years). Given the pace of technological change, to be conducting empirical estimations based on projections and discounting much more than 50 years seems to move beyond the bounds of credibility and usefulness.

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[31] Whilst conceptually clear, the zero baseline does tempt anarchic thoughts such as, if there is no agriculture there can be no population, and hence no willingness to pay for the resulting very natural environment!

[32] Although the concept of zero output is clear, there might well be practical, data and other problems of actually doing this. For example if the only data available on the costs imposed by diffuse pollution on water relate to the costs of bringing pollutant concentrations down to statutorily defined safe standards, i.e. non-zero standards, then estimates might be underestimates of true costs. It is the responsibility of the green accountants to warn when these situations arise.

[33] There might be a larger problem for greenhouse gas-related measures given the baseline of 1990 set by Kyoto. This deserves a little more exploration.

5. Some Empirical Issues

The task of actually constructing green accounts for an economic sector – especially agriculture which has such pervasive (positive and negative) influence on the environment – is immense. There will be a non-ending effort to extend, refine, and update the estimates of the component values which make up the accounts. After summarising and commenting on the steps in the analysis, attention will be focussed here on four issues which seem rather striking from the eftec/IEEP analysis.

The structure of the analysis is simple, logical and clear. The first stage is to categorise the physical impacts and then try to quantify them using the so-called DPSIR framework.[34] This part of the work identifies the best available information on the magnitude of the relevant total, deleterious (or beneficial) effect on the impact variable – e.g. water quality. It is at this stage that important decisions are made about the level of aggregation, and about the effects that are capable of being quantified and thus included in the accounts. For example in defining the impact category 'Nuisance' which is made up of odour and noise, it was true, eftec/IEEP acknowledged, that 'agriculture can contribute to the peacefulness of the countryside'. However, because quantification is 'very difficult', it was not included, not even as a *notional* positive sign in the tables (2.3 and 2.4) of their framework.[35]

The next step is to quantify the proportion of this effect which can be ascribed to the sector under analysis, i.e. agriculture. The concept for doing this is called the 'linking data'. Sometimes, the data are based on clear objective measurement, but in the absence of such data, for example in the case of flooding, reliance is placed on the judgement of whichever authority seems best placed to offer an opinion. The Environment Agency says that as 25% of flooding events in the 1980s and 1990s were hillslope events, and 57% of hillslope events were caused by erosion and deposition, then the product, i.e. 14% of all flood events and flood event costs should be attributed to agriculture. This is the figure used by eftec/IEEP for the 2003 accounts. There is nothing wrong with this, and as long as the assumptions and their source are explicit; then, sensitivity analysis can be performed to test alternatives. A common approach used in the sensitivity analysis of some parameters (although not the linking data) is to half and double the central estimate – this itself indicates the crudeness of some of the data used in compiling green accounts.

Having arrived at quantified estimates of the physical effects of agriculture on each aspect of the environmental impact category, the second stage is find the

[34] It is hard to fault this, now widely advocated, framework as a sensible way of organising empirical analysis. However there might be some danger that its scientific-sounding moniker cloaks it with an authority which disguises the essentially ad hoc nature of what is done. What matters is the underlying causal relationships in the chain described and the thoroughness of the analysis of these relationships. Much of it is currently 'expert judgement'.

[35] This surely is a mistaken judgement, one of the prime reasons for people wanting to walk, and move to live, in the countryside is the solitude, peace and quiet. However, difficult this is to quantify and separate, for example, from landscape it does not merit its exclusion from the account.

economic value of those physical effects. The economic concept for doing this is 'Willingness To Pay'. Notwithstanding the huge growth in the literature of such studies for many aspects of agriculture and the environment, there are of course gaps.[36] To fill these gaps, another concept is introduced called 'benefits transfer'. This is defined as 'borrowing estimates of non-market values from previous studies and applying them to a new, but similar context'.[37] To agricultural economists, if 'supply and demand elasticities' is substituted for 'non-market values' in the above definition, this describes a practice so ingrained that it scarcely merits a mention.

The third and final stage is to combine the physical and economic data with the linking data to calculate the summary accounts (as shown in Table 2 above). This process boils down to simple multiplication. As shown in Chapter 5 of eftec/IEEP report the central estimates of the environmental costs (or benefits) after various preparatory calculations are summarised as follows:

$$p(a \times B_c)$$

where a is the (DPSIR-derived) physical data (e.g. length of river affected, area concerned); B_c is the (benefit transferred) central estimate of the economic cost per unit; and p is the (linking data) adjustment factor attributing the portion due to agriculture.

The coining of these phrases (DPSIR, linking data, and benefits transfer) for *ad hoc* 'techniques' is an understandable shorthand. But it comes with the danger that it endows what is a purely practical and pragmatic process with some sort of technical, quasi scientific respectability and a mark of quality. However, like a pan-fried steak if the meat is leather and the frying badly done the label is meaningless – yet impressive-sounding.

The sensitivity technique is to show where possible upper (B_U) and lower (B_L) bounds for the economic unit values. However, no such sensitivity is allowed for the linking, or physical data, which, when multiplied, would otherwise produce an even wider range of values for the resulting total economic adjustment, and an even harder task of digesting and presenting the results.[38] The eftec/IEEP analysts cannot be faulted for the care with which they laid out the criteria for selecting the variables and parameters used, the sources and their explanations of what lies behind the estimates used. This sets the standard for future work.

5.1. *Four specific empirical points*

Space precludes detailed discussion of the multitude of assumptions which lie behind these accounts. It is important that the profession plays a full part in critiquing the analysis in detail so that future accounts can be steadily improved, not least

[36] Willingness to Pay, based, as it invariably is, on contingent valuation studies is provides area where economists face a wall of distrust from non-economists. This methodology is easily disparaged as 'small sample opinion polls'.

[37] eftec/IEEP (2004) p. 52.

[38] Where the physical data measure an indisputable national total such as the length of rivers in England this is less of an issue. However when, as with air pollution, there is a range of estimates of the total physical output, it adds to the challenge of both doing the analysis and communicating the results.

by filling the gaps which eftec/IEEP spell out in their final chapter. The following four points represent one view of the priorities for further work.

Because the air pollution cost is the single biggest negative component of the account, it is worrying how dependent this is on the environmental cost of carbon given the large range of values in the literature for this figure. The figure used is that currently recommended by DEFRA based on Clarkson and Deyes (2002) of a central value of £70/tonne of carbon, notwithstanding central estimates derived by others, e.g. Pearce (2003) of £4–£30 per tonne. Given the massive importance of this variable, this value is under review. If, as a result of the review, the chosen value is nearer the bottom end of Pearce's range, this single amendment could reduce the measured negative impact of UK agriculture by 84%.[39]

Estimates of the impact of agriculture on soil show a worryingly large range (see Table 1). This is not a result of debate on parameter values, but on what and how to measure the damage to soil.[40]

The calculation of the positive impact of agriculture on landscape, habitat and species creates very large values. These also rest on a very small number (five) of parameter estimates (B_C). The eftec/IEEP calculations also relate only to a small fraction of the farmed land area. Two considerations suggest that this could be a very important omission (i.e. underestimate on the positive side) of the total economic adjustment. First the importance of the wider farmed countryside in providing the connectivity between the environmental hotspots, the value of which is included.[41] Secondly, evidence, as for example from residential property values is beginning to be collected which can help indicate that 'ordinary farmland' contributes to landscape value. Even if it turns out that such value is captured in conventional accounts in other sectors, this is no reason to omit it from the agricultural account.

The omission of any attempt to measure the economic effect of the environmental contribution of agriculture to the tourism industry also seems a serious gap. This will be captured in conventional accounts for the whole economy, so this is not an issue for overall sustainability. However, it could potentially make a big difference to the agricultural sector accounts.

6. Some Policy Issues

The eftec/IEEP study authors are extremely careful to point out that in computing green accounts there is no intrinsic policy implication at all about the resulting economic adjustments to the conventional accounts. Green accounting is an accounting exercise. Like most accountants, the purists at this activity will profess 'only' to be computing the 'correct' environmental flows during a period, i.e. the changes in stocks of natural capital over the period, and the stock levels at the end

[39] This is calculated by replacing the value of C in CO_2 in Table 5.3 of eftec/IEEP by £7/tonne instead of £70/tonne. This single adjustment reduces the totals estimated in the table from £956 m to £155 m.

[40] New estimates of these effects are being calculated by the Environment Agency but were not available at the time of publication.

[41] A great deal of stress in the proposed entry level stewardship scheme, and in the 2-m buffer strips included in the Good Agricultural and Environmental Conditions for the Single Farm Payment is placed on the importance of connectivity of ecosystems and habitats.

of the period. What anyone chooses then to do with this information is their business. In principle, these accounts could be drawn up at firm level as well as sectoral and national levels. Individual firms are presumably highly interested in judging their own sustainability – especially those involved in land management which depend vitally on, and are an intrinsic part of, the natural resource base.

However, it can be argued that sectoral and national green accounts are implicitly a policy statement in themselves. They are intimately concerned with the area of market failure which in turn compels questions about the correct collective responses which society might like to take to deal with them. In this section, policy issues are discussed under three headings: sustainability, agricultural policy and environmental policy, and the paper concludes with some thoughts on the state of the art of green accounting.

6.1. *Is UK agriculture sustainable?*

It does not seem too demanding to expect 10 years of applied economics research to provide some sort of answer. However, only two (Hartridge and Pearce, and eftec/IEEP) of the above five studies set out to do so within an appropriate theoretical framework. Indeed, this question was the title of the Hartridge and Pearce paper. However, the authors do not answer their own question. The reason offered by Hartridge and Pearce was that a complete adjustment of conventional accounts requires deducting the (CAP) subsidies in the system. However, they judged that this would so affect the size and nature of the sector that the current measures of externalities would no longer apply. IEEP (ibid p. iii) do not offer this as a reason for not adjusting the conventional accounts, but instead cite missing data and incomplete understanding of linkages between agriculture and environmental outputs.

The main obstacle to drawing a conclusion is thus essentially the empirical difficulty of quantifying some components of the accounts. If true, then with more research these gaps will be filled and the question will be answered. Given the framework of the analysis the answer will tell us whether or not agriculture is weakly sustainable.

It is worth asking if this is worth knowing. If agriculture is not sustainable, then attention focuses on the actions could be taken to reduce the depreciation of specific categories of natural capital. If the sector is weakly sustainable, would this satisfy society? This seems unlikely.

The uniqueness of agriculture is that it has the power to enhance (certain categories of) natural capital, although, in common with all other sectors, it also causes depreciation of natural capital.[42] The most comprehensive green accounting exercises to date show that agriculture's impact on natural resources involves netting out large positive and negative flows of roughly the same order of magnitude. Depending on which effects are included and what values are chosen for a relatively small number of critical parameters (such as the value of carbon), the net effect on natural capital is a relatively small positive or negative. The authors of the five studies

[42] A CLA member provided me with a variation on this insight when he observed that whilst all other sectors of the economy had the obligation to help protect the environment from society, the land-based sector was the only one which had the potential to offer society protection from environmental damage caused by other sectors (by carbon sequestration, flood water management, and providing peace and solitude).

cited show they are quite comfortable summing the positive and negative flows of environmental services, although they resist conclusions on sustainability. Suppose that the next series of calculations fill the data gaps and the net impact is positive, what conclusion will be drawn? It seems unlikely that the policy conclusion will be to turn attention to other sectors of the economy where the net outcome is negative, and to leave agriculture alone.

First, the view would be taken, that the challenge is to make the agricultural effect even more positive by reducing depreciation of natural capital wherever it is found. Second, and more fundamentally, it is hard to imagine the interest groups which focus on particular categories of natural capital accepting that depreciation in 'their' sector can be offset by appreciation elsewhere. In short, one suspects that there is little 'buy-in' to weak sustainability; especially amongst green organisations, governmental and non-governmental. If correct, this line of argument leads to the suspicion that only the strongest of strong definitions of sustainability will satisfy such groups; viz there must be no depreciation of the particular aspect of natural capital that they are concerned about, at all. In this view, for example, the loss of a single species would be unacceptable and policies which permitted it would be deemed unsustainable. It is far from clear that concepts of non-zero optimal rates of pollution or extinction are widely accepted beyond the economics profession.

It would be useful if this line of debate on the goal of sustainability could be extended beyond the circle of environmental economists. From the perspective of broad macro-economic development, the idea that a growth path which embraces non-negative genuine saving is sustainable may be quite acceptable seen at the level of the national political debate. This could be so, even if this growth path embraces a trade-off in which appreciation in produced plus human capital exceeds a reduction in natural capital. It is an interesting empirical question whether this was the sort of growth path the current developed countries followed during their most vigorous growth phases and whether it is what the BRIC[43] group are following now.

Weak sustainability is inherently more appealing to those who have faith in human ingenuity; its capacity for adaptive response and the capability of humankind to develop resource-saving technology; and in the adjustment of societal preferences to grasp opportunities and deal with whatever environment exists. Strong sustainability hints of a backward-looking, preservationist approach.[44] At its extreme, the idea that sustainable development requires there to be no further loss of natural capital, seems too restrictive.

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[43] BRIC refers to Brazil, Russia, India and China. These are the large, vigorously growing countries for whom there are real concerns about the impacts of this growth on natural capital. Likewise, the 19th and 20th century growth in Europe and North America eroded much natural capital; whether such depreciation, could it be back-estimated, exceeded the net investment in produced plus human capital is not known.

[44] The debate does not seem any easier when it shifts to the concepts of irreversibilities, and so-called critical natural capital. If the depreciation of natural capital really is irreversible, or if there are categories of natural capital which are critical in the sense that once stock of natural capital depreciates below a certain threshold absorptive capacity diminishes and maybe negative feedback effects lead to system collapse then clearly such systems are unsustainable. Such absolute limits, and thresholds are hard to define, and some might question their existence.

Moving beyond the formal model which underlies green accounting and sustainability, economists have a role to question the plausibility of the suggestion (behind strong sustainability) that natural capital stocks should not be depleted, or if they are there is a presumption that the growth path is unsustainable implying some change in behaviour. Is human development possible without *some* depletion of natural capital? To put this another way, are we correctly valuing natural capital in relation to its (global) relative abundance? If a natural capital stock is abundant, then the marginal value for a small depreciation is presumably small, perhaps close to zero. These principles and those of optimal pollution rates (which are not zero) are core ideas which economist bring to the debate. There are plenty of signs that they are not sufficiently noticed and absolutist ideas of fixed standards and targets carry the day in policy debates on sustainability.

The confusion about what governments are signing up to when they proclaim sustainable development as a national policy goal manifests itself with rather different arguments when considered at the individual sector level, closer to the 'ground'. At the sector level, sustainability is often explained with respect to the three pillars: economic, social and environmental.[45] At this level, the social pillar gets least attention, although it is not dropped altogether as has been done in the economic framework for green accounts.[46] However, there are (at least) two problems with sustainability at the sectoral level. First the indicators of economic sustainability are either absent or at best very indirect, and not offered in the sense of avoiding depreciation of produced and human capital. In DEFRA's Sustainable Strategy, 13 of the 22 indicators are environmental, three are health and animal welfare related, two are social, and four are economic. These four are: value of fish landings per tonne of fleet capacity, the index of total factor productivity of UK agriculture; the real retail food price index, and the economic performance in the less well performing rural areas. Even allowing for the fact that many of these indicators are 'under further development', the reaction to this *ad hoc* view of sustainability from the (agricultural) industry is characteristic in that it indicates a lack of real commitment to the three legs of sustainability, and it is really a process aimed at reducing the environmental footprint of farming. Once again, the rhetoric (the three pillars) sounds like weak sustainability; the reality (the indicators used and the focus of policies and indicators pursued) seems closer to strong sustainability.

6.2. *Which sector(s)?*

The definitions of sectors for conventional accounts no doubt have arisen from convention, economic history and policy concerns. They are largely unchanged for 70 years, despite the massive structural changes in the economy and society. For the purpose of constructing green accounts, a different definition of sectors might seem more appropriate, even if this causes difficulty for the conventional accounting. For many of the environmental issues included in green accounts of agriculture, it would be sensible to include the other prime land-using sectors too,

[45] DEFRA (2002a,b) sustainable development strategy: Foundations for our Future.

[46] eftec/IEEP ibid p. iii.

particularly forestry.[47] Four reasons can be offered for this. First, land itself, or aspects of it for example soil and landscape, are vital parts of natural capital. Second, there are important ecological interactions between contiguous areas of land in different (economic) sectors. Third, the decision-making business units are generally land-based rather than sector-specialised, often spanning agriculture, forestry, leisure and recreation. These businesses are increasingly embracing environmental service provision as schemes and mechanisms arranging contracts for the supply of such services are developed.[48] Fourth, it highlights the scope for the switch to renewable energy and material substitution (e.g. timber for concrete and brick), given the right policy signals.

Acknowledging that negative externalities justify attention wherever they arise, rational decisions on where to apply to apply effort and resources (political and administrative as well as financial) to reduce externalities requires information on the green accounts for all sectors. Regulatory resources are scarce and should be allocated according to the ease, i.e. costs, of reducing negative externalities taking risks into account. This is indeed the approach proposed by the Environment Agency for tackling agricultural externalities. It has suggested that the achievable reductions for soil air and water externalities were unrelated to the scale of the damage, as shown in Table 3 below.

It is not clear if these estimates of achievable reduction were based on the principle of equalising marginal costs of regulatory effort and costs to the firms affected. 'Achievability' based on some, doubtless, expert assessment of technical feasibility is not a sound basis for proceeding with decisions on where to start, or how far to go with policies to reduce pollution.

But decisions on how much effort to expend on reducing agricultural externalities and where to direct it require these decisions to be taken first at sectoral level, then within sectors. Transactions costs must be an important part of such analysis. The prime justification for this is the efficiency of utilisation of resources, both the natural capital whose protection is the *raison d'être* of green accounting, and scarce regulatory resources. It is also necessary to demonstrate

Table 3

Annual costs and achievable damage reductions in UK agriculture

Natural resource Impacted	Agricultural damage caused (£m in 2000 prices)	Achievable reduction in the short run (£m in 2000 prices)	Achievable reduction in the long run (£m in 2000 prices)
Soil	264	172	198
Air	203	83	126
Water	760	76	201
Total	1226	331	525

Source: Environment Agency (2002) p. ii.

[47] This was the approach used by Whitby and Adger (1996).

[48] The new Environmental Stewardship Schemes launched in England (Entry Level and Organic Level Stewardship) and in Wales (Tir Cynnal) in 2005 provide options for woodland and forestry based services to 'score' in these essentially agriculturally based schemes. Thus agri-environment schemes are slowly turning into rural environmental schemes.

that this rational approach is being taken in order to gain the support of the affected sectors and civil society generally.

There is a perception that having focussed hard during the last quarter of the 20th century on point-source pollution in the UK the regulatory authorities are now turning their attention to diffuse pollution. This, it is said, turns the spotlight from manufacturing onto the energy, transport and agricultural sectors. Such decisions, if they are to carry weight, should be based first on sectoral green accounts for all sectors.[49] We now have skeleton accounts for one part of the food chain, agriculture. It is important to be able to compare this with the rest of the chain, up to and including the household sector.[50]

6.3. *Agricultural policy implications*

The facts that agriculture occupies almost three-quarters of the land area in the UK[51] and that this sector is associated with significant positive externalities (landscape, habitat and species and, potentially, carbon sequestration), are enough to justify consideration of agricultural policy under a distinct heading within general environmental policy. Agriculture *is* different. The above characteristics, its strategic role in food supply, combined with its atomistic structure, and its position, wedged between globalised and highly concentrated upstream and downstream supply, food processing and distribution industries, justifies distinct consideration, and policies for this sector. The economic structure of the food chain has implications for environmental regulation as well as for the economic fortunes of farming. To the extent that external costs are imposed on farming, the ease with which these costs can be shared up and down the chain is very different, i.e. much more restricted, than for example in the water industry where local monopoly suppliers can pass on all such costs to their customers (provided they can persuade the water regulator).

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[49] It should also logically focus on the consumer, especially for example, for energy. However, government in democracies finds this difficult to grasp.

[50] Given the relatively small part of final consumption value in the food chain accounted by agriculture (£8b of £144b, i.e. less than 6%), it is not inconceivable that agricultural negative externalities are also a minor part of total food chain externalities. Having such information is the first step in deciding how to focus efforts to reduce the externalities. It is known for example that UK agriculture contributed only 8% of UK GHG in 2002 (Chapter 3, DEFRA Review of UK Climate Change Programme), and yet this is by far the largest negative components of the green agricultural account. Pretty *et al.* (2005) provide support for the proposition that primary agriculture is not the biggest source of negative environmental externalities in the food chain. However, the reluctance of these authors to follow a recognisable accounting framework, means that their calculations and results are *ad hoc* and difficult to compare to other accounts. This prevents them being used as a reliable guide to the relative contributions of all parts of the food chain. Also there seem some notable gaps in their estimates of externalities in the chain downstream of farming. For example their analysis makes no attempt to measure the environmental impacts of the food processing, food service and food packaging components of the chain.

[51] Actually 73%, according to Agriculture in the UK (2002) Land use in the United Kingdom.

Agricultural policy in the European Union since 1993 has radically changed. MacSharry commenced the process by substituting direct payments for price support. Without this, it would not have been possible to take the next step, decided in 2003 and to be implemented in Britain in 2005, of decoupling the direct payments from production. These reforms were undertaken for a complex mix of reasons, and environmental objectives are certainly a part of the mix. The agreed approach includes elements both to do less environmental bad and to do more good.

Part of the 'doing less bad' is the sequence of reducing and removing the most important policy-induced incentives for intensification of agricultural production which can be environmentally damaging.[52] Unfortunately, the development of green accounts has come too late to test the hypothesis that these policy changes have reduced negative externalities – although some indicators like reductions in artificial fertiliser and pesticide use would support this.[53] Another contribution will come from the requirement, for receipt of the Single Farm Payment, to keep land in good agricultural and environmental condition and to respect other, mostly environmental, conditions. The intention is that these conditions will lead to production of less bads, but in turn they will also stimulate and maintain some of the goods.[54]

The main focus of 'doing more good' derives from the parallel process to the Pillar 1 changes, to build-up programmes explicitly designed to correct the under-provision of environmental services from agriculture. This has been and continues to be a slow and extremely cumbersome process.[55] The first steps were to initiate the 'accompanying measures' in the MacSharry reform (Official Journal of the European Communities 1992). Two of these were environmentally important, the Agri-Environment and Less Favoured Area schemes.[56] In the Agenda 2000 (Official Journal of the European Communities 1999), this developed into the full-blown Rural Development[57] Pillar 2 of the CAP which includes, *inter alia*, the accompanying measures and other measures allowing payments for management of natural resources, e.g. support for Natura 2000 sites. Importantly, Agenda 2000 also provided a mechanism to switch resources from

[52] Namely the high and stable product prices which are way out of line with world market conditions.

[53] See Buckwell and Armstrong-Brown (2004).

[54] A key problem in the whole area of agricultural externalities is the multi-dimensional nature of the goods and bads and the fact that they are extremely difficult to separate from one another and from the agricultural practices which give rise to them.

[55] The clumsiness arises from the complexities of EU financing and administrative control procedures; in particular how to arrange optional, regionallydefined, multi-annual schemes within a programme (the CAP budget Guarantee Section) originally designed for obligatory, pan-EU, annual support.

[56] The environmental basis for LFA support is still hotly debated; arguments can be made that this is the only durable basis for specific public support to such areas in the context of liberalisation of markets for agricultural produce.

[57] Irretrievable misnomer no. 1. Confusingly, the Rural Development regulation contains agri-environmental and also rural development measures.

Pillar 1 to 2 namely, modulation.[58] However, this was an optional facility and only the UK took it up to any extent. The 2003 CAP reform agreed that modulation should be compulsory in all Member States, rising to 5% in 2007.[59] This expands the resource available for the proposed new Rural Development Regulation which will operate from 2007 to 2013.[60]

The lesson from this complex development process is that the CAP has been moving away from a system of production support for agricultural produce, and towards a system for helping diversify and stimulate the rural economy, and provide public payments for public environmental services delivered by land managers. It is well known that reform of European agricultural policy is a slow, piecemeal process in which agreement on the big structural reforms is always 'bought' by concessions to sectors or Member States which invariably obscure the vision of the reform path. Thus until the next big reform, which is unlikely to be agreed much before 2010, the CAP, for example as it will be applied in the UK, can be described as four-fifths decoupled direct payments which are untargeted base payments for respecting quite rigorous EU environmental regulations,[61] plus one-fifth more targeted agri-environmental payments securing the continued or increased delivery of landscape, habitat, biodiversity services and some degree of resource protection.[62]

There is no suggestion here that this perspective is shared by all stakeholders across the UK, far less the EU. It is far from clear that even many of the farmer's representative organisations around Europe support this vision.[63] It is offered as an, admittedly charitable, broad-brush perspective of some farmers and other land managers, and – here is the point – one for which some support can be derived from the green accounts examined in this paper.

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[58] Irretrievable misnomer no. 2. The act of reducing Pillar 1 direct payments and switching them to fund Pillar 2 schemes has been confused with the idea of differentiating (modulating) the size of the payment cuts depending on the size of the payments. There was a political desire to differentiate in this way with larger payment cuts for the larger payment recipients. However, because this would impinge so starkly on just two member states, Germany and the UK, it has been watered down. The first €5000 are exempt from payment reductions. In any case to the extent that CAP supports are acknowledged to be payment for environmental services then payment thresholds and ceilings make no sense unless calibrated in relation to costs or value of environmental services delivered.

[59] Commission of the European Communities (2003) CAP reform 2003.

[60] Official Journal of the European Union (2004) Proposal for new RDR and EAFRD, which is, of course, conditional on the outcome of the battle over the size of the total EU budget for the next financial period.

[61] Rigorous, that is, compared with most of the rest of the world.

[62] The intermixed nature of production by land managers of environmental goods and bads is mirrored by a similar intermix of delivery of goods and bads in both the Pillar 1 cross compliance conditions, and the Pillar 2 agri-environment schemes. There are elements dealing with resource protection (mostly a matter of reduction of bads) in both, and elements for delivery of landscape and biodiversity (which is mostly a matter of increase in the goods) in both.

[63] This has been the position of the Country Land and Business Association since its paper A Rural Policy for Europe (Country Land and Business Association 1996), and this is shared by its Brussels-based counterpart the European Landowners Organisation.

A very large part of the point of monetised green accounts is to be able to value and sum otherwise incomparable phenomena. Accepting that the figures reviewed in this paper are provisional, incomplete and subject to wide margins of error, it is still just possible to hazard some potentially far-reaching policy implications. First, it might be concluded that the current level of gross public payments through agri-environment schemes specifically for the supply of public environmental landscape and biodiversity services is too low. Second, if we take the data discovered to date at face value, it does not seem wildly beyond the bounds of possibility that the total value of environmental services delivered by land managers could be of the same order of magnitude as the current total financial support to farmers under the CAP. This focus on the magnitude of payments and positive services is without prejudice to the actions to be taken and costs thereby incurred on the sector in dealing with the negative externalities.

Support for these hypotheses is provided first by comparing the sort of magnitudes of total economic value of environmental services found by Hartridge and Pearce and eftec/IEEP, which range from £595m to £1800m,[64] with the current expenditures on total agricultural support and agri-environment schemes which for 2003 were £2711m and £385m respectively.[65] Second, as explored in section 5 there are several practical, empirical reasons to suppose these may be underestimates: these are mostly a matter of non-inclusion of: (i) ordinary (non-designated) farm land; (ii) option values, (iii) the positive impacts on the tourism and recreational industries, (iv) carbon sequestration, (v) the value of peace, quiet and solitude, and (vi) (potentially) biofuels and timber substitution. In addition, Whitby and Adger (1996) argues that with increasing general income levels, if the demand for environmental services is income elastic, it is possible that real prices of environmental services may rise in future.

No doubt there will be resistance to these hypotheses, even horror! The point is that careful, independent investigation by doing green accounts is the only way to provide evidence for the debate. Moreover, whatever the numerical results, a further conceptual question has still to be resolved. This is expressed by Whitby and Adger (1996) who suggest somewhat provocatively 'Who should receive the credit for additions to welfare depends on whether they arise in spite of land use activity or because of it'. EFTEC/IEEP[66] raise the same issue but from a different angle; they query 'the extent to which the services provided are attributable to the agricultural or government accounts'.

Land managers themselves will, of course, give very clear answers to these questions. The services under discussion are byproducts of farming which are not

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[64] Source: DEFRA (2004) Table 10.1, the figures on agri-environment for 2003 include both EU and UK public expenditure.

[65] It is acknowledged that the mere existence of a market failure of a certain magnitude is not a sufficient justification for a publicly financed scheme of the same magnitude. There are other ways of inducing the internalisation of the externalities, including private paid-for provision, or delivery of the benefits by charitable organisations. Also for some elements, the costs of remedying the under-provision of public goods might exceed their value. The point is that debate on these issues is greatly helped by estimates of the relevant environmental values.

[66] Ibid p. 24.

directly paid-for. It has so happened that, just as technical change enabled farmers to squeeze more marketed products out of their land, for example by removing field boundaries to enlarge fields (often with Government financial assistance), and thereby diminishing unpaid-for environmental services, societal changes brought about an increase in demand for these very services. In a society based on private ownership and use rights in land,[67] landowners claim that we start from a presumption that they hold the relevant property rights and that the debate takes the form of the payments required to induce land use change from marketed to non-marketed goods and services. It does not seem to them that it is enough simply to say, as in eftec/IEEP, that as 'a fraction of the value arises from government regulation' then this value should be attributed to the government sector. The riposte is that without the private land management there would have been no value to regulate or designate in the first place, and that left to the vagaries and inefficiencies of a 'government sector' such values would face a precarious future. A critical aspect of the resolution of this debate must centre on the extent of the knowledge and costs of providing the land management which supplies the environmental services. This takes us to the heart of the debate in which the precise assignment of the multiple aspects of property rights in land use to provide the complex mix of positive environmental services is gradually being thrashed out.[68] As Pannell (2004) points out, slogans like 'polluter pays' and 'provider gets' are only one ingredient in this debate. Fairness, effectiveness, transactions costs of various delivery mechanisms are equally important ingredients in the debate.

A further point of the connection between green accounts and the delivery of environmental benefits through agri-environment schemes concerns the principles used in arriving at both the quantum of resource devoted to such schemes, and the payment rates on individual schemes. The clear economic logic which underlies the accountancy framework proposed by eftec/IEEP, if it were generally understood and propagated amongst the relevant agencies and stakeholders, can help bring some coherence to the current muddle of arrangements for agri-environment. By the end of 2006 in England for example, there will be large (approximately £1.6b) total transfers in Pillar 1 for cross-compliance at a rate (in lowland England) of approximately £170/ha; a smaller (say £180m) wide-application, Entry-Level Stewardship Scheme offering approximately £30/ha, and more targeted Higher Level Stewardship schemes (approximately £300m) offering a range of payment rates up to approximately £300/ha for certain activities. The unravelling of the distortions in the commodity markets through the creation of the Single Farm Payment and the production of a comprehensive economic framework for green accounts for agriculture offers an opportunity to clarify these magnitudes of support and payment rates.

A comprehensive set of green accounts can also assist the decision processes at work in dealing with the negative externalities of agriculture. One of the biggest efforts underway on this is the implementation of the Water Framework Directive, (Commission of the European Communities, 2000). The Directive itself has set in place a sophisticated iterative process to arrive at the precise standards which will define the 'good status' of water bodies, which it is the objective of the Directive

[67] As enshrined in Article 17 of the European Convention on Human Rights.

[68] In the UK this debate takes many forms, over the very many different types of land designations, e.g. Natura 2000 sites, ESAs, National Parks, LFAs, AONBs and green belt.

to deliver. The approach embodied in the WFD is to mandate Member States to conduct even-handed cost-effectiveness studies of all the potential Programmes of Measures (POMs) which are identified as offering ways for each sector of achieving good status. If these cost-effectiveness studies identify for certain sectors and POMs that the costs are 'disproportionate', then this evidence may be used to justify derogations either to reduce the standard or to permit delayed achievement of the standard. Assessing disproportionate costs of course means assessing benefits.

Implementing these procedures is underway with a large 4-year Collaborative Research Programme to define and develop the cost-effectiveness and disproportionate cost methodologies and databases, DEFRA (2005). It would seem highly desirable that this work is consistent with, and builds on the green accounts framework. In turn, detailed studies on individual impact categories such as this water analysis (covering all sectors) should also contribute to the future calibration of green accounts. It would be a misallocation of scarce, public, research and regulatory resources if this is not done.

7. Final Comments on Green Accounting

The thrust of this address is that agricultural policy has well and truly changed. Whereas for the bulk of the post-WWII period, if not the 80 years of the Society's existence, the subject has chiefly been concerned with the economics of agricultural production and product markets, now the emphasis has swung to the non-market services and interactions of the land-based sectors. A green accountancy framework for this wider set of activities is therefore essential.

Whilst the paper has addressed green accounting from the point of view of its ultimate usefulness in guiding public policy, the questions posed are also of fundamental importance to the agricultural sector itself that is to farmers and land managers. As factor owners, still predominantly organised in individual family businesses in which intergenerational succession is an important goal, business sustainability is of great importance. If scientific evidence suggests that the sector as a whole is unsustainable then this should stimulate thought, research and corrective action. This is particularly so given the dependence of the sector on public financial support. It is interesting to note that the eftec/IEEP study placed great stress on internal sustainability of current farming with respect to its impact on future crop yields, but was unable to answer this question with data that could be fitted into the green accounting framework. This prompts the observation that, if we wish to address such specific questions we would do so much more directly and not through a green accountancy framework. The usefulness of green accounts is for the overview they provide and for priority setting, and not for detailed diagnostics.

Consistent sets of green accounts are essential if we wish to compare impact categories and sectors, and, of course, if we wish to assess overall sustainability. The state of this work clearly has advanced a great deal in the last decade. However, it seems premature to claim that the conceptual framework is complete. Questions remain with respect to global environmental resources; the appropriate time horizon and discount rates; and the valuation of non-market resources and services. Empirically, considerable progress has also been made in establishing some broad orders of magnitude of economic adjustments for agricultural accounts as between impact categories. Identified gaps must now be filled. At the same time it is important that comparable work is done, within the framework which has now been established,

for other sectors of the economy, and particularly for the rest of the food chain and other aspects of land management. Consensus on the accounting framework is clearly a very big step in doing this.

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