

Mineral bookkeeping, new manure legislation in The Netherlands

Comptabilité des minéraux, nouvelle législation sur le lisier aux Pays-Bas

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Abstract

Intensive livestock production in The Netherlands gave rise to considerable surpluses of manure on individual farms, which may create an environmental risk. Attempts in the past to improve manure distribution or to change the animal feed composition to reduce mineral output of the animals were only partly successful. Therefore, additional measures are needed to avoid further environmental pollution.

Future measures should be optimised in terms of individual freedom for farmers, accuracy, possibilities for verification and tamperproofness. As a result the Mineral Bookkeeping System is introduced. Each farmer has to show an annual balance between minerals entering and leaving his farm. When the input exceeds the output a severe tax has to be paid. The level of this tax is so high, Dfl 10.-/kg P₂O₅, that unbalanced mineral bookkeeping threatens the economic feasibility of the farm.

To enable farmers to account accurately for all the phosphorous and nitrogen flows from and to their farms they are offered tables containing national average figures about the nutrient content of a number of agricultural products. In addition the farmer can include farm specific data. For obtaining accurate data about the quantity of animal manure minerals sampling and weighing of each load is obligatory. Recent research has made available new techniques that meet the required accuracy levels, possibilities for verification and tamperproofness. The different technical modules will be introduced into farmers practice step by step. Final goal is to obtain accurate information, with as little human effort as possible and preferably offering no options for misuse.

The article describes the various aspects of the mineral bookkeeping system in detail and discusses technical options and strategies to improve accuracy and practical value of the system.

Keywords : balance - nutrients – sampling – environment

Résumé

Aux Pays-Bas, l'élevage intensif a amené la constitution de considérables excédents de lisier dans les exploitations individuelles, ce qui peut présenter un risque pour l'environnement. Les efforts déployés dans le passé en vue d'améliorer la répartition ou de modifier la composition de l'alimentation du bétail pour réduire la production de minéraux des animaux n'ont réussi qu'en partie. Aussi des mesures complémentaires sont-elles nécessaires pour éviter toute pollution supplémentaire de l'environnement.

Les mesures futures devraient être optimisées sur le plan de la liberté individuelle des éleveurs, de la précision, des possibilités de vérification et de la protection contre la fraude. Le système de comptabilité des minéraux a été introduit à cette fin. Chaque agriculteur doit présenter annuellement le bilan de la quantité de minéraux entrant et quittant son exploitation. S'il en entre davantage qu'il n'en sort, une taxe substantielle doit être payée ; son niveau est si élevé, 10 florins / kg P₂O₅, (soit environ 30 FF/kg P₂O₅) qu'une telle situation n'est pas viable économiquement.

Pour permettre aux agriculteurs d'estimer avec précision chacun des flux d'entrée et de sortie de phosphore et d'azote de leur exploitation, des tableaux contenant les moyennes nationales en matière de contenu nutritif leur ont été remis. Il leur est de plus possible d'inclure des données spécifiques à l'exploitation. Afin d'obtenir des chiffres précis sur la quantité de minéraux contenue dans le lisier, il est obligatoire de procéder à des prélèvements d'échantillons et à la pesée de chaque chargement. De nouvelles techniques permettant de répondre aux exigences quant aux niveaux de précision, aux possibilités de vérification et à la protection contre la fraude sont devenues disponibles grâce à des recherches récentes. L'introduction dans la pratique des nouveaux modules techniques concernés va se faire petit à petit. L'objectif final est d'obtenir des informations précises avec le moins possible d'effort humain, suivant un système qui, de préférence, ne soit pas susceptible d'être enfreint.

L'article décrit plus en détail les différents aspects du système de comptabilité minérale et examine des choix techniques et des stratégies visant à améliorer l'exactitude et la valeur pratique de ce système.

Mots clés : bilan - substances nutritives - échantillonnage - environnement

1. Current situation in the Netherlands

Over the last decades livestock production in the Netherlands has developed into a highly specialised branch of agricultural activity. Due to the availability of artificial fertilisers and cheap feed components on the world market the productivity per

hectare increased and the production of especially pigs and chickens was no longer linked to the availability of arable land to produce animal feed. As a result the number of animals has increased in this period as shown in Table 1.

	1960	1980	1984	1988	1996
Dairy cattle	1.628	2.356	2.549	1.971	1.665
Other cattle	1.879	2.870	2.967	2.739	2.885
Pigs	2.955	10.14	11.15	13.93	14.40
Laying hens	37.90	37.50	42.70	45.40	39.50
Broilers	45.00	38.60	34.50	40.30	44.10

*Table 1.
Changes in the number of livestock in The Netherlands
in the period 1960 – 1996 expressed as millions
(source: Dutch Ministry of Agriculture, Nature and Fisheries, 1997).*

The increasing trend is most striking for the number of pigs and broilers. With the growing number of animals there was an increase in the amount of manure produced. Due to measures taken at farm level the annual manure production has decreased over the last decade (Table 2). As an example, the amount of slurry produced annually by one fattening pig has decreased from 1.5 m³ to 1.1 m³. This was mainly achieved by a more strict water management on the farms. Spillage of water in the houses was avoided and rainwater was prevented to mix with the slurry into the storages.

	1986	1996
Cattle	72.6	59.2
Pigs	19.2	15.9
Chickens	2.5	2.4

*Table 2.
Annual manure production in The Netherlands expressed in millions of tons.
(source: Central Office for Statistical Data)*

Not only the amount of manure but also the composition is of importance when considering the effect on the environment. Due to the differences in water management on the farms the composition of slurry and manure in The Netherlands may differ considerably from the composition common in other countries. In Table 3 the major constituents of the manure are mentioned.

	Dry matter	Organic matter	N	P ₂ O ₅	K ₂ O	MgO	Na ₂ O
Slurries :							
Cattle	90	66	4.9	1.8	6.8	1.3	0.8
Veal calves	20	15	3.0	1.5	2.4	-	-
Sows	55	34	4.2	3.0	4.2	1.1	0.6
Fattening pigs	90	60	7.2	4.2	7.2	1.8	0.9

Laying hens	145	93	10.2	7.8	6.4	2.2	0.9
Solid manure :							
Laying hens (belt)	515	374	24.1	18.8	12.7	4.9	1.5
Laying hens (bedding)	640	423	19.1	24.2	13.3	5.3	4.2
Broilers	605	508	30.5	17.0	22.5	6.5	3.0

Table 3.

Average composition of slurry and manure in The Netherlands expressed as g/kg wet product. (source: Quantitative information Livestock production, 1997 – 1998).

As already mentioned the production of pigs and chickens is no longer linked to the area of arable land available in the direct vicinity of the farm. As a result farms with larger numbers of animals and hardly any land for manure application were created. A surplus of manure on farm level is the logic outcome of this development. Moreover, as these types of farms are regionally concentrated in the south-east and the middle east of the country there is also a manure surplus on regional level. Measures taken in the past to improve the transport of manure surpluses to regions with more arable land and measures to decrease the mineral content of the feed were only partly effective. Therefore, Dutch authorities had to take additional measures to avoid further environmental pollution by excess use of manure in surplus areas. Measures taken so far did not distinguish between individual farms, which was felt as unfair by those who were more strict in their mineral management.

In addition, authorities occupied with the supervision of manure legislation so far were aware of the poor possibilities for verification and the extended possibilities for tamper. This gave rise to a large number of court cases, where judges often had to dismiss farmers from any prosecution due to lack of evidence.

New legislation should overcome the disadvantages mentioned above as good as possible. Summarising this implies that new measures not only should treat farmers more individually, but also create better tools for the authorities to verify the data supplied by the farmers. Techniques included in a new system should be designed in a way that tamperproofness is guaranteed.

2. The Mineral Bookkeeping System

In order to meet the criteria mentioned above, a new system of mineral bookkeeping was developed. It shows a high degree of similarity with financial bookkeeping. Where in the latter the farmer shows the amount of money coming in and going out of his farm, the same process is applied to the minerals nitrogen and phosphorous in the former. At the end of each year the farmer has to show the results of his farm to the Dutch authorities. For each kg of phosphorous (P_2O_5) missing he has to pay a levy of Dfl.10.- and for nitrogen the levy amounts to Dfl 1.50 per kg.

MINERAL BOOKKEEPING SYSTEM

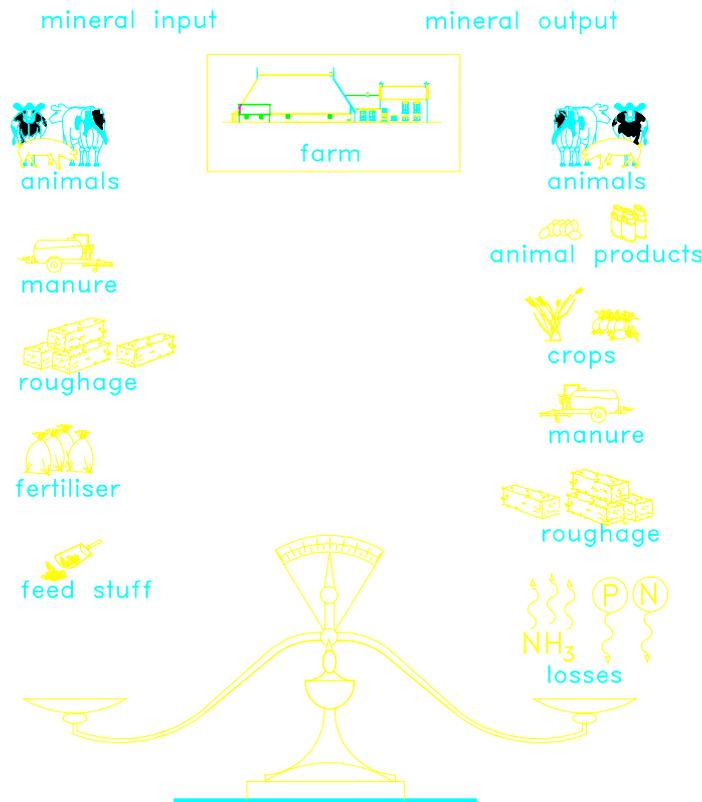


Figure 1.
Schematic representation of the mineral bookkeeping system

All mass flows containing nitrogen and/or phosphorous should be included accurately in the mineral bookkeeping. Figure 1 represents the essential of the system schematically. For those flows, which mineral composition only differ slightly from farm to farm or with time, standard figures for the nitrogen and phosphorous content are provided. Animal products and crops are typical examples for this category. For flows where these criteria imply to a lesser extent farm specific data must be collected, e.g. number of hectares and animals belonging to the farm. Major mineral input flows are typically artificial fertilisers or animal feed concentrates. On request the suppliers provide the farmer with detailed information on the mineral content of their products. Animal manure forms a special flow in this respect. In particular on the most intensive farms it is the most important mineral output flow. Its composition differs both from farm to farm and with time. Therefore,

standard figures, based on averages from a large number of farms, are inaccurate for most individual farms. Within the new legislation the standard figures for the mineral content of manure are included in the law by the Ministry of Agriculture, Nature management and Fisheries. It is a demonstration of the political value of these figures. The values are chosen at such a level that they are unfavourable for most farmers. As an alternative they are allowed under conditions to use farm specific figures for the manure composition. The conditions mainly deal with the procedures and techniques involved in estimating the manure composition. More details will be given in the section about technical aspects.

3. Introduction of the mineral bookkeeping system

From the description above it may be clear that the introduction of the new system means a large step for farmers, authorities and people involved in agricultural business. As the mineral bookkeeping system is meant as protection of the environment the most intensive farms are first included. As a result about 50,000 Dutch farms with a livestock density larger than 2.5 livestock units per hectare are fully involved in the system from the start at January 1st 1998. Other farms will follow suit step by step. In 2000 all farms with livestock and from 2002 also the farms with only arable land will have to present a total mineral account to the Dutch authorities. The last two categories now only have to prove that the amount of minerals used on their farm, originating from animal manure and calculated on base of standard figures, does not exceed a given limit.

4. Technical aspects of the determination of the minerals present in manure

In order to determine accurately the quantity of minerals leaving or entering the farm with a load of manure not only the mineral content but also the size of the load is of interest. As levies are based on these figures, Dutch legislation states that estimation of the size of the load can only be done by calibrated weighing techniques. Currently on board weighing systems are adapted to fit on slurry tankers.

For calculating the mineral balance for a particular farm the manure composition on the farm is less important than the composition of the manure leaving the farm. As slurry has the tendency to settle and possibilities for stirring prior to tanker loading are limited, there may not only exist a difference in composition of the slurry in the storage and the slurry in a particular tanker, but also between the subsequent tankers. Accurate determination of the quantity of minerals transported therefore requires weighing and sampling of each individual load. Recently, a newly developed sampling technique demonstrated that a more representative sample from a load of slurry can be taken. In Figure 2 a schematic representation of the side tube technique is given. During loading five samples of about 150 ml each are taken and collected in the sample bottle. This technique is completely automated and therefore the operator cannot influence either the moment of sampling nor the sample composition. The high degree of automatism increases the

tamperproofness of the technique and enables the automatic recording of relevant data which relieves the operator of the transport of a large part of his administrative job.

The box shown below the sampling device in Figure 2 contains the sample bottle and is meant to handle the sample bottle fully automatic. Prior to the sampling process the bottle and the lid are introduced in the box separately. An in built camera system checks the cleanness and records the numbers present on both. Only then the bottle is available for the sample and the sampling process can be started. After completion of this process the lid is placed on the bottle automatically and the closed bottle is available for further transport to the laboratory. The sample bottle and lid are special designed for this sampling system. After closing the lid can only be removed by breaking a security strip. Laboratories only accept samples with intact security strips. At the moment the technical development of the sample bottle handling box and the techniques included is still running. Compulsory application of this part of the system is foreseen for 1st of January 2000.

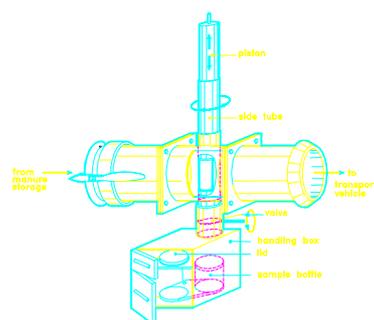


Figure 2.
Schematic representation of the side tube slurry sampling technique.

The samples obtained have to be sent to a laboratory for the determination of the total content of nitrogen and phosphorous. The Netherlands is the first country with established standard methods for the analysis of slurry and manure. Moreover, the laboratories involved in these analysis have to meet special criteria in addition to Good Laboratory Practice. Regularly held ring tests and audits by the certifying organisation guarantee the quality of the participating laboratories. Data recorded for each load of slurry or manure are not only reported to the farmers involved but also to a registration office, ran by the Dutch authorities.

5. Costs

The levy involved in the mineral bookkeeping system amount to Dfl. 10.- per kg P_2O_5 and Dfl. 1.50 per kg N exceeding the limits of the accepted losses. Related to the Dutch slurry composition this implies about Dfl. 60.- per ton of slurry originating from fattening pigs. From these figures it can be derived that it is economically unfeasible for a farmer to produce pigs without a proven discharge of their slurry.

Moreover, the levy for phosphorous will be increased to Dfl. 20.- per kg P₂O₅ from 2000 on.

The mineral bookkeeping system increases the need for an accurate financial administration at each farm. Most figures needed for the mineral bookkeeping system are linked with the financial bookkeeping. When farm specific data are needed for the amount of minerals in the manure or slurry additional costs have to be made for weighing, sampling and analysing the individual truck loads. Depending on the situation these costs range from Dfl. 50.- to Dfl. 100.- per load.

Not only farmers are confronted with additional legislation and costs. Transport companies as well get their part. They pay either for weighing at a public weighing facility and lose some time by visiting such a place or they have to invest in on board weighing equipment. The preference for either of the possibilities is linked to particular circumstances such as the distance to a public weighing facility and the number of transports served by a particular transporting vehicle. The price of on board weighing systems amount from Dfl. 30,000.- to Dfl. 75,000.-, depending on the configuration of the weighing system and the vehicle.

A fully automatic sampling device will cost about Dfl. 25,000.-, and with the introduction of a fully automatic sample bottle handling it will be doubled. The price of an analysis in one of the certified laboratories will amount from Dfl. 30.- to Dfl. 50.-.

6. Future developments

Introduction of such a complex system is hardly ever done at once. Furthermore, the interest of different parties involved are so much apart that it is nearly impossible to serve them all at the desired level at the start. The Dutch government has chosen for a start at 1st January 1998 with a system which already contains the headlines of the approach and then extend both the number of farms and the level of verification and tamperproofness. Especially for these last two aspects additional technical solutions are desirable. Tamper with the sample composition and the sample bottle will be more difficult when both the automatic sampling and the automatic sample bottle handling will be compulsory.

To improve possibilities of verification additional data from every transport are needed. By the introduction of the mineral bookkeeping system a new transport form is introduced, with a first step towards this extended data recording. With the availability of highly automatic sampling equipment on the transporting vehicle a further extension of the data recording comes into sight without increasing the effort required from the operator. At the moment studies are carried out to investigate possibilities of application of modern data transfer together with automatic data

recording on the transporting vehicle. The intention of these studies is to make the paper version of the transport form superfluous and make the data related to a given transport available for parties involved as soon as possible, preferable before the transport is completed.

Introduction of such sophisticated technical solutions can only be successful when all parties involved underline the benefits. Automatic sampling and sample bottle handling reduce not only the possibilities for tamper but also free the transporting companies from discussion with farmers about the correctness of the sample. Automatic data registration and transfer not only enable an extension of the parameters but also increase the efficiency for all parties involved. At the moment the information collected on a paper version of the transport form has to be copied at the administration of the transporting company, the laboratory and the registration office of the authorities. As it is hand written information the chances for intended or unintended errors or difficulties with the readability are not imaginary.

Another aspect of future development is the level of accepted losses related to ground linked activities. At the start the accepted losses are at a level that rather limited actions of farmers are needed to meet these standards. With time these levels will decrease (Table 4) and more effort from farmers is needed not to exceed these levels.

	1998	2000	2002	2005	2008 e.v.
Phosphorous (P₂O₅) :					
Natural environment	10	10	10	10	10
Agricultural land	40	35	30	25	20
Nitrogen :					
Natural environment	50	50	50	50	50
Grassland	300	275	250	200	180
Other agricultural land	175	150	125	110	100

Table 4.

Accepted losses for phosphorous and nitrogen in The Netherlands related to the mineral bookkeeping system, values expressed as kg per hectare per year.

Figures shown in Table 4 beyond the year 2000 serve as an indication as for that year a political evaluation of the mineral bookkeeping system is announced and the level of accepted losses will be subject of further discussion.

7. Conclusions

The mineral bookkeeping system, as introduced at the beginning of this year in The Netherlands, creates optimal freedom to take individual differences between farms into account without losing the desirable accuracy. Within the agricultural business environmental unsound use of minerals in general and animal manure in particular will become economically unattractive.

The inclusion of highly automatic techniques improve possibilities for verification and tamperproofness without converting farmers or truck drivers into administrators. Modern data communication techniques may improve the efficiency of the administration process.

8. Further reading

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