Project ‘Annual Nutrient Cycling Assessment (ANCA)’

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Background and objective

Unlike in arable farming and intensive livestock farming, cropping and animal husbandry are linked in dairy farming. On average 70% of the required feed, such as fresh grass, silage grass, or forage maize, is grown on own land. Of the nutrients used for grass and fodder production 65% (nitrogen) to 100% (phosphorus) consists of excretion products from the own herd. Consequently, dairy farming is characterised by strong cycles of nitrogen (N), phosphorus (P), and carbon (C): feed turns into manure and manure turns into feed. Losses of nutrient from those cycles, by selling milk and cattle, and through emissions to the environment are compensated by purchasing feeds and fertilisers.

Increasingly efficient utilisation of feed and fertilisers results in lower losses to the environment while less inputs need to be purchased. Efficiency is partly governed by conditions that cannot be affected by the dairy farmer, such a soil type or weather conditions. But nutrient management usually is the most important factor.

Objective of the project is the development of the instrument ANCA, presenting a scientific, integrated, unambiguous, and fraud-proof picture of the N, P and C cycles of the individual dairy farm. This results in a number of indicators; these enable the dairy farmer to justify his farm management towards authorities and milk processing industry as well as to optimise his management. This might offer the authorities possibilities for replacing generic legislation by farm-specific regulations which would give dairy farmers more management freedom. And it may offer the milk processor possibilities for concretising the sustainability strategy agreed with its dairy farmers. The potential use of ANCA is discussed in more detail further on in this document. The project should ensure that the intended users are familiarised with the possibilities and that the set-up of the instrument meets their wishes. Whether ANCA will indeed, completely or partially, be used of course depends on the decision made by potential users themselves.

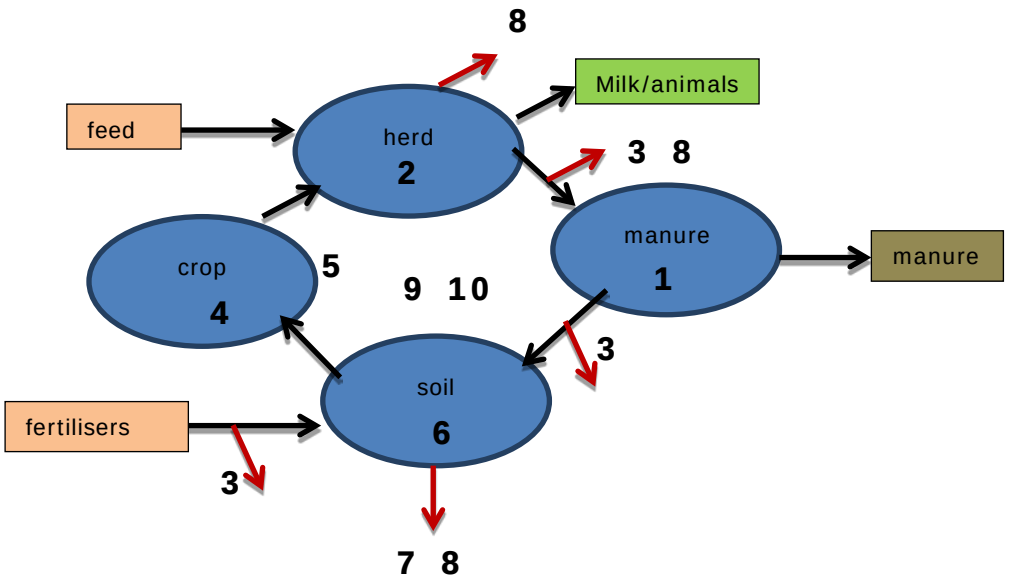
Execution of the project involves almost all stakeholders in Dutch dairy farming: farmers’ unions, supplying and processing industries, knowledge organisations and governments. Wageningen-UR is responsible for the project management. The project is running during the period 2012 - 2014.

Cycle Indicators

Mapping of the cycles on the dairy farm follows a step-by step procedure and ultimately leads to the following indicators, quantified on an annual basis. Their positions in the cycle are presented in Figure 1.

1. Manure production: nitrogen (N) and phosphate (P_2O_5) excretion;
2. Efficiency of feeding (= conversion of feed into milk and meat): N and P_2O_5 utilisation;
3. Ammonia (NH_3) emission, divided over housing, manure storage, grazing, manure spreading and fertiliser use;
4. Yield grassland and maize land: dry matter, energy (kVEM), N, and P_2O_5;
5. Efficiency of fertilisation (= conversion of nutrients into crop yield): utilisation of N and P_2O_5 present in chemical fertilisers and organic manures;
6. Soil surplus N, P_2O_5 and C (development organic matter content);
7. Nitrate (NO_3) in groundwater;
8. Emission of greenhouse gases methane (CH_4), nitrous oxide (N_2O) and carbon dioxide (CO_2);
9. Farm surplus N, P_2O_5 and C;
10. Efficiency of farming (= part of the input converted into milk and meat): utilisation N and P_2O_5 in purchased feed or fertiliser.

Figure 1. Position of the ANCA indicators (see numbers above) in the cycle.



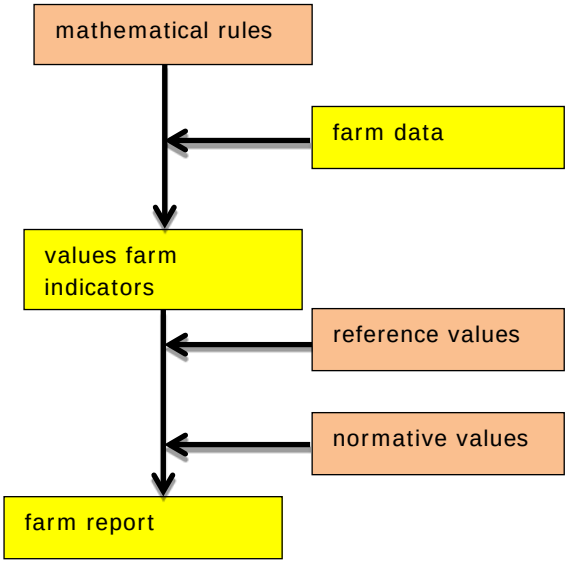
The indicators are, with corresponding background information, presented over the past year and the preceding years, thus showing the development of the indicators over time.

Reference and normative values are given for the indicators. Reference values may be the average values achieved by farms under similar conditions or, e.g., the values of the 25% best performing farms.
Normative values are values on which legislation is based. An example: the European Nitrate Directive stipulates that the nitrate concentration of groundwater may not exceed 50 mg/l. This is the normative value. Criteria for fertiliser use, laid down for the Netherlands as application standards, should ensure that this normative value is not exceeded. These reference and normative values enable the dairy farmer to compare the performance of his farm with that of colleagues as well as with the target values laid down by the government.

Project execution

The cycles should be mapped in a scientifically sound and transparent fashion. The mathematical rules that are to be developed need approval by the authoritative (inter)national scientists in the relevant domain.

Figure 2. Procedure ANCA



The mathematical rules will mainly be fed with data that are digitally recorded at suppliers, purchasers, and other relations of the dairy farm. Put together without involvement of the farmer they can be entered into ANCA. This restricts administrative burdens, prevents mistakes and makes correct use verifiable. A structure is being developed for this data traffic.

The combination of mathematical rules and farm data yields in farm-specific values of the indicators. This is followed be establishment of the reference and normative values. The farm report presents the farm-specific values and clarification of deviations from reference and normative values by using background data (secondary indicators).

The instrument is in fact a modular extension of BEX, a mathematical programme, developed in the context of the project Cows & Opportunities, that quantifies the herd part of the N and P cycles. It calculates the excretion of the herd as feed intake minus the production of milk and additional bodyweight. Most Dutch dairy farmers are already familiar with BEX. If N or P_2O_5 excretions are below the national standards, the authorities accept the farm-specific outcome. The dairy farmer is also gaining information about efficiency of feeding, which enables him to optimise. Use of BEX often means that the costs of manure disposal as well as those of feed purchasing are reduced.

As in the development of BEX, each new module is first technically compared with the farm data of the “De Marke” experimental farm and subsequently with those of the 16 commercial pilot farms in Cows & Opportunities for which farms the data required to judge whether the calculations are yielding an adequate representation of the actual situation are available. After any required adjustment, larger groups of farmers, often together with their advisors and chain partners, are testing practicability, enforceability, and user-friendliness. This may again lead to further adjustment.

Stakeholder’s benefits

The project is a private-public collaboration (PPS) in the context of the Top Sector policy of the Dutch government. This means that the results of the project should contribute to meeting the targets laid down by the government (public interest) as well as by the industry. The potential benefits for each of the stakeholders are briefly presented below.

<u>Dairy farmers</u>

1. Many dairy farmers consider space for entrepreneurship very important. Environmental legislation often consists of ‘means’ regulations rather than ‘target’ regulations. ANCA may well contribute to making legislation more specific where the farmer himself is devising suitable measures to meet the environmental targets while accounting for the results. The target approach increases cost effectiveness and work satisfaction. But legal restrictions will remain. The Nitrate Directive stipulates that Member States must formulate fertilisation criteria for N. ANCA enables

differentiation of these criteria based on, e.g., realised crop yield (indicator 4) or efficiency of fertilisation (indicator 5).

2. As chain party the dairy farmer can show his milk processor that the milk has been produced without spillage of resources or unacceptable emissions.

3. Use of ANCA objectively familiarises the dairy farmer with the strengths and weaknesses of his farm, thus enabling appropriate measures to be taken. He can specifically update his knowledge and is becoming 'cycle wise'.

Governments

National

1. The government wishes to meet the desired quality of the environment, to stimulate the efficiency of the use of scarce resources and to maintain an economically strong dairy farming sector that support legislation. Incorporation of ANCA in such a policy can contribute to all this. Government stimulants, e.g., by giving room in regulations in case good indicator scores are obtained may stimulate sustainability of dairy farming.
   An example. The generic fertilisation standards on sandy soils are based on the average annual yields achieved by farms on those soils. ANCA calculates the achieved yield for the individual farm (indicator 4). Entering the farm-specific yield in the formula used to calculate the generic fertilisation standard results in a farm-specific fertilisation standard that may be higher or lower. This in fact results in a strong differentiation of the generic standard.

2. Relatively low emissions (indicators 3, 6, 7 and 8) shown with ANCA may possibly be used in the context of the 'greening' paragraph of the new European agricultural policy because restriction of the N and P losses may strengthen the biodiversity in the surroundings of the farm. This would make ANCA a certification instrument.

3. The extent of derogation (deviation from the 170 kg N criterion organic manure) can be made dependent on the achieved efficiency of fertilisation (indicator 5) and/or soil surplus (indicator 6).

4. Knowledge and innovations as results of investments in research are sooner implemented in practice when any resulting improvement of the environmental quality is rewarded. ANCA can objectively visualise such improvements.

Provinces

1. Provinces have been given more responsibilities for nature and environmental policies. This, for instance, involves them in Natura 2000 areas where (locally) additional measures are required to, e.g., sufficiently restrict the ammonia load. (Parts of) ANCA may help to regulate the quality of the environment in a way the farmer considers meaningful and to which a reward system can be linked. This may probably combine the desired reduction in environmental pressure with an improvement of the financial-economic position of the farm. A number of provinces are already experimenting with ANCA in this way.

Water Board Authorities

1. In a number of cases Water Board Authorities soon need to take additional measures to let the water quality - in time - meet the requirements laid down in the Water Framework Directive. It is expected that ANCA can contribute to those additional measures becoming more location- and farm-specific, which decreases costs and increases support. Water quality indicators (nitrate leaching, phosphate surplus) will of course be most important in this respect.

<u>Milk processors</u>

1. Milk processors want to guarantee the buyers of their products that their raw materials have been produced in an environmentally acceptable way. For some buyers this is a supply clause that can be made controllable with ANCA.

2. Most milk processors have agreed a sustainability strategy and route with their dairy farmers. This includes a reduction of harmful emissions. ANCA is clearly and verifiably mapping these emissions and their development over time.

3. Most milk processors are cooperatives with dairy farmers as their members. This means that the arguments given under ‘Dairy farmers’ do also apply for these milk processors.

<u>Farming industries</u>

1. ‘Farm visitors’, like the representative of the feed supplier, the veterinarian or farm advisor, wish to support their clients in the best possible way to properly manage the increasingly complex farm. They can work more efficiently (and thus gain appreciation) when in their conversations with the dairy farmer they have access to reliable, uniformly calculated farm indicators and their backgrounds.

2. The supplying industry is better able to match its products with the needs of the dairy farmer (e.g., feed composition).

3. Feed suppliers as such have also developed a sustainability strategy in which ANCA can play a useful role.

4. Many feed suppliers are cooperatives, with dairy farmers as members. This means that the arguments given under ‘Dairy farmers’ do also apply for these suppliers.