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**GREENING ECONOMIC ACCOUNTS FOR AGRICULTURE
– SOME CENTRAL ISSUES IN CREATING A NEW ENVIRONMENTALLY
INTEGRATED, SATELLITE ACCOUNT**

Invited paper submitted by the United Kingdom*

Summary: A “green” version of the Economic Accounts for Agriculture is proposed, the calculation that is central to the assessment of the economic situation of agricultural activity in the European Union. To make the adjustment a number of central issues have to be tackled, especially which environmental items are to be taken into consideration. The outcome should be an account that enables the environmental impact of agriculture production to be traced.

Keywords: national accounts; agricultural activity; environment

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I. Introduction

1. Environmental issues constitute an area of public concern in the EU and other OECD countries and are the basis of policy action. There is an increased awareness of the impact of agricultural production on the environment (such as the leaching of fertilizers) but also an appreciation that changes in the environment can have implications for affect on agriculture (such as global warming). An indication of this is that the OECD has for some time encouraged the integration of agricultural and environmental policy (OECD, 1989, 1993).
2. Changes in the environment can be accounted for in physical terms. Natural resource accounting focuses on physical asset balances (opening and closing stocks and flows over time) of materials, energy and natural resources. Where appropriate, changes in quality of resources can also be involved. Data on physical attributes are useful in promoting understanding of the wider impact of changes (see (Repetto, 1989)).
3. Following this tradition, a large literature now exists on the interaction between agriculture and environment, and an international range of agri-environmental indicators have been developed (Commission of the EC, 1999; 2000; 2001; OECD, 1996, 2000; Parris, 2001). Such indicators, predominantly of a physical nature, are well suited to guiding policies (by establishing targets and monitoring performance) that are concerned with specific environmental issues and for informing a broad public (de Haan, 1998).
4. Similarly, a large literature has been developed on the principles by which national accounts can be “greened” (for example (Bartelmus, 1991; 1993; Canada, 1997, 2000; El Serafy, 1997; Hanley, 2001; Keuning, 1999; Lauber, 2000; Nordhaus, 1990, 1999a; 1999b; Peskin, 1991). Accounts are mostly applied in policy assessment and research, though they also have a role in establishing targets and policy monitoring (Bartelmus, 1999). The level of interest has been largely that of the national economy, and a variety of purposes have lain behind this “greening” (El Serafy, 1997). Some observers are concerned with sustainability and the environmental modifications to national income that, in theory under some fairly stringent conditions, would result in a level that was consistent with sustainable growth. Others have their main interest in preserving the stock of environmental assets, while others focus on the effect of environmental change on welfare.
5. The purpose of this paper is modest. It attempts to bring together the two strands (agri-environment indicators and “green national accounts”) by considering the conceptual problems encountered when applying, at the agricultural “industry” level, the principles developed for integrating environmental and aggregate economic accounting. This would take the form of a new satellite account for agricultural activity, a “green” version of the Economic Accounts for Agriculture (EAA) developed by making a small number of transparent adjustments to the conventional EAA. The implication is that any changes in physical environmental characteristics associated with agricultural production activity must be capable of expression in monetary terms.
6. It must be stressed that there is no suggestion here that the current EAA should be displaced or discontinued; the EAA is founded on well-understood principles and has been widely used as a major policy tool. Rather, attention is concentrated on the opportunity for *additional* ways in which the basic accounting framework can be used to generate information

that is relevant to policy involving agriculture and the environment. Comparison between the conventional EAA and the “greened” versions, and in particular how this relationship is evolving over time, might be expected to cast light onto the environmental implications of agriculture as an economic activity and of the policies directed at agricultural production.

II. Provision in the SNA 1993, ESA 1995 and SEEA 2000

7. The United Nations *System of National Accounts* (SNA93) (UN, 1993b), the reference methodology for accounting at this level, stresses the need to take a flexible approach to meet the statistical needs of policy-makers and others. To this end it proposed an array of satellite accounts, linked to the main framework and leaving the main aggregates intact but allowing rearrangements to facilitate the use of alternative concepts (“internal” satellites) and, where appropriate, making extensions to include items not part of the conventional coverage (“external” satellites).

8. SNA93 devoted an entire chapter (Chapter 21) to functionally-orientated satellite accounts, of which a major proportion (par. 21.122 to 21.186) was concerned with the general design, concepts and classifications of integrated economic and environmental satellite accounts. The explanations are based to a large extent on the System of Environmental Economic Accounts (SEEA) that was presented in the UN handbook *Integrated Environmental and Economic Accounting* (UN, 1993a) and which is in a late stage of revision (publicly available in draft form) as SEEA 2000 (UN, 2000). The treatment in the SNA93 is described by its authors as “a description of the present state of the art of integrated and economic accounting, which may evolve over time as a result of continuing discussions”. It should not therefore be regarded as providing complete conceptual and practical guidance.

9. SEEA 2000 deals with a wide range of issues in details, discussing alternative approaches, problems of valuation etc. It presents a schematic set of current and asset accounts, with adjustments for environmental “residuals” and consumption of “natural capital”. Despite the prominence of physical accounting in SEEA 2000, de Haan (1999) characterised the SEEA as having the eventual aim of computing one single indicator for economic and ecological performance by putting prices on environmental losses (in contrast to the approach of the National Accounting Matrix including Environmental Accounts (NAMEA) that attempts to embed indicators for economic and environmental performance into one information system). Expressing change using the common denominator of money has advantages when a variety of disparate changes are involved, as long as satisfactory methods of valuation are employed.

10. SEEA 2000 is not a recipe manual but gives guidance as to what might be appropriate in particular circumstances; flexibility is paramount. However, its annex gives examples of how the principles have been applied by some countries, and these prove valuable in the present circumstance.²

III. Theoretical aspects of integrating environmental and economic accounts

11. The system of national accounts incorporates a number of important conventions. The main concepts, barely changed in successive sets of international guidelines, focus on describing the economic process in monetary and readily observable terms. For the most part, stocks and flows that are not readily observable in monetary terms, or that do not have a clear monetary counterpart, are not taken into account. Exceptions to this generality are made on the grounds of consistency and various data needs. For example, consistency requires that the value of collective services produced by government is recorded as output, because the payment of compensation of employees and the purchase of all kinds of goods and services by government are readily observable in monetary terms.

12. National accounts relate to activities that fall inside a production boundary, the nature of which is in part a matter of convention. For example, own-account production of housing services by owner-occupiers and goods for own final consumption (such as agricultural products), and breeding of fish in fishfarms are considered to be within the boundary, whereas domestic and personal services produced and consumed within the same household (e.g. the preparation of meals or the care of elderly people) and the natural breeding of fish in open seas are both excluded. Thus the production boundary “is a compromise, but a deliberate one that takes account of the needs of most users” (SNA93). It follows that, when drawing up satellite accounts for particular purposes, that boundary can, and should, be adjusted.

13. The thrust of the case against the docile acceptance of the conventional production boundary, and hence the Net National Product (national income) and related measures that are bound to it, comes from three main direction.

- (1) **Firstly**, some of the GDP arises from activities that are necessary to defend the environment from the harmful affects of other activities, both the negative externalities of production and of consumption. Where this defensive activity is undertaken by farms (firms) that are forced to take steps to limit air or water pollution, the cost is already treated as intermediate consumption and deducted in the calculated of Value Added. However, defensive spending financed by the state (e.g. of actions to reduce pollution in rivers or to clean up oil spillage) or by households (that purchase water-treatment devices, or who resort to buying bottled water) is not treated in this way. Perversely, more pollution that requires more corrective action will lead to an increase in GDP as conventionally calculated. Such public and consumer expenditure might more appropriately be treated as intermediate consumption and deducted from the value of aggregate output to achieve an environmentally-adjusted final demand. A case can be made ((Harrison, 1989)) that, even if such defensive expenditure does not take place, an estimate should be deducted to reflect decreased welfare.
- (2) **Secondly**, while consumption of the stock of fixed capital is treated as a negative item in reaching conventional estimates of national income, no account is taken of the consumption of non-produced natural resources (apart from the activity that results in the depletion or degradation of the resource, such as the mining or fishing process). Under the SNA, where the major interest is on production, the activities that result in degradation and depletion of natural resources are only regarded as an economic gain; no

loss is incorporated ((da Motta, 1996)). “As both environmental and natural resource capital are crucial to the production of goods and services, neglecting to value their depletion necessarily means that net or sustainable income is overstated”((Peskin, 1991?)). The SEEA extends the concept of capital to include the “naturally-grown” assets of agriculture, forestry, and fisheries, non-produced natural assets of scarce renewable resources such as marine resources, tropical forests, non-renewable resources of land, soil and subsoil assets (mineral deposits), and cyclical resources of air and water ((Bartelmus, 1996)). Consumption of these items is treated in a manner in principle identical with that of produced capital, though it must be acknowledged that some of these resources are not marketed (such as clean air, the stock of fisheries, and bio-diversity) and problems of valuation will arise. Natural resources often also have a self-regenerative or renewable characteristic, so that the critical consumption is likely to be that rate of use that exceeds the natural and managed regenerative rate of the asset, a rate that is not easily defined. Nevertheless, it is evident that a running down of natural resources will restrict the ability to generate income in the future and must be accounted for. A build up of produced capital that is achieved only by a reduction in natural resources will not represent a net change. As a corollary, the concept of capital formation (covering only produced assets) is changed by adopting an integrated approach into a broader concept of capital accumulation, which can encompass bringing into the stock additional assets that are created by nature rather than by man’s activities.

Thus, when the two adjustment just mentioned are made, in a very simple form:

Sustainable Net National Product = Net National Product *less* Defensive Expenditures
less Depreciation of Natural Capital (Adger, 1991a)³.

14. This view of national income is in accord with the original Hicksian approach, that income corresponds with the level of consumption that does not jeopardise future generation of income or welfare ((Daly, 1989). It however takes a broader view of the resources that should not be depleted over the period than has usually been adopted in economic accounting.

- But in addition, adjustments can be made on the output side to include within the boundary the **value of environmental and other non-market services**. Where these are supplied in exchange for money values (such as public payments to landowners to permit recreational access) the case for inclusion is strong; this is only one step away from the private marketing of access by an admission ticket. The situation is less clear when there is no payment and access is viewed more as a public right. A further complication is that, frequently in agriculture, environmental services are externalities associated with market production, so no private resource costs are involved in their generation. There may be a problem of double counting if adjustments for both the value of environmental services and costs of defensive action are made (Maler, 1991).

15. To include such services is rather a large adjustment in the boundary of economic accounting and shifts the resultant to a Measure of Economic Welfare (MEW) rather than one of an adjusted national income (Hamilton, 1994).

16. Although there is general agreement about the desirability of making *some* adjustments to the conventions adopted by national accounts, and a range of revisions has been suggested which involve wider environmental changes (Hanley, 2000), there appears to be little consensus as to correct procedures. “The reasons for this stem from the inconsistencies in the underlying economic model of income generated in an economy and from suggested revisions requiring large capacities for data collection (Blades, 1989; Heuting, 1990)” (quoted in Adger, 1991a). It is not self-evident which spending on activities within the economy should be regarded as “defensive expenditure” in protection of the *natural* environment (as opposed to consumption spending, or spending to defend humans in their built environment on items such as double-glazing to reduce the nuisance of traffic noise). And the valuation of natural resources, particularly where they provide non-marketed services, is notoriously problematical.

17. The upshot of the above is that, in principle, the “greening” of economic accounts can take a flexible form, depending on circumstances. This is borne out by the examples of practical use in different countries contained in the Chapter 9 of SEEA 2000. Hence, when considering the possibility of applying some of the techniques in an agricultural context, we should be influenced primarily by the purpose for which the “greening” takes place and what data exist or can be collected with reasonable reliability. As long as transparency is preserved, the approach can be flexible. The next section considers some of the issues in applying “greening” in the agricultural accounting context.

Integrating environmental and economic accounts for the agriculture “industry” – to where shall we shift the boundary?

18. The opportunity to integrate environmental and economic accounts at the sector level should be welcomed in principle so that the wider implications of policy changes within the sector can be appreciated by decision-makers. “Greening” the EAA involves presenting a more comprehensive picture of the use of resources in agricultural production. However, there are substantial problems to be faced in “greening” at the sector level and few examples involving agriculture are to be found. Both theoretical and practical difficulties have to be faced. (Though integrated accounts for forestry have received attention (Eurostat, 1999), these have gone little further than rearranging items already in the ESA/SNA accounts – including natural growth - and balance sheets, and have not yet incorporated the “non-market, non-wood values” of forests).

What is the appropriate sector boundary? Should the agricultural “industry” be combined with other land-uses?

19. In establishing a new boundary it is important to do so in a meaningful way so as to highlight the environmental externalities. By definition, a sectoral view excludes consideration of the activities that lie outside the sector, and this creates the danger that some important environmental externalities will be ignored or under-represented, but it also brings the benefit of simplification. For example, in their study of the primary land using sector of the United Kingdom, (Adger, 1991a) found it necessary to combine the conventional economic accounts for agriculture and for forestry because they recognised the interdependence of the externalities within these primary land-using sectors of the economy. In contrast, a sectoral exercise for the United States (Hrubovcak, 1996) included aspects of the water sector as the focus of

environmental concern was the relationship between agriculture and water quality, but did not include forestry. A case could be made that a “green” satellite account should take a broad approach and include agriculture, forestry, the supply of water services, and perhaps more. However, this would involve a quantum leap in accounting practice and in the ways that economic statistics are routinely presented by Eurostat and the OECD.

20. On the other hand, a sectoral approach, even one enlarged to encompass the main land-using activities, can avoid certain tricky problems. For example, while modifications for pollution caused by the use by agriculture and forestry of fossil fuels are counted against this sector, the depletion of oil stocks is an element leading to modification of the account for the oil sector. Similarly, while the degradation of the stock of natural capital that results from pollution of water by fertilizer run-off falls within the responsibility of the agriculture sector, the depletion of raw materials used in the production of inorganic fertiliser accrues against the manufacturing sector. Also excluded are the activities of the purchasers of agricultural and forestry products who may quickly convert them to waste and add further to global pollution.

Which forms of “defensive” expenditure are to be covered?

21. With the adjustments for defensive expenditure, there are the problems of identification and measurement. Public spending may not be easily partitioned into that associated with correcting for agricultural (+forestry+water) externalities and others. For some the classification may be quite clear - such as management agreements paid to farmers to maintain the landscape and wildlife amenity of rural areas, or sums spent directly and indirectly for the protection of areas designated as environmentally sensitive or of special scientific interest (though where such agreements are voluntary the sums that could be paid to non-participants who, presumably, farm in environmentally-unfriendly ways is not counted). However, there would be disagreement on whether payment for set-aside or as subsidies to farmers in less-favoured areas should be fully considered as defensive spending (particularly where the latter can be shown to be environmentally damaging through encouraging higher density stocking). These payments have multiple objectives. Similarly, public spending on enforcing pollution controls by water or river authorities may not easily be partitioned from the costs of other functions they undertake. Within private spending, household expenditure to reverse environmental externalities related to a single land-based sector are difficult to identify and measure in practice. Consumers’ concern with food and water quality may reflect more the activities of firms falling outside the statistical coverage of the sector singled out here (such as food processors).

Which parts of the degradation and consumption of natural capital are to be covered?

22. When making adjustments for the degradation of natural capital, decisions have to be reached on the nature of the degradation and how it can be valued. There does not seem to be yet a common approach to what forms of natural capital should be taken into consideration when drawing up integrated environment and economic sector accounts. For the United Kingdom attention has focused on the stock of carbon and the impact on the environment of higher levels of nitrogen⁴ and phosphorus (Adger and Whitby 1991, *op cit*). In their study of the activities of the (combined) agriculture and forestry sector, no modification of the economic accounts was introduced to allow for the depletion of exhaustible resource stocks. It was felt that for Great Britain the use of such resources was slight (though account was taken of the pollution

externalities of their direct use). For phosphorus the sectoral approach is complicated in that agriculture is not the only source; it is a non-point source of water pollution from households and some point sources from industrial outputs. The US study (Hrubovcak, LeBlanc and Eakin 1995, *op cit*) concerned itself only with the economic effects of soil erosion on agricultural productivity, of surface-water quality (sedimentation rather than chemical content) and of the depletion of ground-water stocks. Significantly, neither study included landscape or wildlife as forms of natural capital, though these are items of major sensitivity in terms of environmental concern.

23. Carbon forms a particularly interesting example as, taking agriculture and forestry together, for the United Kingdom there is a net sequestration. Adger *et al.* (1991b) estimated that approaching double the amount of carbon is fixed by the agriculture+forestry sector than it emits. Evaluating this positive net contribution to the environment must rely on indirect methods (with alternative methodologies proposed for example by (Anderson, 1991 and (Nordhaus, 1990)). However, this represents a major positive item of adjustment in the stock of natural capital in the United Kingdom.

Should positive externalities be included, and which?

24. The positive externalities that agriculture generates are of increasing importance to justifying the financial support for the industry. The “multifunctionality” of the “European model” of agriculture covers outputs that relate to both the natural, social and cultural environments, though the notion of “greening” accounts probably only relates to the first of these. Typically “multifunctionality” refers non-commodity outputs that are joint products with agriculture commodities and for which markets do not exist because of market failure (Cahill, 2001; OECD, 2001).

25. A range of techniques exist by which these non-marketed services can be evaluated (contingent valuation, hedonic pricing, travel cost, dose-response based models etc.) though none is without its detractors. Environmental evaluation estimates remain critically affected by the set of inherent property rights of the public goods involved, as well as the acceptability to consumers of a hypothetical market for the good or service (Adger and Whitby 1991, *op cit*). There are also large differences between estimates of willingness to pay and willingness to accept compensation for the same externality.

V. Impact of the environmental adjustments

26. The impression is sometimes given that environmental adjustments to the conventional economic accounts for agricultural activity will inevitably reduce the value of its contribution. This is not necessarily the case. The size and direction of adjustment will reflect the nature of the activities included within the sector and the coverage of externalities and natural resources changes.

27. In the United Kingdom, when forestry and agriculture were combined, the non-market services service flows provided by these industries added a large positive item to the integrated environmental and economic accounts for the sector, to the extent that, when combined with the

positive impact of carbon sequestration, the environmentally-adjusted Net Product rose by almost a quarter, though the authors give little confidence on the reliability of their calculations, stressing that many adjustments were not included⁵.

28. For the United States, the narrower industry grouping and different range of environmental adjustments lowered “traditional” aggregate agriculture net product by some 6 to 8 per cent (for 1982, 1987, 1992), though the researchers were keen to point out that their estimates suggested that agriculture’s contribution to social welfare far exceeded the environmental damages and deterioration of the stock of natural capital resulting from the production of food.

VI. Some issues that agricultural statisticians should consider

29. The idea of making good some of the more obvious deficiencies of the standard conceptual framework of economic accounting to take on board broader environmental changes is attractive. In reviewing the collected work of national experts describing the state of integrating environmental and economic accounts (published as Nordhaus, 1999b), Woodward (2000) regretted the lack of precise guidance and the general plea for more work to be undertaken. This paper is, equally regrettably, no further forward in the practice but suggests some priorities for that work.

30. For “greening” the EAA to proceed and for internationally-comparable figures to be generated there would have to be substantial discussion of some basic concepts. Such discussions do not yet appear to have started within the official *agricultural* accounting system of the European Union. These include:

- (1) The industry group for a “greened” account (agriculture, or a broader land-using group that might include forestry and/or water supply).
- (2) The conceptual framework of the possible adjustments (some of which are still in dispute), presumably developed from SEEA 2000.
- (3) Whether the aim should be for a complete set of environmental adjustments, or a less-than-complete set that are, nevertheless, both transparent, relatively easy to express in money terms, and of significance to the outcome.
- (4) If the latter route is chosen, which adjustments should form the basis of a harmonised methodology. It is practical to devise a common list of adjustments be applied to all countries in the EU and/or OECD?

NOTES

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² The European System of Accounts 1995 (ESA95), the version of the SNA93 prepared for use in the European Union, while listing as a possible use for a satellite account the analysis of the interaction between the environment and the economy, does not include an equivalent section in the main text on environmental accounting. Nevertheless the European Commission, in its response to the EU's Fifth Environmental Action Programme, identified the creation of a handbook on Green Accounting and the development of environmental satellite accounts as among steps it intended to take (EC, 1996).

³ Far more complex formulations are possible. An alternative expenditure-based presentation (Bartelmus 1996) Environmental Domestic Product = Final Consumption + Capital Formation - (environmental cost of production + environmental cost of final demand shifted to production)) + (exports - imports).

⁴ For nitrogen, in addition to defensive expenditure, the benefits that might flow from cleaner drinking water can be evaluated through revealed and expressed preference techniques. However the magnitudes of the potential impacts of nitrogen are far from fully established and the official recommendations (such as the minimum nitrogen content of drinking water) are still contentious.

⁵ Adger and Whitby give the following for GB in 1988

Net product (from national accounts - unadjusted)	4,028
Degradation of natural capital	+ 135
Defensive expenditure	-58
Non-marketed service flows	+888
Modified Net Product	4993

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