



Environmental Farm Accounting: The Case of the Dutch Nutrients Accounting System

J. A. Breembroek

GIBO Accountants & Consultancy, Bergstraat 280, Arnhem, The Netherlands

B. Koole, K. J. Poppe

Agricultural Economics Research Institute (LEI-DLO), The Hague, The Netherlands

&

G. A. A. Wossink

Department of Farm Management, Wageningen Agricultural University, Wageningen,
The Netherlands

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ABSTRACT

In the Netherlands bookkeeping of inputs and outputs at the level of individual farms has been selected as a new solution to control nutrient use and to tax nutrient surpluses in agriculture. At the same time, nutrient accounting presents important management information. This paper presents a theoretical and historical background of the system, a description of the system as such and some first practical experiences. The relationship of the nutrient accounting system with the obligatory financial accounting is discussed and evaluated as crucial. The establishment of conformity of financial and nutrient accounts is an important audit instrument of the nutrient system as a policy instrument. Introduction in practice as a policy instrument will be phased.

INTRODUCTION

This paper discusses the adjustment of farm accounting to satisfy the demand for environmental data. That demand can be exercised by the farmer to improve his management. Public authorities could be the other inquirer. As topics and policies change, statistics and databases have to

adapt to new realities (Fletcher & Phipps, 1991). Some policy proposals, like extensification premiums, intensification levies and perhaps even input levies, demand detailed and auditable records on farm level for all farms concerned. Following sections focus on these environmental farm accounts, with the Dutch situation as an example.

Agriculture, and in particular animal production, contributes substantially to Dutch environmental problems. In the Netherlands, especially in the south and east of the country, a surplus of manure exists (Dietz, 1992). At a national level also it is expected that there will be a surplus of manure (Wijnands *et al.*, 1991). A national environmental policy for nutrient use was started in 1984 by physical measures. The change-over to an economic measure is scheduled for 1996. The nutrient accounting system described in this paper has an important role in the implementation of this new policy strategy.

NUTRIENT POLICIES IN THE NETHERLANDS

In the Netherlands, problems of pollution by nutrients (N, P and K) are mainly caused by overproduction of manure in intensive livestock farming on too small an area. This overproduction of manure is due to excessive nutrient imports from overseas in the shape of animal feedstuffs. The overall objective of the nutrient policy is to achieve a balance between production and utilization of manure by the year 2000. This implies that the total amount of nitrogen and phosphate applied in the form of manure, other organic nutrients and chemical fertilizers must equal the crop uptake. This objective is set out in National Environmental Policy Plan (*Nationaal Milieubeleids Plan*, 1989).

Dutch nutrient policy was established in the beginning of the 1980s. By that time it had become clear that measures needed to be taken against environmental problems caused by agriculture. This led to enactment of the Interim Law for restricting Pig and Poultry Farms in November 1984. The Law prohibited start and expansion (above 10% in numbers) of existing intensive livestock farms in the eastern and south-eastern (sandy soil) regions of the Netherlands. This Law did not stop the increase, and further action was needed. This led to the Three Phases Plan (phase periods 1987–1990, 1991–1994 and 1995–2000) addressing the 2000 goal of nutrient equilibrium. The figures presented in Table 1 are the core of the policy. Application is regulated by means of the phosphate content in manure. The current national surplus (i.e. based on 1994 application rates) can be taken up by directing manure to arable farms and by exports of manure.

TABLE 1
Maximum Admissible Application Rates of Manure and Loss Rates of Nutrients in kg Phosphate (P_2O_5)/Hectare/Year

Period	Grassland		Silage maize		Arable land	
	Manure application	Loss rate	Manure application	Loss rate	Manure application	Loss rate
1987–1990	250	—	350	—	125	—
1991–1992	200	—	250	—	125	—
1993	200	—	200	—	125	—
1994	200	—	150	—	125	—
1995	150	—	110	—	110	—
1996 ^a	135	(55)	90	(30)	90	(30)
1997	(120)	40	(80)	20	(80)	20
1998	(105)	25	(75)	15	(75)	15
1999	(95)	15	(70)	10	(70)	10
2000 ^b	(85)	5	(65)	5	(65)	5

^aThe values in parentheses are advised levels, to compare application rates of manure with loss rates of nutrients; values without parentheses are levels set or (for future years) proposed to be set by law.

^bAfter 2000: crop uptake (zero loss rate).

In the first phase (1987–1990), the Manure Law and the Soil Protection Act (both of 1987) replaced the Interim Law. The main objective was to stabilize the problem. The Manure Law ascribed manure production right (quota) to each individual farm according to livestock population and agricultural acreage in 1986. Livestock population was not permitted to increase at farms with insufficient possibilities of manure application. Hence, registration of the number of animals, land use and acreage was required (manure bookkeeping). The allowable manure application depended on land use and acreage per farm (Table 1).

The second phase (1991–1994) aims at gradually reducing the application rates (Table 1) and at preparing farmers for the third phase. In 1995 the third phase would start and should achieve the overall objective, i.e. a balance between production and utilization for both phosphate and nitrogen by the year 2000. The main points of the third phase are (see Rude & Frederiksen, 1994) as follows:

- introduction of the nutrients accounting system and the introduction of a prohibitive levy on the surplus of P_2O_5 ;
- introduction of loss standards to replace standards for the application of manure;

- reduction in manure quotas (by 30% for pigs and poultry);
- standards on ammonia emission for new intensive animal housing systems (green label);
- new nitrogen fertilizer application standards.

The original plan to start Phase 3 in 1995 has been postponed by one year to 1996. This is partly due to technical and political reasons, but also because of a debate on the (im)possibilities of reducing the national surplus of manure with the nutrient accounting system (see section below).

THE DUTCH NUTRIENTS ACCOUNTING SYSTEM

The basic idea of the nutrients accounting system (*Mineralenboekhouding*) is that only a limited amount of nutrients may be left 'on the farm' i.e. the loss standard (Table 1). After 1997 the loss of N, P and K from all types of input (fertilizer, compound feed, etc.) will be restricted. With the introduction of the nutrients accounting system the policy will be extended to nitrogen.

Originally, the nutrient accounting system was designed to provide management support. It was developed by CLM (Centre for Agriculture and Environment) and different groups of farmers. In 1993, the Government and the sector chose this management information system by official agreement as a policy instrument, i.e. to enable the imposition of a levy on excess losses of N and P_2O_5 (surplus minus loss standard). At first, potassium (K) will not be levied. With the choice of a levy on nutrient surpluses, financial incentives will be used in Dutch agricultural environmental policy from 1996 onwards.

Several inputs purchased by the farmer contain these nutrients (Table 2). Roughly the following groups can be distinguished: starting material, feed, fertilizer and other. Nutrients, nitrogen in particular, are also supplied by the environment, i.e. by deposition, mineralization on peat soils and N-fixation. Balanced against this, products that are sold or disposed of by the farm, export nutrients: animals and animal products, vegetable products, manure and offal/leavings.

Total output minus total inputs equals the surplus of nutrients left on the farm during the production process. This surplus will find its way into the environment through emissions to soil, water and air (ammonia). The surplus is an indicator for the on-farm efficiency of the production process. As a certain amount of inefficiency is unavoidable (from an agricultural point of view) or does not cause much damage (from an environmental point of view), the surplus is reduced by a standard loss rate to calculate the taxable surplus.

TABLE 2
An Example of a Nutrient Balance Sheet^a

	<i>N(kg)</i>	<i>P(kg)</i>	<i>K(kg)</i>
<i>Use of nutrients</i>			
Young animals	2281	448	207
Seeds and plants	50	8	62
Total starting material	2331	456	269
Compound feed	60 545	11 350	19 369
Roughage	432	75	450
Total feedstuffs	60 977	11 425	19 819
Fertilizers and manure	11 810	954	3166
Environmental supply ^b	2695	50	226
Others (a.o. straw)	98	14	112
Total input	77 911	12 899	23 592
<i>Output of nutrients</i>			
Animals	24 370	4557	1647
Milk	1909	315	525
Total animal products	26 279	4872	2172
Total plant products	3600	630	3420
Manure	28 150	5911	14 666
Others (a.o. garbage)	0	0	0
Total output	58 029	11 413	20 258
<i>Surplus of nutrients</i>	19 882	1486	3334
<i>Surplus of nutrients/ha</i>	361	27	61

^aHypothetical farm of 55 ha: 35 ha arable, 20 ha grassland, 50 milk cows, 100 sows and 1000 fattening pigs and 50 000 broilers.

^bDeposition by rain, mineralization on peat soils and N-fixation.

Note that the supply and removal of N, P and K has to be corrected for stock differences between two balance dates, as in ordinary accounting practice. For example, a farmer has 340 000 kg feed in stock (8181 kg N, 1534 kg P and 2617 kg K). During the year the farm buys 2 720 000 kg (65 454 kg N, 12 270 kg P and 20 940 kg K). At the end, 544 000 kg feed is in stock (13 090 kg N, 2454 kg P and 4188 kg K). So in one year the farm used 2 516 000 kg feed. The supplied nutrients, corrected for change of stock, are 60 545 kg N, 11 350 kg P and 19 369 kg K.

The data necessary to account for the flow of nutrients to and from the farm must be gathered from different sources. Many data are needed

from the trade partners of the farm. Standard nutrient contents of all the products involved have been established. In many cases the real content is also available and of course these data are preferable. This should be taken into account when the standard contents are established.

For all the relevant products the accompanying information flows have been mapped. In principle, in future the invoices should contain the nutrient information, as the invoice is the basis for the accounting process. Only when periodic reports are made available that include a specification of all the deliveries and a connection (if necessary through the delivered volume) with the invoice, can the nutrient data be omitted from the invoice. In the case of organic fertilizers the delivery voucher can play the role of the invoice. Periodic reports could be supplied every month (provided that there have been deliveries in that month), with a 12-months moving total added to it. The obligatory report in December is then also the yearly report. For transactions between farmers, a model invoice could be brought into circulation.

In the Netherlands, suppliers of compound feed and fertilizer and buyers of milk periodically (i.e. once a quarter) already provide an overview of the flow of nutrients to the farmer. The nutrient flow linked to the animals is to be calculated as the product of the live weight and a nutrient standard per kg live weight. Most problematic to assess and to audit is the flow of manure. A system of certificates (vouchers) of deliverance has been agreed on and is already used today in the manure bookkeeping system. However, the nutrient content of manure is highly variable.

Handling the data for the nutrient accounting system can be done separately (stand alone), integrated with production records or integrated with financial accounts (Poppe, 1992, p. 199). Gathering the data separately for each system is inefficient especially with respect to auditing. The major advantage of integration with production records is that it supplies the farmer with management information. A problem, however, is that production records are usually branch specific, i.e. separate for dairy, poultry, etc. So on a mixed farm an enlargement of the production records will be needed. Auditability is also weak. The third option offers the best prospects. All Dutch farmers have compulsory financial accounts done by specialized accountancy agencies to make a tax-return (Poppe, 1991, p. 9). The integration of financial and nutrient accounts will result in a considerable saving of accounting time. Data have to be entered only once and are directly available in a format that fits in the audit trail. On the other hand, the farmer's involvement will be less and the results will not be available before closing the fiscal accounting records.

The nutrient accounting system offers information to assess whether changes in farm organization are required and which measures would be

most cost effective. With respect to the measures, various farm economic studies have been published. Berentsen *et al.* (1992) and Berentsen and Giesen (1993) present measures for the reduction of emissions in dairy. Leneman *et al.* (1993) compare possibilities to reduce nitrogen and phosphorus emission on pig farms.

INTEGRATION WITH FINANCIAL ACCOUNTS AND AUDITING

In its role as an environmental policy instrument the nutrient accounting system enables the government to (1) measure the individual contribution of a farm to the saturation of soils and evaporation of ammonia, and (2) impose a levy on surpluses (and not penalize or subsidize farms producing environmentally friendlier than required). As such, a levy on the nutrients surplus is more effective and politically more acceptable ('more fair') than a tax on all fertilizers and feed. It implies, however, stringent requirements of data availability and auditability.

Three ways of accounting for flows of nutrients in the financial accounts are possible. The first way is to account for every nutrient movement individually. The required data can be taken from the invoice or an overview of individual supplies or removals. This means that for each individual entry in a ledger code, besides the amount of money and the quantity, also the kg N, kg P and kg K are accounted for in separate fields. The second way relates to products where the supplier or customer sends a periodical overview with the nutrient figures. In that case it is important to establish whether total quantity and amount of the individual entries corresponds with the periodical overview. This method saves the time needed to account for the individual nutrient movements. When many deliveries take place this way of accounting for the nutrient flow will be attractive. On poultry farms it is not unusual for 50 deliveries of compound feed to take place per year. So the use of a periodical overview will result in a considerable reduction of 'accounting time'. The third way of accounting for nutrients is to use figures from another administration (i.e. management system), such as the animal audit sheet. The purchases and sales of animals are accounted for in financial accounts. At the same time, the nutrient flow is accounted for. At the closing of the farm accounts animals are counted (as balance sheet data) and mortality is established (by animal category). The nutrient flow related with mortality of animals is accounted for in the 'nutrient subsystem'.

Since there is a direct relationship between the nutrient flows and the financial flows on the farm, auditing is possible by comparison of both

flows. In financial accounts most entries of nutrient accounts are considered as costs or benefits. In the nutrient accounting system the same quantities are the basis for assessing the nutrient surplus in kg N and kg P. Between the two accounts a conflict of interest exists in a profit situation. An entry which is accounted for as costs results in less financial income (so this is fiscally attractive); the same entry in nutrient accounting results in a supply of nutrients (and this is not attractive).

Whether it will be attractive to commit fraud depends on marginal financial costs (influenced by the price of inputs and the income tax rate), marginal benefits of the nutrient input (net of income tax) and the levy on nutrient surplus. In general, farmers will not find it attractive to hide income from sales on purpose in order to increase the application of fertilizers. Nevertheless, inputs the farmer can buy abroad and transport himself and which are relatively cheap (i.e. some fertilizers) will be difficult to audit. Manure and dead animals (both important for nutrient removal) do not always have a pendant in financial figures. For the audit of manure the present system of certificates (vouchers) of delivery could be supported by the information on the cost of transport of manure, which will be registered in financial accounts. Further, for financial accounts, an animal audit sheet is often made, reporting the number of animals at the beginning of the period, animal birth and mortality, purchases and sales and change of animals from one category to another (i.e. from female cattle 1–2 years old to dairy cows). So, on a ledger code level it can be indicated whether a certain nutrient flow has to be accounted for and whether an audit is possible.

An audit-matrix has been developed, with criteria to assess how auditable a specific flow of goods will be. Based on that analysis, additional measures can be developed and auditing protocols can be designed. For the moment the sampling of soils does not seem to contribute to the auditability. As the checking of the nutrient declaration assesses the underlying accounts, an obligation to certify the accounts by a public accountant should be considered. This has advantages: among others, lower costs of checking and a higher checking pressure. Checking by a central institution has an additional value and cannot be dismissed. In addition to the audit-matrix, the fraud problems should be taken into account; these involve situations where a number of holdings in the nutrient chain try to create profits by acting fraudulently together.

INTRODUCTION IN PRACTICE

After the official agreement between farmers' organizations and the government in May 1993, a special project office was installed to organize the

introduction of the nutrient accounting system. All activities were financed partly by the government and partly by the agricultural business sector in line with the two functions of the system, i.e. as a management support instrument and as an instrument for environmental policy.

The new nutrient policy will be introduced step by step. As a first step, in 1992 and 1993 farmers were stimulated to use nutrients balance sheets voluntarily for management information. In 1993 more than 15 000 farmers voluntarily calculated or had calculated their nutrients balance sheet. Many farmers asked their accountant or the extension service for assistance. Regional authorities started to subsidize these activities. Evidently once farmers have the figures of their nutrients balance sheet, they are aware of surpluses on their farm. Subsequently they will take into account these results with other management decisions. Farmers decide to participate voluntarily for two reasons: (1) nutrients accounts provide more management information and it has been shown that this can help farmers to raise their income by raising efficiency; and (2) quite severe levies are expected to be announced for unacceptable losses of nitrogen and phosphorus, which stimulates farmers to anticipate.

The information supplied by the nutrient balance sheet of their farms enables the farmer to compare the two options to reduce the surplus on farm level: (1) to raise the efficiency of nutrient use, either by reducing the amount of nutrients in products bought or by raising the amount of (nutrients in) products sold or removed; and/or (2) to reduce livestock intensity, either by reducing the number of animals or by increasing the farm area.

It has been announced that 1994 will be the year of widespread implementation of the nutrient accounting system. It is estimated that over 50% of all livestock farms (40 000 out of 70 000) will have access to their nutrients balance sheet. According to the original agreement between the government and the Agricultural Board, nutrient accountancy will be obligatory for livestock farms in 1995, and from 1996 or 1997 onwards livestock farmers will be faced with a levy on unacceptable surplus.

This agreement has come under attack in the latest government plans. Reviewing the current and proposed methods to reduce the national manure surplus a project team (Werkgroep, 1994) concluded that the proposed Nutrient Accounting System would be an excellent instrument for management and for a levy at farm level as soon as there is no national manure surplus left in the Netherlands. But the nutrient accounting system, as well as the existing manure bookkeeping system, were viewed as being unable to induce the necessary reduction of the manure surplus at the time when lower application rates increased the national manure surplus (Table 1). In both cases the costs of the disposal of manure would

be too high and would induce too much cheating. This, together with the instalment of a new government, has led to a review of the government policy. It is now proposed that farmers will be allowed to choose one out of three methods to calculate the levy on their surplus of nutrients:

- the existing manure bookkeeping system with a prohibitive levy on P_2O_5 ;
- the existing refined manure bookkeeping in which the production of manure (in P_2O_5) is not based on the number of animals but also on the nutrient content of the input of compound feed; the information on the nutrient content is provided by accredited feed companies;
- the proposed nutrient accounting system in which the surplus of N and P would be taxed. This option has advantages over the previous one for farms with above-average efficiency. From an audit point of view, it is a problem that not all farms take part in the scheme. On the other hand, the advantage is that higher demands could be made upon the farm's administration and its suppliers and buyers as it is a voluntary option instead of an obligation for all farms.

FINAL REMARKS

For farmers, the changing society demands a reflection in their farming systems. The need for management, and for management accounting in particular, will develop in connection with the changing demand. Given the changes in institutional regulations, the need for information, especially on new opportunities, is high. Information systems such as the nutrient accounting system that show these differences could support this activity. Study clubs of farmers can be very fruitful as a platform for training, reflection and exchange of information. As there are large differences between farms in environmental impact, extension should be fostered. The practice in the Netherlands shows that the information system as described in this paper can be successful.

With respect to the nutrient accounting system in its role as an optional policy instrument, more conditions must be met. (See, for instance, Van Zeijts *et al.* (1993) for a general presentation of environmental policy instrument requirements.) First, it is important that the system contributes to achieve the goals that the government has chosen. The nutrient accounting system measures the nutrient dynamics at the farm level, so the individual contributions of farmers to national nutrient pollution can be established (and levied). The question is whether imposing

the emission limits at this aggregation level is crucial to fulfil the policy objectives. This is also an important question given the farmers' requirement of a fair instrument. A comparison of the ecological-economic trade-offs of a more regional implementation versus implementation at level of the individual farm could give insights in the additional costs involved. Further, whether there is an acceptable relationship from the farmers' perspective between the costs and the reduction of pollution should be addressed. This is crucial if the system is to become successful.

A clear advantage of the nutrient accounting system is that it enables auditing by its relation with financial accounts. Note, however, that the use of economic instruments such as a levy is complicated by intra-EU and international linkages. The introduction of the single market in 1993, which turned the EC into an open-bordered EU, has reduced the possibility for effective control on smuggling agricultural inputs. In this context, regulations which interfere with the Common Agricultural Policy (CAP) might become important in the attempt to achieve sustainable development in EU agriculture as has been suggested by the EU (CEC, 1992).

At the moment an intensive political debate is going on. In addition to the debate mentioned in the previous section, also new physical measures resulting in a reduction of the number of animals are on the political agenda. This would have severe economic consequences. Hence, research is in progress on the additional or combined measures needed to realize the goal of a well-balanced nutrient management in agriculture. Additional research on (the auditability of) agricultural accounting should be carried out. The growing importance of accounting systems would also be in line with trends in non-agricultural businesses and the Nitrate Directive of the EU (Good Farming Practice).

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