

# **A result-oriented approach to reward N-efficiency improvements**

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## **Abstract**

The EU-Life-project “Water Resources Management in Cooperation with Agriculture (WAgriCo)” outlines and implements integrated measures in accordance with the WFD<sup>1</sup> to reduce diffuse nitrogen pollution from agricultural activities. Outcomes of the ongoing project are presented in this paper.

The hitherto dominating horizontally offered action-oriented agri-environmental measures and the predominant flat-rate payments are limiting the efficiency of water protection measures. In addition to adjustments of existing action-oriented measures, an innovative result-oriented approach is developed and put into practice within the project. The objective is to reward farmers for the improvement of nutrient management at farm level. This approach has potentials to increase positive environmental impacts and cost-effectiveness.

While action-oriented agri-environmental measures demand farmers to adopt well-defined management practices, farmers acting under a result-oriented approach have a free hand in their adjustments to fertilizer and crop management. Thus they are actively involved as entrepreneurs pursuing water protection objectives. The calculation of improvements to be rewarded is based on a farm-gate balance, with additional information about on-farm use of fodder and organic fertiliser. Coefficients for N-efficiency are calculated separately for mineral and organic N to allow for a documentation of efficiency improvements independent from structural changes. In the result-oriented approach the outcome indicator “N-efficiency improvement” is directly rewarded.

**Keywords:** agri-environmental measures, cost, fertilizer efficiency

## **Background and objectives**

Germany’s water-related agri-environmental policies for implementing the EU Water Framework Directive (WFD) consist of basic measures such as the implementation of the EU Nitrates Directive through the fertilising ordinance with mandatory standards for nitrogen use in agriculture. Beyond that level of good farming practice, voluntary agri-environmental measures with compensation payments are promoted as supplementary measures. The selection, design and implementation of water protection measures are in Germany in the responsibility of the Federal States (Laender). Water protection measures can be implemented through EU-co-financed schemes within the Rural Development Programmes, as well as independently from the EU with regional or local funding, the latter mainly in water protection areas. A key problem for implementing the WFD in Germany is diffuse pollution resulting from the high nitrogen surplus of the farming sector, and nitrate leaching into the groundwater.

For co-financed agri-environmental measures the EU sets the general objectives and provides rules for administrative procedures for design and implementation. Design of measures is restricted in terms of maximum payments, calculation of payments, controlla-

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<sup>1</sup> Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy

bility and the duration of at least five years. Regarding the content of supported measures the EU regulation provides a wide scope. For EU co-financed measures the incorporation into the Integrated Administration and Control System (IACS), which was created for direct payments of the so-called first pillar of the CAP, is mandatory. This includes precision in determining the size of eligible area, and a minimum number of on-the-spot controls per measure at a rate of 5 % of beneficiaries (Nitsch et al., 2005). While the payments to the farmers are EU co-funded, administrative costs for agri-environmental programmes have to be born entirely at member-state level. For member states and regions with limited administrative personnel, measures with low cost for administration and control are thus more attractive. Today, there is a dominance of standardised, horizontally offered action-oriented agri-environmental measures with flat-rate payments. Flat-rate payments per hectare, calculated for average farm conditions have been criticised for causing considerable windfall profits in case of variable marginal adaptation cost (Hofreither, 2000; Osterburg and Runge, 2006).

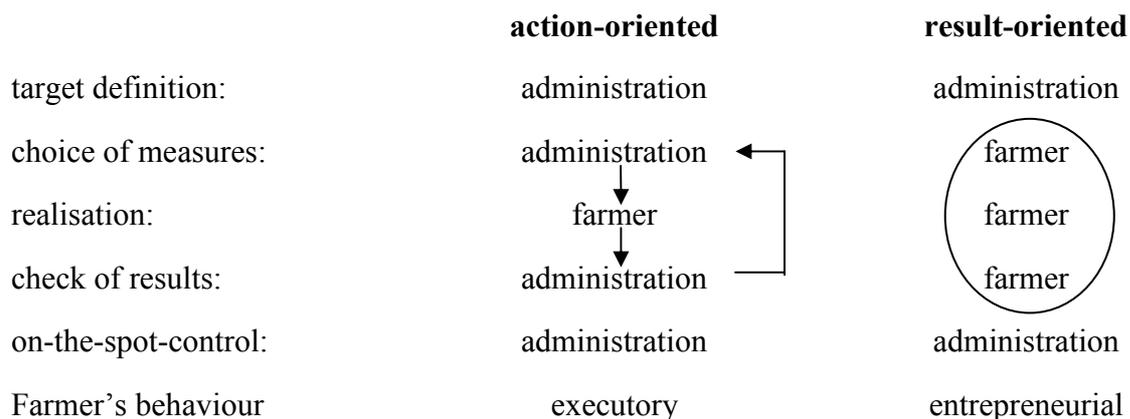
Lower Saxony has 13 years of experience with co-operations for groundwater protection in water protection areas for drinking water. The intention was to develop win-win solutions in a round table approach together with all concerned stakeholders, such as the drinking water company, the authorities involved (e.g. Chamber of Agriculture), and land users (agriculture, forestry and horticulture) (Water4all, 2005). The cooperation committees develop possible water protection concepts for each drinking water catchment. The possible measures within such a concept depend on the soil, land use, agriculture structures and groundwater quality. The solutions differ from group to group. Action-oriented water protection contracts are offered to farmers within the catchment areas using funds paid from a charge on water use. Specially-trained advisors give advice to the farmers about groundwater protection and land use, free of charge, and encourage farmers to agree to these contracts. The farmers' commitment has increased steadily over the last few years through this cooperative and voluntary approach. There are now 115 cooperatives throughout Lower Saxony, representing a total area of about 300,000 hectares, where more than 6,000 farmers are involved. Quite a number of positive achievements can be reported from the farm land under contract in the drinking water catchments. But looking at the financial effort and the man power involved, this approach could not be transferred one by one to implement the WFD. Furthermore it has been observed that the N-surplus could not be reduced as much as required, especially for highly specialised farms and farms with a high number of animals.

A shortcoming of usual agri-environmental measures is the focus on extensification, e.g. through input reduction or decreased livestock densities, thus excluding farms with higher land use intensity. To increase the scope of voluntary water protection measures, a new focus should be the efficiency of nitrogen use especially in more intensive farming systems. Already in 1996 the German Environmental Advisory Board proposed a concept of "remuneration of ecological outputs". Instead of activity-oriented measures based on management prescriptions, support should be based on remunerated results (SRU, 1996 and 2004). But while first result-oriented measures for wild plant biodiversity are put into practice (e.g. G thler and Oppermann, 2005) up to now only little practical testing has been done for N efficiency improvement.

Support conditions of action oriented measures are fixed packages of restrictions going beyond 'good farming practice', the legal baseline for farming. Crucial for action-oriented measures are appropriate requirements/management prescriptions. The more detailed the management conditions are that have to be respected the bigger is the chance that the desired environmental effect could be obtained. In the same time more demanding or complicated requirements have a negative effect on acceptance. For the result-oriented approach selection of the appropriate indicator is decisive as the indicator should reflect the management activities of the farmers to a large extent and has to be suitable for self-assessment. In action-

oriented measures farmers show executing behaviour and have free hand only in the realisation itself. The choice of the measures offered and the check of the results as well as measure adaptations are the task of the administration (see figure 1). Under a result-oriented approach the farmer himself is responsible for the selection of suitable measures, their realisation and the result-check. That gives him much more flexibility, but at the same time participation is more risky: He is only rewarded if the desired environmental effect is achieved. Another difficulty for the farmers is to estimate the real adaptation cost due to uncertainty, e.g. about yield performance.

Figure 1: Action-oriented versus result-oriented measures: Role of farmers and administration



### Materials and methods

The central objective of WAgriCo is to define, select and develop cost-effective measures or measure combinations having a high ecological impact to reduce the nitrate load to groundwater easily to be integrated in the farming process. As the budgets dedicated to reach the good status of groundwater and surface waters are limited, efficiency implies maximisation of positive environmental effects at a given level of public funds. A major source of uncertainty with regard to the cost-effectiveness of water protection measures is the difficulty to quantify and evaluate environmental benefits. The project aims to improve knowledge about these issues including knowledge of farmers in local co-operations.

Results of a former project based on statistical data analysis show a high variation of N-surplus of farms within farm groups of the same type and organic N-input from manure per hectare (see workshop contribution of T. Schmidt et al.). It could be shown that there are farms with extremely high N-surpluses up to 250 kg/ha that could not be explained solely by their production system. The observation that the organic input is not a sufficient indicator to explain variations leads to the conclusion that the fertiliser management at farm level is an important starting-point for water protection. Instead of a single plot approach dominating in action-oriented measures the focus for result-oriented water protection is on the whole farm.

The approach designed within the WAgriCo project targets at rewarding an active improvement of the use of nitrogen fertilisers. Therefore a result-oriented measure was designed. In Lower Saxony there is still a considerable gap between the actual groundwater quality and the target value for groundwater quality of the WFD in most regions with a high livestock density. Looking for a suitable indicator it was obvious that the reduction of N-surplus on farm level is not appropriate for farms with organic input. While a reduction of N-surplus in farms without organic fertiliser is always linked to a better fertiliser use, this must not be the

case for farms with livestock. Structural changes happen independently from water policies and lead to continuous modifications concerning the farm organisation and due to that also to changes of the nitrogen balance. For example a reduction of the number of animals on farm level without other changes as well as an enlargement of the farm surface without change in the number of animal both lead automatically to a reduction of the N-surplus. This effect is not necessarily linked to an improved use of organic fertiliser, but can be due to a shift between mineral and organic N-fertilisation. Using mineral nitrogen always permits to attain a higher N-efficiency compared to organic nitrogen.

For farms with animals it is crucial to improve the efficiency in organic fertiliser use and in this way to reduce the input of mineral fertiliser. Therefore it is necessary to make separate calculations for organic and mineral nitrogen if organic fertilisation takes place. Thus efficiency improvements in the use of organic fertilisers can be documented and rewarded. While focussing on technical efficiency, the approach can cope with structural changes without causing unjustified windfall profits.

### **Results and discussion**

49 farmers in Lower Saxony, Germany, signed an agreement in autumn 2006/ spring 2007 to participate in WAgriCo water protection measures. The specific water protection measures are restricted to vulnerable zones. All of them have their farm land in target areas with high nitrogen surplus within one of three selected project areas. The project farms differ considerably, ranging from intensive livestock farming to cash crop. The farmers had the possibility to sign contracts for eleven selected action-oriented measures that target on green cover crops over winter and on the use of improved technique. The management conditions can be applied easily. For those measures requiring additional operations or inputs without major impacts on land use and productivity (e.g. green cover crops with additional cost for seeds and establishing the crop) flat-rate payments were defined as the cost will not vary substantially between farms and regions. The selected measures have a good controllability and reach a good ecological effectiveness as the required farm activities are strongly linked to the desired ecological effect. Farmers participate with about 1.300 ha contract area. The action-oriented measures comply with the restrictions for the EU co-financing of agri-environmental measures and are thus applicable beyond the project areas within the Rural Development Programmes.

Besides improved action-oriented measures the result-oriented approach was put into practice in spring 2007 to get practical experiences from 49 participating farms. The calculated N-efficiency of the new result-oriented measure is defined as the relation of the N-input to the N-output from plant production. On the basis of total N removal per hectare and the mineral and organic N input, N efficiency for mineral N on the one hand and organic N input on the other hand is calculated. Only farm land in production is chosen as reference area, excluding "dilution effects" of fallow land.

As reward a payment of 1.20 € per kg accountable N-reduction (due to N-efficiency improvements) and productive farm land (thus, without set-aside and fallow land) is offered, with a maximum of 40 €/ ha. Only farms that have an input up to 170 kg organic N/ha get a reward. Farms with more than 90 kg N/ha surplus in the N-balance are only rewarded if they achieve a reduction of the balance while improving their N-efficiency. If an increase of the balance occurs, N-surplus of 90 kg N/ha is the maximum for the remuneration. Farms with a very good N-efficiency already in the initial situation can get a payment if they are able to keep their standard during participation.

The reference is calculated on the basis of an average of the last three cropping years before participating in the scheme. For the actual year the removal is also calculated as three

year-average to smooth down climatic effects (average out of the actual year and the two preceding years), but for the N-inputs (organic and mineral) the values of the actual year are used. While the farmer can directly influence the fertiliser use, the farmer cannot foresee weather conditions that influence plant growth and N removal. An improvement of the N-efficiency compared to the reference is calculated for the N input in the actual year to get the N-reduction to be remunerated. Possible N-mobilisation from soil fraction (reuse of fallow, ploughing of grassland, organic soils) and N-immobilisation in the soil are not yet considered.

The aim is to design a result-oriented measure to reward efficient use of fertilisers with a minimum of effort for data input, and to find an acceptable compromise between farm-individual coefficients and flat-rate coefficients for N content. Regarding the accountable organic N input, a net amount after subtracting gaseous losses from gross excretion is used. Within the project there was the decision to use net figures like in the N-balance calculation obligatory to meet the demands of the German fertilising ordinance. Furthermore net N-balances are used for fertilisation planning by the farmers. However, using gross amounts shows total initial availability of N from excretion without assuming “unavoidable” losses. The developed calculation of efficiency is indifferent to alterations of coefficients for accountable organic N.

A reduction of mineral N-input in most cases leads to a reward without other changes, but for the reduction of the organic fertilisation the situation is different. A reduction of organic fertilisation is only rewarded if the remaining organic N-input is used more efficiently than before. Even if organic fertilisation increases, improved N-utilisation is rewarded.

### **Conclusions**

Up to now few attempts have been made in Germany in order to substantially change the existing system of voluntary horizontally offered action-oriented measures with flat-rate payments in spite of several suggestions from scientists. Path-dependency after once having introduced this system might play a role, as well as expectations that administration cost and thus public transaction cost will increase when changing the existing system. Furthermore there is a risk of higher decision-making cost and lower acceptance. If EU requirements are not completely complied with, there is also the risk of disallowances regarding EU co-funding. However, the presented example of a result-oriented approach gives an outlook for possible evolution of result-oriented agri-environmental measures in future.

Action-oriented approaches provide a payment for compliance with specific requirements beyond the baseline of “good farming practice”, not taking into account real environmental outcomes. This approach is only justified for measures with homogeneous and secure environmental effects throughout farms and regions. As environmental impact varies even for measures for which a flat-rate payment seems appropriate depending on farm and regional conditions, an environmental targeting is crucial.

The result-oriented approach aims at the improvement of N-efficiency at the farms during participation period compared to the years before. To reach a sufficient acceptability of the proposed result-oriented measure it is very important to support implementation by advice, and possibly to flank implementation by auditing. At least in the beginning period it is important to help farmers to become entrepreneurs for water protection oriented agriculture, up to now used to show a merely executing behaviour while implementing agri-environmental measures.

Instead of a fixed amount for management prescriptions in the case of action-oriented water protection or a direct payment for environmental benefits in a result-oriented approach, tenders can be applied as an alternative way for fixing payment levels.

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